5.0 ENVIRONMENTAL EFFECTS, MITIGATION, RESIDUAL ENVIRONMENTAL EFFECTS AND FOLLOW UP

This section is organized by the three main components of the Project scope as defined by the RAs and as presented in Section 2.3 of this CSR. For each main Project component, the VECs are assessed for each Project phase in terms of environmental effects, mitigation, residual effects, and follow up. Cross-referencing occurs where appropriate to reduce repetition.

Pursuant to the CEAA, public consultation was conducted during the comprehensive study. The public consultation that occurred in accordance with the CEAA is discussed in Section 3.2. The issues raised during consultations or received by mail from non-governmental stakeholders and that are within the scope of this CSR are listed by VEC in Table 3.3-1 (Appendix 4, Table 4-4 lists those issues raised by the public that go beyond the scope of this CSR).

Residual effects refer to those environmental effects predicted to remain after the application of mitigation outlined below. The predicted residual effects are assigned a significance rating. The criteria used to define this rating are described in Section 2.5.

5.1 ENVIRONMENTAL EFFECTS OF THE LNG MARINE TERMINAL, MARINE TRANSFER PIPELINES, LNG STORAGE TANKS AND THE REGASIFICATION FACILITIES

5.1.1 Hydrology

5.1.1.1 Environmental Effects Prediction

Construction

The construction of the LNG facility will alter the hydrology of two coastal watershed areas. Clearing and contouring of the Project Site could result in temporary changes in surface water run off volumes and flows and potentially decreased water quality in receiving water courses. Storm-water management practices during construction could result in high volume flushing of watercourses during high rainfall events (i.e., Betty's Cove Brook, and unnamed tributary to Dung Cove).

Operation and Maintenance

The management of storm-water during operation and maintenance of the facility may impact the hydrology of the area. It is anticipated that treated storm-water will be discharged to both Betty's Cove Brook and Stormont Bay.

Controlled drainage from a large land development such as this Project could periodically generate large amounts of storm-water discharge to Betty's Cove Brook. Flushing of the watercourse may occur as a result of the more severe flows experienced during and immediately after storms although the wetland associated with Betty's Cove Brook will likely have an ameliorating effect on the flows.

Reduced groundwater recharge in paved areas (thus, reduced stream base flow) may cause drier conditions and longer dry periods between flow events in streams. The storm-water

management system could limit base flows in watercourses if a substantial percentage of storm-water runoff is redirected from the freshwater system and discharged to Stormont Bay.

Modifications and Decommissioning

Significant changes to storm-water management via both discharge locations and discharge volumes could occur during changes to the facility and during decommissioning. This could affect base flows in watercourses as described above.

5.1.1.2 Mitigation Measures and Monitoring

Construction

Depending on final site grading plans and construction staging, there may be periodic storm-water discharges to Betty's Cove Brook from one or more temporary sediment ponds during plant site construction. While minor sediment and erosion events may be reversible, heavy precipitation events may lead to scouring, which has the potential to alter fish habitat. To avoid and minimize any adverse effects, a site –specific storm-water management plan (SWMP) will be implemented during construction. This includes the establishment of storm-water retention ponds, which will be sized to accommodate flows from the exposed areas upstream of the ponds during the construction phase. Peak flows discharged will not exceed existing peak flows.

Operation and Maintenance

Storm-water management planning will consider the natural flows to each catchment area and discharge collected storm-water within respective watershed, where possible, to maintain base flows. The SWMP will be a distinct component of the EMP.

Hydrologic modeling will be completed as part of the SWMP. The model will be used to design peak flows attenuation via retention ponds and groundwater recharge. This system will be designed to maintain sufficient base flows in watercourses.

Though a large component of the site footprint will be impervious surfaces where possible, consideration will be made for pervious surfaces for recharge areas.

Process areas will generally have paved (i.e., impervious surfaces) and will be curbed to direct runoff to one or more collectors. The SWMP envisages the use of large fire ponds as the primary means to control runoff from the facility prior to being discharged to Betty's Cove Brook and Stormont Bay. Based on the preliminary layout of the facilities, it is expected that much of the storm-water will be directed to Isaac's Harbour; however, the system will be designed to maintain base flows in Betty's Cove Brook.

Monitoring and follow up are required to provide feedback into ongoing storm-water management. This is described in subsection 5.1.1.4.

Modifications and Decommissioning

Similar to other project phases, storm-water management will ensure that base flows in watercourses during any future modifications or decommissioning will be maintained.

5.1.1.3 Residual Effects

Construction

On-site storm-water management will mitigate excessive flows to watercourses (i.e., Betty's Cove Brook) during construction. Residual effects have been determined not significant based on the small magnitude and infrequency of large runoff flows, and storm-water management measures employed to minimize the effect. Residual effects on hydrology will be temporary and reversible (Table 6.1-1). In accordance with Item 2.4 of the NSEL EA approval conditions (NSEL, 2007), a detailed erosion and sedimentation control (ESC) plan, including a monitoring program for site runoff will be prepared. The plan will be reviewed and approved by NSEL. Based on the results of the monitoring program, Keltic will make necessary modifications to the ESC plans and/or operations to prevent any unacceptable environmental effects, to the satisfaction of NSEL.

Operation and Maintenance

Mitigation measures will be used to attenuate peak flows to watercourses and maintain base flows in watercourses. SWMPs will be designed and dimensioned with the help of site-specific hydrologic modeling. Any residual effect environmental effects are considered minor (not significant). No down gradient effects will occur in the watershed as the sub-watersheds directly impacted are coastal. Any effects are temporary and reversible (Table 6.1-1). In accordance with Item 2.4 of the NSEL EA approval conditions (NSEL, 2007), a detailed ESC plan, including a monitoring program for site runoff will be prepared. The plan will be reviewed and approved by NSEL. Based on the results of the monitoring program, Keltic will make necessary modifications to the ESC plans and/or operations to prevent any unacceptable environmental effects, to the satisfaction of NSEL.

Modifications and Decommissioning

Similar to other project phases, mitigation measures will be applied to attenuate peak flows and maintain base flows in receiving waters. Where a residual effect occurs, it is minor (not significant) as noted above (Table 6.1-1).

5.1.1.4 Follow Up

Construction

Stream flow will be monitored as part of the EPP for construction. The flows during the construction period will be compared to baseline conditions. The comparison of flows will provide feedback to the storm-water management system. The collection system and attenuation ponds will be altered, as necessary, to mitigate effects on local hydrology.

Operation and Maintenance

Monitoring of the flows in the watercourses and the discharge-volume curve of the attenuation ponds will serve to calibrate the model used in the SWMP and provide feedback into mitigation measures. Should base flow in watercourses be determined as unseasonably low compared to baseline conditions and considering weather, adjustments will be made including changes to the SWMP to address the effect on local hydrology.

Modifications and Decommissioning

As with other project phases, monitoring of discharge and flow will occur during any future modifications and decommissioning. The results of the monitoring will influence SWMP and implementation if required.

5.1.2 Freshwater Quality/Quantity

5.1.2.1 Environmental Effects Prediction

Construction

The principal interaction between the Project activities and surface waters is associated with land disturbance during construction and commissioning of the Project. The LNG pipeline will be built on a trestle, with footings that may be placed within the Dung Cove Pond buffer zone boundary. The exact spacing of these footings is not currently designed, but will be confirmed during the FEED process.

The Project will not physically impinge on any of Ponds 1, 2, 3 and all required buffer zones will be maintained during construction.

The design of the proposed marginal wharf is not connected to the marine shoreline adjacent to the southeast corner of Pond 3. Pond 3 is a brackish water pond, which implies that there is a hydrologic connection between this pond and Stormont Bay / Isaac's Harbour. The channel of the inlet stream to Dung Cove will be avoided.

The greatest potential for impact to surface waters is expected to be during construction via discharge of storm-water. It is currently the intention of Keltic not to disturb tailings during construction activities. The concerns and potential effects to freshwater quality associated with disturbance of tailings during construction are discussed below in Section 5.1.5

There is a potential for construction activities to disrupt historic gold mine tailings which could enter waterbodies. This is discussed further in Section 5.1.5 Soil/Sediment Quality.

The three principal types of water discharge expected at the site during construction are:

- clean and possibly sediment-laden storm-water;
- construction wastewater (hydrostatic test waters, concrete wash water, storm-water that has been in contact with uncured concrete); and
- sanitary wastewater (worker sites and field offices).

The possible effects of runoff during construction have the highest potential to impact surface water as construction will result in exposing soil to potential erosion. If unmanaged, erosion of site soils can lead to sedimentation of watercourses. During construction, total suspended solids (TSS) concentrations in storm-water, residual hydrocarbons, and/or metals in hydrostatic test waters, or the concentration of lime in concrete production wastewaters, could exceed the water quality guidelines for the protection of aquatic life published by the CCME (1999). Runoff may also have an adverse effect on the flow to nearby watercourses.

The potential for adverse effects on- and off-site watercourses during construction are discussed below.

Betty's Cove Brook

Depending on final site grading plans and construction staging, there may be periodic storm-water discharges to Betty's Cove Brook from one or more temporary sediment ponds during construction. Also the Project is within Betty's Cove Brook catchment area, and therefore, sediment laden storm-water could drain to this watercourse.

Unnamed Tributary to Dung Cove

The footprint of the Project does not impinge on this tributary; however, the Project is within its catchment area. As such, sediment laden storm-water has potential to drain to this tributary.

Operation and Maintenance

The principal interactions between the Project activities and surface waters during the operation phase of the Project are associated with wastewater and storm-water discharges. The largest discharge component by volume is expected to be storm-water.

The principal types of water discharge expected during operations for the component of the Project include:

- potentially oily storm-water from some process complexes (paved or hard surfaces), process water, cooling water blow down;
- clean, (i.e. not contaminated with hydrocarbons or having high levels of suspended solids) storm-water from some process complexes and general areas, either paved (hard surface) and unpaved (soft surface); and
- domestic-type or sanitary waste water (some from process complexes and some from common-user utilities).

As described in Section 2.0, the wastewater streams identified will be treated in a number of ways depending on the source and characteristics of the wastewater stream. At this stage of the Project design, the treated and untreated effluent quality and quantity have not been specifically determined for the LNG facility. Following treatment, process and sanitary wastewater will be discharged to Stormont Bay. Runoff may also have an adverse effect on the flow to nearby watercourses.

Modifications and Decommissioning

Some disturbance of soils will likely occur during decommissioning of the facility. As during the construction period, a range of mitigation measures will be used to control erosion and sedimentation and to minimize potential effects of storm-water discharges to surface waters.

5.1.2.2 Mitigation Measures and Monitoring

Construction

Site preparation will occur within tributary area of several watercourses. These include Betty's Cove Brook and the unnamed tributary to Dung Cove.

The guiding document regarding the mitigation of potential effects on surface water will be "Erosion and Sedimentation Control Handbook for Construction Sites" (Nova Scotia Department of the Environment, 1988).

Once final site layout is determined, if tailings disturbance is required, a tailings management strategy, likely including encapsulation, will be developed in concert with regulatory authorities.

Sanitary wastewater will be stored and hauled off site during early construction and then treated on-site using approved sanitary wastewater treatment methods. Wastewater generated from Project operations will be treated to comply with NSEL and EC criteria prior to discharge as described in Section 2.0. A SWMP will be developed to reduce the total amount of storm-water discharge generated and to prevent sediment-laden runoff from the site from entering surface waters during Project operation.

While minor sediment and erosion events may be reversible, heavy precipitation events may lead to scouring, which has the potential to alter fish habitat. Sediment ponds will be used to control and treat storm-water during construction period. These will be discharged to Betty's Cove Brook. The sediment ponds will be sized to accommodate flows from the exposed areas upstream of the ponds and allow for sufficient settling time for sediments. If necessary, flocculant may be added to the pond to enhance settlement prior to discharge.

To mitigate possible effects of runoff altering flow to watercourses a SWMP will be implemented. This will include a flow measurement analysis and hydrologic modeling to design peak flow attenuation and groundwater recharge.

Routine air emissions from the facility are not expected to cause any degradation in surface water quality.

In accordance with Item 1.5 in the NSEL EA approval conditions (NSEL, 2007), a plan to mitigate the human health and environmental impacts of the contaminated mine tailings and/or soils and sediments on the Project Site, via remediation or risk management will be developed and implemented. This plan will be consistent with the Nova Scotia Guidelines for the Management of Contaminated Sites. The Remedial Action Plan and/or Risk Management Plan will be approved by NSEL prior to commencement of construction. Upon completion of the remediation or risk management work, including any required monitoring, Keltic will submit a

Certificate of Compliance to NSEL to demonstrate that the remediation work has been completed and/or the Risk Management Plan is effective (NSEL, 2007).

Also, in accordance with Item 1.10 in the NSEL EA approval conditions, baseline data collection for all relevant chemical parameters which are expected to enter the environment or be remobilized as a result of Project activities in all receiving environments will be collected. Assimilative capacity of all receiving environments for all relevant chemical parameters will then be predicted (NSEL, 2007). Surface water quality monitoring programs will be established in consultation with regulatory agencies and as part of the permitting process through the Conditions of Approval.

Additional mitigation measures include:

- establishment of a buffer zone around watercourses (Betty's Cove Brook; Unnamed tributary to Dung Cove);
- preparation and implementation of a spill prevention and response plan;
- establishment of designated fuelling and material storage sites; and
- all rock excavation will be tested for acidic conditions and any found to exceed regulatory levels will be disposed of in accordance with the Sulphide Bearing Materials Disposal Regulations (NSDE, 1995) and Guidelines for Development on Slates in Nova Scotia (NSDE, 1995).

Operation and Maintenance

Mitigation measures for the protection of freshwater quality/quantity are summarized below:

- Industrial Site Wastewater Management - Storm-water runoff from uncontaminated areas will be segregated from potentially contaminated areas and discharged through a storm-water outfall. These uncontaminated areas generally include roads, building roof drains, undeveloped areas, and uncontaminated areas in the utility and offsite units. The non contaminated runoff will generally flow through open site ditches with final disposal in Stormont Bay. Ditch checks, vegetation, and siltation ponds will be utilized to treat the storm-water before discharge.

  A first flush approach will be utilized in handling potentially contaminated storm-water. Under this approach the initial 25 mm of rainfall is diverted to storm-water ponds. Rainfall in excess of 25 mm is considered to be clean and is diverted to the storm-water outfall. Water from the storm-water pond will be transferred at a controlled rate to the onsite wastewater treatment system.

  Oily water will be collected in the oily water system and pumped to the Coalescing Plate Interceptor (CPI) separator, where initial separation of oil and water takes place. Water effluent from the CPI separator flows to the Induced Air Flotation Unit (IAFU) for further removal of any remaining free and/or emulsified oils. In the IAFU, oil, suspended solids, and grease adhere to bubbles and are floated to the surface. This froth then overflows to a collection point while the water from the IAFU is pumped to the equalization basin. In the equalization basin, the IAFU water combines with non oily wastes and potentially contaminated storm-water.

Recovered oil from both the CPI separator and the IAFU is collected and pumped to the recovered oil tank. This oil will be disposed of off site by a licensed contractor. Solids removed by the CPI separator will collect in the bottom of the separator and will be removed periodically via vacuum truck for disposal off site.

- A biological treatment unit consisting of an extended aeration and activated sludge system will be utilized for further treatment of wastewater. Effluent from the equalization basin is sent to the bioreactor basin and is contacted with activated sludge. The activated sludge permits natural biological reactions to further treat the wastewater. The mixed biological slurry overflows to the secondary clarifier where the biological solids are removed and recycled back to the bioreactor. The effluent from the biological treatment unit will be of sufficient quality to be discharged to the environment.

  Wastewater generated from Project operations will be treated to comply with regulatory requirements prior to discharge. Sanitary wastewater will be stored and hauled off site during early construction and then treated on-site using approved sanitary wastewater treatment methods. A SWMP will be developed to reduce the total amount of storm-water discharge generated and to prevent sediment-laden runoff from the site from entering surface waters during Project operation.
- Storm-water Management (Plant Site Operation) - Process areas will be paved and curbed to direct runoff to one or more collectors equipped with a sump and oil and water separator to ensure that runoff not meeting regulatory criteria is treated or disposed in accordance with requirements. A SWMP will be developed incorporating the use of large fire ponds to prevent sediment-laden runoff from the facility from entering streams, Isaac's Harbour, and Stormont Bay. The plan will include hydrologic modelling to design peak flows attenuation and groundwater recharge and a flow measurement analysis will be undertaken. Peak flows will be attenuated where possible.
- Storm-water Management (Plant Site Operation) - Reduced groundwater recharge in paved areas (thus, reduced stream base flow) can cause drier conditions and longer dry periods between flow events in streams. The net result can be an increase in stream erosion and channel straightening over time, accompanied by reduced water and aquatic habitat quality. To mitigate Keltic intends to retain as much vegetated (natural or replanted) and porous (unpaved parking areas and walkways) “soft surface” as possible and reduce the amount of paved or “hard surface” needing controlled drainage. This can help to maintain existing water balances and status-quo conditions regarding net overland flow and infiltration to groundwater recharge and base flow to receiving watercourses.

Inter-Watershed Transfers - All storm-water collected within the plant site will be disposed of within each respective watershed. As such, there will be no inter-watershed transfers during the construction, operation, or decommissioning of the KDP.

- Monitoring for the operation phase of the Project will consist of annual qualitative/quantitative sampling of the benthic-invertebrate community at one station on both Betty’s Brook and the unnamed tributary to Dung Cove during post construction years 1, 2, 3, and 5, and every 5 years thereafter. Annual reports based on survey results (ephemeroptera/ plecoptera/ trichoptera index, taxon dominance, density,

species diversity, hilsenhoff biotic index, etc.) will be prepared and the results compared with previous years.

- In accordance with Item 1.5 in the NSEL EA approval conditions (NSEL, 2007), a plan to mitigate the human health and environmental impacts of the contaminated mine tailings and/or soils and sediments on the Project Site, via remediation or risk management will be developed and implemented. This plan will be consistent with the Nova Scotia Guidelines for the Management of Contaminated Sites. The Remedial Action Plan and/or Risk Management Plan will be approved by NSEL prior to commencement of construction. Upon completion of the remediation or risk management work, including any required monitoring, Keltic will submit a Certificate of Compliance to NSEL to demonstrate that the remediation work has been completed and/or the Risk Management Plan is effective (NSEL, 2007).

Modifications and Decommissioning

Mitigation presented for the construction phase is sufficient for the decommissioning phase as well.

5.1.2.3 Residual Effects

The impact of the Project on the quality and quantity of freshwater is not expected to be significant since the magnitude of the effects is low, the geographic extent is only at Betty's Cove and Dung Cove, the duration is for a short term, and the effects are reversible. The following subsections provide a summary of this residual effects determination by Project phase. A summary of residual effects and determination of significance is presented in Section 6.0, Table 6.1-2).

Construction

Mitigation of sedimentation and excessive flows to effected watercourses (i.e., Betty's Cove Brook and unnamed tributary to Dung Cove) during construction will limit any adverse effect to minor (not significant) based on the small magnitude and infrequency of large runoff flows. Any effect will be temporary and reversible.

Operation and Maintenance

Mitigation measures will be used to attenuate peak flows to watercourses and maintain base flows in watercourses. Proper modeling and design of the storm-water management system will ensure maintenance of flows in watercourses. Any residual effect is minor (not significant). The relative size of the footprint compared to the watersheds is negligible. No downgradient effects will occur in the watershed as the sub-watersheds directly impacted are coastal. Any effects are temporary and reversible.

Modifications and Decommissioning

Similar to other project phases, mitigation measures will be implemented which will attenuate peak flows and maintain base flows. Where a residual effect occurs, it is minor (not significant) as noted above.

5.1.2.4 Follow Up

Construction

Mitigation measures proposed to protect watercourses will be checked regularly during construction as required in the EPP for construction. There will be a feedback mechanism to repair, replace, or improve any deficient mitigation measure.

Sampling and analysis of water quality and flow measurements will be completed in Betty's Brook as it will likely receive treated storm-water discharge. Benthic invertebrate surveys will also be completed for effected watercourses.

These flow, benthic community, and water quality data will be compared with baseline values. As per the construction specific EPP, mitigation measures will be evaluated and adjusted as necessary.

Operation and Maintenance

No follow up monitoring is anticipated. For monitoring that will occur during the operational phase of the Project see Section 5.1.2.2.

Modifications and Decommissioning

No monitoring programs have been planned for decommissioning at this time.

5.1.3 Groundwater Quality/Quantity

The issues regarding the quality and quantity of groundwater are the effects that the plant construction and operation may have on water supply wells, and the effects that changes to the groundwater regime may have on surface water bodies, streams, and wetlands adjacent to the Project.

Groundwater quality or quantity effects may often be of long duration. Unlike surface water, where sun, exposure to air, wind, and wave action may help to break down or disperse deleterious substances introduced to a stream or lake, the dark and cold conditions present in the subsurface are generally conducive to the long-term preservation of many substances. Thus, deleterious materials introduced into the subsurface aquatic environment may remain there for long periods of time, and once adsorbed to soil and rock, may serve as a long-term source of material to be dissolved into groundwater. These dissolved materials may in turn be introduced to surface waters via base flow and discharge to wetlands, thus possibly affecting these environments as well.

The field reconnaissance indicates that there are approximately 40 wells located within 1 km of the site boundaries of the KDP. There are also two streams within the site boundaries (Betty's Cove Brook and the unnamed tributary to Dung Cove) which may have groundwater supplies interrupted by excavation associated with site preparation and construction.

Based on the projected gravitational groundwater flow lines shown in Figure 4.1-6, possible surface water receptors include Betty's Cove Brook, and associated wetlands, the unnamed

tributary to Dung Cove, Dung Cove, and Stormont Bay. Possible receptor wells, depending upon the final site configuration, are likely to include wells west of the site within a zone that extends along Highway 316 between Webbs Cove and Dung Cove, the degree and significance of which would depend on the exact locations and nature of the source, well type, nature of the surficial and bedrock geology present between the source and the well, and distance to the well. Depending upon facilities locations, other wells north of this zone could, to a lesser degree, also become receptors.

5.1.3.1 Environmental Effects Prediction

Construction

The main considerations with respect to impacts on water supply wells from the Project during construction include:

- blasting and vibration damages, with consequent temporary siltation (for dug and drilled wells) and possible permanent reduction in well yield (for drilled wells) during construction;
- trenching, site drainage, and large cuts or changes in surface topography, could result in water level reductions during and after construction (dug well effects); and
- accidental release of fuel chemicals due to equipment failure during site preparation and construction.

Major excavations through glacial tills and bedrock could potentially lead to a drop in groundwater table elevation in proximity to the excavation. This could possibly affect wells and streams.

The degree of water level lowering will be proportional to the depth of the excavation below natural water table level, the distance between the well or stream and the excavation, and the hydraulic properties of the earth materials. Dug wells in close proximity to an excavation which, in Nova Scotia, are already susceptible to seasonal water-level fluctuations of 2 m to 4 m may become dry. Drilled wells may experience similar water-level drops, although because of the larger water column of drilled wells, they are not likely to be adversely affected by average overburden or bedrock cuts.

The severity of the water supply well impacts are expected to be a function of well type (spring, dug well, drilled well), age of the well, well construction method, distance from the site boundaries, overburden thickness and the hydraulic properties of the soil and bedrock.

With respect to groundwater quantity, the main concerns related to plant site construction are:

- potential loss of well yield or lowered water level in dug wells (this is not expected to be significant due to the relative distance and small number of wells involved);
- possible damage to, or loss of drilled wells during blasting operations; and
- possible reduction in base flow at on-site streams and reduced (or increased) discharge at wetlands.

With respect to groundwater quality, the main concerns related to plant site construction are:

- chemistry changes in down-gradient wells due to uncontrolled runoff;
- temporary siltation of dug wells during heavy equipment operations; and
- accidental release of hazardous materials up-gradient of wells or streams.

There are locations within the proposed site, which may, or are known to contain, sulphide mineralization, particularly along the lower part of the SOEI gas plant access road and in the southwest and northeast portions of the KDP boundaries. Contamination of wells and/or on-site streams from acidic drainage due to the exposure of acid generating rock may be a concern in these areas. Keltic will be undertaking an assessment of the bedrock as part of the geotechnical site investigation.

The effects of groundwater on surface water bodies and streams adjacent to the Project include stream dewatering which may be caused by deep and/or large-scale site drainage. See Section 5.1.3.2 for a discussion of proposed groundwater mitigation measures and Section 5.1.3.4 for the groundwater monitoring program.

Operation and Maintenance

The main considerations with respect to impacts on water supply wells from the Project during operation include:

- salt contamination from on-site roadways; and
- accidental (acute) and chronic spills and release of chemicals, and possible releases due to fires, during plant operation.

As with the construction phase, the severity of the water supply well impacts will be a function of well type, age of the well, well construction method, distance from the Project Site boundaries, overburden thickness, and the hydraulic properties of the soil and bedrock. With regard to groundwater quantity, the main concern is potential loss of well yield or lowered water level in dug wells. With respect to groundwater quality, the main concerns related to the operation of the plant include:

- chemistry changes in down-gradient wells due to uncontrolled on-site road runoff; and
- chronic and acute accidental release of hazardous materials up-gradient of wells or streams.

The potential for well contamination from acidic drainage should be considered low so long as measures are taken to prevent exposure to water or oxygen if acid bearing slate is present. Preliminary geotechnical testing has not shown the presence of sulphide bearing minerals on the Site.

The effects of groundwater on surface water bodies and streams adjacent to and within the site boundaries, which include stream dewatering (caused by deep and/or large-scale site drainage during construction), are not expected to change from conditions possibly arising from the construction phase.

Modifications and Decommissioning

Potential effects to groundwater resources during the decommissioning phase include possible disruptions to groundwater flow, the temporary siltation of dug wells during heavy equipment operations, and the accidental release of contaminants to the environment.

5.1.3.2 Mitigation Measures and Monitoring

Construction

Petroleum hydrocarbons other than LNG (i.e. diesel fuel for back up generators) and other chemicals will be stored in a manner that will prevent spills from getting into the environment. This may include storage within a containment area and the use of double walled tanks. As well, all site personnel will be trained in use handling of hydrocarbons and chemicals as appropriate. A groundwater monitoring program for the particular chemical(s) of concern will be implemented in accordance with Item 2.6, of the NSEL EA approval conditions.

Blasting has the potential to affect adjacent wells, with possible impacts ranging from minor temporary turbidity to damage to well crocks or casing and loss of water. Eight wells are situated within 800 m of the plant site boundaries may be affected. The severity of the effect being proportional to separation distance, physical properties of the bedrock being excavated, age and construction method of the well, well yield, and blast magnitude. “Natural” mitigating factors include thick overburden and ‘soft’ bedrock.

Based on the detailed design of the plant site grading plans, a detailed survey of homes and wells located within 800 m of the blast areas will be undertaken following the NSEL guidelines for blasting at quarries. The pre-blast survey includes: an inspection of all buildings located with the boundaries of the pre-blast survey area; inventory of wells including water sampling for general chemistry, metals, and bacteria; and short-term pumping tests (where wells are accessible), to determine the capacity of individual wells and nearby aquifers. The Proponent will deliver an arbitration and resolution document to all owners of water supply wells located within 800 m of the proposed plant site boundaries. The Proponent is prepared to provide temporary water supply during construction should existing supplies be disrupted. Additionally, in the event that wells are adversely or permanently affected by plant-site preparation or construction the Proponent will repair or replace any affected wells.

Mitigation measures will be implemented on the basis of the pre-blast survey. The Proponent is prepared to provide temporary water supply during construction should existing supplies be disrupted. Additionally, in the event that wells are adversely or permanently affected by plant-site preparation or construction the Proponent will repair or replace any affected wells

In the south half of the KDP Study Area where the tanks are proposed to be located (areas underlain by bedrock of the Meguma Group), overburden is expected to be relatively thin to non-existent. The bedrock is also hard and topographic relief is severe. These conditions suggest a higher need for blasting in this area. As a mitigation consideration, the Project design will be modified where possible to reduce the need for such blasting.

Design and construction engineers and hydrogeologists will work closely to identify grading requirements and areas at the plant site where water levels in wells and streams may be vulnerable to grade changes. Monitoring and implementation of appropriate mitigation measures (i.e., deepening of drilled wells, replacement of dug wells with drilled ones, design change, etc.) will make it possible to minimize and likely avoid adverse potential effects on groundwater in the Project Area.

Operation and Maintenance

Proper precautions such as secondary containment, leak detection systems, and monitoring alarms will be incorporated into the plant design and processes as appropriate. The potential effects of chronic and accidental spills of deleterious materials on groundwater will be reduced through spill prevention planning, vigilant monitoring and rapid cleanup response. Details of these plans will be provided in the EMP.

In the event that wells are adversely or permanently affected by plant operation the Proponent will repair or replace any affected wells.

Modifications and Decommissioning

Mitigation presented for the construction phase will be sufficient for the modification/ decommissioning the LNG facility.

5.1.3.3 Residual Effects

Provided the proposed mitigative measures are implemented as suggested, the environmental effects are considered to have low magnitude and occur within 1 km of the site. Therefore no significant adverse residual environmental effects on groundwater resources are likely to occur (Table 6.1-3).

5.1.3.4 Follow Up

Construction

As construction work progresses, follow-up well sampling will be done, as required, to adequately assess general groundwater and specific well water supply quality.

The exact nature and location of on-site storage has not yet been determined, and thus detailed groundwater monitoring requirements have not been finalized. Once the design of the plant site, facilities locations, and storage criteria have been completed, a groundwater monitoring well system will be designed and installed to expand upon the existing seven monitoring wells stations installed on-site during spring 2005. Some of the wells will be installed before any site preparation or construction activities begin while others will be completed once the storage systems are in place.

The plant site groundwater monitoring system will be designed, constructed, and maintained in accordance with Conditions of Approvals (NSEL EA approval conditions 1.2, and 2.5), where applicable. The system will also be used to augment current baseline data, to monitor early site preparation and construction effects and assist the Proponent and the neighbouring community

for the duration of plant operation. The intent is to incorporate data collected from groundwater monitoring stations, in conjunction with other data which may become available on the abandoned mine workings, into groundwater models so as to allow for more comprehensive groundwater flow migration forecasting. This information will form part of the spill response and contingency plan.

The plant site monitoring system sampling schedule will include:

- a sufficient number of monitoring stations to provide full (both background or up-gradient and down gradient) on-site and nearby off-site coverage;
- multi-level and multi-well stations at key locations;
- proximal and distal monitoring capability for all fuel/chemical storage;
- timely response to any spill event; and
- four-season and longer temporal coverage.

This will include installations inside and at plant-site boundaries, outside plant-site boundaries (particularly in the east and south between the plant and Betty's Cove Brook, west between the plant site and the ocean, and north and northwest between the plant site and the community of Goldboro). Infill monitoring stations will be installed as suggested by early monitoring results and data collected.

In addition to the on-site and site-perimeter monitoring stations, groundwater monitoring stations will be installed at select locations within the community of Goldboro so as to allow uninhibited and unbiased collection of groundwater quantity and quality data (i.e. to simulate water supply wells).

It is expected that key monitoring stations will be assessed regularly for vapours that are relevant to storage and plant operations, and for water levels (data loggers). At others, groundwater levels will be measured and water samples collected regularly for general chemistry, metals, total petroleum hydrocarbons, and VOCs analysis. A protocol will be established to enable the program to be modified to optimize the use of monitoring resources, scientific data quality, and knowledge of on site hydrogeological characteristics.

The main potential adverse effects on groundwater quality during the construction of the plant are expected to be from accidental spills and siltation from vibration. The EPP will address the issues related to the containment and clean-up from spills. Wells located near the plant site which may be susceptible to siltation from vibration or erosion runoff during construction will be inspected and inventoried for possible future reference. In accordance with Item 2.4, an ESC plan will be developed and implemented. A monitoring program to determine the potential for and extent of sulphide bearing material will also be implemented with a plan to manage any exposed acid generating material and associated drainage. The sulphide monitoring program and management plan will be developed in accordance with Item 2.8 of the NSEL EA approval conditions.

Operation and Maintenance

During plant operation, there will be regular monitoring of well water quality at key wells located near the plant site. A post construction report will identify these wells (selected on the basis of possible exposure to detrimental effects, if any, from plant operations, and on the basis of providing optimum scientific information), other possible future monitoring needs, and protocol for modifying the proposed monitoring program so as to continually optimize scientific data quality and resource utilization. Sampling at these wells will include analysis for general chemistry, metals, coliform, petroleum hydrocarbons, VOCs, and others as deemed necessary based on plant site operations and monitoring results. Keltic will provide sampling results to individual well owners.

The groundwater monitoring system described above in the construction section will continue to serve as a monitoring system during plant operation. To meet the requirements of Item 2.4, in the NSEL EA approval conditions, an ESC Plan will also be developed and implemented. The ESC Plan will include a monitoring program for site runoff and will be reviewed and approved by NSEL. A monitoring program to determine the potential for and extent of sulphide bearing material will also be implemented with a plan to manage any exposed acid generating material and associated drainage. The sulphide monitoring program and management plan will be developed in accordance with Item 2.8 of the NSEL EA approval conditions.

Modifications and Decommissioning

No monitoring programs have been developed at this time. These will be developed in accordance with the regulatory requirements applicable at the time of decommissioning.

5.1.4 Marine Water Quality

5.1.4.1 Environmental Effects Prediction

Potential impacts to marine water quality from storm-water have been discussed in Section 5.1.2. At maximum capacity (18 billion metres cubed per year (m^3/year)) the LNG facility will discharge approximately 490,000 m^3/year of purge water from Submerged Combustion Vaporizers and cooling water from the BOG compressor. There is also the potential for re-suspension of contaminated sediments due to propeller wash and construction activities. Only other potential sources for effects on the marine water from the LNG facility may result from accidental spills of contaminated material. Potential effects from accidental events and malfunctions are described in Section 10.0.

5.1.4.2 Mitigation Measures and Monitoring

Construction-related mitigation measures have been discussed under 5.1.2.2. Mitigation measures during operation and maintenance involve the operation of a non-contact water cycle, which will avoid release of any contaminants to the marine environment. While thermally altered water may be discharged from the Project if the seawater option is exercised, the temperature difference within 100 m of the diffuser is expected to be within 3°C of ambient temperature. This is within natural variation within the water column in the Strait (Stewart and White, 2001) and is not anticipated to cause significant effects. However, thermal pollution models will be run during the FEED process to identify if any further mitigation measures are

required. In order to prevent re-suspension of contaminated sediments from propeller wash large vessels are to be berthed with the assistance of tugs.

In accordance with Item 1.5 in the NSEL EA approval conditions (NSEL, 2007), a plan to mitigate the human health and environmental impacts of the contaminated mine tailings and/or soils and sediments on the Project Site, via remediation or risk management will be developed and implemented. This plan will be consistent with the Nova Scotia Guidelines for the Management of Contaminated Sites. The Remedial Action Plan and/or Risk Management Plan will be approved by NSEL prior to commencement of construction. Upon completion of the remediation or risk management work, including any required monitoring, Keltic will submit a Certificate of Compliance to NSEL to demonstrate that the remediation work has been completed and/or the Risk Management Plan is effective (NSEL, 2007).

No particular mitigation measures beyond those applied during construction and operation have been developed for Project modifications and decommissioning.

5.1.4.3 Residual Effects

Upon implementation of the mitigation measures, the residual environmental effects are expected to be low in magnitude, intermittent and short term, and be reversible. The geographical extent will be Stormont Bay. Therefore, residual adverse environmental effects of the Project on marine water quality is expected to be minor (i.e., not significant) during all Project phases.

5.1.4.4 Follow-up

To ensure the adequacy of the mitigation measures and the proper functioning of the process water treatment, monitoring of effluent quality (including temperature) and quantity at the point of discharge will be conducted. Details of the program will be established in consultation with the provincial regulator during the permitting stage and detailed design.

Thermal pollution models will be run during the FEED process to identify if any further mitigation measures are required.

NSEL EA approval condition 1.5 commits Keltic to develop a plan to mitigate the human health and environmental impacts of contaminated mine tails and/or soils and sediments on the Project Site, via remediation or risk management. Furthermore, NSEL EA approval condition 1.10 commits the Proponent to 1) modelling to predict the assimilative capacity of all receiving environments for all chemical parameters which are expected to enter the environment as a result of Project activities, and 2) baseline data collection for all relevant chemical parameters which are expected to enter the environment or be remobilized as a result of Project activities in all receiving environments.

5.1.5 Soil/Sediment Quality (terrestrial and marine)

5.1.5.1 Environmental Effects Prediction

There are two types of geologically related features in proximity to the KDP area, all of which pre-exist the development of the KDP, and which have the potential to cause environmental impact, namely:

- the abandoned mine workings that are located predominantly in the southwest portions of the proposed site; and
- the tailings areas on site, which remain as a legacy of past gold mining activities in the area.

There are a number of abandoned mine workings on the KDP site, particularly in the southwest portions of the proposed site; including south and west of Route 316 generally coinciding with the proposed LNG facilities. Some of the abandoned mine workings are known to be quite extensive, some are several hundred metres long, and workings in the area are known to have gone to depths that exceed 70 m. Some workings are also believed to have moved upward from greater depth to surface either through the historic mining activity or through progressive collapsing of the underground workings. They are also known to be in direct contact with the ocean.

The exact location and character of these old workings are either poorly documented or undocumented. These workings in the southwestern part of the KDP Site are difficult to find because they have become overgrown and, in some instances, plugged at the surface with debris.

There are three tailings disposal areas within the Project and one located just outside of the Site boundaries. The floor of Dung Cove is believed to have been totally, or nearly totally, flooded with tailings and therefore is perhaps of greater concern than the other tailing sites because of possible exposure to storm surges.

Based on currently available information, with the exception of the local mine dumps and a few localized highly mineralized bedrock zones which have not yet been worked, there appears to be little risk of encountering large amounts of acid generating material within the boundaries of the proposed plant site, if any.

Construction

The old mine workings are of concern from a health and safety and environmental perspective during construction. The locations of the openings are difficult to see through the vegetation on site and workings close to the surface may pose a safety concern for heavy equipment operations.

Construction above undiscovered underground mine workings poses potential long-term structural issues including deformation and collapse.

The tailings areas could become disturbed during plant site preparation or plant construction increasing the potential for arsenic- and mercury-bearing dust and sediment to be released by

wind or via the watercourses that originate from or run through them. The airborne particles can be inhaled directly or migrate downwind to be deposited elsewhere. The mercury may also volatilize, to be introduced in downwind environments as mercury vapour.

Marine sediment may be impacted by the introduction of contaminants in runoff as a result of accidental spills and malfunctions (refer to Section 10.0).

Operation and Maintenance

The greatest concern regarding the mine workings relates to site operation and the possibility of accidental spills. The old mine workings may serve as rapid pathways, or "highways," for spills or other groundwater contaminants from the Project toward soils and to marine sediments in Stormont Bay.

As during construction, should the tailings located on-site or at Dung Cove become disturbed during operation, arsenic- and mercury-bearing sediments and dust could be released via the wind or in streams, to be deposited elsewhere on and off site. The possible release of mercury vapours through volatilization could also pose a concern to plant site worker health.

With respect to acid drainage generation, the Project operation is considered to have minimal effects on the environment, since all surfaces affected by the construction will be stabilized and rehabilitated, where applicable. In addition, it is anticipated that with the implementation of an acid generating rock management plan, if required, there is not expected to be any on-going environmental concerns.

There is potential for re-suspension of contaminated sediments due to propeller wash.

Marine sediment may be impacted by the introduction of contaminants in runoff as a result of accidental spills and malfunctions.

Modifications and Decommissioning

Potential effects to soil/sediment quality during the decommissioning phase are identical to those associated with the construction phase.

5.1.5.2 Mitigation Measures and Monitoring

Construction

Some mapping of the old mine workings in the KDP Study Area has been completed, but additional surveys will be required to identify all former mine sites in areas of concern and to make the proposed plant site safe to workers and/or structures.

Additional surface mapping (Global Positioning System (GPS) and surveyed locations) will be done prior to site development and during the site-preparation and re-grading operations. Those workings believed to be shallow will be pumped out for direct observation to confirm depth, and subsequently filled with stone from the site.

Tailings disposal areas will be fenced and avoided where feasible. In the event that this is not possible, tailings sites will be encapsulated to prevent the emanation of dust, sediment, surface water, or groundwater.

The tailings present at the bottom on Dung Cove will not be disturbed during construction. The pipeline to be developed at the southeastern end of Dung Cove will be constructed on a trestle and the pond footprint will not be disturbed.

Based on the results of the field surveys, the greatest potential for acid drainage is situated at the northern boundary of the proposed petrochemical plant site. Based on current conceptual plans, no excavation into Halifax Formation in that area is proposed.

The Project's engineers and Project geologist/hydrogeologists will work closely together to:

- more clearly define those areas which might become a concern for acid drainage based on preliminary grading design;
- test bedrock in those areas where there might be acid drainage potential and where excavation for grading is deemed necessary, or where new sources of borrow material are likely to be obtained on-site; and
- where acid drainage potential is confirmed based on the testing, change the grading design so as to minimize or avoid excavation of potentially acid generating rock.

In those areas where bedrock is to be tested, the testing work would consist of:

- grab samples of bedrock during preliminary and detailed geotechnical investigations on the site;
- advancing angled bore holes (as near perpendicular to bedrock dip as possible) where equipment allows (vertical bore holes where equipment does not allow), with continuous bedrock coring, to 1.5 m beyond grading design depth; and
- splitting of the core along its axis, with retention of half for future reference, the other half sent for laboratory determination of total sulphide content, acid generation, and acid consumption (net acid production) potential.

It is of note that in compliance with EA approval conditions (Item 1.5) established by NSEL (NSEL, Environmental Assessment Approval. March 14, 2007 - http://www.gov.ns.ca/enla/ea/kelticpetro/KelticPetro_Conditions.pdf), Keltic will generate a plan to mitigate human health and environmental impacts of contaminated mine tailings and/or soils and sediments on the Project Site, via remediation or risk management. This will be consistent with the Nova Scotia Guidelines for the Management of Contaminated Sites. The Remediation Action Plan and /or Risk Management Plan will be approved by NSEL prior to commencement of construction. Upon completion of the remediation or risk management work, Keltic will submit a certificate of Compliance to NSEL to demonstrate that the work has been completed and/or the Risk Management is effective. In addition, as per Item 2.8 of the approval conditions a detailed monitoring plan, in consultation with NSEL, will be developed determine the potential for and extent of sulphide bearing material and to manage any exposed acid generating material and associated drainage.

Also, in accordance with Item 1.10 in the NSEL EA approval conditions, baseline data collection for all relevant chemical parameters which are expected to enter the environment or be remobilized as a result of Project activities in all receiving environments will be collected. Assimilative capacity of all receiving environments for all relevant chemical parameters will then be predicted (NSEL, 2007).

Mitigation for accidental spills and malfunctions is presented in Section 10.0.

Operation and Maintenance

The greatest concern regarding the mine workings relate to site operation and the possibility of accidental spills. The old mine workings may serve as rapid pathways, or "highways," for the large-scale and direct migration of spills or other groundwater contaminants from the proposed petrochemical plant toward neighbouring residential wells and into the ocean. Storage of materials that could result in spills should be located away from areas with mine workings that could provide a preferential flow pathway to surface water or groundwater. Where feasible, tailings areas will be fenced and avoided. Many of the spill containment measures in terms of facility design and component siting are described in Section 2.0.

In addition, all old mine workings that could pose a risk to the integrity of the proposed facilities and infrastructure will be filled or avoided through adjustments in the site design (refer to the mitigation presented for construction). A plan to mitigate the human health and environmental impacts of contaminated mine tailings and/or soils and sediments on the Project Site via remediation or risk management will be developed. This plan shall be consistent with the Nova Scotia Guidelines for the Management of Contaminated Sites. The Remedial Action Plan and/or Risk Management Plan will be approved prior to commencement of construction. Upon completion of the remediation or risk management work, including any required monitoring, Keltic will submit a Certificate of Compliance to NSEL to demonstrate that the remediation work has been completed and/or the Risk Management Plan is effective. The Certificate of Compliance shall be submitted no later than 3 years after completion of construction of the land-based components of the Project. In addition, as per Item 2.8 of the approval conditions a detailed monitoring plan, in consultation with NSEL, will be developed determine the potential for and extent of sulphide bearing material and to manage any exposed acid generating material and associated drainage.

In order to prevent re-suspension of contaminated sediments from propeller wash large vessels are to be berthed with the assistance of tugs.

Modifications and Decommissioning

Refer to the mitigation presented for construction.

5.1.5.3 Residual Effects

Provided the proposed mitigative measures are implemented, the magnitude and geographic extent of the environmental effects will be low (Table 6.1-5, Section 6.0). Therefore, no significant adverse residual environmental effects on soil and sediment quality are likely to occur.

5.1.5.4 Follow Up

Construction

In accordance with Item 2.10 in the NSEL EA approval conditions, a plan will be developed and implemented to monitor environmental effects for all relevant chemical and biological parameters that are expected to enter the environment or be remobilized as a result of Project activities in all receiving environments, including those which may impact human health and/or organisms (NSEL, 2007).

Operation and Maintenance

Any follow-up monitoring required will be identified and implemented as per Condition 2.1 of the Nova Scotia Part V Approval within the EEM Plan. Additional monitoring, as per the NSEL EA is outline in Section 5.1.4.4.

Modifications and Decommissioning

No follow up monitoring is anticipated.

5.1.6 Air Quality

Air quality was originally conducted for the purpose of the provincial environmental report (AMEC, 2006) and included all KDP components as well as the petrochemical and co-generation facilities. This information is presented below. It is considered to represent the worst case scenario as additional facilities outside of the scope of this document are included in the modelled scenarios.

5.1.6.1 Environmental Effects Prediction

Construction

Air quality related impacts associated with the construction of the facility will be comprised mainly of emissions from diesel-powered construction equipment and from marine vessels used to deliver equipment and materials to the site. There will also be emissions from private vehicles driven by the construction labour force (i.e. approximately 900 vehicles per day over the entire construction period). These emissions include NO_x, SO_x, particulates, and GHGs; however, these sources are relatively minor and will be of short duration.

Fugitive dust emissions will be generated as a result of excavation and earth moving activities as well as construction equipment traveling on paved and un-paved roads (i.e. dump trucks, cement trucks, watering trucks, bulldozers, graders, scrapers, compactors, front end loaders, and back hoes). A concrete batch plant will also be a source of fugitive dust emissions. These types of emissions will occur over a relatively brief period of time and will have only very localized impacts with the dust settling out generally within a few hundred metres of the activity.

As the site is fairly isolated from the residents, schools, and businesses of the area, the impacts to the public are expected to be insignificant, approaching background concentrations at off-site

locations. Mitigation for impacts on air quality in all phases is described in Section 5.1.6.2. A discussion of the monitoring program for air quality can be found in Section 5.1.6.4.

Operation and Maintenance

The KDP will consist of the following major elements:

- LNG facility – LNG Extraction Unit, LNG storage; metering stations; marine terminal, marginal wharf, tugs, and berthing facilities, LNG transfer, vessel movement, storage and vaporization facilities; vapour handling system and associated infrastructure/support facilities; including emergency shutdown system, hazard detection system, security system and facilities, and fire response system.
- Shipping and receiving facilities, including marginal wharf; and associated support facilities, including laboratories, administrative buildings, and security.
- Shipping, including vessel types and sizes, frequency of shipping and planned routes.
- Service water and drinking water systems.
- Administration and service buildings.
- Sanitary wastewater system.

Other components outside the scope of this document, but included in the air quality modelling include:

- Petrochemical facilities –Ethylene, Ethylene and Propylene storage (refrigerated), By-product storage, Derivative units of Polypropylene, High Density Polypropylene, Low Density Polypropylene, and Linear Low Density Polypropylene; fuel gas and liquid systems; water and steam system.
- Electrical co-generation plant (i.e. nominal 200 MW) and associated support facilities, which will be integrated with the LNG Extraction Unit and possibly the LNG vaporization facilities.

The conceptual facility layout showing the locations of these units is provided in Section 2.0, Figures 2.2-1 and 2.2-2.

The specific sources of continuous and intermittent air contaminant emissions from the LNG facility during routine operation and malfunctions include the following:

- LNG tanker (intermittent – 24 hours per delivery);
- Submerged Combustion Vapourizers (continuous);
- simple cycle combustion turbine for power supply (intermittent);
- flare (at start up and at emergencies);
- gas vent stacks (intermittent - malfunction only);
- LNG extraction plant fugitive emissions (continuous); and
- marine transportation equipment other than LNG tankers (intermittent).

Other components outside the scope of this document, but included in the air quality modelling include:

- co-generation facility:
    - simple cycle combustion turbine for power supply (intermittent).
- petrochemical facility:
    - ethylene plant.
- cracking furnaces (continuous);
- hydrogenation units (intermittent);
- process vents (intermittent);
- fugitive emissions from equipment leaks (continuous); and
- flare (emergency operation only).

Linear LDPE plant:

- feed unit treater vents (intermittent);
- catalyst activation off-gas vents (intermittent);
- finishing area pelletization, driers, hoppers, silos, etc. (intermittent);
- emergency releases to the main flare (intermittent) and low capacity process vents to cracking furnaces (intermittent); and
- fugitive emissions from equipment leaks (continuous):
    - Polypropylene Plant vents (intermittent);
    - LDPE plant vents; and
    - HDPE plant vents.

The specific air pollutants emitted from some or all of these units that have been evaluated for their impacts consist of the following:

- SO_2, formed when fuel containing sulphur, such as coal and oil, is burned;
- NO_x, generated when fuel is burned at high temperatures as in a combustion process;
- CO, formed from the incomplete combustion of carbon-containing fuel;
- TSP, PM with PM_{10} and $PM_{2.5}$, terms for particles found in the air, including dust, dirt, soot, smoke, and liquid droplets; and
- VOCs.

Preliminary estimates of the emissions of these pollutants from the KDP components are summarized in Table 5.1-1. The emission rates are based either on equipment vendor information or AP-42 emissions factors (US EPA, 2005). The maximum heat input rates to the combustion units and maximum operating capacity of process units are assumed in these emissions estimates along with estimates of operating hours. The PM_{10} and $PM_{2.5}$ emission rates include both filterable and condensable fractions. Table 5.1-2 gives further information on

TABLE 5.1-1 Air Emissions Inventory

Process ID	Emission Point Description	Source Pollutant[1]	Emissions		Emission Factor	
			lb/hr[2]	t/year	Source	lb/MMBtu[3]
Combined Cycle Plant	Gas Turbines (4)	SO_2	0.4	1.7	AP-42, Sec 3.1	0.0003
	Max. Gas Heat Input (Btu/hr[4]): 4.08E+08	TSP	10.8	42.8	AP-42, Sec 3.1	0.007
	Max. Gas Usage (MMcf/hr[5]): 0.40	$PM_{2.5}$	10.8	42.8	AP-42, Sec 3.1	0.007
	Max. Gas Usage (MMcf/yr[6]): 3504.0	NO_x	212.2	843.1	AP-42, Sec 3.1	0.130
	Hours of Operation per Year: 8,760	CO	49.0	194.5	AP-42, Sec 3.1	0.030
		VOC	3.4	13.6	AP-42, Sec 3.1	0.002
LNG Facility	Simple Cycle Gas Turbine	SO_2	0.05	0.004	AP-42, Sec 3.1	0.0003
	Max. Gas Heat Input (Btu/hr): 1.88E+08	TSP	1.24	0.08	AP-42, Sec 3.1	0.007
	Max. Gas Usage (MMcf/hr): 0.184	$PM_{2.5}$	1.24	0.08	AP-42, Sec 3.1	0.007
	Max. Gas Usage (MMcf/yr): 27.6	NO_x	13.9	0.94	Solar (25 ppm)	0.074
	Hours of Operation per Year: 150	CO	5.64	0.38	AP-42, Sec 3.1	0.030
		VOC	0.39	0.03	AP-42, Sec 3.1	0.002
LNG Facility	LNG Tanker	SO_2	82.6	142.1	Bergessen Worldwide	2.12
	Max. Heat Input (Btu/hr): 3.90E+07	TSP	12.1	20.8	AP-42	0.31
	Max. Oil Usage (gal/hr[7]): 286.4	$PM_{2.5}$	12.1	20.8	AP-42	0.31
	Max. Oil Usage (gal/yr[8]): 1,086,056	NO_x	82.6	142.1	Bergessen Worldwide	2.12
	Hours of Operation per Year: 3,792	CO	37.0	63.7	AP-42	0.95
		VOC	13.6	23.5	AP-42	0.35
Ethylene Plant	Flare (emergency only)	SO_2	0	0	Estimate	N/A
	Max. Gas Heat Input (Btu/hr): 1.76E+05	TSP	1.5	0.0	Estimate	N/A
	Hours of Operation: emergency/start up	$PM_{2.5}$	1.5	-	Estimate	N/A
		NO_x	339.7	-	Estimate	N/A
		CO	62.1	-	Estimate	N/A
		VOC	9.8	-	Estimate	N/A
Ethylene Plant	Cracking Furnaces (7 on-line, 1 decoking)	SO_2	24.2	93.5	NOVA Chem E3 Env. Permit Appl.	N/A
	Flue Gas Flow (NM^3/hr[9]): 1.23E+06	TSP	17.6	68.0	"	N/A
	Hours of Operation: 8,520	$PM_{2.5}$	17.6	68.0	"	N/A
		NO_x	268.7	1038.5	"	N/A
		CO	17.6	68.0	"	N/A
		VOC	8.8	34.0	"	N/A

Process ID	Emission Point Description	Source Pollutant[1]	Emissions		Emission Factor	
			lb/hr[2]	t/year	Source	lb/MMBtu[3]
Ethylene Plant	Gasoline Hydrogenation	CO_2	0.0	0.0		N/A
	Flue Gas Flow (NM^3/hr): 1,500					
	Hours of Operation: 64					
	Routed to furnaces					
Ethylene Plant	Mixed Hydrogenation	CO_2	0.0	0.0		N/A
	Flue Gas Flow (NM^3/hr): 1,500					
	Hours of Operation: 48					
	Routed to furnaces					
Ethylene Plant	Process Vents	VOC	0.0	0.0		N/A
	Flue Gas Flow (NM^3/hr): 500					
	Hours of Operation: 50					
	Routed to furnaces					
LLDPE Plant	Purification - Butene-1/ICA Degassing	VOC	0.0	0.0	Univation Technologies	N/A
	Flue Gas Flow (kg/hr[10]): 5					
	Hours of Operation: 8,000					
	Routed to furnaces					
LLDPE Plant	Purging & Vent Recovery	VOC	0.0	0.0	Univation Technologies	N/A
	Flue Gas Flow (kg/hr): 1,290					
	Hours of Operation: 8,000					
	Routed to furnaces					
LLDPE Plant	Pelleting Section	VOC	0.0	0.0	Univation Technologies	N/A
	Flue Gas Flow (kg/hr): 2.2					
	Hours of Operation: 8,000					
	Routed to furnaces					
LLDPE Plant	Fugitive Emissions	VOC	0.0	0.0	Univation Technologies	N/A
	Flue Gas Flow (kg/hr): 1.5					
	Hours of Operation: 8,000					
	Routed to furnaces					
LDPE Plant	Reactor Dumps and Purging	VOC	0.0	0.0	ExxonMobil LDPE	N/A
	Flue Gas Flow (t/hr): 50					
	Hours of Operation: 8,000					
	Routed to furnaces					

Process ID	Emission Point Description	Source Pollutant[1]	Emissions		Emission Factor	
			lb/hr[2]	t/year	Source	lb/MMBtu[3]
LDPE Plant	Purge Gas/Primary Compressor	VOC	0.0	0.0	ExxonMobil LDPE	N/A
	Flue Gas Flow (t/hr):4.0					
	Hours of Operation: 8,000					
	Routed to furnaces					
LDPE Plant	LDPE Finishing Section	VOC	0.0	0.0	ExxonMobil LDPE	N/A
	Flue Gas Flow (t/hr): 100					
	Hours of Operation: 8,000					
	Routed to furnaces					
LDPE Plant	Fugitive Emissions	VOC	6.9	24.9	ExxonMobil LDPE	N/A
	Flue Gas Flow (t/hr): 25					
	Hours of Operation: 8,000					
Polypropylene Plant	Reaction Fugitive Emissions	VOC	3.6	13.0	DOW Unipol polypropylene	N/A
	Flue Gas Flow (kg/hr): 1.6					
	Hours of Operation: 8000					
Polypropylene Plant	Purging & Vent Recovery	VOC	0.0	0.0	DOW Unipol polypropylene	N/A
	Flue Gas Flow (kg/hr): 449					
	Hours of Operation: 8000					
	Routed to furnaces					
Polypropylene Plant	Pelleting - to Flare	VOC	0.0	0.0	DOW Unipol polypropylene	N/A
	Flue Gas Flow (kg/hr): 21.0					
	Hours of Operation: 8000					
	Routed to furnaces					
Polypropylene Plant	Pelleting - to Atmosphere	VOC	41.0	147.0	DOW Unipol polypropylene	N/A
	Flue Gas Flow (kg/hr): 18.4					
	Hours of Operation: 8000					
HDPE Plant	Purification - Butene-1/ICA Degassing	VOC	0.0	0.0	Univation Technologies	N/A
	Flue Gas Flow (kg/hr): 1					
	Hours of Operation: 8,000					
	Routed to furnaces					

Process ID	Emission Point Description	Source Pollutant[1]	Emissions		Emission Factor	
			lb/hr[2]	t/year	Source	lb/MMBtu[3]
HDPE Plant	Purging & Vent Recovery	VOC	0.0	0.0	Univation Technologies	N/A
	Flue Gas Flow (kg/hr): 1,120					
	Hours of Operation: 8,000					
	Routed to furnaces					
HDPE Plant	Pelleting Section	VOC	0.0	0.0	Univation Technologies	N/A
	Flue Gas Flow (kg/hr): 2.2					
	Hours of Operation: 8,000					
	Routed to furnaces					
HDPE Plant	Fugitive Emissions Incl. Analyzer Vents	VOC	3.3	12.0	Univation Technologies	N/A
	Flue Gas Flow (kg/hr): 1.5					
	Hours of Operation: 8,000					
Keltic Facility	All Sources	SO_2	107.25	237.304	N/A	N/A
		TSP	43.24	131.68	N/A	N/A
		$PM_{2.5}$	43.24	131.68	N/A	N/A
		NO_x	917.1	2024.6	N/A	N/A
		CO	171.34	326.58	N/A	N/A
		VOC	90.49	268.03	N/A	N/A
SOEP Gas Plant	Flare	SO_2	0.0	0.0	EC	N/A
	Flue Gas Flow (NM^3/hr): 6.20E+09	TSP	1.5	6.0	EC	N/A
	Hours of Operation: 8,760	$PM_{2.5}$	1.5	6.0	EC	N/A
		NO_x	339.7	1349.8	EC	N/A
		CO	62.1	246.6	EC	N/A
		VOC	9.8	38.8	EC	N/A

Notes:

1. Typically $PM_{2.5}$ is a subset of TSP, however for the purpose of this study, we have considered the TSP and $PM_{2.5}$ to be equal.
2. lb/hr – pounds per hour - lb/hr is a maximum rate, since not all units operate 8760 hours per year (i.e. LNG tankers, emergency flares, etc.)
3. lb/mmBTU – pounds per million British thermal units
4. BTU/hr – British thermal units per hour
5. mmcf/hr – million cubic feet per hour
6. mmcf/yr – million cubic feet per year
7. gal/hr – gallons per hour
8. gal/yr – gallons per year
9. NM^3/hr – normal cubic metres per hour
10. kg/hr – kilograms per hour

TABLE 5.1-2 Air Emission Inventory – Additional Information On Parameters

Process ID	Source ID	Emission Point Description	Source Type	No. of Sources	Source Location	Source Pollutant	Potential Emissions lb/hr	Potential Emissions TPY	Emission Factor (lb/MMBtu)		Air Pollution Controls
Combined Cycle Plant	101 - 104	**Combined Cycle Gas Turbine (each)**	Stack	4	Combined Cycle Plant	SO_2	4.24E-01	1.86E+00	AP-42, Sec 3.1	2.60E-04	Natural Gas
		Max. Gas Heat Input (Btu/hr):				TSP	1.08E+01	4.72E+01	AP-42, Sec 3.1	6.60E-03	Natural Gas
		4.08E+08				PM-10	1.08E+01	4.72E+01	AP-42, Sec 3.1	6.60E-03	Natural Gas
		Max. Gas Usage (MMcf/hr):				NOx	2.12E+02	9.29E+02	AP-42, Sec 3.1	1.30E-01	Water Injection
		0.400				CO	4.90E+01	2.14E+02	AP-42, Sec 3.1	3.00E-02	Natural Gas
		Max. Gas Usage (MMcf/yr):				VOC	3.43E+00	1.50E+01	AP-42, Sec 3.1	2.10E-03	
		3504.0									
		Hours of Operation:									
		8760.0									
		Heat Content (Btu/cf):									
		1020									
		Stack Height (m): 18.29									
		Exit Diameter (m): 3.05									
		Exit Temperatue (K): 720									
		Exit Velocity (m/sec): 30									
		UTM(m): N 5002850; E 607200									
		Elev (m): 45									
LNG Facility	201	**Simple Cycle Gas Turbine**	Stack	1	LNG Facility	SO_2	4.89E-02	3.67E-03	AP-42, Sec 3.1	2.60E-04	Natural Gas
		Max. Gas Heat Input (Btu/hr):				TSP	1.24E+00	9.31E-02	AP-42, Sec 3.1	6.60E-03	Natural Gas
		1.88E+08				PM-10	1.24E+00	9.31E-02	AP-42, Sec 3.1	6.60E-03	Natural Gas
		Max. Gas Usage (MMcf/hr):				NOx	1.39E+01	1.04E+00	Solar (25 ppm)	7.40E-02	Water Injection
		0.184				CO	5.64E+00	4.23E-01	AP-42, Sec 3.1	3.00E-02	Natural Gas
		Max. Gas Usage (MMcf/yr):				VOC	3.95E-01	2.96E-02	AP-42, Sec 3.1	2.10E-03	
		27.6									
		Hours of Operation:									
		150.0									
		Heat Content (Btu/cf):									
		1020									
		Stack Height (m): 18.29									
		Exit Diameter (m): 3.05									
		Exit Temperatue (K): 720									
		Exit Velocity (m/sec): 30									
		UTM(m): N 5002125; E 608075									
		Elev (m): 35									
LNG Facility	202	**LNG Tanker**	Stack	1	LNG Facility	SO_2	8.26E+01	1.57E+02	Bergessen Worldwide	2.12E+00	None
		Max. Heat Input (Btu/hr):				TSP	1.21E+01	2.29E+01	AP-42	3.10E-01	
		3.90E+07				PM-10	1.21E+01	2.29E+01	AP-42	3.10E-01	
		Max. Diesel Usage (gal/hr):				NOx	8.26E+01	1.57E+02	Bergessen Worldwide	2.12E+00	
		286.4				CO	3.70E+01	7.02E+01	AP-42	9.50E-01	
		Max. Diesel Usage (gal/yr):				VOC	1.36E+01	2.59E+01	AP-42	3.50E-01	
		1086056.2									
		Heat Content (Btu/gal):									
		136065									
		Hours of Operation:									
		3792									
		Stack Height (m): 36.7									
		Exit Diameter (m):1.3									
		Exit Temperatue (K): 413									
		Exit Velocity (m/sec): 20									
		UTM(m): N 5000800; E 606350									
		Elev (m): 0									

TABLE 5.1-2 Air Emission Inventory – Additional Information On Parameters

Process ID	Source ID	Emission Point Description	Source Type	No. of Sources	Source Location	Source Pollutant	Potential Emissions lb/hr	Potential Emissions TPY	Emission Factor (lb/MMBtu)		Air Pollution Controls
Ethylene Plant	301	**Flare (emergency only)**	Flare	1	Ethylene Plant	SO_2	2.42E+01	1.21E-02	NOVA Chem E3 Env. Permit Appl.		None
		Max. Gas Heat Input (Btu/hr):				TSP	1.50E+00	7.50E-04	Estimate		
		1.76E+05				PM-10	1.50E+00	7.50E-04	Estimate		
		Hours of Operation:				NOx	3.40E+02	1.70E-01	Estimate		
		8760.0				CO	6.21E+01	3.11E-02	Estimate		
		Heat Content (Btu/cf):				VOC	9.80E+00	4.90E-03	Estimate		
		Stack Height (m): 31.4									
		Exit Diameter (m): 1.22									
		Exit Temperatue (K): 1000									
		Exit Velocity (m/sec): 33									
		UTM(m): N 5003600; E 606750									
		Elev (m): 65									
Ethylene Plant	302 - 309	**Cracking Furnaces (7 on-line, 1 decoking)**	Stack	8	Ethylene Plant	SO_2	2.42E+01	1.03E+02	NOVA Chem E3 Env. Permit Appl.		None
		Flue Gas Flow (NM^3/hr):				TSP	1.76E+01	7.50E+01	"		
		1.23E+06				PM-10	1.76E+01	7.50E+01	"		
		Hours of Operation:				NOx	2.69E+02	1.14E+03	"		
		8520.0				CO	1.76E+01	7.50E+01	"		
		Stack Height (m): 71				VOC	8.80E+00	3.75E+01	"		
		Exit Diameter (m): 2.64									
		Exit Temperatue (K): 448									
		Exit Velocity (m/sec): 10.5									
		UTM(m): N 5003375; E 607000									
		Elev (m): 65									
Ethylene Plant	311	**Gasoline Hydrogenation**	Stack	1	Ethylene Plant	CO_2	0.00E+00	0.00E+00			
		Flue Gas Flow (NM^3/hr):									
		1.50E+03									
		Hours of Operation:									
		64.0									
		Routed to furnaces									
Ethylene Plant	312	**Mixed Hydrogenation**	Stack	1	Ethylene Plant	CO_2	0.00E+00	0.00E+00			
		Flue Gas Flow (NM^3/hr):									
		1.50E+03									
		Hours of Operation:									
		48.0									
		Routed to furnaces									
Ethylene Plant	313	**Process Vents**	Stack	1	Ethylene Plant	VOC	0.00E+00	0.00E+00			
		Flue Gas Flow (NM^3/hr):									
		5.00E+02									
		Hours of Operation:									
		50.0									
		Routed to furnaces									
LLDPE Plant	401	**Purification - Butene-1/ICA Degassing**	Stack	1	LLDPE Plant	VOC	0.00E+00	0.00E+00	Univation Technologies		
		Flue Gas Flow (kg/hr):									
		5.0									
		Hours of Operation:									
		8000									
		Routed to furnaces									

TABLE 5.1-2 Air Emission Inventory – Additional Information On Parameters

Process ID	Source ID	Emission Point Description	Source Type	No. of Sources	Source Location	Source Pollutant	Potential Emissions lb/hr	Potential Emissions TPY	Emission Factor (lb/MMBtu)		Air Pollution Controls
LLDPE Plant	402	**Purging & Vent Recovery**	Stack	1	LLDPE Plant	VOC	0.00E+00	0.00E+00	Univation Technologies		
		Flue Gas Flow (kg/hr):									
		1.29E+03									
		Hours of Operation:									
		8000									
		Routed to furnaces									
LLDPE Plant	403	**Pelleting Section**	Stack	1	LLDPE Plant	VOC	0.00E+00	0.00E+00	Univation Technologies		
		Flue Gas Flow (kg/hr):									
		2.20E+00									
		Hours of Operation:									
		8000									
		Routed to furnaces									
LLDPE Plant	404	**Fugitive Emissions**	Fugitive	1	LDPE Plant	VOC	0.00E+00	0.00E+00	Univation Technologies		
		Flue Gas Flow (kg/hr):									
		1.50E+00									
		Hours of Operation:									
		8000									
		Routed to furnaces									
LDPE Plant	501	**Reactor Dumps and Purging**	Stack	1	LDPE Plant	VOC	0.00E+00	0.00E+00	ExxonMobil LDPE		None
		Flue Gas Flow (t/hr):									
		5.00E+01									
		Hours of Operation:									
		8000									
		Routed to furnaces									
LDPE Plant	502	**Purge Gas/Primary Compressor**	Stack	1	LDPE Plant	VOC	0.00E+00	0.00E+00	ExxonMobil LDPE		None
		Flue Gas Flow (t/hr):									
		4.00E+00									
		Hours of Operation:									
		8000									
		Routed to furnaces									
LDPE Plant	503	**LDPE Finishing Section**	Stack	1	LDPE Plant	VOC	0.00E+00	0.00E+00	ExxonMobil LDPE		None
		Flue Gas Flow (t/hr):									
		1.00E+02									
		Hours of Operation:									
		8000									
		Routed to furnaces									
LDPE Plant	504	**Fugitive Emissions**	Fugitive	1	LDPE Plant	VOC	6.90E+00	2.75E+01	ExxonMobil LDPE		None
		Flue Gas Flow (t/hr):									
		2.50E+01									
		Hours of Operation:									
		8000									
Polypropylene Plant	601	**Reaction Fugitive Emissions**	Stack	1	Polypropylene Plant	VOC	3.60E+00	1.43E+01	DOW Unipol PP		
		Flue Gas Flow (kg/hr):							Strm #12 (ave.)		
		1.60E+00									
		Hours of Operation:									
		8000									

TABLE 5.1-2 Air Emission Inventory – Additional Information On Parameters

Process ID	Source ID	Emission Point Description	Source Type	No. of Sources	Source Location	Source Pollutant	Potential Emissions lb/hr	Potential Emissions TPY	Emission Factor (lb/MMBtu)		Air Pollution Controls
Polypropylene Plant	602	**Purging & Vent Recovery**	Stack	1	Polypropylene Plant	VOC	0.00E+00	0.00E+00	DOW Unipol PP		None
		Flue Gas Flow (kg/hr):							Strm #12 (ave.)		
		4.49E+02									
		Hours of Operation:									
		8000									
		Routed to furnaces									
Polypropylene Plant	603	**Pelleting - to Flare**	Stack	1	Polypropylene Plant	VOC	0.00E+00	0.00E+00	DOW Unipol PP		
		Flue Gas Flow (kg/hr):							Strm #12 (ave.)		
		2.10E+01									
		Hours of Operation:									
		8000									
		Routed to furnaces									
Polypropylene Plant	604	**Pelleting - to Atmosphere**	Stack	1	Polypropylene Plant	VOC	4.10E+01	1.62E+02	DOW Unipol PP		
		Flue Gas Flow (kg/hr):							Strm #12 (ave.)		
		1.84E+01									
		Hours of Operation:									
		8000									
HDPE Plant	701	**Purification - Butene-1/ICA Degassing**	Stack	1	HDPE Plant	VOC	0.00E+00	0.00E+00	Univation Technologies		None
		Flue Gas Flow (kg/hr):									
		1.00E+00									
		Hours of Operation:									
		8000									
		Routed to furnaces									
HDPE Plant	702	**Purging & Vent Recovery**	Stack	1	HDPE Plant	VOC	0.00E+00	0.00E+00	Univation Technologies		None
		Flue Gas Flow (kg/hr):									
		1.12E+03									
		Hours of Operation:									
		8000									
		Routed to furnaces									
HDPE Plant	703	**Pelleting Section**	Stack	1	HDPE Plant	VOC	0.00E+00	0.00E+00	Univation Technologies		None
		Flue Gas Flow (kg/hr):									
		2.20E+00									
		Hours of Operation:									
		8000									
		Routed to furnaces									
HDPE Plant	704	**Fugitive Emissions Incl. Analyzer Vents**	Fugitive	1	HDPE Plant	VOC	3.30E+00	1.32E+01	Univation Technologies		
		Flue Gas Flow (kg/hr):									
		1.50E+00									
		Hours of Operation:									
		8000									
Total/ Combustion	All	**Turbines/Furnaces**	Stack		Keltic Petrochemicals	SO_2	1.07E+02	2.62E+02			
Sources						TSP	4.17E+01	1.45E+02			
						PM-10	4.17E+01	1.45E+02			
						NOx	5.77E+02	2.23E+03			
						CO	1.09E+02	3.60E+02			
						VOC	3.51E+01	1.16E+02			

TABLE 5.1-2 Air Emission Inventory – Additional Information On Parameters

Process ID	Source ID	Emission Point Description	Source Type	No. of Sources	Source Location	Source Pollutant	Potential Emissions lb/hr	Potential Emissions TPY	Emission Factor (lb/MMBtu)		Air Pollution Controls
All Fugitive	All		Fugitive		Keltic Petrochemicals	VOC	5.48E+01	2.17E+02			
All VOCs	All		All		Keltic Petrochemicals	All VOCs	8.99E+01	3.33E+02			
SOEI Gas Plant		Max. Gas Heat Input (Btu/hr):				SO_2	0.00E+00	0.00E+00	EC		
		6.20E+09				TSP	1.50E+00	6.60E+00	EC		
		Hours of Operation:				PM-10	1.50E+00	6.60E+00	EC		
		8760.0				NOx	3.40E+02	1.49E+03	EC		
		Heat Content (Btu/cf):				CO	6.21E+01	2.72E+02	EC		
		1020				VOC	9.80E+00	4.28E+01	EC		
		Stack Height (m): 65									
		Exit Diameter (m): 6.0									
		Exit Temperatue (K): 1,000									
		Exit Velocity (m/sec): 0.1									
		UTM(m): N 5003300; E 608800									
		Elev (m): 45									

the parameters used for air quality modeling purposes. Stack heights for the KDP facilities are from ground level at the particular source location, and elevation relative to sea level is also indicated. The model can be used to account for building downwash as the design for the building structures matures.

Furthermore, it should be noted that the air quality modeling impacts are, of necessity, based on conceptual design data which has been generated at this time. As more information evolves, further information will be delineated, including, but not limited to:

- building layouts and roof heights;
- unit process details, including additional process components; and
- emission control improvements.

For example, given the cooling water requirements for the petrochemical facility, it has been determined that a forced draft cooling tower will be needed, giving rise to potential particulate emissions, as well as vapour plumes. As the design progresses, specific dispersion modeling techniques will be used to determine the impact(s) of the tower. If required, the KDP's EMP, will include provisions to mitigate any potential adverse effects associated with the operation of such tower. This typically includes such items as monitoring weather conditions and operation of a fog warning system along potentially affected roads. In addition, the need for a number of SCV is documented in Section 2.0, and when emission parameters are established, the air quality model will incorporate these units. The modeling will also establish the need for emission control systems and its specifications.

The air quality dispersion modeling results presently available provide a contextual appreciation for the potential impacts of the facility. Keltic will, as part of its environmental permit application process, provide a full air quality modeling report based on the final facility design.

Impact Analysis

A dispersion modeling analysis has been conducted to estimate the impacts of the KDP criteria air contaminant emissions on ambient air quality levels and sensitive receptors in the KDP Area. This dispersion modeling analysis covers routine emissions during normal operation of the units at the facility as well as emissions associated with equipment malfunctions and mobile source emissions. It is noted that the potential emissions from the cargo vessels which will be tied up on occasion at the Marginal Wharf have not been included in the modeling analysis, since their sizes, configurations, and fuel types are unknown at present. However; estimated emissions from the LNG vessels while hoteling and unloading have been included. The impacts of their boiler emissions are not considered to have a significant impact on the dispersion results; however, the models will be run again when further information becomes available through the FEED process.

The US EPA "Guideline on Air Quality Models" (US EPA, 2004) was consulted for guidance in selecting the appropriate methodology for this analysis. The assessment includes the following steps:

- meteorological data selection, review and processing;
- land use analysis and receptor grid development;
- emissions inventory development;
- background air quality evaluation; and
- refined modeling to estimate air quality impacts in the KDP Area and at sensitive receptors.

Modeling was performed with the KDP at full capacity operation for the combustion turbines and cracking furnaces, as well as for expected mobile source activity. According to a 2003 emissions inventory reported by EC, the only other source of air pollutant emissions within 25 km of the site is the SOEP gas plant and M&NP metering station that is adjacent to the KDP Site. Therefore, the KDP Site and SOEP gas plant emissions are both included in the modeling analysis to demonstrate compliance with Nova Scotia Air Quality Regulations and CEPA Ambient Air Quality Objectives as shown in Table 5.1-3. The SOEI gas plant emissions are included in Table 5.1-2.

TABLE 5.1-3 Nova Scotia Air Quality Regulations (*Environment Act*) and *Canadian Environmental Protection Act* (CEPA) Ambient Air Quality Objectives

Contaminant/Units	Averaging Period	Nova Scotia Maximum Permissible	Canada National Ambient Air Quality Objectives & Guidelines		
			Maximum Desirable	Maximum Acceptable	Maximum Tolerable
NO_2 µg/m^3 (ppb)	1 hour	400 (213)	-	400 (213)	1000 (532)
	24 hour	-	-	200 (106)	300 (160)
	Annual	100 (53)	60 (32)	100 (53)	-
SO_2 µg/m^3 (ppb)	1 hour	900 (344)	450 (172)	900 (334)	-
	24 hour	300 (115)	150 (57)	300 (115)	800 (306)
	Annual	60 (23)	30 (11)	60 (23)	-
Total Suspended Particulate (µg/m^3)	24 hour	120	-	120	400
	Annual	70	60	70	-
$PM_{2.5}$ (µg/m^3)	24 hour	30[1]	-	-	-
CO mg/m^3 *(ppm)	1 hour	34.6 (31)	15 (13)	35 (31)	-
	8 hour	12.7 (13)	6 (5)	15 (13)	20 (17)
Ozone µg/m^3 (ppb)	1 hour	160 (82)	100 (51)	160 (82)	300 (153)
	24 hour	-	30 (15)	50 (25)	-
	Annual	-	-	30 (15)	-
Hydrogen Sulphide µg/m^3 (ppb)	1 hour	42 (30)	-	-	-
	24 hour	8 (6)	-	-	-

Note: Canada Wide Standard
*mg/m^3 - milligrams per cubic metre

Refined dispersion modeling for the criteria air contaminant emissions utilizes the USEPA American Meteorological Society/ EPA Regulatory Model (AERMOD) model with topographic considerations along with five years of hourly surface meteorological data collected at Halifax-Shearwater and twice-daily upper air data collected at Yarmouth. KDP impacts on ozone concentrations are assessed by comparing the total KDP ozone precursor emissions (i.e. NO_x

and VOC) with the regional precursor emissions that contribute to the ambient ozone concentrations in the District of Guysborough.

AERMOD modeling options are specified as follows in accordance with the USEPA guidance (USEPA, 2002). The options include:

- use of the elevated terrain algorithms requiring input of terrain height data;
- use of stack tip downwash (except for building downwash cases);
- use of the calms processing routines;
- use of the missing data processing routines; and
- no exponential decay of SO_2 for rural sources.

Building downwash effects are not considered in the impact analysis due to the lack of specific information on building dimensions at this time. However, building downwash effects are more important at close-in distances and would have no meaningful effect on the estimated impacts of the KDP given the relatively large distances from low level sources to off-site areas.

Meteorological Data Selection, Review, and Processing

AERMOD requires hourly surface meteorological data and twice-daily upper air data for calculating downwind concentrations. The data required for each simulation are:

- wind speed;
- wind direction;
- dry-bulb temperature;
- cloud cover;
- ceiling height;
- station pressure; and
- vertical profiles of temperature, pressure, and relative humidity.

The proposed facility site does not have an on-site meteorological station. Therefore, meteorological data used in the analysis consists of 2000 - 2004 hourly surface observations taken at Halifax-Shearwater along with concurrent twice-daily upper air data collected at Yarmouth. Halifax-Shearwater is located approximately 160 km southwest of the KDP Site. This distance from the site supports its spatial representativeness since it places it in the same general synoptic flow regime as well as most mesoscale systems. The Halifax-Shearwater station is also located in a similar geographic setting as the KDP Site being situated on the northeast portion of an inlet and about 5 km north of the southeast coastline. This is the station closest to the KDP Site that monitors all of the meteorological parameters required for the AERMOD model. Other possible sources of the required meteorological data in the area, at Beaver Island and Hart Island, were found to have significant amounts of missing data that precluded their use. The monitoring locations are also islands that have localized microclimates caused by sea breeze circulations that are not particularly representative of the Goldboro site. A wind rose depicting the frequency of occurrence of the Halifax-Shearwater winds from each of

16 directions and frequency of wind speed ranges for each direction is provided in Figure 5.1-1 for the 2000 – 2004 time period.

The aforementioned meteorological data are processed using the AERMET pre-processor program along with the definition of the surface characteristics within the modeling domain. These surface characteristics of albedo (i.e. ratio of reflected to incident solar radiation), Bowen ratio (i.e. ratio of sensible to latent heat fluxes from the earth's surface), and surface roughness length (i.e. height above the ground at which the mean wind speed becomes zero) are specified by season as a function of distance and direction from the KDP Site based on land use information and the AERMOD User's Guide recommended values of these parameters.

Land Use Analysis and Receptor Grid Development

The area surrounding the site can be characterized as rural in nature with very little industrial activity with the exception of the SOEP gas plant and metering station. The KDP Site terrain elevations vary from sea level to about 75 m above sea level. Nearby hills are most prominent to the northwest and north of the site while areas to the east, southeast, south, and southwest are generally flat to gently rolling that do not exceed 60 m above sea level. The terrain elevations reach 100 m at a distance of about 5,000 m from the site to the north, 120 m at a distance of approximately 8,000 m to the northwest, and 150 m at a distance of approximately 12,000 m to the northwest and north. The highest elevation within 20 km of the station is 200 m at a distance of approximately 20 km to the northwest.

The modeling domain in terms of the receptor grid development is selected such that the impacts of both low level and elevated source facility emissions are correctly estimated and are relevant for the analysis. Topography of the KDP Site and the modeling domain are obtained using digital topographic data for the site region.

The UTM coordinate system is used to generate a Cartesian receptor grid starting at the petrochemical facility extending out to a distance as needed such that the maximum air quality impacts are captured in the model runs. A 100 m grid spacing is used from the KDP property boundary out to a distance of 2 km. The property boundary is specified as discreet receptors in order to provide the proper detailed coverage in the receptor grid. A grid spacing of 200 m is used from 2 km to 4 km followed by 1 km grid spacing from 4 km to 10 km to ensure that the maximum impacts are obtained. Receptors are also placed at sensitive receptors such as the Isaac's Harbour Villa Senior Apartments.

The topographic elevations for the receptors in the modeling domain are developed using the AERMAP pre-processor along with Digital Elevation Model equivalent terrain files covering the modeling domain.

Modeling Results

The AERMOD modeling is performed for the KDP facility sources along with the SOEP gas plant emissions to estimate total air quality impacts of the KDP. These impacts are used to

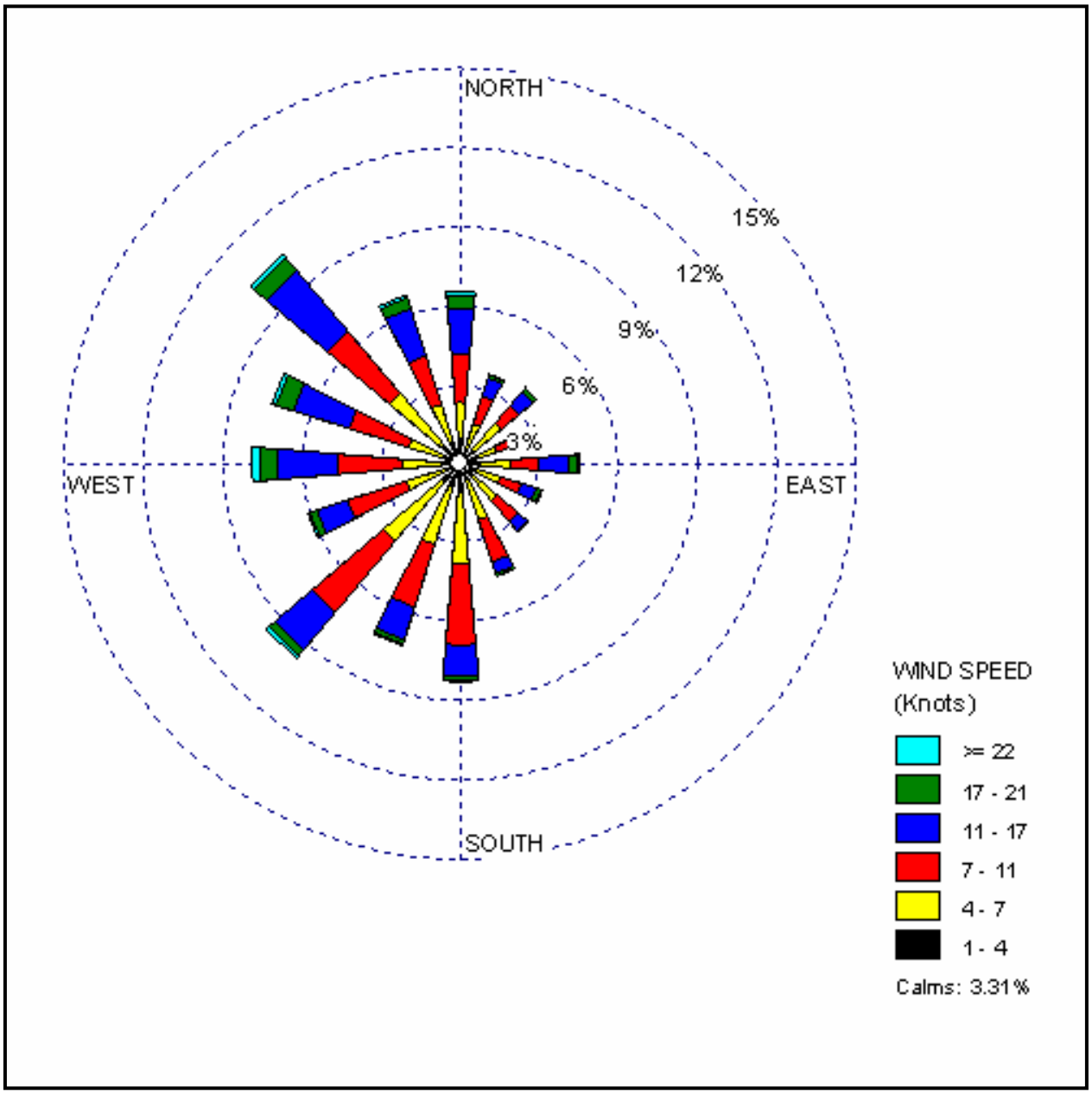

FIGURE 5.1-1
KELTIC PETROCHEMICALS INC.
HALIFAX SHEARWATER WINDROSE
(2000-2004)
JUNE 2007

verify that the Nova Scotia Air Quality Regulations and CEPA Ambient Air Quality Objectives would be met, along with consideration of the appropriate background air quality data. It is noted that the VOC emissions are not modeled, since no criteria are available for comparison, nor is information on the specification of the VOCs available. Odourous compounds will be modeled when further design emission rates/compound information become available. The distance to receptors will undoubtedly mitigate odours. However, it cannot be stated with any certainty that the odours will be completely eliminated. In general, increasing distance from a source of odour will result in a greater opportunity for atmospheric dispersion to reduce the component's concentration in air and thus reduce its odour potential. The specific meteorological condition at any given time will determine the degree of atmospheric dispersion and the reduction in concentration with distance. The least dispersive conditions (i.e., stable conditions) resulting in the lowest reduction in concentration versus distance occur in the night time and early morning hours. The most dispersive conditions (i.e., unstable conditions) resulting in the highest reduction in concentration versus distance occur during the afternoon hours with clear skies and light winds. Strong winds or cloudy skies result in intermediate dispersion conditions (i.e., neutral stability). The detectable odour thresholds for the contaminants in Table 5.1-4 are as follows:

TABLE 5.1-4 Odour Thresholds

Contaminant	Odour Threshold (ppm)
SO_2	0.33
TSP	N/A
$PM_{2.5}$	N/A
NO_2	0.05
CO	Odourless
Ozone	0.00076

N/A – not applicable

The background air quality used in the EA is based on short-term monitoring data collected by ExxonMobil at their Goldboro Gas Plant. Continuous monitoring for NO_2 and SO_2 near the Goldboro plant was conducted in Seal Harbour from June 10, 2004, through August 10, 2004. There are no other longer term background air quality data available that are representative of this area. The highest monitored 24-hour NO_2 concentration during this 2 month period was approximately 2.0 ppb and the highest SO_2 value was 4.0 ppb. Monitoring for TSP and $PM_{2.5}$ at Seal Harbour was conducted for three 24-hour periods in each of July, August, and September of 2004. The highest monitored 24-hour TSP concentration during this 3 month period was 19.8 $\mu g/m^3$ and the highest $PM_{2.5}$ value was 4.0 $\mu g/m^3$.

The results of the modeling analysis are summarized in Table 5.1-5 showing the overall highest predicted pollutant concentrations due to the routine operation of the KDP facility and the SOEP gas plant separately. The total impacts reflect the highest combination of Keltic and SOEP impacts from among all off-site receptors, along with the background concentrations. The impacts during start-up/upset conditions with the ethylene flare operating on an emergency basis are also shown in this Table. Maximum sensitive receptor impacts are summarized in Table 5.1-6. Also, the NO_2 impacts are assessed by applying the empirically derived NO_2/NO_x ratio of 0.75 (i.e. annual national default) to the maximum predicted NO_2 impacts, as recommended in the USEPA "Guideline on Air Quality Models" (USEPA, 2004).

TABLE 5.1-5 Maximum Predicted Overall Facility Impacts vs. Nova Scotia Air Quality Regulations and National Ambient Air Quality Objectives

Contaminant/Units	Averaging Period	Maximum Predicted Impacts				Nova Scotia Maximum Permissible	Canada National Ambient Air Quality Objectives & Guidelines		
		Keltic	SOEP	Total[1]	Upset[2]		Maximum Desirable	Maximum Acceptable	Maximum Tolerable
NO_2 µg/m^3	1 hour	155.9	274.1	274.5	276.2	400	-	400	1000
	24 hour	72.2	114.5	118.4	119.0	-	-	200	300
	Annual	4.7	17.7	19.1	20.2	100	60	100	-
SO_2 µg/m^3	1 hour	74.9	0.0	74.9	90.0	900	450	900	-
	24 hour	42.6	0.0	53.1	62.4	300	150	300	800
	Annual	5.3	0.0	5.3	6.1	60	30	60	-
TSP µg/m^3	24 hour	5.3	0.6	25.1	25.1	120	-	120	400
	Annual	0.8	0.1	0.3	0.8	70	60	70	-
$PM_{2.5}$ µg/m^3	24 hour	0.8	0.1	10.2	10.2	30[3]	-	-	-
CO mg/m^3	1 hour	0.048	0.067	0.067	0.067	34.6	15	35	-
	8 hour	0.031	0.052	0.052	0.052	12.7	6	15	20
Ozone µg/m^3	1 hour	N/A[4]	N/A	N/A	N/A	160	100	160	300
	24 hour	N/A	N/A	N/A	N/A	-	30	50	-
	Annual	N/A	N/A	N/A	N/A	-	-	30	-

Notes:

1. Total impacts reflect the highest combination of Keltic and SOEP impacts from among all off-site receptors and includes background concentrations (24-hour NO_2 of 3.8 µg/m^3, 24-hour SO_2 of 10.5 µg/m^3, 24-hour TSP of 19.8 µg/m^3 and 24 hour $PM_{2.5}$ of 4.3 µg/m^3).
2. Reflects impacts during start-up/upset condition with ethylene flare in operation on emergency basis.
3. Canada Wide Standard assumes all particulate emitted by Keltic and SOEP is $PM_{2.5}$.
4. N/A = Not available

TABLE 5.1-6 Maximum Predicted Sensitive Receptor Impacts vs. Nova Scotia Air Quality Regulations and National Ambient Air Quality Objectives

Contaminant/ Units	Averaging Period	Maximum Predicted Impacts (Keltic + SOEP)			Nova Scotia Maximum Permissible	Canada National Ambient Air Quality Objectives & Guidelines		
		Goldboro Interpretive Centre	Isaac's Harbour Villa Senior Aprts	Isaac's Harbour Medical Centre		Maximum Desirable	Maximum Acceptable	Maximum Tolerable
NO_2 µg/m^3	1 hour	87.5	73.4	79.2	400	-	400	1000
	24 hour	19.2	19.3	13.1	-	-	200	300
	Annual	1.7	1.4	1.1	100	60	100	-
SO_2 µg/m^3	1 hour	11.1	12.0	9.3	900	450	900	-
	24 hour	2.4	2.1	1.6	300	150	300	800
	Annual	0.4	0.3	0.2	60	30	60	-
TSP µg/m^3	24 hour	1.1	0.8	1.0	120	-	120	400
	Annual	0.1	0.1	0.09	70	60	70	-
$PM_{2.5}$ µg/m^3	24 hour	1.1	0.8	1.0	30[1]	-	-	-
CO mg/m^3	1 hour	0.014	0.013	0.013	34.6	15	35	-
	8 hour	0.005	0.003	0.005	12.7	6	15	20
Ozone µg/m^3	1 hour	N/A	N/A	N/A	160	100	160	300
	24 hour	N/A	N/A	N/A	-	30	50	-
	Annual	N/A	N/A	N/A	-	-	30	-

Notes:

1. Assumes all particulate emitted by Keltic and SOEP is $PM_{2.5}$.
2. Canada Wide Standard

The highest NO_2 and CO offsite concentrations tend to occur to the southwest of the co-generation plant near the property boundary due to the combined cycle gas turbine emissions. The highest SO_2, and TSP concentrations occur near the LNG tanker and in the area northwest of the ethylene unit near the property boundary. Figures 5.1-2 through 5.1-11 show the spatial distribution of the maximum KDP facility NO_2, SO_2, TSP, and CO impacts for the various averaging times. The KDP property boundary is outlined in black east of Stormont Bay and the SOEP boundary is just east of the KDP Site.

The results indicate that the Nova Scotia Maximum Permissible Concentrations and Canada National Ambient Air Quality Objectives & Guidelines will be met in all cases.

KDP impacts on ozone concentrations are assessed by comparing the total KDP ozone precursor emissions (i.e. NO_x and VOC) with the regional precursor emissions that contribute to the ambient ozone concentrations in the KDP Area. From Table 5.1-1, the total annual KDP emissions of NO_x and VOC are estimated to be approximately 2,000 t and 270 t, respectively. According to EC's NPRI, the total NO_x and VOC emissions for the Province of Nova Scotia for the year 2003 were 70,749 t and 56,082 t, respectively. Therefore, the KDP emissions of NO_x and VOC are estimated to be approximately 2.8 and 0.5%, respectively, of the total province emissions. Such a small contribution to the regional emissions of ozone precursors will result in a negligible contribution to ozone concentrations in the KDP Area, particularly since it has been estimated that 60-80% of the ozone found in Nova Scotia is due to long range transport.

As was noted above (Table 5.1-2), lakes in this area typically exhibit fairly low pH values (4.3-5.5), which is not uncommon for Nova Scotia. These low values are likely the result of a number of factors, including the underlying geology of the area, the disposal/runoff with regard to past mining activities, and acid precipitation. The total release of SO_2 in Nova Scotia is estimated to be approximately 166,000 t/year according to the NPRI. The relevant emissions from the KDP operations would only constitute a small percentage of the total for Nova Scotia with respect to SO_2 (0.14%), and 2.8% with respect to NO_x. Furthermore, it is generally well-accepted that more than half of the acid deposition in eastern Canada originates from emissions in the USA as well as from Ontario and Quebec.

The wind rose shown in Figure 5.1-1 indicates that the winds in the region predominate from the northwest through the southwest, meaning that the emissions will most often be carried offshore. Since the chemical reactions that change SO_2 and NO_x to acid rain can take from several hours to several days, it is expected that the emissions will most often be carried well offshore before contributing to acidic precipitation.

Regasification of LNG will be a source of GHG emissions. GHG emission estimates from similar projects are the following: 329,694 tonnes per year for a facility with a 1,000 million standard cubic feet per day send out capacity (Irving Oil Limited, LNG Marine Terminal/Multi-purpose Pier Project, Environmental Impact Statement 2004); 325,761 tonnes per year for a facility with 610 million standard cubic feet per day send out capacity (Kitimat LNG Terminal Project Assessment Report/CSR 2006). The Keltic send out rate is approximately 1,829 million standard cubic feet per day.

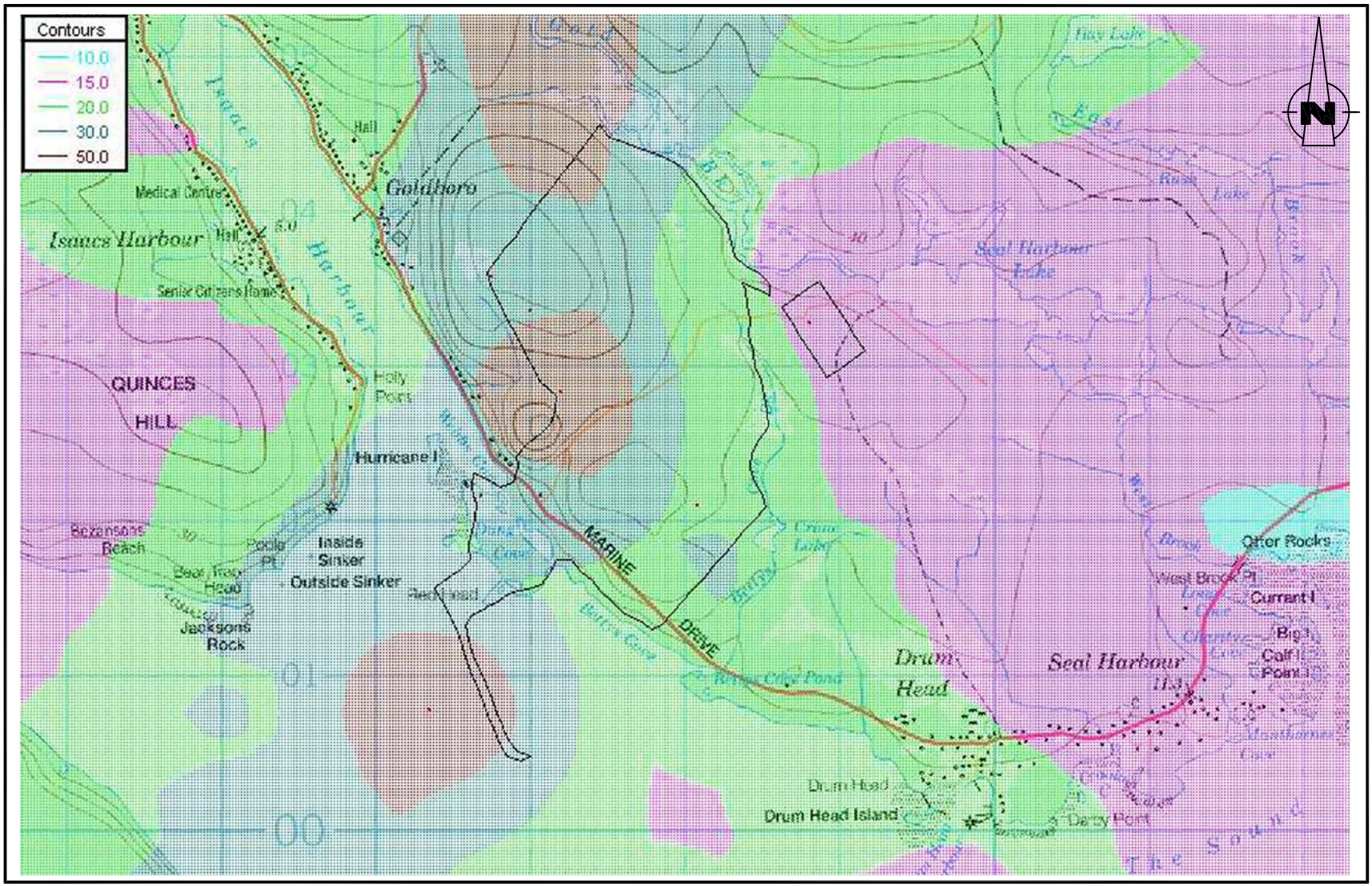

FIGURE No. 5.1-2
KELTIC PETROCHEMICALS INC.
MAXIMUM 1-HOUR NO_2 IMPACTS
JUNE 2007

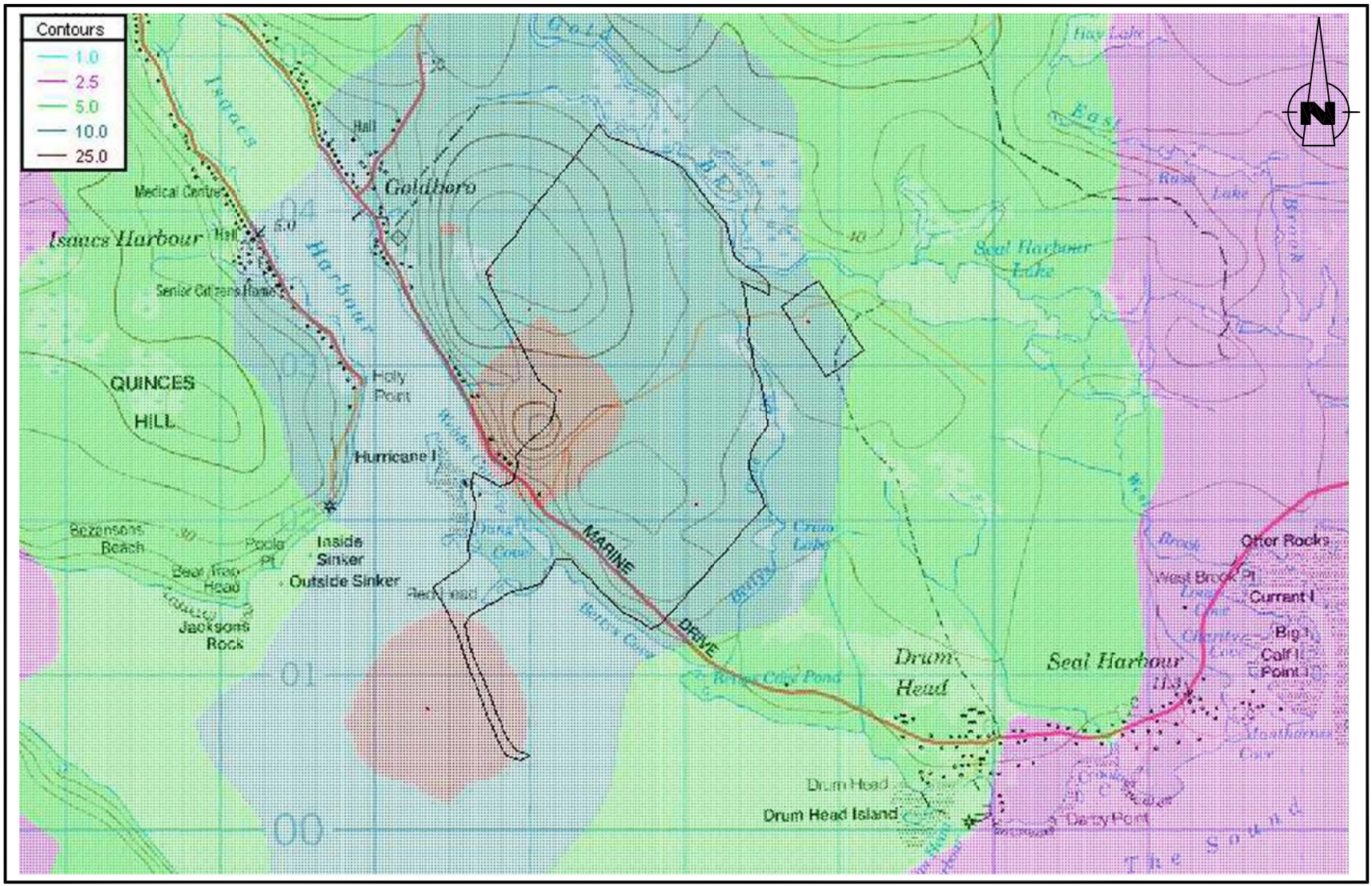

FIGURE No. 5.1-3
KELTIC PETROCHEMICALS INC.
MAXIMUM 24-HOUR NO_2 IMPACTS
JUNE 2007

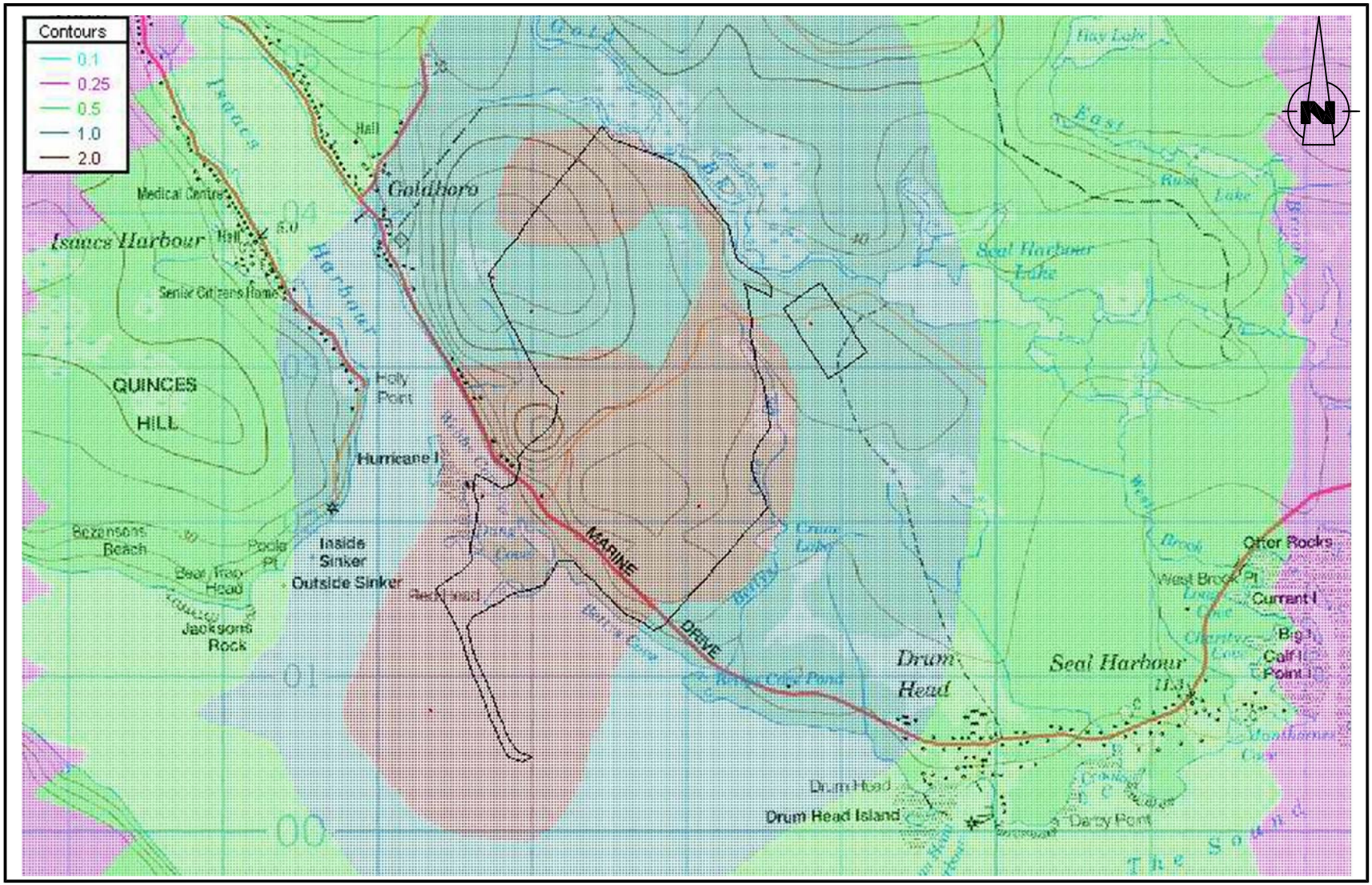

FIGURE No. 5.1-4
KELTIC PETROCHEMICALS INC.
ANNUAL AVERAGE NO_2 IMPACTS
JUNE 2007

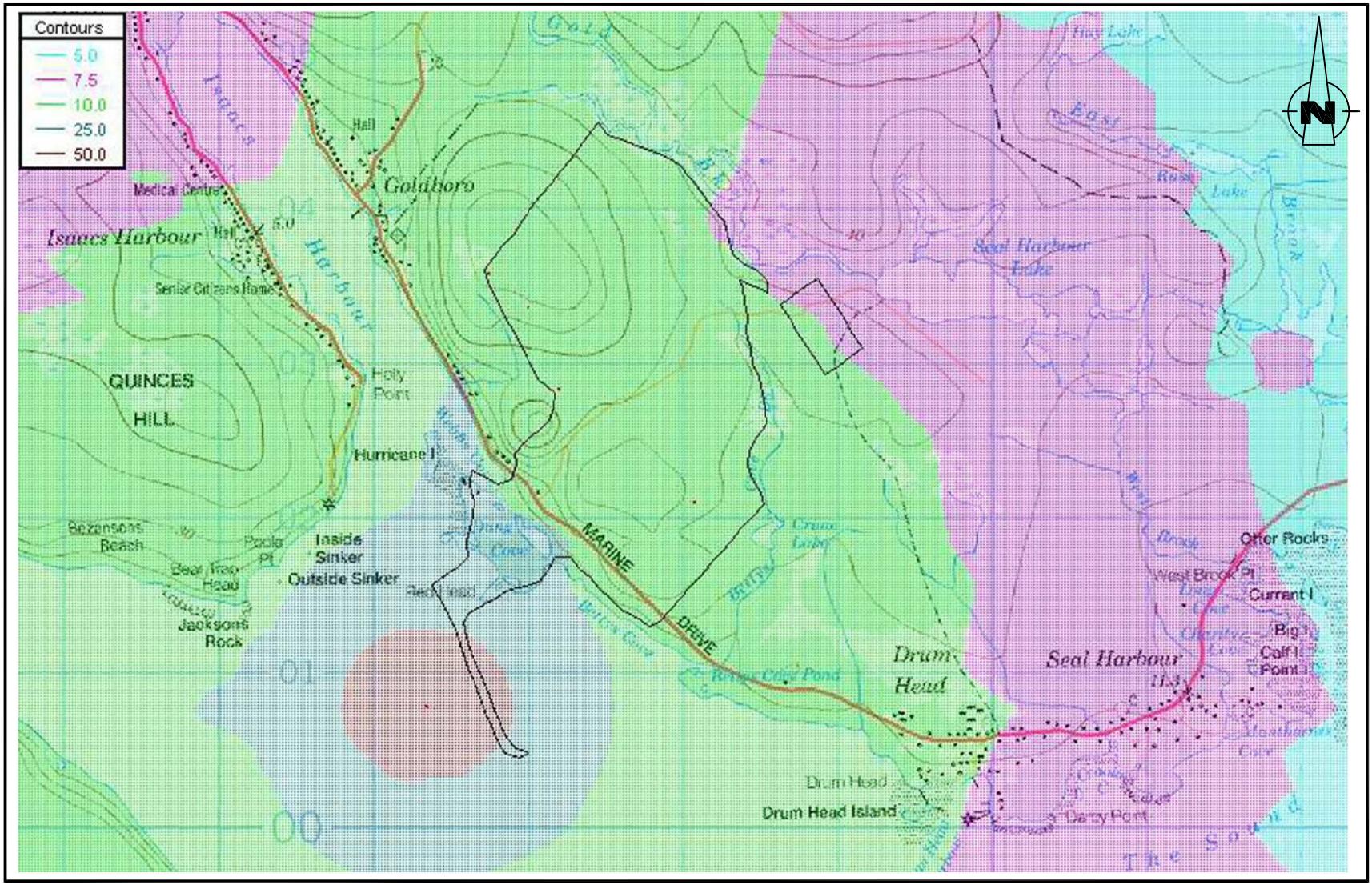

FIGURE No. 5.1-5
KELTIC PETROCHEMICALS INC.
MAXIMUM 1- HOUR SO_2 IMPACTS
JUNE 2007

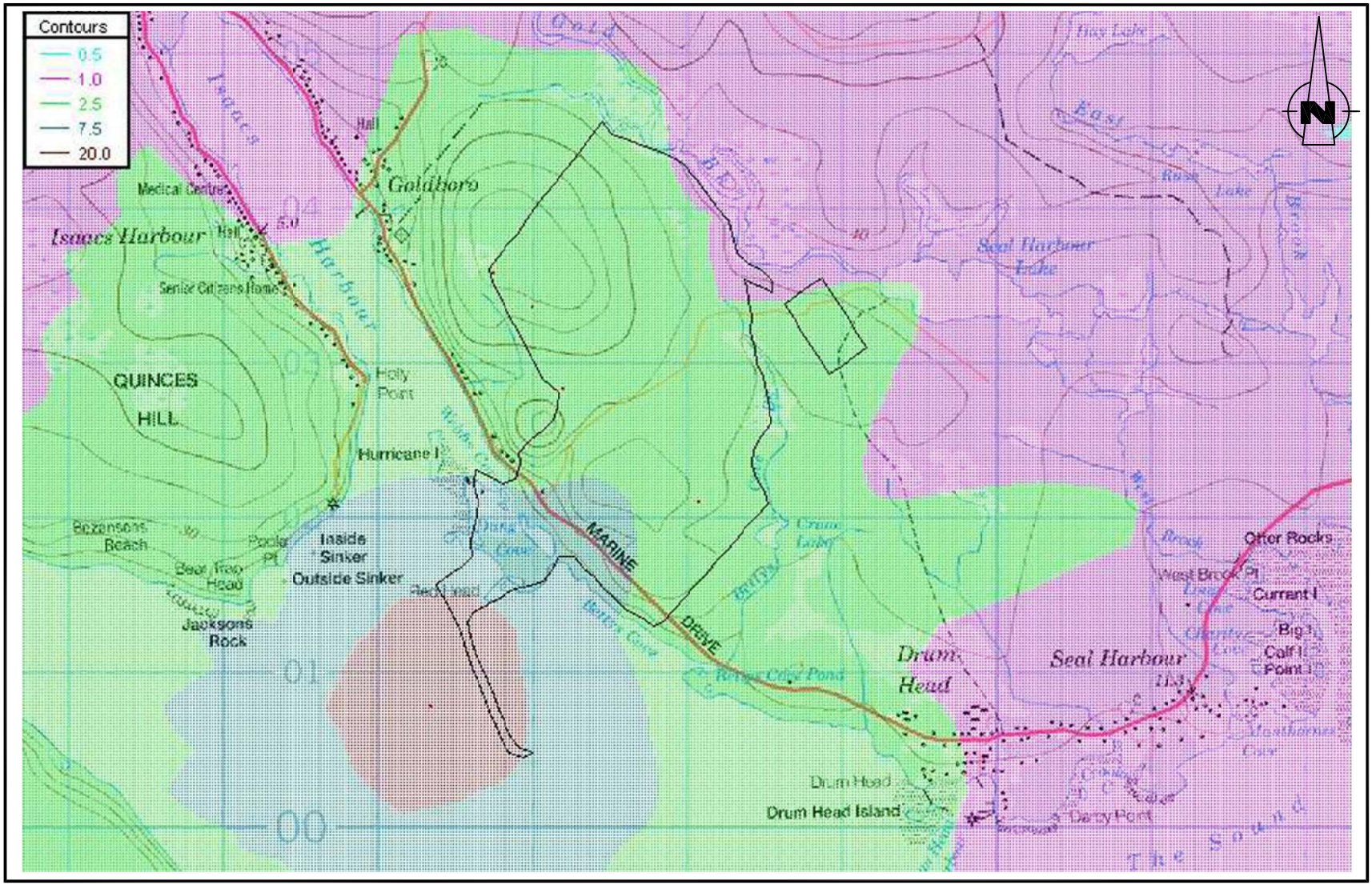

FIGURE No. 5.1-6

KELTIC PETROCHEMICALS INC.

MAXIMUM 24- HOUR SO_2 IMPACTS

JUNE 2007

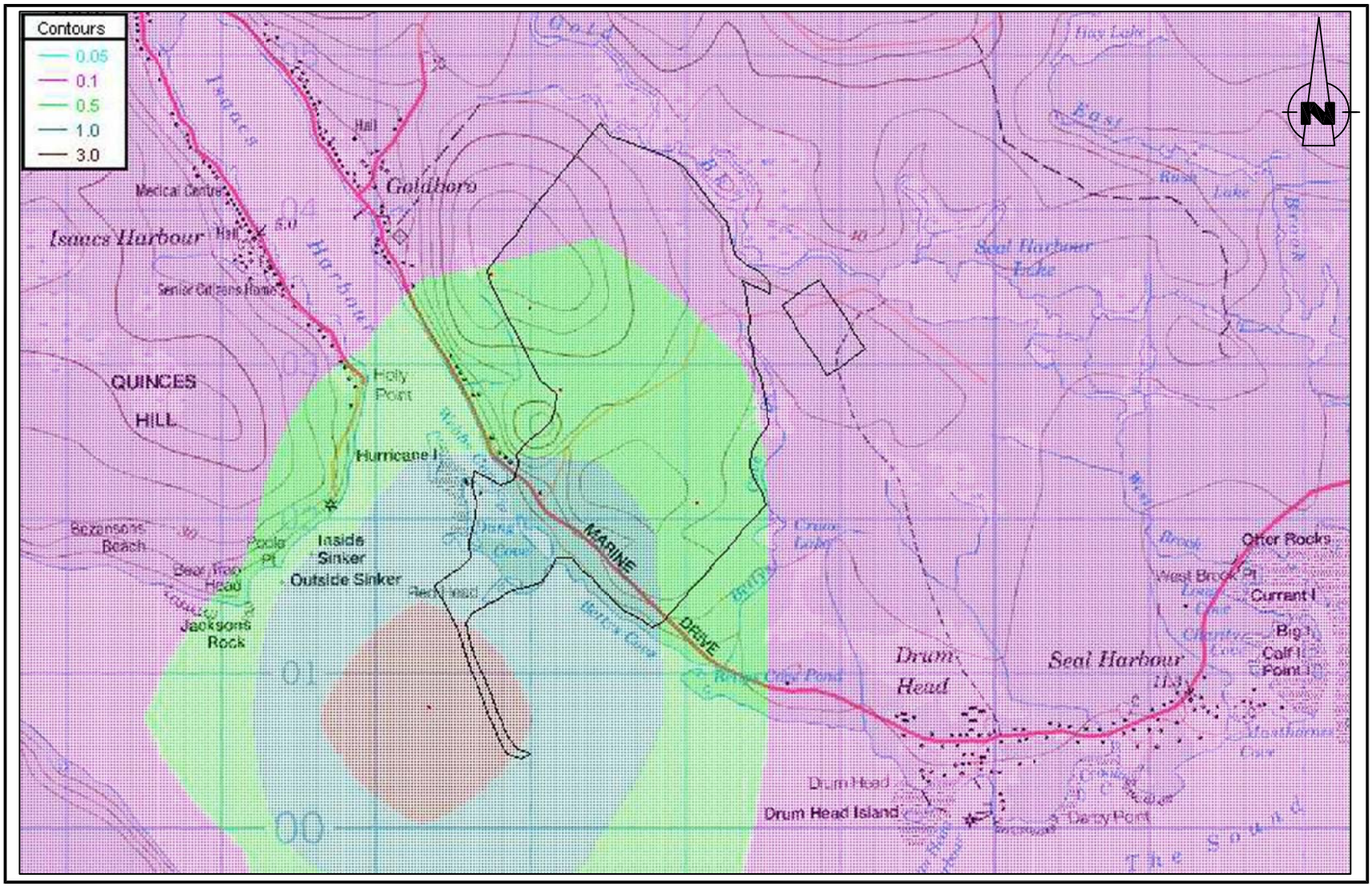

FIGURE No. 5.1-7
KELTIC PETROCHEMICALS INC.
ANNUAL AVERAGE SO_2 IMPACTS
JUNE 2007

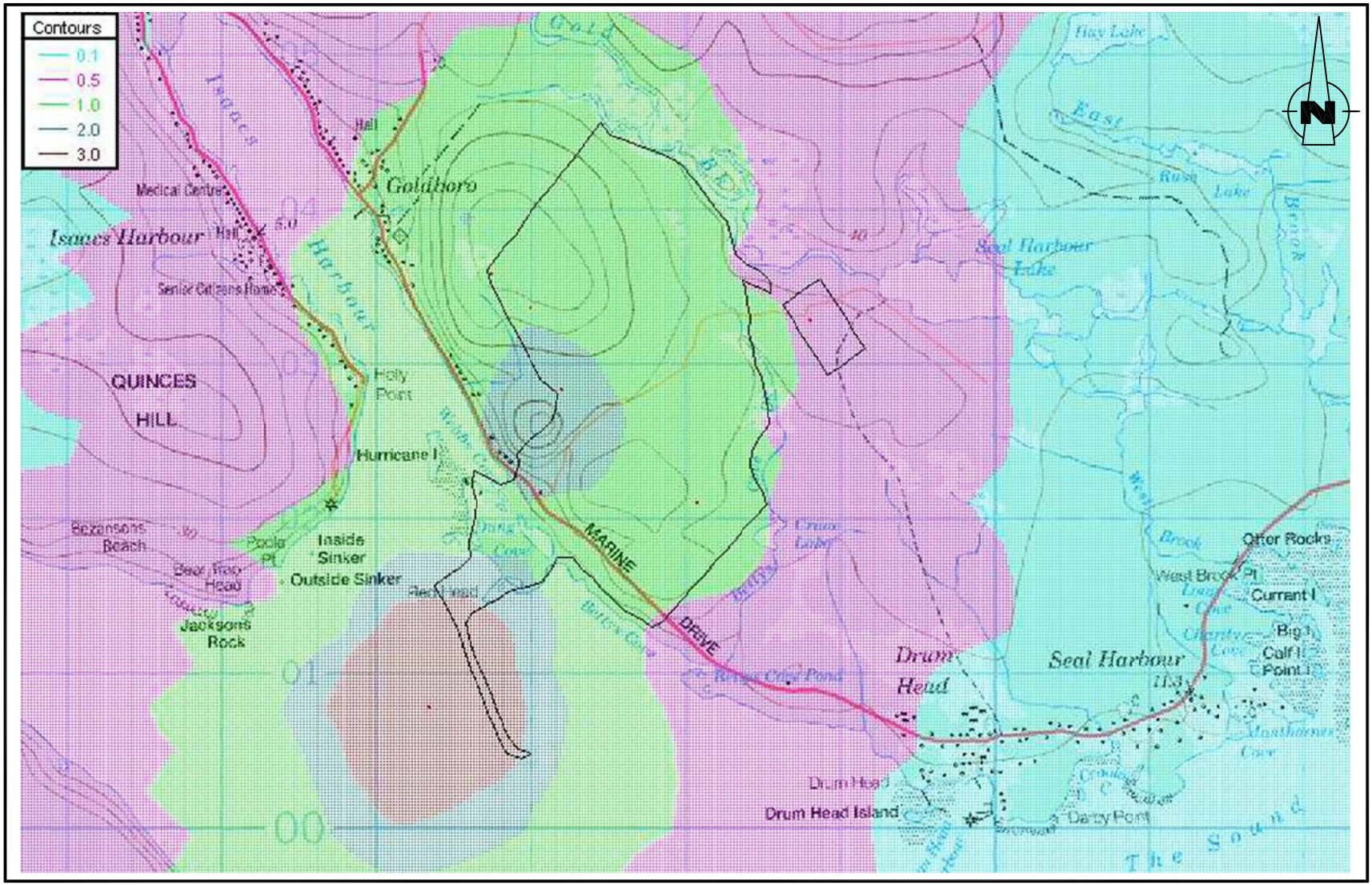

FIGURE No. 5.1-8

KELTIC PETROCHEMICALS INC.

MAXIMUM 24-HOUR TSP IMPACTS

JUNE 2007

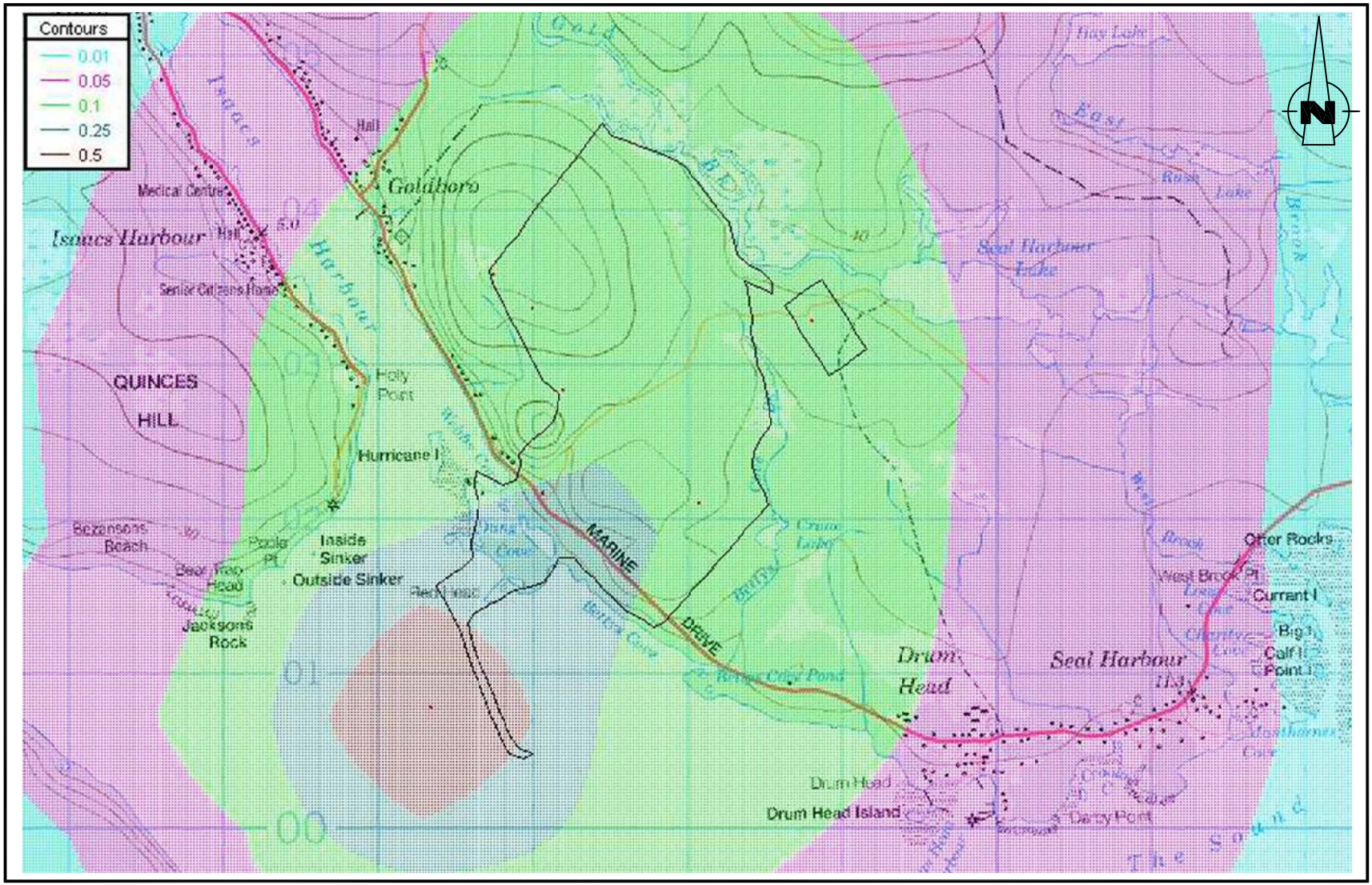

FIGURE No. 5.1-9
KELTIC PETROCHEMICALS INC.
ANNUAL AVERAGE TSP IMPACTS
JUNE 2007

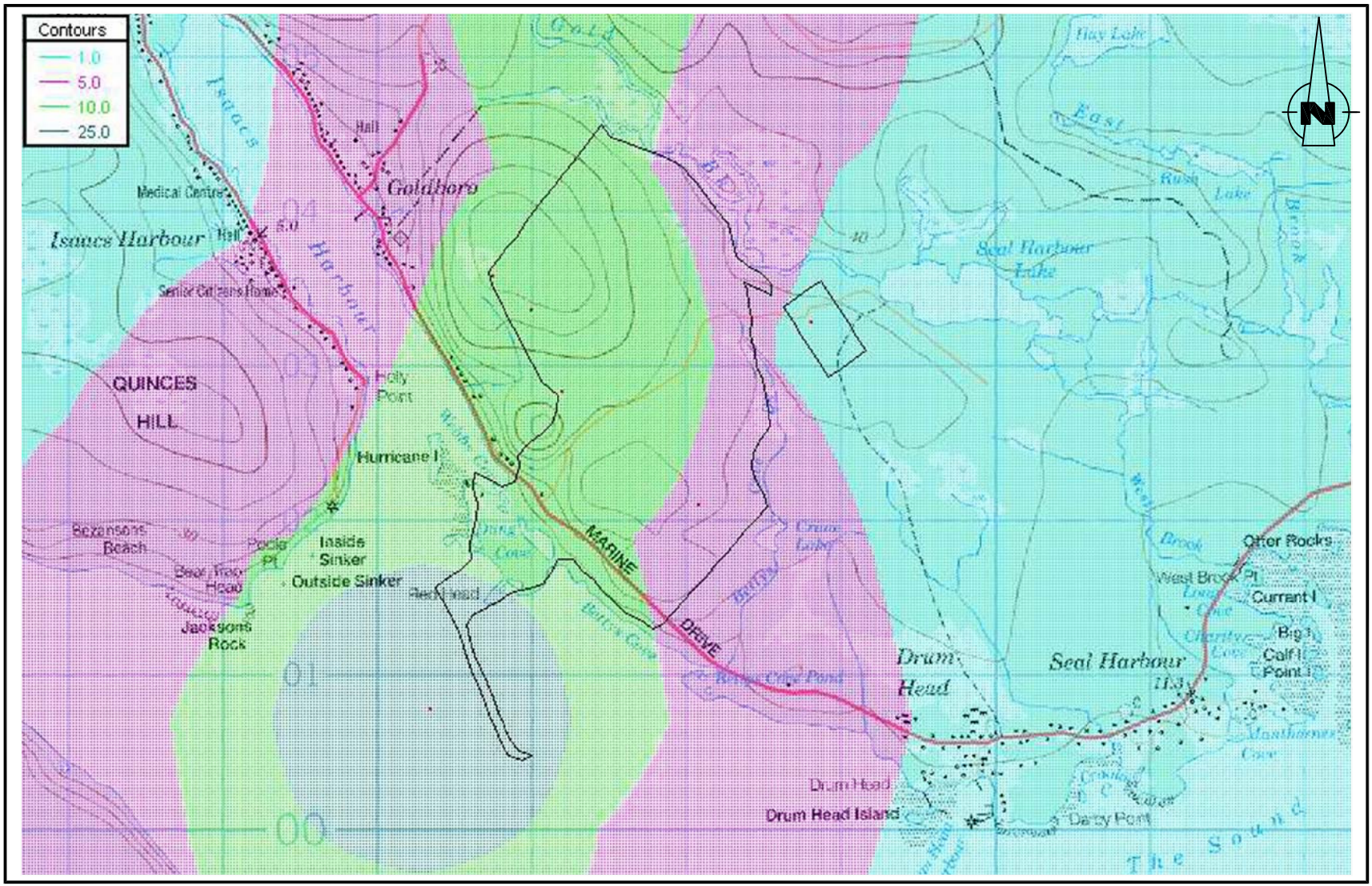

FIGURE No. 5.1-10
KELTIC PETROCHEMICALS INC.
MAXIMUM 1- HOUR CO IMPACTS
JUNE 2007

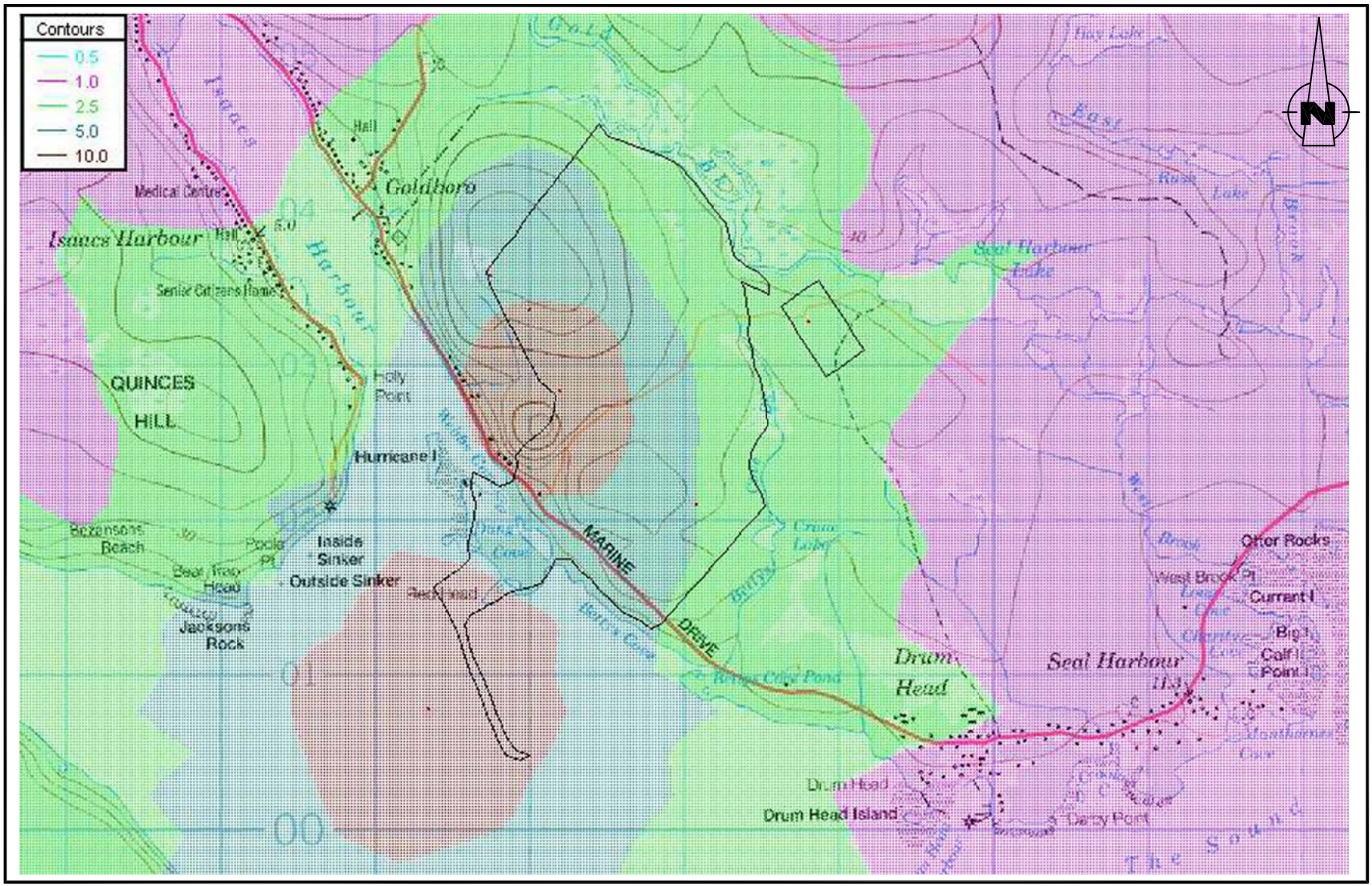

FIGURE No. 5.1-11
KELTIC PETROCHEMICALS INC.
MAXIMUM 8- HOUR CO IMPACTS
JUNE 2007

This compares to the GHG emission estimate for NS for 2004 of 22,978,000 tonnes (Government of Canada http://pubmap.on.ec.gc.ca/cwc2_22/cesicwc2.php?LANGUAGE=en-CA&service=VCG&request=GetApplication&version=0.1.0&LANGUAGES=en-CA,fr-CA&TEMPLATES=http://pubmap.on.ec.gc.ca/cesi/templates/index.php?query=ghg-c-6-2006-en-s,http://pubmap.on.ec.gc.ca/cesi/templates/index.php?query=ghg-c-6-2006-fr-s)

Modifications and Decommissioning

Air quality related impacts associated with the decommissioning of the facility will be similar to construction.

5.1.6.2 Mitigation Measures and Monitoring

Construction

Dust control techniques will include watering and/or chemical stabilization of potential dusty sources. Other techniques that will be used to control fugitive dust emissions include covering materials being hauled from the site by truck, employing routine washing of trucks, cleaning the area around stored materials, and covering stored materials (if possible). If a concrete batch plant is located within the KDP's boundary, dust emissions from anticipated concrete batch plant operations will also be mitigated through the use of enclosures, hoods, shrouds, and water sprays. Gaseous emissions from construction equipment are mitigated by requiring regular maintenance of equipment and by maintaining speed restrictions. Background VOC monitoring will be undertaken pre-construction, and pre-operation.

Typically, in rural settings, air emissions, in particular dust, are not monitored during construction. If concerns are expressed on site related to occupational health and safety, portable PM_{10} monitors may be used for real time measurements of PM by field inspectors. If concerns are expressed regarding dust levels off-site, Keltic may elect to employ high-volume samplers to determine particulate levels at specific receptors.

Operation and Maintenance

It is anticipated that the KDP's operational air emissions will not result in exceedances of the provincial and CCME ambient air quality objectives/regulations. This will be confirmed through monitoring programs described in the following section. Air emissions from the LNG facility will mainly concern NO_x, CO, and C_xC_y (unburned hydrocarbons) caused by flue gas combustion in the submerged combustion vaporizers. To suppress the NO_x emissions, the submerged combustion vaporizers will be fitted with low NO_x burners. As process design progresses, the Proponent will take all practical measures to further reduce the air emissions discussed above, including both energy efficiency measures and improvement in emission-control technologies.

As outlined in the NSEL Terms and Conditions for Environmental Approval, under Point 2.3, a project air monitoring program will be developed. Based upon the results of the air monitoring program, necessary modifications to mitigation plans and/or operations will be implemented to prevent unacceptable environmental effects. The siting of the air monitoring stations for the air monitoring program will be based on the location of sensitive receptors, air dispersion modelling results, and meteorological data. Background VOC monitoring will be undertaken pre-

construction, and pre-operation. An operational VOC monitoring program will be designed taking into account the dispersion modelling results for speciated VOCs.

Also, as outlined in the NSEL Terms and Conditions for Environmental Approval, condition 1.1 includes the requirement for a GHG Management Plan. The plan is to include an accounting of all anticipated GHG emissions, GHG monitoring and reporting protocols, GHG management and reduction targets over the life of the project, and plans for the use of best management practices.

For information on monitoring programs for the KDP outside the scope of this document, please refer to Section 13.1.2 of the Provincial EA Report (AMEC, 2006).

Modifications and Decommissioning

Mitigation recommended for construction is sufficient for decommissioning.

5.1.6.3 Residual Effects

It is anticipated that air emissions from the KDP will not exceed the ambient air quality objectives and/or regulations.

Construction

Provided the proposed mitigative measures are implemented, the environmental effects will be low in magnitude, reversible, and temporary. Therefore, no significant adverse residual environmental effects on air quality are likely to occur.

Operation and Maintenance

The effects on air quality caused by the operation of the plant are not expected to be significant with the implementation of the mitigation measures. The site is fairly isolated from the public and the effects of air emissions are expected to be not significant at off-site locations. Effective emission control measures will be employed at all identified emissions sources and will ensure that concentrations of air emissions remain within applicable government standards and guidelines. Air dispersion modelling and monitoring will be done as required by NSEL EA Terms and Conditions 1.4 and 2.3; and a GHG Management Plan will be prepared as required by condition 1.1. The modelling will include expected size, configuration, and fuel types.

Modifications and Decommissioning

Provided the proposed mitigative measures are implemented, no significant adverse residual environmental effects on air quality are expected.

5.1.6.4 Follow Up

As outlined in the NSEL Terms and Conditions for Environmental Approval, under Point 2.3, a project air monitoring program will be developed.

5.1.7 Climate Conditions

Climate change has been clearly linked to emissions of GHG. KDP-related GHG emissions, climate conditions and climate change are discussed in the context of air quality, please refer to Section 5.1.6.

5.1.8 Vegetation (terrestrial and marine)

5.1.8.1 Environmental Effects Prediction

Construction

The CSR assumes that most of the vegetation within the Project footprint will have to be removed as a result of site development work (see Figure 4.2-2 for affected vegetation types and Project footprint). The Project as defined by the scope of the CSR will affect the vegetation on Red Head only along a narrow corridor. The construction of the (above ground) marine pipeline will lead to the removal of the existing vegetation type (mapped as "Old Agricultural Fields" – see Figure 4.2-2). It is of note that the overall KDP will affect other vegetation beyond the pipeline corridor over Red Head peninsula. This is beyond the scope of the CSR and has been addressed in the provincial EA (AMEC, 2006).

Habitat disturbance from Project-related construction activities will result in the reduction of local forest habitat by approximately 149 ha. Also, clearing may expose the forest profile in adjacent areas, altering wind, temperature, and light regimes resulting in some die-off and reduced growth until edge vegetation matures.

Emissions may have an adverse effect on local vegetation nearby due to dust on leaf surfaces which may have a temporary inhibiting effect on the processes of photosynthesis and transpiration (Farmer, 1993).

A timber evaluation conducted by Scott and Stewart Forestry Consultants Ltd. (2003) indicated that the majority of the forest stand at the site is immature, and has not reached commercial size (i.e., small diametre stems and low merchantable volume). Therefore clearing at the site and inhibited growth due to emissions in nearby forest areas is expected to have minimal effects on forestry.

Construction of the Project Site will likely encourage colonization of non-native plants, as has already occurred on the site to some degree (see Section 4.2.1). These may include invasive species (such as purple loosestrife) that could spread off site into adjacent natural areas, displacing native habitat.

The LNG facility will not impinge on any marine vegetation. However, the jetty and LNG Marine Terminal will displace a minimal amount of habitat. The habitat in the vicinity of the proposed Project facilities comprises three basic types: rock and kelp; eelgrass and sand; and sand and mud. Based on video transects, the area to be occupied by the jetty associated with the LNG Marine Terminal is located in deeper water (>12 m) and characterized as having sand and mud bottom.

Operation and Maintenance

No interaction between the Project's operation and terrestrial vegetation has been identified.

There is potential for disturbance to marine vegetation as a result of propeller wash from tankers and delivery ships.

Modifications and Decommissioning

Adverse effects on terrestrial vegetation would be similar to the Construction phase however much smaller in scale as no vegetation clearing is expected. Instead, a beneficial effect is anticipated since abandoned/ decommissioned portions of the Project Site may be re-habilitated and revegetated.

No effects to marine vegetation are anticipated during the decommissioning of the facility.

5.1.8.2 Mitigation Measures and Monitoring

Construction

The mitigation measures for use during the Project operation are primarily intended to address potential effects related to the new infrastructure and to human presence and activities. To prevent the establishment of non-native vegetation the following mitigation measures will be implemented:

- do not allow disturbed soil to be exposed for longer than necessary;
- store and return top soil to sites to be landscaped, before new planting;
- use native species (i.e., species that occur naturally in the Project Area) as much as possible; and
- in some cases, pioneer species may be needed for ground cover and erosion control, but these should be short-lived successional species that eventually give way to planting and natural seeding of native species.

All temporarily used sites that have seen habitat removal should be rehabilitated.

Mitigation for emissions is discussed in Section 5.1.6. In compliance with NSEL EA approval conditions (NSEL, 14 2007) (Item 2.7), the Proponent will also implement a wildlife and vegetation monitoring plan during Project realization. This plan will provide details on effects levels and the effectiveness of vegetation rehabilitation, where applicable.

Operation and Maintenance

No mitigation is recommended for terrestrial vegetation. See comment on vegetation monitoring under "Construction." To mitigate against the effects of propeller wash on marine vegetation large vessels will be berthed with the support of tugs.

Modifications and Decommissioning

Mitigation for effects on terrestrial vegetation would be similar to the construction phase above.

5.1.8.3 Residual Effects

Construction

Given the type of vegetation involved (mostly clear-cut brush and barrens, old agricultural fields, some conifer stands), and the presence of large tracks of land adjacent to the Project Site, the residual effects on vegetation are considered not significant.

Operation and Maintenance

No effects are predicted.

Modifications and Decommissioning

The environmental effects are expected to be low in magnitude, reversible and be within the Project Site (Table 6.1-7, Section 6.0). Therefore, no significant residual effects on vegetation are likely to occur during modifications and decommissioning.

5.1.8.4 Follow Up

As mentioned under mitigation, in compliance with NSEL EA approval conditions (NSEL, 14 2007) (Item 2.7), the Proponent will implement a wildlife and vegetation monitoring plan during Project realization. This plan will provide details on effects levels and the effectiveness of vegetation rehabilitation, where applicable.

5.1.9 Species at Risk

5.1.9.1 Environmental Effects Prediction

Construction

A single rare plant species – a horsetail (*Equisetum variegatum*) was found on the plant site near the junction of Sable Road and Highway 316. This site possibly could be disrupted during construction, but proposed plans suggest this is not likely. A large population of this species is at Gold Brook Lake, and it probably is in other neighbouring areas with similar habitat places as well.

It has been suggested by the Protected Areas Branch of the Nova Scotia Government that the Endangered (COSEWIC, 2005) boreal felt lichen (*Eriodermea pedicellatum*) may be in the Study Area. The site is in the historical range of this small lichen. However, the likelihood of this lichen being in the Study Area is remote, since it is thought to be very sensitive to forestry activity; which has been extensive in the Project Site. It is known from only two small and relatively distant areas in the province; therefore, the occurrence of this species within the site would be a highly significant population.

The roseate tern colony on Country Island is listed as endangered on Schedule 1 of SARA, and as red by the NSDNR. There is potential for construction to affect the foraging of roseate tern individuals. Although no foraging sites are known to be located within or adjacent to the marginal wharf location, one individual roseate tern was observed flying near the shore of the south terminal area. The closest documented foraging site is located approximately 2 km from the Project Site, on the shore of Harbour Island. The Roseate Tern Recovery Plan (Environment Canada, 2006) identifies the need for further research on foraging habit and indicates that foraging habitat may be considered as "critical habitat" in the future.

Pipeline construction is planned to occur on the beach and dike at Dung Cove. In 2005, a greater yellowlegs was observed exhibiting breeding behaviour on the cobble beach adjacent to the eastern side of Dung Cove. The habitat at Dung Cove is not typical breeding habitat for the species. Typically the greater yellowlegs nests on the ground, in boggy coniferous areas characterized by black spruce and larch trees with abundant clearings. Erskine (1992) states that a characteristic of this species is to be noisy and appear agitated during all seasons. Therefore, during the Breeding Bird Survey reported in Erskine (1992) sightings of this species along the coast and in habitats other than forest bogs were not included as breeding bird observations. Greater yellowlegs nest in early June, and the chicks fledge by the end of July. Fall migration peaks in late August, early September. Greater Yellowlegs are known to be particularly sensitive to human disturbance and noise and are prone to abandon nests as a result.

Mainland moose (endangered) are not known to be in the direct vicinity of site, and field surveys of the area indicated no evidence of moose, so the probability of interaction with this component of the Project is low.

The LNG facility will not impinge on any marine species at risk. Adverse effects to marine species are possible due to the degradation of the marine environment through fuel spills during the construction, operation and decommissioning of the facility. These effects and the relevant mitigation have been presented in Section 10.0.

Operation and Maintenance

Disturbance of Greater Yellowlegs may occur due to maintenance activities at the pipeline.

No adverse environmental effects are anticipated as collisions of roseate terns with the marine terminal are unlikely to occur. These species are agile flyers and very rarely collide with large stationary objects such as lighthouses, bridges, light poles, communication towers or with large moving objects such as ships, even when they are brightly lit (Hatch and Kerlinger, 2004).

Adverse effects to marine species are possible due to the degradation of the marine environment through accidental fuel spills during the operation of the facility. The potential effects and mitigation for accidental events are presented in Section 10.0.

Modifications and Decommissioning

Disturbance of Greater Yellowlegs may occur due to modifications and/or decommissioning of the pipeline.

Adverse effects to marine species are possible due to the degradation of the marine environment through accidental fuel spills during the operation of the facility. The potential effects and mitigation for accidental events are presented in Section 10.0.

5.1.9.2 Mitigation Measures and Monitoring

Construction

Prior to site clearing, field surveys for species at risk (including boreal felt lichen) will be conducted in targeted habitats with high potential to support species at risk in order to identify the presence of any such species within the Project footprint. If any species at risk are identified, site specific mitigation will be developed in consultation with regulatory agencies; which could include protection/avoidance of specific areas, relocation/transplantation of species at risk, and/or Project design modifications.

To prevent the loss and/or disturbance of rare plants (i.e., *Equisetum variegatum*), a buffer zone will be flagged around these plant location(s) to keep construction activities away; otherwise plants will be transplanted to a site with similar conditions. The buffer zone size will be developed in consultation with NSDNR. The impacts on vegetative communities are expected to be minimized.

In order to prevent disturbance to the seabird colony, particularly the roseate tern on Country Island, the following will be followed:

- No ships will approach within 200 m of the island (as per the Roseate Tern Recovery Plan), unless in an emergency situation. The final location of the shipping lanes will be determined through TC's TP 1802 Routing Standards.
- No garbage is to be tossed overboard from any Project related vessel.
- All garbage is to be properly disposed (i.e., as per municipal regulations) of in closed containers in order to avoid the attraction of predators (i.e., gull species and other scavengers) to the area.

As a component of NSEL Condition 2.7, the Proponent is committed to prepare an Adaptive Management Plan (AMP), consisting of various elements acceptable to EC and NSDNR, as well as a spill response plan. Based on consultations with NSDNR and CWS, the proponent will present specific details of the plan in a draft format to NSEL for evaluation and further consultations, as necessary. The plan will include:

- A program for monitoring tern foraging activities prior to construction of the marginal wharf and LNG receiving terminal will be implemented. Such monitoring will entail land and boat-based surveys of the area throughout the upcoming breeding season (May 1 to August 31) so as to enhance current understanding of the spatial and temporal patterns of tern use of foraging habitats. The results of this upcoming season's monitoring will be used to develop mitigation measures for the construction, operation, and decommissioning phases of the project.
- Provisions for submission and review of monitoring results with Environment Canada and Nova Scotia Department of Natural Resources to allow for verification of ongoing

monitoring needs that the Proponent would be required to implement for all phases of the Project. Implementation of such monitoring will be necessary for the identification of project-related interactions and in evaluating any cumulative effects.

- A detailed description of the technically and economically feasible measures that may be necessary so as to avoid or minimize adverse effects should the potential for adverse interactions with terns be detected at any stage during the monitoring program. Such actions could include adjustments to the scheduling of certain construction and project-related activities in the vicinity of tern foraging habitats.
- A commitment to work with other stakeholders in the Country Harbour area to monitor and manage potential cumulative effects on the Roseate Tern. It is recognized that this could entail participation in an area-wide, multi-stakeholder committee that is formed to advance recovery strategy objectives. As another example, and subject to timing considerations, tern monitoring efforts will be coordinated with the Deep Panuke tern monitoring program.

In order to minimize effects on potential nesting by Greater Yellowlegs in the Dung Cove area, avoid construction, maintenance activities at the pipeline during the sensitive nesting period (June to August).

The mitigation relevant to accidents and malfunctions has been provided in Section 10.0.

Operation and Maintenance

The mitigation presented for the construction phase is identical for the operations and maintenance as well.

Modifications and Decommissioning

The mitigation presented for the construction phase is identical for modifications and decommissioning as well.

5.1.9.3 Residual Effects

Provided the proposed mitigative measures are implemented, the environmental effects will be reversible and have a low to medium magnitude. Therefore, no significant adverse residual environmental effects on species at risk are likely to occur.

5.1.9.4 Follow Up

A vegetation monitoring program will be established to check the success of replanting and habitat restoration programs, where applicable. These will be done for three consecutive years, at least twice per year in late May-early June and again in late August. Appropriate restorative plantings will be done shortly after these inspections.

As outlined in the NSEL Terms and Conditions for Environmental Approval, under Condition 2.7, a project wildlife and vegetation monitoring program will be developed in consultation with NSDNR and CWS. An AMP for the Roseate Tern will be prepared and implemented as per Section 5.1.9.2.

5.1.10 Fish and Fish Habitat (marine and freshwater)

5.1.10.1 Environmental Effects Prediction

Construction

Freshwater

Construction of the LNG facility will potentially interact with two watercourses, Betty's Cove Brook and the unnamed tributary to Dung Cove. The footprint of the Project does not impinge on any part of Betty's Cove Brook. There will be a minimum 15 m setback between the on-site reaches of this watercourse and any Project-related infrastructure. There will be periodic storm-water discharges to Betty's Cove Brook from one or more storm-water ponds during plant site construction and operation (see Section 5.1.2). While minor sediment and erosion events may be reversible, heavy precipitation events may lead to scouring, which has the potential to alter freshwater fish habitat. The storm-water ponds will be sized and managed to meet or exceed relevant provincial storm-water quality and quantity objectives. As such, the potential effects on fish and fish habitat in Betty's Cove Brook are expected to be minor.

A small first-order tributary is located a short distance east of the SOEI gas plant road. It appears to be spring fed, and from its origin, flows generally southward to where it crosses the existing highway and discharges to the largest pond on the Red Head peninsula. No fish were observed in this drainage feature during any Keltic survey, and no aquatic "species of concern" are associated with this tributary. The footprint of the Project does not impinge on any part of this tributary and will have no discharge of any kind to this watercourse. As such, the construction of the Project will not have any effect on the aquatic biota or habitat in this tributary.

Marine

The LNG facility will not impinge on any marine species. However, the LNG Marine Terminal will displace a minimal amount of habitat. The habitat in the vicinity of the proposed Project facilities comprises three basic types: rock and kelp; eelgrass and sand; and sand and mud. Based on video transects, the area to be occupied by the LNG Marine Terminal is located in deeper water (>12 m) and characterized as having sand and mud bottom. This habitat is of most value to lobster and sea urchins, two species that are fished in the area. Lobster is the principal commercial species fished in the area.

Past surveys have shown that the area of fish habitat in the eastern part of Stormont Bay is relatively consistent between the proposed Project facilities and Harbour Island – a mix of rock, boulder, kelp, and patches of sand. In deeper areas, outside Country Harbour Head and past Harbour Island, habitat is patchier, related primarily to water depth and substrate.

There is potential disturbance to kelp, eel grass, and other habitats as a result of propeller wash from tankers and delivery ships.

Adverse effects to marine species are possible due to the degradation of the marine environment through fuel spills during the construction, operation and decommissioning of the facility. These effects and the relevant mitigation have been presented in Section 10.0.

Operation and Maintenance

Freshwater

As discussed in Section 5.1.2, at the Project Site, all wastewater will be collected and treated to applicable government standards and objectives prior to discharge to the environment. The discharge quality will be monitored in order to verify the effectiveness of the treatment.

Marine

Adverse effects to marine species are possible due to the degradation of the marine environment through fuel spills during the operation of the facility. These effects and the relevant mitigation have been presented in Section 10.0.

Modifications and Decommissioning

Adverse effects to fish and fish habitat during the decommissioning phase include potential for the accidental release of contaminants to the environment.

5.1.10.2 Mitigation Measures and Monitoring

Construction

Freshwater

Please refer to the mitigation described in Sections 5.1.1 (Hydrology) and 5.1.2 (Freshwater Quality/Quantity), as they are also valid for the protection of freshwater species and their habitats. In addition, refer to Section 10.0 (Hazardous Material Spills) for impacts on freshwater species and habitat (more specifically the impacts of accidental spills on freshwater environments).

Marine

To mitigate against adverse effects to fish habitat due to propeller wash large vessels will be berthed with support of tugs. No sediment contamination has been identified in the area.

It is of note that the Proponent will also undertake further baseline work and effects predictions relevant to fish and fish habitat (both freshwater and marine). In compliance with the NSEL EA approval conditions (Item 1.10) the work will entail baseline data collection for all relevant chemical parameters which are expected to enter the environment or be remobilized as a result of Project activities in all receiving environments (including freshwater and marine environments). Baseline data and information will then be used by the Proponent to predict the assimilative capacity of all receiving environments and assessments of potential effects and/or risks on human health and organisms (including freshwater and marine biota).

In accordance with Item 1.5 in the NSEL EA approval conditions (NSEL, 2007), a plan to mitigate the human health and environmental impacts of the contaminated mine tailings and/or soils and sediments on the Project Site, via remediation or risk management will be developed and implemented. This plan will be consistent with the Nova Scotia Guidelines for the

Management of Contaminated Sites. The Remedial Action Plan and/or Risk Management Plan will be approved by NSEL prior to commencement of construction. Upon completion of the remediation or risk management work, including any required monitoring, Keltic will submit a Certificate of Compliance to NSEL to demonstrate that the remediation work has been completed and/or the Risk Management Plan is effective (NSEL, 2007).

Operation and Maintenance

Minor changes in sediment type and quality near proposed shoreline facilities are anticipated as a result of wave and current action. Changes in terminal design, however, may be required as part of the federal permitting process. Once design has been finalized, modeling will be carried out in more detail to assess potential changes in substrate and a monitoring program will be developed if required.

The mitigation presented for the construction phase is also sufficient for the operation and maintenance of the LNG facility.

Modifications and Decommissioning

Mitigation presented for the construction phase will be sufficient for the decommissioning the LNG facility.

5.1.10.3 Residual Effects

Construction

Freshwater

Provided the proposed mitigative measures are implemented, the effects on water courses due to erosion, sediment loading, and storm-water discharges will be low in magnitude and reversible. Therefore, no significant adverse residual environmental effects on fish and fish habitat are likely to occur.

Marine

The small amount of fish habitat lost as a result of the construction, operation, and decommissioning phases of the Project would not result in a significant impact on fish resources in the area. None of the habitat lost is in anyway unique to the Bay, nor does it provide a critical function to the ecosystem. The loss of production of lobster, and other fish species, would be minimal when compared to local variations in environmental factors such as water temperature and larval drift into the area. Provided the proposed mitigative measures are implemented as suggested, no significant adverse residual environmental effects on fish and fish habitat are likely to occur.

5.1.10.4 Follow Up

Construction

Freshwater

The following measures will be implemented to ensure mitigation measures are effective. Fish communities in Betty's Cove Brook and the unnamed tributary to Dung Cove will be surveyed by electro-fishing and the sediment/erosion control measures at each on-site watercourse will be inspected and/or monitored during the pre-construction period. During the construction period annual fish community surveys (electro-fishing) in all on-site watercourses will be undertaken and annual description/photographs of aquatic and riparian habitat at established representative locations will be prepared. In addition, annual reports to present results of the erosion-control monitoring and the annual fish surveys will be prepared and compared with the results (species presence, composition, etc) of previous years.

Marine

In the event that DFO requires a HADD Authorization for the LNG Marine Terminal, prior to implementation of a habitat compensation project, additional physical assessment of the area will be required. Monitoring of the habitat compensation program will be carried out to document the success of the Project. The program will be developed in consultation with DFO.

Operation and Maintenance

The following measures will be implemented to ensure mitigation measures are effective. Fish-community surveys will be undertaken in all on-site watercourses for post-construction years 1, 2, 3 and 5, and every 5 years thereafter, if required. The aquatic/riparian habitat will be described and/or photographed at established representative locations on all on-site watercourses for post-construction years 1, 2, 3 and 5, and every 5 years thereafter. Reports on results of the annual habitat and fish surveys will be prepared and compared with results (species presence, composition, etc) of previous years.

See above "Mitigation Measures" for description of follow up work in response to NSEL EA approval conditions.

Modifications and Decommissioning

No follow up monitoring has been developed at this time. Monitoring will be prepared in compliance with the regulations in place at the time of decommissioning.

See above "Mitigation Measures" for description of follow up work in response to NSEL EA approval conditions.

5.1.11 Marine Mammals

5.1.11.1 Environmental Effects Prediction

Construction

Noise that can be heard by marine mammals can be generated from construction associated with the LNG Marine Terminal, in particular, noise related to driving piles. Source levels have been shown to range from 131 - 135 decibel referenced to 1 microPascal (dB re 1 µPa) up to one kilometre from the source (Richardson et al, 1995 in Hammond et al, 2005) however there are no available data on the effects of pile driving on marine mammals (Hammond et al, 2005). At 358 m from pile driving, sound pressure levels were found to be 179 dB (decibels) at 6 m depth (Caltran, 2001). For Incidental Harassment Authorizations, the NMFS has been known to establish preliminary safety zones that have a 500 m radius around pile driving sites. These safety zones include all areas that are expected to exceed 190 dB re 1 µPa root mean square (RMS).

Construction-related adverse effects on marine mammals are possible. The NMFS has suggested that sound pressure levels that exceed 190 dB re 1 µPa may cause threshold shifts or temporary hearing impairments in marine mammals. Research on marine mammals shows that under certain circumstances underwater noise can cause a variety of effects. This includes behaviour modifications, tissue rupturing or haemorrhaging at close range to the acoustic source, and temporary or permanent hearing loss. In addition new noise sources can mask other sounds important to survival, such as those made by calves, mates, or predators (Richardson, 1995).

Stormont Bay is not particularly important in relation to marine mammals. Marine mammals appear to be transitory. Seals may haul out on the shoreline and small whales may enter the area to feed, following schools of herring and mackerel.

Adverse effects to marine mammals are also possible due to the degradation of the marine environment through fuel spills during the construction, operation and decommissioning of the facility. These effects and the relevant mitigation have been presented in Section 10.0.

Operation and Maintenance

During the operation of the Project, vessel traffic is expected to increase. 83% of the underwater acoustic field surrounding large vessels is the result of propeller cavitation (Southall, 2005). Noise from vessels may contribute to masking of sounds important to the survival of mammals. However, marine mammals have been known to adapt to masking sounds by changing the intensity and frequency of their vocalizations.

Stormont Bay is not particularly important in relation to marine mammals. Seals may haul out on the shoreline and small whales may enter the area to feed, following schools of herring and mackerel.

Modifications and Decommissioning

Adverse effects to marine mammals during the decommissioning phase include potential for the accidental release of contaminants to the environment.

5.1.11.2 Mitigation Measures and Monitoring

Construction

To minimize the effects of noise on marine mammals during construction of the jetty and the LNG Marine Terminal, the following mitigation will be applied as required:

- work at low tide;
- the use of ramped warning signals;
- the use of bubble curtains to mask the noise; and
- the use of alternative techniques to pile driving such as vibratory pile driving.

The relevant mitigative measures for accidents and malfunctions have been presented in Section 10.0.

Operation and Maintenance

No mitigation of operational activities is required given the low level of marine mammal activity in the area.

Modifications and Decommissioning

Mitigation presented for the construction phase will be sufficient for the decommissioning.

5.1.11.3 Residual Effects

Construction

Given the low importance of the marine environment at the Project Site for marine mammals, and the implementation of the proposed mitigative measures identified above, no significant adverse residual environmental effects on marine mammals are likely to occur.

Operation and Maintenance

Given the low importance of the marine environment at the Project Site for marine mammals, and the implementation of the proposed mitigative measures identified above, no significant adverse residual environmental effects on marine mammals are likely to occur.

Modifications and Decommissioning

Given the low importance of the marine environment at the Project Site for marine mammals, and the implementation of the proposed mitigative measures identified above, no significant adverse residual environmental effects on marine mammals are likely to occur.

5.1.11.4 Follow Up

No follow up monitoring is required.

5.1.12 Wildlife and Wildlife Habitat

5.1.12.1 Environmental Effects Prediction

Habitat removal may result in loss of associated wildlife. Those forms that can move easily may move to similar habitats elsewhere. Successful survival may depend on the number of individuals of the same or closely related species already in those habitats. There is potential for some loss of the wildlife currently inhabiting the site areas.

Construction

Habitat removal during the breeding season for vertebrate wildlife, roughly April through July, can have adverse effects on wildlife populations. Impact on small mammals is mainly related to loss of habitat. The main impact on raptors would be removal of prey habitat on both sides of Highway 316. The tank storage and pipe rack portion of the Project will remove approximately 20% of the existing amphibian and reptile habitat available on the LNG Project Site, and 50% of the deer wintering habitat.

Birds may be affected by noise from construction activities. Flushing of nesting birds may result in decreased productivity from such factors as increased nest predation and changes to less favourable nesting sites (Interior Waste Authority, 1994). The data regarding effective distance due to noise disturbance are relatively few and conflicting, with various field studies showing effects from edge of area of disturbance to 200 m. The distance of effect is of course related to noise volume and quality. The effects of noise on the site due to construction are expected to be short-term.

Pipeline construction is planned to occur on the beach and dike at Betty's Cove. This is important habitat for resident shorebirds. Great blue herons were noted in this area during field surveys; however no heronry was noted in the area. A heronry is reported to exist in the Gold Brook Lake wetland area, over 1 km from the Project Site.

Operation and Maintenance

Amphibians are likely to be affected, other than by habitat removal, only if drainage patterns are changed and/or if there is a significant change in water quality from operational procedures. Increased human activity will have a depressing effect on most mammal populations that remain after construction. An exception to this may be with bats, the foraging potential of which may be increased by concentrations of insects attracted to lights. Increased human activity may encourage some animals such as raccoons and skunks.

There is expected to be an increase in birds that are especially compatible with human activity; i.e. starlings, robins, grackles, cowbirds, rock doves, some of which are nest predators and may otherwise compete with woodland and edge birds. Birds are likely to undergo some mortality by collision with lighted towers and other structures. This is of particular concern with migratory birds therefore it is addressed separately in Section 5.1.13.

Modifications and Decommissioning

As mentioned in construction, noise from decommissioning activities may have an effect on birds during the breeding season. The effects of noise on the site due to decommissioning are expected to be short-term.

5.1.12.2 Mitigation Measures and Monitoring

Construction

The development of the proposed Project will involve the removal of much of the existing vegetation as well as the displacement of most of the associated wildlife. The mitigation measures proposed for this phase and location of the Project focus on minimizing the clearing area where possible, the use of effective ESCs, and the stabilization and re-vegetation of disturbed areas on the site.

Mitigation measures will include:

- clear vegetation outside the April through July time frame of vertebrate animal reproduction;
- minimize area cleared where possible;
- avoid clearing in deer wintering areas when the snow conditions are such that deer would be utilizing the area;
- progressive removal of habitat, as required, vs. clearing the entire area at once;
- use proper maintenance procedures regarding building materials, slash, litter, etc;
- try to preserve the most sensitive sites;
- ensure that all equipment has appropriate noise-muffling equipment installed and in good working order;
- conduct routine noise monitoring at the site boundaries as appropriate; and
- clear vegetation outside of bird nesting season (May 1 through August 1).

Construct the LNG pipeline along Dung Cove outside of the sensitive nesting season for the greater yellowlegs (i.e., outside of the June through July timeframe).

A monitoring program to assess wildlife populations will be established prior to commissioning and will continue 3 to 5 years following commissioning. The surveys will be carried out at appropriate times of the year as shown in Section 7.0 Table 7.2-2.

Evidence of wildlife presence and activity, and vegetation condition requiring attention, will be monitored during the surveys.

Operation and Maintenance

Proper maintenance procedures, including measures to eliminate garbage, should be followed everywhere on the Project Site to discourage the attraction of animals.

New vegetation should be established as comprehensively and as soon as possible to restore habitat for birds. New buildings should be constructed without ledges to prevent rock dove nesting.

The Proponent will initiate a monitoring program which will consist of sampling noise levels over a 24-hour period following commissioning. Noise sampling will be conducted quarterly and the results evaluated on an annual basis or following process or equipment changes. This will include monitoring of ship noise, vehicle movement, heavy equipment operations, emergency operations, and normal operating modes.

Modifications and Decommissioning

Mitigation presented for the construction phase will be sufficient for the decommissioning the LNG facility.

5.1.12.3 Residual Effects

Provided the proposed mitigative measures are implemented, the environmental effects are predicted to be low in magnitude and reversible. Therefore, no significant adverse residual environmental effects on wildlife and wildlife habitat are anticipated.

5.1.12.4 Follow Up

No follow up monitoring for has been developed.

5.1.13 Migratory Birds and Migratory Bird Habitat

5.1.13.1 Environmental Effects Prediction

Construction

As with terrestrial wildlife, the environmental effect of concern is the removal of migratory bird habitat from the LNG facility site and disturbance to migratory birds as a result of noise during construction. The effects discussed in Section 5.1.12.1 are applicable for migratory birds and habitat.

Operation and Maintenance

Migratory birds use a variety of navigational cues for finding their way between breeding and wintering sites. Some species are genetically predisposed to fly in a certain direction for a certain amount of time. Other species may use the angle of the setting sun (and the pattern of polarized light created), land features such as mountains and rivers, or wind direction.

Birds that travel by night or over vast ocean distances, such as warblers, swallows and thrushes, use a combination of star patterns, geomagnetic field, and polarized light for orientation. This makes them particularly susceptible to disorientation caused by man-made light, especially under overcast or foggy weather conditions (Evans Ogden, 1996). Birds that are not killed outright by collisions with the light sources can succumb to exhaustion brought

upon by prolonged fluttering around a light source or to predation upon individuals in weakened states (Evans Ogden, 1996).

Migratory birds are likely to undergo some mortality by collision with lighted towers and other structures. These types of lights may impact upon migrating birds; however, the extent of the impact cannot be forecasted at this stage. The number of birds killed may vary from a large number per night in collision with high towers (Ornithological Council, 1999) to only a few striking household windows. Klein (1990) indicated that collision with household windows, in one instance, resulted in 26-33 birds being killed annually, and that greater than one-half of bird strikes at lighted windows were fatal. Johnston and Haines (1957) recorded thousands of bird-lighted-object deaths in Georgia; most if not all species they reported have been observed in the Project Study Area. Mortality is greatest with lighted towers (i.e., 70 m in height), and less with lights near ground level.

Previous studies have suggested that migrating birds are not equally attracted to all kinds of light (Avery et al., 1976). Strobe lights have been reported to attract fewer birds for shorter periods of time than either slow flashing lights or constant sources (Baldwin, 1965). In previous studies, migratory birds have been disoriented by red light, apparently unable to use their magnetic compass and that the ability to orient under red light depends on previous exposure to the same or similar wavelengths (Wiltschko et al., 2004).

Modifications and Decommissioning

Noise from decommissioning activities may have an effect on migratory birds during the breeding season. The effects of noise on the site due to decommissioning are expected to be short-term.

5.1.13.2 Mitigation Measures and Monitoring

Construction

The mitigation presented in Section 5.1.12.2 is sufficient for migratory birds and migratory bird habitat.

Operation and Maintenance

The lighting regime for the entire Project Area will be illuminated with downward facing white lights to minimize visual disorientation of nocturnal migrants as well as diurnal species migrating in inclement weather. It is thought that this type of lighting will not attract even night migrating songbirds (Kerlinger, 2004). It is advisable not to use illuminated structures taller than 50 feet (15 m), as these have been demonstrated to disorient birds. It is further recommended that fast-blinking strobes be used when feasible. Further details on lighting will be provided in the NSEL EA Lighting Plan.

It is of note that the Proponent will generate a lighting plan, which will incorporate a program to monitor impacts to birds. This work will be undertaken by the Proponent in compliance with Item 1.6 of the NSEL EA approval conditions (NSEL, 2007). In accordance with the NSEL conditions, the plan must be submitted to NSDNR, CWS, and TC for review and approval. Based on the results of the monitoring programs, the Proponent must make necessary

modifications to the mitigation plans and/or operations to prevent any unacceptable environmental effects to the satisfaction of NSEL, based on consultation with NSDNR and CWS.

The mitigation presented in Section 5.1.12.2 and Section 5.1.15.2 is also relevant for migratory birds and habitat.

Modifications and Decommissioning

Mitigation presented for the construction phase in Section 5.1.12.2 will be sufficient for the decommissioning the LNG facility.

5.1.13.3 Residual Effects

Provided the proposed mitigative measures are implemented, the environmental effects will be reversible and will have a low magnitude (Table 6.1-12, Section 6.0). Therefore, no significant adverse residual environmental effects on migratory birds are predicted.

5.1.13.4 Follow Up

No follow up monitoring is recommended for migratory birds beyond the implementation of the approval conditions established by NSEL (see note above under “Operation and Maintenance”).

5.1.14 Wetlands

Both collectively and as individual units, wetland resources serve a variety of important ecological and socio-economic functions, including the maintenance of surface and groundwater resources and quality, as well as providing habitat for fish, wildlife, and migratory bird species. The value of wetlands to society and their ecological value are derived from their biological productivity and biodiversity. Wetland functions have been defined as the capability of wetland environments to provide goods and services including basic life-support functions (Bond et al., 1992).

As of March 1, 2006, wetlands are protected in Nova Scotia by the Wetlands Designation Policy, which replaces the Wetlands Directive from 1995. Alteration of a wetland may remove or interrupt the ability of the wetland to continue to support the same level of pre-development functions.

The Federal Government is committed to wetland conservation by adopting the “Federal Policy on Wetland Conservation” that essentially requires a no net loss in wetland function. The objective is to “promote the conservation of Canada’s wetlands to sustain their ecological and socio-economic functions.” According to the “Federal Policy on Wetland Conservation - Implementation Guide for Federal Land Managers,” in some areas (where wetland loss has been severe), the further loss of wetlands will be avoided wherever possible.

5.1.14.1 Environmental Effects Prediction

Construction

The functions and values of wetlands are generally not compatible with construction activities. Spills of fuels, lubricants, and hydraulic fluids, erosion, sedimentation, and damage caused by heavy machinery can potentially result in significant impacts.

Wetlands 1 and 12 (see Figure 4.2-1) will be affected by the construction of the marine LNG pipeline from along the Marginal Wharf to the LNG Storage Tanks. The LNG pipeline will be built on a trestle, with footings that may be placed within the wetland boundary. The exact spacing of these footings is not currently designed, but will be confirmed during the FEED process. Wetland 13 will most likely be affected by Site preparation and construction related to the LNG facility.

The construction may result in some filling, excavating, and otherwise disturbance of wetlands, which in addition to some loss of wetland habitat may alter the hydrological integrity of the site.

The kinds of potential effects on wetland function include:

- alteration/displacement of habitat;
- soil erosion;
- reduction of water quality due to suspended solids in runoff;
- noise/physical disturbance of wildlife; and
- introduction of invasive plant species.

It is of note that the other wetland located on Read Head (Wetland # 4) may also be affected by the KDP. However, any such effects would be attributed to the components that are beyond the scope of the CSR but have been addressed and assessed through the provincial EA process.

Alteration/Displacement of Wetland Habitat

Wetland vegetation is the primary biological indicator of major ecological processes, their vitality, and their ability to support wildlife. Wetland vegetation abundance and diversity depend upon a variety of factors, including soil type, topography, and the hydrologic regime (Glouschenko and Grondin, 1988). The type of wetland habitat present is a major determinant of function and values within a wetland. For instance, major changes in vegetative communities, and thus habitat types, may result in a redistribution of wildlife species within a wetland (Kobriger et al., 1983). Thus, maintenance of wetland function is dependent on maintenance of habitat types within a given wetland, as defined by vegetation, soils, and hydrologic conditions.

The movement of surface water in wetlands may contribute to the character of the existing ecosystem. Cut and fill activity can inhibit, enhance, or redirect the flow of water and, in so doing, change the nature of both the established water regime and the biological community of a site (Shuldiner et al., 1979). Engineered structures in wetlands can often affect both the timing and duration of water regime fluctuations. When the changes are pronounced, they may

have significant effects (i.e., alteration of vegetation assemblages) on the wetlands involved (Shuldiner et al., 1979).

A shift in wetland habitat composition (such as distribution and abundance of wetland habitat types within a wetland) is a community level effect that may result from altered water levels, and may occur to a lesser degree from changes in periodicity, or heavy sedimentation. Wetland habitat composition is a major determinant of the wildlife values a wetland affords. Major changes in the class composition of a wetland can result in redistribution of wildlife species in relation to habitat use (Kobriger et al., 1983).

Wetlands 1 and 12 will experience some alteration and displacement of habitat with the construction of the LNG marine pipeline. The pipeline will be on a trestle with only the footings in the wetland boundary to minimize the effects. Wetland 13 may also be affected by construction through infilling that would cause displacement of habitat.

Soil Erosion

Erosion and sedimentation during and following construction may affect wetlands within the Project Site. These effects may include destabilization of slopes in wetland areas, sedimentation of wetland habitat, and sedimentation of any downstream aquatic habitat.

Changes in Water Quality

The quality of wetland waters may be subject to adverse local and/or short-term effects; widespread or long-term effects on water quality are less common (Shuldiner et al., 1979). Due to the predominance of aquatic-based food chains in wetlands, water quality changes may have significant adverse effects on wetland productivity and diversity.

The proposed Project construction activity has potential to influence water quality in wetlands 1, 12, and 13. The water quality may be affected by suspended solids in runoff and accidental leakage/spillage of hazardous materials/contaminant mobilization.

Erosion and sedimentation are known to adversely affect the ecology of most aquatic systems. The severity of problems caused by suspended solids generally decreases with distance from the area of disturbance and with time after construction is completed (Shuldiner et al., 1979). Turbidity is known to have adverse effects on aquatic primary productivity, feeding, and reproductive success of higher organisms. When prolonged turbidity is experienced, significant changes in wetland function and class structure can be expected (Shuldiner, et al., 1979).

Degradation of water quality in wetlands may occur through contamination from accidental releases of hazardous materials such as leaks from construction machinery, accidental spills of fuels and lubricants, and leaching from surfacing/construction materials. The severity of the effect of these substances on wetland habitat is variable, and may be affected by water regime, precipitation patterns, topography, and the sensitivity of particular organisms to the chemical concerned (Shuldiner, et al., 1979).

Noise/Physical Disturbance of Wildlife

Due to the limited duration of construction adjacent to wetland habitat, no significant effects to wildlife as a result of noise or physical disturbance are anticipated, assuming construction time (15 months) and habitat disruption (effected area to total approximately 0.210 km^2) are minimized.

Prevention of the Spread of Invasive Species

Invasive plants are defined as those species that have moved into a habitat and reproduced so aggressively that some of the original components of the vegetative community are displaced. An alien species is one which did not originally occur in an area where it is now established, but which arrived as a direct or indirect result of human activity. Introduction of invasive alien plant species can result in: a change to or displacement of habitat, resulting in the elimination or a decrease in the abundance of flora/fauna dependant on the original habitat; decrease in biodiversity; displacement of native genotype; hybridization with native species; and/or making an area unsuitable for human use (White, et al., 1993).

Most invasive alien plant species in Canada have first become established in the most disturbed areas (i.e., areas of high population density such as southern Ontario) and then spread to less disturbed habitats. One of the most harmful invasive alien species in eastern Canada is Purple Loosestrife (*Lythrum salicaria*), which has become well established in eastern Canada and also British Columbia. Loosestrife rapidly becomes the dominant species on wetlands, displacing valuable wildlife habitat and diversity. Loosestrife has no natural competitor, no native animals use it as forage, and it does not provide habitat for any native wildlife species.

There is potential for the use of equipment or machinery that was previously used in areas known to support invasive alien plant species, which may result in the spread of these species to and within all three wetlands in the Project Site.

Operation and Maintenance

During operation of the LNG facilities, there is potential for recreational all terrain, or off-highway vehicle users to access wetlands 1 and 12 and potentially cause environmental damage. The Nova Scotia government passed Bill 275 in 2005, amending the *Off Highway Vehicle Act*. Under the Act, off-highway vehicles cannot be operated in sensitive areas designated by the regulations, highland or coastal barrens, beaches, sand dunes, watercourses, or wetlands. Operation in a watercourse or wetland must be approved by Nova Scotia Environment and Labour through the *Environment Act*. Water quality may be adversely affected resulting from discharges and/or runoff.

Adverse effects to wetlands 1, 12, and 13 during operation are also possible through fuel spills during the operation and maintenance activities. These malfunction and accident-related effects have been described in Section 10.0.

Modifications and Decommissioning

Wetlands are at risk for disturbance from many of the same potential activities as during construction. Refer to Construction section above.

5.1.14.2 Mitigation Measures and Monitoring

Construction

A wetland functional analysis study will be conducted for wetlands 1, 12, and 13 prior to construction. A wetland mitigation plan will be drafted prior to construction for those wetlands where encroachment is unavoidable (see also note below on work to be undertaken by the Proponent in compliance with NSEL EA approval conditions). The first principal is avoidance. Where wetlands cannot be avoided, mitigative measures will protect wetlands during construction. The EPP will include the site specific protection plans for these wetlands during the construction phase. These generally include:

- minimize the length of wetland habitat disturbed;
- minimize the construction area, and construction period in wetlands;
- adhere to conditions of an applicable wetland alteration permit;
- stabilize watercourse/wetland beds and banks with clean rip rap when necessary to ensure stability; and
- minimize ground and vegetative disturbance by:
    - locating staging areas outside of the wetland, at least 30 m from the edge of wetland, where possible;
    - minimizing equipment in wetland to only that required for construction activity; and
    - using upland access roads wherever practical.
- maintain vegetative diversity by:
    - incorporating practices to prevent the spread of non-desirable invasive species throughout the construction area, including cleaning and inspection of construction equipment prior to use in wetland areas; and
    - allowing wetlands to revegetate naturally unless adjacent to areas of potentially erodible soils.
- during site restoration, mitigate effect on vegetation by:
    - not applying fertilizer, lime or mulch to wetland as part of revegetation plan;
    - in areas where there is no open water or saturated soils, separate organic top soil from underlying soils, and stock pile separately; return top soil to original horizon; and
    - restoring original contours and cross drainage patterns.
- inspect equipment daily prior to use to detect leaks of fuels;
- all on-site fuels, oils, and chemicals should be stored at least 150 m from any surface waters where possible;
- ensure all spill prevention planning and detailed cleanup procedures are in place prior to construction;

- take necessary measures to reduce or avoid disruption of surface and ground water patterns;
- drainage control features will be implemented to prevent soil erosion and impacts to water quality;
- boulders and tree trunks harvested during construction to be retained for possible use in aquatic habitat enhancements; and
- raise the pipeline in the terminal area to avoid impeding wetland flow to Betty's Cove.

Adhering to a "no net loss of function" policy is part of Project mitigation. As such, there will be a compensation plan for the impact by replacing, enhancing, or providing substitute resources or environments. This plan will be designed in conjunction with regulators and stakeholders and completed before any construction activity.

A detailed ESC plan, including a monitoring program for site runoff, to be reviewed and approved by NSEL, will be developed. Based on the results of the monitoring program, the Proponent must make necessary modifications to ESC plans and/or operations to prevent any unacceptable environmental effects, to the satisfaction of NSEL.

It is of note that the Proponent will detail the impacts to wetlands in compliance with Item 1.2 of the NSEL EA approval conditions for the KDP (NSEL, 2007). This work will address methods and plans for avoidance, mitigation, and/or compensation and will be developed in consultation with NSEL and NSDNR.

Operation and Maintenance

It is recommended that the LNG facilities are fenced to ensure no public access. Monitoring for illegal off-highway vehicle use will be conducted as part of routine operation and maintenance checks of the LNG pipeline.

See also note under "Construction" with respect to development of further mitigation measures.

Modifications and Decommissioning

As potential interactions are similar during the construction phase, similar mitigation measures apply. Requirements for mitigative measures during any future modifications and decommissioning activities will be included under the EMP.

See also note under "Construction" with respect to development of further mitigation measures.

5.1.14.3 Residual Effects

The impact of the Project on the wetlands on and near the Project Site is not expected to be significant. With the implementation of mitigation measures outlined above, the environmental effects will be low in magnitude and will only affect 3 wetlands. The site is designated for industrial use and there are numerous other wetlands in the site's vicinity. Therefore, residual effects are expected to be not significant.

5.1.14.4 Follow Up

Construction

No follow up monitoring is recommended.

For additional follow up work – see note under "5.1.14.2 Mitigation Measures".

5.1.15 Lighting Conditions

5.1.15.1 Environmental Effects Prediction

Construction

No adverse environmental effects are expected from lighting during construction, prior to commissioning of the LNG facility.

Operation and Maintenance

The area of the LNG storage tanks will be mostly in plain view of the community of Isaac's Harbour. Therefore, uncontrolled Project lighting could result in unwanted light pollution or skyglow. While the lighting levels have not been designed at this stage, they will be set to provide a low level of general lighting sufficient for security cameras. This level is not expected to provide task lighting and high masts with multi-unit high intensity fixtures will be avoided as much as possible. Where high mast lighting is required the illumination fixtures will be selected to direct light downward. Therefore, effects on local residents should be minimal.

Project lighting could also have effects on birds, as described in Section 5.1.12 and 5.1.13 above. The severity of potential effects will generally be limited to minor changes in flight path but could include uncommon instances of mortality due to collisions with taller structures or exhaustion due to disoriented flight behaviour (mainly at night).

Modifications and Decommissioning

No adverse environmental effects are expected from lighting due to the decommissioning of the LNG facility.

5.1.15.2 Mitigation Measures and Monitoring

Construction

No effects have been identified therefore mitigation is not necessary.

Operation and Maintenance

To minimize the impacts of light on the surrounding community the Proponent will apply the following measures:

- no use of unnecessary lighting;

- avoidance of use of lighted structures over 15 m in height; when necessary, use of flashing strobe lights as recommended in CWS's Best Management Practices for Tall Structures;
- shielding of lighting where possible; and
- angled lighting or lighting directed close to work area.

Mitigation to address the effects of lighting on birds has been described in Section 5.1.13.

It is of note that the Proponent will generate a lighting plan, which will incorporate a program to monitor impacts to birds. This work will be undertaken by the Proponent in compliance with Item 1.6 of the NSEL EA approval conditions (NSEL, 2007). In accordance with the NSEL conditions, the plan must be submitted to NSDNR, CWS, and TC for review and approval. Based on the results of the monitoring programs, the Proponent must make necessary modifications to the mitigation plans and/or operations to prevent any unacceptable environmental effects, to the satisfaction of NSEL, based on consultation with NSDNR and CWS.

Modifications and Decommissioning

No effects have been identified therefore mitigation is not necessary.

5.1.15.3 Residual Effects

Construction

No residual effects from this phase of the Project are anticipated.

Operation and Maintenance

Appropriate lighting is necessary to ensure safe and secure operations. While measures will be implemented to minimize disturbances to humans and wildlife as much as possible, some light sources will be unavoidable. However, the environmental effects are considered reversible and low in magnitude. Therefore, no significant residual effects are expected.

Modifications and Decommissioning

No residual effects from this phase of the Project are anticipated.

5.1.15.4 Follow Up

No follow up programs are currently considered necessary. If local residents complain about Project lighting, Keltic will make every reasonable attempt to reduce unwanted light effects based on the specific situation.

5.1.16 Atmospheric and Underwater Acoustic Environment

5.1.16.1 Environmental Effects Prediction

As a matter of good practice, Keltic will develop an atmospheric noise monitoring program that will include routine measurements during construction and operation.

In the absence of particular regulatory requirements, the Nova Scotia Government's "Guidelines for Environmental Noise Measurement and Assessments" will be used as the reference point for adhering to acceptable noise levels during construction activities at the Project Site. These Guidelines are:

- 65 dBA between the hours of 0700 to1900 (day);
- 60 dBA between the hours of 1900 to 2300 (evening); and
- 55 dBA between the hours of 2300 to 0700 (night) and on Sundays and Statutory Holidays.

The following discussion of potential effects from Project related atmospheric noise is considered in the context of these guidelines. Isaac's Harbour Villa Senior Apartment and the Isaac's Harbour Medical Centre have been identified as sensitive human receptors. However, neither of these receptors are located within 1 km of the Project Site. No hospitals, daycare centres, schools, or seniors' residences are located within a 1 km radius of the Project Site.

Construction

The construction of the KDP facility will span a period of some 33 months, and will involve site preparation (blasting, earthmoving, etc.), followed by the erection of major industrial components.

Table 5.1-7 identifies some typical noise levels for construction equipment. For comparison, a chainsaw at 1 m is approximately 110 dB, a busy highway at roadside is 80 dB, conversational speech at 1m is 60 dB, and a library is 40 dB.

TABLE 5.1-7 Typical Construction Equipment Noise Levels at 50 Feet (15 m)

Equipment	Typical Noise Range (dBA)
Loader	74-84
Bulldozer	82-95
Trucks	82-92
Pumps	68-72
Generators	72-80
Compressors	74-83

It is noted that the nearest occupied properties are some 300-500 m from the site boundary lines, and, accordingly, sound pressure levels (noise) will decrease from that point. The inverse square law states that the sound pressure level will decrease by 6 dBA for every doubling in distance from the source of noise. The following formula is used to determine the change in sound pressure levels over a distance:

$$\Delta D = 10 \log (d_1/d_2)^2$$

Where d_1 and d_2 are the two distances and ΔD is the change in sound pressure level in decibels (dBA)

Given the above formula, the approximate sound pressure levels for a bulldozer at 300m from the property boundary would be 33-49 dBA. A level of 49 dBA is below the lowest recommended noise level in the NSEL Guidelines presented above. The attenuation formula does not take into account the effect of vegetation, topography, or climatic conditions, which would further reduce the noise levels.

It is noted that when several pieces of equipment are operating in proximity to each other, sound levels (in dBA) are not additive. For example, two bulldozers, each with an operating sound level of 82 dBA would be the equivalent of a level of 85 dBA, since 3 dBA represents a doubling of the noise level, a difference that is considered to be barely perceivable to the human ear.

Blasting will be managed so as to minimize blast size and reduce maximum noise levels. It is not known precisely what sound levels blasting will cause but it will likely be noticeable and potentially disturbing to local residents.

The underwater environment may be affected by noise impacts from construction activities for the development for the LNG Marine Terminal and the LNG Tanks. Although there is not an extensive use of the nearshore waters by cetaceans and seals, these species may be susceptible to damage from the underwater noises generated using conventional pile-driving techniques. The underwater noise impacts on marine mammals are further discussed in Section 5.1.11. and the mitigation describe in this section will also mitigate any impacts of noise on fish.

Operation and Maintenance

In order to determine potential noise levels during the operational phase of the LNG Marine Terminal, similar processes from the LionGas LNG Marine Terminal in Rotterdam were reviewed. While somewhat different from the proposed process for Goldboro, the projects are comparable. The noise levels for operation at the Rotterdam project ranged from 94 dB for a BOG cooling system to 145 dB for relief/blowdown valves. Sources like relief/blowdown valves are not continuous and would only be an incidental source. The sources with the highest noise levels were flaring operations and these are periodic or incidental operation. The continuous operations ranged from 94 to 110 with mitigative measures in place such are insulation or noise hoods.

As in the construction phase, noise levels generated from a particular point source would degenerate over distance. The noise levels at 300m from the property boundary generated from the continuous sources would be in the range of 45 dB to 61 dB. The noise levels generated by periodic or incidental sources such as flaring would be between 77 and 96 dB.

Underwater noise impacts on marine mammals during operation are not expected to be significant as most noise generated (i.e., ship engines) would be of a lower frequency than pile driving and other marine construction practices. The effects of underwater noise on marine mammals due to Project operations were discussed previously in Section 5.1.11.

Modifications and Decommissioning

Potential interactions are similar as those identified for the construction phase.

5.1.16.2 Mitigation Measures and Monitoring

Construction

In conducting site construction operations, Keltic will:

- ensure that all equipment has appropriate noise-muffling equipment installed and in good working order;
- as required by the NSEL EA Approval Condition 2.2, provide for review and approval a noise monitoring program. Based on the results of the monitoring program Keltic will be required to make necessary modifications to mitigation plans and/or operations;
- conduct routine noise monitoring at both the site boundaries and nearby sensitive receptors; the measured noise levels will be compared to the Day-Night Average Sound Level (DNL) levels outlined in the Health Canada Draft Guidance on Noise Assessment for CEAA Projects;
- restrict intensive construction activities to the hours of 0700-1900 where practical;
- ensure that the public has contact numbers for appropriate construction and government personnel in the case of noise issues;
- ensure that the public is given adequate prior notice of any blasting activities scheduled to take place;
- use alternative techniques to pile driving such as vibratory pile-driving;
- confer with representatives from recreational and commercial fisheries to develop daily and seasonal activity schedules;
- work at low tide;
- use ramped warning signals;
- use bubble curtains to mask the noise if necessary; and
- maintain, where practical, treed buffers between the working site and the public.

Operation and Maintenance

In order to decrease the effects of facility operations on the acoustic environment, Keltic will:

- employ the use of a treed buffer between plant site and residences;
- use silencers and baffles on equipment;
- conduct routine noise monitoring to ensure noise levels at nearest occupied properties do not exceed Canadian Mortgage and Housing Corporation (CMHC) levels;
- supply public with contact numbers in case of noise issues;
- minimize evening and night-time operations;
- work activities will be planned as to create minimal disruption in the evening and night time hours; and
- discussions with local fishers will take place to minimize potential effects on the commercial fisheries.

As required by the NSEL EA Approval Condition 2.2, Keltic is required to provide for review and approval a noise monitoring program. Based on the results of the monitoring program Keltic will be required to make necessary modifications to mitigation plans and/or operations. The monitoring program will consist of sampling noise levels over a 24-hour period following commissioning. Noise sampling will be conducted quarterly and the results evaluated on an annual basis. The percentage of highly annoyed will be evaluated as outlined in the Health Canada Draft Guidance on Noise Assessment for CEAA Projects. Noise levels at designated sensitive receptor sites will also be determined through monitoring and compared to the sound levels outlined in the Health Canada Draft Guidance on Noise Assessment for CEAA Projects. Should noise levels be consistent over the first year, noise sampling would subsequently be conducted on a complaint basis or following process or equipment changes. This will include monitoring of ship noise, vehicle movement, heavy equipment operations, emergency operations, and normal operating modes.

Modifications and Decommissioning

As potential interactions are similar during the construction phase, similar mitigation measures apply.

5.1.16.3 Residual Effects

Provided the proposed mitigative measures are implemented as suggested, the environmental effects due to noise will have a low magnitude and will occur within 500 m of the site's boundaries. Therefore, no significant adverse residual effects on the acoustic environment are likely to occur.

5.1.16.4 Follow Up

No follow up monitoring is anticipated.

5.1.17 Current Use of Lands and Resources for Traditional Purposes by Aboriginal Persons

5.1.17.1 Environmental Effects Prediction

Construction

Mi'kmaq continue to undertake traditional activities throughout the KDP Study Area. Medicinal plant gathering sites and areas were identified by the wetlands that are within the Project Site. The construction may result in some filling, excavating, and otherwise disturbance of wetlands, in addition to some loss of wetland vegetation.

Some of the reported hunting and fishing areas overlap with the proposed LNG facility; which will result in an unavoidable loss of traditional resource area. However, the affected area (approximately 149 ha) is a very small proportion (less than 2%) of one hunting area out of approximately 10 large traditional hunting areas in Guysborough County; which encompass very large areas of land or include entire waterways. Therefore, the construction activities will result in minimal impacts to the land and resource use.

Operation and Maintenance

There are three identified sea urchin diving areas located at Betty's Cove and Red Head. It should be noted that sea urchins in this area were largely decimated by a parasite in the late 1990's and have not made a significant recovery.

Modifications and Decommissioning

No environmental are expected due to modifications or decommissioning of the LNG facility.

5.1.17.2 Mitigation Measures and Monitoring

Construction

Wetlands within the LNG facility, if affected, will be rehabilitated and/or compensated to achieve "no net loss" in wetland functions. As required by the NSEL Terms and Conditions for Environmental Assessment Approval, wetland plans for avoidance, mitigation and/or compensation will be developed in consultation with NSEL and NSDNR.

For the effects on fishing, the draft FHCP outlined in Appendix 5 includes enhancement of benthic habitat within the same urchin licence area. This is predicted to offset any loss of sea urchin production and/or access once the species returns to commercial levels.

To meet the requirements of Item 4.3 in the NSEL EA approval conditions, Keltic will develop a Mi'kmaq Communication Plan for the Project which will include but not be limited to:

1. processes for communicating Project details and seeking input from the Mi'kmaq community; and
2. plans for Mi'kmaq involvement in EEM and other Project aspects. The plan will be developed in cooperation with the Mi'kmaq Community.

Also, in accordance with Item 4.4 of the NSEL EA approval conditions, Keltic will take steps to further assess traditional Mi'kmaq use of the Project Site lands. The Proponent will develop the proposed steps in cooperation with the Mi'kmaq Community and will submit the results to NSEL.

Operation and Maintenance

For the effects on fishing, the draft FHCP outlined in Appendix 5 includes enhancement of benthic habitat within the same urchin licence area. This is predicted to offset any loss of sea urchin production and/or access once the species returns to commercial levels.

Modifications and Decommissioning

No mitigation is necessary.

5.1.17.3 Residual Effects

Provided the proposed mitigative measures are implemented, the environmental effects will have low magnitude and will be reversible. Therefore, no significant adverse residual effects on aboriginal lands or resources are expected.

5.1.17.4 Follow Up

Monitoring of the fish habitat compensation will be done to ensure successful habitat creation.

5.1.18 Physical and Cultural Heritage

5.1.18.1 Environmental Effects Prediction

Construction of the LNG Marine Terminal may have effects on physical and cultural heritage. Due to previous excavation and removal of burials at Red Head in 2000 and 2001, complemented by subsurface testing in October 2004, there is confidence that no burials remain in the cemetery and, therefore, the site is no longer believed to be of high archaeological sensitivity. However, due to its association as the final resting place of the first Black Loyalists in Goldboro and Isaac's Harbour, it remains to be of cultural significance to the nearby Black community at Lincolnville.

5.1.18.2 Mitigation Measures and Monitoring

Prior to construction, an agreement with the Department of African Nova Scotia Affairs will be entered into for the establishment of a memorial at the Red Head Cemetery site. A Cultural Heritage Plan will also be developed to ensure that Project development and operations proceed in a manner that respects the cultural heritage value of the Red Head Cemetery site to the community, and that public access to the site will be maintained. The plan will be reviewed and approved by NSEL. An archaeology and heritage resources monitoring and contingency plan will also be prepared in consultation with Mi'kmaq stakeholders, African Nova Scotia Affairs, and the Nova Scotia Museum.

5.1.18.3 Residual Effects

Provided the proposed mitigative measures are implemented as suggested, the environmental effects will have low magnitude. Therefore, no residual effects due to the Project are anticipated.

5.1.18.4 Follow Up

No follow-up programs are recommended.

5.1.19 Structures/Sites of Archaeological, Paleontological or Architectural Significance

5.1.19.1 Environmental Effects Prediction

The historical review of the Project Area demonstrated that there are key areas within the Study Area that have at one time, seen Mi'kmaq occupation. This points to the probability that Mi'kmaq artefacts could be found during construction.

Previous archaeological investigations in the vicinity of the development area, such as the archaeological intervention at Red Head Cemetery in 2001-2002 and archaeological assessments for the M&NP and SOEI project, indicated that this area was of high potential for heritage resources. The potential that it is related to late eighteenth century Black Loyalist settlement exists. Therefore, this area is believed to be of high archaeological sensitivity. Several such resources were located within the development zone during the current archaeological assessment. Under the *Special Places Protection Act*, mitigation of those resources expected to be impacted by construction or related ground-disturbance activities is required.

Construction

Each archaeological resource within the Study Area has been evaluated according to its relative significance based on the cultural and physical integrity of each resource, existing documentation, and the expected impact on those resources (Table 5.1-8).

TABLE 5.1-8 Relative Significance of Archaeological Sites within the LNG Plant Study Area

Archaeological Site or Resource	Archaeological Sensitivity	Cultural Sensitivity	Expected Impact (Yes/No)
Hattie's Belt	Medium	N/A	No
Giffin Lead	Medium	N/A	No
Skunk Den Mine Crusher	Medium	N/A	No

No archaeological sites of significance have been identified within the footprint of the proposed Project. Therefore no adverse effects are anticipated.

Operation and Maintenance

There are no anticipated effects to archaeological resources during the operation of the LNG facility.

Modifications and Decommissioning

The potential effects addressed in the construction section are relevant for the decommissioning of the facility as well.

5.1.19.2 Mitigation Measures and Monitoring

Construction

Should any artefacts or human remains be discovered, the work is to be terminated until a qualified archaeologist assesses the find. If the find is deemed significant, the work will not resume until further steps and protective measures are discussed in consultation with the archaeologist and regulatory authorities.

There is a probability that Mi'kmaq artefacts could be found during construction, and in such cases, construction workers should be made aware that this is a possibility. This may include cultural resource awareness training for construction workers. In the event that artefacts are found during construction activities, construction activities in the area of the discovery will be suspended and the discovery be reported to the Nova Scotia Museum and the Executive Director of the Union of Nova Scotia Indians immediately. In accordance with Item 4.5 in the NSEL EA approval conditions, a complete archaeological assessment of the entire KDP site will be submitted for review by NSEL. Also, as requested by Item 4.9 in the NSEL EA approval conditions, a plan will be developed to ensure the KDP construction and operations proceed in a manner that respects the cultural heritage value of the Red Head Cemetery and that public access to the site will be maintained.

Operation and Maintenance

In accordance with Item 4.9 in the NSEL EA approval conditions, a plan will be developed to ensure the KDP construction and operations proceed in a manner that respects the cultural heritage value of the Red Head Cemetery and that public access to the site will be maintained (NSEL, 2007). In accordance with Item 4.6, the Proponent, prior to construction, shall submit for review and approval of NSEL, an archaeology and heritage resources monitoring and contingency plan. The plan shall be developed in consultation with Mi'kmaq stakeholders, African Nova Scotia Affairs, and the Nova Scotia Museum.

Modifications and Decommissioning

No adverse effects are anticipated. For precautionary mitigation measures – see Construction.

5.1.19.3 Residual Effects

Construction

No residual effects on archaeological resources are expected.

Operation and Maintenance

No residual effects on archaeological resources are expected.

Modifications and Decommissioning

No residual effects on archaeological resources are expected.

5.1.19.4 Follow Up

No follow-up programs are recommended.

5.1.20 Navigation

5.1.20.1 Environmental Effects Prediction

The LNG facility is located on the mainland and therefore will have no effects on the navigation of vessels in the area.

The operation and construction of the LNG Marine Terminal may alter navigation into Isaac's Harbour from Stormont Bay. The area for the planned marine facilities is not a major fishing area and represents only a very small portion of the lobster habitat in the Stormont Bay (approximately 1.6%). Few vessels routinely use Isaac's Harbour even though the community wharf in Goldboro was substantially upgraded by SOEI for construction of the gas plant. Currently, marine traffic within the harbour is composed of the sporadic inshore fishery including a monthly passage of a shrimp trawler to the Stormont facility in Country Harbour. Proposed Project vessels are estimated to be 1 ship per day.

5.1.20.2 Mitigation Measures and Monitoring

The facilities will be well lit and marked on all navigation charts for the area. The navigation lighting and other markings will be required as per federal legislation. The very low level of boating activity in Stormont Bay and Isaac's Harbour is not expected to result in any important navigation issues with respect to marine facilities. Keltic will also provide advance notice of ship arrivals and departures to fishermen.

5.1.20.3 Residual Effects

No significant adverse residual effects on navigation are likely to occur since the effects of Project shipping will be managed through procedures that are developing during the TERMPOL process.

5.1.21 Marine Safety and Security

5.1.21.1 Environmental Effects Prediction

The LNG facility is located on the mainland and therefore will have no effects on the marine safety and security. The LNG Marine Terminal may represent an obstacle for vessels destined for or leaving Isaac's Harbour.

5.1.21.2 Mitigation Measures and Monitoring

The LNG Marine Terminal facilities will be well lit and marked on all navigation charts for the area. The navigation lighting and other markings will be required as per federal legislation. The very low level of boating activity in Stormont Bay and Isaac's Harbour is not expected to result in any important navigation issues with respect to marine facilities. Keltic will also adhere to the *Marine Transportation Security Act* and regulations.

5.1.21.3 Residual Effects

No significant adverse residual effects on marine safety and security are likely to occur as the magnitude of the effects will be minimized by the implementation of procedures developed as part of the TERMPOL process.

5.1.22 Human Health and Safety

5.1.22.1 Environmental Effects Prediction

Human health and safety includes two facets of potential adverse effects; public health and safety and worker health and safety. It is evaluated primarily to address potential health and safety risks to the public and workers associated with routine plant emissions, accidents, malfunctions, and unplanned events. Section 10.0 addresses potential effects and mitigation for accidents, malfunctions, and unplanned events.

In order to protect worker health and safety, Keltic will develop a comprehensive Health and Safety Program that will be implemented throughout the KDP, including construction, operation, and decommissioning.

Humans that may be potentially affected by construction, routine facility activities, as well as accidents, malfunctions, and unplanned events are primarily those that live in the Study Area. The nearest communities to the KDP are Goldboro and Seal Harbour. According to Industry Canada (2005), Goldboro has a population of about 80. The primary sensitive receptors in the area of the Project include the Goldboro Interpretive Centre, Isaac's Harbour Villa Senior Apartments, and Isaac's Harbour Medical Centre.

Residents in the area all use private wells, as described in Section 8.7 of the Provincial EA Report (AMEC, 2006). There are also approximately 1780 people within 30 km of Goldboro, although most of these are outside of the potential area of Project impact.

During the 33 month construction period, the facility is expected to employ up to 3000 people. Approximately 60% of the workforce could be housed in temporary construction quarters at the facility, if required. During operation, the facility is expected to employ approximately 600 workers.

The following sections describe potential impacts to health and safety during construction, operation, and decommissioning. These impacts, as well as mitigative measures, are summarized in Table 6.1-21.

Construction

During construction, there are several activities that could potentially impact human health and safety:

- dust generation during facility and roadway construction, in particular concerns with arsenic and mercury that are residuals of mining operations;
- safety concerns regarding former mine workings;
- air emissions from construction equipment and vessels transporting construction materials and equipment;
- water and waste management and control; and
- air emissions from vehicular traffic to the construction locations.

Dust generation during facility and roadway construction could occur, although potential impacts are expected to be localized. A Dust Control Plan to be implemented during construction will address this issue and provide specific monitoring requirements and controls to minimize dust. This is of particular concern in areas where mine tailings are found. As discussed in Section 5.1.5, sediment/tailing samples in Dung Cove have been shown to have elevated concentrations of arsenic ranging from 14 mg/kg to 1700 mg/kg, well above the Canadian Environmental Quality Guideline for soil of 12 mg/kg, considering either residential or industrial land use, as shown in Table 5.1-9. Concentrations of mercury in this area slightly exceed the residential guideline of 6.6 mg/kg in only one sample. Since the tailings in this area are wet, particulate generation is unlikely. However, handling of this material by workers should be conducted with adequate Health and Safety Controls, and re-use at the ground surface in other locations should be prevented. Such use could result in transport as particulates and potential exposure to the public.

Two other known tailings areas are found in locations potentially within the KDP Area (see Figure 8.13-4 from the Provincial EA Report; AMEC, 2006). In addition, others may be identified during construction activities. Health and Safety controls should be used to protect workers involved in activities in these areas, and potential airborne transport should be minimized.

Air emissions from construction equipment transporting equipment and materials should be localized with limited transport, due to their sporadic nature and emissions close to ground surface. Air emissions of vehicular traffic to the construction site will also occur, however, many of the workers may be located at the site, and much of the equipment and materials will be transported to the site by sea. Therefore, traffic to the site during construction will be minimized.

Water and waste management should not pose a hazard to public health or worker safety during construction. The primary concern is preventing run-off or other transport of soils impacted by mining. Construction practices in such areas should include provisions to control run-off and potential migration of impacted soils.

TABLE 5.1-9 Residual Environmental Effects Criteria - Health and Safety

Chemical	Soil (mg/kg)											
	Canadian Environmental Quality Guidelines				Atlantic RCBA Version 2.0 Tier I Risk-Based Screening Level							
					Residential				Commercial			
					Potable		Non-Potable		Potable		Non-Potable	
	Agri.[1] (fine soil)	Res./Park[2] (fine soil)	Comm.[3] (fine soil)	Industrial[4] (fine soil)	Coarse-grained soil	Fine-Grained soil	Coarse-grained soil	Fine-grained soil	Coarse-grained soil	Fine-grained soil	Coarse-grained soil	Fine-grained soil
Petroleum Hydrocarbons												
Gasoline					39	140	39	330	450	520	450	10,000
Diesel/#2					140	220	140	4,400	7,400	840	7,400	7,700
#6 Oil					690	970	690	8,300	10,000	4,700	10,000	10,000
VOCs												
Benzene	0.00068	0.0068	.0.0068	0.0068	0.03	0.01	0.16	1.5	0.03	0.01	1.8	11
Toluene	0.08	0.08	0.08	0.08	0.38	0.08	14	120	0.38	0.08	160	680
Ethyl Benzene	0.018	0.018	0.018	0.018	0.08	0.02	58	430	0.08	0.02	430	430
Xylenes	2.4	2.4	2.4	2.4	11	2.3	17	160	11	2.3	200	650
Metals												
Arsenic	12	12	12	12								
Chromium (hexavalent)	0.4	0.4	1.4	1.4								
lead	70	140	260	600								
Mercury	6.6	6.6	24	50								
Criteria Air Pollutants												
CO												
Hydrogen Sulphide												
NO_2												
Ozone												
SO_2												
TSS												

1. Agricultural Land Use
2. Residential/Parkland Uses
3. Commercial Land Use
4. Industrial Land Use

Equipment and materials storage during construction is likely to consist of building materials, process components, and other items needed for construction. Spills could occur from construction equipment kept on-site during this period, or from stored fuels, or other liquid materials needed for equipment or construction. Such spills are likely to be of small volume and localized, as large quantity storage is not expected during the construction period. Nevertheless, uncontrolled spills could impact groundwater and potentially migrate to private supply wells. As discussed in Section 5.1.5, old mine workings could provide a preferential pathway for spills to impact private wells. Equipment and materials storage that could result in spills should be located away from areas with former mine workings. Spill prevention and emergency response planning will be implemented as part of the EPP during construction to provide specific requirements for storage, prevention, and response to spills to minimize any potential impact.

Old mine workings also present a safety hazard for workers during construction activities due to their potential lack of structural integrity. Steps should be taken to assure their stability, or activities or structures should be located away from such areas.

Operation and Maintenance

During facility operation, there are several activities that could potentially impact human health and safety:

- air emissions during vapourization/regasification of LNG to natural gas;
- facility wastewater discharges;
- air emissions from vehicular traffic; and
- potential spills during materials transfer and storage.

Section 5.1.6 estimated emissions from the KDP components during operation and modeled air concentrations based on these emissions and those from the SOEP gas plant. The highest predicted pollutant air concentrations are compared to Nova Scotia Maximum Permissible Concentrations. This comparison (Table 5.1-2) shows that all regulatory standards are met. In addition, the highest predicted pollutant concentration is not likely to be where there are any receptors. Table 5.1-3 shows that maximum estimated concentrations at identified sensitive receptors are much lower than the highest predicted concentrations. These comparisons indicate that air emissions during facility operation are not likely to pose a health risk.

A Spill Control Plan will be developed for facility operation. It will describe required monitoring, storage requirements, and response procedures should a spill occur. The implementation of this plan will minimize any potential impact to soils and groundwater that could result in potential impacts to human health. Many of the spill containment measures in terms of facility design and component siting are described in Section 2.0.

Expected wastewater discharges from the facility have been described in Section 5.1.2. Effluents from the facility will be treated to applicable quality standards and are not expected to present a hazard to health or safety.

Worker safety concerns are present at this facility, similar to any other industrial facility. A health and safety program will be developed and implemented for the facility that will address

routine and non-routine activities and procedures to minimize potential chemical exposures and safety incidents. This program will provide the basis for compliance with all workplace standards and guidelines.

Modifications and Decommissioning

Potential adverse effects addressed for the construction phase of the Project are relevant for the decommissioning phase as well.

5.1.22.2 Mitigation Measures and Monitoring

Construction

Mitigation for human health and safety during construction involves the preparation and implementation of several plans, including:

- dust control plan;
- worker health and safety plan;
- erosion control plan; and
- EPP including spill prevention and emergency response (clean up) plan.

Further mapping will be undertaken to delineate the extent and location of old mines. For mitigation on air emissions refer to Section 5.1.6.2. Potential airborne transport of tailings should be minimized.

Mitigation for water and waste management control will include:

- Implementation of a Spill Control Plan;
- Water effluent treatment;
- Development of an Emergency Response Plan;
- Prevention of run-off and transport of mined soils; and
- Control of run-off and potential migration of impacted soils.

Operation and Maintenance

The mitigation for human health and safety during the LNG facility construction phase is relevant for the operation phase and includes the preparation and implementation of a spill prevention and emergency response (clean up) plan.

Modifications and Decommissioning

Mitigation for human health and safety during the decommissioning of the LNG facility includes the preparation and implementation of a dust control plan and spill prevention and emergency response (clean up) plan. In addition, the cover over areas containing mine tailings should be retained to prevent re-suspension if affected by the modification/decommissioning work.

5.1.22.3 Residual Effects

Table 5.1-9 summarizes the relevant criteria for chemicals that might be spilled or released during construction, operation, or decommissioning. Anticipated concentrations exceeding criteria shown in this Table have been considered a significant adverse effect.

Criteria are not shown in Table 5.1-9 to address worker health and safety. A preventative health and safety program will be implemented for construction, operation, and decommissioning that ensures that the public and workers are not adversely affected during routine operations, and that contingency plans are in place to prevent impacts during accidents, malfunctions, and unplanned events.

Provided the proposed mitigative measures are implemented, the environmental effects will:

- be low in magnitude;
- occur within the KDP area, Betty's Cove, or Dung Cove;
- be reversible; and
- will be intermittent and short term.

Therefore, the significance of the environmental effects is expected to be not significant (see Table 6.1-21).

5.1.22.4 Follow Up

No follow up monitoring is anticipated.

5.1.23 Fisheries

5.1.23.1 Environmental Effects Prediction

Commercial fishing is an important economic activity that occurs within the marine environment of Stormont Bay. Commercial fishing occurs almost entirely outside of the estuaries of Country Harbour and Isaac's Harbour. Recreational fisheries in the area are small but diverse, and include both freshwater and estuarine components. Brook trout are the primary recreational species. They are fished both in many of the lakes, rivers and streams that flow into Stormont Bay and in the inner parts of the estuary. Smelt are often fished recreationally under the ice in the upper estuaries. Commercial lobster fishing is the only harvesting that occurs in close proximity to the Project.

Information on harvesting was obtained primarily through discussion with local residents. Background information was also provided by the Guysborough County Coastal Resources Mapping Project. Numerous consultation meetings with the commercial fishers who fish within Stormont Bay were held by Keltic and Project consultants. A traditional Aboriginal fishery for urchin was also identified in Section 5.1.17.

Construction

Freshwater

Betty's Cove Brook and the unnamed tributary to Dung Cove could support local recreational fisheries, which may be effected by water quality/quantity effects described in Section 5.1.2 due to storm water runoff during construction. Accidental spills of contaminants could also harm local fisheries. Potential effects and mitigation for accidental events are presented in Section 10.0.

Marine

Local fishers have expressed concern about disruption to their traditional fishing activities from construction and operation of the Project. Marine impacts of construction will be concentrated in the wharf and terminal areas, either as a result of construction or facilities equipment being transported to the site, or actual construction of the wharf and terminal.

The magnitude of construction impacts will be related to the seasonal timing of activities. Impacts will be greater if activities occur during the relevant fishing seasons, particularly the lobster fishing season, which runs from April 19 to June 20. Little fishing activity takes place in the central deep water part of the bay where the larger LNG and cargo vessels will be transitting.

For a significant impact on fishing activity to occur, the earnings from the fishery would need to be affected as a result of decreased catch quantity and/or quality, or increased costs of fishing from longer travel times or similar issues. The overall productivity of the bay and the associated amount of lobster habitat are important factors determining the potential quantity and quality of the catch and thus monetary return to local fishers.

The fishery may be affected because of the attraction of fish to lighting from construction activities.

In the event that the construction of the LNG Marine Terminal will result in the loss of fish habitat, DFO will require replacement of the area of fish habitat lost with habitat of similar or higher type and quality. Potential compensation areas in Fisherman's Harbour has been identified (see Appendix 5) where a habitat augmentation project could provide several times more lobster habitat of similar in quality to that lost to construction. Keltic will continue consultations with local recreational fisheries groups and municipalities to refine compensation plans. Additional details for proposed Habitat-Compensation Plans are being prepared separately from this CSR process and as part of Keltic's Application to DFO for Authorization.

Adverse effects to fisheries are also possible due to the degradation of the marine environment through freshwater quality effects described in Section 5.1.2. Accidental spills of contaminants could also harm local fisheries. Potential effects and mitigation for accidental events are presented in Section 10.0.

Operation and Maintenance

Potential interaction will be similar to construction.

Modifications and Decommissioning

Potential interaction will be similar to construction. No significant effects are expected.

5.1.23.2 Mitigation Measures and Monitoring

The effects of the LNG Marine Terminal construction and operation will be mitigated by the development of a compensation plan for local fishers who hold licences for that area.

A compensation policy for fishing equipment damaged by the KDP's construction phase will also be developed and implemented. This compensation policy will follow the Canada – Nova Scotia and Canada – Newfoundland Offshore Petroleum Board document: Compensation Guidelines Respecting Damages Relating to Offshore Petroleum Activity. As requested in the NSEL Terms and Conditions, a monitoring program for site runoff will also be developed.

Provided the following mitigative measures are implemented the potential lighting effects on fish should be insignificant:

- no unnecessary lighting will be used, especially on structures taller than 15 m, and use fast-blinking strobes if possible;
- area lighting will be angled directly at work areas and shielded where possible; and
- implementation of a Lighting Plan.

A Potential Effects Analysis should be developed, including consultation with marine fisheries authorities and the local fishing community and advance notice of ship arrivals will be provided to fishers.

No potential adverse effects have been identified for decommissioning of the LNG facility, therefore mitigation is not necessary.

5.1.23.3 Residual Effects

Provided mitigation is implemented as described above, no potential adverse effects are expected. The effects will be low in magnitude. Therefore, residual effects of the Project during all Project phases have been determined not significant.

5.1.23.4 Follow Up

Follow up monitoring presented in Section 5.1.2.4 will detect any unpredicted adverse effects.

5.1.24 Aquaculture

5.1.24.1 Environmental Effects Prediction

There is no direct interaction between the LNG facilities and local aquaculture. The only effects to aquaculture would be the accidental release of contaminants to the marine environment. Potential effects and mitigation for accidental events and malfunctions is described in Section 10.0.

5.1.24.2 Mitigation Measures and Monitoring

In accordance with Item 3.4 of the NSEL EA approval conditions, a proposed aquaculture compensation plan will be developed to be implemented in the event that any KDP related adverse effects on aquaculture are detected.

5.1.24.3 Residual Effects

No residual effects are expected.

5.1.24.4 Follow Up

No follow up monitoring is required.

5.1.25 Tourism

5.1.25.1 Environmental Effects Prediction

The Guysborough County Heritage Association works to promote tourism, heritage, and culture in the region. One of the prime assets of the Eastern Shore tourism sector is its natural beauty. However, the sector also suffers from lack of accessibility which leads to reduced tourism flows and limited services for tourists.

The Project may have adverse effects on tourism near the Project Site due to the inevitable change of the visual landscape character.

Construction

Tourism may be impacted during construction in the short term due to potential highway detours and truck access to the site as well as possible lane closures during construction near Highway 316.

Operation and Maintenance

Although, some components of the proposed development will be hidden from views along the highway, the new facility will be clearly visible and change the local visual character of the landscape from a rural, mostly natural setting to a landscape with industrial development. This is likely to affect outdoor-oriented tourism in the immediate vicinity of the Project Site.

The increased economic activity in the area caused by the new facility will bring about improvements in accommodations and food services, other personal services, and retail trade. The Eastern Shore has a limited supply of these services. Their expansion will make the general area more attractive to tourists and provide the potential for tourism related economic growth.

The Guysborough County Heritage Association is currently developing a marketing strategy that includes a website, brochures, and signage, to increase the profile of the region and highlight its heritage resources. Currently, most visitors are likely to just pass through the area due to a lack of infrastructure.

There are potential adverse effects to the visual character of the landscape due to the construction of the facilities.

Modifications and Decommissioning

No environmental effects on tourism are expected during the decommissioning of the LNG facility.

5.1.25.2 Mitigation Measures and Monitoring

Construction

Dust suppressants and regular road cleaning protocols will be applied as required to reduce the loss of the natural landscape character. Also, during initial site clearing, the tree and shrub buffer along the site perimeter will be maintained as a visual screen. Road access will also be designed to minimize views into the construction site.

Operation and Maintenance

Tree and shrub planting as visual screens along the site perimeter and Marine Drive will be implemented near the Project. Colour schemes that support background blending will also be utilized for stacks and higher buildings. Road access will be jogged to prevent clear views of the facility and roadways will be cleaned regularly. A Dust Management Plan, ESC Plan, and Surface Water Monitoring Program will be implemented.

Modifications and Decommissioning

During decommissioning and modifications, the interpretive centre will be used to keep the public informed of current activities.

5.1.25.3 Residual Effects

The Project is not expected to have significant adverse effects on tourism near the Project Site. It is unlikely that the Project will have a significant effect on tourism over the long term and on a regional scale. It has been seen with other large scale developments in rural areas with little tourism-related infrastructure, the effects may be beneficial to the tourism.

Construction

During construction, the Project is expected to have no significant adverse effects on tourism near the Project Site.

Operation and Maintenance

During operation and maintenance, no significant adverse residual effects on tourism are likely to occur.

Modifications and Decommissioning

During modifications and decommissioning, no significant adverse residual effects on tourism are likely to occur.

5.1.25.4 Follow Up

No follow up monitoring is anticipated.

5.2 ENVIRONMENTAL EFFECTS OF THE MARGINAL WHARF

5.2.1 Hydrology

There are no environmental effects on hydrology for this Project component as it is marine and intertidal in nature.

5.2.2 Freshwater Quality/Quantity

5.2.2.1 Environmental Effects Prediction

Construction

The construction of the marginal wharf on the Red Head peninsula will result in the filling in of two brackish ponds. The potential effects and mitigation are discussed in Section 5.2.14. The portion of the unnamed tributary to Dung Cove will be avoided. The potential effects to it are discussed in Section 5.1.2.1.

Operation and Maintenance

There are no environmental effects on freshwater quality/quantity for this Project component as it is marine and intertidal in nature.

Modifications and Decommissioning

The potential effects to freshwater quality/quantity during the decommissioning of the LNG facility are applicable for decommissioning of the marginal wharf.

5.2.2.2 Mitigation Measures and Monitoring

The mitigation presented in Section 5.1.2.2 is considered to be sufficient for construction, operation, and decommissioning of the marginal wharf.

5.2.2.3 Residual Effects

With the implementation of the mitigation measures provided in Section 5.1.2.2, the magnitude of the environmental effects from potential sedimentation will be low and the geographic extent will be a small local water course adjacent to the Marginal Wharf. The duration of the effect will be short term and restricted to only storm events. Also, the effect from sedimentation is

expected to be reversible. Therefore, no significant adverse residual effects are likely to occur during any of the Marginal Wharf Project phases.

5.2.2.4 Follow Up

The follow up presented in Section 5.1.2.4 is considered to be sufficient for construction, operation, and decommissioning of the marginal wharf. Other monitoring for mitigation measures are presented in Section 5.1.2.2.

5.2.3 Groundwater Quality/Quantity

5.2.3.1 Environmental Effects Prediction

There are no environmental effects on groundwater quality/quantity for this Project component as it is marine and intertidal in nature.

5.2.4 Marine Water Quality

5.2.4.1 Environmental Effects Prediction

The construction, operation and decommissioning of the marginal wharf may cause impacts to marine water quality.

The water quality may be impacted by the re-suspension of contaminated sediments through construction activities and propeller wash from large vessels. Additional potential impacts would be the result of fuel spills from construction vehicles or marine vessels or the release of contaminants from the operation of the facility. The effects and mitigation for accidents and malfunctions is discussed more thoroughly in Section 10.0.

The effects of suspended sediments during construction, operation, and decommissioning are addressed in Section 5.2.5.

5.2.4.2 Mitigation Measures and Monitoring

As per the Provincial EA Report commitments, silt screens, curtains, and containment booms surrounding the construction area will be utilized to reduce the potential siltation/sediment loading impacting fish populations (especially sensitive species that may frequent the area) and benthic communities. Construction techniques will be designed to minimize the disturbance of sediment and the use of appropriate erosion and sediment control measures will be implemented to also minimize the disturbance of sediment. See Section 10.0 for mitigation measures for accidents and malfunctions, and Section 5.2.5 for more mitigation measures for suspended sediments. In accordance with Item 1.5 in the NSEL EA approval conditions (NSEL, 2007), a plan to mitigate the human health and environmental impacts of the contaminated mine tailings and/or soils and sediments on the Project Site, via remediation or risk management will be developed and implemented. This plan will be consistent with the Nova Scotia Guidelines for the Management of Contaminated Sites. The Remedial Action Plan and/or Risk Management Plan will be approved by NSEL prior to commencement of construction. Upon completion of the remediation or risk management work, including any required monitoring, Keltic will submit a

Certificate of Compliance to NSEL to demonstrate that the remediation work has been completed and/or the Risk Management Plan is effective (NSEL, 2007).

Large vessels will be berthed with the support of tugs to prevent the re-suspension of contaminated sediments. Vessels will operate with adherence to International Convention for the Prevention of Pollution from Ships (MARPOL) as outlined in Section 10.0.

Mitigation for marine water quality will include visual monitoring for turbidity which will then require the collection of water sampling for the measurement of sediment levels. If sediment levels exceed CCME limits as a result of construction or infill activities, the work will be stopped and DFO / NSEL will be contacted. Materials used for infill will be free of excessive fines, clean, non-toxic and from a non-ore bearing source. If any construction debris/material enters the marine environment it will be removed immediately and disposed of in a provincially approved manner. Any equipment that has been in the marine environment will be cleaned of any sediments, plants, or animals and washed with freshwater and/or sprayed with undiluted vinegar prior to being mobilized to the Project Site. All construction waste material (including excavated soil and creosote timber waste) will be disposed of in a provincially approved manner. Careful maintenance and monitoring of all equipment will be carried out to minimize the risk of spills or leaks of petroleum based products.

Equipment refuelling operations will take place at least 30 m from any watercourse and as well as Stormont Bay harbour and the refuelling will take place on a prepared impermeable surface with a collection system with the exception of marine equipment. All equipment to be used in or over the marine environment is to be free from leaks or coating of hydrocarbon-based fluids and/or lubricants that are harmful to the environment. Hoses and tanks will also be inspected on a regular basis to prevent fractures and breaks.

Contaminated material will not be placed in a non-contained area. All debris and leachates (films on water surface) will be contained within the area of the work by using containment devices such as floating booms or screens.

The following protection procedures are intended to minimize the potential effect of accidental releases and the cleaning of concrete pouring equipment in the terrestrial and/or marine environment:

- any accidental release of concrete will be removed prior to solidification;
- concrete trucks will be clean and will not release any material during transport to the site;
- wash water from the cleaning of concrete trucks will be discharged either at the concrete manufacturer's place of business or to a designated area off-site;
- all such discharges will be of minimal volume and will not occur within the buffer zone of a watercourse/wetland or other environmentally sensitive area;
- miscellaneous concrete equipment will be washed and cleaned at an approved location off-site.
- residual concrete, including concrete resulting from cleaning of concrete pumping systems/equipment and rejected concrete batches, will be disposed of at concrete collection facilities;

- concrete handling will be conducted under the WHMIS program, whereby only trained personnel handle the concrete and only in accordance with manufacturer's instructions and government regulations; and
- all employees responsible for the handling of concrete will be appropriately trained.

5.2.4.3 Residual Effects

Provided the proposed mitigation measures are implemented as suggested in Sections 10.0 and 5.2.5, all environmental effects on marine water quality are expected to be reversible and of low magnitude. Therefore, any residual environmental effects on marine water quality are likely not significant.

5.2.4.4 Follow Up

As per the Provincial EA Report commitments, turbidity will be monitored during construction of the marginal wharf and will continue 2 to 3 days after construction is complete.

5.2.5 Soil/Sediment Quality (terrestrial and marine)

5.2.5.1 Environmental Effects Prediction

Construction of the marginal wharf may impact both terrestrial and marine soil quality. The potential adverse effects, mitigation, residual effects, and follow up for terrestrial soil quality have been presented in Section 5.1.5 and are relevant here. The potential impacts for marine sediments will be covered in this section.

Construction

The marginal wharf will be constructed from pre-cast concrete caissons, placed on a granular stone mattress then positioned on the seabed. Construction of the marginal wharf will involve enclosing the future wharf area with concrete caissons or sheet piling, followed by filling the interior with aggregate to provide a structure capable of holding heavy large storage silos and other equipment. The construction procedure will prevent sediment escape from the interior of the wharf infill area. Propeller wash from vessels could potentially disturb sediments in and around the wharf and terminal. As per Condition 1.10 of the NSEL EA sediment modelling to predict the assimilative capacity of all receiving environments will be conducted.

Marine sediment may be impacted by the introduction of contaminants in runoff as a result of accidental spills and malfunctions. This has been addressed in Section 10.0.

Operation and Maintenance

Propeller wash from vessels could potentially disturb sediments in and around the wharf and terminal.

Marine sediment may be impacted by the introduction of contaminants in runoff as a result of accidental spills and malfunctions. This has been addressed in Section 10.0.

Modifications and Decommissioning

Potential effects to soil and/or sediment quality due to the decommissioning of the marginal wharf include the re-suspension of contaminants from marine sediment and the introduction of contaminants in runoff as a result of accidental spills and malfunctions.

5.2.5.2 Mitigation Measures and Monitoring

Construction

To mitigate possible re-suspension of sediment during construction of the marginal wharf concrete caissons or sheet piling will be put in place followed by filling the interior with aggregate to provide a structure capable of holding heavy large storage silos and other equipment. The construction procedure will prevent sediment escape from the interior of the wharf infill area. Silt curtains and booms will also be used during construction to minimize siltation in the marine environment.

Tugs will be used to manoeuvre and dock large vessels, minimizing the potential impact of propeller wash. As a result, no impact from sediment contamination is anticipated.

Also, in accordance with Item 1.10 in the NSEL EA approval conditions, baseline data collection for all relevant chemical parameters which are expected to enter the environment or be remobilized as a result of Project activities in all receiving environments will be collected. Assimilative capacity of all receiving environments for all relevant chemical parameters will then be predicted (NSEL, 2007).

Mitigation for spills from potential accidents and malfunctions is covered in Section 10.0.

Operation and Maintenance

Tugs will be used to manoeuvre and dock large vessels, minimizing the potential impact of propeller wash. As a result, no impact from sediment contamination is anticipated.

Modifications and Decommissioning

Mitigation measures presented for the construction phase are sufficient for modifications and the decommissioning phase as well.

5.2.5.3 Residual Effects

Construction

The low probability of contaminants occurring in the marine construction area, coupled with the proposed construction methods, will ensure no heavy metal contamination results from the construction of the marginal wharf. Therefore, no significant adverse residual environmental effects on soil and sediment quality are likely to occur.

Operation and Maintenance

Provided the proposed mitigative measures are implemented as suggested, the environmental effects due to re-suspension of contaminated sediments from propeller wash and accidental spills from vessels will be low in magnitude and reversible. Therefore, no significant adverse residual environmental effects on soil and sediment quality are expected.

Modifications and Decommissioning

See "Construction" above.

5.2.5.4 Follow Up

No follow up monitoring is anticipated.

5.2.6 Air Quality

Air quality was originally conducted for the purpose of the provincial EA Report (AMEC, 2006) and included all KDP components as well as the petrochemical and co-generation facilities. Therefore, the case presented for air quality is for the worst case scenario as additional facilities outside of the scope of this document are included in the modelled numbers. Please refer to Section 5.1.6 for details on the effects of air quality for the KDP.

As mentioned in Section 5.1.6.1, potential emissions from cargo vessels which will be tied up at the Marginal wharf were not included in the modeling assessment as the size, configuration and fuel types were not known. However, an additional air dispersion modelling analysis will be done in accordance with the NSEL Terms and Conditions for Environmental Assessment Approval. This analysis will include potential emissions from cargo vessels at the Marginal Wharf.

5.2.7 Climate Conditions

Climate conditions and climate change are discussed in the context of air quality, please refer to Section 5.1.6.

5.2.8 Vegetation (terrestrial and marine)

5.2.8.1 Environmental Effects Prediction

Construction

The marine habitat in the vicinity of the proposed marginal wharf facilities is predominantly rock and kelp with patches of eelgrass and sand. This habitat is of most value to lobster, the principal commercial species fished in the area, however the area that will be lost has not been identified as limiting or critical habitat. In addition, contaminated sediments could be re-suspended and re-distributed during construction of the marginal wharf.

Terrestrial vegetation on the Red Head Peninsula will be lost as a result of the marginal wharf construction. A more complete discussion of the effects, mitigation and residual effects to terrestrial vegetation can be found in Section 5.1.8.

Several wetlands may receive impacts from construction of the marginal wharf. Site construction may result in filling, excavating, and otherwise disturbing wetlands, which in addition to unique habitat loss may alter the hydrological integrity of the site. A more complete discussion of the effects, mitigation and residual effects to wetlands can be found in Section 5.2.14.

Operation and Maintenance

Contaminated sediments could be re-suspended and re-distributed by propeller wash from LNG tankers or supply ships docking at the marginal wharf. There is also an opportunity for invasive aquatic species to be introduced via ballast water from these vessels.

Modifications and Decommissioning

Adverse effects to vegetation during the decommissioning phase include potential for the accidental release of contaminants to the environment.

5.2.8.2 Mitigation Measures and Monitoring

Construction

Construction of the marginal wharf will not include dredging and will begin by enclosing the future wharf area with concrete caissons or sheet piling, followed by filling the interior with aggregate. This procedure will prevent sediment escape from the interior of the wharf infill area. In addition, silt curtains and booms will be used during construction to minimize siltation in the marine environment.

No sediment contamination was identified in the area of the marginal wharf. Large vessels, however, will be berthed with support of tugs in order to minimize the effect of propeller wash.

Marine vegetation can be expected to establish itself on the marginal wharf following construction and FHCP will provide some habitat for the establishment of marine plants (Appendix 5).

Operation and Maintenance

Mitigation measures will be used to prevent the spread of invasive and non-native species within the marine environment. LNG vessels will be brought in fully loaded and re-ballasted offshore. Keltic will adhere to the Ballast Water Control and Management Regulations.

No sediment contamination was identified in the area of the marginal wharf. Large vessels, however, will be berthed with support of tugs in order to minimize the effect of propeller wash.

Modifications and Decommissioning

Mitigation presented for the construction phase is sufficient for the decommissioning phase as well.

5.2.8.3 Residual Effects

Provided the proposed mitigative measures are implemented, the magnitude of the Marginal Wharf Project effects on vegetation will be low (See Table 6.2-5, Section 6.0). Therefore, no significant adverse residual environmental effects on vegetation are likely to occur.

5.2.8.4 Follow Up

Construction

Monitoring of the Fish Habitat Compensation will be done to determine the success of the new habitat

Operation and Maintenance

A vegetation monitoring program will be established to check the success of replanting and habitat restoration programs, where applicable. These will be done at least twice per year in late May-early June and again in late August, as required. Appropriate restorative plantings will be done shortly after these inspections.

Modifications and Decommissioning

No vegetation monitoring programs have been developed at this time.

5.2.9 Species at Risk

5.2.9.1 Environmental Effects Prediction

Construction

There is potential for the construction of the marginal wharf to effect the foraging of roseate tern individuals. Although no foraging sites are known to be located within or adjacent to the marginal wharf location, one individual roseate tern was observed flying near the shore of the south terminal area. The closest documented foraging site is located approximately 2 km from the Marginal Wharf Project Site, on the shore of Harbour Island. The Roseate Tern Recovery Plan (Environment Canada, 2006) identifies the need for further research on foraging habit and indicates that foraging habitat may be considered as “critical habitat” in the future.

Construction of the marginal wharf will be short term (approximately 15 months).

Adverse effects to species at risk during the construction phase include potential for the accidental release of contaminants to the environment. Mitigation for accidental events is presented in Section 10.0.

Operation and Maintenance

There are potential adverse effects to the roseate tern nesting habitat on Country Island, including foraging. The colony could be affected by ship deliveries, ship lights, and from bilge water or accidental spill of fuel or other contaminants from vessels. Booms and other spill prevention and clean-up equipment will be maintained at the wharf facilities to ensure minor spills do not impact the local environment. Mitigation for accidental events is presented in Section 10.0.

Modifications and Decommissioning

Adverse effects to species at risk during the decommissioning phase include potential for the accidental release of contaminants to the environment. Mitigation for accidental events is presented in Section 10.0.

5.2.9.2 Mitigation Measures and Monitoring

Construction

Keltic personnel will be trained in identifying the roseate tern and will report any occurrences of the species in the marginal wharf area during construction to the CWS. Information on the bird's activities such as flying, diving, swimming, etc will be documented and provided.

As a component of NSEL Condition 2.7, the Proponent is committed to prepare an Adaptive Management Plan (AMP), consisting of various elements acceptable to EC and NSDNR, as well as a spill response plan. To address concerns with potential impacts to foraging Roseate Terns in Stormont Bay, it is expected that the AMP will include coordination with multiple stakeholders to monitor and manage potential cumulative effects on the Roseate Tern.

Mitigation relevant to accidents and malfunctions has been provided in Section 10.0.

Operation and Maintenance

To mitigate potential effects shipping lanes will be established so no ships will approach within 200 m of Country Island (as per the Roseate Tern Recovery Strategy) as well as establishment and adherence to MARPOL.

Mitigation relevant to accidents and malfunctions has been provided in Section 10.0.

Modifications and Decommissioning

Mitigation relevant to accidents and malfunctions has been provided in Section 10.0.

5.2.9.3 Residual Effects

Construction

No significant adverse residual environmental effects on roseate tern are likely to occur. The environmental effects will be low in magnitude, temporary, and reversible (See Table 6.2-6, Section 6.0).

Operation and Maintenance

No residual effects are anticipated since the environmental effects are low in magnitude and are reversible.

Modifications and Decommissioning

No residual effects are anticipated.

5.2.9.4 Follow Up

As outlined in the NSEL Terms and Conditions for Environmental Approval, under Condition 2.7, a project wildlife monitoring program will be developed in consultation with NSDNR and CWS. An AMP for the Roseate Tern will be prepared and implemented as per Section 5.2.9.2.

5.2.10 Fish and Fish Habitat (marine and freshwater)

5.2.10.1 Environmental Effects Prediction

The potential adverse effects, mitigation, and residual effects to fish habitat as a result of contaminated sediment are discussed in Section 5.2.5. The FHCP (Appendix 5) details the potential effects on the fish habitat to be altered or destroyed.

Construction

Freshwater

No freshwater areas are anticipated to be impacted as a result of the proposed Project; however, the construction of the marginal wharf on the Red Head peninsula will result in the filling in of Ponds 4 and 5 at that site (Figure 4.1-5). These ponds both have brackish water and are less than 1 ha in total area. Given the size of the ponds and that they are isolated and only provide habitat for forage fish, destruction of the ponds does not represent a significant impact to fish habitat. Fish habitat compensation will be determined through a *Fisheries Act* authorization.

Marine

The marine habitat of Stormont Bay supports a typical range of marine and estuarine species (i.e. fish, shellfish, marine mammals, and coastal and seabirds), and provides a migratory path for some fish, such as Atlantic salmon and sea-run trout. Lobster is by far the most important

species in terms of economic value within the Bay, and thus the emphasis in assessing impacts has been placed on this species.

The marginal wharf will result in loss of fish habitat measuring approximately 210,000 m^2. A permitting process (HADD) through DFO is required to authorize this loss.

The marginal wharf has the potential to affect wave action and currents around the facilities which influence sediment distribution, particularly the marginal wharf. The information contained in the Country Harbour Report was used to design the jetty and the trestle and will be used to finalize wharf design as FEED progresses.

A general assessment of these potential impacts was carried out. In summary, currents in the vicinity of the marginal wharf will be affected by the presence of the wharf. The increased strength of currents adjacent to the face of the wharf is anticipated to increase by between 10 and 20 per cent. Increased current strength near the face of the wharf will tend to create more scour and may result in the movement of material, with more movement of finer-grained sediments. The effect of the local wave climate will be to lessen the potential for sediment transport north in the lee of the wharf but increase it to the west and south due to reflected wave energy. The existing shoreline is composed primarily of coarse cobble-sized rock pushed shoreward during storms. Sand and finer materials are only available in relatively small depressions near the wharf. Overall, relatively minor changes in sediment texture and thus fish habitat are anticipated following wharf construction.

Detailed oceanographic modelling and the impact on shorelines in the area will be conducted as part of the FEED to confirm the configuration of the wharf and jetty. Any sediment movement identified during this modelling stage will be addressed through Project design and/or mitigation.

The habitat in the vicinity of the proposed Keltic facilities comprises three basic types: rock and kelp; eelgrass and sand; and sand and mud. Based on video transects, the area to be occupied by the wharf is predominantly rock and kelp with patches of eelgrass and sand. Sand and mud bottom are primarily associated with deeper water (>12 m) where the proposed LNG Marine Terminal is to be located. This habitat is of most value to lobster and sea urchins, two species that are fished in the area. Lobster is the principal commercial species fished in the area.

Environmental effects of the marginal wharf on macrobenthos habitat and communities will occur during the construction phase. Physical destruction and alteration, of the seabed will occur as a result of the marginal wharf concrete caissons placed on the substrate. These activities will displace a limited number of benthic organisms that are considered typical in the area. These species are listed in Section 4.2.2.1.

Past surveys have shown that the area of fish habitat in the eastern part of Stormont Bay is relatively consistent between the proposed Keltic facilities and Harbour Island – a mix of rock, boulder, kelp, and patches of sand. In deeper areas, outside Country Harbour Head and past Harbour Island, habitat is patchier, related primarily to water depth and substrate.

Approximately 60% of the wharf area is typical of lobster habitat, representing approximately 1.6% of the lobster habitat within Stormont Bay. If lobster habitat within the approaches to Stormont Bay is also considered, the percent lost to construction of the wharf drops to 0.45%.

Factors that most influence lobster productivity is habitat and food supply (Cobb et al., 1999). The type of fish habitat preferred by lobster, however, changes with the age of the animal.

Post-larval lobsters live in burrows until they reach about 25 mm carapace length (CL). For lobsters between 25-50 mm CL a coarse substrate and a suitable amount of cover is necessary. Lobsters with a CL of >50 mm prefer areas with algae, stones, and large crevices. Some larger lobsters have been observed on compact sand or mud bottoms consolidated by eelgrass. All sizes of lobster have been observed co-existing in areas with large stone size and heavy algal cover. Sand covered in eelgrass had a low abundance of juveniles and adults, while on bare sand bottoms no resident lobsters were observed (National Oceanographic and Atmospheric Association, 1994).

Post-larval lobsters spend a few years "in self-dug tunnels or in the natural crevices under cobble" (Harding, 1992). Post-larvae, in their burrows, feed on plankton and may also prey on small benthic organisms. This habitat provides shelter from potential predators when the post-larval lobsters are still small and quite vulnerable. This part of the life cycle is critical to recruitment to the fishery, and the amount of post-larvae that settle in an area is directly proportional to the number of fishery recruits to that area (Miller, 1997). At the same time, the numbers of post-larvae that settle in an area is an overriding factor in determining an area's productivity.

The nearshore migration of a small number of searun trout and Atlantic salmon may be affected by the construction of the wharf.

Operation and Maintenance

Freshwater

As discussed in Section 5.1.2, at the Project Site, all wastewater will be collected and treated to applicable government standards and objectives prior to discharge to the environment. The discharge quality will be monitored in order to verify the effectiveness of the treatment. Adverse effects on aquatic species and habitat during the operation phase are not expected to be significant.

Marine

The operation of the Marginal Wharf Project facilities will involve arrival, loading or unloading of cargo, and departure of cargo vessels. Anticipated traffic is perhaps as many as three traditional cargo vessels. Booms and other spill prevention and clean-up equipment will be maintained at the wharf facilities to ensure minor spills do not impact the local environment, including fish habitat. Thus, no ongoing impacts on fish habitat are anticipated.

Modifications and Decommissioning

Decommissioning activities may increase the turbidity in both the freshwater and marine environments. The potential also exists for the accidental release of contaminants into these environments.

5.2.10.2 Mitigation Measures and Monitoring

Construction

Freshwater

No impacts are anticipated to freshwater areas as part of the proposed Project, however, construction of the marginal wharf and LNG Marine Terminal on Red Head Peninsula will result in the loss of two brackish ponds and their associated habitat and fish community. These losses will be separately addressed in the FHCP which will be submitted to DFO as part of Keltic's Application for Authorization, a draft of which is presented in Appendix 5 of this CSR. The FHCP will be completed in accordance with DFOs hierarchy of compensation options and the "no net loss" of habitat objective. In addition, the following mitigative measures should be followed:

- conduct in-water works during non-critical periods;
- restore substrates;
- use suitable backfill materials; and
- implement effective erosion control measures.

Marine

The construction of the Marginal Wharf Project will result in some losses and alterations of fish and aquatic habitat that cannot be avoided. In accordance with the requirements of the *Fisheries Act* and relevant policies of the DFO, Keltic will be required to compensate for these losses/alterations to the satisfaction of DFO so as to achieve "no net loss" of fish habitat. Information on fish habitat was collected by ROV survey and submitted to DFO as part of this permitting process, along with an assessment of the role of this habitat to fish production, primarily lobster. Under the HADD process, compensation for loss of productive habitat is required, and information on a potential compensation projects were also submitted to DFO. The proposed mitigation and compensation plans are addressed in the FHCP. These assessments indicated that it should be possible to augment fish habitat in the vicinity of Stormont Bay to more than replace any loss of habitat due to the facilities. Keltic will continue consultations with local recreational fisheries groups and municipalities to refine marine compensation plans. Options for proposed FHCPs are presented in Appendix 5.

Essentially all of the mitigative actions described in Section 5.1.2 and 5.1.4 are also valid for the protection of marine species and their habitats, so the reader is referred to this section. In addition, readers should refer to the following two sections relating to impacts on marine species and habitat (more specifically the impacts of accidental spills on marine environments):

- Section 5.1.5 Mine Workings; and
- Section 10.0 Hazardous Material Spills.

Existing habitat could be adversely affected by sediment from construction, disturbance of heavy metals in sediment, or accidental spills. Mitigation of these effects includes the use of construction techniques designed to minimize the disturbance of sediment in the marine environment. Sediments in the vicinity of the proposed wharf do not have concentrations of

contaminants to be of concern. Mitigation related to sediment and spill control will include standard measures such as the use of a boom and silt curtain around the construction area to contain any accidental spills or minor sediment plumes.

Once the wharf and terminal design has been finalized, modeling will be carried out in more detail to assess potential changes in substrate and a monitoring program will be developed if required. For mitigation measures for the possible effects from the Marginal Wharf infill, readers should also refer to Section 5.1.4.2 and Table 10.9-1 from the Provincial EA Report (AMEC, 2006).

Operation and Maintenance

Freshwater

Contingency and remediation measures will be in place in case accidental spill events occur that have the potential to damage freshwater aquatic habitat. This includes measures applicable to the operational phase of the LNG Unloading Facilities. Spill prevention and clean-up equipment will be maintained at the wharf facilities to ensure minor spills do not impact the local environment, including fish habitat. Additional mitigation for freshwater quality is presented in Section 5.2.2.

Marine

The operation of the Marginal Wharf Project will not result in routine emissions which will impact fish habitat. Equipment will be maintained on-site to handle small accidental spills, and a boom will be deployed around vessels actively loading or unloading hydrocarbons or other noxious material. Arrangements will be made with appropriate responder organizations to assist in the event of a large spill (see also discussions in Section 10.0).

Modifications and Decommissioning

Mitigative measures presented for the construction phase are sufficient for the decommissioning phase as well.

5.2.10.3 Residual Effects

Construction

It is unlikely that the nearshore migration effects on searun trout and Atlantic salmon will be significant for either of these species since the remaining channel area will be very large and these fish tend to move relatively slowly upstream during the period of adjustment from saltwater to freshwater, generally moving towards a river mouth with tidal flows.

The amount of fish habitat lost as a result of construction of marine facilities, between 0.45 and 1.6%, will be replaced through the fish habitat compensation project required by DFO.

Provided the proposed mitigative measures are implemented, no significant adverse residual environmental effects on fish and fish habitat in both freshwater and marine environments are likely to occur.

Operation and Maintenance

Provided the proposed mitigative measures are implemented, the environmental effects are expected to be low in magnitude and reversible. The geographic extent of the effect is the entrance to Isaac's Harbour and Stormont Bay. Therefore, no significant adverse residual environmental effects on fish and fish habitat in both freshwater and marine environments are likely to occur (See Table 6.2-7, Section 6.0).

Modifications and Decommissioning

Provided the proposed mitigative measures are implemented, no significant adverse residual environmental effects on fish and fish habitat in both freshwater and marine environments are likely to occur since the environmental effects are expected to be temporary, reversible, and low in magnitude.

5.2.10.4 Follow Up

Construction

Freshwater

The monitoring programs planned for the construction period for freshwater fish and fish habitats are:

- survey fish communities in the unnamed tributary to Dung Cove by electrofishing and by trap netting in Dung Cove Pond;
- inspect/monitor sediment/erosion control measures at each on-site watercourse;
- annual fish community surveys (electro-fishing) in the unnamed tributary to Dung Cove Pond and annual trap-net surveys in Dung Cove Pond throughout construction period;
- annual description/photographs of aquatic and riparian habitat at established representative locations on all on-site watercourses and in Dung Cove Pond; and
- prepare annual reports to present results of the erosion-control monitoring and the annual fish surveys, and compare results (species presence, composition, etc) with previous years.

Marine

Monitoring of the habitat compensation project will be conducted in order to determine the success of the compensation project in relation to habitat production. Monitoring details will be developed in consultation with DFO and finalized once a Project has been accepted.

Operation and Maintenance

Freshwater

The monitoring programs to ensure the mitigation measures are effective for the construction period for freshwater fish and fish habitat are:

- Fish-community surveys in all on-site watercourses and the large Red Head pond for post-construction years 1, 2, 3 and 5, and every 5 years thereafter, if required.
- Describe/photograph aquatic/riparian habitat at established representative locations on all on-site watercourses and in Dung Cove Pond for post-construction years 1, 2, 3 and 5, and every 5 years thereafter.
- Prepare reports on results of the annual habitat and fish surveys and compare results (species presence, composition, etc) to previous years.

Marine

The monitoring program described for the construction phase will apply to the operational phase as well.

Modifications and Decommissioning

No follow up monitoring plans have been developed at this time.

5.2.11 Marine Mammals

5.2.11.1 Environmental Effects Prediction

Construction

Noise that can be heard by marine mammals can be generated from construction associated with the marginal wharf and the jetty, in particular, noise related to driving piles. Source levels have been shown to range from 131 - 135 decibels referenced to 1 microPascal (131 – 135 dB re 1 µPa) up to one kilometre from the source (Richardson et al, 1995 in Hammond et al, 2005) however there are no available data on the effects of pile driving on marine mammals (Hammond et al, 2005). At 358 m from pile driving, sound pressure levels were found to be 179 dB at 6 m depth (Caltran, 2001).

Construction-related adverse effects on marine mammals are possible. The NMFS has suggested that sound pressure levels that exceed 190 dB re 1 µPa may cause threshold shifts or temporary hearing impairments in marine mammals. Research on marine mammals shows that under certain circumstances underwater noise can cause a variety effects. This includes behaviour modifications, tissue rupturing or haemorrhaging at close range to the acoustic source, and temporary or permanent hearing loss. In addition new noise sources can mask other sounds important to survival, such as those made by calves, mates, or predators (Richardson et al., 1995).

Operation and Maintenance

During the operation of the Marginal Wharf, vessel traffic is expected to increase. 83% of the underwater acoustic field surrounding large vessels is the result of propeller cavitation (Southall, 2005). Little underwater acoustic energy is transmitted into the water from on-board machinery or movement of the vessel through the water. Noise from vessels may contribute to masking of sounds important to the survival of mammals. However, marine mammals have been known to adapt to masking sounds by changing the intensity and frequency of their vocalizations.

Stormont Bay is not particularly important in relation to marine mammals. Seals may haul out on the shoreline and small whales may enter the area to feed, following schools of herring and mackerel, but it is not considered critical or limiting habitat. Therefore, no significant impacts from the operation of the Marginal Wharf Project are expected.

Modifications and Decommissioning

An increase in noise may occur due to decommissioning efforts. Adverse effects during the decommissioning phase may also include potential for the accidental release of contaminants to the environment.

5.2.11.2 Mitigation Measures and Monitoring

Construction

The mitigation measures for underwater noise due to construction activities are outlined in Section 5.2.16.2 and Section 5.1.11.2. Mitigation for spills from potential accidents and malfunctions is covered in Section 10.0.

Operation and Maintenance

No mitigation of operational activities is required given the low level of marine mammal activity in the area.

Modifications and Decommissioning

Mitigation presented for the construction phase will be sufficient for the decommissioning.

5.2.11.3 Residual Effects

Construction

Given the low importance of the marine environment at the Marginal Wharf Project Site for marine mammals, and the implementation of the proposed mitigative measures identified above, no significant adverse residual environmental effects on marine mammals are likely to occur.

Operation and Maintenance

No significant adverse residual environmental effects on marine mammals are likely to occur (see Table 6.2-8 and text above in “Construction”).

Modifications and Decommissioning

No significant adverse residual environmental effects on marine mammals are likely to occur (see Table 6.2-8 and text above in “Construction”).

5.2.11.4 Follow Up

No follow up monitoring is planned.

5.2.12 Wildlife and Wildlife Habitat

5.2.12.1 Environmental Effects Prediction

Construction

A number of furbearers are on-site. The aquatic furbearers, mink, muskrat, beaver, and otter are on the terminal area around Dung Cove Pond and associated wetland. Habitat removal and disturbance may result in some or all of these being extirpated from the area.

The most concentrated winter deer activity observed was on Red Head Peninsula (See Figure 4.1-5). Clearing and construction activities are expected to have an impact, in all likelihood reducing or eliminating winter use by deer. Some loss of habitat is expected especially in the wetter areas such as Map Sites 4 and 5 (Figure 4.2-1) and Dung Cove Pond in the terminal area. Loss of habitat will affect snakes throughout, and possibly turtle habitat in Dung Cove Pond in the terminal area. Impact on small mammals is mainly related to loss of habitat. There are no rare or otherwise unique species expected in the area. There may be some minor noise effects on waterfowl that spend time along the marine shore in the terminal area due to blasting (if required).

Operation and Maintenance

The furbearers and wintering deer populations on the terminal area may be displaced; deer may winter elsewhere along the coast toward Drum Head and Seal Harbour.

There is expected to be an increase in birds that are especially compatible with human activity; i.e. starlings, robins, grackles, cowbirds, rock doves, some of which are nest predators and may otherwise compete with woodland and edge birds. Noise affects could cause changes in wildlife behaviour in nearby areas.

Birds are likely to undergo some mortality by collision with lighted towers and other structures. A more thorough discussion of the effects on birds can be found in Section 5.2.13 (Migratory Birds).

Modifications and Decommissioning

No adverse effects have been identified for the decommissioning of the marginal wharf. Potential impacts to water quality and soil and/or sediment quality are discussed in Sections 5.2.4 and 5.2.5 respectively.

5.2.12.2 Mitigation Measures and Monitoring

Construction

In addition to the mitigation provided in Section 5.1.12.2, disturbance to Dung Cove Pond will be minimized in order to avoid the potential loss of furbearer habitat in the Dung Cove Pond area. The area that is disturbed/ lost will also be minimized as much as possible in order to avoid the potential loss of white-tailed deer habitat (i.e., winter-concentration area in and near terminal area). Blasting activities will be conducted outside of bird nesting season (May 1 through August 1). Equipment must have appropriate noise-muffling equipment installed and in good working order. Noise monitoring at the site boundaries will be conducted as appropriate.

An EPP will be developed to mitigate the disturbance of the Dung Cove Pond area. The EPP will include site specific protection plans that will include:

- minimize the length of Dung Cove Pond area habitat disturbed;
- minimize the construction area, and construction period;
- stabilize watercourse/wetland beds and banks with clean rip rap when necessary to ensure stability;
- minimize ground and vegetative disturbance by:
    - locating staging areas outside of the Dung Cove Pond area, at least 30 m from the edge of wetland, where possible;
    - minimizing equipment in the Dung Cove Pond area to only that required for construction activity; and
    - using upland access roads wherever practical.
- maintain vegetative diversity by:
    - incorporating practices to prevent the spread of non-desirable invasive species throughout the construction area, including cleaning and inspection of construction equipment prior to use in Dung Cove Pond areas; and
    - allowing the Dung Cove Pond area to revegetate naturally unless adjacent to areas of potentially erodible soils.
- during site restoration, mitigate effect on vegetation by:
    - not applying fertilizer, lime, or mulch to the Dung Cove Pond area as part of the revegetation plan;
    - separating organic top soil from underlying soils, stock piling separately; and returning top soil to original horizon in areas where there is no open water or saturated soils; and
    - restoring original contours and cross drainage patterns.
- inspect equipment daily prior to use to detect leaks of fuels;
- all on-site fuels, oils, and chemicals will be stored at least 50 m from any surface waters where possible;

- ensure all spill prevention planning and detailed cleanup procedures are in place prior to construction;
- take necessary measures to reduce or avoid disruption of surface and ground water patterns;
- drainage control features will be implemented to prevent soil erosion and impacts to water quality; and
- boulders and tree trunks harvested during construction to be retained for possible use in aquatic habitat enhancements.

In compliance with NSEL condition for approval (Item 3.1), the EPP will be submitted to NSEL for review and approval. Also, the effects on Dung Cove Pond due to any drainage will be minimized due to the piping being on tresses.

Operation and Maintenance

The mitigation presented in Operation and Maintenance for the LNG facility is sufficient for the marginal wharf (Section 5.1.12.2).

Modifications and Decommissioning

The mitigation presented in construction for the LNG facility is sufficient for the marginal wharf (Section 5.1.12.2).

5.2.12.3 Residual Effects

Construction

The displacement and/or loss of wildlife are both permanent and non-reversible. The species that are being affected are not protected and there are no designated or protected lands involved in the clearing. Provided the proposed mitigative measures, such as the EPP (see Section 5.2.12.2 for details), are implemented, no significant adverse residual environmental effects to wildlife and wildlife habitat are likely to occur. Refer to Table 6.2-9 for more details on the criteria to determine the significance of residual environmental effects.

Operation and Maintenance

Provided the proposed mitigative measures are implemented as suggested, the magnitude of the environmental effect from the increased risk of bird collisions to the marginal wharf lighting is low in magnitude and temporary. Therefore, no significant adverse residual environmental effects on wildlife and wildlife habitat are likely to occur.

Modifications and Decommissioning

As outlined in Table 6.2-9, the criteria for residual environmental effects for the modifications and decommissioning phase is the same as the construction phase. Provided the proposed mitigative measures are implemented, no significant adverse residual environmental effects on wildlife and wildlife habitat are likely to occur.

5.2.12.4 Follow Up

The monitoring program described in Section 5.1.12 is applicable to the construction and operation of the marginal wharf.

5.2.13 Migratory Birds and Migratory Birds Habitat

5.2.13.1 Environmental Effects Prediction

Construction

As with terrestrial wildlife, the environmental effect of concern is the removal of migratory bird habitat from the LNG facility site and disturbance to migratory birds as a result of noise during construction. The effects discussed in Section 5.1.12.1 are applicable for migratory birds and habitat.

Operation and Maintenance

The effects discussed in Section 5.1.12.1 are sufficient to cover the possible effects for the operation of the marginal wharf.

Modifications and Decommissioning

No adverse effects have been identified for the decommissioning of the marginal wharf.

5.2.13.2 Mitigation Measures and Monitoring

Construction

The mitigation presented in construction for the LNG facility is sufficient for the marginal wharf.

Operation and Maintenance

The mitigation presented in operation and maintenance for the LNG facility is sufficient for the marginal wharf.

Modifications and Decommissioning

No mitigation is required.

5.2.13.3 Residual Effects

Provided the proposed mitigation measures are implemented, the magnitude of the environmental effects is low. Therefore, no significant adverse residual environmental effects on migratory birds are likely. See Table 6.2-10 in Section 6.0 for more details on the significance criteria.

5.2.13.4 Follow Up

No follow up monitoring is recommended for migratory birds.

5.2.14 Wetlands

5.2.14.1 Environmental Effects Prediction

Construction

The construction of the marginal wharf requires the infilling of two wetland ponds on the red head peninsula. This wetland habitat will be permanently lost. The loss of these wetlands accounts for less than 0.8 ha of the 5.2 ha of wetland habitat present on the LNG Project Site. Details of the impacts to wetlands will be submitted in accordance with Item 1.2 in the NSEL EA approval conditions (NSEL, 2007).

Operation and Maintenance

The two wetlands located within the marginal wharf footprint will be infilled during construction; therefore no environmental effects will occur as a result of operation and maintenance of the wharf.

Modifications and Decommissioning

The two wetlands located within the marginal wharf footprint will be infilled during construction; therefore no environmental effects will occur as a result of modifications and decommissioning of the wharf.

5.2.14.2 Mitigation Measures and Monitoring

Construction

A wetland functional analysis will be conducted prior to construction of the marginal wharf to document the habitat and functions that will be lost from the wetlands. This information will be used in completing a wetland compensation plan for the loss of this habitat. The Proponent will provide details for the plans for avoidance, mitigation, and or compensation for review and approval by the NSEL. This work will be undertaken by the Proponent in compliance with Item 1.2 of the NSEL EA approval conditions (NSEL, 2007). In accordance with the NSEL conditions, an EPP will also be implemented that will include the site specific protection plans for wetlands during the construction phase. See Section 5.1.14.2 for more details on the measures that will be implemented through the EPP.

Operation and Maintenance

No mitigation is required.

Modifications and Decommissioning

No mitigation is required.

5.2.14.3 Residual Effects

The geographic extent of the effects is the Red Head Peninsula, and the magnitude of the environmental effects is determined to be medium. Therefore, significance of the residual environmental effects is medium (not significant). Provided the wetland compensation plan is carried out, no significant adverse residual effects are expected during any of the Marginal Wharf Project phases.

5.2.14.4 Follow Up

A wetland compensation plan will be submitted to regulators for approval prior to construction. The compensation plan will include a monitoring program to verify that the work has been successful.

5.2.15 Lighting Conditions

5.2.15.1 Environmental Effects Prediction

Construction

No adverse environmental effects are expected from lighting during construction, prior to commissioning of the LNG facility.

Operation and Maintenance

Light will be emitted from all components of the KDP; however, the most noticeable will be from the Marine terminals, especially when vessels are at berth. This area is in the direct view plane of the communities of Goldboro, Isaac's Harbour, and Drum Head.

As discussed in Section 5.1.13, some migratory bird species can be particularly susceptible to disorientation caused by man-made light, especially under overcast or foggy weather conditions (Evans Ogden, 1996). Birds that are not killed outright by collisions with the light sources can succumb to exhaustion brought upon by prolonged fluttering around a light source or to predation upon individuals in weakened states (Evans Ogden, 1996).

Modifications and Decommissioning

No adverse environmental effects are expected from lighting due to the decommissioning of the marginal wharf.

5.2.15.2 Mitigation Measures and Monitoring

Construction

The mitigative measures presented for the facility operation are sufficient for the construction phase of the Marginal Wharf Project.

Operation and Maintenance

To minimize the impacts of light on the surrounding community the following measures should be applied:

- no unnecessary lighting should be used;
- lighting is to be shielded where possible; and
- lighting is to be angled or directed to work area.

The mitigation measures presented in Section 5.1.13 for migratory birds are sufficient for the operation and maintenance phase of the Marginal Wharf Project. In particular, the Proponent will comply with Item 1.6 of the NSEL EA approval conditions (NSEL, 2007).

Modifications and Decommissioning

No effects have been identified therefore mitigation is not necessary.

5.2.15.3 Residual Effects

Provided the proposed mitigative measures are implemented for construction and operations, the environmental effects are expected to be reversible and low in magnitude. Therefore, no significant adverse residual effects from lighting are predicted.

Modifications and Decommissioning

No residual effects from this phase of the Marginal Wharf Project are anticipated.

5.2.15.4 Follow Up

No follow up monitoring is anticipated.

5.2.16 Atmospheric and Underwater Acoustic Environment

5.2.16.1 Environmental Effects Prediction

There are concerns as to the impacts from construction activities that generate noise emissions transmitted through the underwater environment.

Construction

Although there is not an extensive use of the nearshore waters by cetaceans and seals (Section 5.2.11.1), these species may be susceptible to damage from the underwater noises generated using conventional pile-driving techniques.

A recent study on bottlenose dolphins showed that pile driving has the potential to negatively affect dolphin populations at a distance of up to 40 km. The potential impacts include interfering with communications, foraging, echolocation, and breeding.

Source levels have been shown to range from 131 - 135 dB re 1 µPa up to one kilometre from the source (Richardson et al, 1995 in Hammond et al, 2005) however there are no available data on the effects of pile driving on marine mammals (Hammond et al, 2005). At 358 m from pile driving, sound pressure levels were found to be 179 dB at 6 m depth (Caltran, 2001). For Incidental Harassment Authorizations, the NMFS has been known to establish preliminary safety zones that have a 500 m radius around pile driving sites. The safety zone is to include all areas that are expected to exceed 190 dB re 1 µPa RMS.

Construction-related adverse effects on marine mammals are possible. The NMFS has suggested that sound pressure levels that exceed 190 dB re 1 µPa may cause threshold shifts or temporary hearing impairments in marine mammals. Research on marine mammals shows that under certain circumstances underwater noise can cause a variety effects. This includes behaviour modifications, tissue rupturing or haemorrhaging at close range to the acoustic source, and temporary or permanent hearing loss. In addition new noise sources can mask other sounds important to survival, such as those made by calves, mates, or predators (Richardson et al., 1995).

Operation and Maintenance

Noise impacts on marine mammals during operation is not expected to be significant as most noise generated (i.e. ship engines) would be of a lower frequency than pile driving and other marine construction practices. The effects of underwater noise on marine mammals due to Project operations were discussed previously in Section 5.1.11.

Modifications and Decommissioning

The potential effects present for the construction phase are applicable for the decommissioning phase as well.

5.2.16.2 Mitigation Measures and Monitoring

Construction

The disturbance of marine life through noise emissions transmitted through the underwater environment (from activities such as conventional pile driving) (David, 2006) will be mitigated by the implementation of alternative techniques for pile driving such as vibratory pile-driving, adjusting the timing around sensitive periods and conducting driving during low tide. In addition recreational and commercial fishery representatives will be conferred with to develop seasonal and daily schedules to minimize disruption of fisheries.

Operation and Maintenance

No mitigation of operational activities is required given the low level of marine mammal activity in the area.

Modifications and Decommissioning

The potential effects addressed in the construction section are relevant for the decommissioning of the facility as well.

5.2.16.3 Residual Effects

Provided the proposed mitigative measures are implemented, the environmental effects will be reversible, temporary, and medium in magnitude (see Table 6.2-13, Section 6.0). Therefore, no significant adverse residual environmental effects are likely to occur.

5.2.16.4 Follow Up

No follow up programs are anticipated to be necessary.

5.2.17 Current Use of Lands and Resources for Traditional Purposes by Aboriginal Persons

5.2.17.1 Environmental Effects Prediction

Construction

There are three sea urchin diving areas located at Betty's Cove and Red Head. The construction of the marginal wharf will likely limit Mi'kmaq harvesting in this area. It should be noted that sea urchins in this area were largely decimated by a parasite in the late 1990's and have not made a significant recovery.

Medicinal plant gathering sites and areas were identified by the wetlands that are within the Project Site. The construction may result in some filling, excavating, and otherwise disturbance of wetlands, in addition to some loss of wetland vegetation.

Operation and Maintenance

The environmental effects for operation are the same as construction.

Modifications and Decommissioning

There are no environmental effects expected due to the decommissioning of the marginal wharf.

5.2.17.2 Mitigation Measures and Monitoring

Construction

For the effects on fishing, the draft FHCP outlined in Appendix 5 includes enhancement of benthic habitat within the same urchin licence area. This is predicted to offset any loss of sea urchin production and/or access once the species returns to commercial levels.

Wetlands within the LNG facility, if affected, will be rehabilitated and/or compensated to achieve "no net loss" in wetland functions. As required by the NSEL Terms and Conditions for Environmental Assessment Approval, wetland plans for avoidance, mitigation and/or compensation will be developed in consultation with NSEL and NSDNR.

To meet the requirements of Item 4.3 in the NSEL EA approval conditions, Keltic will develop a Mi'kmaq Communication Plan for the Project which will include but not be limited to:

1. processes for communicating Project details and seeking input from the Mi'kmaq community; and
2. plans for Mi'kmaq involvement in EEM and other Project aspects. The plan will be developed in cooperation with the Mi'kmaq Community.

Also, in accordance with Item 4.4 of the NSEL EA approval conditions, Keltic will take steps to further assess traditional Mi'kmaq use of the Project Site lands. The Proponent will develop the proposed steps in cooperation with the Mi'kmaq Community and will submit the results to NSEL.

Operation and Maintenance

For the effects on fishing, the draft FHCP outlined in Appendix 5 includes enhancement of benthic habitat within the same urchin licence area. This is predicted to offset any loss of sea urchin production and/or access once the species returns to commercial levels.

Modifications and Decommissioning

No mitigation is required.

5.2.17.3 Residual Effects

Construction

There will be no significant adverse residual effects due to the construction of the marginal wharf as the FHCP will offset any loss of sea urchin production and/or access once the species returns to commercial levels.

Operation and Maintenance

There will be no significant adverse residual effects due to the operation and maintenance of the marginal wharf as the FHCP will offset any loss of sea urchin production and/or access once the species returns to commercial levels.

Modifications and Decommissioning

No significant adverse residual effects due to the decommissioning of the marginal wharf are anticipated.

5.2.17.4 Follow Up

Monitoring of the Fish Habitat Compensation projects will be done to determine the success of the new habitat structures.

5.2.18 Physical and Cultural Heritage

5.2.18.1 Environmental Effects Prediction

Construction and operation of the Marginal Wharf may have effects on physical and cultural heritage. Due to previous excavation and removal of burials at Red Head in 2000 and 2001, complemented by subsurface testing in October 2004, there is confidence that no burials remain in the cemetery and, therefore, the site is no longer believed to be of high archaeological sensitivity. However, due to its association as the final resting place of the first Black Loyalists in Goldboro and Isaac's Harbour, it remains as a site of cultural significance to the nearby Black community at Lincolnville.

5.2.18.2 Mitigation Measures and Monitoring

In compliance with NSEL conditions of approval, prior to construction, an agreement with the African Nova Scotia Affairs will be entered into for the establishment of a memorial at the Red Head Cemetery site (Item 4.8) and a Cultural Heritage Plan will also be developed to ensure that the KDP construction and operations proceed in a manner that respects the cultural heritage value of the Red Head Cemetery site to the community, and that public access to the site will be maintained (Item 4.9). The plan will be reviewed and approved by NSEL. Additionally, an archaeology and heritage resources monitoring and contingency plan will also be prepared by engagement with Mi'kmaq stakeholders, African Nova Scotia Affairs, and the Nova Scotia Museum (Item 4.6).

5.2.18.3 Residual Effects

Table 6.2-15 outlines the significance of the criteria such as magnitude and geographic extent that is used to determine if there will be residual environmental effects. No significant adverse residual effects due to the construction, operation and decommissioning of the marginal wharf are anticipated.

5.2.18.4 Follow Up

No follow-up programs are required.

5.2.19 Structures/Sites of Archaeological, Paleontological or Architectural Significance

5.2.19.1 Environmental Effects Prediction

A complete discussion on the significance of archaeological resources is presented in Section 5.1.19.1

<u>Construction</u>

Each archaeological resource within the Study Area has been evaluated according to its relative significance based on the cultural and physical integrity of each resource, existing documentation, and the expected impact on those resources (Table 5.2-1).

TABLE 5.2-1 Relative Significance of Archaeological Sites within the Marginal Wharf Study Area

Archaeological Site or Resource	Archaeological Sensitivity	Cultural Sensitivity	Expected Impact (Yes/No)
Red Head Cemetery	Medium	High	Yes
Sculpin Cove 1	High	High	Unknown
Sculpin Cove 2	High	High	Unknown
Sculpin Cove 3	High	High	Unknown
Sculpin Cove 4	High	High	Unknown
Sculpin Cove 5	High	High	Unknown
Hurricane Island Mine	High	N/A	Unknown
McMillan Mine	Low	N/A	Yes
Dung Cove	High	High	Unknown
Giffin's Mill	High	N/A	No

Construction of the Marginal Wharf may have effects on several archaeological features. However, due to previous excavation and removal of burials at Red Head in 2000 and 2001, complemented by subsurface testing in October 2004, there is confidence that no burials remain in the cemetery and, therefore, the site is no longer believed to be of high archaeological sensitivity. However, due to its association as the final resting place of the first Black Loyalists in Goldboro and Isaac's Harbour, Red Head remains a site of cultural significance to the nearby Black community at Lincolnville. This site lies within the impact zone and is expected to be heavily disturbed.

The Sculpin Cove 1 to 5 sites produced no surface artefacts and shoreline erosion has not exposed any material culture. Although they are obviously of human construction, there is no evidence to indicate that they were occupied for extensive periods of time and their cultural, functional, and historical period affiliations are unknown. However, the possibility that they are related to late eighteenth century Black Loyalist settlement is present. Research into Black Loyalist settlement is just beginning in Nova Scotia and it is a current focal point of several projects in the province (Cottreau-Robins, MacLeod-Leslie, Niven, Whitehead). For these reasons, these features are believed be of high archaeological and cultural sensitivity. Although none of these five features are expected to be directly impacted by construction, the effect of ship wakes on these features as a result of product storage construction and ship berthing is of concern.

Hurricane Island Mine is a pristine example of late nineteenth-century mining in Nova Scotia. To the best of the archaeologists' knowledge, no research has been conducted to date on historic mining in the province during any period of the past. This site, then, is deemed of high archaeological sensitivity and community members have expressed concern regarding the fate of historic resources on the island. Hurricane Island is not expected to be impacted by construction.

The McMillan Mine is of early to mid twentieth-century origin and, therefore, is believed to be of low archaeological sensitivity. This site is located directly in the impact zone and is expected to be heavily disturbed by construction of the product storage area and access road.

The Dung Cove site is located within close proximity to the impact zone and the possible level of impact needs to be further understood. Due to the obscurity of features by low tree cover, no structural remains were visible at the Dung Cove site. However, the site does exhibit landscape modification congruent with agricultural activity. Although no surface artefacts were present to

indicate the age of the site or its cultural affiliation, the potential that it is related to late eighteenth century Black Loyalist settlement exists. Therefore, this area is believed to be of high archaeological sensitivity.

The physical integrity of features at Giffin's Mill and the possibility of recoverable material culture make this site one of high archaeological sensitivity. There has been little or no research conducted on early twentieth century mills in the province and this site and its contents would likely be of interest to the Museum of Industry. The mill site is not expected to be impacted by construction.

Operation and Maintenance

The only expected impacts to archaeological resources during the operation phase are associated with the continued rise in water levels at Sculpin Cove and Hurricane Island. A rise in sea level and wakes created by ship berthing as a result of the operation of the marginal wharf may cause erosion to known archaeological sites at Sculpin Cove and on Hurricane Island.

Modifications and Decommissioning

The potential effects addressed in the construction section are relevant for the decommissioning of the facility as well.

5.2.19.2 Mitigation Measures and Monitoring

Construction

As a general rule, should any artefacts or human remains be discovered at any time during the construction work, the work is to be terminated until a qualified archaeologist assesses the find. To meet the requirements of the NSEL EA approval conditions (Item 4.7) (NSEL, 2007), if an archaeological site or artefact is discovered, the work will be halted and the Curator of Archaeology at the Nova Scotia Museum, and the Executive Director of the Union of Nova Scotia Indians will be contacted immediately. Should the find be deemed significant, the work is not to resume until further steps and protective measures are discussed in consultation with the archaeologist and regulatory authorities.

Red Head Cemetery

There is a high level of confidence that additional burials at the Red Head cemetery site are unlikely and that no further manual excavation is necessary. Due to the remaining cultural sensitivity of the site, however, a plan to ensure that Marginal Wharf Project development proceeds in a manner that respects the cultural heritage value of the Red Head Cemetery site to the community, and that public access to the site will be maintained. Also, an agreement will be entered into with the Office of African Nova Scotia affairs for the establishment of a memorial at the site. The agreement and the Cultural Heritage Plan will be implemented in accordance of Items 4.8 and 4.9 in the NSEL EA approval conditions (NSEL, 2007).

Sculpin Cove

The Sculpin Cove sites 1 through 5 are not expected to be directly impacted by construction and, therefore, no recommendations for mitigation are considered necessary. A complete archaeological assessment of the entire KDP site will be completed prior to construction as requested in the NSEL EA approval conditions (NSEL, 2007). Also, in accordance with Item 4.6 of the NSEAL EA approval conditions, an archaeology and heritage resources monitoring and contingency plan will be developed prior to construction. The plan will be developed in consultation with Mi'kmaq stakeholders, African Nova Scotia Affairs, and the Nova Scotia Museum.

McMillan Mine

The McMillan Mine is expected to be affected by construction of the product-storage area and wharf at Sand Cove as well as by the associated access road. It is considered to be of low archaeological sensitivity given its recent age, however, and no pre-construction investigation of the features is required. It should be noted that Sand Cove is situated north of Dung Cove, between Sculpin Cove and Red Head Cemetery. The Marginal Wharf will be constructed where Sand Cove is.

A complete archaeological assessment of the entire KDP site will be completed prior to construction as requested in the NSEL EA approval conditions (NSEL, 2007). Also, in accordance with Item 4.6 of the NSEAL EA approval conditions, an archaeology and heritage resources monitoring and contingency plan will be developed prior to construction. The plan will be developed in consultation with Mi'kmaq stakeholders, African Nova Scotia Affairs, and the Nova Scotia Museum.

Dung Cove

The Dung Cove location is believed to be of high archaeological and cultural sensitivity. The level of confidence concerning an understanding of the full extent of the site is low due to the obscurity of features by low tree cover. At this time, the site is not located within a direct impact zone (i.e., within the footprint of necessary infrastructure). A complete archaeological assessment of the entire KDP site will be completed prior to construction as requested in the NSEL EA approval conditions (NSEL, 2007). Also, in accordance with Item 4.6 of the NSEAL EA approval conditions, an archaeology and heritage resources monitoring and contingency plan will be developed prior to construction. The plan will be developed in consultation with Mi'kmaq stakeholders, African Nova Scotia Affairs, and the Nova Scotia Museum.

Giffin's Mill

Giffin's Mill is not expected to be affected by construction. Due to elevated levels of archaeological sensitivity, however, a complete archaeological assessment of the entire KDP site will be completed prior to construction as requested in the NSEL EA approval conditions (NSEL, 2007). Also, in accordance with Item 4.6 of the NSEAL EA approval conditions, an archaeology and heritage resources monitoring and contingency plan will be developed prior to construction. The plan will be developed in consultation with Mi'kmaq stakeholders, African Nova Scotia Affairs, and the Nova Scotia Museum.

Operation and Maintenance

In accordance with Item 4.9 in the NSEL EA approval conditions, a plan will be developed to ensure the KDP construction and operations proceed in a manner that respects the cultural heritage value of the Red Head Cemetery and that public access to the site will be maintained (NSEL, 2007). In accordance with Item 4.6, the Proponent, prior to construction, shall submit for review and approval of NSEL, an archaeology and heritage resources monitoring and contingency plan. The plan shall be developed in consultation with Mi'kmaq stakeholders, African Nova Scotia Affairs, and the Nova Scotia Museum.

Modifications and Decommissioning

Mitigative measures for the construction phase of the Marginal Wharf Project will be sufficient for the decommissioning phase as well.

5.2.19.3 Residual Effects

Construction

Table 6.2-16 outlines the significance of the criteria such as magnitude and geographic extent that is used to determine if there will be residual environmental effects. Provided the proposed mitigative measures are implemented, no significant adverse residual effects on archaeological resources or resources are likely to occur.

Operation and Maintenance

Table 6.2-16 outlines the significance of the criteria such as magnitude and geographic extent that is used to determine if there will be residual environmental effects. Provided the proposed mitigative measures are implemented, no significant adverse residual effects on archaeological resources or resources are likely to occur.

Modifications and Decommissioning

Table 6.2-16 outlines the significance of the criteria such as magnitude and geographic extent that is used to determine if there will be residual environmental effects. Provided the proposed mitigative measures are implemented, no significant adverse residual effects on archaeological resources or resources are likely to occur.

5.2.19.4 Follow Up

Archaeological compliance and monitoring programs are regulated by the NSMNHs manager of Special Places and subject to approval. The monitoring plans for these sites are summarized in Section 7.0 Table 7.2-4.

5.2.20 Navigation

5.2.20.1 Environmental Effects Prediction

Construction

Vessel traffic required during construction will have similar effects to vessels required during operation and maintenance of the marginal wharf.

Operation and Maintenance

Potential operational impacts are associated with Marginal Wharf Project-related vessels entering and leaving the bay, but may also be related to other marine traffic traveling around the proposed marginal wharf into and out of Isaac's Harbour from Stormont Bay.

The wharf extends into the entrance of Isaac's Harbour, occupying about 45% of the width of the entrance between Red Head and Bear Trap Head. However, the entrance to Isaac's Harbour naturally reduces to a similar width another 500 m further into the Harbour. Furthermore, the marginal wharf is located in an area of comparatively shallow water, leaving the deeper water portion of the entrance unaffected.

The wharf itself will be equipped with navigation aids, such as lights and fog horns, as required by TC, mitigating navigation concerns. Few vessels routinely use Isaac's Harbour even though the community wharf in Goldboro was substantially upgraded by SOEI for construction of the gas plant.

The current marine traffic within the harbour is composed of one or two inshore fishery vessels and the occasional recreational vessel. In addition, there is a monthly passage of a shrimp trawler to the Stormont facility in Country Harbour. These vessel dimensions and displacements range respectively from: 5.5 m length overall x 1.8 m beam and 1 m draft, to 19 m length overall x 6 m beam and 3.3 m draft, to 52 m length overall x 11 m beam and 5.5 m draft. An exact count and analysis of marine shipping activity within the harbour will be accomplished during the engineering FEED study.

Overall, the reduction in channel width at the entrance should not have a significant impact on navigation.

Modifications and Decommissioning

Vessel traffic required during decommissioning will have similar effects to vessels required during operation and maintenance of the marginal wharf.

5.2.20.2 Mitigation Measures and Monitoring

Construction

The marginal wharf may alter navigation into Isaac's Harbour from Stormont Bay; however, the wharf will be well lit and marked on all navigation charts for the area in accordance with federal legislation. The very low level of boating activity in from Stormont Bay into Isaac's Harbour is

not expected to result in any important navigation issues with respect to marine facilities. Fishermen will be notified in advance on the arrival and departure of vessels.

Operation and Maintenance

Potential operational impacts are associated with shipping entering and leaving the bay, but may also be related to other marine traffic traveling around the proposed marginal wharf into and out of Isaac's Harbour. The wharf protrudes into the entrance of Isaac's Harbour, occupying about 45% of the width of the entrance between Red Head and Bear Trap Head. However, the entrance to Isaac's Harbour reduces to a similar width another 500 m further into Isaac's Harbour. Furthermore, the marginal wharf is located in an area of comparatively shallow water, leaving the deeper water portion of the entrance unaffected. The wharf itself will be equipped with navigation aids, such as lights and fog horns, as required by TC, mitigating other navigation concerns. Fishermen will be notified in advance on the arrival and departure of vessels.

Modifications and Decommissioning

Mitigative measures for the operations phase of the Marginal Wharf Project will be sufficient for the decommissioning phase as well.

5.2.20.3 Residual Effects

Provided the proposed mitigative measures are implemented, the environmental effects will be reversible and will have low magnitude (see Table 6.2-17, Section 6.0). Therefore, no significant adverse residual effects to navigation are predicted to occur during any phases of the Marginal Wharf Project.

5.2.20.4 Follow Up

No follow up monitoring is anticipated.

5.2.21 Marine Safety and Security

5.2.21.1 Environmental Effects Prediction

Environmental effects of construction, operations and maintenance as well as modifications and decommissioning on marine safety include mainly navigational issues. These have been addressed in the previously in Section 5.2.20.

Marine security issues are addressed in the through the requirements of the *Marine Transportation Security Act* and in the QRA conducted for the KDP.

5.2.21.2 Mitigation Measures and Monitoring

Mitigation for construction, operations and maintenance as well as modifications and decommissioning are the same as for navigation and has been addressed in Section 5.2.20.

Marine security issues are addressed through the requirements of the *Marine Transportation Security Act* and in the QRA conducted for the KDP.

5.2.21.3 Residual Effects

With the implementation of the recommended mitigation measures in Section 5.2.20 and the outcomes of the QRA minimal significant adverse residual effects are likely. The effects will be of low magnitude and reversible. Therefore, the residual environmental effects are not significant.

5.2.21.4 Follow Up

No follow up monitoring is anticipated.

5.2.22 Human Health and Safety

5.2.22.1 Environmental Effects Prediction

A thorough discussion of the potential environmental effects is presented in Section 5.1.22. This section will focus on additional effects and mitigation for the construction, operation and decommissioning of the marginal wharf. The spatial boundaries for Marginal Wharf Project-related marine accidents are the shipping lanes and Stormont Bay from the end of the shipping lanes to the pier. Temporal boundaries include the time traveling to the pier and docked at the facility. It is estimated that vessels will arrive approximately every 3-4 days during the initial Marginal Wharf Project phase and then every 3.5 to 1.8 days.

Construction

The potential effects presented in 5.1.22.1 for construction of the LNG facility are relevant for the construction of the marginal wharf. In addition, there will be potential effects due to air emissions from vessels and vehicular traffic delivering equipment to the job site.

Operation and Maintenance

As with construction, the potential effects presented in 5.1.22.1 for operation of the LNG facility are relevant for the marginal wharf. In addition, air emissions from marine vessel and vehicular traffic are unlikely to impact humans, since the shipping lane is quite distant from human receptors. However, during hoteling and unloading of LNG ships (approximately 24 hours), engines will be idling. Emissions are expected to occur over this period. These impacts have been considered in the modeling of air emissions, which is discussed in Section 5.2.6.

Modifications and Decommissioning

The potential effects addressed for decommissioning of the LNG facility (Section 5.1.22.1) are relevant for the marginal wharf.

5.2.22.2 Mitigation Measures and Monitoring

Construction

The mitigation presented in Section 5.1.22.2 (Human Health and Safety) and 5.1.6.2 (Air Quality) is sufficient for construction of the marginal wharf.

Operation and Maintenance

The mitigation presented in Section 5.1.22.2 (Human Health and Safety) and 5.1.6.2 (Air Quality) is sufficient for operation of the marginal wharf.

Modifications and Decommissioning

The mitigation presented in Section 5.1.22.2 (Human Health and Safety) is sufficient for decommissioning of the marginal wharf.

5.2.22.3 Residual Effects

Provided the proposed mitigative measures are implemented, the environmental effects due to increased risk of air emissions, dust generation, and water/waste management control will be reversible. Therefore, no significant adverse residual effects on human health and safety are likely to occur.

5.2.22.4 Follow Up

No follow up monitoring is anticipated.

5.2.23 Fisheries

5.2.23.1 Environmental Effects Prediction

Construction

Freshwater

The construction of the marginal wharf on the Red Head peninsula will result in the filling in of Ponds 4 and 5 at the Marginal Wharf Project Site (Figure 4.1-5). There is no recreational, Aboriginal, or commercial fishery associated with these ponds. No Marginal Wharf Project-related interactions with fishery resource uses are expected. Mitigation for fish and fish habitat is discussed in Section 5.2.10 and mitigation for freshwater quality/quantity is discussed in Section 5.2.2.

Marine

Local fishers have expressed concern about disruption to their traditional fishing activities from construction and operation of the Marginal Wharf Project. Marine impacts of construction will be concentrated in the wharf and terminal areas, either as a result of construction or facilities equipment being transported to the site, or actual construction of the wharf and terminal.

The magnitude of construction impacts will be related to the seasonal timing of activities. Impacts will be greater if activities occur during the relevant fishing seasons, particularly the lobster fishing season, which runs from April 19 to June 20. The level of fishing effort in the area of the marginal wharf is variable, depending on the catch in other parts of the bay, lateness in the fishing season, water temperatures, and closeness to a particular fisher's home. In consultations with the eight local registered fishers it was identified that while at times a number of fishers do set traps in the area the marginal wharf is not a major fishing area, and most fishing tends to occur further out into the harbour, limiting the potential for disruption to traditional fishing patterns. In addition, little fishing activity takes place in the central deep water part of the bay where the larger LNG and cargo vessels will be transitting.

For a significant impact on fishing activity to occur, the earnings from the fishery would need to be affected as a result of decreased catch quantity and/or quality, or increased costs of fishing from longer travel times or similar issues. The overall productivity of the bay and the associated amount of lobster habitat are important factors determining the potential quantity and quality of the catch and thus monetary return to local fishers.

During construction of these facilities, the potential for unavoidable light (direct or reflected) hitting the water exists, and may have some effect on fish activity in the immediate area, although the long-term effects should not be significant. These construction activities will be the focus of some consultation with both recreational and commercial fishery representatives in the area.

Mitigation for fish and fish habitat is discussed in Section 5.2.10 and mitigation for marine water quality/quantity is discussed in Section 5.2.4.

Operation and Maintenance

There will be no additional effects on Aboriginal, or commercial fisheries than those described in construction.

Potential operational impacts are associated with Marginal Wharf Project-related vessels entering and leaving the bay, but may also be related to other marine traffic traveling around the proposed marginal wharf into and out of Isaac's Harbour.

The marginal wharf will occupy approximately 45% of the width of the entrance to Isaac's Harbour between Red Head and Bear Trap Head. The current marine traffic within the harbour is sporadic, composed of one or two inshore fishery vessels and the occasional recreational vessel. In addition, there is a monthly passage of a shrimp trawler to the Stormont facility in Country Harbour and the occasional offshore supply vessel interfacing with the ExxonMobil SOEI facility. The dimensions and displacements of the vessels in the area vary. The potential impact of safety or exclusion zones around LNG vessels is considered to be negligible.

Impacts associated with commercial fisheries other than lobster are expected to be minor. For example, fishers may have to shift gillnets set for herring or mackerel in the central part of the bay. The potential effect on overall catch or the cost of fishing is anticipated to be insignificant. The marginal wharf area will, by necessity, be well-lit with high intensity lighting at night, and will be directed as narrowly as possible on the work areas (wharf and vessel). The lighting may

have some effect on fish activity in the immediate area, although the long-term effects are not expected to be significant.

Modifications and Decommissioning

Adverse effects to fisheries during the decommissioning phase include potential for the accidental release of contaminants to the environment.

5.2.23.2 Mitigation Measures and Monitoring

Construction

DFO will require replacement of the area of fish habitat lost with habitat of similar or higher quality. Several potential compensation areas have been identified (see Appendix 5). Keltic has consulted with local recreational fisheries groups and municipalities to identify marine and freshwater compensation options.

A compensation policy for fishing equipment damaged by the Marginal Wharf Project construction will be developed and implemented. This compensation policy will follow the Canada – Nova Scotia and Canada – Newfoundland Offshore Petroleum Board document: Compensation Guidelines Respecting Damages Relating to Offshore Petroleum Activity.

Provided the following mitigative measures are implemented the potential lighting effects on fish should be insignificant:

- no unnecessary lighting will be used, especially on structures taller than 15 m, and use fast-blinking strobes if possible;
- area lighting will be angled directly at work areas and shielded where possible; and
- implementation of a Lighting Plan.

A Potential Effects Analysis should be developed, including consultation with marine fisheries authorities and the local fishing community and advance notice of ship arrivals will be provided to fishers.

To mitigate potential effects of fish habitat, in accordance with the NSEL EA approval conditions, the following will be implemented:

- Condition 1.10 - modelling to predict the assimilative capacity of all receiving environments for all relevant chemical parameters which are expected to enter the environment as a result of Project activities;
- Condition 1.12 - Project EMP;
- Condition 2.4 - a detailed ESC plan, including a monitoring program for site runoff; and
- Condition 2.8 - a monitoring program to determine the potential for and extent of sulphide bearing material and a plan to manage any exposed acid generating material and associated drainage.

Additional mitigative measures are discussed in Section 5.2.4.

Operation and Maintenance

In addition to the mitigation measures outlined above, the effects of the marginal wharf on local fisheries are due to the reduction in size of the mouth of Isaac's Harbour and the additional shipping traffic generated by the Marginal Wharf Project. The mitigation measures for these effects include:

- Keltic will provide advance notice of ship arrivals and departures to ensure fishers can manage their gear without damage.
- Local vessel operators will be notified of the LNG tanker schedules and the extent and duration of the exclusion zone.
- A Potential Effects Analysis and consultation with marine fisheries authorities and the local fishing community will be completed to address the potential effect on overall catch or the cost of fishing.

The mitigation measures for the effects of lighting during the marginal wharf operation are discussed in Section 5.2.15.

Modifications and Decommissioning

Mitigative measures for accidents and malfunctions are presented in Section 10.0.

5.2.23.3 Residual Effects

Provided mitigation is implemented as described above, no potential adverse effects are expected. The effects will be low in magnitude. Therefore, residual effects of the Project during all Project phases have been determined not significant.

5.2.23.4 Follow Up

There is no freshwater fishery associated with this area, therefore no follow up monitoring is recommended.

Monitoring of inshore fishing activity is difficult because reporting of specific fishing locations is not required for most fisheries and individual catches are considered confidential by DFO. However, since lobster is the primary species caught in Stormont Bay, a monitoring catch-rate program will be implemented in conjunction with local fishers. Such a program will be important as part of a compensation program to provide independent and objective assessment of potential impacts on the fishery. A monitoring program will document catch in different parts of Stormont Bay during the commercial fishing season. It will involve placing an observer on local fishing vessels at three different times during the fishing season, with specific criteria for consistent setting of traps. Details of such a program will need to be developed in consultation with and approved by local fishers and DFO.

Monitoring of the Fish Habitat Compensation projects will be done to determine the success of the new habitat structures.

5.2.24 Aquaculture

5.2.24.1 Environmental Effects Prediction

Aquaculture is an important economic activity within the marine environment of Country Harbour.

Construction

Aquaculture operations are located entirely within Country Harbour and no construction activities or transport of equipment will occur near these operations. Release of sediments or contaminants to the water column from construction is also anticipated to be minimal, and thus no impacts on aquaculture operations are expected.

Blasting is not expected in the marine environment. If required, blasting in or near watercourses will require approval from DFO and shall be conducted in accordance with the "Guidelines for Use of Explosives in or Near Canadian Fisheries Waters." Blasting shall also be conducted in accordance with the General Blasting Regulations made pursuant to the *Nova Scotia Occupational Health and Safety Act*.

Operation and Maintenance

Routine operations are not anticipated to have any impacts on aquaculture within Country Harbour, but hydrocarbons or other contaminants could be released in a major accident at the KDP Site or during shipping operations. The potential for such an accident is judged to be extremely low.

Modifications and Decommissioning

Adverse effects to aquaculture during the decommissioning phase include potential for the accidental release of contaminants to the environment.

5.2.24.2 Mitigation Measures and Monitoring

Construction

Standard mitigating measures to control sediment and small spills will be implemented to ensure the aquaculture operations in Country Harbour are not adversely affected by construction activities.

Operation and Maintenance

Aquaculture operations could be affected by a large spill. In accordance with Item 3.4 in NSEL EA approval conditions, a proposed aquaculture compensation plan will be implemented in the event that any Project related adverse effects on aquaculture are detected. The compensation plan will ensure adequate compensation is provided in the event a large spill affects operations.

Modifications and Decommissioning

Mitigative measures for accidents and malfunctions are the same as the construction phase.

5.2.24.3 Residual Effects

Provided the mitigation measures are implemented, the environmental effects from the release of sediments into the water column from construction or a large spill have a low magnitude, are localized, and are reversible. Therefore, no significant residual environmental effects are expected.

5.2.24.4 Follow Up

No follow up monitoring is anticipated.

5.2.25 Tourism

The discussion regarding effects on tourism for the construction and operation of the LNG facility is presented in detail in Section 5.1.25 and is consistent with effects for the construction of the marginal wharf.

5.2.25.1 Mitigation Measures and Monitoring

Refer to the mitigation described for tourism for the construction and operation of the LNG facility in Section 5.1.25.

5.2.25.2 Residual Effects

With the implementation of the mitigation measures described in Section 5.1.25, no significant residual effects are likely. Table 6.2-22 in Section 6.0 summarizes the criteria used to determine the likelihood of significant residual effects.

5.2.25.3 Follow Up

No follow up monitoring is anticipated.

5.3 ENVIRONMENTAL EFFECTS OF THE PROJECT RELATED SHIPPING WITHIN 25 KM OF COUNTRY ISLAND

In support of the product output, marine traffic for the proposed Keltic facility will include the transshipment of feedstocks, product components, and byproducts. These shipments will increase traffic levels somewhere in the neighbourhood of 200 additional vessels entering the port per year. This means a yearly traffic flow into the harbour of 300 to 400 LNG and product carriers. The total number of ships accessing the zone equals approximately half the number of moves presently managed through the pilot authority. This number does not include the movement of harbour tug, offshore and inshore fisheries vessels or vessels of less than 100 m length overall.

At the two-vessel proposed output scenario assuming a lower end of tanker capacity of 160,000 m^3, one LNG tanker will arrive at the LNG Marine Terminal every 3.5 to 1.8 days. This will result in a total of 105 to 210 LNG tankers per year. This number can be marginally reduced if larger capacity LNG tankers (250,000 m^3) are made available (5.4 to 2.7 days).

5.3.1 Hydrology

There are no environmental effects on hydrology for this Project component as it is solely marine in nature.

5.3.2 Freshwater Quality/Quantity

There are no environmental effects on freshwater for this Project component as it is solely marine in nature.

5.3.3 Groundwater Quality/Quantity

There are no environmental effects on groundwater for this Project component as it is solely marine in nature.

5.3.4 Marine Water Quality

5.3.4.1 Environmental Effects Prediction and Mitigation

The potential effects on marine water quality related to shipping are limited to routine releases such as bilge water or accidental spill of fuel or other contaminants from vessels and potential re-suspension of contaminated sediments from propeller wash during the construction, operation and decommissioning of the LNG Marine Terminal or marginal wharf.

The MARPOL is the main international convention addressing pollution in the marine environment by oil, chemicals, harmful substances in packaged form, sewage, and garbage discharges from shipping (http://www.imo.org/Conventions/contents.asp?doc_id=678&topic_id=258#1). Project shipping will conduct all activities in strict adherence to both the *Canada Shipping Act* and related regulations and MARPOL as a result, routine releases will be minimized and effects on marine water quality are not considered significant. To mitigate the re-suspension of contaminated sediments large vessels will be berthed with the support of tugs.

Potential effects and mitigation measures for accidents and malfunctions are addressed in Section 10.0.

5.3.4.2 Residual Effects

As identified in Section 10.0, no residual effects are expected. The effects due to bilge water or accidental spills from vessels will have a low magnitude and will be reversible.

5.3.4.3 Follow Up

As identified in Section 10.0, no follow up monitoring is required.

5.3.5 Soil/Sediment Quality (terrestrial and marine)

Two sampling programs found no areas with contaminated sediments near the Project shipping site. However, higher levels of arsenic and mercury exist within Isaac's Harbour and Stormont Bay; however sediments in these areas are not expected to be affected by shipping activities. .

There are no environmental effects on terrestrial soil/sediment for this Project component as it is solely marine in nature.

Similar to marine water quality above, the potential effects on marine sediment quality related to shipping are limited to accidental spill of fuel or other contaminants from vessels and potential re-suspension of contaminated sediments from propeller wash during the construction, operation and decommissioning of the LNG Marine Terminal or marginal wharf.

5.3.5.1 Mitigation Measures and Monitoring

To reduce the sediment disturbance from the vessels, large vessels will be berthed with the support of tugs. A plan to mitigate the human health and environmental impacts of contaminated mine tailings and/or soils and sediments due to the KDP will be developed. The plan will be consistent with the Nova Scotia Guidelines for the Management of Contaminated Sites. As outlined in the NSEL EA approval conditions (NSEL, 2007), when any remediation or risk management work is completed, which includes any required monitoring, a Certificate of Compliance to demonstrate the remediation or risk management work is completed and effective. A detailed ESC plan will also be developed in accordance with Item 2.4 in the NSEL EA approval conditions (NSEL, 2007).

Potential effects and mitigation measures for accidents and malfunctions are addressed in Section 10.0.

5.3.5.2 Residual Effects

As identified in Section 10.0, no residual effects are expected. The effects on soil/sediment quality due to bilge water or accidental spills from vessels will be low in magnitude and reversible (see Table 6.3-2, Section 6.0).

5.3.5.3 Follow Up

As identified in Section 10.0, no follow up monitoring is required.

5.3.6 Air Quality

Effects on air quality from shipping will be limited to emissions related to fuel combustion.

The specific air pollutants emitted consist of the following:

- SO_2, formed when fuel containing sulphur, such as coal and oil, is burned;
- NO_x, generated when fuel is burned at high temperatures as in a combustion process;
- CO, formed from the incomplete combustion of carbon-containing fuel;

- TSP, PM with PM_{10} and $PM_{2.5}$, terms for particles found in the air, including dust, dirt, soot, smoke, and liquid droplets; and
- VOCs.

5.3.6.1 Environmental Effects Prediction

Air dispersion modelling of predicted concentrations of air pollutants from all KDP sources has been presented in Section 5.1.6.1. Given the emission rates, the ground level concentrations would be below any health criteria, either federal or provincial, and it is expected that the distance to receptors will mitigate potential odours. The highest NO_2 and CO offsite concentrations tend are predicted occur to the southwest of the co-generation plant near the property boundary due to the combined cycle gas turbine emissions. The highest SO_2, and TSP concentrations are predicted to occur near the LNG tanks and in the area northwest of the ethylene unit near the property boundary.

Vessel traffic (particularly LNG tankers) is expected to contribute a significant proportion of all KDP related air emissions as follows:

- SO_2 – 142.1 t/year (60% of KDP total);
- NO_x – 142.1 t/year (7% of KDP total);
- CO – 63.7 t/year (24% of KDP total);
- TSP – 20.8 t/year (16% of KDP total); and
- VOCs – 23.5 t/year (9% of KDP total).

5.3.6.2 Mitigation Measures and Monitoring

Project shipping will be in good working order and will take every reasonable measure to reduce unnecessary fuel consumption. As outlined in the *Canada Shipping Act*, no soot will be blown while a ship is within 915 m of land if:

1. it would have been practicable to carry out that operation before approaching land;
2. it would be practicable to delay that operation until after leaving land; or
3. an alternative method of removing soot could be employed.

5.3.6.3 Residual Effects

The results of air quality monitoring are presented in Section 9.6 of the provincial EA Report (AMEC, 2006). These results indicate that emissions related to Project shipping during all Project phases will be far below the Nova Scotia Maximum Permissible Concentrations and Canada National Ambient Air Quality Objectives & Guidelines for all parameters. Consequently, the effects of the shipping on air quality have been determined not significant.

5.3.6.4 Follow Up

Construction

No monitoring during construction is recommended.

Operation and Maintenance

Real-time ambient air quality analysis will serve as both a check on the ground-level concentrations of pollutants which have been modeled, as well as an assurance that other activities are not unduly impacting upon local conditions. It is anticipated that any requirements for such monitoring (both in terms of parameters; number of monitoring sites; and duration) will form part of the Industrial Approval, and would likely focus on NO_x and SO_2, and PM and be conducted periodically during the year. An Industrial Approval is a site specific NSEL Regulatory Document that is enforceable under the *Nova Scotia Environment Act*. The approval contains terms and conditions that the Project Proponent must follow to prevent adverse effects to the environment.

Normally, monitoring sites are located (where practical) at locations indicated by modeling as the point of greatest impact, and/or sites involving sensitive receptors. Reporting of results of the ambient monitoring are made available to both the regulatory authorities and the public. Although real-time monitoring of VOCs is not contemplated, Keltic intends to commission VOC monitoring (essentially 24 hour 'grab' sampling) both prior to and during operations, in order to assess the quantity and makeup of any VOCs at a number of points which will be determined as the specific design phase is completed. In addition, should odours be detected off-site, VOC monitoring will be undertaken to determine the source(s), and allow for appropriated mitigation measures.

Efforts will be made to coordinate with SOEI regarding existing monitoring equipment utilization and data resources.

Modifications and Decommissioning

No monitoring during construction is recommended.

5.3.7 Climate Conditions

Climate change has been clearly linked to emissions of GHG. Project related shipping will contribute minor amounts of GHG to the atmosphere during all phases of the KDP; therefore the potential for adverse effects should be considered.

5.3.7.1 Environmental Effects Prediction

Construction

GHG emissions during construction are expected to be short term and limited in volume.

Operation and Maintenance

Tankers are expected to contribute up to 63.7 t/year of CO_2 (based on modelling presented in the provincial environmental report (AMEC, 2006)). This volume is not expected to have any measurable effect on global climate change. Larger potential sources for GHG occur in other KDP components (described above); and the incremental contribution of GHG from shipping is duly considered in Section 8.0 (cumulative effects).

Modifications and Decommissioning

GHG emissions during any modifications or decommissioning are expected to be short term and limited in volume.

5.3.7.2 Mitigation Measures and Monitoring

During all phases of the KDP, Keltic will implement energy-efficiency measures throughout its facilities including the use of low pressure fuel or waste heat. Further planning and implementation of measures related to climate change issues will take place as the Federal and Provincial Governments move forward with policy/legislative guidance.

5.3.7.3 Residual Effects

The additional shipping that will occur within 25 km of Country Island is not expected to significantly contribute to global GHG concentrations.

5.3.7.4 Follow Up

Follow up monitoring of GHG emissions for the KDP will likely be included in the operating permit. Specific monitoring related to shipping would only be conducted if such a requirement were included in the permit.

5.3.8 Vegetation (terrestrial and marine)

5.3.8.1 Environmental Effects Prediction

There are no environmental effects on terrestrial vegetation for this Project component as it is solely marine in nature.

The potential effects on marine vegetation related to shipping are limited to accidental spill of fuel or other contaminants from vessels and disturbance from propeller wash during the construction, operation and decommissioning of the LNG Marine Terminal or marginal wharf. To mitigate the effects of propeller wash large vessels will be berthed with the support of tugs. Potential effects and mitigation measures for accidents and malfunctions are addressed in Section 10.0.

5.3.8.2 Residual Effects

The effects of these spills are low in frequency and are reversible. Therefore, as identified in Section 10.0, no residual effects are expected.

5.3.8.3 Follow Up

As identified in Section 10.0, no follow up monitoring is required.

5.3.9 Species at Risk

The potential for increased shipping within the Study Area to cause adverse effects to the colony of roseate terns that nest on Country Island and/or protected marine mammals in the shipping lanes should be considered. While there is a remote possibility that other marine species at risk (particularly certain marine mammal species at risk) could occur (as described in Section 4.2.5 above) within the 25 km zone around Country Island, such occurrences would be extremely infrequent and the likelihood of potential interaction is negligible.

5.3.9.1 Environmental Effects Prediction

Project related shipping may take place during all phases (construction, operation, and decommissioning). Vessel traffic may be more frequent during construction and decommissioning but will be of very short duration. In support of the product output, marine traffic for the proposed Keltic facility will include the transshipment of feedstocks, product components, and byproducts. These shipments will increase traffic levels somewhere in the neighbourhood of 200 additional vessels entering the port per year. This means a yearly traffic flow into the harbour of 300 to 400 LNG and product carriers. The total number of ships accessing the zone equals approximately half the number of moves presently managed through the pilot authority. This number does not include the movement of harbour tug, offshore and inshore fisheries vessels or vessels of less than 100 m length overall.

Country Island hosts one of the few breeding populations of roseate terns in Canada and ships are not permitted within 200 m of the island, according to the Recovery Plan. The proposed shipping lane for Keltic traffic will be established in accordance with TC's TP 1802 Routing Standards. Even so, due to the large foraging area of the roseate tern, there is still potential for interaction between the shipping and the species. In the event that a foraging roseate tern encounters an LNG ship, the tern could change course leaving the chicks vulnerable for longer periods or even abandon the effort entirely, returning back to the nest without food.

There are shoals around Country Island that would be avoided by LNG tankers; recently, a shrimp boat was grounded near Country Island with no adverse effect on the roseate tern colony (A. Boyne, pers. comm.). No impacts are expected during typical operations.

While effects of extreme weather may cause minor changes in shipping schedule or routing, and could increase difficulty of safe and accurate navigation, mitigation measures related to extreme weather are discussed in Section 9.0 that will reduce potential impacts to insignificance.

5.3.9.2 Mitigation Measures and Monitoring

Adherence to the designated shipping lane will prevent disturbance of nesting roseate terns. In addition, prescribed navigational routes are not to pass within the exclusion zone established for Country Island.

As a component of NSEL Condition 2.7, the Proponent is committed to prepare an Adaptive Management Plan (AMP), consisting of various elements acceptable to EC and NSDNR, as well as a spill response plan. To address concerns with potential impacts to foraging Roseate Terns in Stormont Bay, it is expected that the AMP will include coordination with multiple stakeholders to monitor and manage potential cumulative effects on the Roseate Tern.

Mitigation relevant to accidents and malfunctions has been provided in Section 10.0.

5.3.9.3 Residual Effects

The magnitude of the environmental effects is determined to be low and reversible (see Table 6.3-5, Section 6.0). Therefore, it is predicted that no significant residual effects on species at risk are likely to occur.

5.3.9.4 Follow Up

As outlined in the NSEL Terms and Conditions for Environmental Approval, under Condition 2.7, a project wildlife monitoring program will be developed in consultation with NSDNR and CWS. An AMP for the Roseate Tern will be prepared and implemented as per Section 5.3.9.2.
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5.3.10 Fish and Fish Habitat (marine and freshwater)

5.3.10.1 Environmental Effects Prediction

There are no environmental effects on freshwater fish and fish habitat for this Project component as it is solely marine in nature.

The potential effects on marine water quality related to shipping are limited to potential releases such oil, chemicals, harmful substances in packaged form, sewage and garbage or accidental spill of fuel or other contaminants from vessels during the construction, operation and decommissioning of the LNG Marine Terminal or marginal wharf.

As stated in Section 5.3.4.1 above, the *Canada Shipping Act* and regulations and MARPOL will be followed by all Project shipping.

Potential effects and mitigation measures for accidents and malfunctions are addressed in Section 10.0.

5.3.10.2 Residual Effects

Provided the proposed mitigative measures are implemented, no significant adverse residual environmental effects on fish and fish habitat are likely to occur since the environmental effects are expected to be temporary, reversible, and low in magnitude.

5.3.10.3 Follow Up

As identified in Section 10.0, no follow up monitoring is required.

5.3.11 Marine Mammals

Stormont Bay/Country Harbour is not an important area for cetaceans. Whales or seals may enter the area following schools of herring or mackerel from spring to fall and seals frequently haul out on the shoreline.

5.3.11.1 Environmental Effects Prediction

The potential effects on marine mammals related to shipping are limited to underwater noise and potential releases such oil, chemicals, harmful substances in packaged form, sewage and garbage or accidental spill of fuel or other contaminants from vessels during the construction, operation and decommissioning of the LNG Marine Terminal or marginal wharf. 83% of the underwater acoustic field surrounding large vessels is the result of propeller cavitation (Southall, 2005). Noise from vessels may contribute to masking of sounds important to the survival of mammals. The noise disturbance may also add to the risk of injury or death due to collisions with vessels. However, marine mammals have been known to adapt to masking sounds by changing the intensity and frequency of their vocalizations. Little underwater acoustic energy is transmitted into the water from on-board machinery or movement of the vessel through the water.

See Section 5.3.16.2 for mitigation measures for vessels to minimize the likelihood of mammal collisions. As stated in Section 5.3.4.1 above, the *Canada Shipping Act* and regulations and MARPOL will be followed by all Project shipping; therefore, no significant effects are anticipated from routine releases (if any).

There is potential for impairment to the marine habitat as a result of re-suspension of contaminated sediments from propeller wash. Although no sediment contamination has been identified large vessels will be berthed with support of tugs. In addition a mitigation plan for contaminated tailings and/or soils and sediments will be developed.

Potential effects and mitigation measures for accidents and malfunctions are addressed in Section 10.0.

5.3.11.2 Residual Effects

As outlined in Section 6.3.7, the effects on marine mammals will be of low magnitude and reversible. Therefore, no significant adverse residual effects are expected.

5.3.11.3 Follow Up

As identified in Section 10.0, no follow up monitoring is required.

5.3.12 Wildlife and Wildlife Habitat

There are no environmental effects on (terrestrial) wildlife and wildlife habitat for this Project component as it is solely marine in nature.

5.3.13 Migratory Birds and Migratory Birds Habitat

5.3.13.1 Environmental Effects Prediction

The potential effects on migratory birds and their habitat related to shipping are limited to potential releases such oil, chemicals, harmful substances in packaged form, sewage and garbage or accidental spill of fuel or other contaminants from vessels during the construction, operation, and decommissioning of the LNG Marine Terminal or marginal wharf.

As stated in Section 5.3.4.1 above, the *Canada Shipping Act* and MARPOL will be followed by all Project shipping; therefore, no significant effects are anticipated from routine releases (if any).

There is potential for seabird mortality due to attraction to ship related lighting. One of the seabird species found in Stormont Bay is Leach's storm-petrel, which is known to be attracted to lights on ships, barges, dredges, and offshore platforms. They commonly feed offshore on bioluminescent plankton, so are particularly drawn to light. The petrels may be attracted to lighthouses, offshore drilling platforms, and the high-intensity lamps used by fishers (Guynup, 2003).

5.3.13.2 Mitigation Measures and Monitoring

With respect to LNG shipping/delivery, seabird mortality due to artificial lights Keltic will employ the following mitigation measures:

- alerting vessels to the risk associated with the use of ice-lights and other deck lighting, particularly on nights when visibility is poor and in the vicinity of seabird islands;
- encourage the use of black-out blinds on all portholes and windows with external lighting kept to the minimum required for safe navigation and operation of vessels;
- keeping deck lights to a minimum when at anchor or close to inshore overnight;
- providing information on how to treat and release birds found on deck; and
- maintaining records of birds found on deck (species, position, and weather conditions).

5.3.13.3 Residual Effects

Provided the mitigation measures provided above are implemented, no significant adverse residual effects are expected since the magnitude of the environmental effects are expected to be low and reversible. See Table 6.3-8 in Section 6.0 for more details.

5.3.13.4 Follow Up

As identified in Section 10.0, no follow up monitoring is required.

5.3.14 Wetlands

There are no environmental effects on wetlands for this Project component as it is solely marine in nature.

5.3.15 Lighting Conditions

5.3.15.1 Environmental Effects Prediction and Mitigation

It has been demonstrated that ships lights can cause some behavioural changes or disorientation for foraging and migratory birds at sea. These effects are generally considered to be insignificant for most species but could be significant for the roseate tern colony on Country Island. Adherence to the Roseate Tern Recovery Plan will mitigate against potential effects to the colony on Country Island. Potential effects and mitigation have been discussed in detail for this species at risk in Section 5.3.9 above.

5.3.15.2 Residual Effects

The effect of seabirds being attracted to ship lights is low in magnitude and is reversible. Therefore, as identified in Section 5.3.9, no significant adverse residual effects are expected.

5.3.15.3 Follow Up

As identified in Section 5.3, Keltic will explore follow up measures in consultation with EC which could include such things as contribution to monitoring programs to help identify roseate tern foraging areas.

5.3.16 Atmospheric and Underwater Acoustic Environment

5.3.16.1 Environmental Effects Prediction

Noise impacts may be associated with shipping and may result in disturbance in the marine environment. 83% of the underwater acoustic field surrounding large vessels is the result of propeller cavitation (Southall, 2005). Noise from vessels may contribute to masking of sounds important to the survival of mammals, which may result in collisions. However, marine mammals have been known to adapt to masking sounds by changing the intensity and frequency of their vocalizations.

The noise impact on marine mammals during operation is not expected to be as significant as noise impacts generated by pile driving. The ship engines would be of a lower frequency than pile driving and other marine construction practices. Most acoustic energy radiating from large commercial vessels is below 1 kilohertz (kHz) (Southall, 2005).

5.3.16.2 Mitigation Measures and Monitoring

Standard vessel operating procedures will be followed to further avoid the minimal risk of marine mammal collisions and disturbance. The procedures will include measures such as:

- reviewing current versions of the Canadian Annual Notice to Mariners for marine mammal guidelines and marine mammal protected areas before entry into Canadian waters;
- reducing vessel speeds when passing through areas where they have been recent whale sighting reports;

- when in an area frequented by whales, posting a look-out to increase the likelihood of sighting and avoiding marine mammals;
- when manoeuvring around marine mammal activity, travelling parallel to marine mammals, avoiding sudden changes in speed or direction, avoiding heading directly toward marine mammals; and
- reducing speed and waiting until animals are more then 400 m away when it is not possible to manoeuvre around marine mammals.

5.3.17 Current Use of Lands and Resources for Traditional Purposes by Aboriginal Persons

The operational phase will likely limit Mi'kmaq sea urchin fishing in this area. It should be noted that sea urchins in this area were largely decimated by a parasite in the late 1990's and have not made a significant recovery.

For the effects on sea urchin fishing, the draft FHCP outlined in Appendix 5 includes enhancement of benthic habitat within the same urchin licence area. This is predicted to offset any loss of sea urchin production and/or access once the species returns to commercial levels.

Therefore, no significant adverse residual effects are expected due to marine operations.

5.3.18 Physical and Cultural Heritage

No effects on physical and cultural heritage from Project related shipping are likely since this Project component is entirely marine in nature.

5.3.19 Structures/Sites of Archaeological, Paleontological or Architectural Significance

No effects on structures/sites of archaeological, paleontological, or architectural significance from Project related shipping are likely since this Project component is entirely marine in nature. No potential for interaction with marine sites of potential archaeological significance has been identified.

5.3.20 Navigation

Project related shipping during operation will increase the current volume of large vessel traffic (mainly LNG tankers) in the Study Area. The current marine traffic within the harbour is composed of one or two inshore fishery vessels and the occasional recreational vessel. In addition, there is a monthly passage of a shrimp trawler to the Stormont facility in Country Harbour. These vessel dimensions and displacements range respectively from: 5.5 m length overall x 1.8 m beam and 1 m draft, to 19 m length overall x 6 m beam and 3.3 m draft, to 52 m length overall x 11 m beam and 5.5 m draft. An analysis of marine shipping activity within the harbour is being completed as a component study under the TERMPOL process.

In general navigation within 25 km of Country Harbour is well established and shoals such as Black Ledge and Tom Cod Rock are marked with navigation aids. The shipping lane will be established under TP 1802 Routing Standards. Communications and port operations plans will be developed by Keltic for approval by TC Marine Safety. In addition, the Atlantic Pilotage

Authority has indicated that the approach to the KDP will be a Mandatory Pilotage Area. Therefore, no significant effects on local navigation are expected.

5.3.21 Marine Safety and Security

Environmental effects on marine safety include mainly navigational issues. The KDP has initiated the TERMPOL process. Keltic is currently preparing a scoping document on the proposed simulations to be conducted for the Project. This, as well as a number of related studies, will be reviewed with the TERMPOL Technical Review Committee and the recommendations that arise will be incorporated by Keltic to protect marine safety and security. As well, Keltic and the ships it charters will follow the *Marine Transportation Act* and regulations.

A Marine Terminal Manual shall be developed in consultation with the Canadian Coast Guard, the Atlantic Pilotage Authority, and TC Marine Safety and be submitted to TC Marine Safety for written approval in advance of any vessels carrying LNG or for delivery to the facility. A draft of this plan shall be submitted to the Canadian Coast Guard, the Atlantic Pilotage Authority, and TC Marine Safety six months in advance of the first shipment to the facility. Further, the Proponent shall require adherence to the approved Marine Terminal Manual as a condition to the acceptance of all vessels at the facility.

The Proponent must comply with TC's new marine security requirements under the IMO International Ship and Port Facility Security (ISPS) Code. The requirements under the ISPS Code are being implemented through Canada's Marine Transportation Security Regulations, as well as through amendments to the International Convention for the Safety of Life at Sea, 1974. In accordance with the Marine Transportation Security Regulations, the Proponent is required to prepare a Port Facility Security Assessment and develop and implement a Facility Site Security Plan. This must be completed prior to the operation of the marine terminal.

Therefore, no significant impacts on marine safety and security in the Study Area are expected.

5.3.22 Human Health and Safety

Effects on human health and safety from the KDP related shipping would only stem from navigational marine safety and accidental events. These have been previously addressed in Sections 5.3.20 and 5.3.21 above and no significant effects on human health and safety are expected.

5.3.23 Fisheries

5.3.23.1 Environmental Effects Prediction

Marine activities associated with construction and operation of the KDP is related to vessels entering and leaving the bay. The impacts will be greater when activities occur during the relevant fishing seasons, particularly the lobster fishing season, which runs from April 19 to June 20. Little fishing activity takes place in the central deep water part of the bay where the larger LNG and cargo vessels will be transiting. The potential effects on marine water quality related to shipping are limited to potential releases such as oil, chemicals, harmful substances in packaged form, sewage and garbage or accidental spill of fuel or other contaminants from vessels during the construction, operation, or decommissioning of the LNG Marine Terminal or

marginal wharf. The *Canada Shipping Act* and regulations and MARPOL will be followed by all Project shipping.

Impacts associated with commercial fisheries other than lobster are expected to be minor. For example, fishers may have to shift gillnets set for herring or mackerel in the central part of the bay.

5.3.23.2 Mitigation Measures and Monitoring

The mitigation measures for these effects include:

- Keltic providing advance notice of ship arrivals and departures to ensure fishers can manage their gear without damage;
- local vessel operators being notified of the LNG tanker schedules and the extent and duration of the exclusion zone;
- analyzing potential effects and consulting with marine fisheries authorities and the local fishing community to address the potential effect on overall catch or the cost of fishing; and
- a Potential Effects Analysis will be developed in consultation with marine fisheries authorities and the local fishing community.

DFO will also require replacement of three to five times the area of fish habitat lost with habitat of similar or higher type and quality. Potential compensation areas have been identified (see Appendix 5) where habitat augmentation projects would provide more lobster habitat, similar in quality to that lost to construction. Keltic will continue consultations with local recreational fisheries groups and municipalities on the compensation plans. Options for proposed FHCPs are being prepared in Appendix 5 of this CSR and as part of Keltic's Application to DFO for Authorization.

A compensation policy for fishing equipment damaged by the Project's shipping will be developed and implemented. This compensation policy will follow the Canada – Nova Scotia and Canada – Newfoundland Offshore Petroleum Board document: Compensation Guidelines Respecting Damages Relating to Offshore Petroleum Activity.

5.3.24 Aquaculture

Shipping routes stay clear of aquaculture sites. Appropriate ballast water and discharge water control and antifouling protocols will be undertaken with establishment and adherence to MARPOL (see Section 5.3.4.1)). Only accidental spillage of fuel or other contaminants could result in significant impacts on local aquaculture.

Potential effects and mitigation measures for accidents and malfunctions are addressed in Section 10.0.

5.3.24.1 Residual Effects

The environmental effects from potential releases of contaminants from vessels have a low magnitude and are reversible (see Table 6.3-15, Section 6.0). Therefore, as also identified in Section 10.0, no significant adverse residual effects are expected.

5.3.24.2 Follow Up

As identified in Section 10.0, no follow up monitoring is required.

5.3.25 Tourism

There are no known tourism ventures that will be affected by shipping around Country Island or any neighbouring islands. Effects on tourism due to shipping are deemed to be not significant.