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ᐱᕈᑦ ᐃᓄᐅᐅᐅ: Fisheries and Oceans Canada (DFO) seeks to continue marine ecosystem research and monitoring of the Eclipse Sound region, including Tremblay Sound and Milne Inlet. This field program consists of passive acoustic monitoring, remote biopsy and tagging of killer whales and photo identification of killer whales. Length: 8 weeks Time: August – September Research Questions: 1.What are the fine-scale movements of narwhals in the Eclipse Sound area, and how do these movements relate to prey availability, predator presence, shipping traffic and oceanographic parameters? 2.What are the temporal and spatial patterns of underwater sound (biological, wind, ice, shipping) in Tremblay Sound and Milne Inlet?3.What is the population size and structure of killer whales in the Eastern Canadian Arctic and what is their ecology (distribution, movement, diet)? 4.What is the fine-scale behaviour of killer whales and how do they interact with their prey species and influence the Arctic marine ecosystem? Project Objectives: 1.Assess narwhal and killer whale abundance, behaviour and distribution in Eclipse Sound. 2.Examine environmental noise and vocalizations of marine mammals in Tremblay Sound and other areas. 3.Continuation of community-based research teams for remote tagging of killer whales and narwhals. 4.Produce a catalogue of killer whale calls and associated behaviors to allow for passive acoustic monitoring (PAM) of presence and activity throughout the study area. Rationale: Killer whale presence and shipping traffic is increasing in Eclipse Sound and there is growing concern among Inuit that this will negatively impact marine mammals and food security. This project seeks to understand cumulative effects of shipping and killer whales on narwhals. Methods: Hydrophones and recorders will be attached to small bottom anchored moorings placed within Milne Inlet and Tremblay Sound to record ambient noise, shipping noise, and marine mammal vocalizations. Specific locations will be determined after consultation with local Hunters and Trappers Organizations (HTO), Parks Canada, and local communities. Recorder deployments in Milne Inlet will be retrieved in the fall and retrieved the following summer in Tremblay Sound. Biopsy collection and satellite tag deployment will be done remotely from a boat using either CO₂ rifles or crossbows. For satellite tagging of killer whales, the whales will be slowly approached by boat, to within 10m, and Limpet model satellite tags will be deployed onto the dorsal fin with 6-cm metal darts that will anchor below the skin into the cartilage. Impacts: Researchers will be stationed out of Pond Inlet. Environmental impacts from the project are expected to be minimal. Impacts from remote tagging are expected to be minimal and will follow the required DFO animal use protocols to ensure that the methods meet the Canadian Council on Animal Care guidelines. Community Involvement and Data: Locally hired project participants have been previously trained and involved in narwhal and killer whale research program (moorings, drones, remote tagging). The 2021 field program and beyond will continue to hire, train and work with Inuit researchers. Data will be stored and managed using DFO protocols. Interim and final results will be shared with local communities and organizations including those from graduate students' research. *** The previous NPC application included narwhal and killer whale research. Due to covid-19 travel restrictions DFO personnel will not travelling to Nunavut and will not be doing any narwhal tagging or skin biopsies. Only killer whale research included in this application will be conducted in the summer of 2021 and all research will be done by trained Inuit researchers. Researchers will no longer be based in field camps, instead will be based from their homes in Pond Inlet. This has results in changes in the Materials Used, Water Use and Waste components of the NIRB application compared to the NPC application. The NIRB application is up to date with changes based on the revised research program.

▷ΔΑΠΝΩC: N/A

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Personnel on site: 4

Days on site: 60

Total Person days: 240

Operations Phase: from 2021-07-17 to 2021-09-15

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Project Area - Tremblay Sound, Milne Inlet and Eclipse Sound	Researching	Marine	Established as Tallurutiup Imanga National Marine Conservation Area in 2019. Baffinland shipping operations in the area begun in 2015.	None	Within the Tallurutiup Imanga National Marine Conservation Area. Adjacent to Sirmilik National Park and Bylot Island Migratory Bird Sanctuary.

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North Baffin

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Project transportation types

Transportation Type	Transportation Mode	Length of Use
Water	Small aluminum frame boat	

Project accomodation types

$\mu_{\text{C}} \approx 0.6$

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Λ⁹δ^c Δ⁹β^cΓ⁹Δ⁹σ^cΔ⁹γ^c Δ^cε^cΓ^cΔ^cΠ^cΔ^c Δ^cδ^cΔ^c, Γ^cΔ^cΠ^cΔ^c, β^cε^cΔ^cΔ^c, Δ^cε^cΔ^c Δ^cΓ^cΔ^cΔ^c

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Boat	2	-	Aluminum frame boat or zodiacs. To move personnel to camp, deploy and retrieve hydrophones and to remotely tag narwhal and killer whales.
Remote tagging (killer whales)	5	-	Limpet model satellite tags will be deployed onto the dorsal fin with 6-cm metal darts that will anchor below the skin into the cartilage, using crossbows. A maximum of 20 killer whales will be tagged this final number will be decided with the Pond Inlet HTA
Dan Inject CO2 gun	1	-	Skin biopsies will be collected using a Dan Inject CO2 gun to fire biopsy darts fitted with a 25 mm long x 6 mm diameter sterile stainless steel biopsy tip. Biopsies will be used for killer whale genetics work (Max=25).
Hydrophones	5-6	-	Collecting passive acoustic data (underwater noise recordings). Moored either with a surface buoy (vinyl fishing float and anchor, or a subsurface buoy and acoustic VEMCO release.

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Gasoline	fuel	8	45	360	Gallons	Gasoline will be used to

						fuel boats. Local boat operators will determine how much fuel to bring. It is estimated that there may be 5-8 45-gallon drums of fuel used during the research season.
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ΔL⁹⁶ ΔJ⁹⁶CDΔL⁹⁶J⁹⁶

Δ ^c ΔL ⁹⁶ ΔJ ⁹⁶ CDΔ ⁹⁶ J ⁹⁶	96 ⁹⁶ ΔΓ ⁹⁶ C ⁹⁶ C ⁹⁶ σ ⁹⁶ Δ ⁹⁶ < ^c	ΔP ^c ΔΓ ⁹⁶ C ⁹⁶ C ⁹⁶ σ ⁹⁶ Δ ⁹⁶ < ^c
0	N/A	N/A

$$\Delta^b C d \subseteq \rho \sigma \Delta^a \sigma^b$$
[illegible]

$\Delta^{\circ} \text{G}_{\text{f}}^{\circ}(\text{C}_6\text{H}_6) = -123.4 \text{ kJ mol}^{-1}$

Project impacts are expected to be minimal on the physical environment. To mitigate impacts researchers will: - Be based out of their homes in Pond Inlet - Conduct day trips using small boats to limit noise to the underwater environment - Fueling boats will be done carefully to avoid spills - Any spills will be reported Project impacts are anticipated to be minimal to the biological environment. Killer whales will be pursued in order to deploy satellite tags and collect skin biopsies, which may temporally increase stress to killer whales. To mitigate impacts researchers will: - Observe animals' behaviour to determine if/when the boat should stop pursuing the animals - Satellite tags will be attached using subdermal anchors into the cartilage of the dorsal fin or blubber tissues of the animals. - Anchors are pre-sterilized and sealed in a clean pack until use. - Skin biopsies will be collected using a Dan Inject CO2 gun - biopsy tips are pre-sterilized - Tagging and biopsying will be done by experienced Inuit researchers who have been trained on all procedures These protocols include provisions to minimize short-term impacts on killer whales, and long-term studies of killer whales and several other marine mammal species have shown no long-term negative impacts of satellite tag deployment or biopsy collection. Project impacts on the socioeconomic environment will be positive by: - Funding upwards of \$60,000 for Inuit field researchers salaries. - Developing Inuit scientific research capacity and ownership in northern communities - Training Inuit beneficiaries in tissue biopsies, the deployment of satellite transmitters, the recording of observational data, and data entry. Research assistants hired and trained in this manner in previous years are now operating as independent researchers in their communities. Research activities will not affect Inuit's harvesting activities or travel in the project area.

Additional Information

SECTION A1: Project Info

SECTION A2: Allweather Road

SECTION A3: Winter Road

SECTION B1: Project Info

SECTION B2: Exploration Activity

SECTION B3: Geosciences

SECTION B4: Drilling

SECTION B5: Stripping

SECTION B6: Underground Activity

SECTION B7: Waste Rock

SECTION B8: Stockpiles

SECTION B9: Mine Development

SECTION B10: Geology

SECTION B11: Mine

SECTION B12: Mill

SECTION C1: Pits

SECTION D1: Facility

SECTION D2: Facility Construction

SECTION D3: Facility Operation

SECTION D4: Vessel Use

SECTION E1: Offshore Survey

SECTION E2: Nearshore Survey

SECTION E3: Vessel Use

SECTION F1: Site Cleanup

SECTION G1: Well Authorization

SECTION G2: Onland Exploration

SECTION G3: Offshore Exploration

SECTION G4: Rig

SECTION H1: Vessel Use

To deploy acoustic equipment and remote tags on killer whales, we will have a field team of four people using a single boat approximately 8 m/24 ft in length run by two 150 HP outboard motors. The team will be all Inuit researchers and be based out of Pond Inlet. Researchers will use vessels to deploy and retrieve acoustic equipment and to access different locations in Pond Inlet, Eclipse Sound and adjacent fjords depending on killer whale locations. We aim to deploy five passive acoustic recorders (hydrophones) in total. Each recorder will be part of a small mooring with a rock anchor at the bottom. We will deploy three in Tremblay Sound at the same locations they were previously deployed during the Ecosystem Approach to Tremblay Sound project (2017-2019). Recorders will be deployed in the summer and then retrieved and redeployed to overwinter in Tremblay Sound. The three other passive acoustic recorders will be deployed in Milne Inlet where there is shipping related to the Baffinland Mary River mine. These passive acoustic recorders will record for the summer and be retrieved at the end summer of 2021. This data will be used to measure noise level related to shipping as well as investigate the presence of narwhals in areas with different noise levels and look at killer whale call occurrence and repertoire. Killer whales will be slowly approached by boat to within 10m and Limpet model satellite tags (Wildlife Computers) will be deployed onto the dorsal fin with 6-cm metal darts that will anchor below the skin into the cartilage, using crossbows. Skin biopsies will be collected using a Dan Inject CO₂ gun to fire biopsy darts fitted with a 25 mm long x 6 mm diameter sterile stainless steel biopsy tip. The core of skin and blubber will be removed from the biopsy tip using sterile forceps, wrapped tightly in foil, and frozen until genetics and chemical analyses (stable isotopes, fatty acids, trace elements, and contaminants) are completed at Fisheries and Oceans Canada or commercial labs. Genetics analyses (e.g., whole-genome) will provide information on group and population structure of ECA killer whales, while the suite of microchemistry analyses will provide information on both distribution and diet.

SECTION H2: Disposal At Sea

All waste create by the project will be properly disposed of in Pond Inlet and no discharge will occur into the water.

SECTION 11: Municipal Development

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The project area is located within the Tallurutiup Imanga National Marine Conservation Area and encompasses the Baffinland Iron Mine Corporation Shipping Route in Milne Inlet. The project area includes Tremblay Sound, Milne Inlet, and Eclipse Sound which are important areas for multiple marine species including: ringed seals, bearded seals, Arctic char, beluga, bowhead whales, and narwhal. Tremblay Sound is an important summering ground for narwhal. It is also an important harvesting

area for Inuit and experiences little to no large vessel traffic. Milne Inlet is also an important summering ground for narwhal and Inuit harvesting activities. The Baffinland Iron Mine Corporation Mary River Port is located within Milne Inlet; therefore, there is a large amount of vessel traffic in the area. Eclipse Sound is a biologically productive area, home to many marine species. Eclipse Sound also borders Sirmilik National Park and the Bylot Island Migratory Bird Sanctuary. These protected areas are important for both terrestrial and marine species. Due to the area's abundant marine and terrestrial biodiversity, it is an important region for Inuit culture and harvesting activities. In Eclipse Sound, there has been an increase in shipping which has led to elevated noise levels in the underwater environment.

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Eclipse Sound has long been recognized as an ecologically and culturally significant area in the Arctic. This area supports the Eclipse Sound narwhal summering stock of 10,500 whales. Narwhals are an important cultural and economic species for Inuit communities and are currently listed as a species “of special concern” by the Committee of the Status of Endangered Wildlife in Canada. Eclipse Sound is used by narwhal during the open water season (July to November) as a migration corridor between summering and overwintering areas. Aggregations of narwhal are mainly located in the Milne Inlet and Tremblay Sound. These areas may provide refuge from Killer whales which feed in Eclipse Sound. Killer whales are also seasonal occupants of the Eclipse Sound region, occurring from late June/July until October. Some years, killer whale sightings are brief as they pass through the area enroute to locations further west (e.g., Admiralty Inlet and Gulf of Boothia), although in recent years they have been sighted regularly in the Eclipse Sound and Milne Inlet throughout August and September. Narwhals are important prey of killer whales in Milne Inlet and Tremblay Sound, although additional research on killer whale diet and general ecology in the area is needed. Many other migratory species including seabirds utilize the project area and adjacent areas. Bowhead whales and more rarely, belugas and even sub arctic marine mammals (i.e. humpback and sperm whales) are observed in the project area. Ringed seals are also abundant in the study area and are present year-round.

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The project area is near the community of Pond Inlet. The project area is an important area for Inuit hunting activities and culture. There are also significant cultural and archaeological sites in adjacent protected areas. Vessel traffic is limited near the Bylot Island Migratory Bird Sanctuary, but the area of Eclipse Sound sees large amounts of vessel traffic. In Eclipse Sound, there has nearly been a threefold increase in shipping traffic from 1990 to 2015. This increase in shipping activity was largely due to tourism vessels as well as bulk carrier and cargo vessels that were associated with construction of the Mary River Mine. Since 2015, there has been a further increase in vessel traffic in the Eclipse Sound area mostly due to bulk carrier vessels from the Mary River Port. The Baffinland Northern Shipping Route runs through Milne Inlet and Eclipse Sound. There is also local vessel traffic in Eclipse Sound, Milne Inlet and Tremblay Sound related to harvesting activities.

Miscellaneous Project Information

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Project impacts are expected to be minimal on the physical environment. Inuit researchers will be based in Pond Inlet and conduct day trips using small boats. Fuelling will be done safely and carefully to avoid any spills and negative impacts to the marine environment and protected areas. Any spills will be cleaned up and any large spills will be reported per regulations. All garbage and waste will be properly disposed of in Pond Inlet. Boats used during the project will contribute to underwater noise in the environment, however vessels are small and will not produce noise levels above disturbance or injury thresholds for marine mammals. The impacts of noise from project related activities will be short term. The impacts of vessel noise from the project cannot be mitigated; however, one of the

objectives of this research is examining the underwater environment and how vessel traffic impacts the noise levels underwater. This research is important in order to examine the cumulative effects of underwater noise from vessel traffic. Project impacts are anticipated to be minimal to the biological environment. Killer whales will be pursued in order to deploy satellite tags and collect skin biopsies, which may temporally increase stress to killer whales. However, researchers will be assessing the whales' behaviour to determine if/when the boat should stop pursuing the animals. Satellite tags have two titanium darts that anchor subdermally into the cartilage of the dorsal fin or blubber tissues of the animals. Anchors are pre-sterilized prior to fieldwork using Betadine or isopropyl alcohol and sealed in a clean pack until use. Skin biopsies will be collected using a Dan Inject CO2 gun to fire biopsy darts fitted with a 25 mm long x 6 mm diameter sterile stainless steel biopsy tip. As with tag darts, biopsy tips are sterilized using Betadine or isopropyl alcohol. Tagging and biopsying will be done by experienced Inuit researchers who have been trained on all procedures. A missed tagging or biopsy attempt may cause a scrape or small puncture wound to the animal, but will not cause long term harm. In the case of a miss, the tag darts or biopsy tip will be re-sterilized on board the ship using Betadine or isopropyl alcohol. All biopsy, tagging, and behaviour data collection procedures have been reviewed and approved for 2021 by DFO's Freshwater Institute Animal Care Committee. These protocols include provisions to minimize short-term impacts on killer whales, and long-term studies of killer whales and several other marine mammal species have shown no long-term negative impacts of satellite tag deployment or biopsy collection. Project impacts on the socioeconomic environment will be positive, with project funds upwards of \$60,000 going towards salaries of Inuit field researchers. Research activities will not affect Inuit's harvesting activities or travel in the project area. In addition to financial gains, DFO has trained and worked with researchers in the North for many years to develop scientific research capacity and ownership in northern communities. Inuit beneficiaries hired to assist with field research have received training in the collection of tissue biopsies, the deployment of satellite transmitters, the recording of observational data, and data entry. Research assistants hired and trained in this manner in previous years are now operating as independent researchers in their communities. Our project relies heavily on the engagement and participation of local communities, and as such, there will be strong focus on training of Inuit/Nunavut beneficiaries. We will use this opportunity to build long-term science/research capacity in several communities, such that each eventually has teams of local researchers who direct and conduct field research programs independently. Travel restrictions in 2021 will mean DFO staff will train and work with researchers remotely.

Cumulative Effects

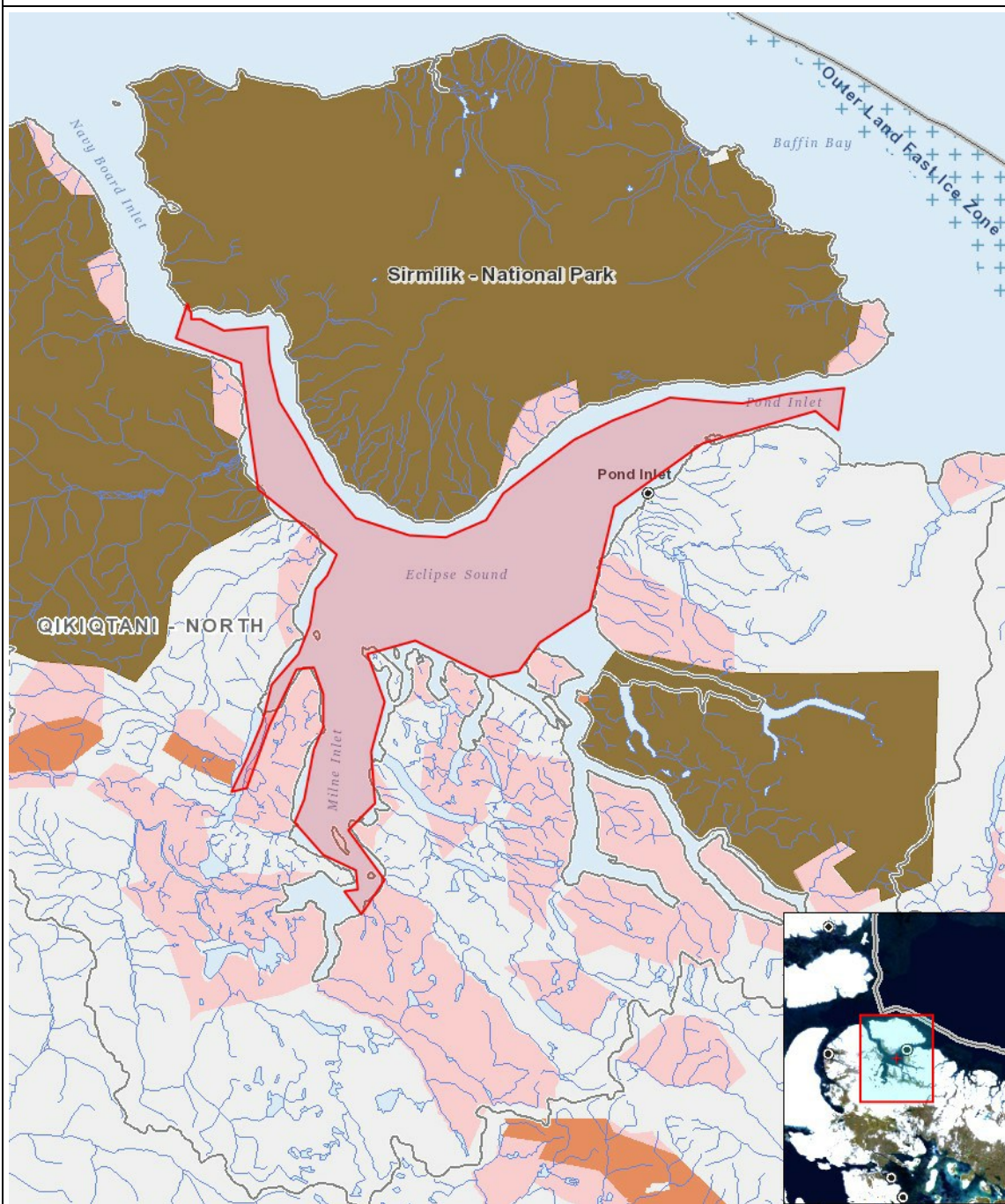
The use of vessels for research activities will contribute to underwater noise from a single boat approximately 8 m/24 ft in length run by two 150 HP outboard motors. The effects from our project will be small due to the short time period and small size of the vessels compared to cruise ship and cargo ships that are abundant in the area, and local boating traffic by Pond Inlet residents. A goal of this project is to examine the cumulative effects of vessel traffic on underwater noise levels and this research cannot be completed without some vessel use to deploy and retrieve hydrophones.

Impacts

$\mathcal{L}(\mathcal{A}) \cap \mathcal{L}(\mathcal{B}) = \mathcal{L}(\mathcal{A} \cap \mathcal{B})$
 $\mathcal{L}(\mathcal{A}) \cup \mathcal{L}(\mathcal{B}) = \mathcal{L}(\mathcal{A} \cup \mathcal{B})$
 $\mathcal{L}(\mathcal{A}) \cap \mathcal{L}(\mathcal{B}) \subseteq \mathcal{L}(\mathcal{A} \cap \mathcal{B})$

PHYSICAL																
Designated environmental areas																
Ground stability																
Permafrost																
Hydrology / Limnology																
Water quality																
Climate conditions																
Eskers and other unique or fragile landscapes																
Surface and bedrock geology																
Sediment and soil quality																
Tidal processes and bathymetry																
Air quality																
Noise levels																
BIOLOGICAL																
Vegetation																
Wildlife, including habitat and migration patterns																
Birds, including habitat and migration patterns																
Aquatic species, incl. habitat and migration/spawning																
Wildlife protected areas																
SOCIO - ECONOMIC																
Archaeological and cultural historic sites																
Employment																
Community wellness																
Community infrastructure																
Human health																

$$(P = \langle b \rangle \dot{\cup} P \cap \langle a \rangle^c, N = \langle b \rangle \cap \langle \langle \langle \langle a \rangle^c \rangle^c \rangle^c \rangle^c, M = \langle b \rangle \cap \langle \langle \langle \langle \langle a \rangle^c \rangle^c \rangle^c \rangle^c, U = \langle \langle \langle \langle \langle a \rangle^c \rangle^c \rangle^c \rangle^c \rangle^c)$$



List of Project Geometries

1 polygon Project Area - Tremblay Sound, Milne Inlet and Eclipse Sound