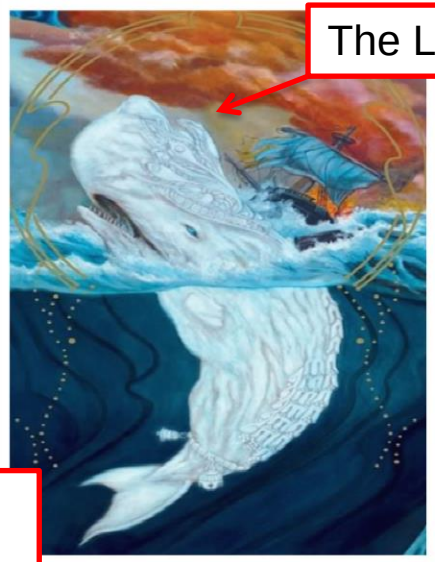
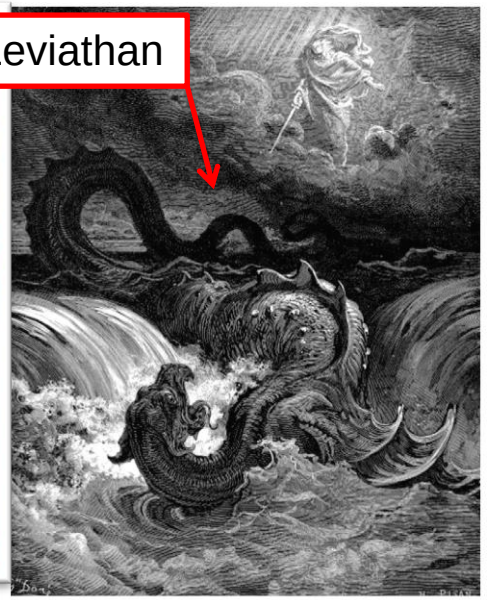
# Outer Bay of Fundy Tidal Energy Development: Where the Leviathans Live

Annex IV webinar - October 28, 2014 - Greg Trowse (Fundy Tidal) / Chloe Malinka (SMRU)

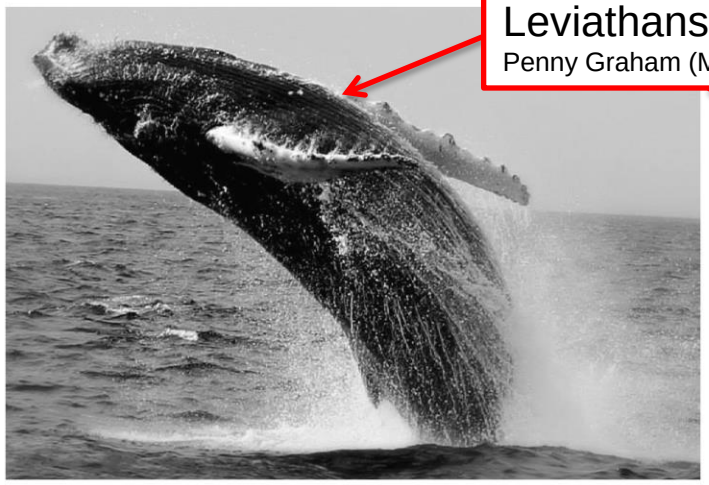
Fundy Tidal Inc.
~Current Thinking



The Leviathan



Leviathans Photos from Penny Graham (Mariner Cruises)



# Fundy Tidal Inc. – Community Tidal Energy Developer

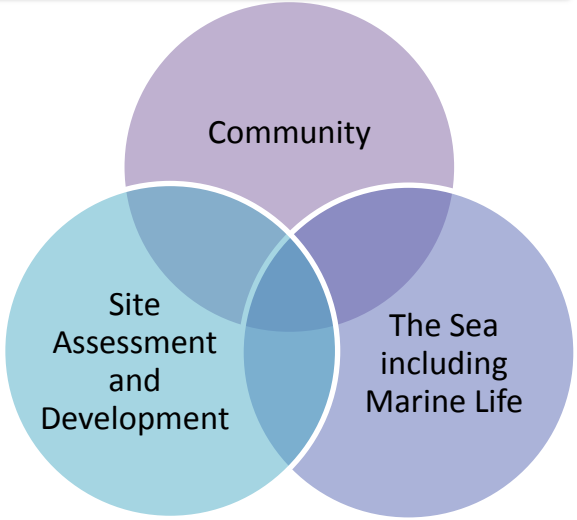
**Objectives:**

A) Introduce Fundy Tidal and our sites
B) Overview of some environmental work done to date
C) Outline next steps and opportunities to collaborate

# Site Introduction – COMFIT / CEDC / CEDIF

**Community ownership and control**

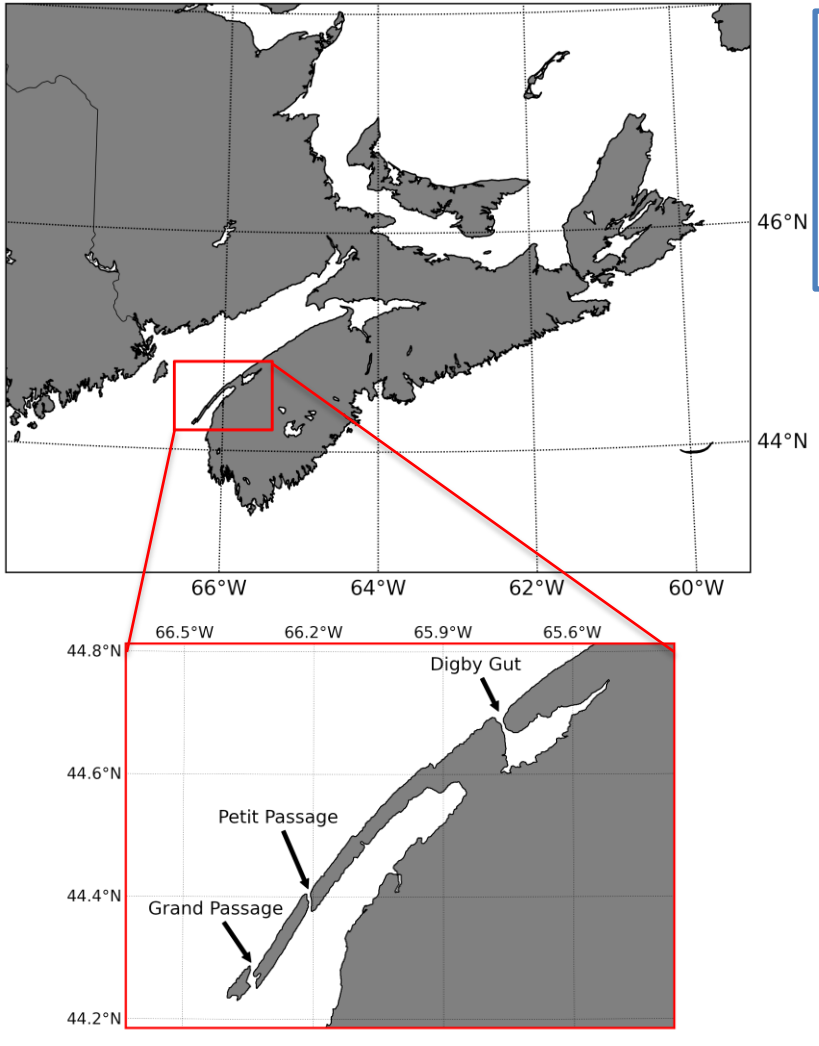
"Small-scale" **Community** Feed-in Tariff (COMFIT) program
**Community** Economic Development Corporation (CEDC)
**Community** Economic Development Investment Funds (CEDIF)
http://www.novascotia.ca/econ/cedif/



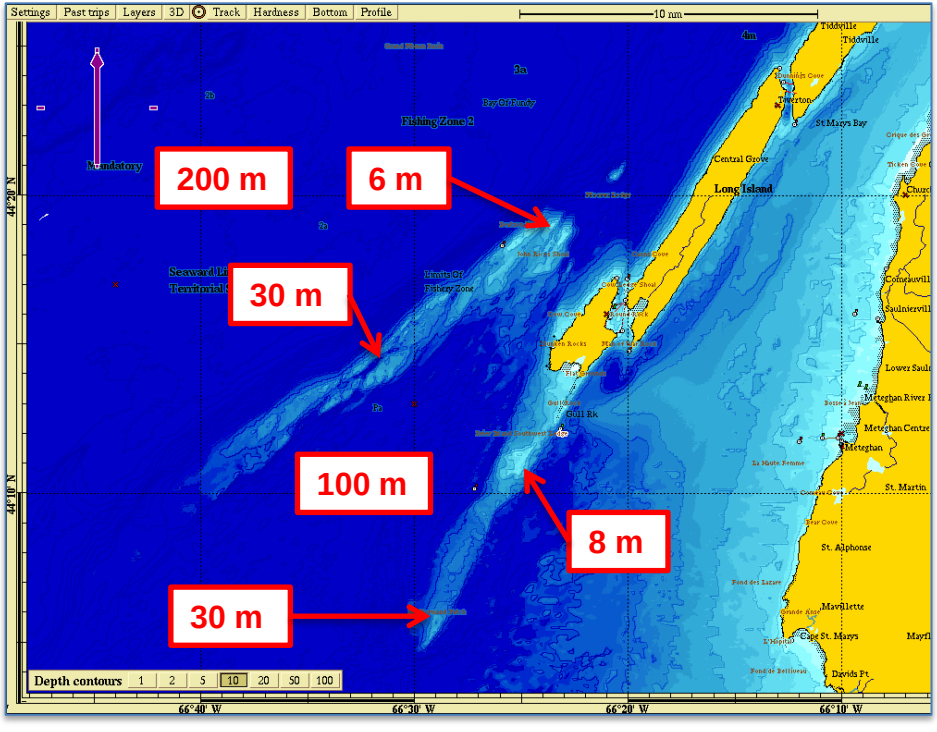

- **$652/MWh** for a 20 year PPA with Nova Scotia Power
- Individual turbines up to 500 kW (arrays of 500 kW machines OK)
- Distribution connected, **local use** limits **local power production**
- Goal to generate dividends for community shareholders through:
  a) sale of tidal energy to grid, and
  b) providing technical consulting services to other projects.

You never know what can grow!

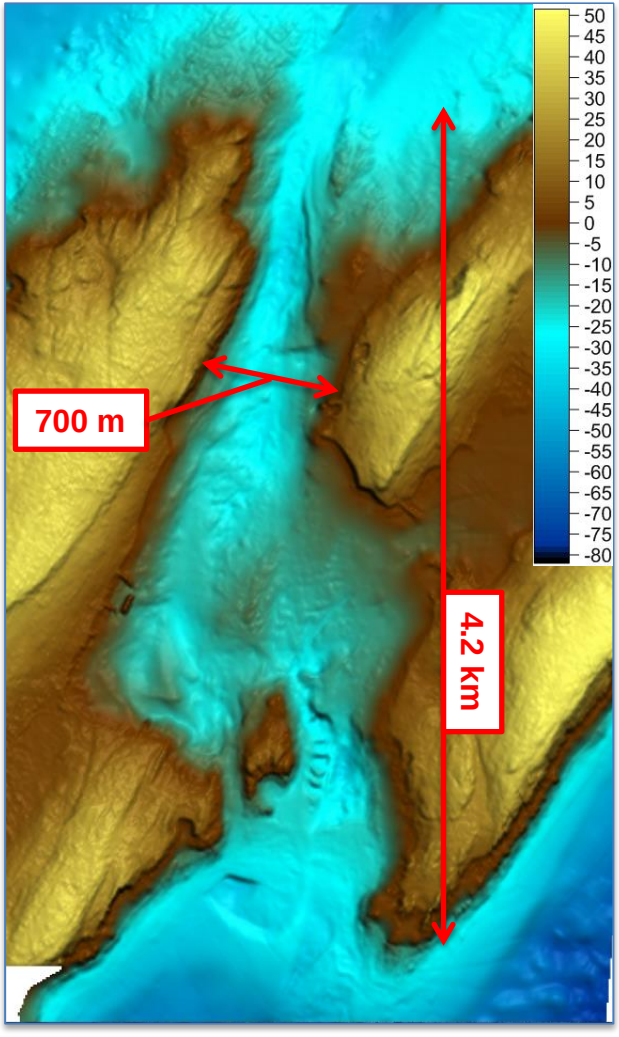
# Site Introduction – Locations



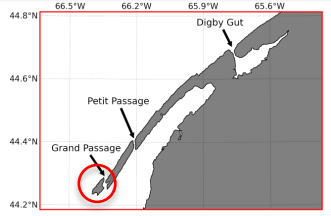

- 3 tidal energy sites located in SW Nova Scotia
- Grand Passage adjacent to productive feeding ground for several species of marine mammals, including “Charismatic Megafauna” a.k.a. in the sea “Leviathans”

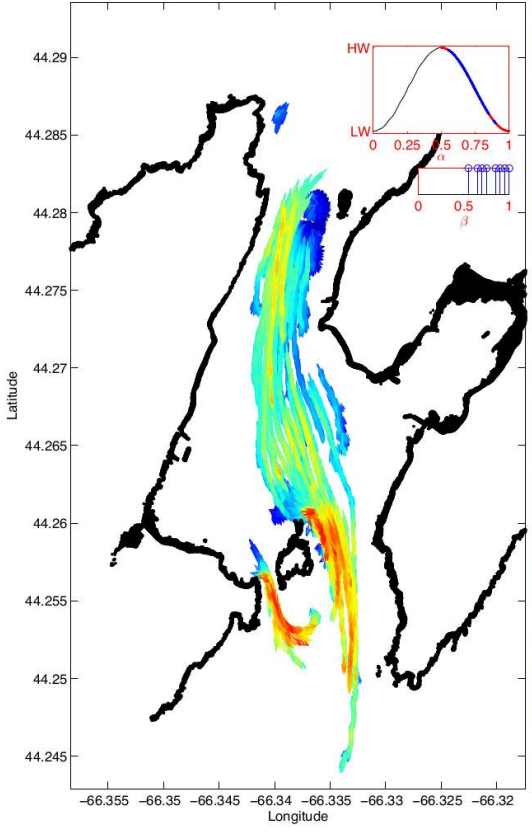


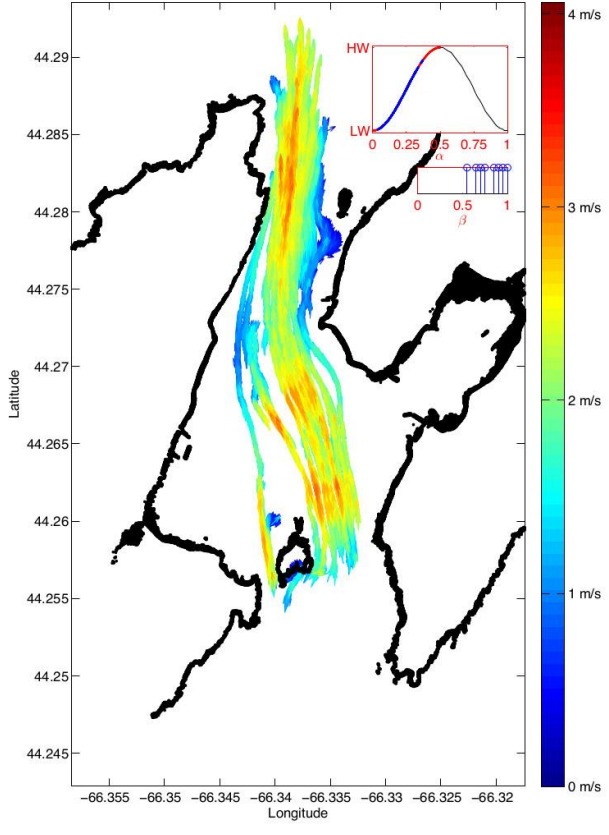
# Site Introduction – Flow and Bathymetry (Grand Passage 500 kW)



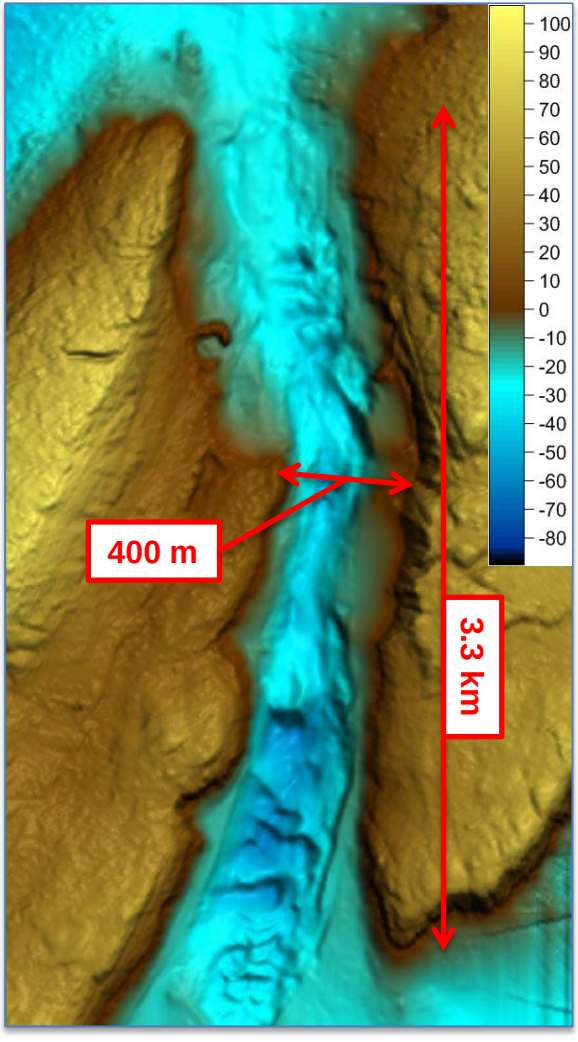

Turbine Berths
- 10 to 30m deep
- Max flow ≈ 3 to 3.5 m/s



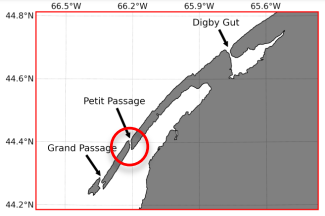



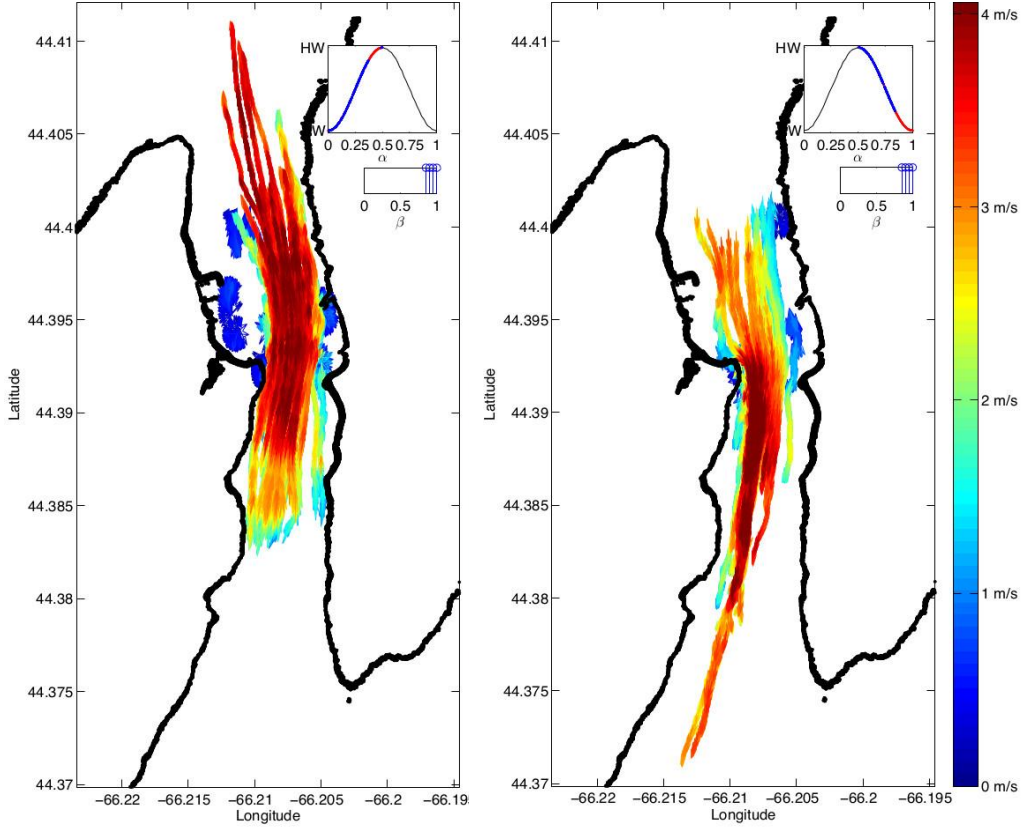



# Site Introduction – Flow and Bathymetry (Petit Passage 500 kW)

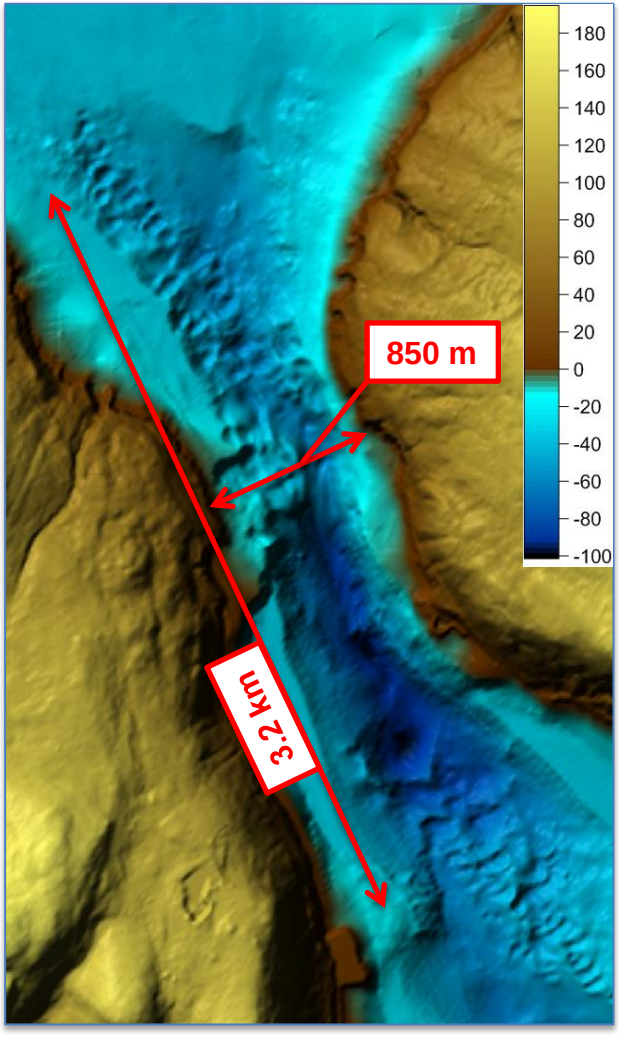



Turbine Berths
- 20 to 50m deep
- Max flow ≈ 4 to 4.5 m/s

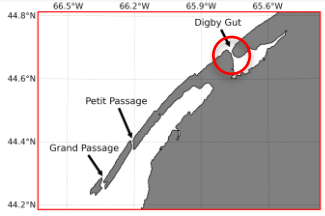


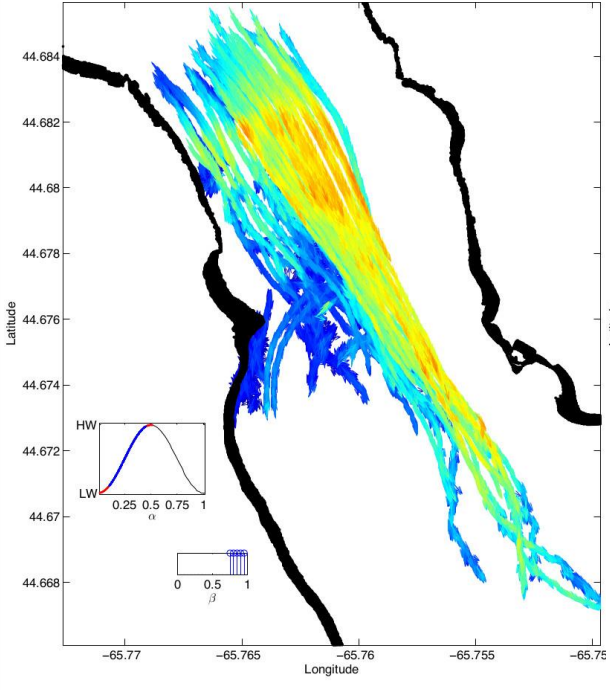



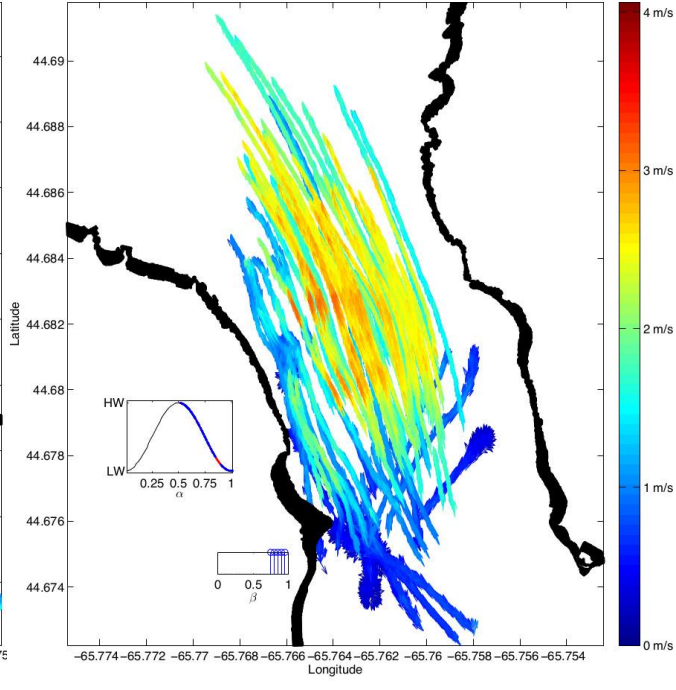
# Site Introduction – Flow and Bathymetry (Digby Gut 1.95 MW)




Turbine Berths
- 10 to 30m deep
- Max flow ≈ 3 to 3.5 m/s



# Site Introduction – Turbines

**Digby Gut**
- Develop with Tocardo (Netherlands)
- 1.95 MW in 2 phases (2015 / 2016)
- Prelim. design, 12 to 16 turbines
  - 3 or 4 floating platforms


**Grand Passage**
- MOU with Clean Current (BC, Canada)
- 500 kW in 2 phases (2015 / 2016)
- Prelim. design, 4 x 125 kW turbines
  - 1 or 2 platforms

**Petit Passage**
- MOU with Nautricity (Scotland)
- 500 kW in 1 phase (2016)
- Prelim. design, 1 or 2 turbines
  - similar to mid-water column system tested at EMEC

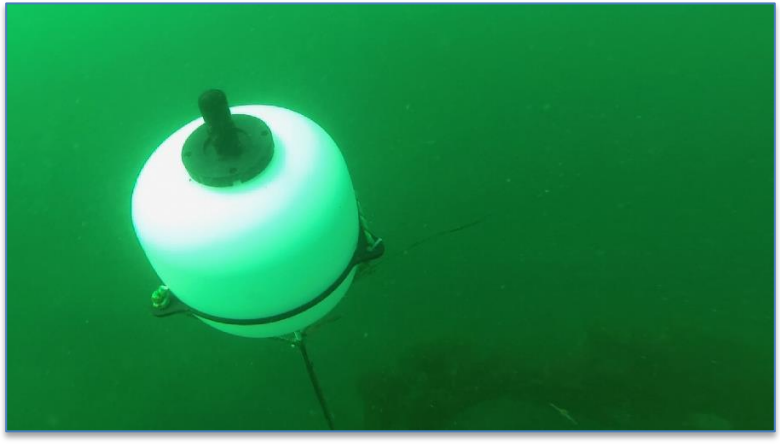
# Site Introduction – Fundy Tidal Field Office and Whale Tour Boats

A) Field office located in Freeport
- “Small-scale” cabled observing system (500m cable to ADCP bottom pod, flow, waves, temperature, and pressure)
- Cabled passive acoustic monitoring (PAM) test with OceanSonics “icListen”

B) Whale tour vessels of opportunity for equipment testing (video, hydrophones, imaging sonars)

# Environment – Overview

**Look and Listen** approach to environmental monitoring



2014 focus is baseline environmental monitoring

a) assess initial conditions prior to turbine deployment
   - marine life and noise

b) test methods and sensors for use around turbine(s) in 2015 / 2016

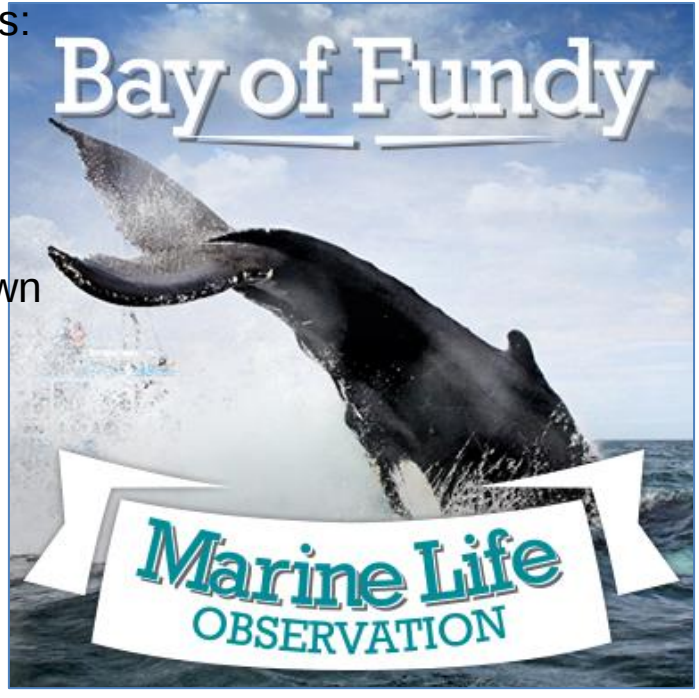
Objective:
- Help develop a real-time marine life monitoring system
- Using acoustics, video, and marine observers to assess potential near and mid-field interactions between turbines and marine life

# Environment – Look and Listen (Marine Observers 1 of 4)

**Bay of Fundy Marine Life Observation Program**, includes:

- public ("citizen scientists"),
- local whale tour operators, and
- dedicated trained observers (part-time local jobs)

2 day marine observer training conducted by Dr. Moira Brown




Data collection using 2 free smart phone applications

A) Whale Alert 2 – opportunistic data (public use)

**B) Spotter Pro – effort based surveys**

- **Trained observers (whale tour operators and dedicated observers)**

Opportunistic data also contributed through social media

Compare data from whale tours to observations collected in the passages

OERA Offshore Energy Research Association

CANADIAN WHALE INSTITUTE TURNING THE TIDE

Conserve.iO Technology for a Better Planet

# Environment – Look and Listen (Marine Observers 2 of 4)

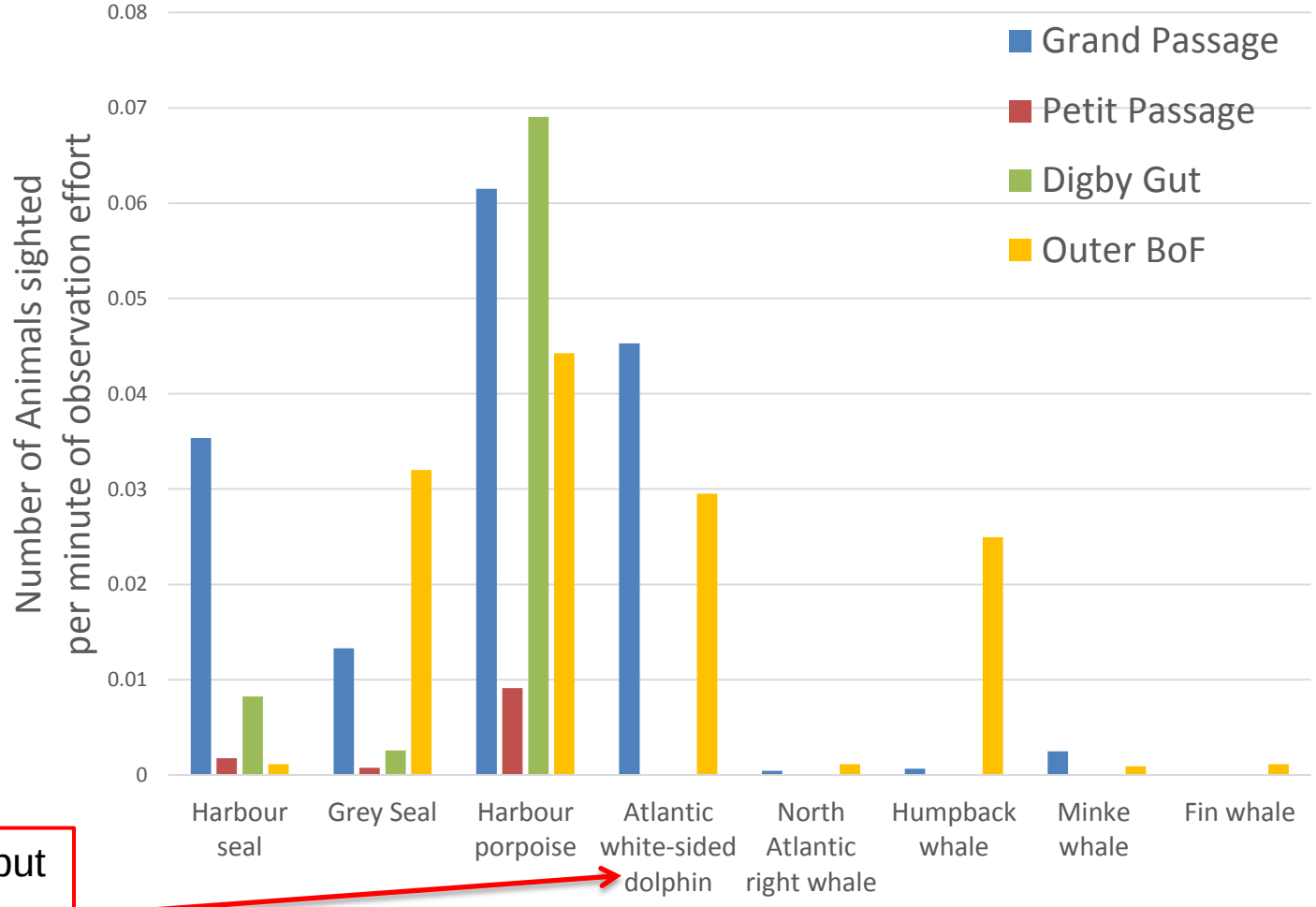
Over 246 hours of dedicated observation (Jun 13 – Oct 19, 2014) over 79 observation periods, representing nearly 9,500 individual marine mammals, fish, and birds sighted in the 3 passages and outer BoF!

- 1,541 individual marine mammals (8 species)
  - Harbour seal, grey seal, harbour porpoise, Atlantic white-sided dolphin, North Atlantic right whale, minke whale, fin whale, humpback whale
- 8 fish (sharks and tuna) (4 species)
  - Porbeagle, thresher, basking, bluefin tuna
- 7,937 individual birds (48 species)

# Environment – Look and Listen (Marine Observers 3 of 4)

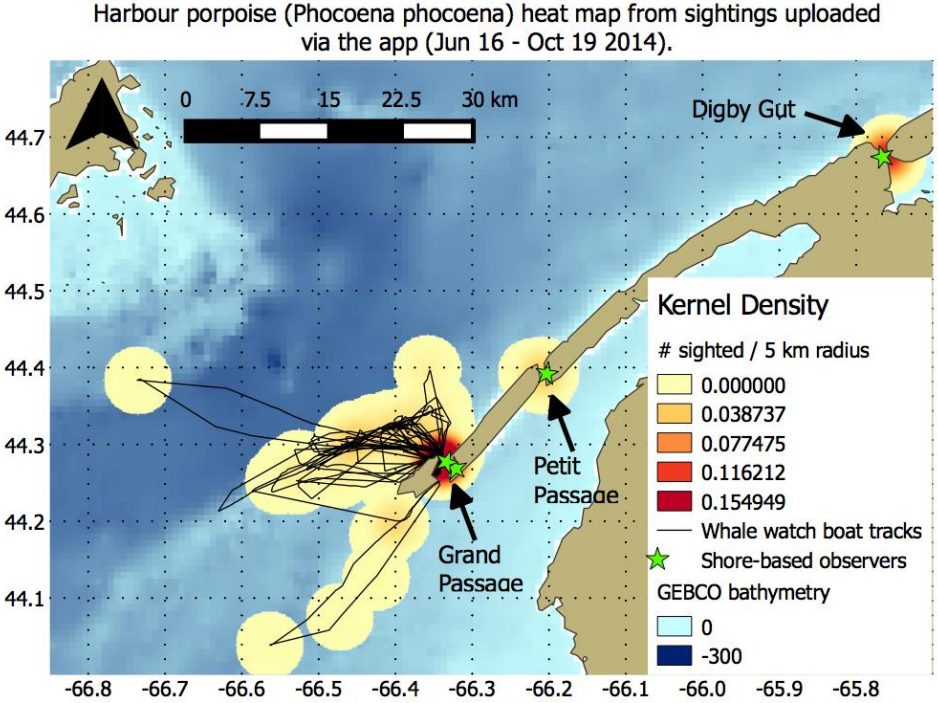
Example of marine mammal species sighting rates

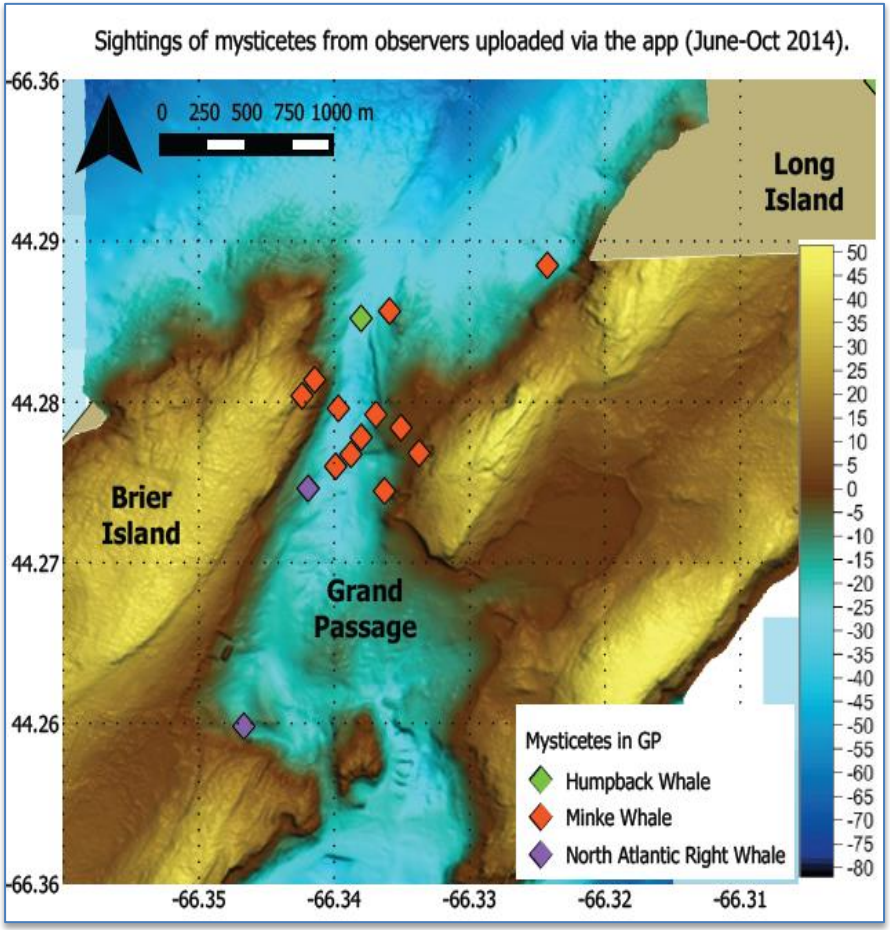
(Jun. - Oct. 14)




Few events, but large groups

# Environment – Look and Listen (Marine Observers 4 of 4)

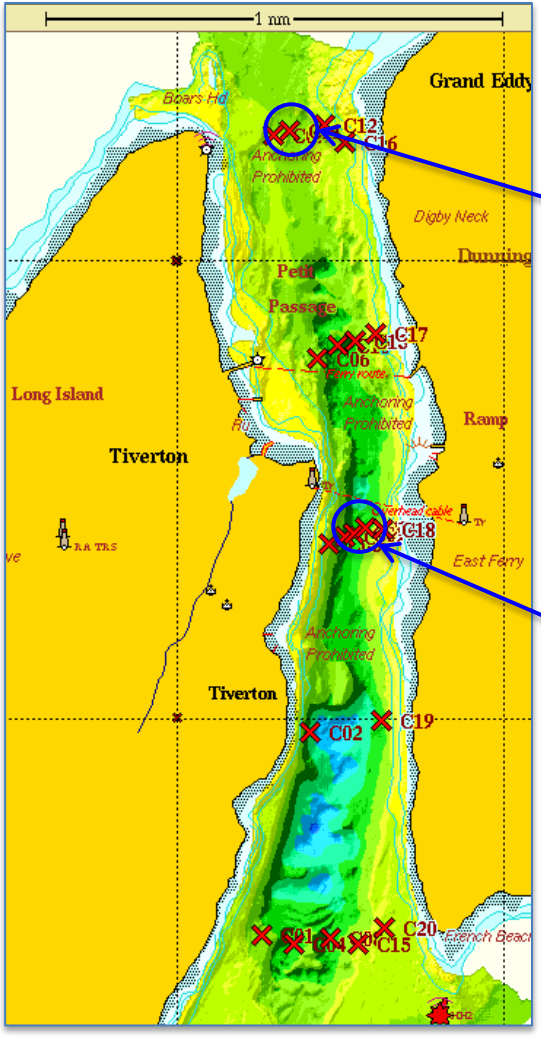



**DOWNLOAD THE APP HERE:**

https://itunes.apple.com/us/app/spotter-pro-field-data-capture/id651453350?mt=8

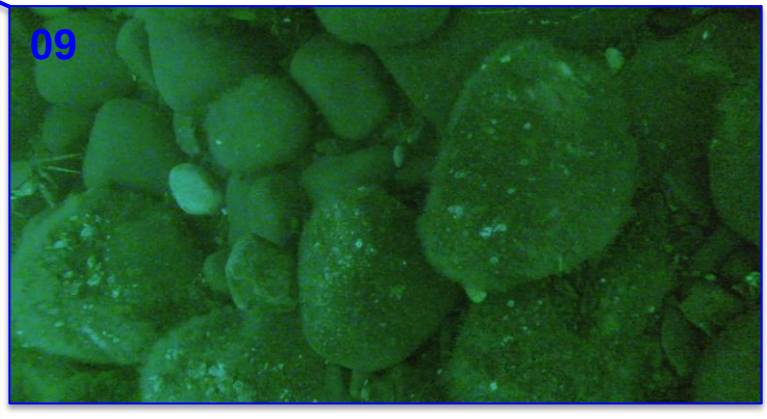
# Environment – Look and Listen (Seabed Video – Petit Passage)




Work conducted to assess seabed composition and benthos

Example of broad initial survey


25 – 30m depth
Productive habitat at north entrance to passage (starfish, crabs, mussels, etc.)



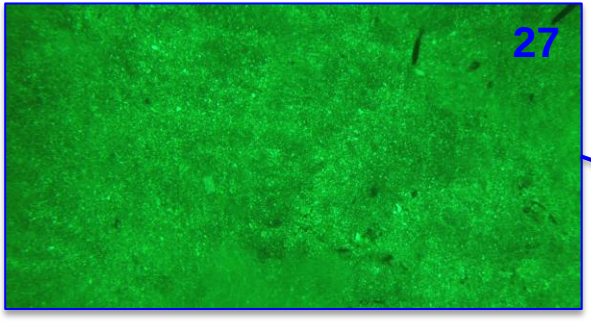

40 – 45m depth
Cobbles and crab at potential turbine berth site

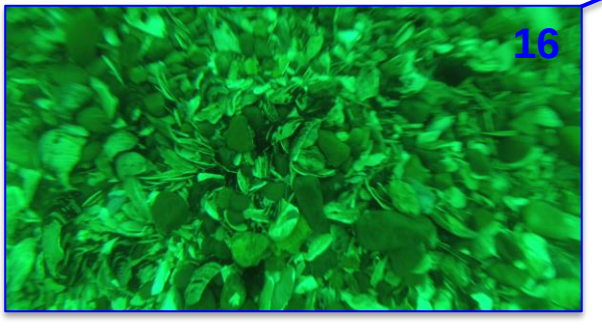
# Environment – Look and Listen (Seabed Video – Petit Passage)

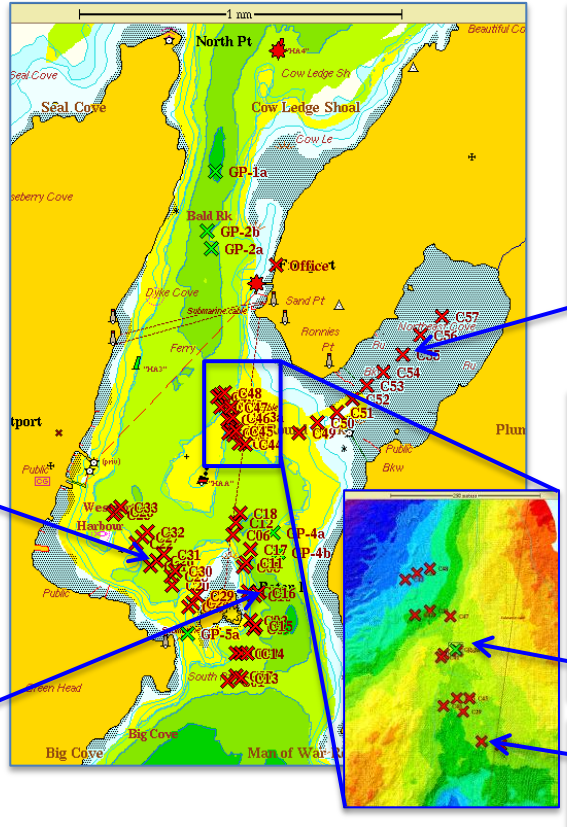
## Example of focused surveys

Investigating

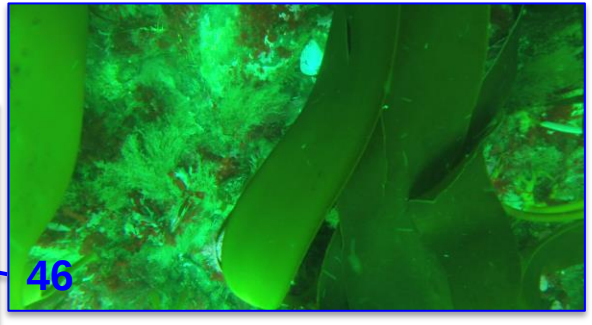
a) potential turbine berth site
b) areas for scientific interest

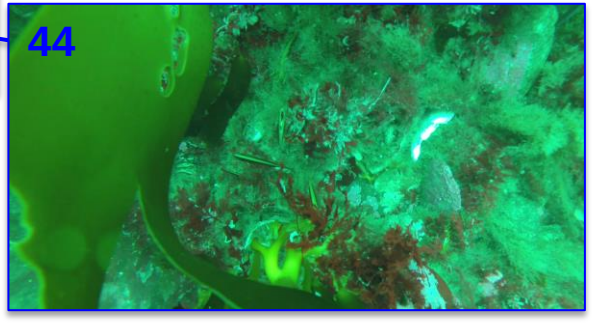






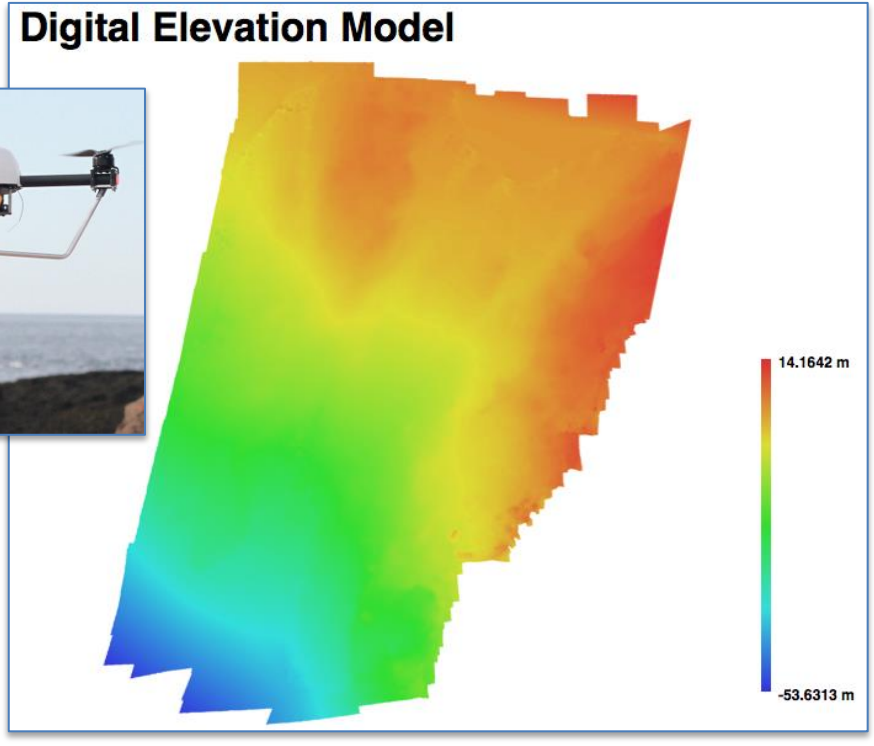

- Heterogeneous seabed
- Island wake effects
- Large mudflat / intertidal zone

# Environment – Look and Listen (UAV/Drone Survey)

Unmanned Aerial Vehicles (UAVs) used to survey the intertidal zone

- Useful for models, cable routing, and assessing intertidal benthos
- Collaborating with Scottish Association for Marine Science (SAMS)
- Conducted test in GP with SkySquirrel (Inverness, NS)

SkySquirrel technologies

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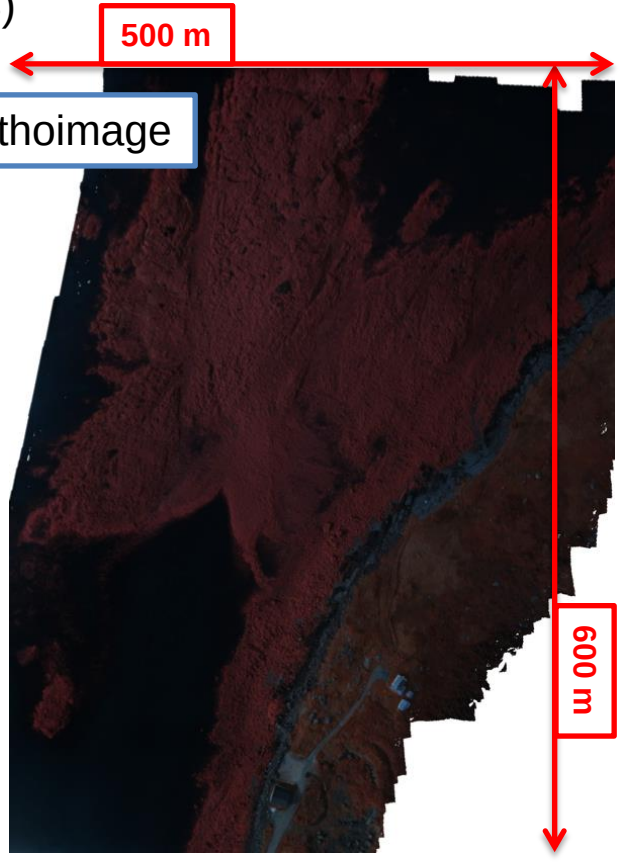


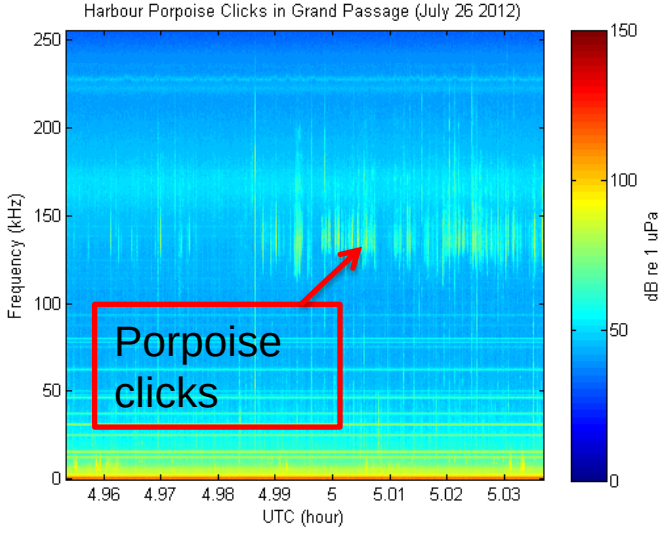
# Environment – Look and Listen (PAM with *ic*Listen – GP 2012)

**Initial research project**

Estimating acoustic detection ranges over tidal cycle as a partial basis for determining the feasibility of a PAM system for marine mammals [Undergraduate honours project at Dalhousie University (Dr. Alex Hay, Chloe Malinka)]

Challenges:

- Overcoming constraints on detection limits of naturally occurring noise at high-flow sites
- Ambient noise levels increase with current speed
- High background noise levels impact acoustic detection ranges for monitoring marine mammals

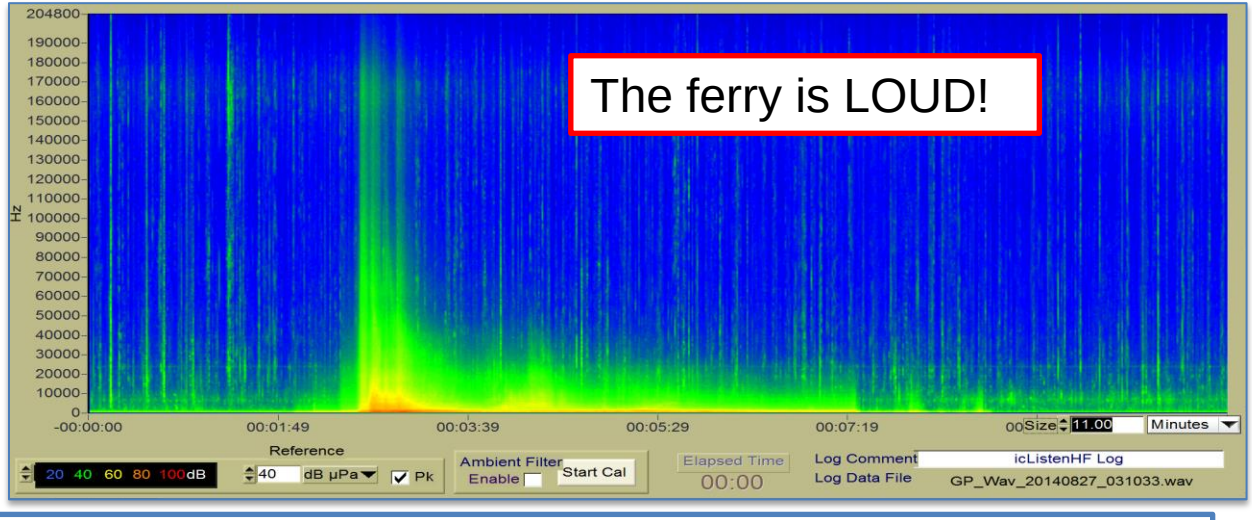


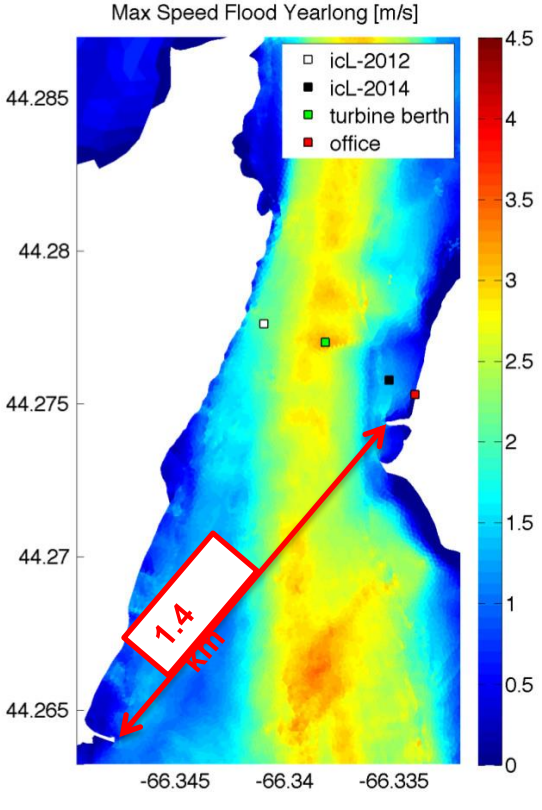

Ocean Sonics
The Smart Hydrophone Company

# Environment – Look and Listen (PAM with *ic*Listen – GP 2014)

Short term test with cabled icListen HF hydrophone

- deployed at sheltered low flow site adjacent to turbine berth
- continuous data collection, Aug 21 – Aug 28, 2014
- concurrent with dedicated marine observation periods
- 204.8 kHz FFT (7 days, 3 GB)
- 12.8 kHz wav (4 days, 28 GB)
- 204.8 kHz wav (3 days, 192 GB)



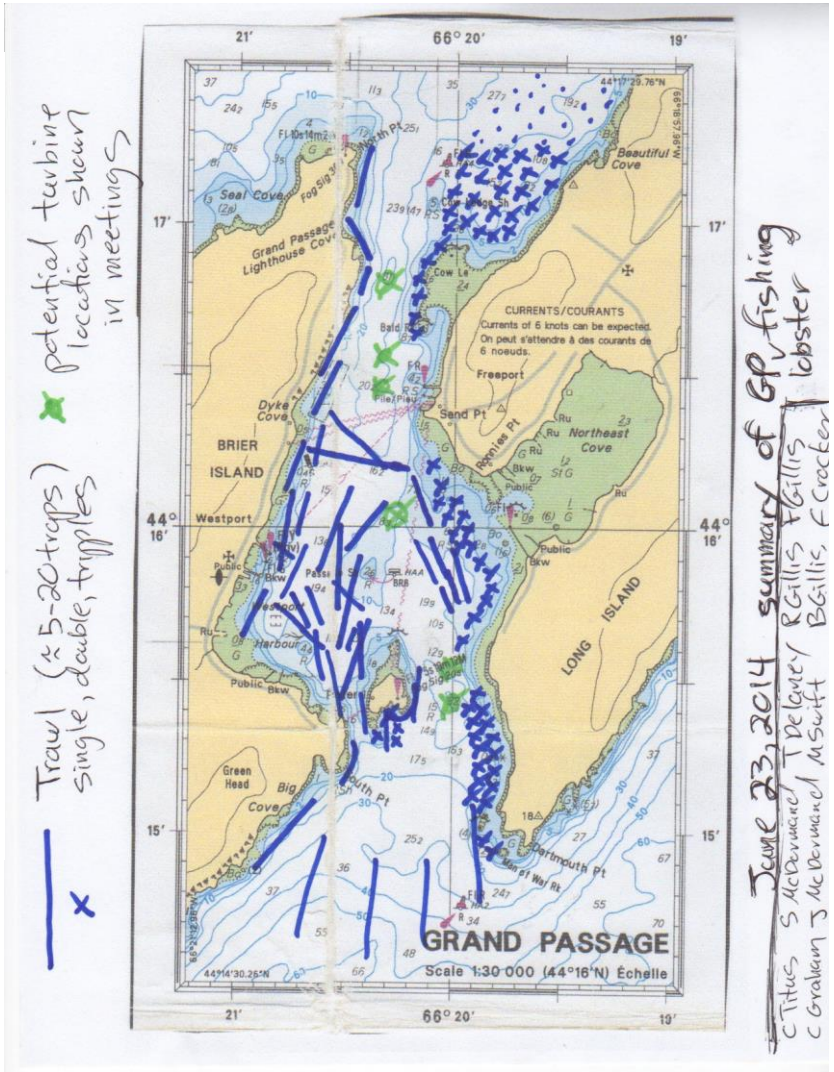




Planning longer term cabled deployment, test software for real-time animal detection and classification

# Environment – Look and Listen (Community Engagement)

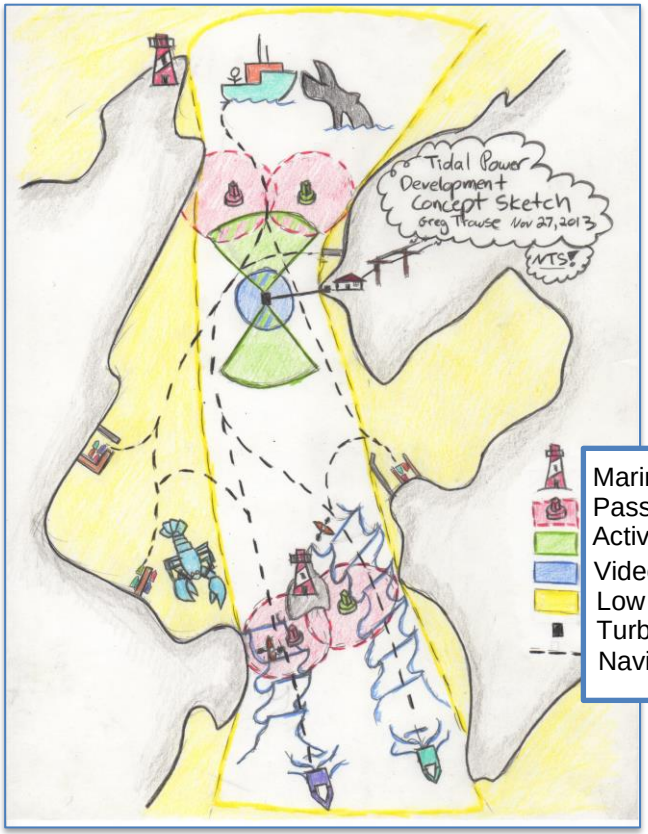
Door to door meetings held with several fishing captains from Freeport and Westport

- Individual discussions and input
  a) Potential turbine locations
  b) Valued fishing areas
  c) Navigation routes
- Generated combined map
- Minimal direct impact on fishing at turbine berth sites
- Cable route and navigation important considerations
- Most Captains not concerned about local traffic, vessels from away could be higher risk
- Community preferred site apparent



# Environment – Next Steps

Participate in collaborative work to focus on potential **near and mid-field** interactions between tidal turbines and marine life




- High species diversity and abundance
- Excellent test environment (flow, depth, visibility, infrastructure, community support)
- “Small-scale” projects may help answer questions required before moving to large array developments

- Background noise analysis (existing data)
- Benthic characterization, existing data and and focused surveys (foundations, moorings, cables)
- Fish detection from cabled ADCP data
- PAM real-time animal detection and classification
- PAM sound source localization in high-flow
- Drifting hydrophones
- Testing active acoustics with automated detection