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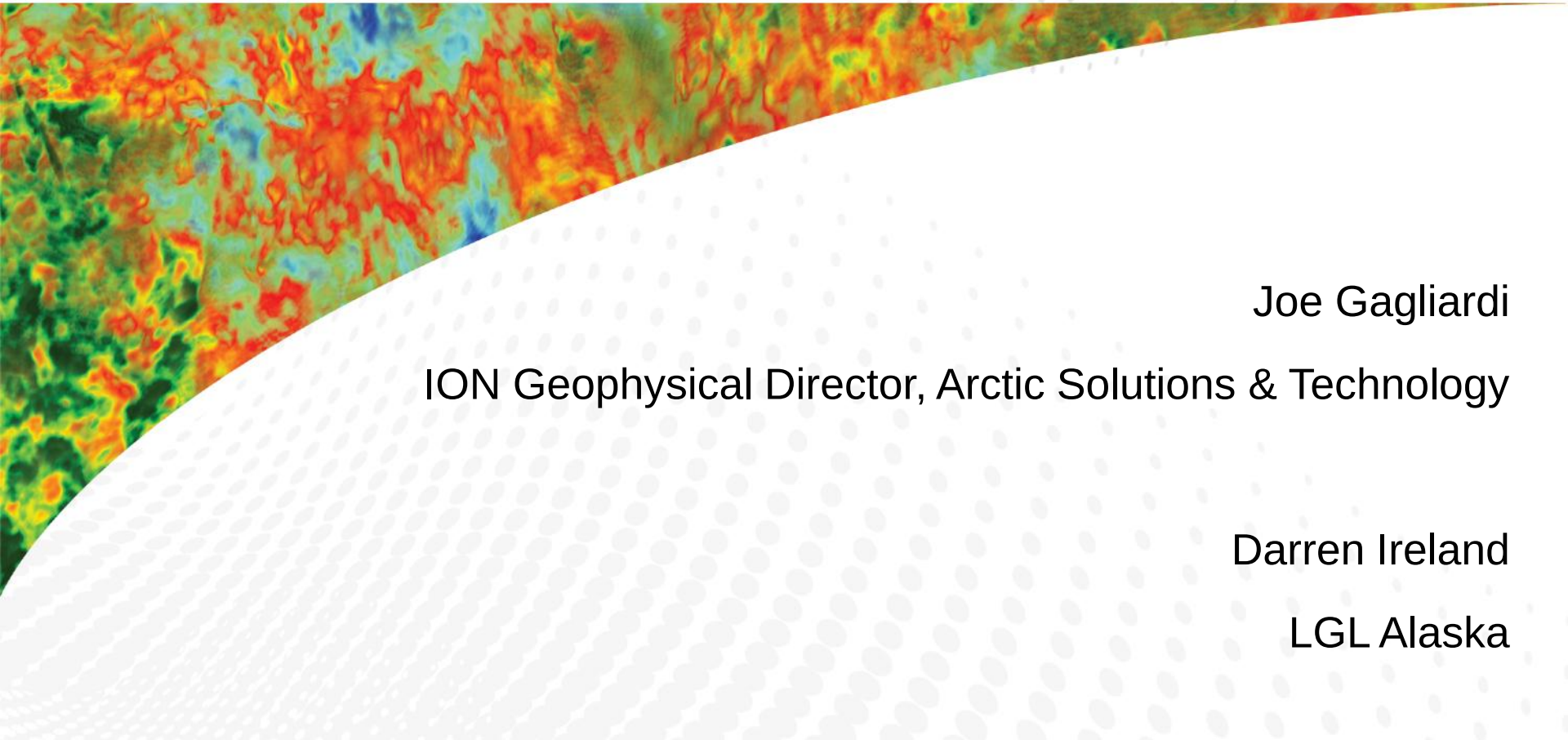
2012 BeaufortSPAN West 2D Seismic Survey

NMFS 2012 Open Water Meeting



Joe Gagliardi

ION Geophysical Director, Arctic Solutions & Technology

Darren Ireland

LGL Alaska

2012 BeaufortSPAN™ West Survey

- ION Arctic Experience.
- IA Arctic Solution Technology.
- 2012 BeaufortSPAN West 2D Survey.
- Stakeholder Outreach.
- Marine Mammal Monitoring and Mitigation.

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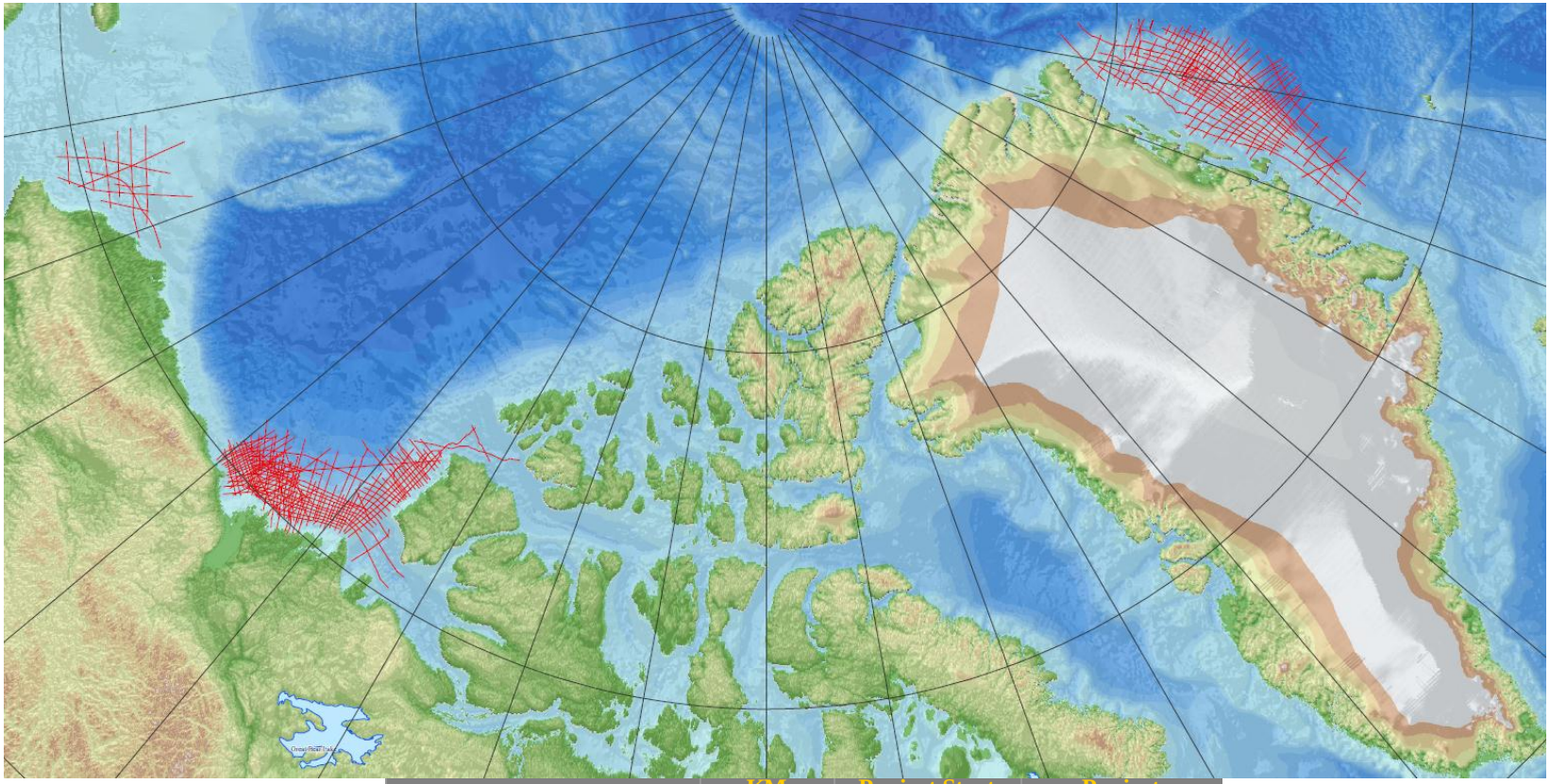
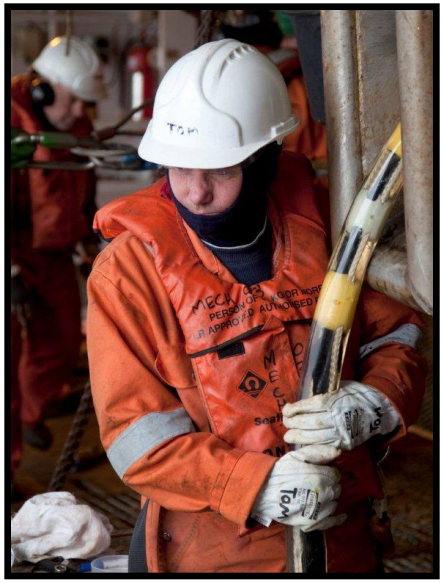
Is Arctic Focused



Project	KM Acquired	Project Start Date	Project Completion Date
NE Greenland III (2011)	5,128	August	September
Beaufort OBC (2010)	490	August	September
NE Greenland II (2010)	5,279	August	September
Beaufort IV (2010)	5,598	August	September
Flex Wave Test (2008)	6,535	July	September
Beaufort III (2008)	7,438	August	October
Beaufort II (2007)	5,645	August	September
Chukchi (2006)	3,129	October	November
Beaufort I (2006)	3,590	August	September
TOTAL	42,832		

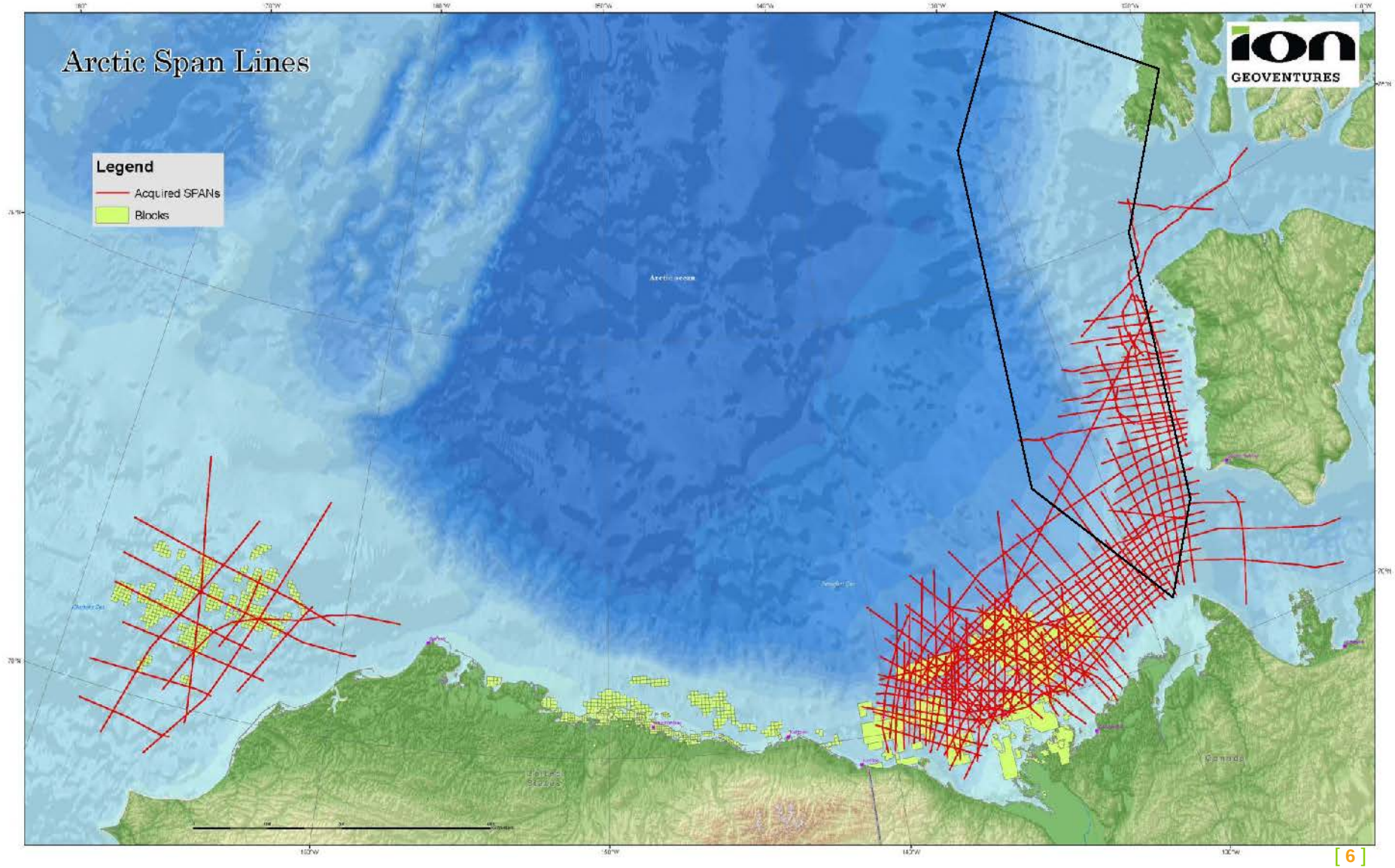
ARCTIC: MARINE HSE STATISTICS

Project	Man-Hours	TRIR	LTIF
NE Greenland (2010)	134,088	1.49	0
Beaufort IV (2010)	127,752	1.57	1.57
Beaufort OBC (2010)	196,472	1.02	0.00
NE Greenland (2009)	162,840	1.23	0.00
Flex Wave Test (2008)	24,092	0.00	0.00
Beaufort III (2008)	119,136	0.00	0.00
Beaufort II (2007)	77,412	0.00	0.00
Chukchi (2006)	52,992	0.00	0.00
Beaufort I (2006)	97,728	0.00	0.00
TOTAL	992,512	0.81	0.02

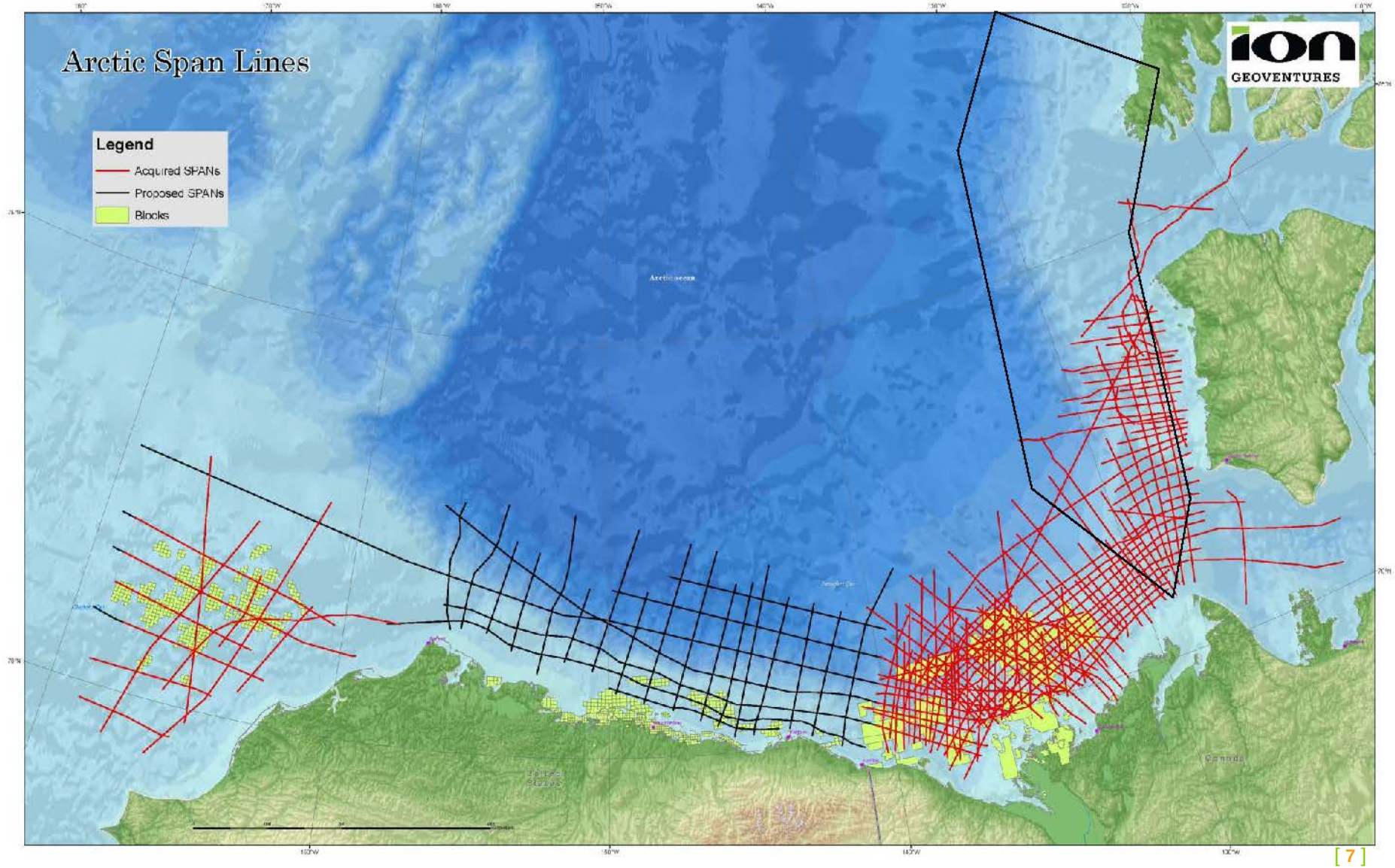


Project	First Aid Cases	Medical Treatment Cases	Restricted Work Day Cases	Lost Work Day Cases
NE Greenland (2010)	0	1	0	0
Beaufort IV (2010)	0	0	0	1
Beaufort OBC (2010)	0	0	1	0
NE Greenland (2009)	2	1	0	0
Flex Wave Test (2008)	0	0	0	0
Chukchi (2006)	0	0	0	0
Beaufort III (2008)	0	0	0	0
Beaufort II (2007)	5	0	0	0
Beaufort I (2006)	0	0	0	0
TOTAL	7	2	1	1

Regional Acquired Survey Maps



Regional Acquired & Planned Survey Maps



2012 BeaufortSPAN™ West Survey

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The Method Of Acquisition

- ISS
  - Arctic Operational Experience
    - Ice Management
    - Project Execution
  - Handling Equipment
    - Ice Skeg
    - Source flotation
- GX Technology
  - Arctic Focused Noise Removal
    - Ice Breaker Noise
    - Rugose Base Ice Noise
    - Submerged Permafrost
    - Larner Noise
    - Coherent Seismic Interference

- MISD
  - DigiStreamer
    - Continuous recording
    - Non foam matrix design
  - DigiFin
    - Cable defense
  - CompassBird
    - Upgraded for Arctic conditions
      - Cold conditions
      - Magnetic declination
- Concept Systems
  - Orca
    - Integration with “Ice Nav”
    - Ghost Streamer capable
    - High latitude flexible

Survey Operations

Ice Escort Operations

Ice Conditions Expected

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2012 Survey Vessels

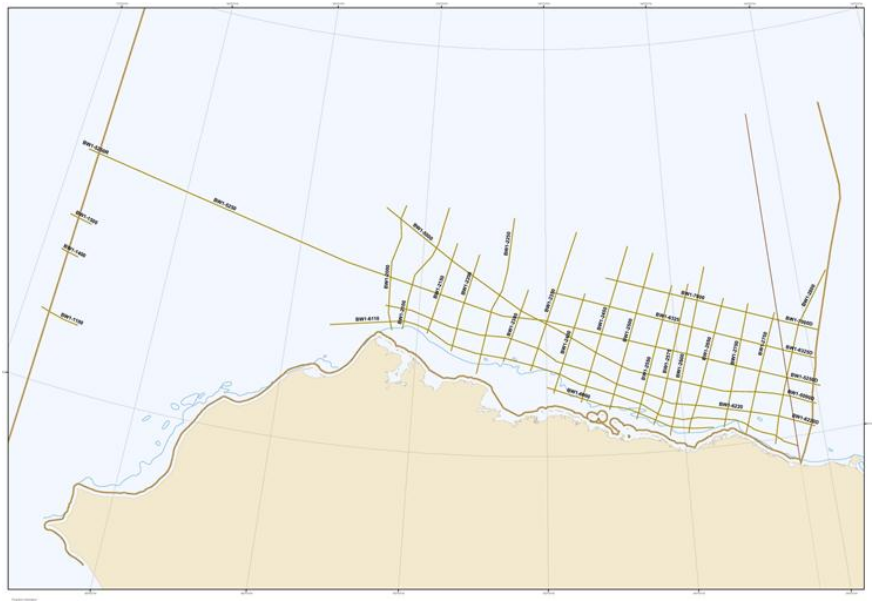
Geo Arctic – Seismic Vessel

Polar Prince – Support Vessel

Vladimir Ignatyuk – Icebreaker

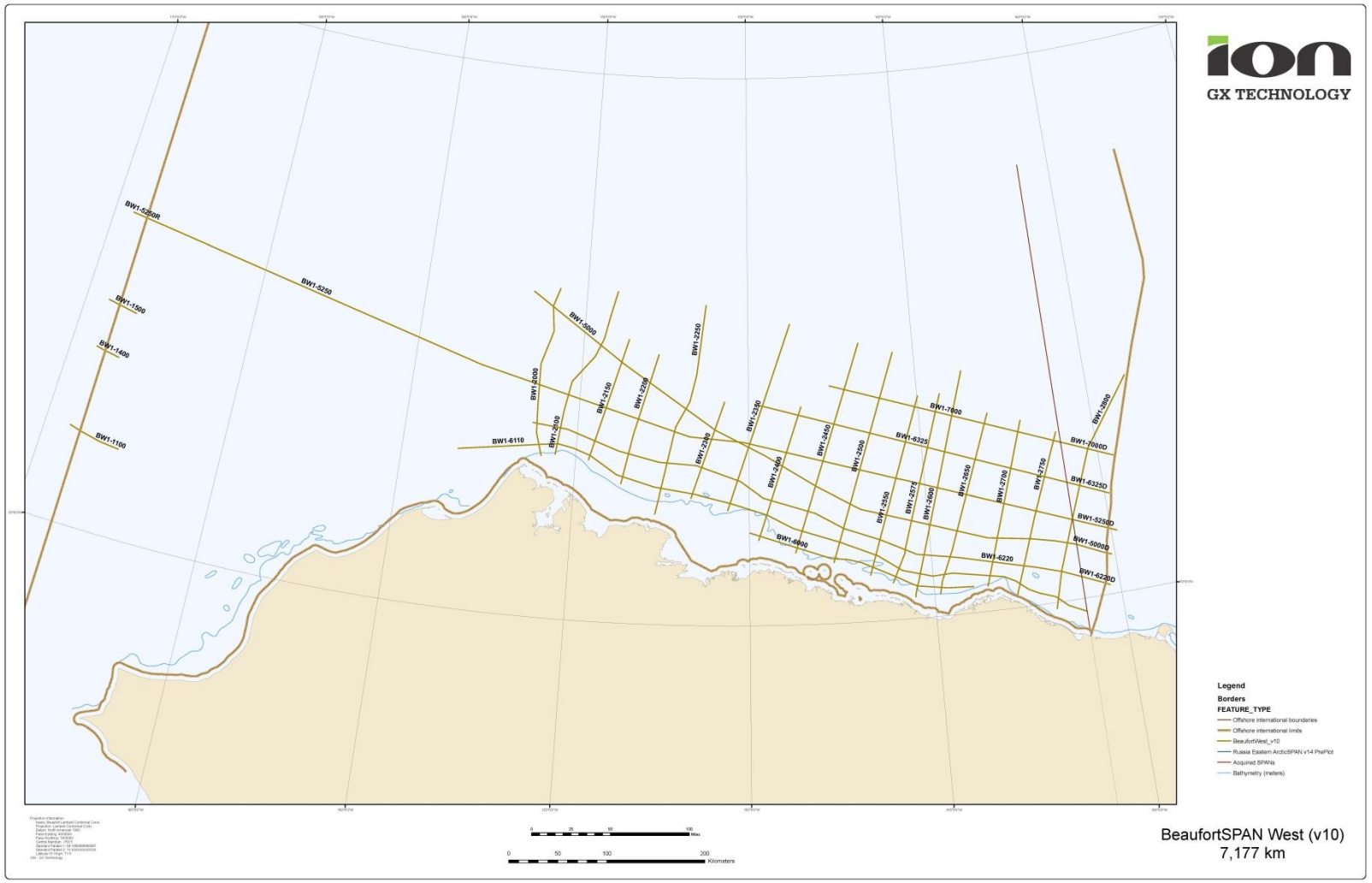
2012 BeaufortSPAN™

- Proposed 7,177 kms
- Proposed acquisition time line
  - October & mid December 2012
  - Timed to avoid whale hunts and whale migrations
- Proposed acquisition parameters
  - Recording
    - Streamer Length 9,000 m
    - Group Interval 25 m
  - SOURCE ARRAY
    - Array: 4,450 CUIN
  - RECORDING
    - Record Length 18.0 seconds
    - Shot Point Interval 50m



2012 BeaufortSPAN™ West Program

- Proposed 7,177 kms miles



Acquisition in October to mid December 2012

Ice Conditions Expected

- Ice Operations
- Continuous forward motion required
- No backing and ramming
- Ice conditions anticipated
  - 100% or 10/10^{ths} Ice
  - Less than 2 feet thick.

10/10^{ths} Ice

9/10^{ths} Ice

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- Stakeholder Outreach.
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Stakeholder Outreach 2010

- 2010 Stakeholder Outreach
  - Met with the NSB Wildlife Department
  - Presented project to NSB Planning Commission
  - Attended AEWC 2010 Annual Captains' Mini Convention
  - Presented project at the 2010 NMFS Open Water Meeting
  - Met with Barrow, Nuiqsut, and Kaktovik leadership
  - Held public meetings in Barrow, Nuiqsut, and Kaktovik
  - Attended AEWC 2010 4th Quarter Meeting

Stakeholder Outreach 2011

- 2011 Stakeholder Outreach
  - Attended AEWC 2011 Annual Captains' Mini Convention (Feb 18)
  - Held public meetings in Barrow, Nuiqsut, and Kaktovik (Feb & March)
  - Presented project to the NSB Planning Commission (Feb 24)
  - Notified AEWC that project was postponed at AEWC quarterly meeting
  - Held meetings in Aug 2011 notifying communities project was postponed

Stakeholder Outreach 2012

- 2012 Completed Meetings
  - Met with AEWC Commissioners on December 12, 2011 to discuss planned 2012 CAA
  - Public meetings were held in Kaktovik and Barrow January 23 through January 25
  - Met with Barrow Whaling Captains Association on January 25
  - Attend 2012 AEWC CAA meeting February 16 and 17
  - Met with Wainwright Whaling Captains Association February 20
  - Public meeting was held in Nuiqsut February 21
  - Attend Open Water Meeting March 6 through March 8

Conflict Avoidance Agreement

- ION has signed a Conflict Avoidance Agreement with the AEWC and the affected villages.

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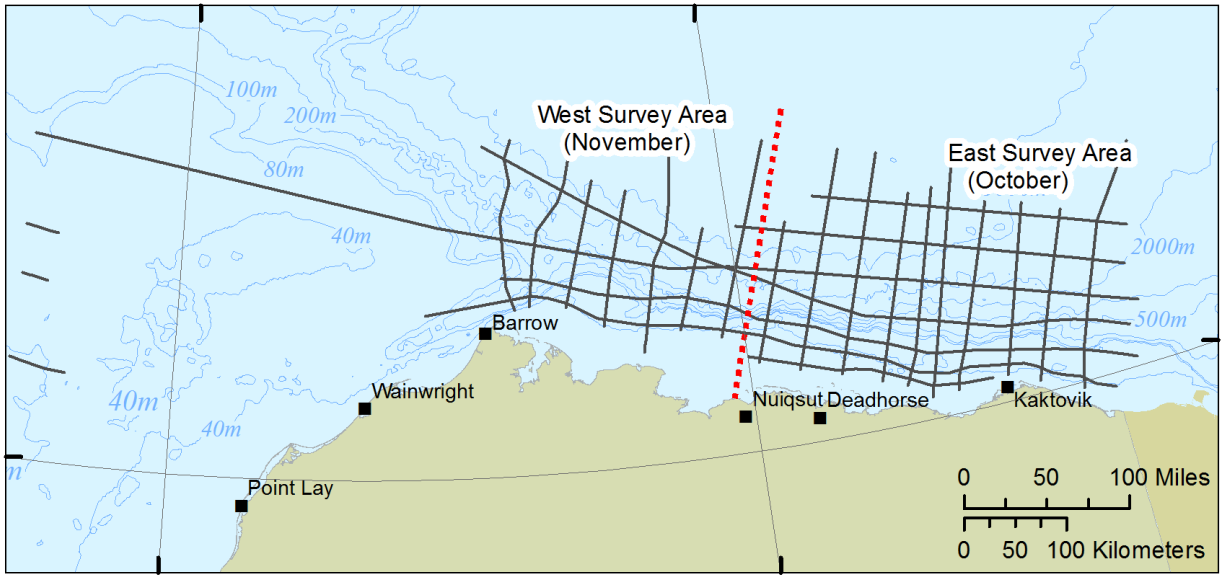
Marine Mammal Monitoring

- Overall objectives:
  - Implement mitigation measures to minimize impacts
  - Document marine mammal presence near seismic operations and any observable reactions
  - Collect baseline data on marine mammal occurrence in study area during non-seismic periods
  - Measure sounds produced by airguns and icebreaking

Marine Mammal Monitoring

- Primary mitigation measure is timing
  - Start 1 Oct (or after completion of Kaktovik and Nuiqsut bowhead whale subsistence hunts)
  - Avoid October bowhead hunt in Barrow and most migrating whales by working East to West
  - End late November or early December



Marine Mammal Monitoring

- Vessel based observers
  - 3 on ice-breaker (operating ahead of source vessel)
  - 2 on source vessel
  - 3 on support vessel

- On watch for:
  - all daylight seismic operations
  - most daylight non-seismic operations
  - 30 min before, and during start ups

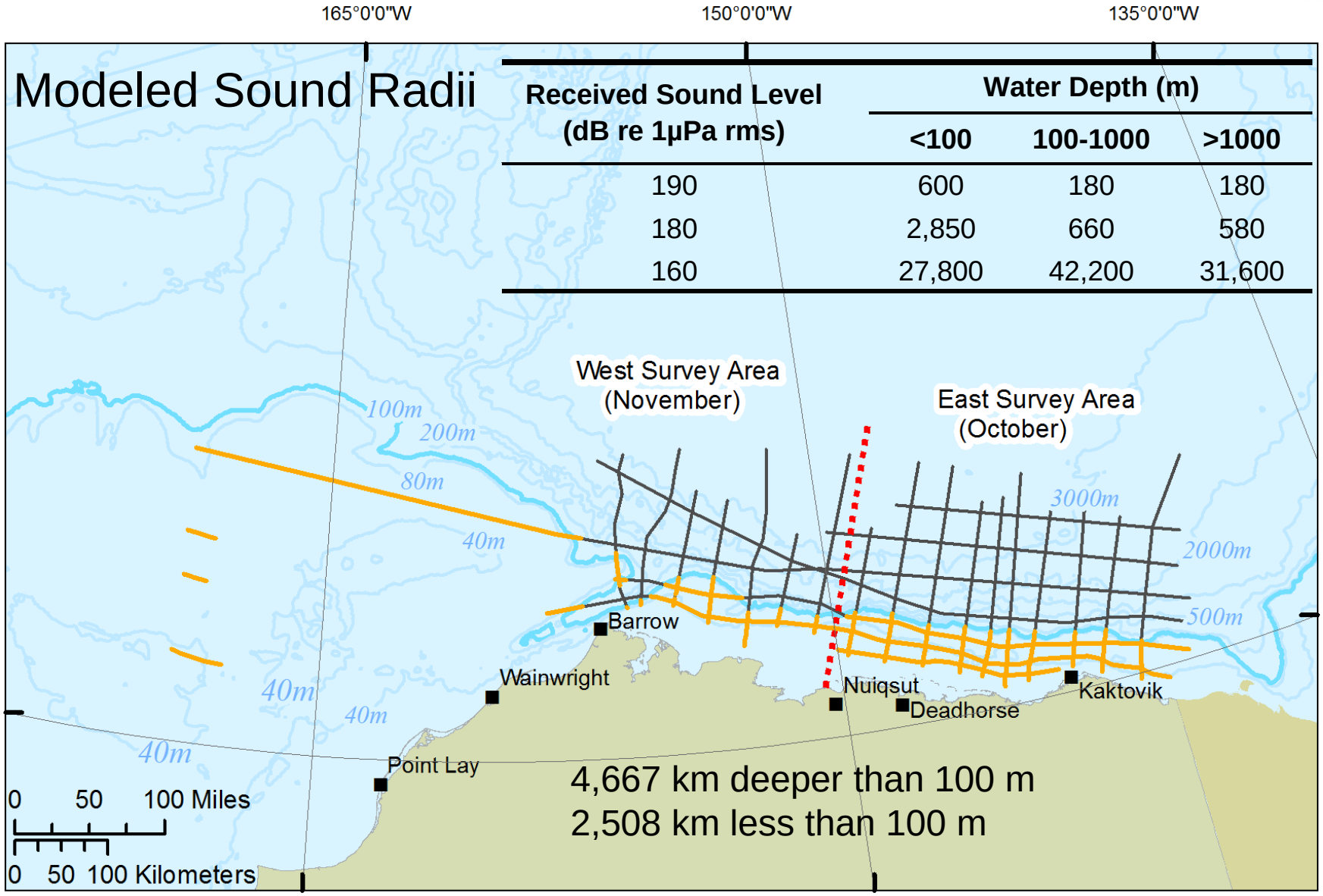
Marine Mammal Monitoring

- Ensure safety radii are clear of marine mammals for 30 minutes prior to and during start-ups
  - 180 dB zone for cetaceans and walruses
  - 190 dB zone for pinnipeds and polar bears
- Start ups only performed when full safety radii are fully visible for ≥30 min

Marine Mammal Monitoring

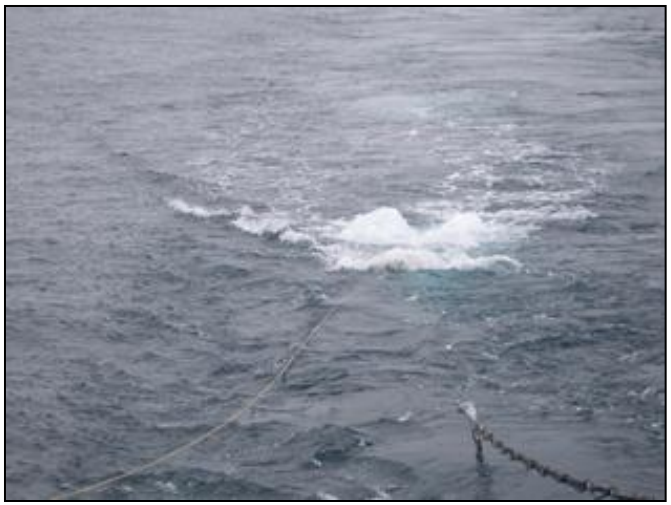
- Modeled Sound Radii

Received Sound Level (dB re 1µPa rms)	Water Depth (m)		
	<100	100-1000	>1000
190	600	180	180
180	2,850	660	580
160	27,800	42,200	31,600



Marine Mammal Monitoring

- Continually monitor safety zones during daylight airgun activity
  - Power down to mitigation gun if a marine mammal is sighted within or likely to enter the full airgun array safety radii
  - Shut down of all airguns if a marine mammal is sighted within or likely to enter the mitigation airgun safety radii

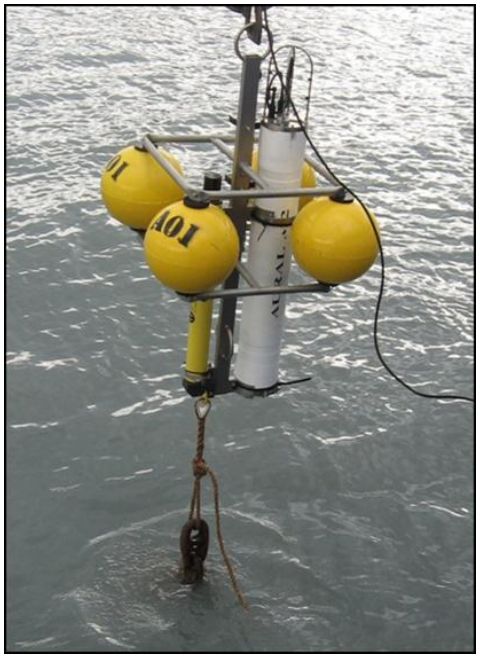


Marine Mammal Monitoring

- Implement any additional mitigation measures stipulated by NMFS and USFWS IHAs
- Big-eye binoculars for use during daylight
- Infrared camera (FLIR) on ice-breaker and support vessel for testing and evaluation

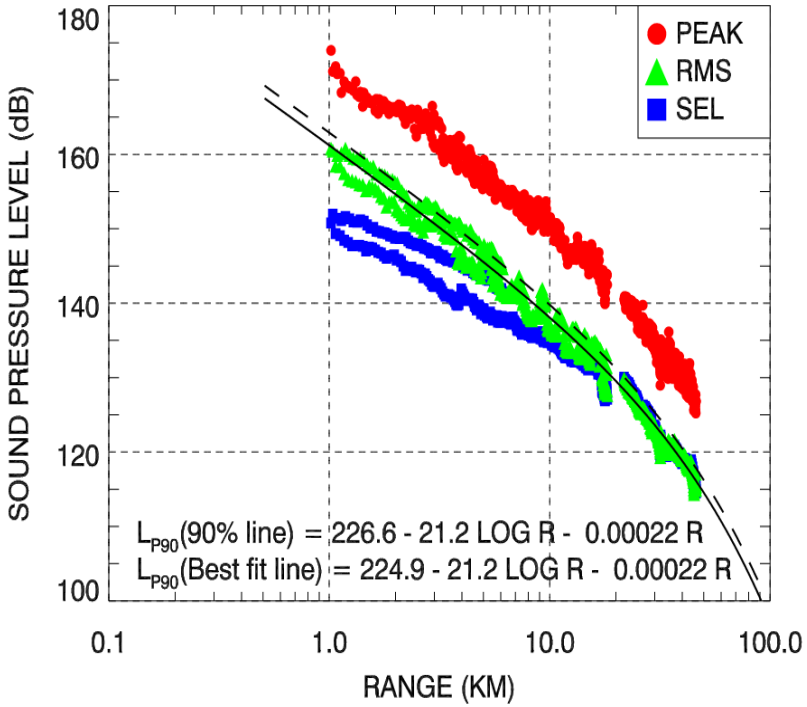
Marine Mammal Monitoring

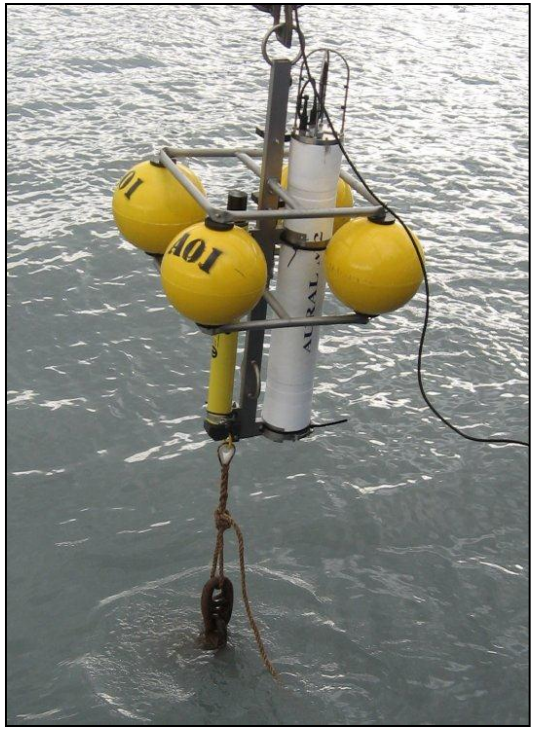
- Acoustic Monitoring
  - Sound Source Measurements
  - Seismic Streamer Acoustics Records
  - Over-winter Acoustic Recorders
  - Acoustic Monitoring from the Support Vessel



Marine Mammal Monitoring

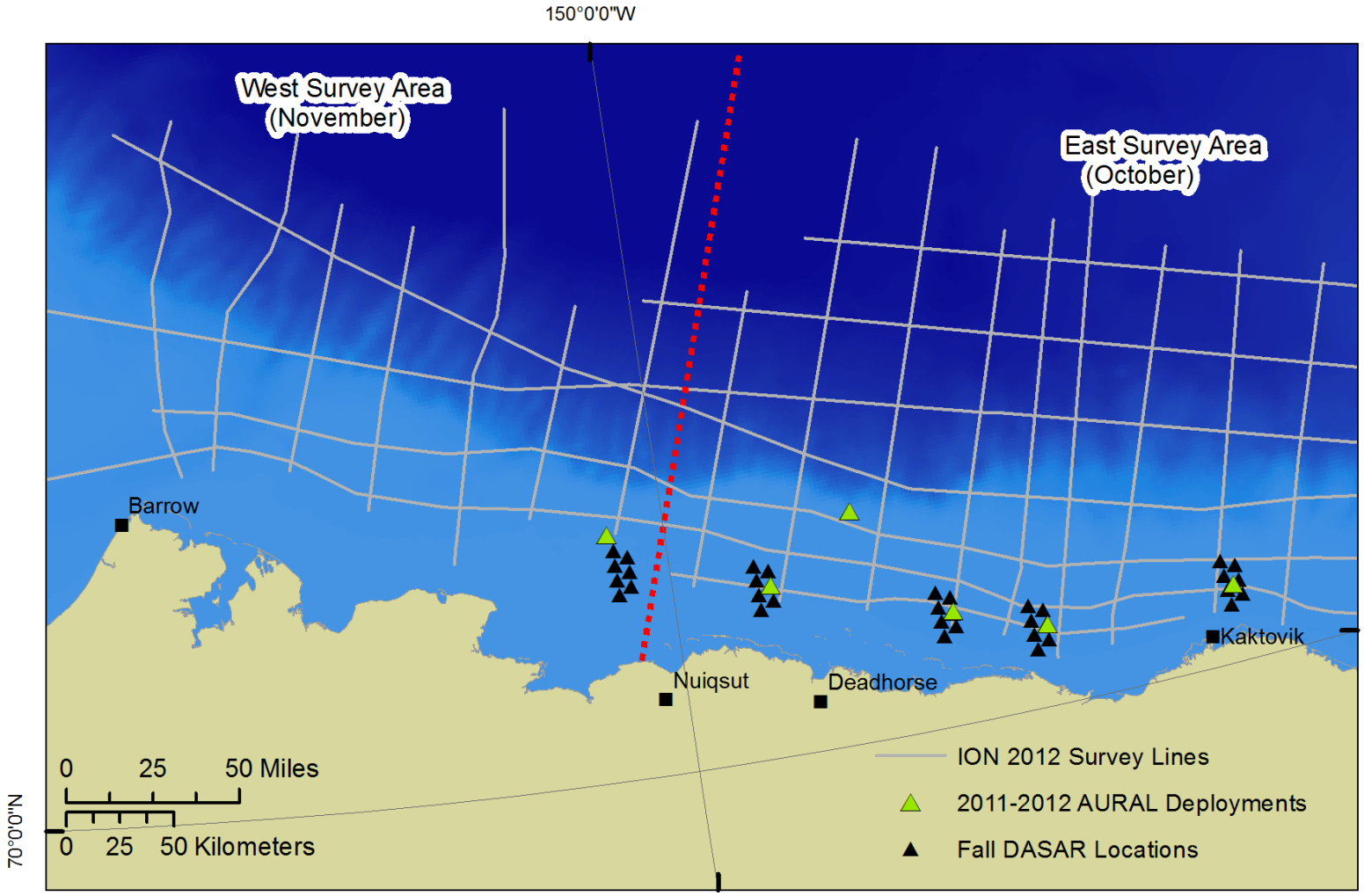
- Sound Source Measurements
  - Conducted at the start of the survey
  - Revise safety radii, as needed, for implementation by MMOs





Marine Mammal Monitoring

- Over-winter Acoustic Recorders



Marine Mammal Monitoring

- Acoustic Monitoring from the Support Vessel
  - Real-time acoustic data on icebreaking sounds and seismic sounds in ice-covered waters
  - Sonobuoys
    - Less self-noise contamination
    - Limited functional period once deployed
    - Not recoverable
  - Towed Hydrophone System (PAM)
    - Self-noise contamination
    - Likely to lose or damage equipment due to ice
    - Unlikely to be successful

Marine Mammal Monitoring

- Estimated Cetacean and Pinniped Exposures to Airgun Sounds ≥160 dB rms

	Water Depth							
	<200 m		200–1000 m		>1000 m		Total	
Species	**Avg.**	**Max.**	**Avg.**	**Max.**	**Avg.**	**Max.**	**Avg.**	**Max.**
Odontocetes								
Beluga	43	173	1,195	4,780	3,077	12,308	4,315	17,261
Harbor porpoise	9	37	2	6	10	40	21	84
Mysticetes								
Bowhead whale	269	1,073	3	12	10	40	282	1,125
Gray whale	9	37	2	6	10	40	21	84
Minke whale	9	37	2	6	10	40	21	84
Humpback whale	9	37	2	6	10	40	21	84
Pinnipeds								
Ringed seal	59,445	86,727	808	3,231	40	161	60,293	90,119
Bearded seal	37	149	13	53	40	161	91	363
Spotted seal	9	37	3	13	10	40	23	91
Ribbon seal	9	37	3	13	10	40	23	91

Marine Mammal Monitoring

- Estimated Exposures to Icebreaking Sounds ≥120 dB rms, if refueling occurs

	Water Depth (m)				Total	
	200–1000		>1000			
Species	**Avg.**	**Max.**	**Avg.**	**Max.**	**Avg.**	**Max.**
Odontocetes						
Beluga	253	1,010	320	1,281	573	2,291
Harbor porpoise	0	1	1	3	1	4
Mysticetes						
Bowhead whale	1	2	1	3	1	5
Gray whale	0	1	1	3	1	4
Minke whale	0	1	1	3	1	4
Humpback whale	0	1	1	3	1	4
Pinnipeds						
Ringed seal	181	726	3	11	184	737
Bearded seal	1	3	3	11	4	14
Spotted seal	0	1	1	3	1	4
Ribbon seal	0	1	1	3	1	4

Marine Mammal Monitoring

- 90-day technical report
  - Address requirements of permits and agreements
  - Quantify monitoring effort
  - Summarize marine mammal sightings (e.g., species, numbers, locations, age/size/gender, environmental correlates)
  - Describe power downs, shut downs, and ramp up delays
  - Analyze factors influencing detectability of marine mammals
  - Estimate number of marine mammals exposed to industry sounds
  - Analyze effects of seismic operations (e.g., on sighting rates, sighting distances, behaviors, movement patterns)

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