



2008/2009 Annual Report Volume II - Appendices

JOINT OBSERVATIONAL STUDY (JOS)

Seaway Shoreline Icebreaking Impacts Between Snell Lock & Lake St-Francis

Prepared by

JOS PROJECT MANAGEMENT TEAM

Under the direction of

KIJE SIPI LTD

and under the technical leadership of

BMT FLEET TECHNOLOGY LTD

June 2009



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1. APPENDIX A: SUMMARY OF 2007/2008 ANNUAL REPORT



SUMMARY

As stipulated in the 2006 *Memorandum of Understanding* a project management structure was established in the autumn of 2006 to oversee the three (3) year observational study. This included the selection of a study coordinator in 2006 and the addition of an ice specialist in 2007. The study team has now successfully completed two (2) of the mandated three (3) years of observation.

Eight (8) meetings were held this year to review progress and prepare for the more comprehensive spring ice clearing observation program. Specifically, half of the meetings brought together the **Steering Committee** while the other meetings were technical discussions focussed on developing and organizing the field observation program. Minutes were taken at all meetings and were generally approved at the following meeting.

The study coordinator maintains a register of all study expenses including the reported **In-Kind** contributions by all parties. A total of **\$60,711.22** was charged to the study this year bringing the total expenditures to-date to **\$73,367.46**, or approximately **56.4%** of the currently allocated **\$130,000.00**. Also, a total of **\$23,765.00** was recorded as **In-Kind** charges to the study during this second reporting period bringing the total study **In-Kind** charges to **\$33,758.00**. A significant portion of this year's contributions are attributable to the **St. Regis Mohawk Tribe**. They repeatedly provided technical personnel and transportation for the field portion of the **Work Program**.

A password-protected electronic document archive site was established early in the study and is still actively maintained by the study coordinator and accessible via the internet by all members.



Four (4) letters in total were distributed this year. Two (2) letters of appreciation; one letter was sent to the captain of the CCGS **Martha L. Black** for welcoming on-board two (2) JOS team observers and, the other letter was forwarded to the **Canadian Ice Centre** for providing multiple **RADARSAT** imagery. Their superiors were also copied. Two (2) letters were also drafted and provided to border patrols and police agencies in order to accelerate transit between the countries. The letters also served notice of the frequent **JOS** field activities that could otherwise be construed as suspicious.

Only one (1) significant issue arose during this second year of the study. It involved a landowner that refused to grant access to his property in order for a **JOS** observation team to complete shoreline measurements. Unfortunately, this occurred on the day of spring observations, while the icebreaker was clearing the channel; and consequently, one (1) of three (3) observation sites had to be eliminated. Closure was brought to this issue in the following days when representatives from both tribes went to clarify the situation with the landowner to ensure no ill-feeling. Finally, several **Steering Committee** members apologized to their respective employees who were directly involved during this unfortunate event.

A detailed **Technical Work Program** was developed and approved by the **Steering Committee** in early **2007**. This document served as a guide for all study team activities in **2008**. The main components of the program that were initiated or completed this year include:

- Study Site Field Program.
- Establish a **Monitoring System** for the winter/spring of 2008.
- Collect and analyze observational data during the winter/spring of 2008.
- Report findings and conclusions and make recommendations.

This second year of the three-year mandate saw a dramatic increase in field activities. This is in part due to having acquired specialized technical resources



during the year and, as a result, the **JOS** study team was able develop a more rigorous and comprehensive field observations plan. The technical findings are all documented in this annual report.

In addressing the central question of this study it is concluded, in principle, that during the **2008** spring ice clearing operations of the **Seaway Channel** within the study area, there were no observable shoreline physical impacts. This statement is supported by the many types of observations as outlined in the following list of specific conclusions:

Shoreline Surveys

1. Field surveys were completed during the fall of 2007 to ascertain if the potential observation sites identified during the previous year were feasible locations for the study. Accessibility and site representativeness requirements reduced this original set of sites. Eventually, only three (3) sites were retained for shoreline observations during ice clearing operations while other sites were selected for pre/post winter shoreline change assessments.
2. Although surveyed vertical elevation profiles were intended to be completed at each site, the task proved time-consuming and ultimately not focused on the water's edge where the subject impacts occur. A simpler survey approach was devised and eventually used on all but one site; however, a number of limitations were experienced including difficulty in winter re-survey and inaccuracies in re-locating reference stakes. This simplified method will require adjustment if the technique is retained for next year.
3. No major shoreline changes were visually identifiable at each of the three (3) surveyed sites. No evidence of ice-induced shoreline damage, such as berms, ridges or scars were observed.



4. Although variations in elevations were noted at several sites, these were considered well within the resolution of the survey technique and consequently not indicative of any slope movement.
5. All but two (2) of eight (8) marked shoreline stones that were originally surveyed in the fall of 2007 showed no significant movement over the course of the winter. Further analyses revealed that the movement of those two (2) stones might be explained by wave action rather than any ice impacts, their weight being less than that required for stability when considering the observed wave height of a passing ship during the spring survey.

Ice Conditions Index - Freezing-Degree Days Evaluation

6. Following last year's recommendations, the **Freezing Degree Days (FDDs)** index method was re-evaluated as a means to characterize the severity of winters and indirectly infer the ice conditions within the seaway channel. Two methods were assessed: (a) the method used by the **Canadian Ice Service (CIS)**, and; (b) the method traditionally used by the **Saint Lawrence Seaway**. The "**Saint Lawrence Seaway**" method produced **FDDs** totals that were on average only 3 to 4% higher than those obtained from the **CIS** method. However, it is clear that the results from the two methods are closely related. Consequently, the same general trends would be obtained by using either method.
7. **FDDs** were also compared using meteorological data from **Massena, NY** versus **Dorval, QC** in order to investigate the suitability of each as the basis for an index. The **FDDs** at **Massena** and **Dorval** both exhibit the same trends. On average, the **FDDs** calculated for **Massena** were 4 to 5 % less than those at **Dorval**, although clearly, the results for each site are correlated with each other. Consequently, the same general trends would be obtained by using either method.
8. Historically, the accumulated **FDDs** on the **Seaway Opening Date** have varied greatly, from a minimum of less than 400, to a maximum of over 1000.



This reflects natural variability in winter conditions, as well as changes in the **Seaway Opening Date** from year to year. **FDDs** at **Dorval, QC** on the **Seaway Opening Date** for **2008** were slightly below the average for the **1984-85** to **2007-2008** winters (712 vs 758 respectively, using the **CIS** method to calculate **FDDs**).

9. Two index methods using **FDDs** were investigated based on historical data (which unfortunately do not include ice temperature measurements) as they are both measures of the degree of deterioration that the ice sheet would have experienced on the **Seaway Opening Date**:
 - (a) Number of days between the **Seaway Opening Date** and the date when the peak **FDDs** were reached.
 - (b) Difference between the **FDDs** on the **Seaway Opening Date** versus the peak **FDDs** that were reached during the winter.

Both of these indices showed significant scatter. For various reasons, they can not be relied upon as independent measures. The most significant limitation is that information defining the winters in which significant ice-induced problems occurred, and didn't occur, is not available. This limits the extent to which the above "index" analyses can be used at present.

Water Levels

10. Water level records were reviewed this year. The spring **2008** water level data was 14-18 cm higher than the long-term average. Furthermore, the water level on the **Opening Date** was also higher, by 19-20cm as compared to the previous years, dating back to **1984**.

Evolutions of Ice Cover & Properties

11. The formation of an ice cover over the course of a winter plays an important role in defining its state at any given time within the winter. Consequently, observations were made during the winter to track the development of the ice cover. This was accomplished using **RADARSAT** satellite imagery, aerial reconnaissance flights and ground-level (ice/land) observations. The aerial surveys and ground-level data were particularly useful to ground truth the



satellite data while the **RADARSAT** data itself was particularly useful to provide insight on the overall development and macro structure of the ice cover. A higher level of detail was also obtained from each aerial flight survey. These sources of information were practically essential to supporting field observations.

12. Ice thickness and temperature profiles were gathered several times during the winter and spring in order to evaluate ice strength leading up to the ice clearing operations. The data was also correlated with **FDDs** computations as a means to assess the indices. The minimum ice temperature (-1.7°C) was recorded on **March 6** while the average value was near zero on the day of ice clearing.

Ice Clearing Observations

13. The ice clearing operations on **March 20th, 2008** were again observed and documented this year from the vantage point of the icebreaker **CCGS Martha L. Black**; however, difficulties further downstream delayed the ship's arrival to the study area. The on-ship observers arrived under the full cover of darkness thereby limiting the direct recording of any shoreline impact near the target observation sites. Nevertheless, ice clearing immediately downstream of the study site (**Lac St. Francis**) was documented in daylight and yielded good insight on the ice clearing operations that day. It was noted that the **USCGC Penobscot Bay** followed the **CCGS Martha L. Black** and widened the broken channel by transiting along the northern edge of the track left behind by the **CCGS Martha L. Black**. The width of the broken track left behind the **CCGS Martha L. Black** was close (tight) to the ship's beam, and it did not close in the channel, indicating that the ice was not pressurized. Furthermore, significant ice cracking did not occur along the edges of the broken track, indicating that the ice was relatively weak and soft at the time.
14. A review of the icebreaker's speeds during the ice clearing operations indicated they were similar to those of last year. Furthermore, the ship had to



- back-and-ram again this year. In both years, ramming was required in the reach defined by the **South of Cornwall Island** to **Raquette Point**. This area generally corresponds to the area of ice rubble build-up during ice cover formation that was previously identified on the **RADARSAT** imagery.
15. Improving on last year's simplistic ice marking technique, an array of stake-mounted targets was devised to be deployed at the three selected observation sites. Unfortunately, the site on **Cornwall Island** was abandoned when the landowner refused access to the shoreline. Nevertheless, the arrays were deployed at two sites and surveyed before the passage of the icebreaker and again the next day. No ice movement was detected at either of the two sites.
 16. Although one significant crack was documented near and, running parallel to the shore, it was attributed to changes in water levels and not ice clearing operations. The resulting ice-cleared channel was further investigated on **March 21st** by venturing out onto the ice, alongside the broken track left by the **CCGS Martha L. Black** and the **USCGC Penobscot Bay**. As noted by the observers onboard the **CCGS Martha L. Black**, the width of the broken track was only slightly more than the combined width of the vessels while the ice beyond this track remained unbroken. The neatly cleared open ice channel was clogged with ice pieces, which were in the process of re-freezing together. Again, no cracks or movements were observed running from the channel to the shoreline.
 17. It was recognized that ice-induced shoreline impacts could potentially occur after the ice-clearing operations due to moving ice floes created and "set free" by the icebreaking operations. This was investigated by using both aerial and land based observations in the week following the ice clearing operations. The study team did not observe any significant ice-induced post-clearing impacts.



18. Analyses were completed to estimate the actual forces applied on the shoreline during the icebreaking operations, especially those during **March 20th, 2008**. These forces are of interest to the study team for obvious reasons as they have a significant effect on the magnitude of any potential shoreline impacts caused by the icebreaking. Using a conservative approach, the calculations revealed a very low range of contact pressures (0.2 to 0.4 kPa) that is about 1,000 to 10,000 times less than the pressures at which ice failures tend to occur. The icebreaking forces were also compared to the expected drag forces resulting from a strong wind blowing over an ice surface (60 knots). The exploratory calculations showed that the icebreaking forces applied to the shoreline were significantly less than those expected from wind drag.
19. Although difficult ice clearing conditions were encountered downstream of our study area this spring, good communications by all stakeholders, has demonstrated that the process of icebreaking the navigation channel can be successfully managed.
20. No shoreline physical impacts were reported by any landowners along the shoreline being studied.

Based on last year's experience and this year's findings, the following recommendations were developed:

1. The current **JOS Project Management Team** is effective at moving forward the delegated mandate; hence, the current participants should be retained to ensure ongoing progress during the final year of the study.
2. The **Freezing Degree-Days (FDDs)** index method, which was used to gauge the severity of ice conditions and to serve as an input to the selection of the **Seaway Opening Date** and the **Icebreaking Planning** processes should continue to be studied in conjunction with field observations in order to



- develop a more rigorous methodology. Guidelines on usage as a planning tool should also be investigated and developed in order to maximize its potential benefits but also to articulate the method's limitations.
3. The **Opening Date Selection** and icebreaking operations should continue to be an inclusive process for the current stakeholders and include risk assessment elements of icebreaking operations and ice conditions. Incorporating better planning tools such as **RADARSAT** satellite imagery, aerial and land-based surveys plus usage of an improved **FDDs** methodology can only improve the knowledge of field conditions; hence, mitigate the risk of potential ice impacts in clearing the navigation channel.
 4. Considering the usefulness of the **RADARSAT** imagery to the stakeholders, the process of securing this type of data should be initiated with the appropriate government department in order to ensure on-going availability.
 5. The greatly expanded and more rigorous field observation activities in **2008** yielded a large pool of information. This knowledge should be used to develop and also focus the **2009** spring observation activities during the last year of the study mandate. Priority should be given to the important and practical aspects of the field observation program for input in planning and monitoring.



2. APPENDIX B: SUMMARY OF EXPENDITURES & IN-KIND EQUIVALENT

As of May 19, 2009.



2006 / 2009 JOS Project Financial

<i>Joint Observational Study Financial Report</i>					as of: 5/19/2009		
<u>ITEM</u>	Budget	Charged 2006/2007	Revised Charges 2007/2008	Charged 2008/2009	Project Totals		
					Total Charged 2006/2009	%Budget	Remaining
1. Kije Sipi Ltd	\$ 60,000.00	\$ 11,939.85	\$ 28,329.23	\$ 5,897.37	\$ 46,166.45	76.9%	\$ 13,833.55
2. BMT-Fleet Ltd	\$ 60,000.00	\$ -	\$ 33,276.93	\$ 17,840.29	\$ 51,117.22	85.2%	\$ 8,882.78
3. Contingency	\$ 10,000.00	\$ -	\$ -	\$ 3,490.63	\$ 3,490.63	34.9%	\$ 6,509.37
Sub-Totals	\$ 130,000.00	\$ 11,939.85	\$ 61,606.16	\$ 27,228.29	\$ 100,774.30		\$ 29,225.70
Charged	\$ 130,000.00	\$ 11,939.85	\$ 61,606.16	\$ 27,228.29	\$ 100,774.30		
GST		\$ 716.39	\$ 3,206.31	\$ 1,186.88	\$ 5,109.58		
Total Billed	\$ 130,000.00	\$ 12,656.24	\$ 64,812.47	\$ 28,415.17	\$ 105,883.88	81.4%	

2006 / 2009 JOS Project In-Kind Contributions

<i>JOS In-Kind Contributions Summary Report</i>					as of : 5/19/2009	
Group	Days Worked	Time Claimed	Expense Claimed	In-Kind Claimed		
MCA	9	\$ 2,250.00	\$ 100.00	\$ 2,350.00		
SLSDC	20	\$ 5,012.50	\$ 378.00	\$ 5,390.50		
SLSMC	14	\$ 3,375.00	\$ 690.00	\$ 4,065.00		
SRMT	98	\$ 24,487.50	\$ 3,890.00	\$ 28,377.50		
TC	6	\$ 1,437.50	\$ 50.00	\$ 1,487.50		
Total In-Kind Contributions	146.25	\$ 36,562.50	\$ 5,108.00	\$ 41,670.50		



3. APPENDIX C: MINUTES OF MEETINGS

Minutes of **JOS** meetings held on:

October 2nd 2008 –Steering Committee
January 27th 2009 – Steering Meeting
June 28th 2009 – Steering Committee



APROVED MINUTES

JOS Project Management Meeting

Saint Regis Mohawk Tribe

Environment Centre, 412 State Route 37, Akwesasne, NY 13662

Thursday, October 2, 2008

Attendees:

T. David, SRMT	D. Jobin, Project Coordinator
J. Snyder, SRMT	C. Fenton, SLSDC
K. Jock, SRMT	T. Lavigne, SLSDC
L. Lefebvre, SLSMC	K. Westerlaken, TC
G. Comfort, BMT	

A1 – Welcome:

D. Jobin and H. K. Jock welcomed all JOS Steering Committee members.

A2 – Approval of Agenda:

The agenda was reviewed and approved.

A3 - Approval of Minutes from Last Meeting:

Minutes of the last meeting were reviewed and approved.

A4 – Review of Action Items:

1. Check and send any revisions to JOS Contacts Sheet. **Ongoing**
2. Send in-kind contributions to Daniel Jobin. **Ongoing**
3. Correct budget for GST. **Done**
4. Finalize 2007/2008 Annual Report. **Done**
5. Develop 2008/2009 Observation Plan. **Ongoing**
6. Send appreciation letters (CCG & CIS). **Done**
7. Order RADARSAT imagery for 2009. **Ongoing**
8. Check protocol for making a formal request from the parties to obtain RADARSAT imagery on the St. Lawrence River below St. Lambert lock. **Ongoing**

A5 – Review of Study Budget:

The group reviewed the summary. D. Jobin noted that 59.6% of the budget has been used; a little over \$56,000 remains. The group approved the current budget.

A6 – Review of In-Kind Contributions:

The group reviewed the in-kind contributions. The group agreed the contributions accurately reflect the current status.

B1 – 2007/2008 Annual Report:

D. Jobin handed out CD's to each member containing the 2007/2008 final Annual Report. He noted most of the comments he received were editorial in nature. A few things were changed but generally, the content is the same as the DRAFT in June. He anticipates similar format for next year's annual report.



B2 – Fall 2008 – Spring 2009 Observation Plan:

G. Comfort gave a power point presentation (attached).

The purpose of the presentation was to determine what worked and what didn't work so adjustments can be made prior to next years program.

The point was made that we are fairly confident that an icebreaker going through causes little to no shoreline pressure as it was observed that the breaker went straight through with no impacts. Under current procedures, icebreaking should be no problem and the group agreed there may be no value added to continue to make this the focus of the observational program. The focus this year may be better spent on ship transits through the ice.

It was also noted that water level changes impact ice along the shore and should be factored in to any observations.

The 2009 program will include shoreline survey and observations. The group discussed the possibility of utilizing a SLSDC or CCG escort vessel to take pictures of the shoreline after the ice is gone.

It was noted we need to explore different types of marking options for the rip rap as it was difficult to see without causing disturbance. Alternatives were discussed and will be evaluated in the field.

G. Comfort then reviewed the plan for 2009 winter/spring ice observational program. J. Snyder noted that the ACOE may have some camera equipment we could utilize; he will check. If equipment is obtained, we could look at positioning on a lighted aid on Cornwall Island or at the Water Treatment Plant. T. David and K. Jock will explore that option.

G. Comfort will make arrangements for getting video of the shoreline in October/November 2008. He will also coordinate the fabrication of targets for ice movement detection.

C1 – Varia:

None

D-1 Conclusion:

In addition to the above action items that remain open; new items are as follows:

1. Determine availability of SLSDC or CCG asset for shoreline observation in the spring. **C. Fenton/L. Lefebvre**
2. Explore marking options for rip rap. **G. Comfort**
3. Check with ACOE on camera equipment. **J. Snyder**
4. For camera equipment, determine utilizing Water Treatment Plant or aid on Cornwall Island. **T. David/K. Jock**
5. Video of shoreline in Oct./Nov. **G. Comfort**
6. Make targets. **G. Comfort**



The next meeting, if determined necessary, will be December 12th at 9AM at the SLSMC offices in Cornwall.



JOS – Joint Observational Study

Investigation of Shoreline Impacts Resulting from Ice Clearing Operations Conducted to Open the St Lawrence Seaway

Oct. 2, 2008 Meeting

Agenda

- Overall: Plan for 2008-09 Observations
- Details:
 - Review Scope of 2007-08 JOS
 - Lessons Learned from 2007-08
 - Plans for 2008-09



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2007-08 JOS Project Team – Expected to be Similar for 2008-09

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- St Regis Mohawk Tribe

- Support From:
 - St Lawrence Seaway (Cdn & US)
 - MCA
 - D Jobin
 - Canadian Ice Service
 - Canadian Coast Guard



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2007-08 JOS – Shoreline Surveys

- Pre-Winter Surveys
 - Set Out Elevation Profiles at 3 Locations
 - Marked Rip Rap Stones at Stanley Island & Mitchell Dock
 - Surveyed Locations of Posts of Mitchell Dock
- Post-Winter & Ice Clearing Surveys
 - Aerial Survey by Helicopter (Canadian Coast Guard)
 - Shore-Based Photos
 - Surveyed Elevation Profiles at 3 Locations
 - Re-located Marked Rip Rap Stones at Stanley Island



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2007-08 JOS – Winter/Spring Ice Surveys

- Throughout the Winter Starting at Freeze-up
 - RADARSAT (Canadian Ice Service)
 - Aerial Fly-Overs & Photos (St Lawrence Seaway Mgmt Corp)
 - Site Visits, Incl. Ice Properties (Thickness, Temp.)
- At the Time of Ice Clearing & Up to About 1 Week After
 - Onboard CCGS Martha L Black
 - Aerial Surveys by Helicopter (Canadian Coast Guard)
 - Ice Movement Measurements at the Time of Ice Clearing
 - Shore-Based Observations & Photos
 - Surveyed Elevation Profiles at 3 Locations
 - Re-located Marked Rip Rap Stones at Stanley Island



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2007-08 JOS – Analyses

- Analyzed & Evaluated the 2007-08 Data
 - Including Engineering Analysis
 - Icebreaker-Induced Shoreline Pressures & Loads
 - Rip Rap Stability in Waves
- Historical Analyses
 - Freezing Degree-Days
 - Water Levels & Flows
 - Ice Thicknesses



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2007-08 JOS – Lessons Learned

- Successes: Combination of Methods was Useful:
 - Aerial Surveys & Photos & Satellite Imagery
 - Shore, Ship & Ice-Based Observations
 - Engineering Analysis & Historical Analysis



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2007-08 JOS – Lessons Learned

- Improvements Needed
 - Focus: Aftermath of the Ice Breaking Needs More Attention, when the Broken Ice Pieces May Drift and Contact the Shoreline
 - Cooperation of Landowner Essential (e.g., Mitchell Dock)
 - Ice Movements During Ice Breaking –
 - Before vs After Useful
 - BUT Not During the Passage of the Icebreaker (Timing Issues)
 - Elevation Surveys at Shoreline Sites – Too Local, Higher Precision Needed if This is to be Repeated in 2008-09
 - Rip Rap Stone Marking Method – More Permanent Method Needed



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Planned JOS Program for 2008-09

- General – Same Two General Components Planned
 - Shoreline Surveys
 - Winter/Spring Ice Observations



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Planned 2008-09 Shoreline Surveys

- To be Eliminated:
 - Dock Surveys
 - Shoreline Elevation Surveys

- To be Included:
 - Broad-Based Shoreline Surveys: Before & After Winter
 - Marking Rip Rap Stones
 - “Tagging Along” on CCG’s Helicopter Flight After the Ice Breaking



Planned 2008-09 Shoreline Surveys

- Broad-Based Shoreline Surveys
 - Before Winter (Mid-Oct. to mid-Nov) – Travel along Shore & Photograph the Full Shore Length (Video & Stills)
 - Access Method: Boat
 - After Ice Breaking & Clearing (Should be Late March & also mid-April)
 - Step 1 – Travel Along Shore & Photograph It
 - Step 2 (if Necessary) – Return to Sites Later if Changes are Observed and Document Them with Detailed Surveys
 - Access Method: Boat, and/or helicopter? To be discussed





Logistics for Shoreline Surveys

- Boat (SRMT):
 - Pre-Winter: Available till Mid-November
 - Post-Winter: Available After Ice Gone (mid-to-late April ?)
 - Using Only a Boat Would Leave a Gap
- Aerial Reconnaissance:
 - Fixed Wing (Cessna 172): Relatively Cheap & Available Locally but Can't Fly Low Enough (>1000 ft) for Shoreline Surveys
 - Helicopters: Various Sources (CCG, Transport Canada, CHC)
 - CCG – No Cost if we “tag along” – OK for Observation for Initial Stages But Not Later On – Suggest That One More Flight Needed
 - Other Sources More Expensive – Least Cost Ones:
 - Transport Canada Arranges it as an Internal Flight (\$895/hr)
 - Charter from Canadian Helicopters (\$1100/hr plus fuel)



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Shoreline Surveys: Rip Rap Stones

- Sites: Stanley Island & Perhaps Clark Island Too
- Method: Mark 8 Rip Rap Stones at Each & Position Them using Local References (e.g., Trees)
- Improvement: More Permanent Marking Needed



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Planned Winter/Spring Ice Obs. Program

- Aerial Surveys & Photos & Satellite Imagery
 - Photos From Fly-Overs (by St Lawrence Seaway) – Will Be Requested
 - RADARSAT Imagery Requested - Have Emailed CIS But No Response Yet
 - CCG Helicopter Overflights – Have Contacted CCG and Received Tentative Approval to “Tag Along”
 - Planned Addition to Last Year: More Observation After the Icebreaker Passage:
 - Boat Trip After Ice-Out
 - Another Helicopter Flight ?
 - Potential Addition:
 - Camera on Bridge South of Cornwall Island ?



Planned Winter/Spring Ice Obs. Program

- Shore, Ship & Ice-Based Observations
 - Will Travel With the Icebreaker During Its Trip: Need to Request Permission from CCG
 - Ice Movements (3-4 Sites):
 - Don't Intend to Measure Ice Movements During Icebreaker Passage
 - BUT Intend to Measure Ice Movements Before & After the Icebreaker's Passage
 - Ice Properties Measurement (Thickness, Temperature): Intend to Repeat This Using the Same Techniques as Last Year





Potential Ice Monitoring Sites



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Planned Winter/Spring Ice Obs. Program

- Engineering Analysis & Historical Analysis
 - Analyses Done Last Year Will be Updated (FDDs, Water Levels & Flows, etc)
 - Engineering Analyses Will be Done as Appropriate



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Wrap-Up

- Plan Presented
- Any Comments or Questions?





APPROVED MINUTES

JOS Project Management Meeting

Saint-Lawrence Seaway Management Corporation

202 Pitt Street, Cornwall, ON K6P 3P7

Tuesday, January 27th, 2009

Attendees:

C. Fenton, SLSDC

K. Jock, SRMT

T. Lavigne, SLSDC

T. David, SRMT

S. Kwok, SLSDC

D. Benedict, MCA

L. Lefebvre, SLSDC

J. Snyder, SRMT

D. Jobin, Project Coordinator

H. Lickers, MCA

G. Comfort, BMT

A1 – Welcome:

S. Kwok welcomed all JOS Steering Committee members.

A2 – Approval of Agenda:

Agenda reviewed and approved.

A3 – Approval of Minutes from Last Meeting:

Minutes of the last meeting were reviewed with one minor edit on Number 7, date change to 2009. Minutes were then approved.

A4 – Review of Action Item List (see attached list):

1. New version of Contact List was distributed. Any updates need to be provided to D. Jobin. **Ongoing**
2. Send in-kind contributions to D. Jobin. **Ongoing**
3. Order 2009 RADARSAT images; dates unknown. **Ongoing**
4. Check protocol for making a formal request from the parties to obtain RADARSAT imagery on the St. Lawrence River below St. Lambert lock. **Ongoing**
5. Ice flight for spring observation scheduled for first week in February. **Closed**
6. Options for marking rip rap. **Closed**
7. Use of ACOE camera (answer is no). **Closed**
8. Explore utilization of Water Treatment Plan on Cornwall Island (answer is yes). **Closed**
9. Video of shoreline. **Closed**
10. Make targets. **Open**



A5 – Review Study Budget:

D. Jobin reviewed the Study Budget. This is the 20th billing period and the project is still within the budget – 70% allocation. The budget was approved by the group.

A6 – Review & Approve In-Kind Contributions:

D. Jobin reviewed the In-Kind Contributions to date. The group needs to continue to submit any new hours to be added to the summary. The contribution summary sheet was approved by the group.

B1 – Seaway Opening Date:

C. Fenton noted the Pre-Opening meeting with tribal representatives was scheduled for next week, February 6. When a date is selected, the tribal POC's will be notified. L. Lefebvre will send updated FDD to G. Comfort.

B2 – Spring 2009 Observation Plan:

G. Comfort presented the proposed 2009 Observation Plan (copy attached).

- 2008 shoreline survey was completed in October 2008.
- Shoreline survey to be done in Spring 2009.
- Need to extend ice observations to include the period from when the icebreaker transits in mid-March into April following ice out. This should be accomplished by ice over flights, shoreline observations and by boat with video if possible.
- October 2008 marked rip rap sites.
- Discussed contingency of leasing a CCG helicopter to take pictures while there is still ice on shore and then after ice out. Decided to keep as contingency plan.
- Discussed use of aerial surveys, time lapse video and shore/boat observations.
- Post winter work should include analysis on FDD, water levels and engineering analysis as appropriate.
- G. Comfort has requested four RADARSAT II images; they will get back to him on the exact dates dependent on satellite flight schedule.
- Discussed position of video camera in the Water Treatment Plant. Decision is inside the window looking out onto the river. We need to determine how many days one tape will hold as well as number of frames per minutes. This needs to be done by mid-February.
- Video images schedule – 1) Feb. 16 set up, 2) before Seaway opening, 3) after Seaway opening, 4) one week after opening. Should make a copy of the tape as backup. D. Jobin will develop protocol.
- Need to send out notice to radio and local police force that activity on the ice related to Joint Study.
- Develop schedule for technical group and route to all.
- C. Fenton to check on use of SLSDC asset for spring water observation of shoreline.



- Reviewed timeline for Final Report. D. Jobin will look at schedules for meetings in order to meet the timelines in the MOU.
- Discussed the need for a technical meeting prior to the opening but all agreed no need for a further meeting of the Steering Committee.
- T. David will nominate someone to ride on the icebreaker.
- L. Lefebvre will circulate pictures from the aerial ice flights to the group.
- D. Jobin will ensure all data is archived.
- G. Comfort reviewed logistics and will develop a list of items for the technical group.
- Need to take a group picture.

C1 – Varia:

None.

D1 – Conclusion:

D. Jobin requested if any other matters to discuss. With nothing further, C. Fenton was asked to review this list of new action items:

In addition to the above action items that remain open or ongoing; new items are as follows:

9. Notify Mohawk POC's when final opening date selected. **C. Fenton**
10. L. Lefebvre to send G. Comfort FDD data. **L. Lefebvre**
11. G. Comfort will coordinate RADARSAT image acquisitions. **G. Comfort**
12. Determine how many days one video tape will hold; also number of frames per minute. **G. Comfort**
13. Formalize request to CCG for icebreaker ride. **L. Lefebvre**
14. Send out a notice to radio and police force regarding activity on the ice related to study. **H. Lickers**
15. G. Comfort will prepare a chron schedule for technical group and send to all for review and approval. **G. Comfort**
16. C. Fenton will check on utilization of SLSDC ROBINSON BAY or PERFORMANCE for water side review of shoreline in April. **C. Fenton**
17. T. David to nominate person to ride on ice breaker. **T. David**
18. D. Jobin will create protocol for video tapes. **D. Jobin**
19. L. Lefebvre will provide pictures from ice flights. **L. Lefebvre**
20. Need to take Project Management Team picture. **All**

Discussed planning for next meeting. No date set at this time, D. Jobin will be in touch with the group following the spring observations and suggest dates for a meeting.

Meeting adjourned.



DRAFT MINUTES

JOS Project Management Meeting

Saint Lawrence Seaway Development Corporation
180 Andrews Street, Massena, NY, USA 13662
Wednesday, June 24th, 2009

Attendees:

C. Fenton, SLSDC	K. Jock, SRMT
T. Lavigne, SLSDC	T. David, SRMT
S. Kwok, SLSMC	H. Lickers, SRMT
L. Lefebvre, SLSMC	G. Comfort, BMT
K. Westerlaken, TC	D. Jobin, Project Coordinator

A1 – Welcome:

D. Jobin and C. Fenton welcomed all JOS Steering Committee members.

A2 – Approval of Agenda:

The agenda was reviewed and approved.

A3 - Approval of Minutes from Last Meeting:

Minutes of the last meeting were not available but action items were reviewed and the minutes were approved in principle. The finals will be available in the Final Draft Report.

A4 – Review of Action Items:

21. Notify Mohawk POC's when final opening date selected. **Done**
22. L. Lefebvre to send G. Comfort FDD data. **Done**
23. G. Comfort coordinate RADARSAT images. **Done**
24. Determine how many days one video tape will hold; also number of frames per minute. **Done**
25. Formalize request to CCG for icebreaker ride. **Done**
26. Send out a notice to radio and police force regarding activity on the ice related to study. **Not Necessary**
27. G. Comfort will prepare a chron schedule for technical group and send to all for review and approval. **Done**
28. C. Fenton will check on utilization of SLSDC ROBINSON BAY or PERFORMANCE for water side review of shoreline in April. **Not Necessary**
29. T. David to nominate person to ride on ice breaker. **Not Necessary**
30. D. Jobin will create protocol for video tapes. **Done**
31. L. Lefebvre will provide pictures from ice flights. **Done**
32. Need to take Project Management Team picture. **Open**



A5 – Review of Study Budget:

The group reviewed the summary. D. Jobin noted that as of the end of May, 83.5% of the budget has been used. The money remaining in the budget will not be exceeded. In the breakdown, G. Comfort is over \$1,000 and D. Jobin is under. He would like to reallocate funds in order to finish the project. SLSDC, SLSMC and TC will discuss and get back to D. Jobin. The group approved the current budget.

A6 – Review of In-Kind Contributions:

The group reviewed the in-kind contributions. D. Jobin stressed the importance of getting updated contribution numbers to him so he can include in the Final Report.

B1 – Spring 2009 Observations:

G. Comfort presented a power point on the 2009 observations (attached). The observation program consisted of both video and photo surveys. No changes to shoreline were observed.

There were a total of 12 marked rip rap on two sites, Clark Island and Stanley Island. The largest movement was on Clarke Island for a total of 6.5 feet; however, it was noted these were smaller stones than those at Stanley Island. The average movement appeared to be about one foot. Since no icebreaking was done in these areas in 2009, the most plausible explanation for the movements appears to be waves induced by ship passage.

G. Comfort then reviewed the Freezing Degree Day (FDD) data as a measurement. The conclusion is that the FDD is good but does not take into account ice temperatures, thickness and coverage; these need to be considered along with the FDD data.

It was also noted that water levels and flows also have an impact on ice breakup. There was a spike in water flows around the same time as ice breakup.

The group also noted the three year study reinforced the need for operational diligence on the part of icebreakers. Two out of the three years, icebreaking did occur and no observable impacts were noted.

B2 – Annual Report:

D. Jobin reviewed the format for the Annual Report. It is basically the same format used for prior years annual reports. The group reviewed the Draft Report paying particular attention to the Conclusions and Recommendations sections.

Edits by the group are necessary and should be submitted by June 30th. Daniel will then have the final PDF version of the Annual Report back to the group by July 3, 2009.



The group agreed in principle with the conclusions and recommendations of the Annual Report.

B3 – Study Report:

D. Jobin had prepared and handed out a DRAFT Study Report that included the JOS Project Management Team Declaration, a Table of Contents, and the Study Conclusions and Recommendations.

The format was reviewed and approved by the group.

There were several suggestions for edits for the Conclusions and Recommendations section. These will be captured in the Action Item portion of these minutes.

The timeline for the Final Report is as follows:

- July 17 – Draft Final Report to the parties.
- July 24 – Edits by Study Group to D. Jobin.
- July 31 – Final Report to the parties.

The group agreed in principle, pending final edits, with the Conclusions and Recommendations of the Final Report.

C1 – Varia:

D. Jobin raised the issue of archives for the 3-Year Study. There is a large amount of data that was collected over the course of the study. It was agreed that D. Jobin will make an electronic archive DVD and will provide one copy to each party.

NOTE: During the lunch break, a Study Team picture was taken. A copy will be provided to each member and it will be included in the Final Study Report.

D-1 Conclusion:

New Action Items:

7. Contact RADARSAT to determine status of agreement between government and RADARSAT. **G. Comfort**
8. Determine budget re-allocation and inform D. Jobin. **K. Westerlaken, C. Fenton, S. Kwok**
9. Submit final In-Kind contribution figures to D. Jobin for inclusion in final report. **All**
10. Edit to slide on FDD – add secondary axis. **G. Comfort**
11. Final edits to Annual Report to D. Jobin by June 30. **All**
12. Submit Final Annual Report to Study Group by July 3. **D. Jobin**
13. Suggested edits to Final Report offered during this meeting:



- a. Number 4 regarding analysis of expected forces should be moved up to the opening paragraph before the Conclusion section.
- b. Number 6 conclusion on FDD should be moved up to number 4.
- c. Need to qualify the observations on icebreaking operations were during the 2 years of icebreaking during this study period.
- d. Need to add in the complexity of the study in the 1st paragraph.
- e. Need to edit the current number 6 sentence regarding “potential impacts”.
- f. Need to add inclusion of ice thickness in the Recommendations section.
- g. Need to add a fourth item under Recommendations to “continue the current ice breaking operations with the same operational diligence as demonstrated during the 2 years of the study.”
- h. Need to add a paragraph on how effectively the Study Group worked together as a team given the many technical aspects of the study.
- i. Electronic signatures of the Study Group need to be provided to D. Jobin for inclusion in the Final Report. **D. Jobin**

Planning for next meeting:

The group agreed there may not be a need for a further meeting of the Study Group if no major edits to either report are necessary. C. Fenton pointed out that the MOU in paragraph 7.18 calls for a meeting of the parties; however, the group decided if after review of the final report any party felt a meeting the necessary, they would notify the other parties by August 14, 2009.

In addition, paragraph 7.19 contains the language regarding the parameters for requesting a meeting of the parties’ senior officials.



4. APPENDIX D: CORRESPONDENCE & DOCUMENTS

One (1) letter of appreciation was sent to the **Canadian Ice Service** in appreciation of providing **RADARSAT** imagery for the study. A protocol for archiving video and photographs was also developed.



May 19th, 2009

Roger DeAbreu Ph.D.
Science Project Manager
Canadian Ice Service
Environment Canada
373 Sussex Drive, Block E.
Ottawa, ON
K1A 0H3

Subject: Spring 2009 Icebreaking Operations Near Akwesasne

Dear **Mr DeAbreu**,

In May of 2006, an out of court agreement was established as a mechanism to assess issues related to icebreaking impacts near the shorelines of the **Mohawk Territory of Akwesasne**. Accordingly, a three-year “**Joint Observational Study**” (**JOS**) was launched in late 2006 to assess and report on the physical impacts of ice removal within navigational channel of the study area. The study is actively managed by a steering committee composed of representatives from the:

St. Lawrence Seaway Development Corporation (U.S.)
St. Lawrence Seaway Management Corporation (Canada)
Transport Canada
Mohawk Council of Akwesasne
St. Regis Mohawk Tribe

As you know, your group has yet again provided the study team members with several **RADARSAT** images this spring for use in better understanding the characteristics of the ice sheet within the vicinity of the **Mohawk Territory of Akwesasne** reserves. The data was used in conjunction with aerial and ground based surveys throughout the observation period within the seaway navigation channel. We particularly appreciated the use of **RADARSAT II** imagery this year that produced far better ice structure discrimination within our relatively small surface area of interest.

This important contribution during our last year of the study was noted by the **JOS Management Committee** that unanimously wish to express their appreciation to you, **Mr. DeAbreu** for being part of the solution and helping the group achieve its mandate. We trust you will convey our many thanks to those in your group that also participated in generating the image products and, we look forward to working again with you next spring.



Sincerely,

Joint Observational Study Coordinator

Daniel I Jobin M.Eng., P.Eng.

cc:

Environment Canada – Ice Centre

Douglas Bancroft, Director

John Falkingham, Special Advisor

St. Lawrence Seaway Development Corporation (U.S.)

Carol Fenton, Deputy Associate Administrator

Thomas Lavigne, Director of Engineering & Maintenance

St. Lawrence Seaway Management Corporation (Canada)

Stephen Kwok, Director, Operations & Technical Services

Luc Lefebvre, Chief, Operational Services

Transport Canada

Karen Westerlaken, Senior Policy Advisor

Mohawk Council of Akwesasne

Henry Lickers, Director, Department of Environment

St. Regis Mohawk Tribe

Ken Jock, Director, Environmental Division

Tony David, Manager, Water Resources Program



PROTOCOL FOR ARCHIVING CAMERA IMAGERY

At its January 27th, 2009 meeting, the **Steering Committee** of the **Joint Observation Study (JOS)** has agreed to establish a protocol in order to safeguard access to the camera imagery collected during the study.

The protocol consists of the following four (4) actions:

1. Imagery obtained from the video camera positioned at the **St. Regis Mohawk Tribe Water Treatment Plant** will be copied onto a suitable media for archiving purposes.
2. The integrity of the archive copy will be verified to ensure readability.
3. The archive copy will be sent to the **JOS Project Coordinator** for safe-keeping and storage in the project archives.
4. Upon request, a copy of the archived imagery will be provided to any law enforcement agency. The **JOS** project coordinator will be notified of any such actions.



5. APPENDIX E: RADARSAT IMAGERY

Contents:

- E.1 Objectives and Imagery Received**
- E.2 Results: RADARSAT Imagery For Feb. 10**
- E.3 Results: RADARSAT Imagery For Feb. 25**
- E.4 Results: RADARSAT Imagery For March 21**
- E.5 Results: RADARSAT Imagery For March 28**
- E.6 Assessment**



E.1 OBJECTIVES AND IMAGERY RECEIVED

It is well known that the development of an ice cover over the course of a winter plays an important role in defining its state at any given time within the winter. RADARSAT imagery was obtained to meet several objectives:

- (a) to provide information regarding the global ice conditions between Snell Lock and Lake St. Francis over the course of the winter. The RADARSAT imagery was high-resolution which allowed key parameters to be quantified such as.
 - a. the ice coverage and the location of the ice edge
 - b. the presence of ridges or major cracks in the ice.

- (b) to allow an assessment to be made regarding the utility of the RADARSAT imagery for this specific project and application. This included:
 - a. comparisons of the RADARSAT imagery against ground truth that was obtained by the project team such as land-based photos, aerial photographs, and direct observations
 - b. general evaluations based on for example, the delivery time required to receive the imagery and the effort required to interpret it. Of course, real-time imagery is of most value.

RADARSAT imagery was received during the 2008 JOS which contributed valuable information to the project (ref.: 2008 JOS report). As a result, it was decided to continue acquiring RADARSAT imagery for the 2009 JOS.

High-resolution RADARSAT-2 imagery was received during the 2008-09 winter, as listed in Table E.1. This acquisition schedule provided two RADARSAT images prior to the break-up of the ice cover in the channel between St Regis and Cornwall Islands, and two after this event.



Table E.1 RADARSAT Imagery Obtained

Date	Satellite Orbit
Feb 10,2009	Ascending
Feb 25,2009	Ascending
March 21, 2009	Ascending
March 28, 2009	Ascending

Figures showing the RADARSAT imagery received for February 10, February 25, March 21, and March 28 are provided in sections E.2, E.3, E.4, and E.5, respectively. The raw RADARSAT images have been annotated by BMT FTL by adding:

- (a) blue shading to identify the ice cover, and;
- (b) adding photos obtained from site visits and aerial overflights as appropriate.

The RADARSAT images are discussed in the main report with respect to the ice information that they provided.



E.2 RESULTS: RADARSAT IMAGERY FOR FEB. 10

E.2.1 Feb. 10 RADARSAT Imagery

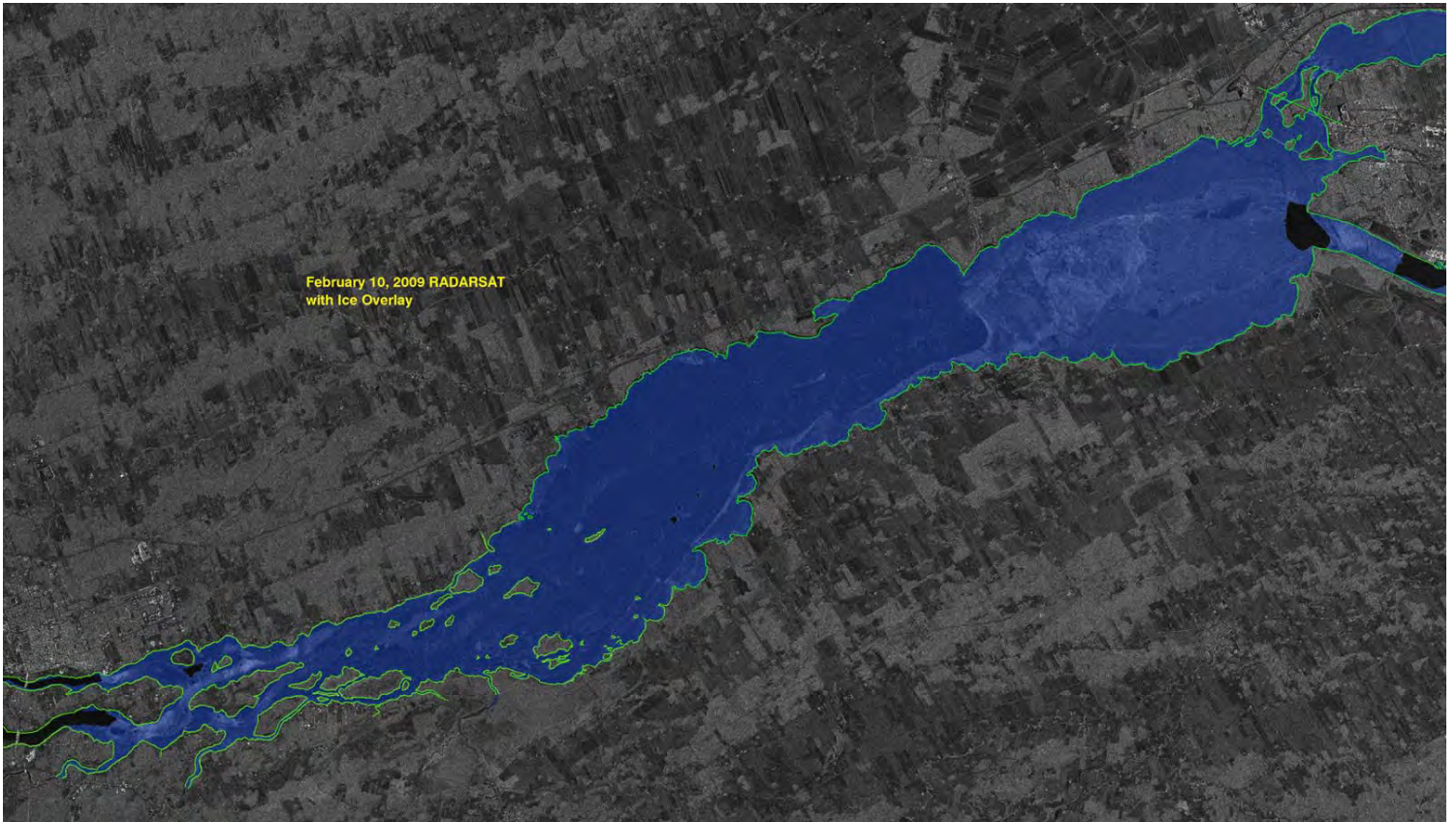


Figure E.1: RADARSAT Imagery for Cornwall Isl. to Lac St Francis on Feb. 10



E.2.2 Feb. 10 RADARSAT Imagery With Ground Truth Information

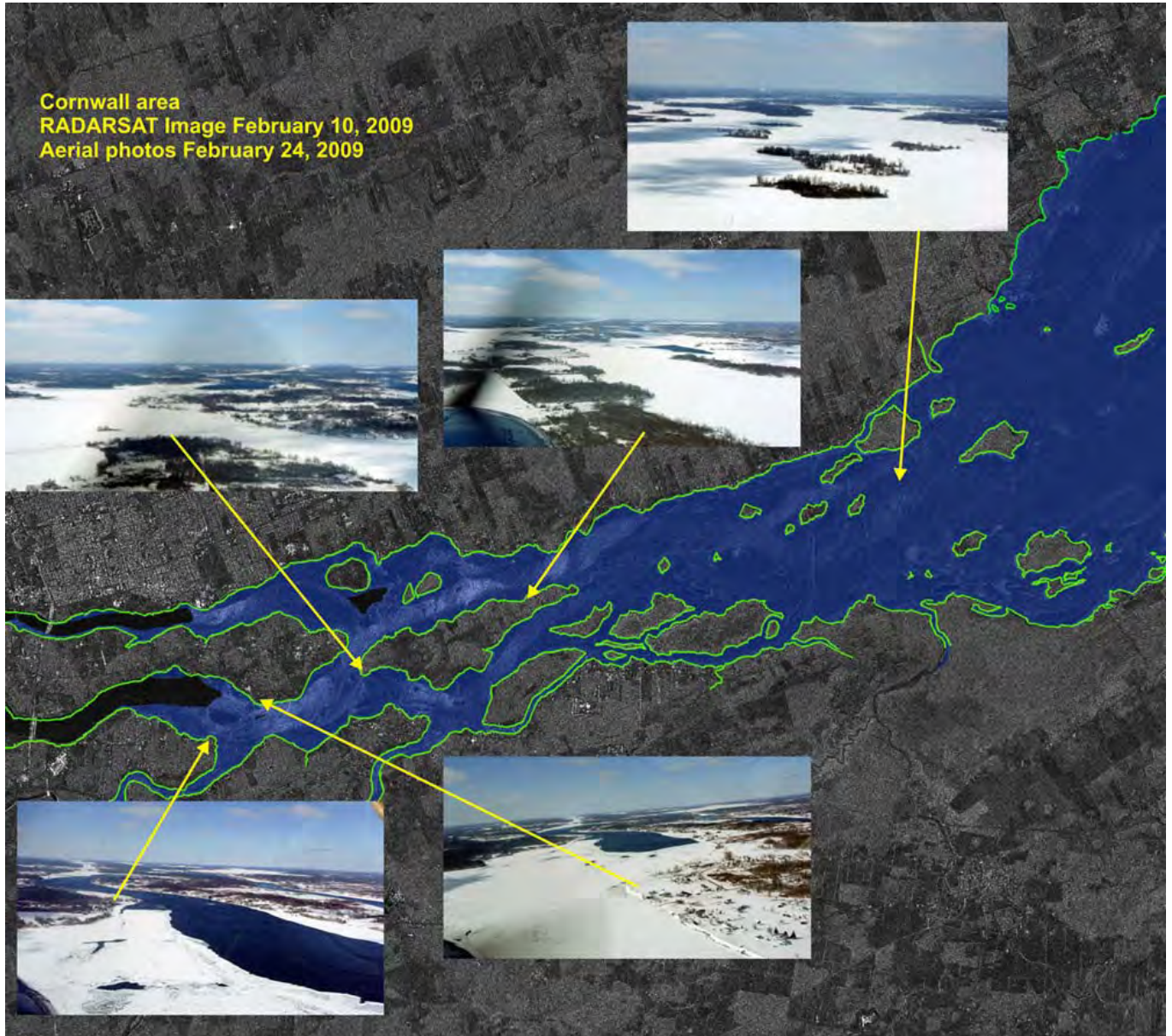


Figure E.2: RADARSAT and Photos for Cornwall to Lac St Francis on Feb. 10

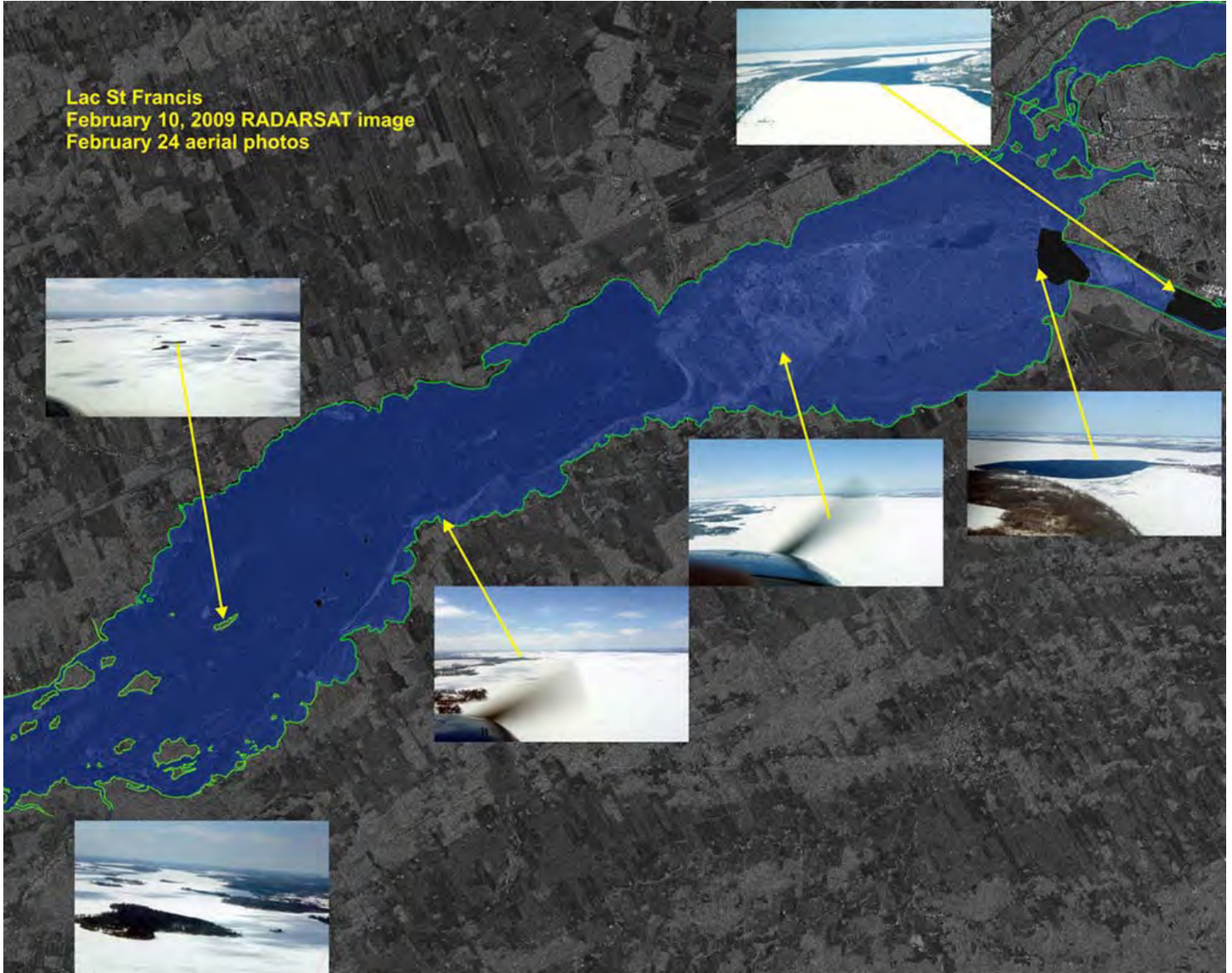


Figure E.3: RADARSAT Imagery and Photos for Lac St Francis on Feb. 10



E.3 RESULTS: RADARSAT IMAGERY FOR FEB. 25

E.3.1 Feb. 25 RADARSAT Imagery

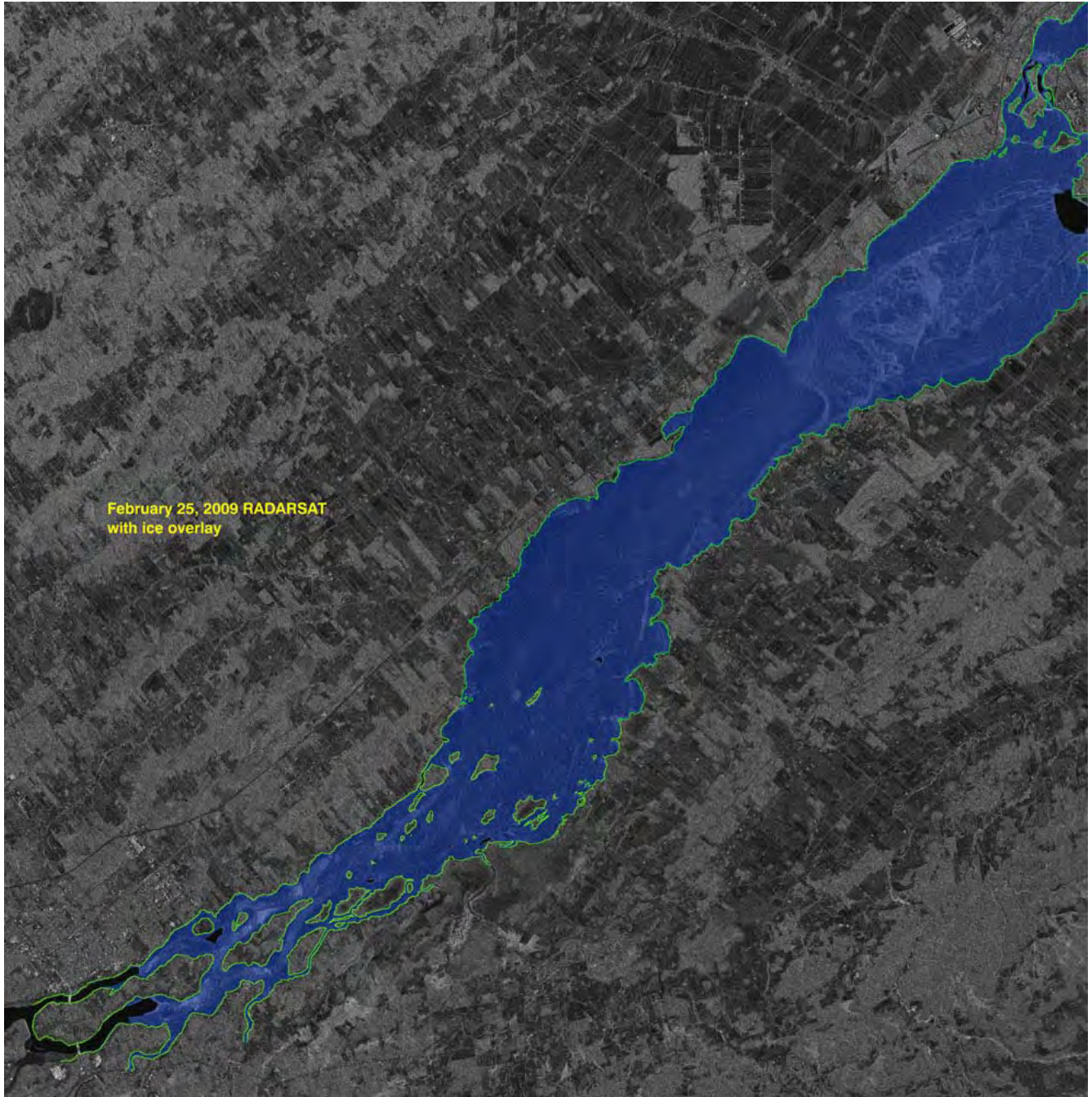


Figure E.4: RADARSAT Imagery for Cornwall Isl. to Lac St Francis on Feb. 25



E.3.2 Feb. 25 RADARSAT Imagery With Ground Truth Information

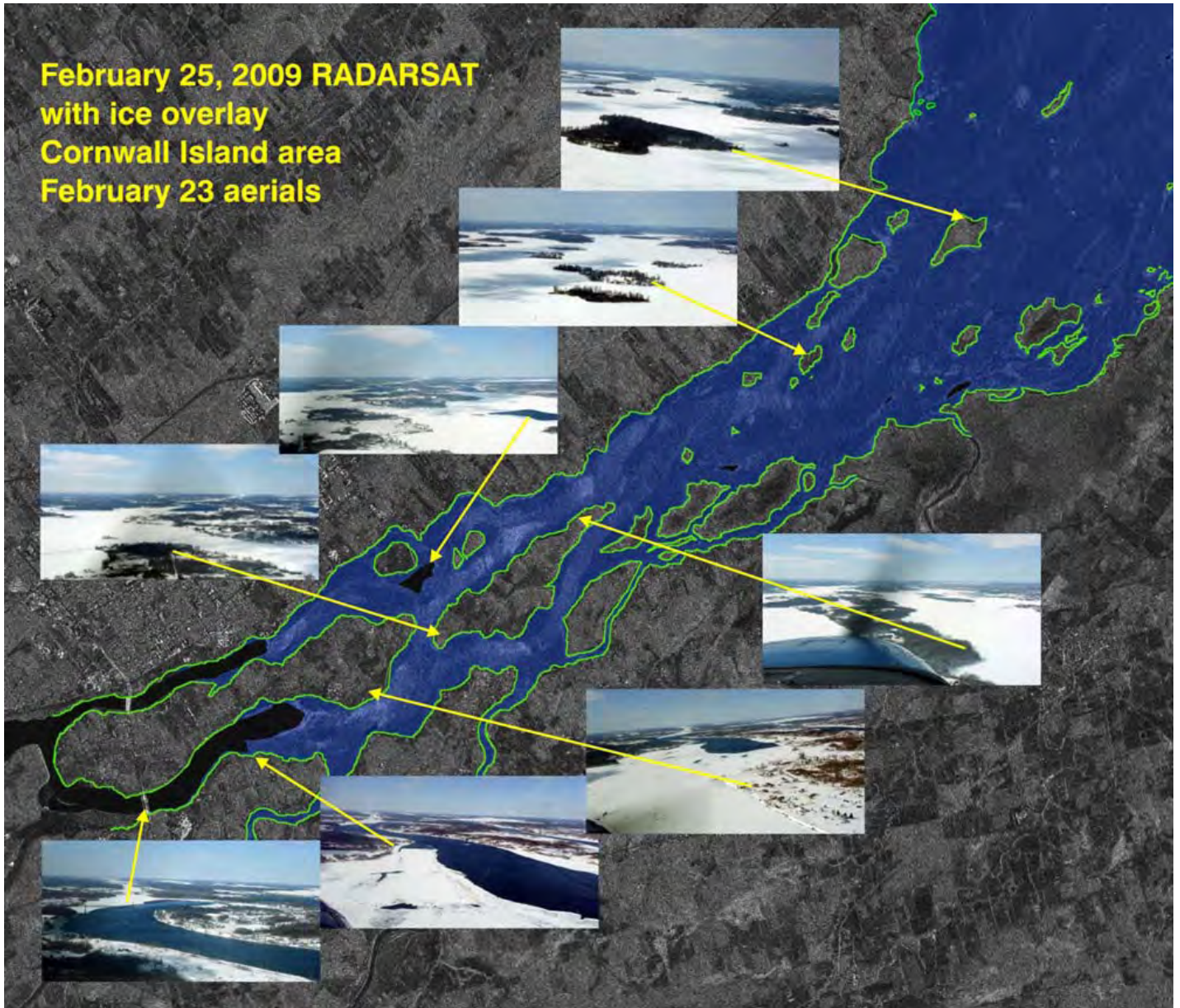


Figure E.5: RADARSAT and Photos for Cornwall to Lac St Francis on Feb. 25

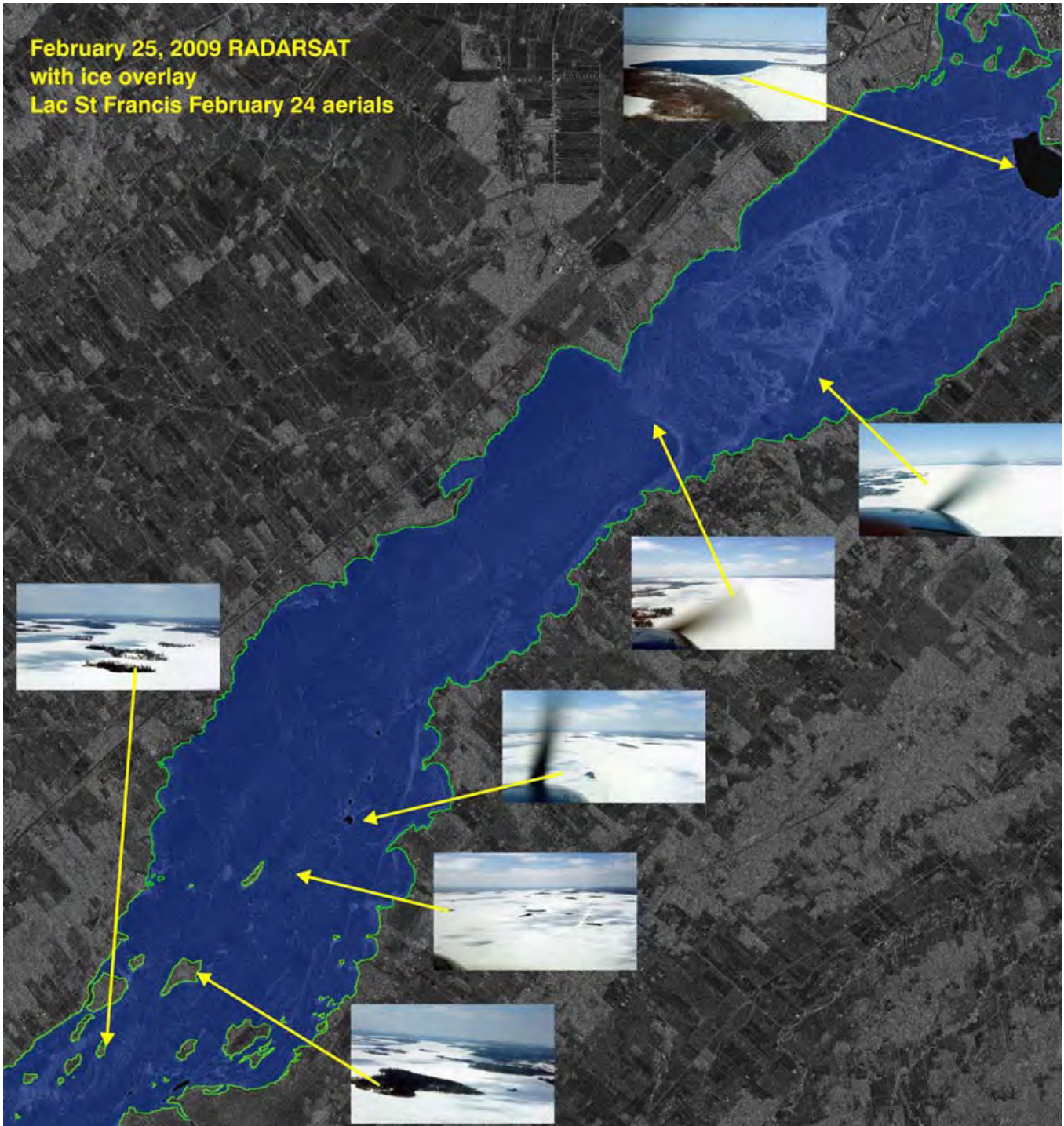


Figure E.6: RADARSAT Imagery and Photos for Lac St Francis on Feb. 25



E.4 RESULTS: RADARSAT IMAGERY FOR March 21

E.4.1 March 21 RADARSAT Imagery

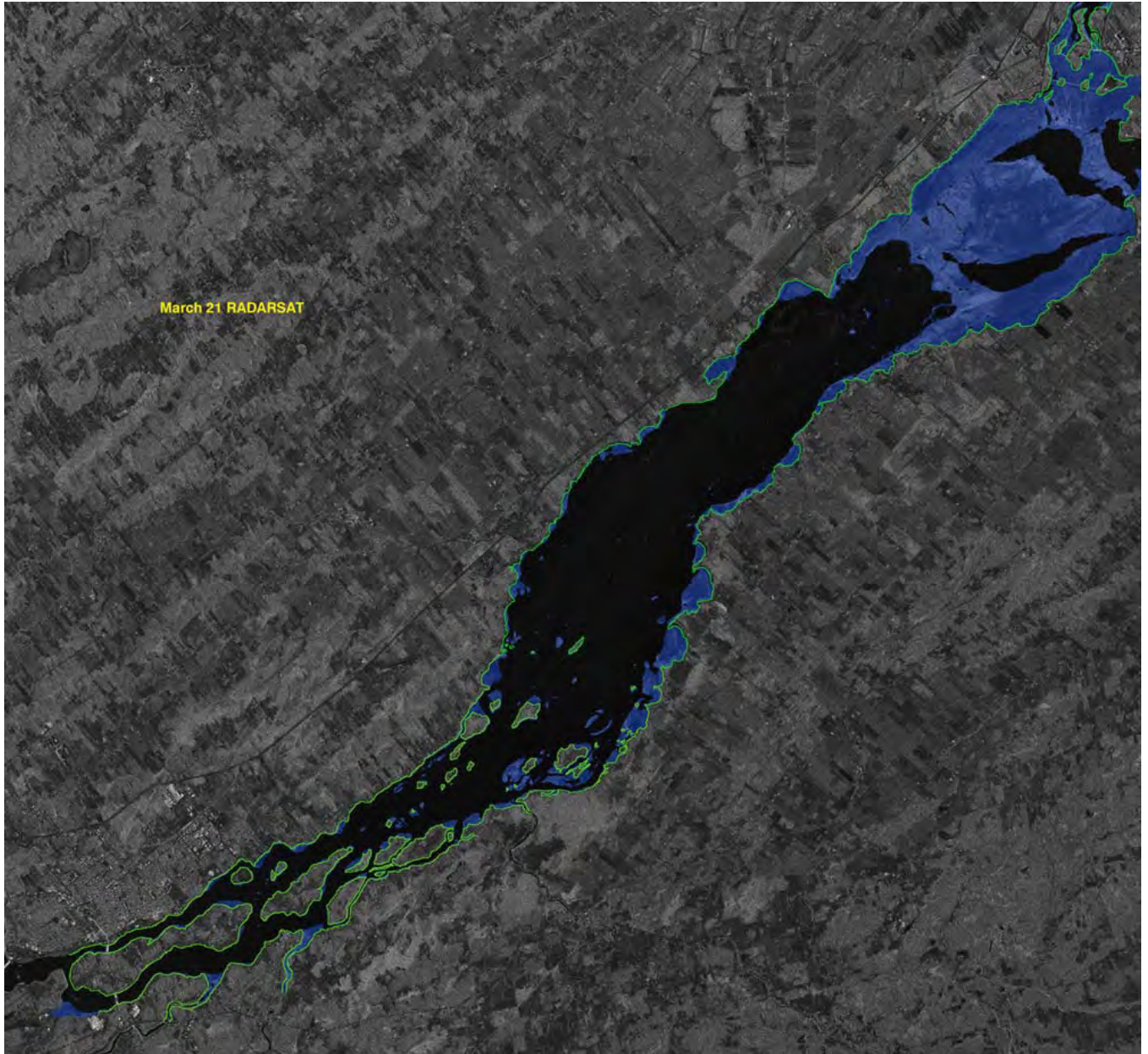


Figure E.7: RADARSAT Imagery for Cornwall Isl. to Lac St Francis on March 21



E.4.2 March 21 RADARSAT Imagery With Ground Truth Information

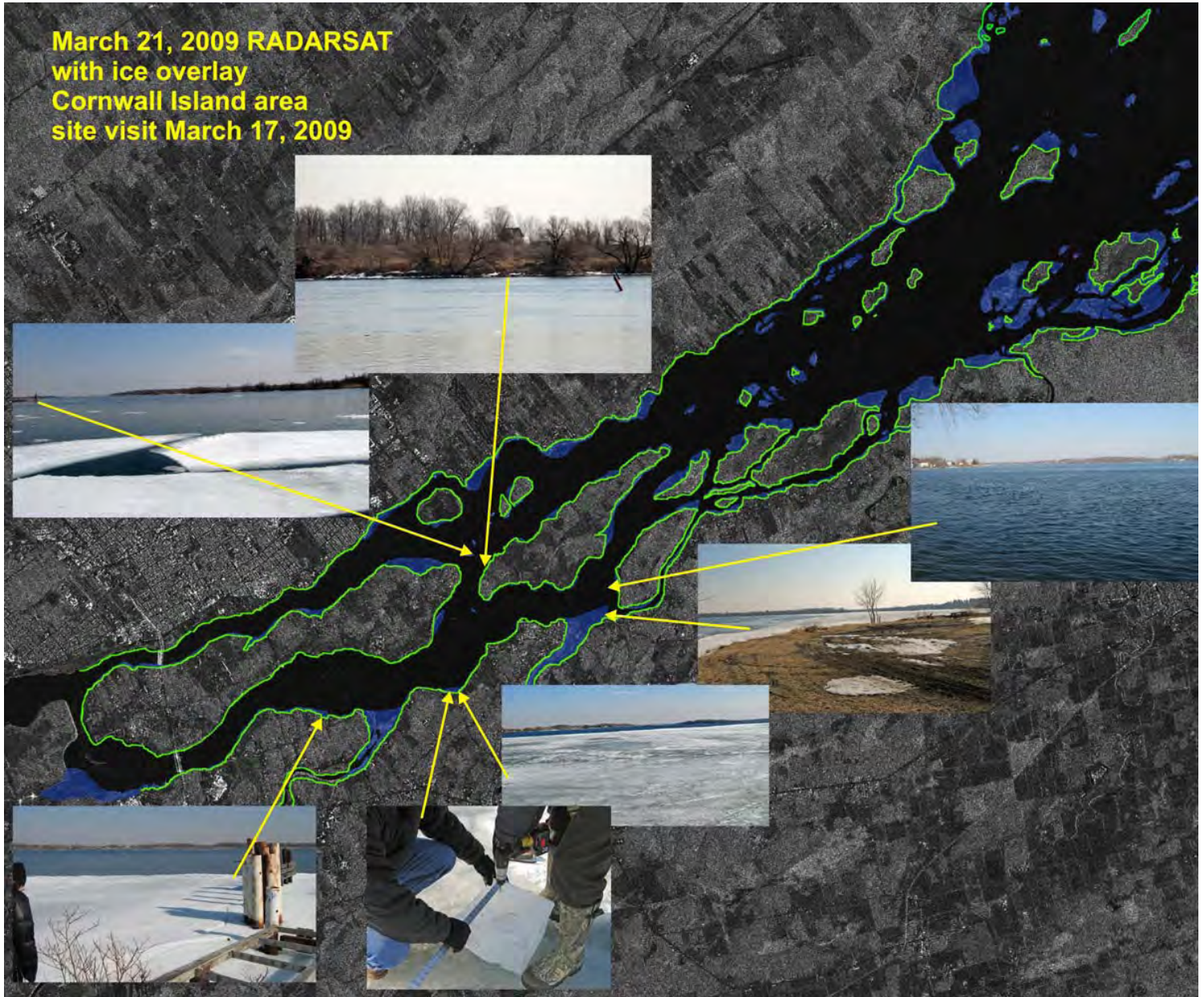


Figure E.8: Annotated RADARSAT for Cornwall to Lac St Francis on March 21

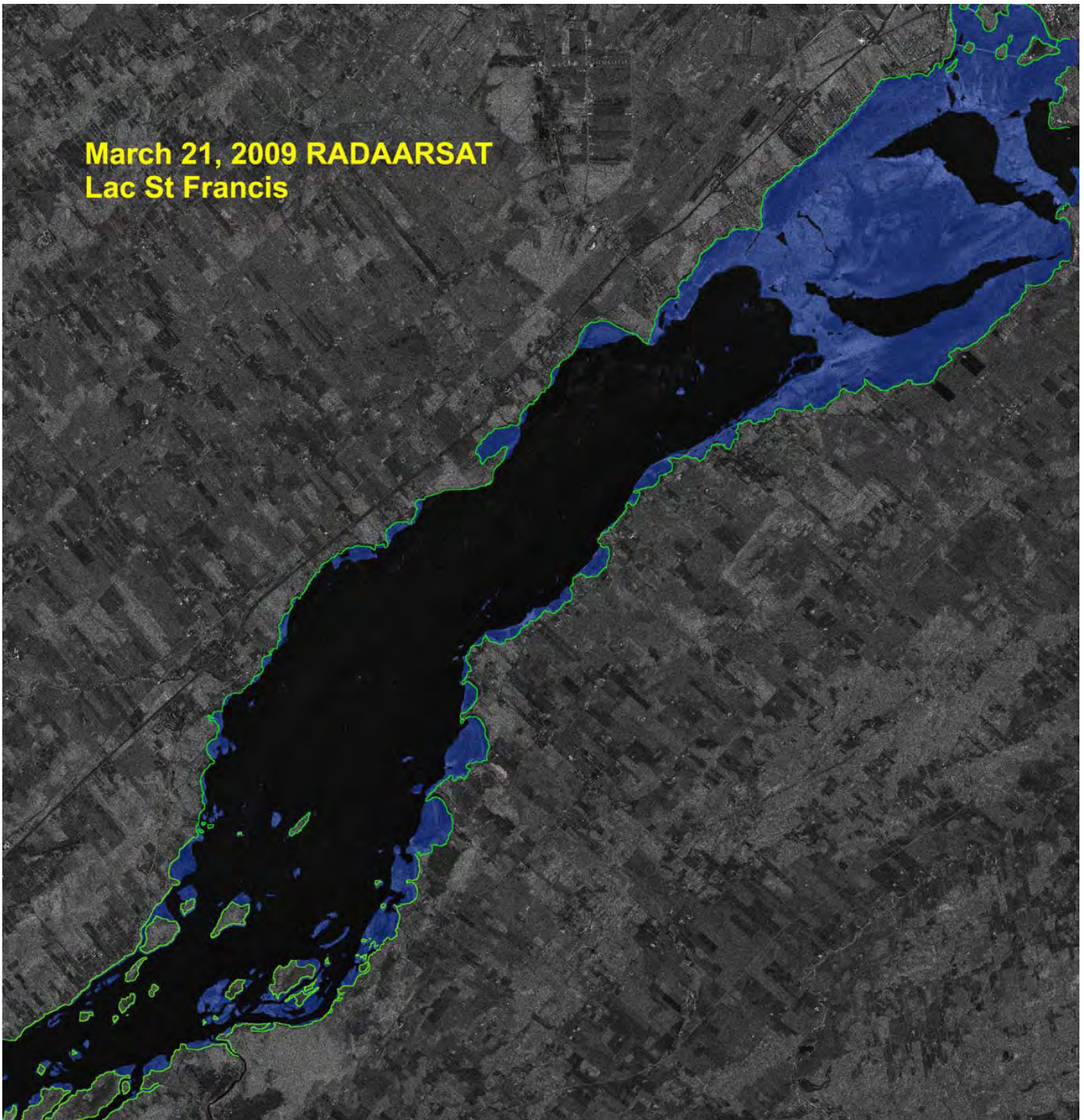


Figure E.9: Annotated RADARSAT and Photos for Lac St Francis on March 21



E.5 RESULTS: RADARSAT IMAGERY FOR March 28

E.5.1 March 28 RADARSAT Imagery

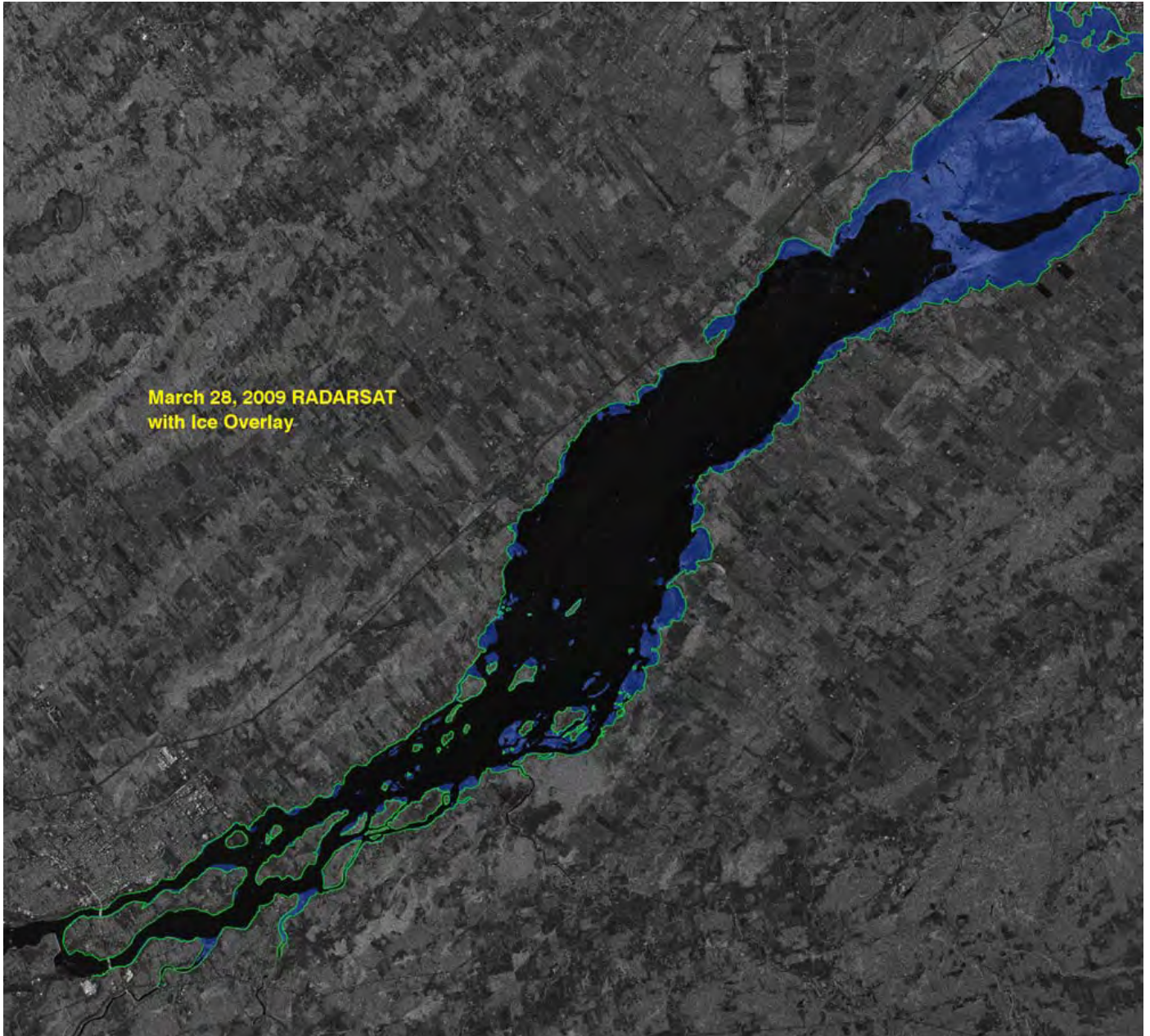


Figure E.10: RADARSAT for Cornwall Isl. to Lac St Francis on March 28



E.5.2 March 28 RADARSAT Imagery With Ground Truth Information

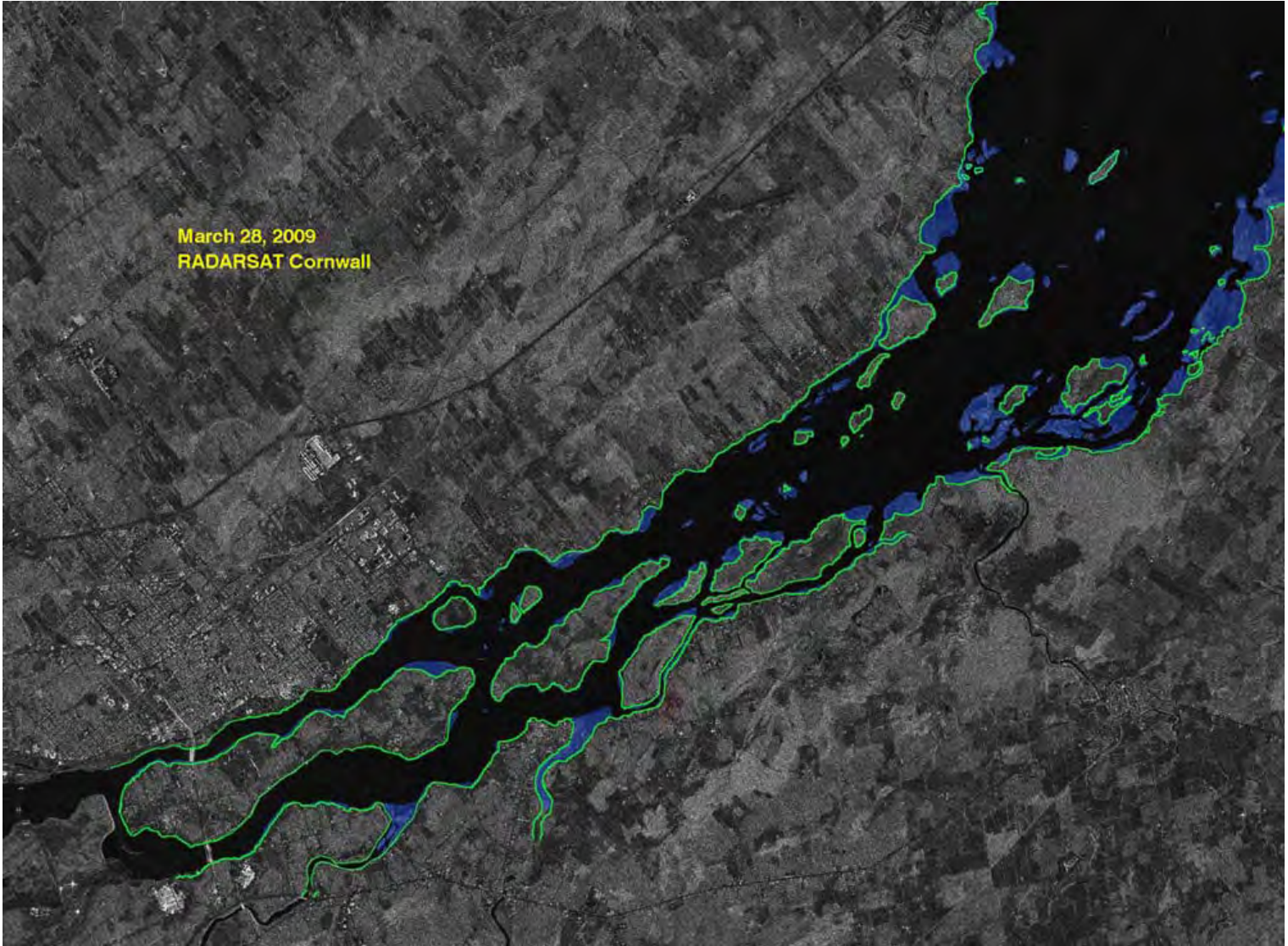
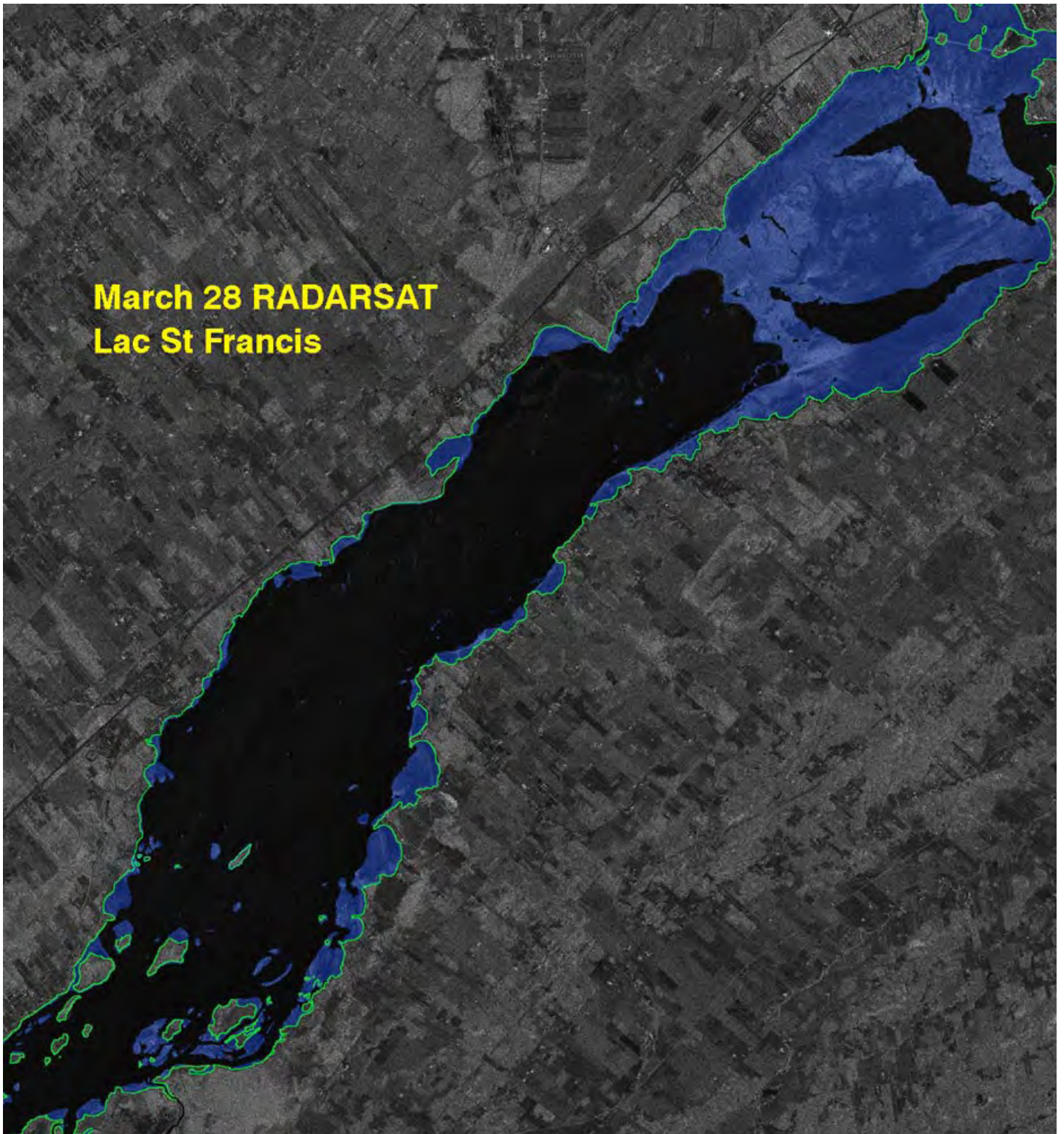


Figure E.11: Annotated RADARSAT for Cornwall to Lac St Francis on March 28



**March 28 RADARSAT
Lac St Francis**

Figure E.12: Annotated RADARSAT for Lac St Francis on March 28



E.3 ASSESSMENT

E.3.1 Overall Recommendation

RADARSAT imagery should continue to be collected as part of the information-gathering process for developing a knowledge base for establishing the Opening Date for the Seaway.

E.3.2 Information Content and Interpretation

Some ground truth is required to allow accurate interpretation of the RADARSAT imagery. The aerial photos and the onsite observations collected during this project were sufficient for this purpose. Similar ground truth data should continue to be collected in future years to accompany RADARSAT imagery that is obtained.

With proper interpretation, and comparisons to appropriate ground truth data, the RADARSAT images added significantly to the information base versus that which would have been obtained only from aerial fly-overs. One of the principal benefits of the RADARSAT imagery was that they provided high-resolution maps depicting the overall ice cover. For example, the successive RADARSAT images obtained allowed the progression of the ice cover's development to be tracked.

E.3.3 Timeliness of Information

The RADARSAT images were timely as they received within about 2 days after the passage of the satellite.



6. APPENDIX F: DETAILED ICE PROPERTIES

Contents:

Table F.1: Ice Temperature Data for February 23, 2009

Table F.2: Ice Temperature Data for March 17, 2009

Figure F.1: Ice Temperature Measurements on February 23, 2009

Figure F.2: Ice Temperature Measurements on March 17, 2009



Ice Temperature Measurements on Feb. 23, 2009					
Cecil Garrow Bay		Ferry Dock			
Core 1		Core 1			
Ice Thickness, in		Ice Thickness, in 19.75			
Ice Temperature Profile		Ice Temperature Profile			
Depth, in	Temp, °C	Depth, in	Temp, °C		
		-1	-0.5		
Unreliable Due to Delay		-4	-0.9		
In Making the		-8.5	-0.7		
Measurements		-12.25	-0.3		
		-17	-0.3		
Core 2		Core 2			
Ice Thickness, in		18	Ice Thickness, in		19.5
Ice Temperature Profile		Ice Temperature Profile			
Depth, in	Temp, °C	Depth, in	Temp, °C		
-3.5	-2	-1.5	-0.6		
-7	-0.8	-6	-0.7		
-11	-0.6	-9.5	-0.7		
-15	-0.3	-13.5	-0.4		
		-17.25	-0.3		
Air Temp. (°C):		-8.7	Air Temp. (°C):		-7.4
Surface Temp.(°C):		-7.6	Surface Temp.(°C):		-2.8
Snow Depth, in:		0	Snow Depth, in:		2; 2.5; 2.5; 3
Made By: Tony David, Jim Snyder, George Comfort, Leo Fox, Tira Benedict					
Weather: -10C mostly cloudy w/scattered show showers. Winds 15-20mph					

Table F.1: Ice Temperature Data for February 23, 2009



Ice Temperature Measurements on March 17, 2009						
Cecil Garrow Bay				Ferry Dock		
Core 1				No measurements made		
Ice Thickness, in		12.5		Conditions were unsafe		
Ice Temperature Profile						
Depth, in	Temp, °C					
-3	0					
-6	0					
-9	0					
Core 2						
Ice Thickness, in		11				
Ice Temperature Profile						
Depth, in	Temp, °C					
-3	0					
-6	0					
-9	0					
Air Temp. (°C):		-1				
Surface Temp.(°C):		-0.4				
Snow Depth, in:		0				
Made By: Tony David, Jim Snyder, George Comfort, Leo Fox, Tira Benedict						
Weather: Air Temp: 36°F, clear, sunny, SW Winds 10-15 mph						

Table F.2: Ice Temperature Data for March 17, 2009



Cutting Ice Block Out Of Ice Sheet



Ice Temperature Measurement



Ice Block Cut Out at Cecil Garrow Bay



Ice Block Cut Out at Ferry Dock

Figure F.1: Ice Temperature Measurements on February 23, 2009



Cutting Ice Block Out Of Ice Sheet



General View of Ice Conditions



Ice Block Cut Out at Cecil Garrow Bay



Ice Block Cut Out at Cecil Garrow Bay

Figure F.2: Ice Temperature Measurements on March 17, 2009



7. APPENDIX G: LIST OF ARCHIVED JOS DOCUMENTS



The **JOS** document archives contain as of the 19th of May 2009 the following documents:

All JOS meeting documents including Agendas and Minutes

All JOS financial and In-kind reports

Lake Francis Aerial Surveys (multiple docs from 1997 to 2006)

NYPA Erosion Study Report

Seaway IceBreaking Literature Reference List Document

NYPA Habitat Figures

LandSat 7 Image

2007, 2008 and 2009 Seaway Opening Documents consisting of:

- Grasse River Issue
- References
- Aerial Photos and RADARSAT Imagery
- Sub-Consultant TOR
- Field Observation Photos
- Ice Breaker Navigation Tracks
- Freezing Degree-Day Data
- Ice Charts
- Icebreaking Observational Report (aboard Martha L. Black)
- Water Levels

Annual Reports (2007, 2008 and 2009)



8. APPENDIX H: VIDEO RECORD ANALYSIS

Contents:

Figure H.1 Camera Field of View

Table H.1 Video Record Summary With Screen Captures

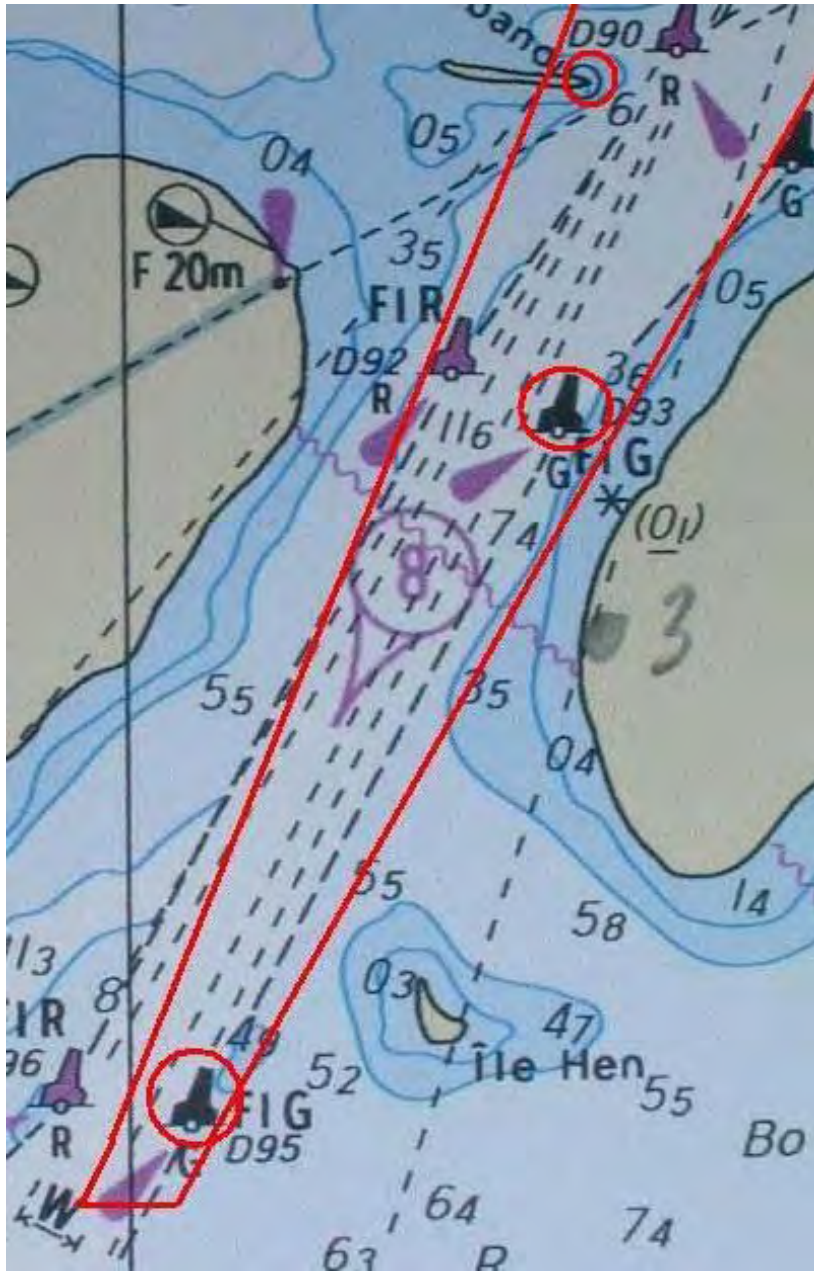





Figure H.1 Camera Field of View



Table H.1 Video Record Summary With Screen Captures

Date	Time	Comments
Feb 24	N/A	100% Ice-covered - No visible changes
Feb 25	N/A	100% Ice-covered - No visible changes
Feb 26	N/A	100% Ice-covered - No visible changes
Feb 27	N/A	100% Ice-covered - No visible changes
Feb 28	N/A	100% Ice-covered - No visible changes
March 1	N/A	100% Ice-covered - No visible changes
March 2	N/A	100% Ice-covered - No visible changes
March 3	N/A	100% Ice-covered - No visible changes
March 4	N/A	No Usable Image due to weather conditions
March 5	N/A	No Usable Image due to weather conditions
March 6	N/A	100% Ice-covered - No visible changes
March 7	N/A	100% Ice-covered - Open water now present around navigation buoy
March 8	7AM	Ice rubble built up in the foreground, near buoy location 




	8AM	<p>Ice beginning to break up between the buoy and light house. More ice rubble formed.</p> 
March 8 con't	12PM	<p>Rubbled ice and sheet ice between the navigation buoy and the lighthouse. Ice has deteriorated appearance (e.g. ice surface appears to be wet)</p> 
	1:30PM	<p>Large-scale ice movements starting to occur. Ice in foreground beginning to drift away. Open water formed in foreground of camera's field of view (near navigation buoy) starting at about 1:40 PM.</p>



	3PM	<p>The ice coverage steadily decreased as more and more ice drifted away. At 3PM, the area between the navigation buoy and the “old” light stand was about 50% open water, with ice only being present in the background, and open water being present in the foreground.</p>
March 8 con't	6PM	<p>No significant changes from afternoon</p>
March 9	N/A	No Usable Image due to weather conditions



March 10	N/A	<5% covered - Narrow band of ice between buoy and light house
March 11	N/A	<5% covered – the band of ice was slightly smaller
March 12	N/A	<5% covered – Ice band in middle of channel now only reaches halfway across viewing area, small amounts of rubble float by in channel
March 13	N/A	<p>Very little ice was left in center of river now. A pan with the camera showed that the only location with ice was the shoreline immediately in front of the water treatment plant (i.e., Cecil Garrow Bay). It was ice-covered with broken ice pieces at the ice edge.</p> 
March 18	N/A	100% open water
March 19	N/A	100% open water
March 20	N/A	100% open water