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Management
Division

Department of
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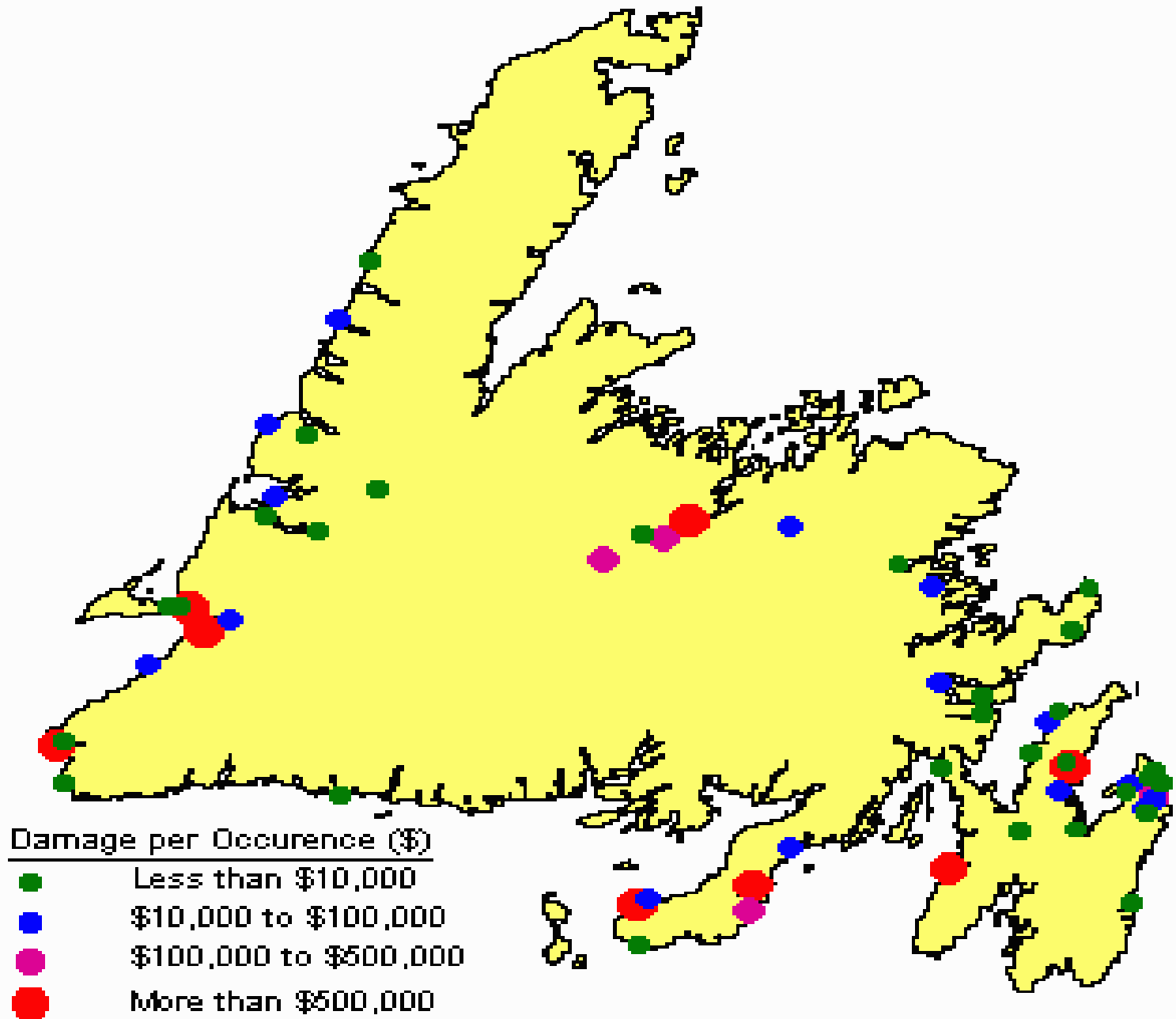
Hurricane Igor A Water Resources Perspective

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Department of Environment and Conservation
Government of Newfoundland and Labrador

March 24th, 2011

Economic Impacts of Flood Damage



Hurricane Igor

- 90 communities isolated
- 100 road breaches
- \$100m in damage



EC Weather Statement

AWCN16 CWHX 231857

SPECIAL WEATHER SUMMARY MESSAGE FOR NEWFOUNDLAND AND LABRADOR ISSUED BY ENVIRONMENT CANADA AT 4:27 PM NDT THURSDAY 23 SEPTEMBER 2010.

THIS IS A FOLLOWUP SUMMARY OF INFORMATION AND METEOROLOGICAL DATA FROM HURRICANE IGOR'S IMPACT IN NEWFOUNDLAND ON MONDAY AND TUESDAY SEPTEMBER 20TH AND 21ST 2010. THE INITIAL BULLETIN CONTAINING STORM DATA WAS ISSUED UNDER THIS SAME HEADER AT 4:47 AM NDT ON SEPTEMBER 22ND. THE PURPOSE OF THIS FOLLOWUP SUMMARY IS TO FOCUS SPECIFICALLY ON THE METEOROLOGICAL ASPECTS AND TO SERVE AS AN UPDATE TO THE DATA AND PROVIDE AN HISTORICAL PERSPECTIVE.

THE EXTREME WEATHER EVENT THAT CAUSED SEVERE FLOODING AND HEAVY WIND DAMAGE OVER EASTERN NEWFOUNDLAND EARLY THIS WEEK WAS RELATED TO THE COMBINED EFFECTS OF HURRICANE IGOR AND A STATIONARY FRONT THAT HAD PREVIOUSLY DEVELOPED TO THE NORTH OF THE HURRICANE. THE FRONT WAS ASSOCIATED WITH A SHARP TROUGH OF LOW PRESSURE IN THE UPPER ATMOSPHERE WHICH PROVIDED A SIGNIFIGANT AMOUNT OF ENERGY TO THE HURRICANE. THIS PREDICTED INTERACTION EXPLAINS WHY THE HURRICANE DID NOT WEAKEN OVER THE COOLER OCEAN WATERS SOUTH OF NEWFOUNDLAND. IN FACT THE INTENSITY OF IGOR INCREASED AS A RESULT OF THE TROUGH WHILE THE CENTRE OF THE STORM APPROACHED THE AVALON PENINSULA TUESDAY MORNING SEPTEMBER 21ST.

Precipitation during Igor

Location	Rain (mm)
St. Lawrence	236.2
Bonavista	230*
Lethbridge	186
St. Pierre	159.8
Whitbourne	144.4
Pouch Cove	142
Gander (airport)	124.4
St. John's (airport)	120.2
St. Shotts River (near Trepassey)	118.3
St. John's (west)	117.9
Gander (airport cs)	114.4
Grey River (near Grey River)	109.7
Bay d'Espoir (gen. stn.)	105.5
Brownsdale	105.4
Exploits River (Badger east of stadium)	99.6
Wooddale (Bishop's Falls)	91.8
Grand Lake (on Glover Island)	90

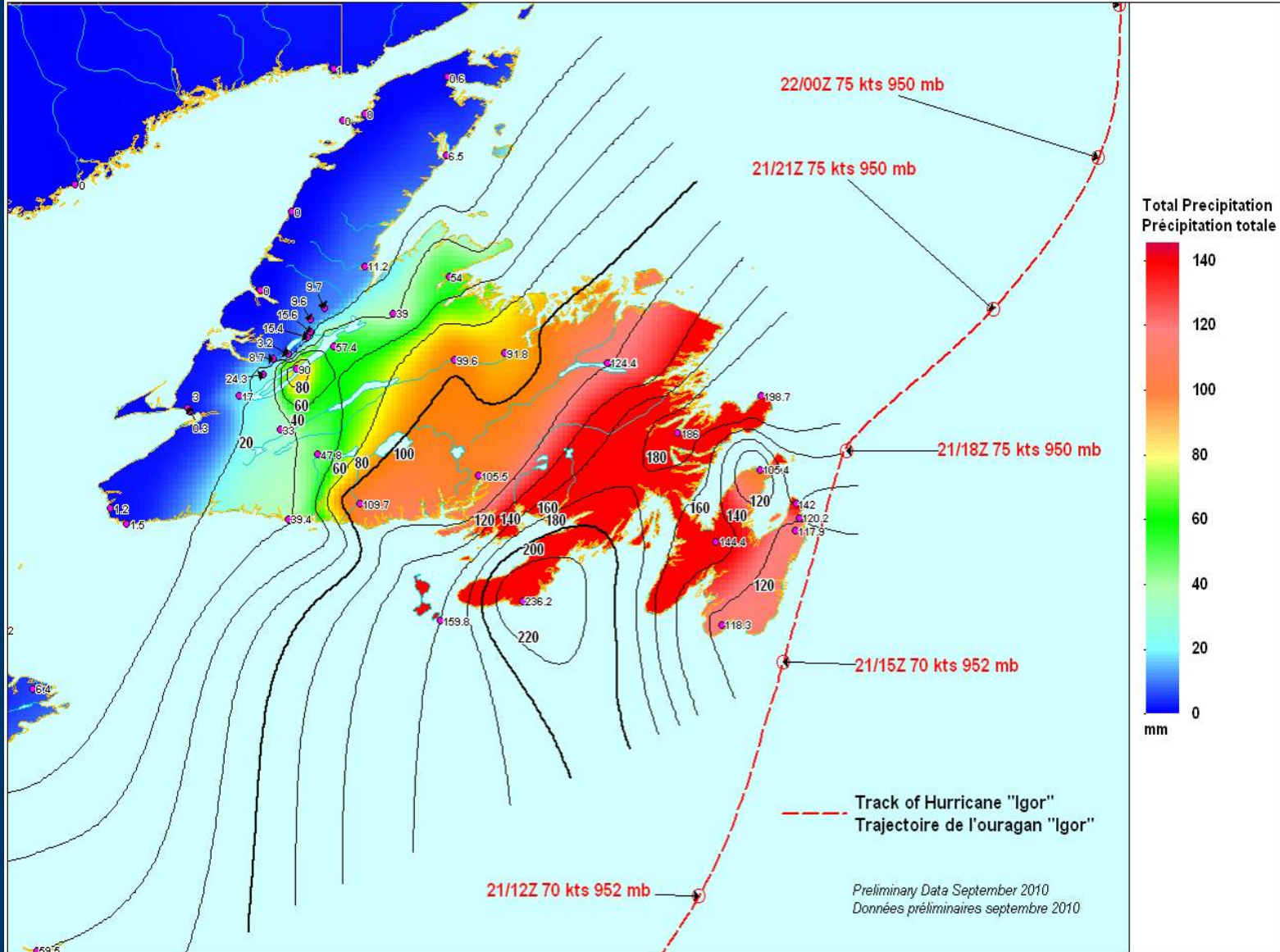


Total Precipitation September 20-21 2010
Précipitation totale 20-21 septembre 2010



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Max wind speed during Igor

Location	Wind (kph)
Cape Pine	172
Sagona Island	163
Bonavista	156
Pouch Cove	147
Pools Island	146
St. Pierre	141
St. John's (airport)	137
Grates Cove	135
Argentia	132
Twillingate	132
Marticot Island	131
St. Lawrence	124
St. John's (west)	117
Englee	111
Winterland	111
Sable Island	106
Cape Kiglapait	104
Burgeo	100
Port aux Basques	100



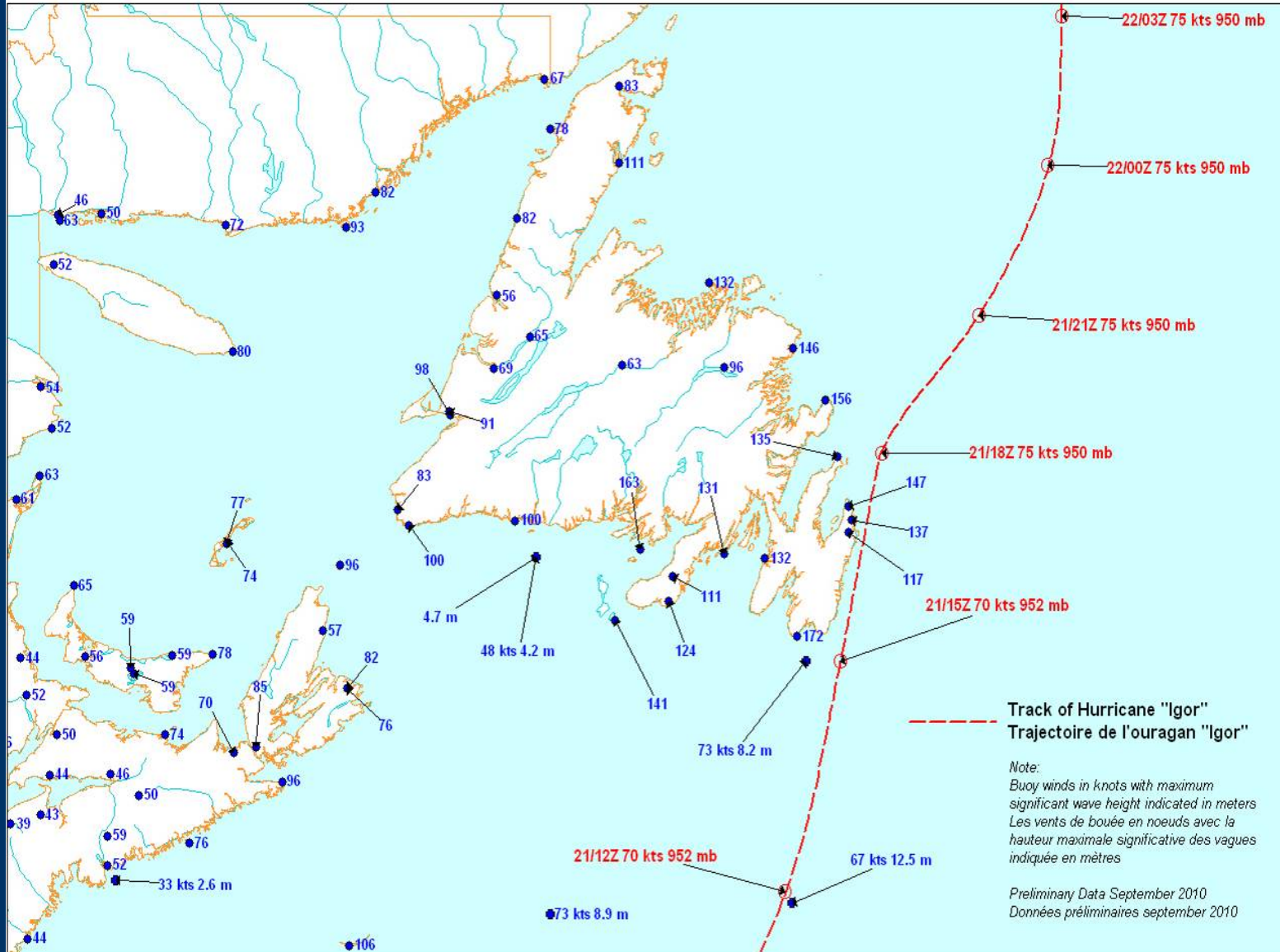
Maximum Wind Gusts (km/h) September 20-21 2010

Rafale maximum de vent (km/h) 20-21 septembre 2010



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Storm surge during Igor

Buoy	Max. Wind (kph)	Avg. Wave (m)	Peak Wave (m)	Lowest Pressure
44139	138	9	17*	970 MB
44251	135	8	16	952 MB
44138	123	13	25	957 MB
44140	98	13	21	976 MB
44255	90	4	7	985 MB



Streamflows

Hydrometric Station	Flow (cms)	Comment
Garnish River Near Garnish	208	New Peak Flow
Salmon River Near Glenwood	78	New Peak Flow
St. Shotts River Near Trepassey	18	New Peak Flow
Grandy Brook Below Top Pond Brook	151	Over Daily Max
Star Brook Above Star Lake	48	Over Daily Max
White Bear River Above Big Indian Brook	176	Over Daily Max
Grey River Near Grey River	653	
Exploits River Below Noel Pauls Brook	611	
Great Rattling Brook Above Tote River Confluence	317	
Conne River At Outlet Of Conne River Pond	66	
Bay Du Nord River At Big Falls	229	
Gander River At Big Chute	746	
Middle Brook Near Gambo	45	
Terra Nova River At Glovertown	240	
Indian Bay Brook Near Northwest Arm	51	
Little Salmonier River Near North Harbour	140	
Rocky River Near Colinet	238	
South River Near Holyrood	18	
Seal Cove Brook Near Cappahayden	31	



Hurricane Igor - Streamflows

Legend

Reporting Hydrometric Stations

Number of years on record

- less than 20 years
- ▲ more than 20 years

Over Maximum Daily Average Flow

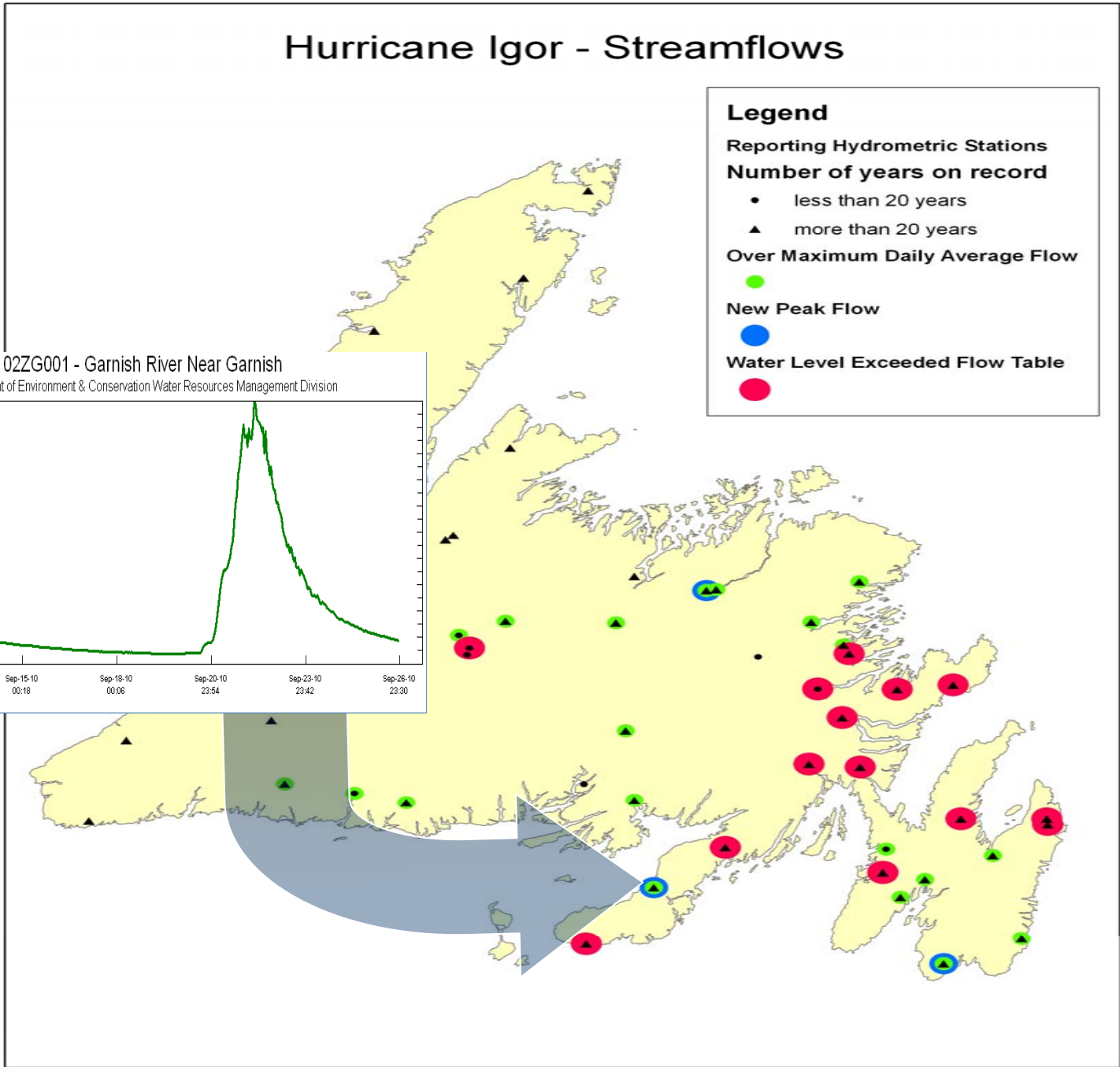
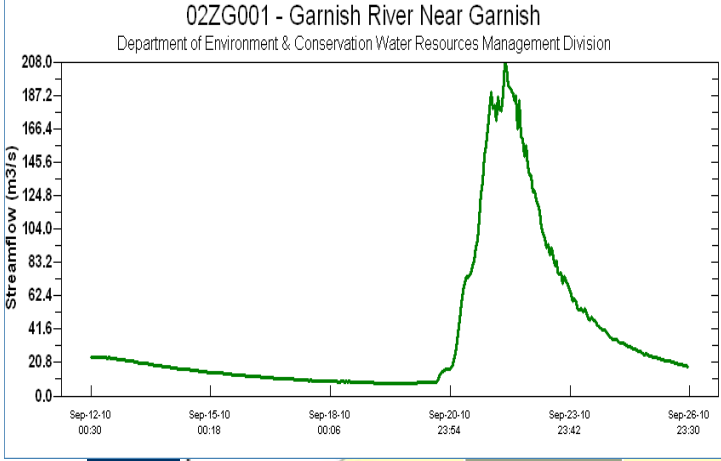
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New Peak Flow

-

Water Level Exceeded Flow Table

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Lessons learned from Igor

Two tier approach in managing future Igor-like events:

1. Preventative: actions needed to minimize damages.
Ex. **intensity-duration frequency curves** which are used to determine adequately-sized infrastructure.
1. Strategic: actions needed for informed decision making. Ex. **flood risk mapping studies** identify flood zones and restrict development in flood areas.

Both approaches need to consider **climate change adaptation**, there will be more extreme precipitation events.

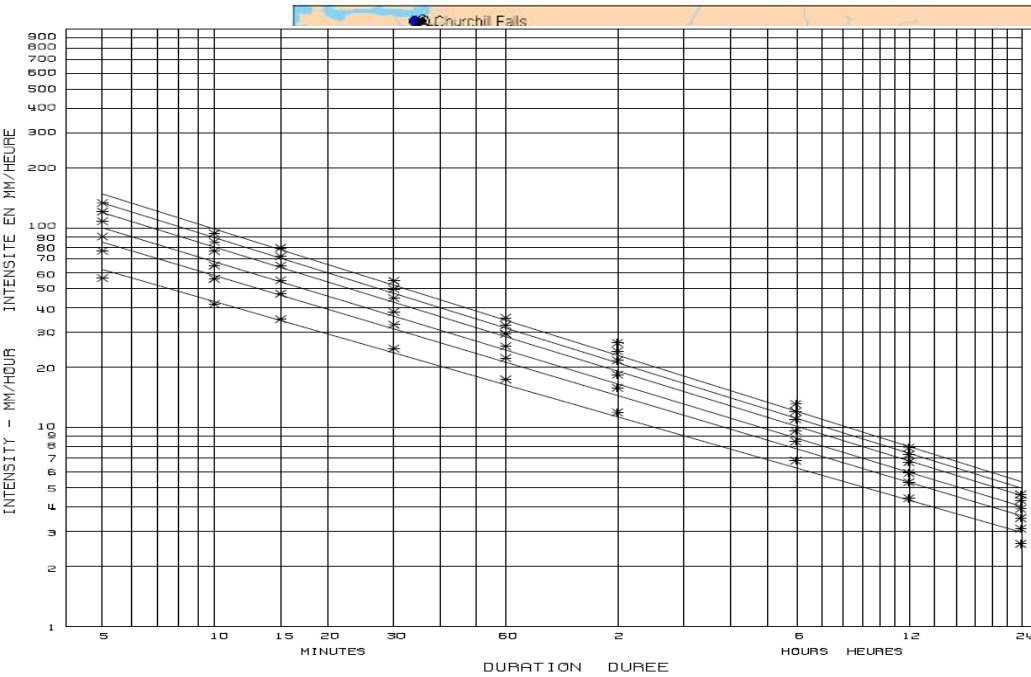
Climate change adaptation

Table 3b

Return Period Projections for Extreme 24-hour Precipitation Amounts (mm)

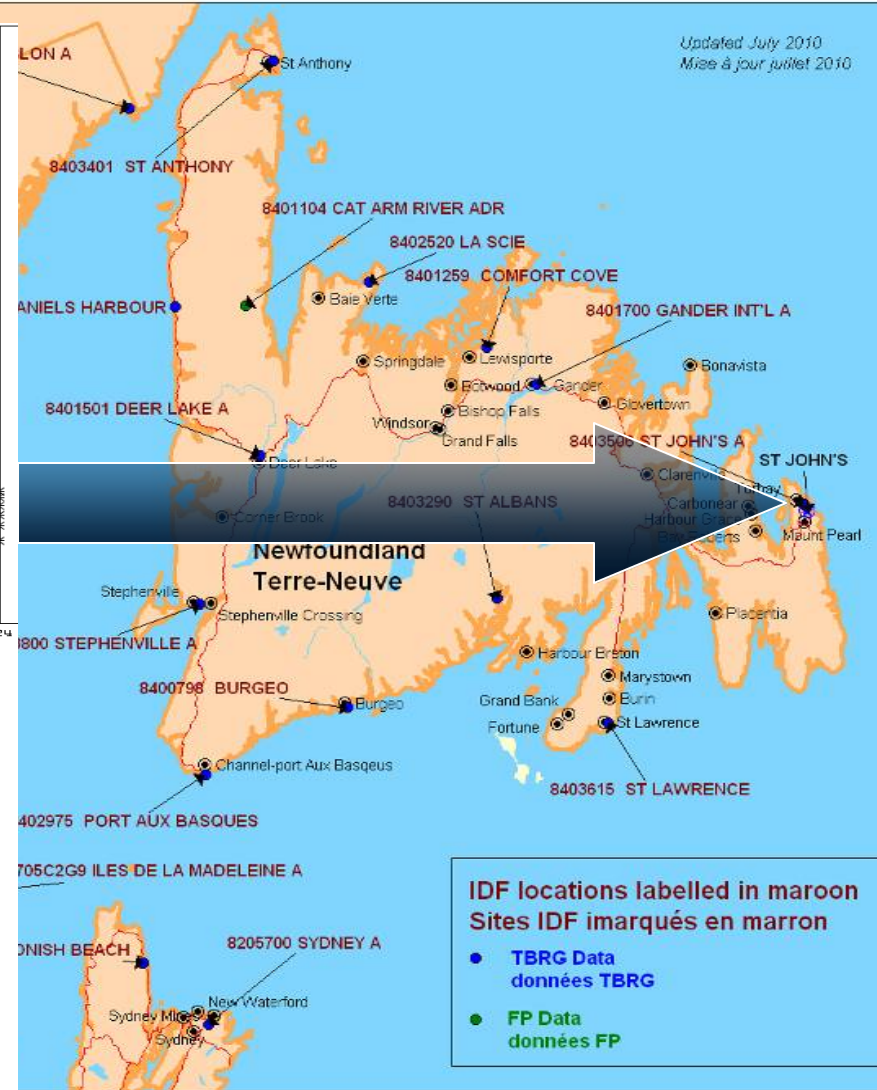
Return Period	10 Years				50 Years				100 Years			
	Hist	2020s	2050s	2080s	Hist	2020s	2050s	2080s	Hist	2020s	2050s	2080s
Newfoundland and Labrador												
<i>Gander CGCM2</i>	59.4	65.8	65.5	62.1	72.8	82.8	82.9	76.4	78.5	89.9	90.3	82.5
<i>Gander HadCM3</i>	59.4	61.7	70.7	81.3	72.8	77.5	89.7	108.8	78.5	84.2	97.7	120.5
<i>St Johns CGCM2</i>	75.9	113.2	118.5	107.2	92.2	149.2	160.3	134.5	99.1	164.4	178	146
<i>St. Johns HadCM3</i>	75.9	103.5	139.1	110.8	92.2	128.6	199	147.1	99.1	139.1	224.3	162.4
<i>Cartwright CGCM2</i>	62.7	44.7	50.5	56.5	80.2	54.6	64.8	74.6	87.6	58.8	70.8	82.3
<i>Cartwright HAdCM3</i>	62.7	56.8	61.6	62.2	80.2	69	78.7	77	87.6	74.9	85.9	83.2
<i>Goose Bay CGCM2</i>	59.6	75.1	73	68.1	76.5	98.6	96.7	83.7	83.7	108.6	106.7	90.6
<i>Goose Bay HadCM3</i>	59.6	46.5	50.8	43.7	76.5	58	64	62.1	83.7	62.8	69.6	67.1
<i>Stephenville CGCM2</i>	69.8	83.7	86.3	93.8	89.2	106.9	109	121.5	97.3	116.7	118.6	133.2
<i>Stephenville HadCM3</i>	69.8	73.2	95.6	78.5	89.2	94	132.7	101.8	97.3	102.7	148.2	111.6

IDF Data Newfoundland and Labrador and Southeastern Quebec Locations Données IDF des sites de Terre-Neuve-et-Labrador et du sud-est du Québec



RETURN PERIOD RAINFALL AMOUNTS (MM)
PERIODE DE RETOUR QUANTITIES DE PLUIE (MM)

DURATION DUREE	2 YR/ANS	5 YR/ANS	10 YR/ANS	25 YR/ANS	50 YR/ANS	100 YR/ANS	# YEARS ANNEES
5 MIN	4.7	6.4	7.6	9.0	10.1	11.2	35
10 MIN	6.9	9.3	10.8	12.8	14.3	15.7	35
15 MIN	8.7	11.7	13.7	16.2	18.1	19.9	35
30 MIN	12.5	16.4	19.0	22.3	24.8	27.2	35
1 H	17.4	22.3	25.5	29.5	32.5	35.5	36
2 H	23.7	31.6	36.8	43.3	48.2	53.1	36
6 H	40.9	51.0	57.7	66.1	72.3	78.5	35
12 H	52.2	63.5	71.1	80.5	87.6	94.5	35
24 H	62.0	75.0	83.6	94.5	102.6	110.6	36

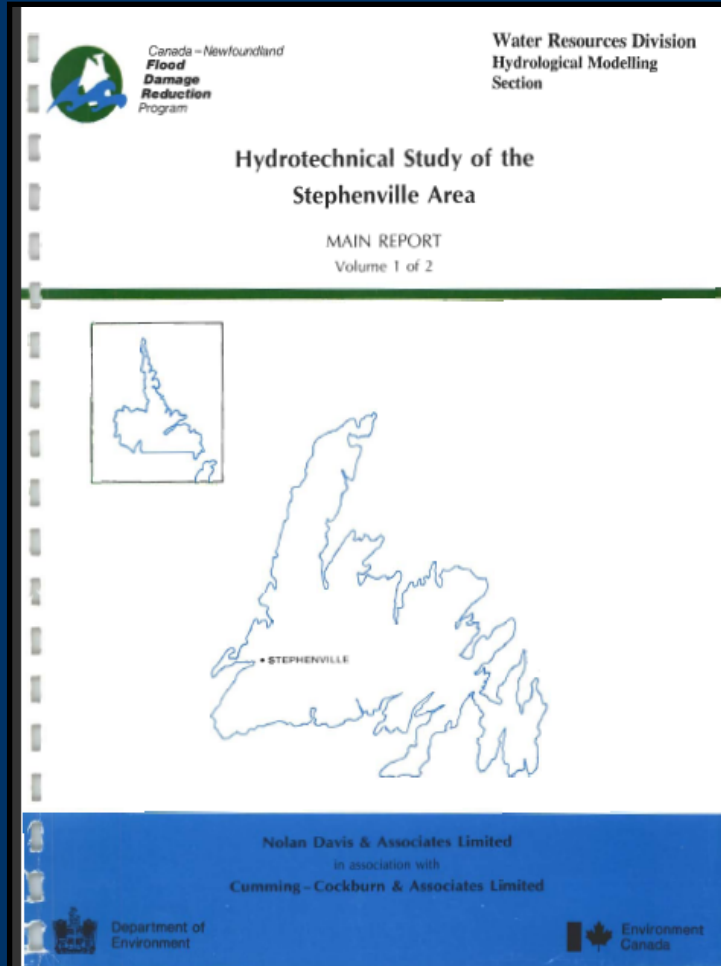


IDFs

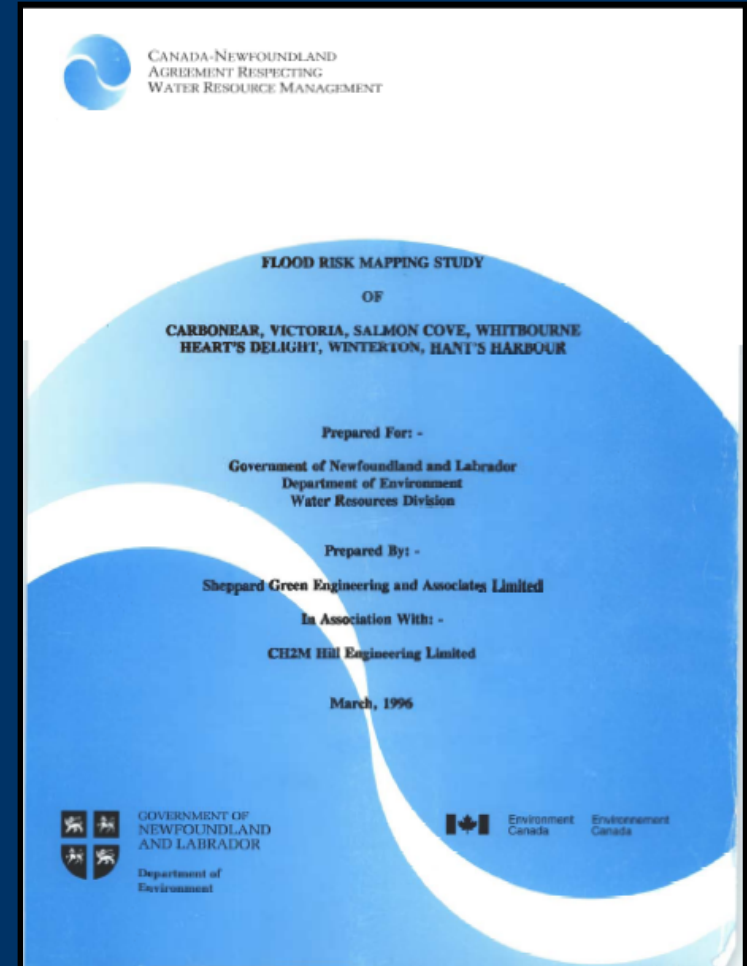
Station	Year
Battle Harbour	1983
Burgeo	1994
Churchill Falls Airport	1992
Comfort Cove	1995
Daniels Harbour	1995
Deer Lake Airport	2002
Gander International Airport	1990
Goose Airport	2007
La Scie	1995
Mary's Harbour	1995
Nain	2007
Port Aux Basques	1995
St. Alban's	1983
St. Anthony	1995
St. John's Airport	1996
St. Lawrence	1996
Stephenville Airport	2007
Wabush Lake Airport	2003



Flood Risk Mapping Studies



Canada – NL Flood Reduction
Program (1981-1993)

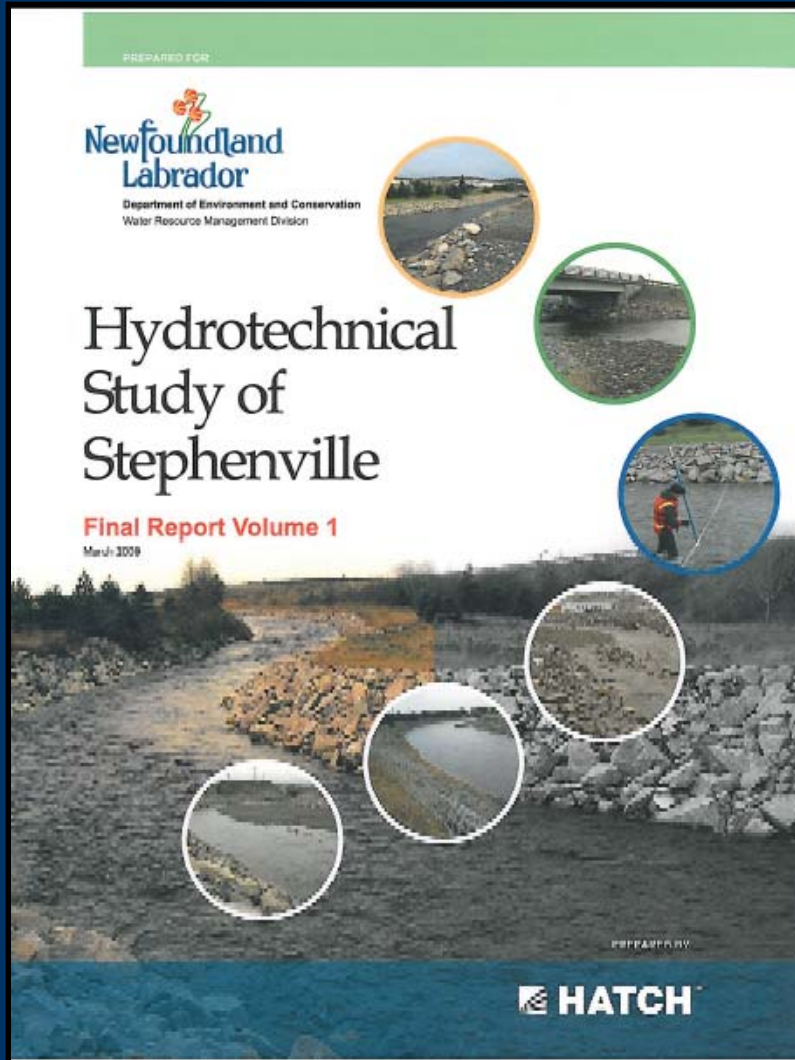


Canada–NL Agreement Respecting
WR Management (1993-1996)

Flood Risk Mapping Areas

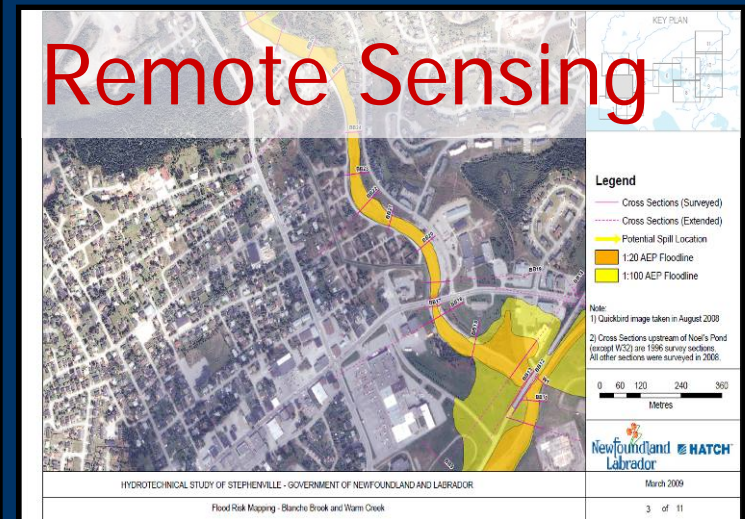
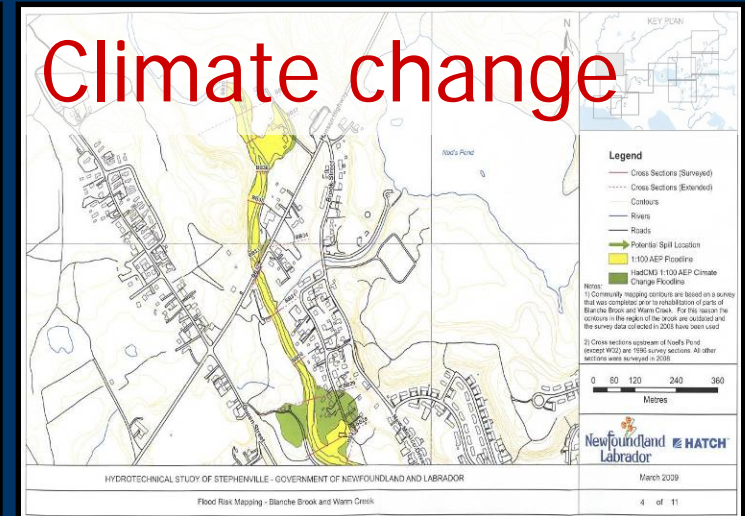
Appleton	Goulds	Rushy Pond
Badger	Hant's Harbour	Salmon Cove
Bishops Falls	Heart's Delight	Shoal Harbour
Black Duck Siding	Hickman's Harbour	St. Phillips
Brigus	Hodges Cove	Steady Brook
Carbonear	Kippens (Gaudon's Brook)	Stephenville
Codroy Valley		Stephenville Crossing
Cold Brook		Outer Cove
Cox's Cove	Parson's Pond	Trout River
Deer Lake	Petty Harbour	Victoria
Ferryland	Placentia	Waterford River
Glenwood	Portugal Cove	Whitbourne
Glovertown	Rushoon	Winterton

2009 Flood Risk Study



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Summary

- Case study of Hurricane Igor
- Need for climate change adaptation
- Design using intensity duration frequency curves
- Development based on flood risk mapping studies



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Thank you!

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