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Water Measurement and Data Availability

Environment Canada Perspective

2008 Water Measurement Workshop

Lethbridge Alberta

Jeff Woodward

Water Survey/Environment Canada

July 16-17 2008

Water Survey of Canada

- The Water Survey of Canada is the national agency responsible for the collection, interpretation and dissemination of standardized water resource data and information in Canada.

Presentation

- Water Survey Partnership.
- The Water Monitoring Network and Data Collection
- Discharge Measurements.
  - Conventional.
  - Hydro-Acoustics.

Water Resources Management Mandate

Federal Government Jurisdiction

fisheries, navigation, federal lands (including aboriginal territories), relations with foreign governments, and interjurisdictional waters.

Provincial Government Jurisdiction

property, civil rights, and the management and sale of public lands; this jurisdiction includes the management of water within a provincial boundary.

1.0 HYDROMETRIC AGREEMENTS

- Single resource with multiple and shared uses.
- Surface Water measurements were first made Alberta and Saskatchewan in 1894.
- Activities were funded initially through the Federal Governments
- Evolved to be funded via ad-hoc arrangements with provincial governments, crown corporations, and the private sector.
- 1975 formal establishment of Federal Provincial and Federal Territorial cost share agreements.

Cost Share Agreements

- Administrators – Usually Federal and Provincial Civil Servants.
- Coordinating Committee – Set up by administrators
- Operators – operate the networks.
  - In general, the operator is the Water Survey however each province has an operational branch that fulfills some of the operational duties of the network.
    - Province of Quebec.
    - Province of Saskatchewan.

Cost Share Partners
Prairie and Northern Region

- NWT/NU
  - Environment Canada/Diand/Commercial
- Alberta
  - Environment Canada/Alberta Environment
- Saskatchewan
  - Environment Canada/Sask Watershed Authority
- Manitoba
  - Environment Canada/Manitoba Water Stewardship/Manitoba Hydro.

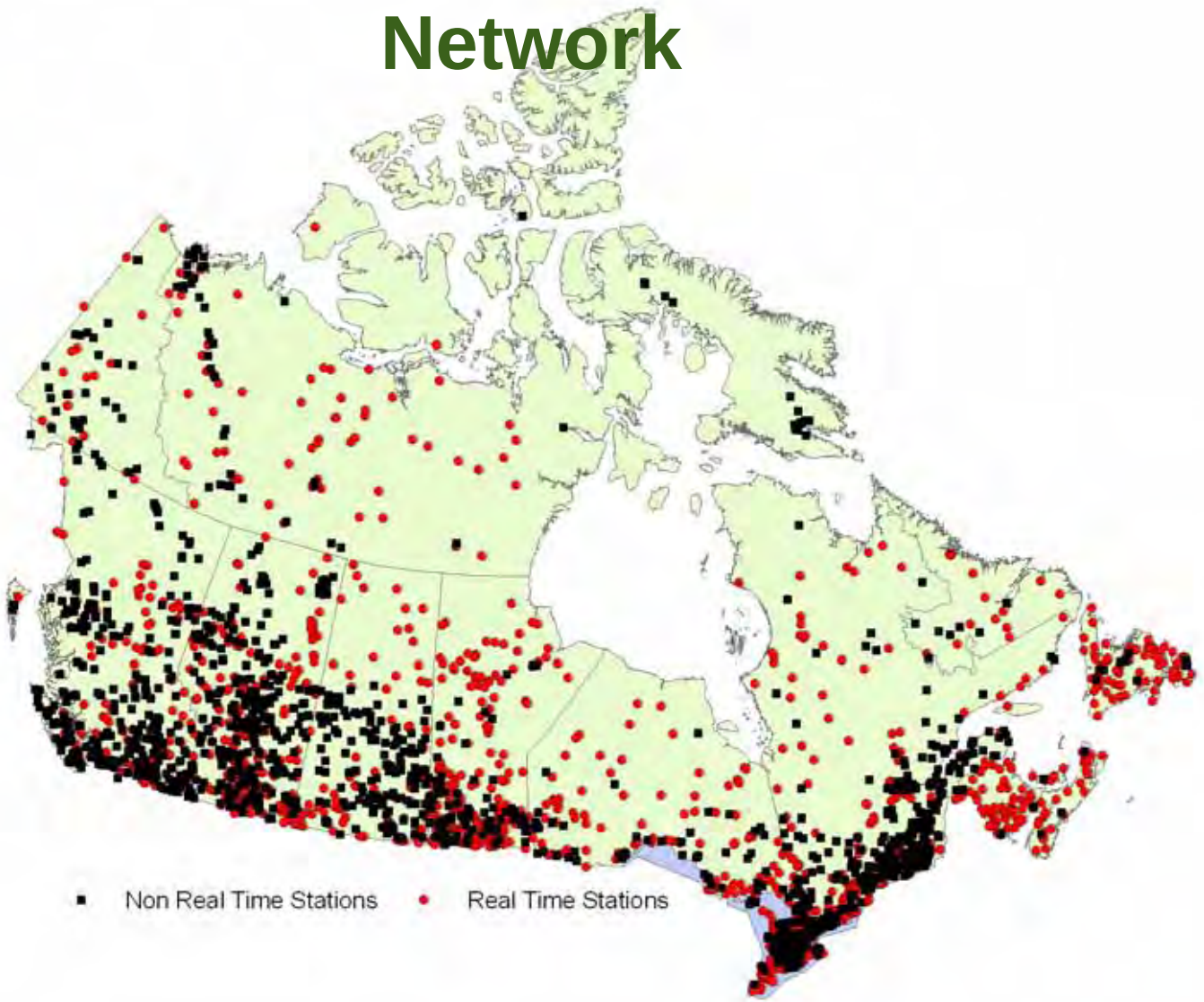
Partnership Summary

- Water Survey operations are cost shared and co-managed attempting to meet the needs of multiple users.

THE HYDROMETRIC NETWORK and DATA

- Active Water Level and Streamflow network – 2850
- Federal Government operates about 2350
- Real Time Stations – 1450
- Discontinued Stations 5600.

Operational Canadian Hydrometric Network



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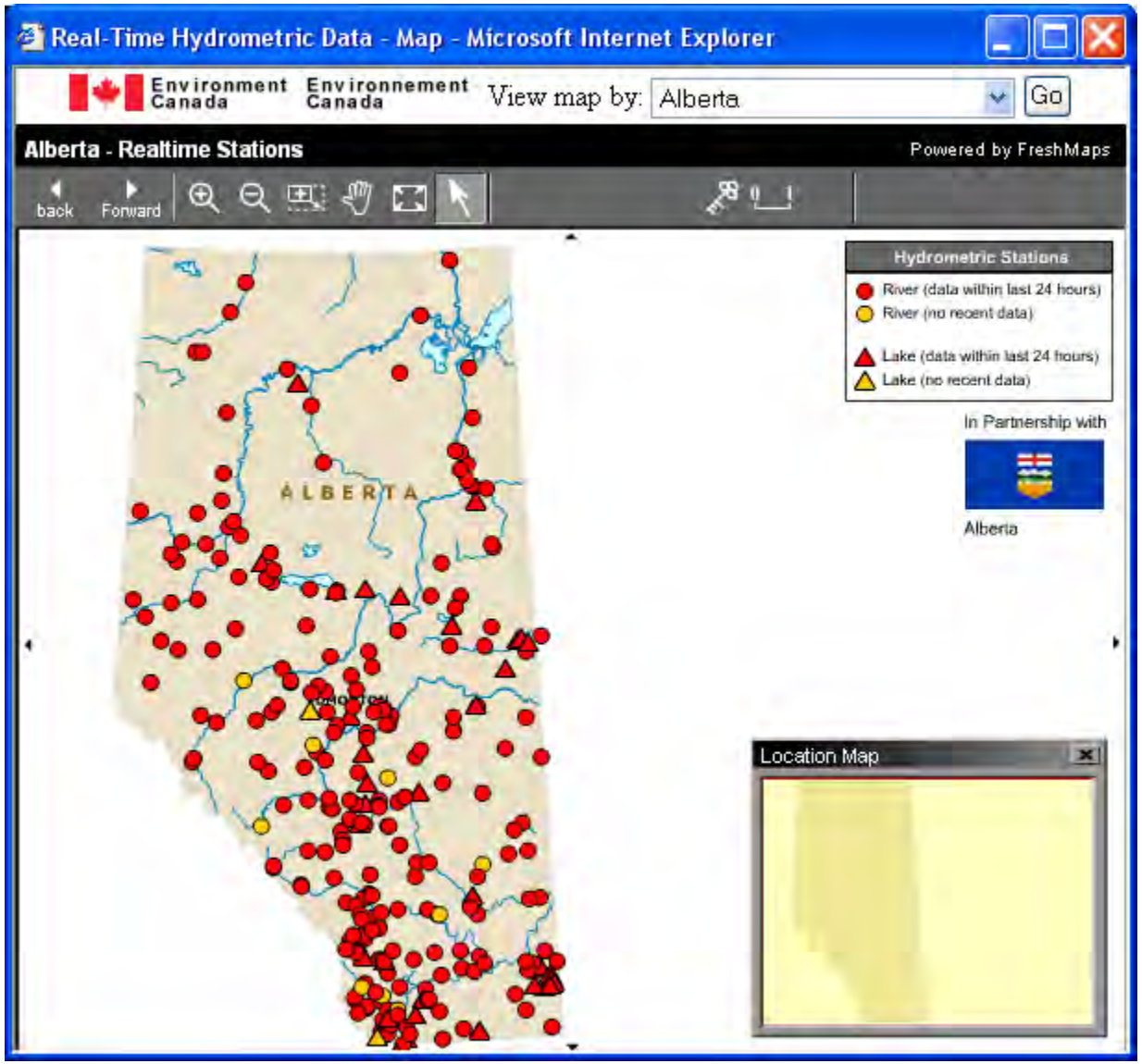
Public Website

http://www.wsc.ec.gc.ca/

Online Data and Information

- HYDAT
  - Canada's national archive for water quantity data
  - HYDAT CD-ROM - Order or download the database
  - Archived Hydrometric Data - Query the database on-line
  - Archived Sediment Data - Query the database on-line
- Real-Time Hydrometric Data
  - Search for real-time water levels at over 1200 hydrometric stations across Canada
  - Maps of real-time hydrometric stations
- Water Level and Streamflow Statistics
  - Generate statistics for selected hydrometric stations
  - Hydrometric Station Reference Index



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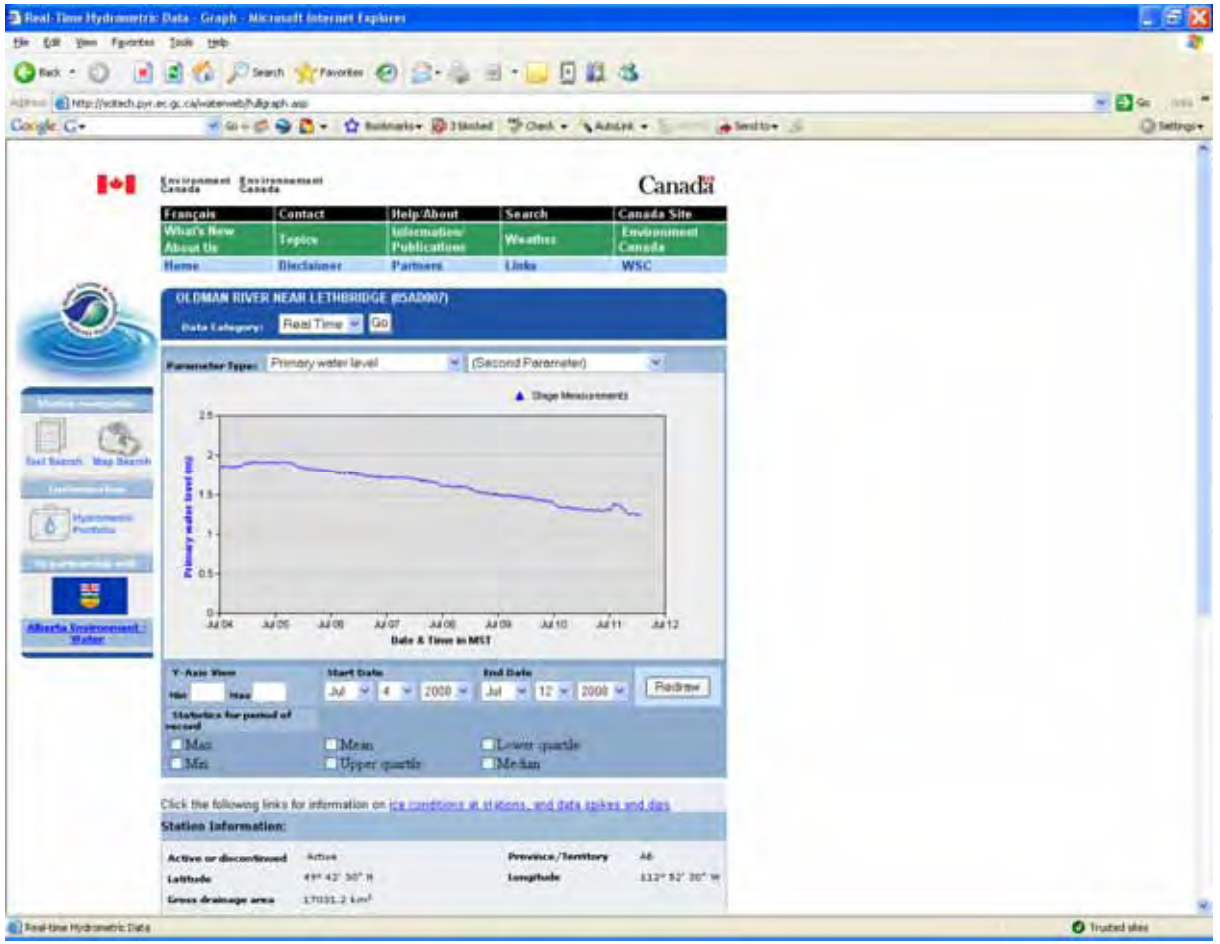
Real Time Water Level Data



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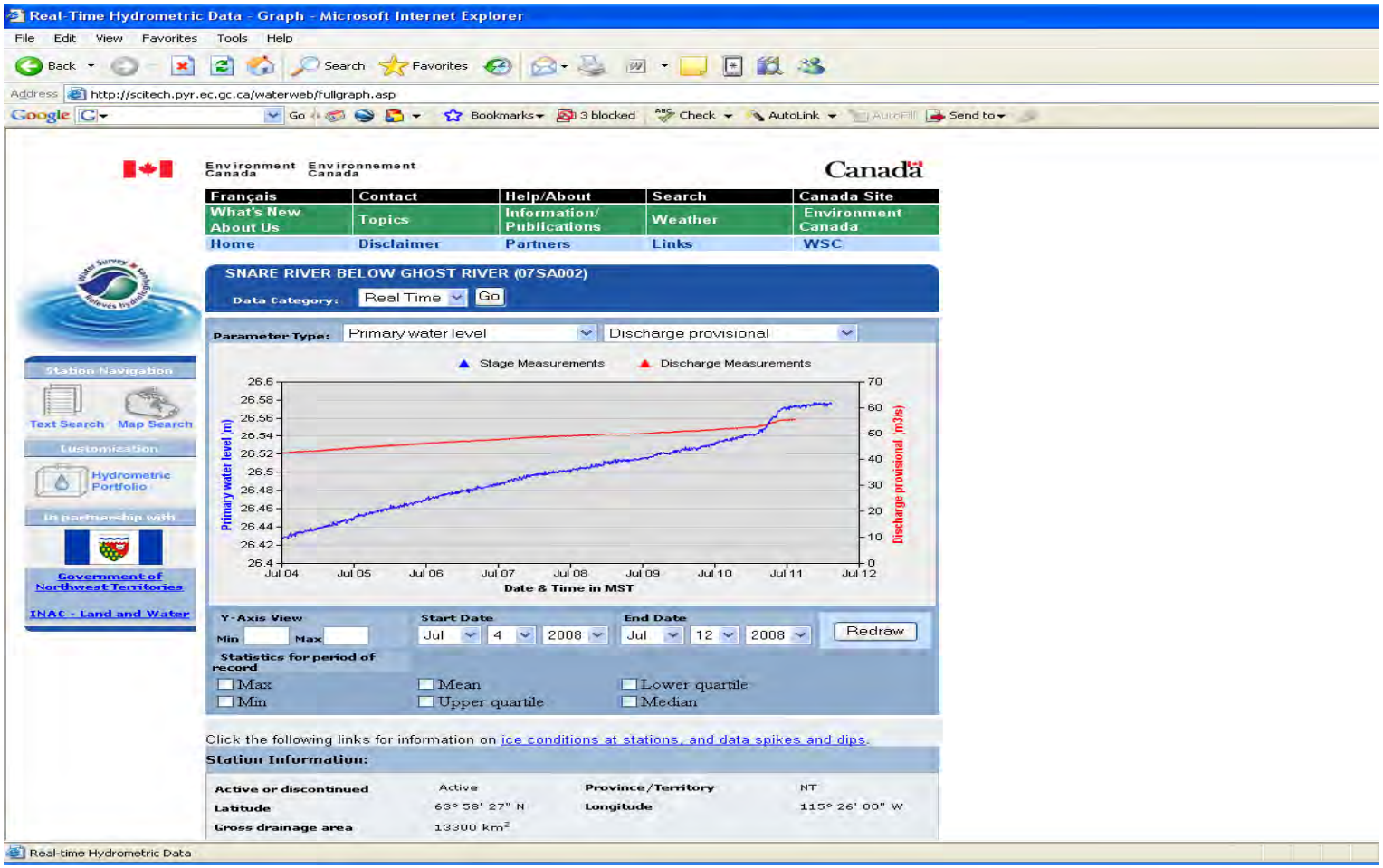
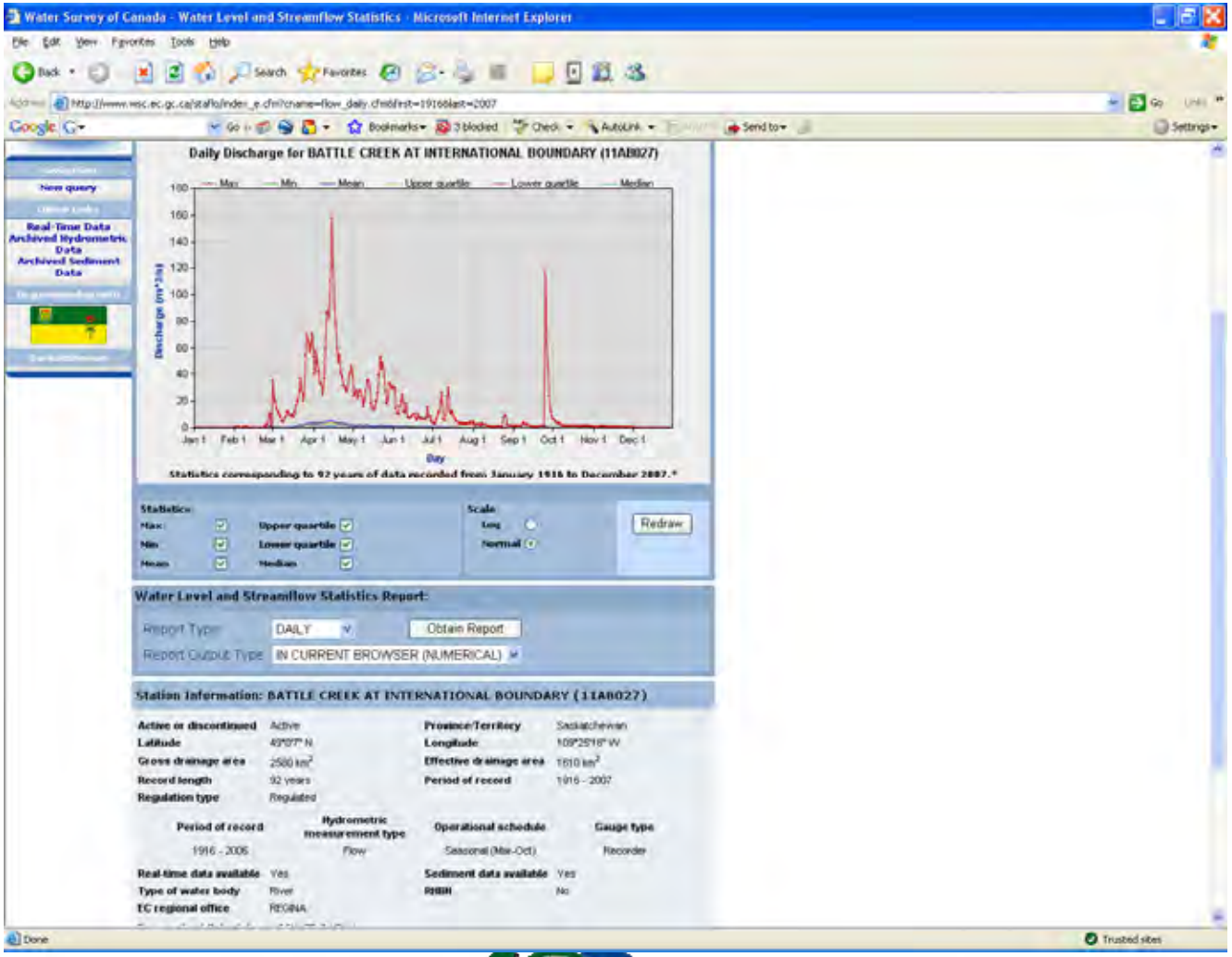
Real Time Flow Information



Historical Statistics on Station Data



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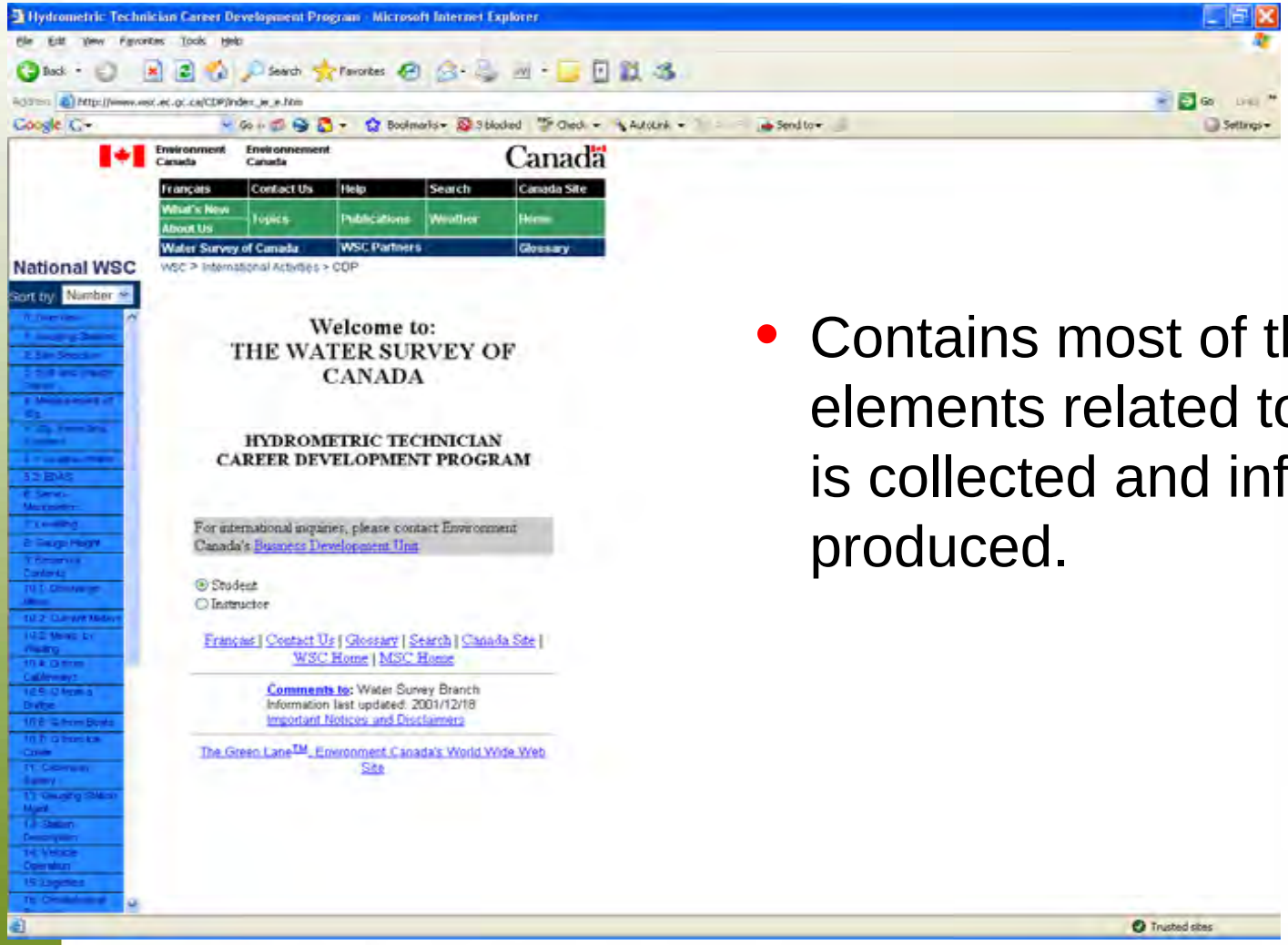
Apprenticeship and Training Program



- Contains most of the training elements related to how data is collected and information is produced.

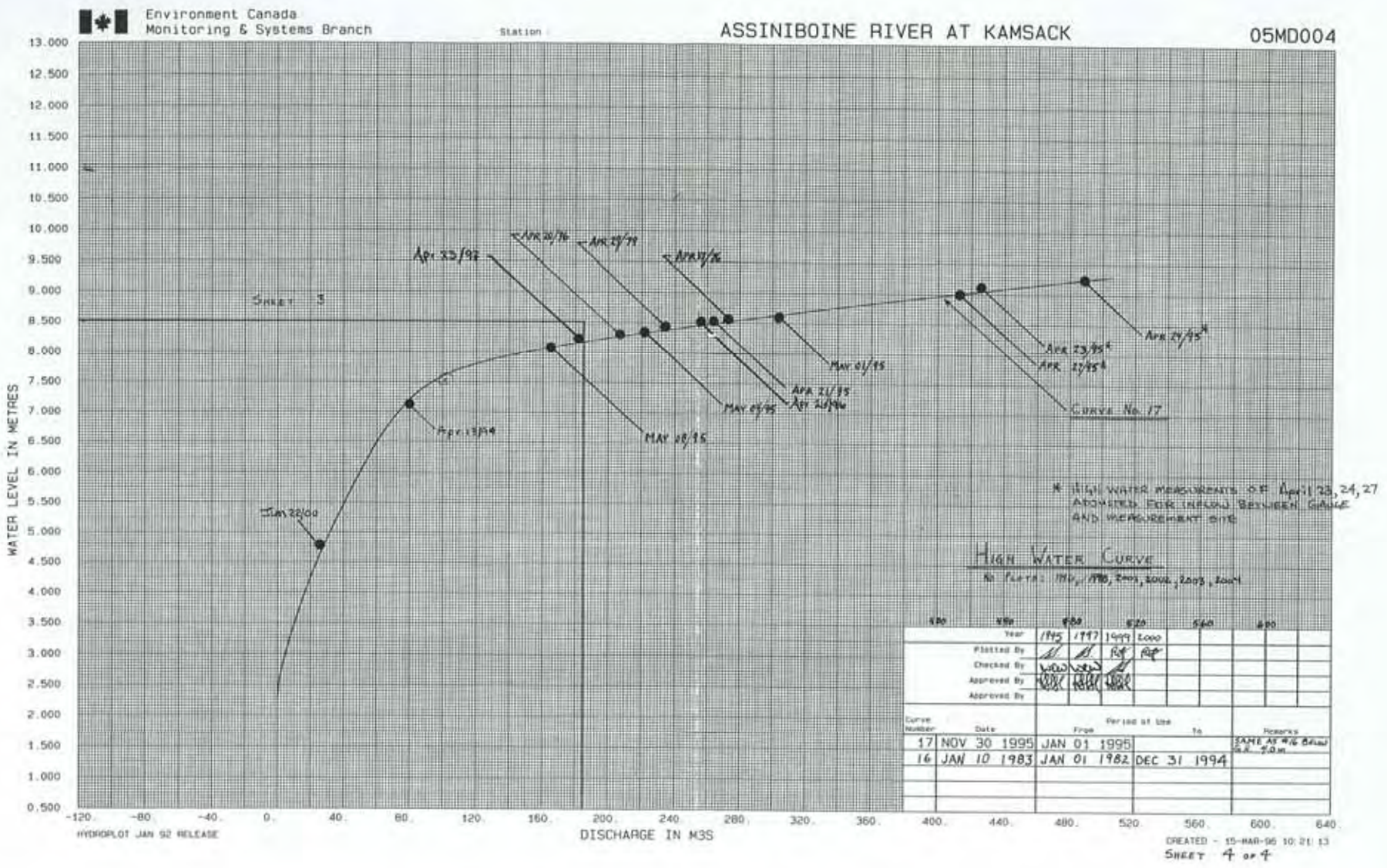
Hydrometric Network and Data Summary

- There are 2850 active stations in Canada of which about half are real time
- All historical data and real time data is available online. (there is a gap between real time data and data that is available online)
- Training packages are available online.

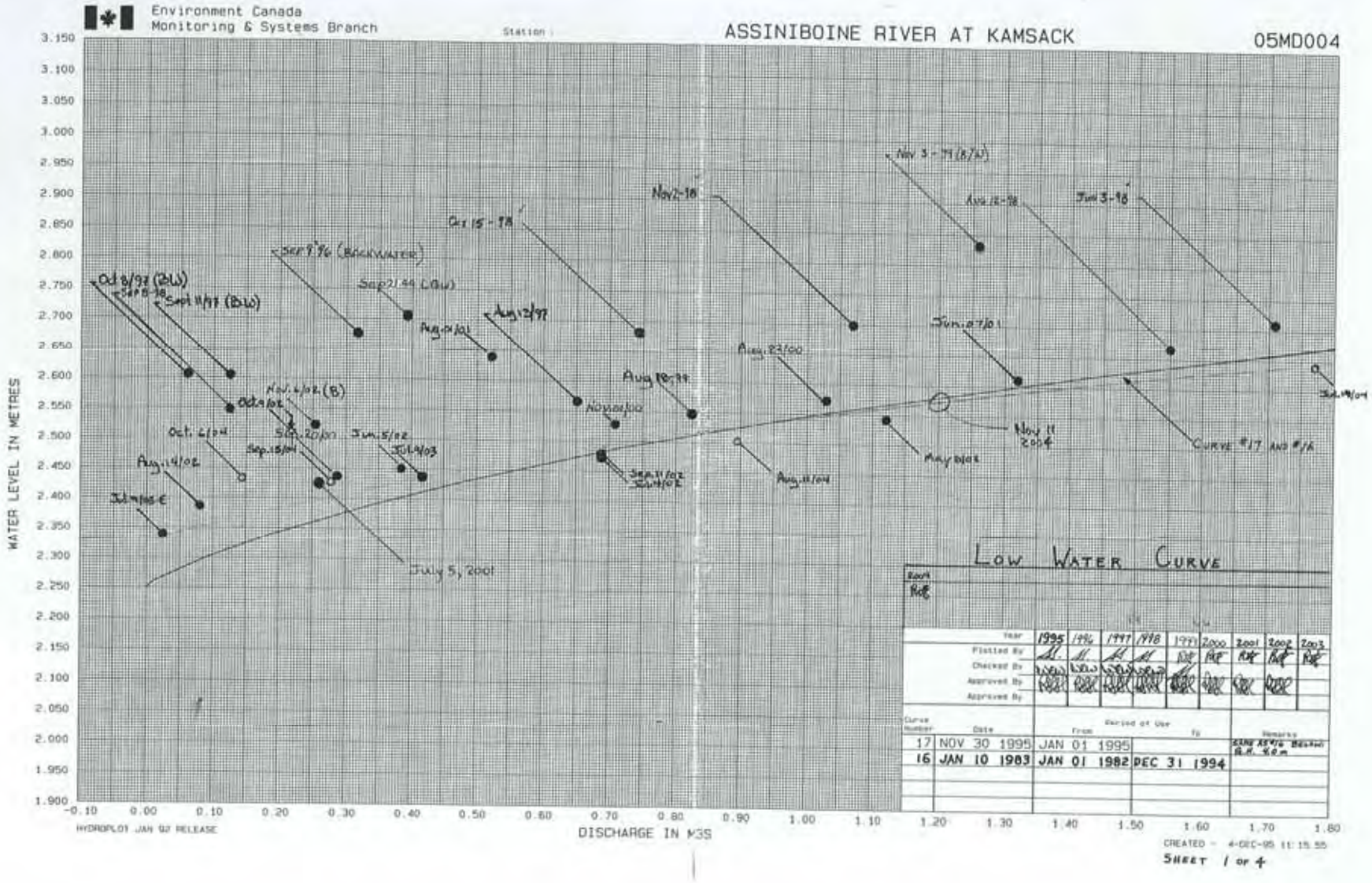
DATA COLLECTION AND INFORMATION PRODUCTION

- Water Survey predominantly collects Water Level Data.
- Discharges are calculated from water levels using a stage discharge relationship.

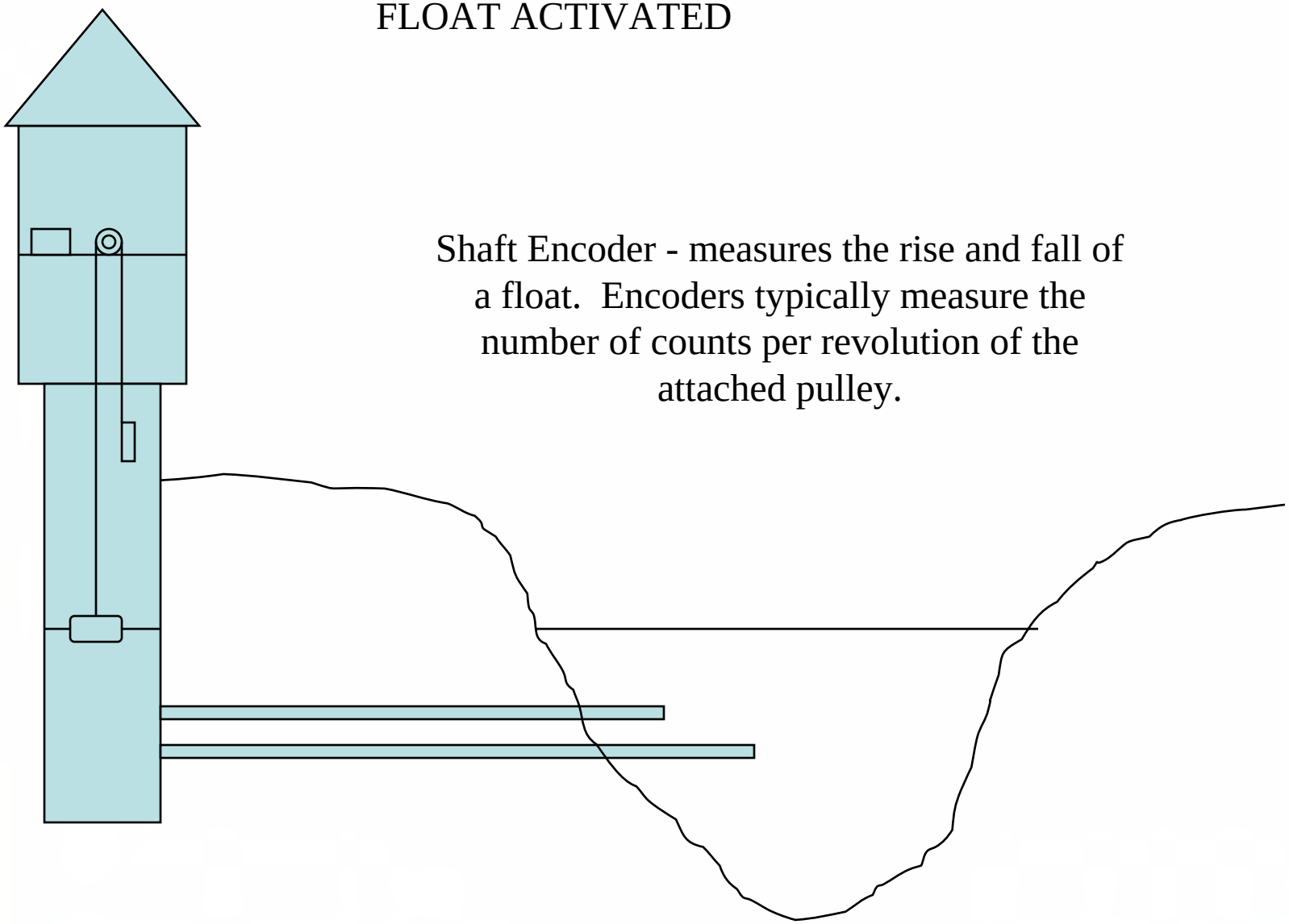
Assiniboine River at Kamsack, Sk.
High Water Curve



Assiniboine River at Kamsack, Sk.
Low Water Curve



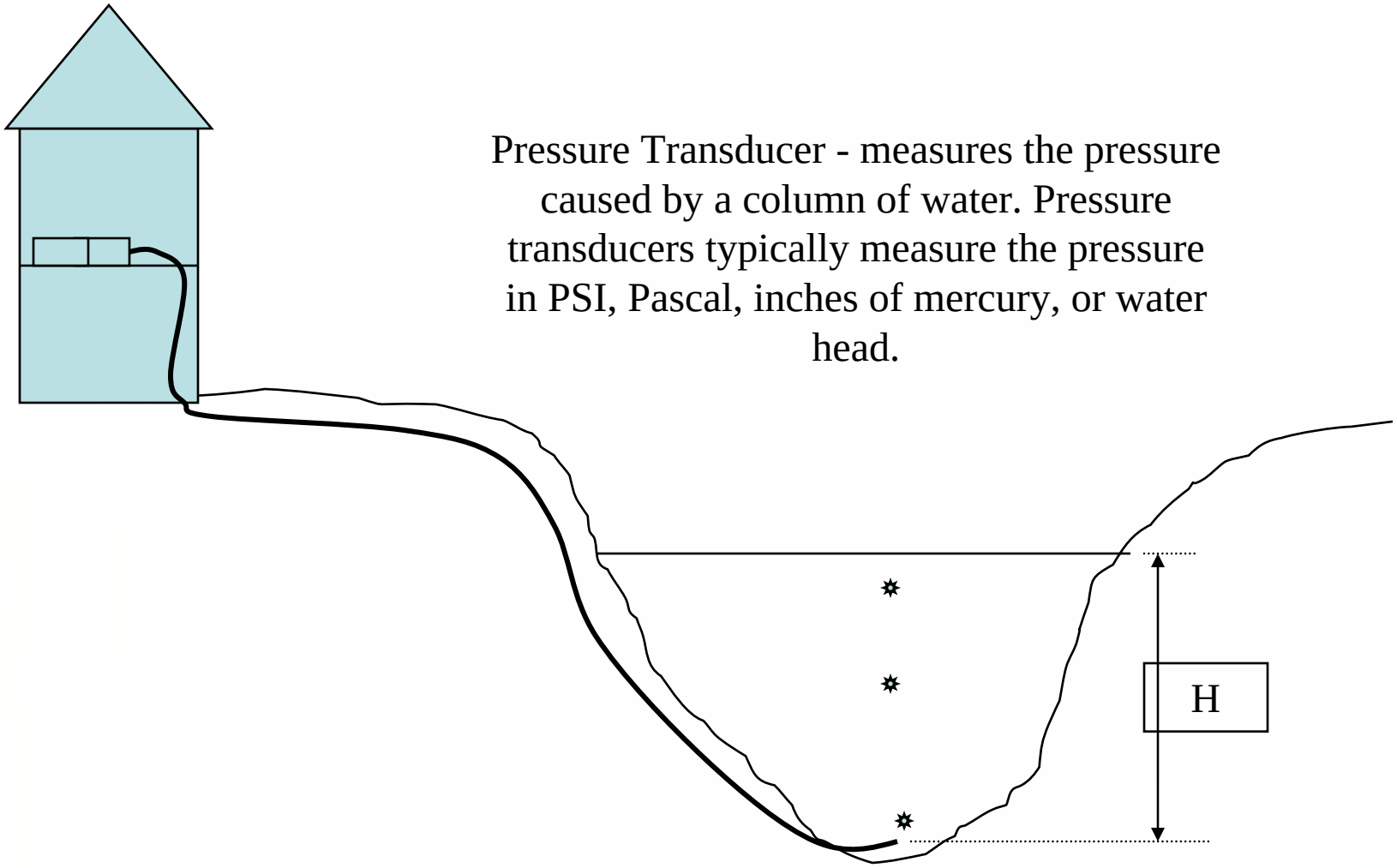
FLOAT ACTIVATED



Shaft Encoder - measures the rise and fall of a float. Encoders typically measure the number of counts per revolution of the attached pulley.

PRESSURE TRANSDUCERS

Pressure Transducer - measures the pressure caused by a column of water. Pressure transducers typically measure the pressure in PSI, Pascal, inches of mercury, or water head.



Typical Hydrometric Station

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Standards and Procedures

- The Water Survey uses standard methods in the collection of all the data.
  - Leveling Standards
  - Equipment Standards
  - Discharge Measurement Standard Procedures
  - Etc.
- The Water Survey uses standard methods in the production of discharge information.
  - Applying Shift Corrections to the data
  - Developing and applying rating curves
  - Submission of data for publication

How accurate is the data?

- The Water Survey does not have a “standard” for the data that is produced.
- This means that although the data is produced in a consistent and repeatable manner, the accuracy of the resulting information is dependent on:
  - physical conditions of the site,
  - procedures used to make the various measurements,
  - frequency of calibration and verification measurements, and
  - quality of the record that is collected.

Data Collection Summary

- Water Survey collects water level data
- Stage discharge relationships are used to convert water levels to flows.
  - Calibration and Verification measurements of water level and discharge as conditions change.
- Standard procedures are used to yield a consistent result.
- The overall accuracy of the final data is not quantified.

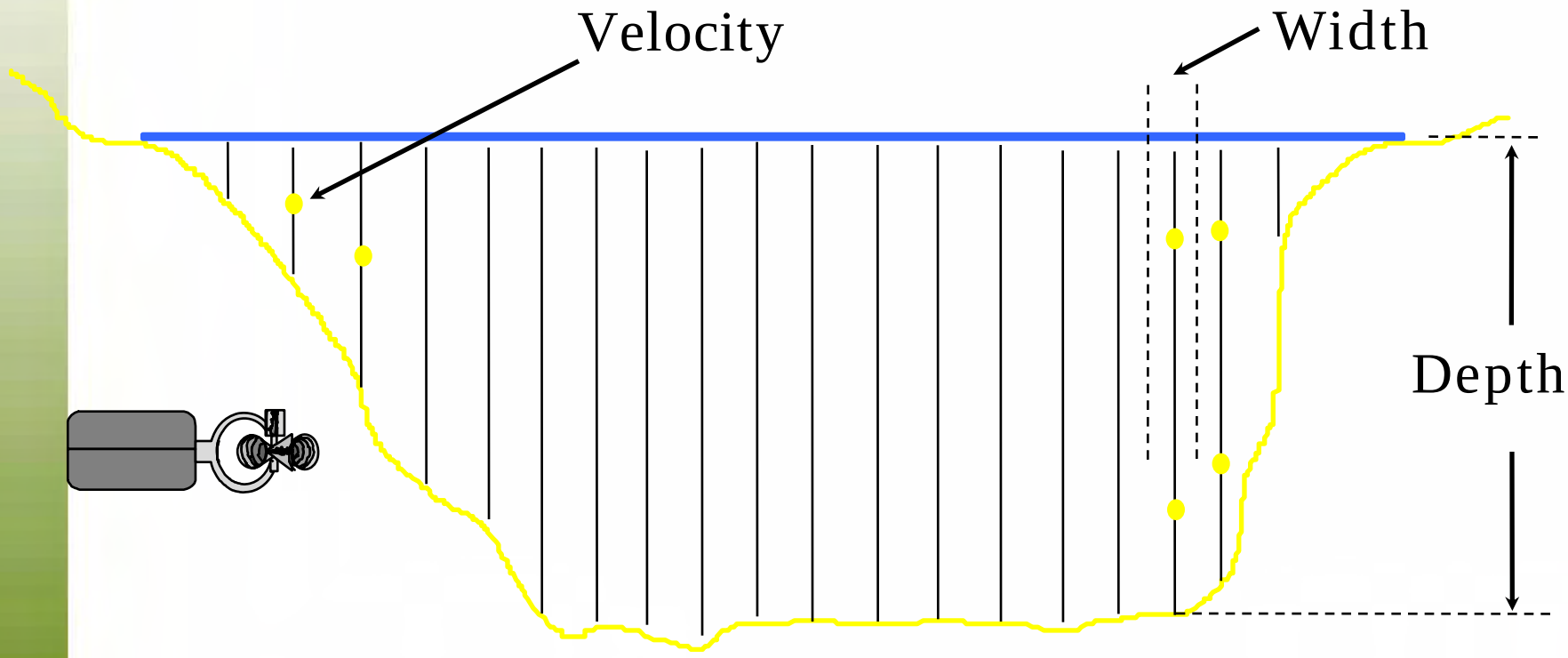
DISCHARGE MEASUREMENTS

- CONVENTIONAL and HYDROACOUSTIC

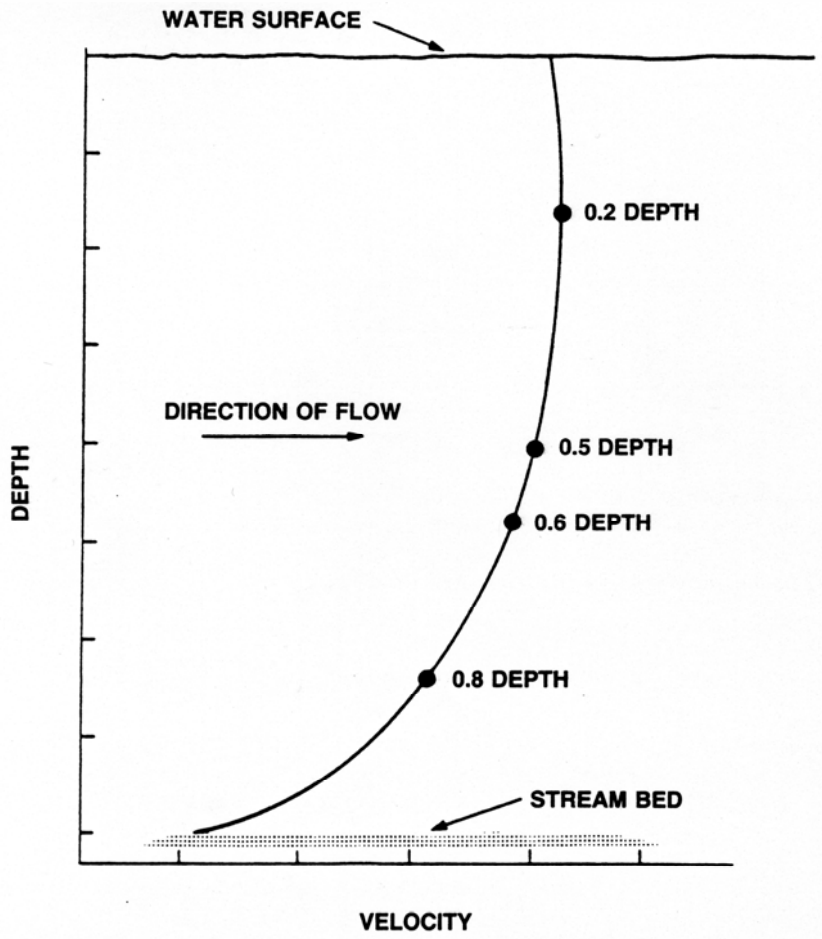
Conventional Measurements

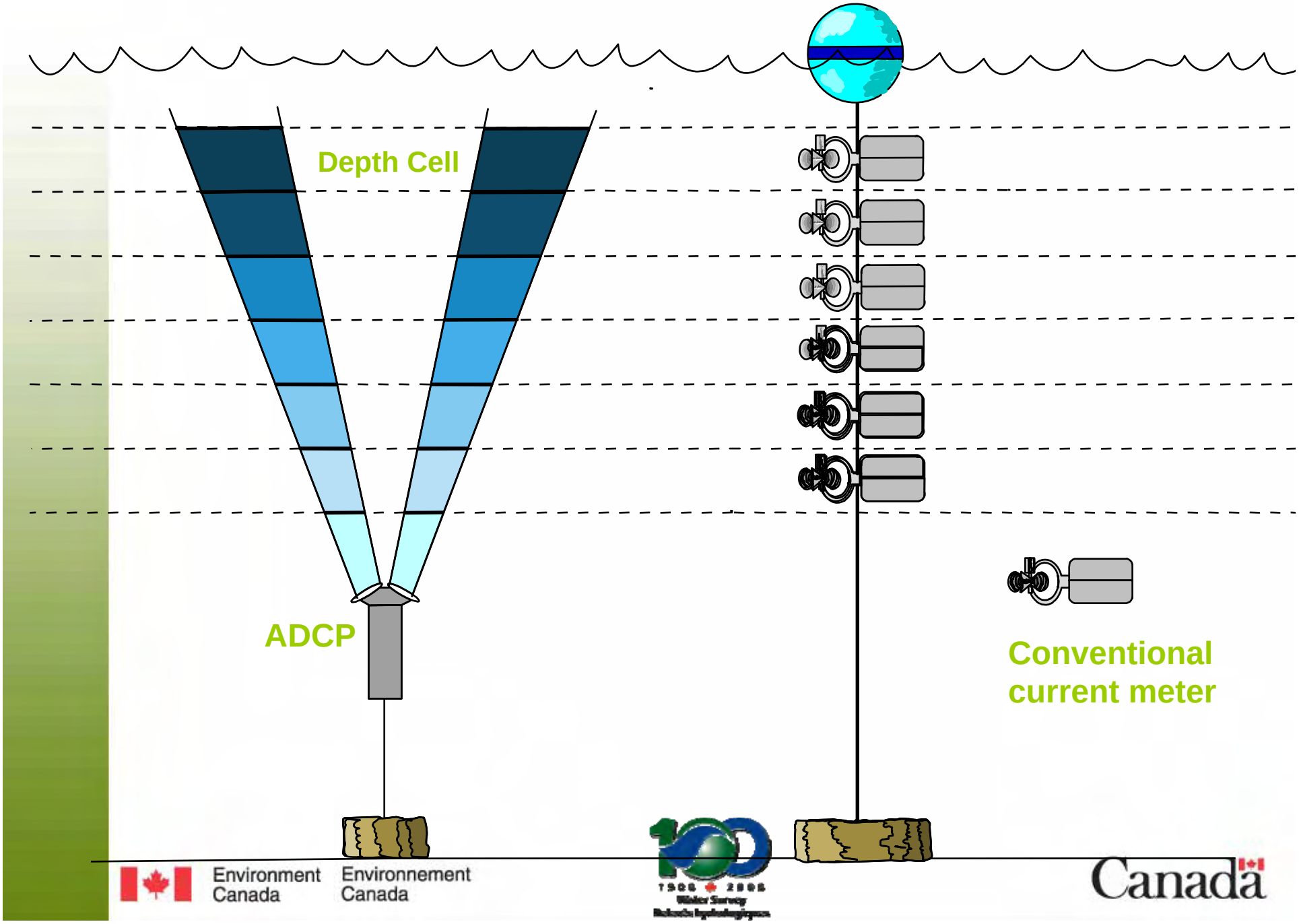
- Price Current Meter is the standard for discharge measurements in Canada.
- Wading, Boat, Bridge, Cableway
- 0.6, 0.2/0.8,velocity measurements
- Standard velocity distribution assumed for each measurement.
- Midsection method.
- 20 panels.
- Representative water level.

Conventional Discharge Measurement



Velocity Profile




Depth Cell
ADCP
Conventional
current meter
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Hydro-acoustics

- Wading measurements – Sontek Flowtracker
- Bridge/Cableway/Boat measurements
  - RioGrande Teledyne RDI ADCP
  - 1200kHz
  - 600kHz.

Policies/Standards/Procedures

- Policy on the Use of Hydro-Acoustic Technologies in Water Survey of Canada Operations - February 11, 2003
- Procedures For Conducting ADCP Discharge Measurements.
- Procedures for Review and Approval of ADCP Discharge Measurements.
- Procedures for ADCP Operator Accreditation.

Technology Shift

- Flowtracker
- RDI ADCP

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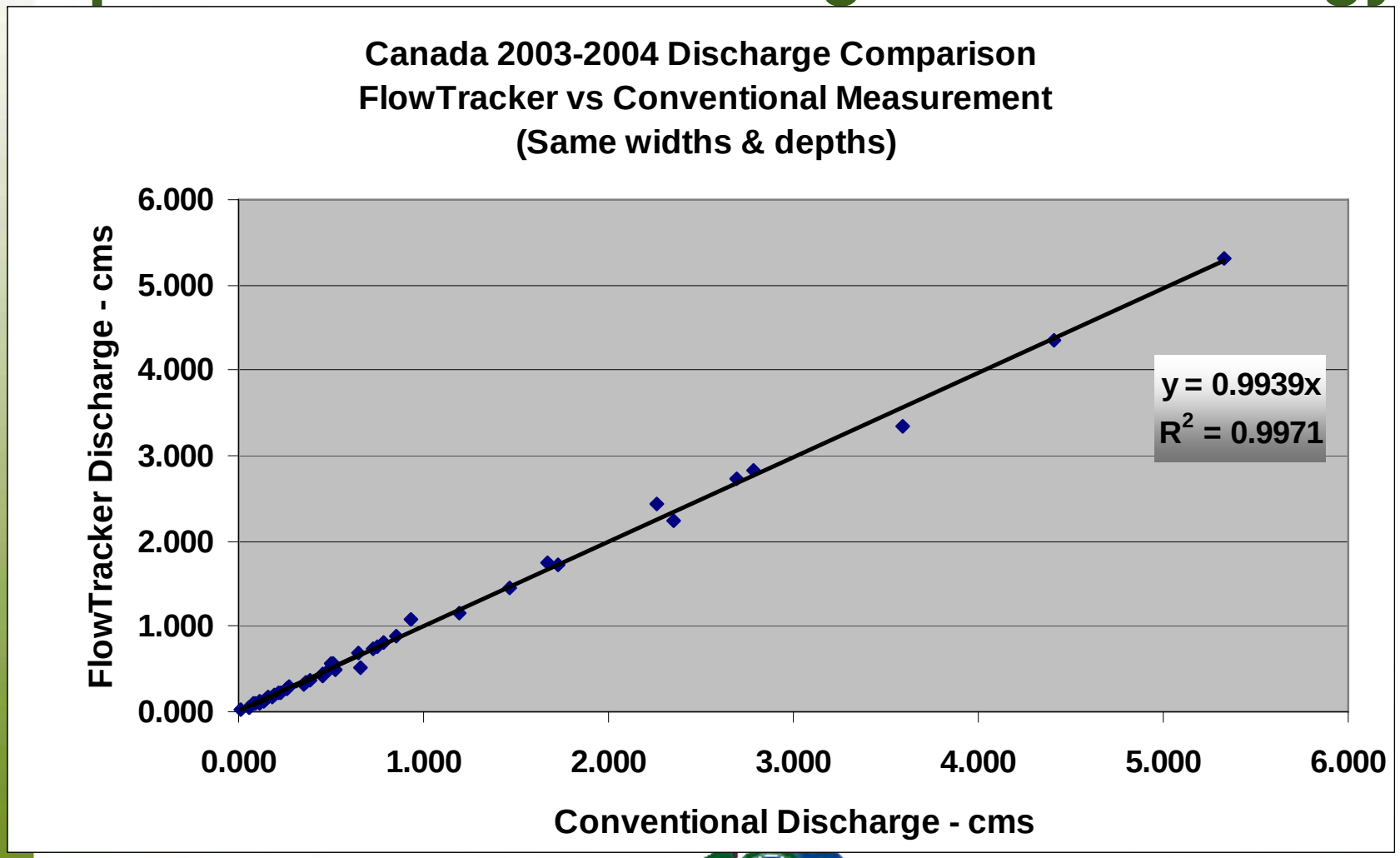
Flow Tracker
Expected Affect of Change in Technology



Flow Tracker Results

- There is no shift in the data expected as a result of using the flowtracker in place of the price current meter.
- Low flow data will be improved by using the flowtracker.
- There is no specialized training required to use the flow tracker.
- There are conditions where the flow tracker will not work that still need to be quantified
- There are characteristics of hydro-acoustics that we are not yet taking advantage of in conducting discharge measurements.

ADCP Measurements
Expected Affect of Change in Technology

- Hydro-acoustic measurements are becoming the standard in discharge measurements
- Significantly more complicated in operation
- Significant training is required to operate the ADCP and use the data.

OVERALL AFFECT ON THE DATA -

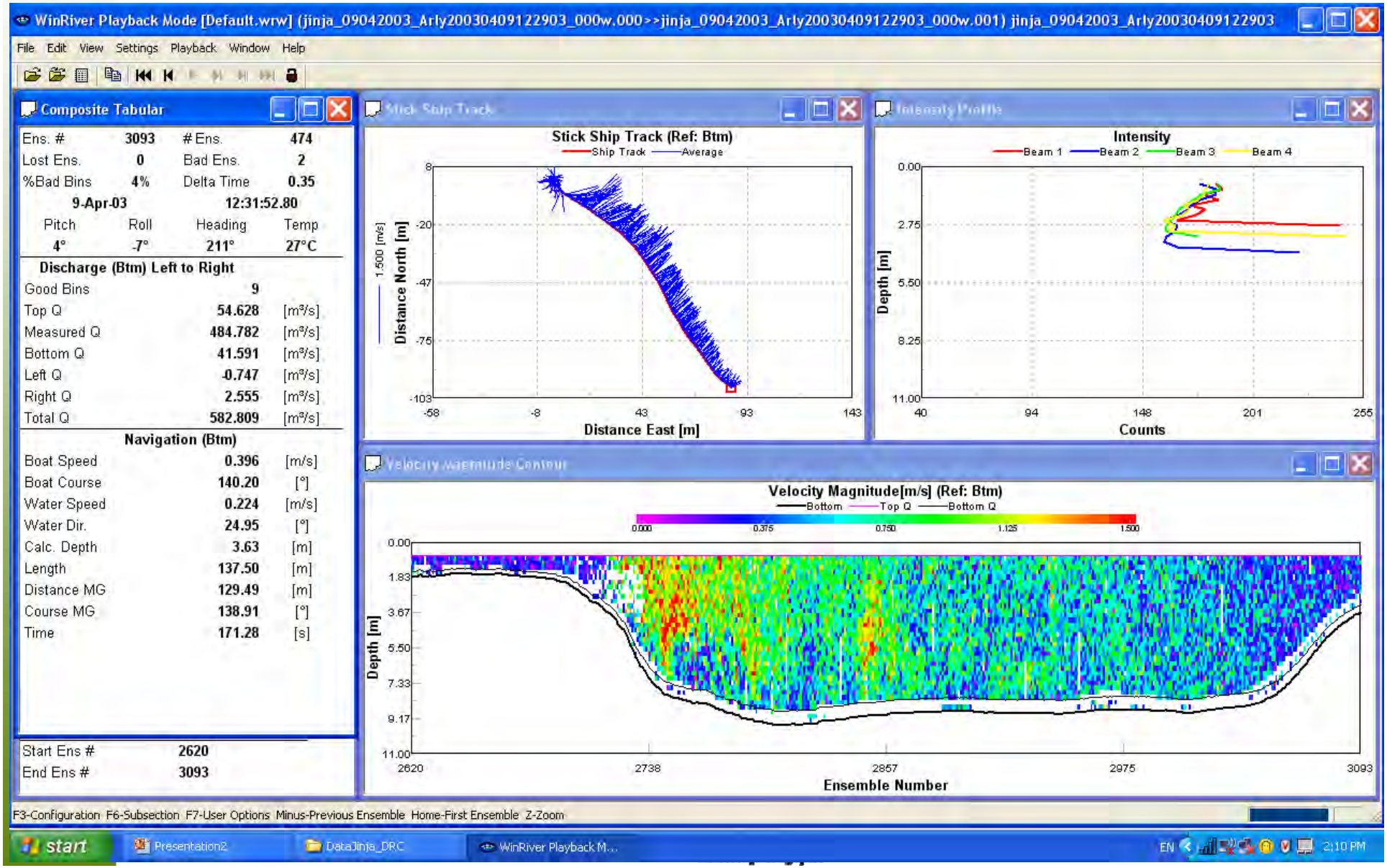
ADCP CONVENTIONAL COMPARISON - Canadian Results

- The overall difference between conventional and ADCP measurements is in the range of -1.5%.
- Low Water Modes show the biggest difference in the range of -2.5% to -4.5%
- ADCP Mode12 SB shows a bias in the range of -4.5% to -5%.

The Data

- Significant increase in the amount of data to manage.
- Data consists of the same basic data as a conventional measurement – velocity area info.
- Velocity profile is measured directly (not assumed)
- Distances and areas are measured automatically.
- User needs to understand the basic physics of acoustics in order to interpret data.

Discharge Measurement



Acoustic Discharge Measurements

RDI

Sontek

Tethered Boats

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Powered Boats

Manned Boats

Remote Control Boat

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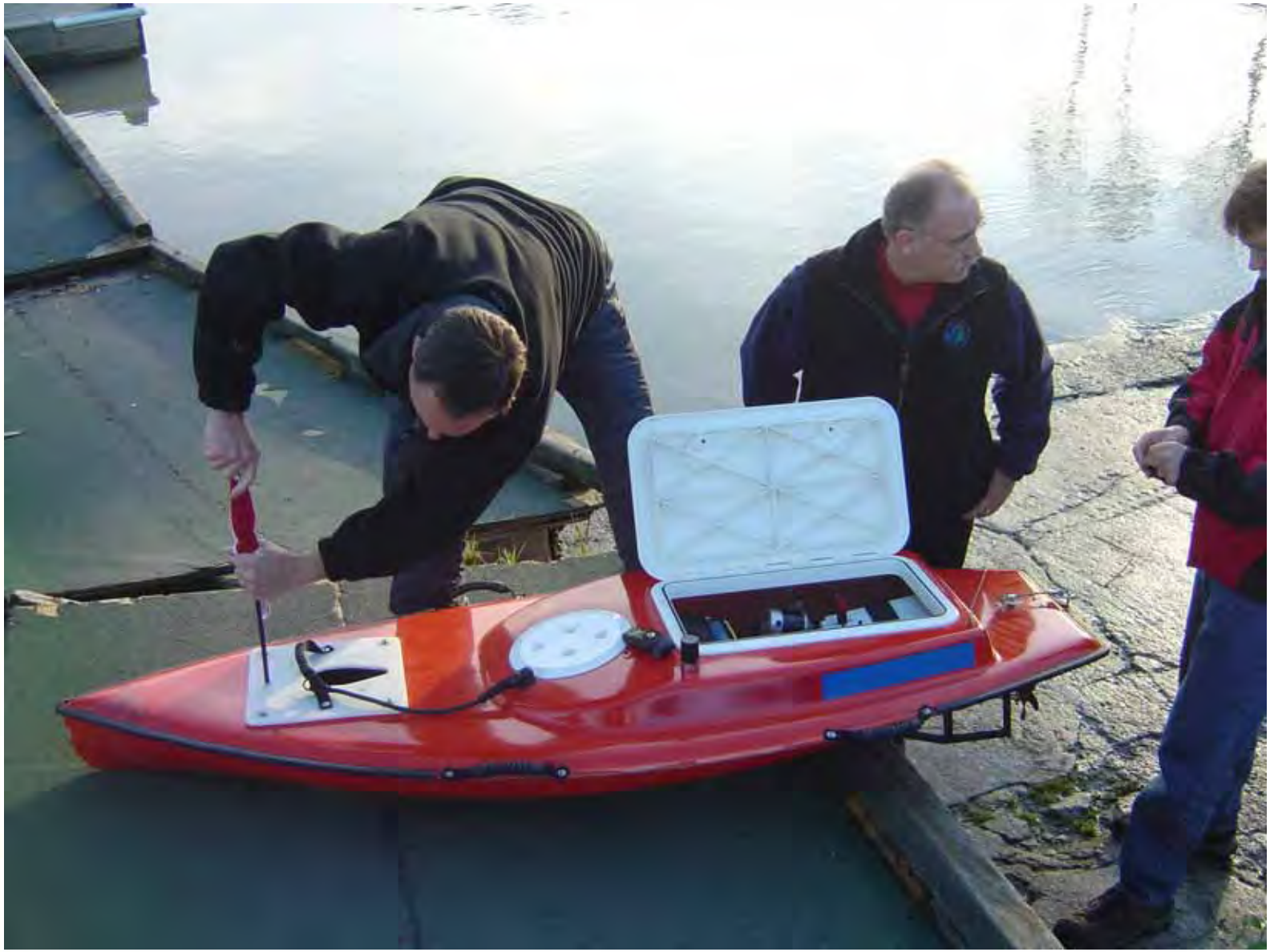

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Bank Operated Cableway

MEASUREMENTS UNDER ICE

Training

- Two levels of training are available
  - Basic Training
  - Advanced Training
- There is the need for additional training
  - Data Review
  - Accreditation Trainnig
  - Refresher Training

Competency

- Accreditation
  - To ensure that technologists understand ADCP operations, the data that is produced, and maintain their proficiency, they needs to be accredited.
- Accreditation consists of
  - Completion of Introductory ADCP training
  - One year of apprenticeship
  - Four ADCP measurements done in conjunction with conventional measurements
  - Complete documentation of the ADCP and conventional measurements
  - Minimum of 2 measurements over 2 years to maintain accreditation.

Accreditation

- Accreditation has two purposes:
  - To ensure that the user is proficient at using and ADCP. (press F5)
  - To ensure that the user understands the application of the result of the measurement.
    - What are the differences with the conventional.
    - When do measurements fail using a conventional or an ADCP.
    - What are the limitations of the ADCP.

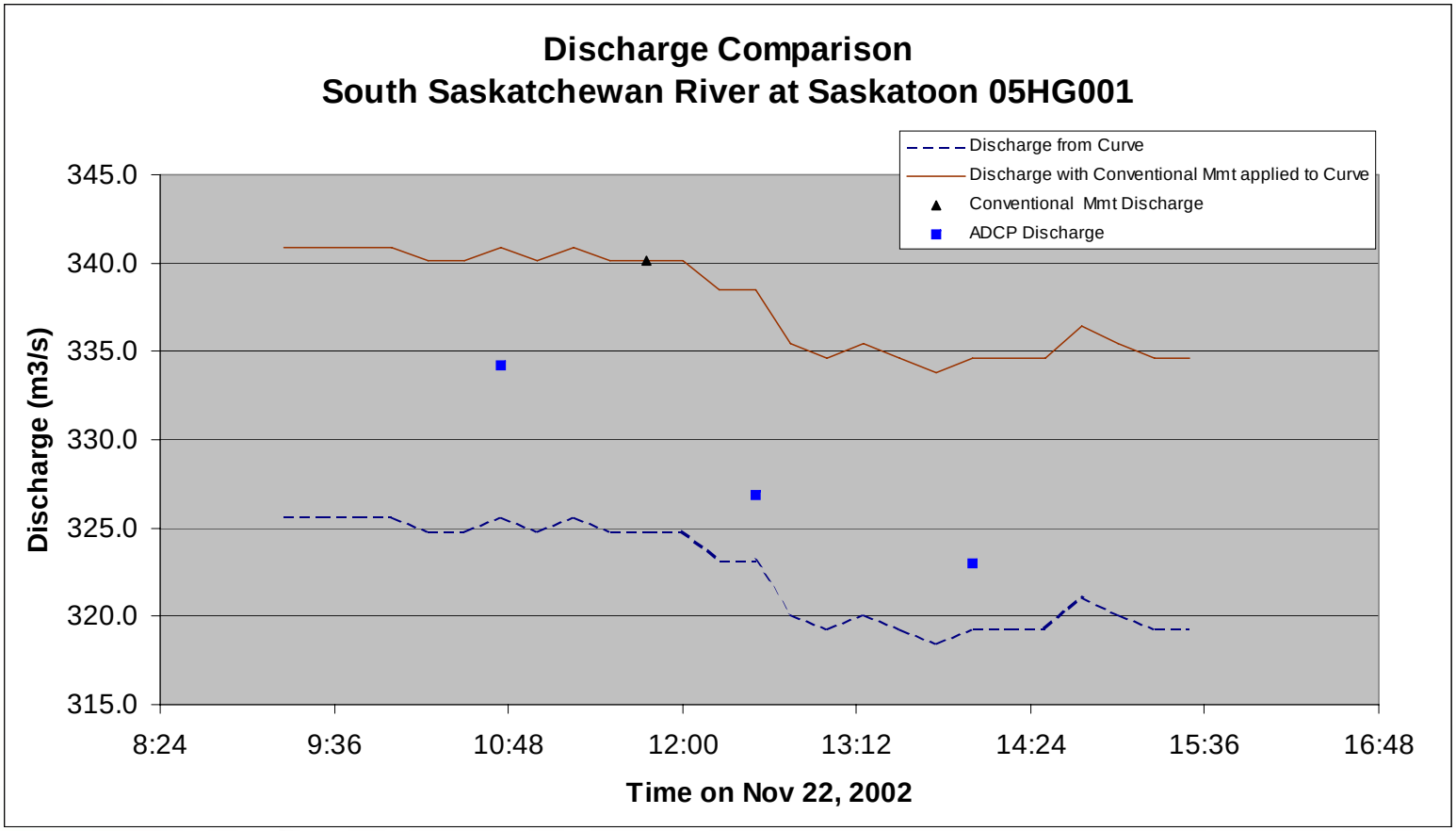
Accreditation Benefits

- Ensures minimum competency in conducting ADCP measurements.
- Encourages the technologist to consider the differences in ADCP derived discharges and Conventional Discharges.
- Provides the basic tools to document where differences on a station by station basis exist between ADCP and conventional measurements.
- Creates a dataset of comparison data and information.

Accreditation Costs

- Significant overhead to the operational program
  - Basic training – 1 week
  - Apprenticeship - 1year
  - Accreditation measurements and documentation – 1-2 weeks.
  - Accreditation maintenance.
  - Equipment maintenance and support
- Significant overhead to the support program.
  - Training development and delivery
  - Record Keeping
  - Maintenance of expertise.
- Significant Overhead to Management
  - Capital Costs are Large

Discharge Comparison



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Summary

- Cost Shared Program
  - This is a cost shared and co-managed program with Federal, Provincial and commercial interests maintained under one operator. It is not a Federal program.
- Hydrometric Network
  - The Network consists of 2850 stations of which about half are real time.
- Data
  - The majority of the data that is produced is available as historical data on the web and in real time in some formats.
- Information
  - The Water Survey collects water level data and produces flow values from this data.

Summary Continued

- Measurement
  - Conventional measurements are being replaced to some degree by hydro-acoustic measurements.
  - Challenge is to understand and document the change in technology
- Competency
  - To ensure competency, Water Survey has implemented an accreditation requirement for all hydro-acoustic measurements.
  - Accreditation has a number of indirect benefits.
  - Accreditation has significant overhead.

END

Multiple Uses

Water Management
Planning
Environmental Assessment
Research Government
International
Public Uses
Design and Construction.

- *The 1975 Agreement provides this context …for the* purpose of:
  - securing ***co-ordinated and standardized*** basic data;
  - to facilitate ***resource planning and management*** in general and
  - the design and implementation of projects related to ***navigation, hydro-electric development, irrigation, drainage, flood control, recreation, domestic and industrial water supply and other purposes***;

Federal Objectives of the Hydrometric Network

- Federal Priorities:
  - Statutory Obligations.
  - Reference Hydrometric Basin Network (RHBN).
  - Environment Canada Science.
  - Other Government Departments
  - Special Activities

Provincial/Territorial/Other Partners Objectives

- Resource management
  - Agriculture
  - Municipal
- Energy
- Emergency Planning/Response
- Regulatory Monitoring
- Etc.

Natural Flow Stations

- Active Continuous Natural Flow Stations
  - 1163 with record
  - 587 with 20 years of record
  - 421 with 30 years of record
  - 200 with 40 years of record
  - 55 with 50 years of record
  - 23 with 60 years of record
  - 20 with 75 years of record
  - 6 with 90 years of record
  - 0 with 100 years of record

Natural Flow 50 Years of Record

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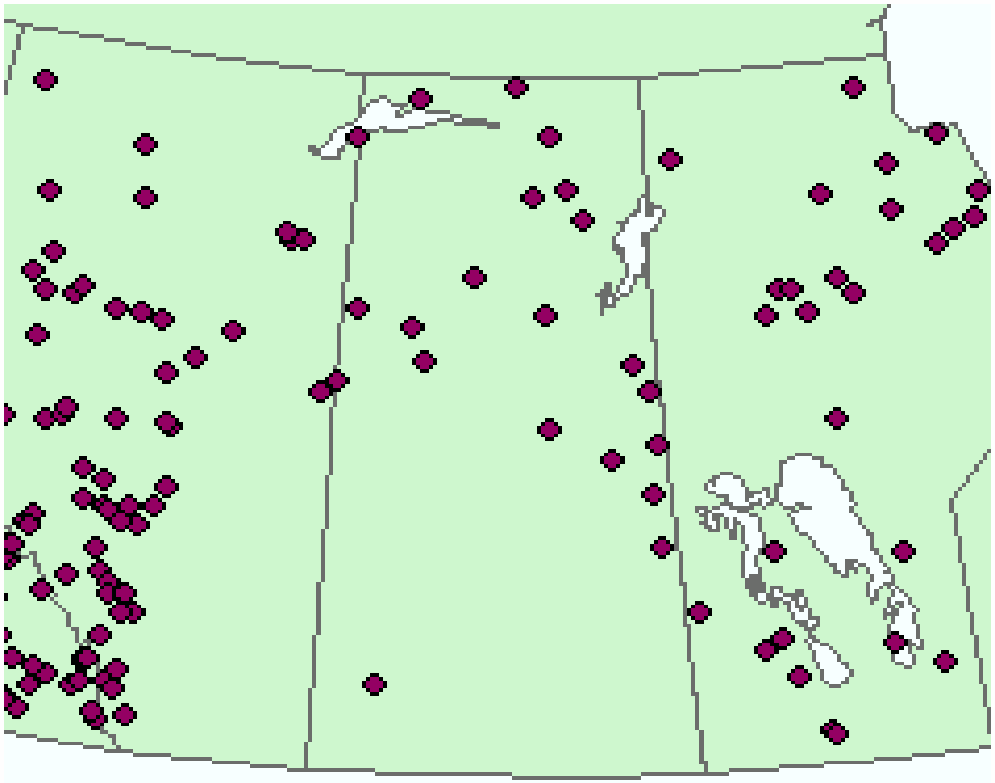
How Representative is the Data?

- Of the more than 1100 active sites, there is only one in the Palliser Triangle area.
- Is this true?…



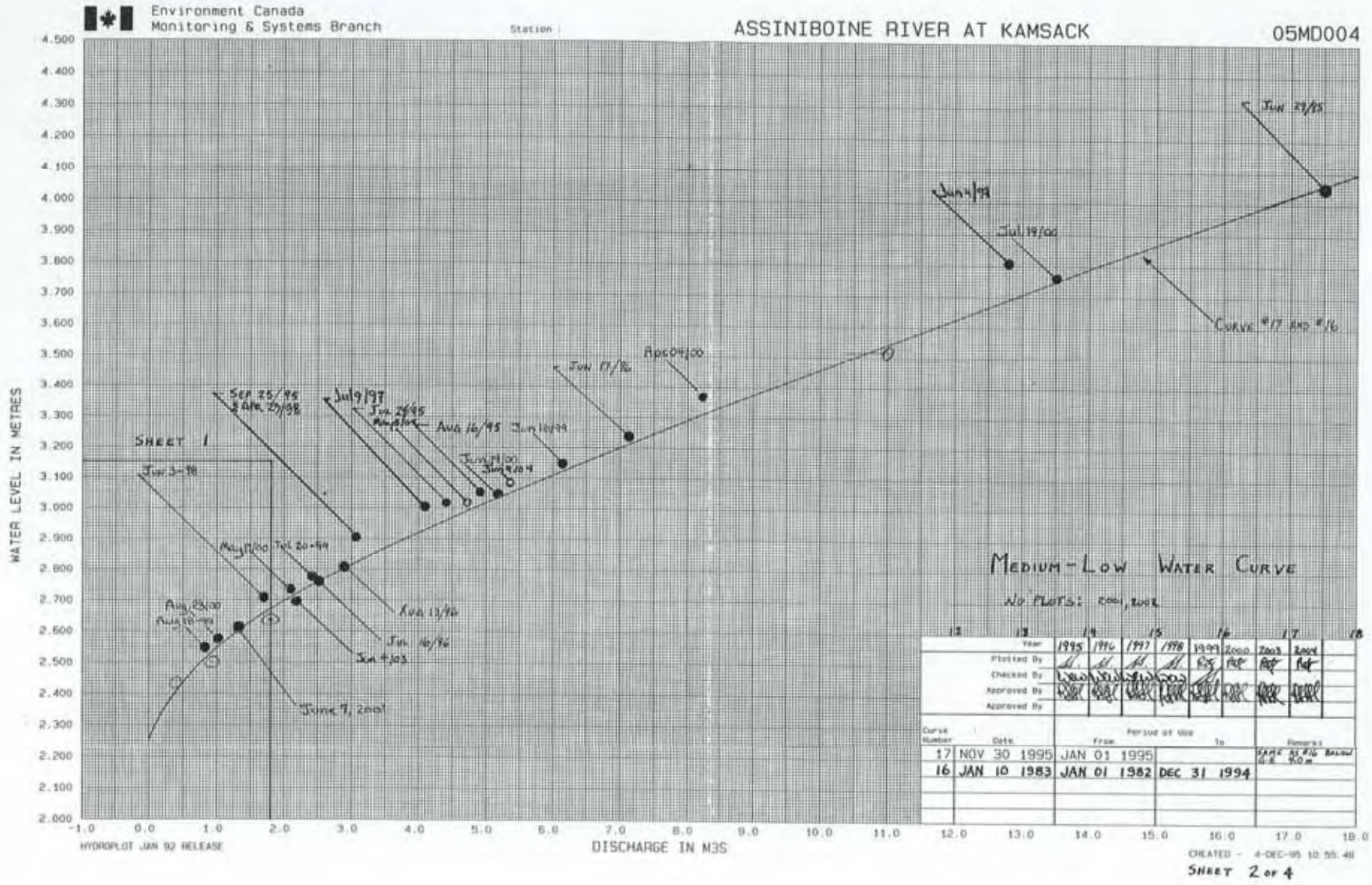
1002 Continuous Natural Flow Sites in 2006

Hydrometric Network Summary

- 2850 active stations of which 1100 are considered natural flow.
- Half of the active stations report in real time.
- There is a deficit of natural flow stations in the area where climate change will potentially have the greatest impact.
- Terminology is “ambiguous” in some cases.
- Work with the hydrometric data services so that you understand what data is really available and what it really means

3.0 THE HYDROMETRIC DATABASE

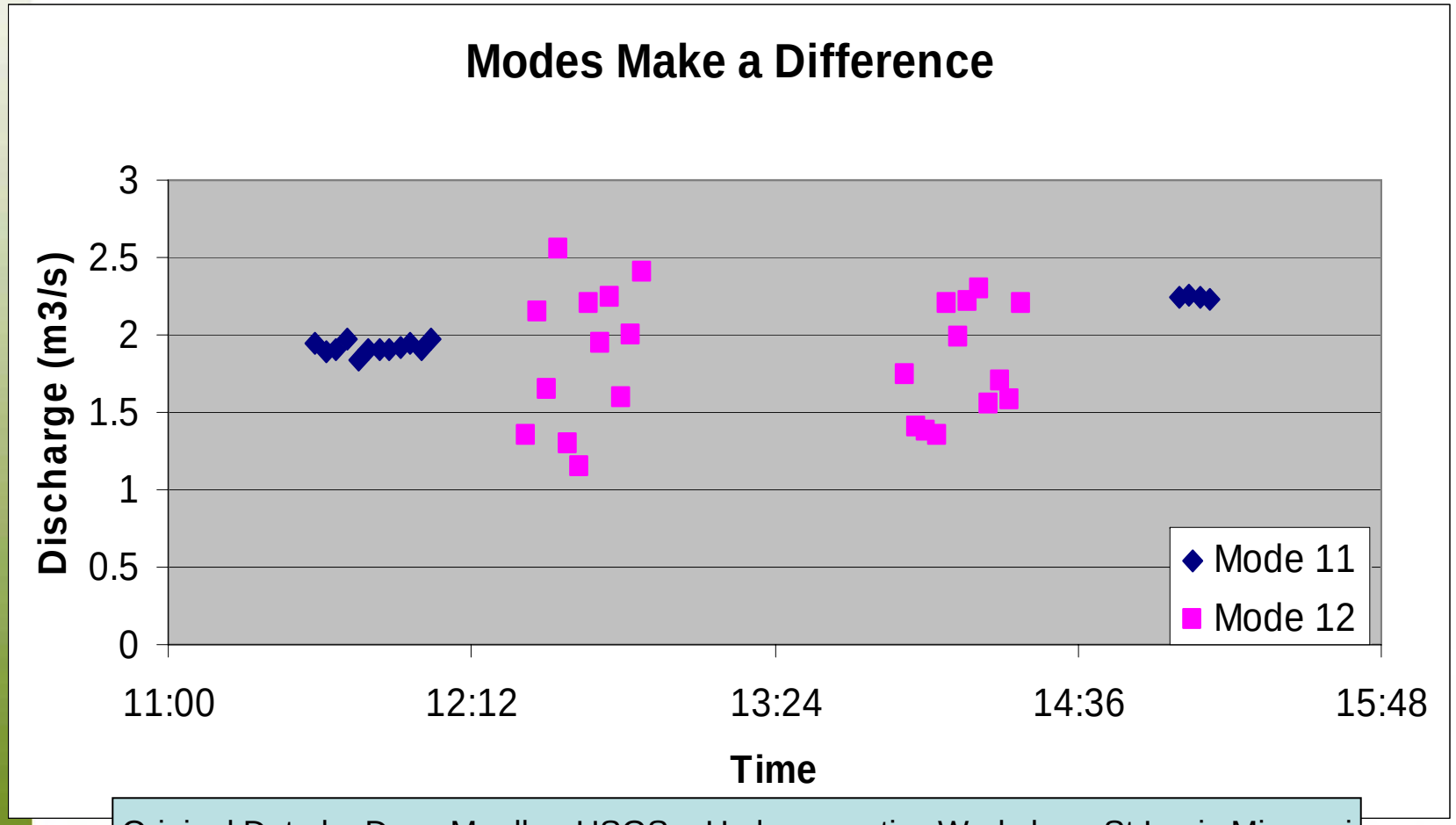
Assiniboine River at Kamsack, Sk.
Medium Water Curve



DISCHARGE DATA IS NOT THE SAME

1-3% Negative Bias

Mode 12 Issue

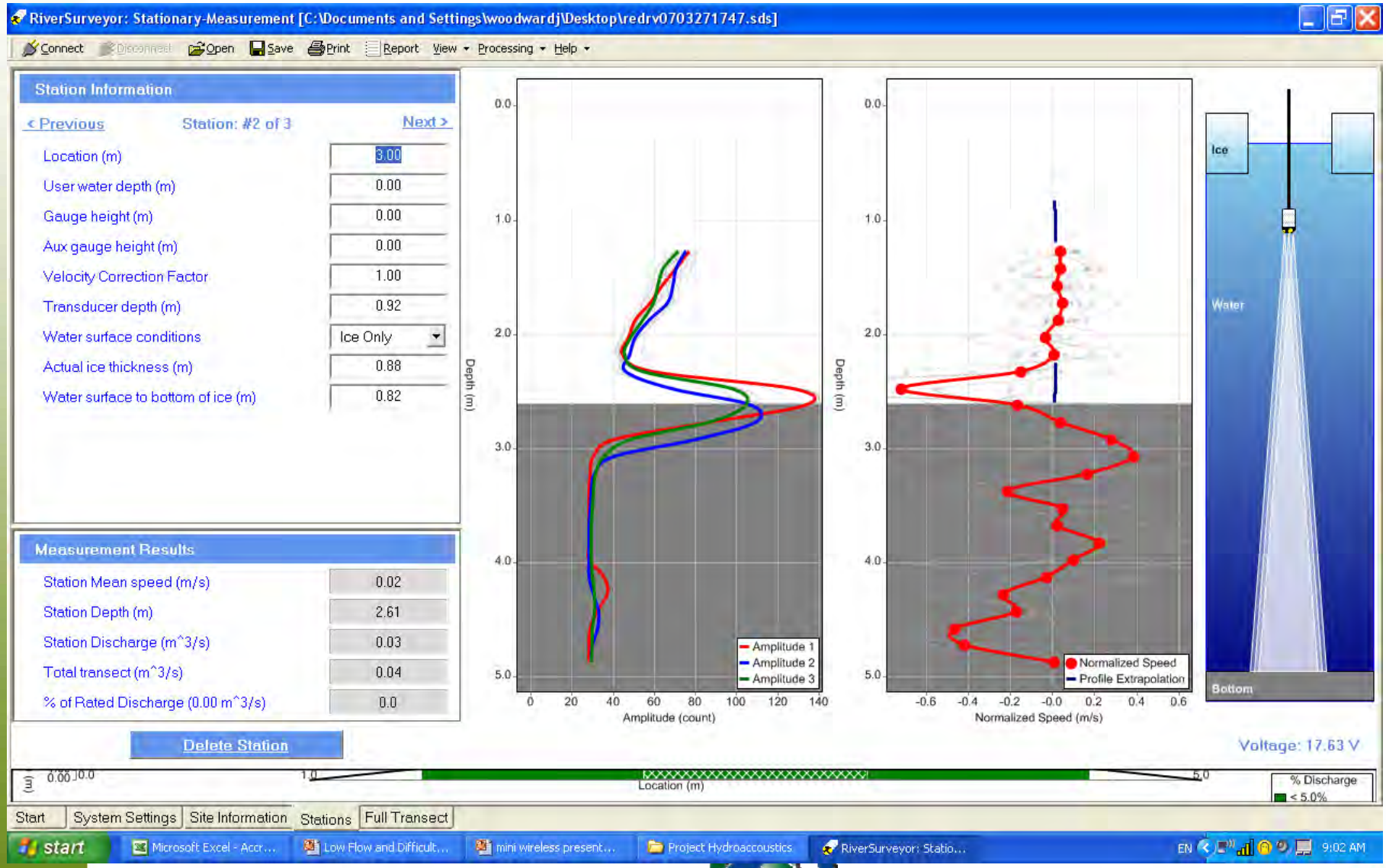


Original Data by Dave Mueller, USGS – Hydroacoustics Workshop, St.Louis Missouri

Accreditation

- The overall purpose is to understand the application of the ADCP result so that there are no differences in the data we collect. It shouldn't matter how the measurement is made.
- For every site that you compute using ADCP measurements, you should know that you are getting the same data as if conventional measurements were used to define the curve.
- If the data is different, one method is better than the other. It must be understood and documented.

Sontek Stationary Software



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There are two areas of interest

- Overall affect on the data in general.
- Affect on a site by site basis.

Overall affect on individual stations

- There are significant differences at specific sites.
- Accreditation is an attempt to give the technician and supervisors the tools to understand the differences while demonstrating proficiency.