Expanding Water Quality Assessments beyond the Realm of 'Impairments' and into a Tool Useful to Watershed Managers at the Local Level

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Original Impetus for Surface Water Quality Assessments

- 1972 – Clean Water Act

- Section 305(b) - Report of surface water quality for all waterbodies of the state.

- Section 303(d) - List of impaired waters requiring a Total Maximum Daily Load study.

- 303(d) is required to go out for public comment.

- Due to Congress (submitted to EPA) April 1st of even years.

Problem:

- How do you find and assess enough data to make a meaningful assessment of surface water quality?

Every state produces a Consolidated Assessment and Listing Methodology (CALM)

- Translator for how the water quality data will be used to make surface water quality attainment decisions by designated use consistent with state surface water quality standards.

Sounds pretty simple, but…

1. Water Quality Criteria (WQC)

Waterbody Type	Bacteria	Geometric Mean Criteria (GMC)	Single Sample Maximum Criteria (SSMC)
Class A Fresh water	Escherichia coli	47	153
Class B Fresh water	Escherichia coli	126	406
Class B Tidal water	Enterococci	35	104

Base WQ criteria from NH WQStds Env-Ws 1700

Table 3-15: Use Support Matrix for Bacteria (Primary Contact Recreation)

May 24 – September 15 (Critical Period)				September 16 - May 23				Use Support
Geometric Mean (GM)		Single Samples (SS)		Geometric Mean (GM)		Single Samples (SS)		
# of GM Calculations	Results	# SS	Results	# of GM Calculations	Results	# SS	Results	
≥ 1	< GMC	≥ 0	< SSMC	≥ 0	< GMC	≥ 0	< SSMC	FS
≥ 0	< GMC	≥ 2	< 75% of GMC					
0		≤ 1	< SSMC	≥ 0	< GMC	≥ 0	< SSMC	INSUFFICIENT INFORMATION or NOT ASSESSED
0		≥ 2 and ≥ 1	< SSMC $\geq 75\%$ GMC but < SSMC					
0 exceedances of the GMC and only 1 exceedance of the SSMC								
≥ 1 exceedance of the GMC and/or ≥ 2 exceedances of the SSMC								NS

Data matrix table that accommodates any data combination and yields a unique use support Assessment while giving priority to critical periods.

Assessment Unit (AU) – Distinct, homogenous surface water segments or areas; based on 1:100k NHD hydrology; linked to GIS

NHDES Assessment Units Indexed to the 100K NHD

Distinct AU based on waterbody type (river)

Distinct AU based on waterbody type (lake)
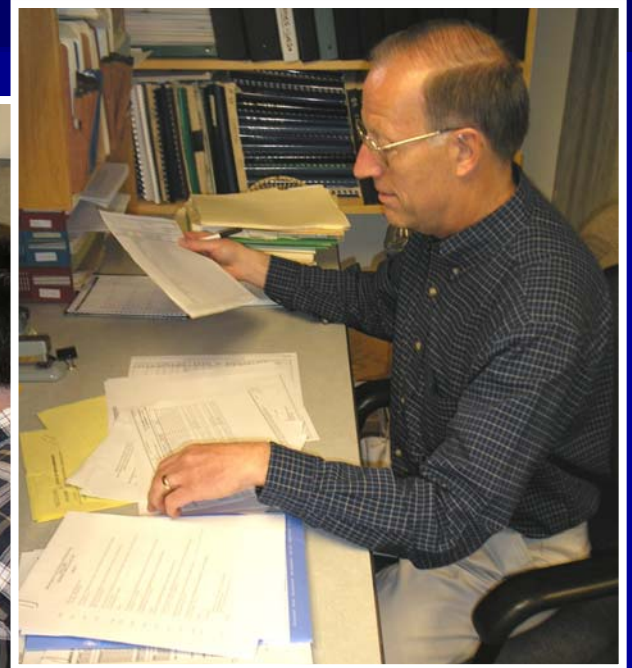
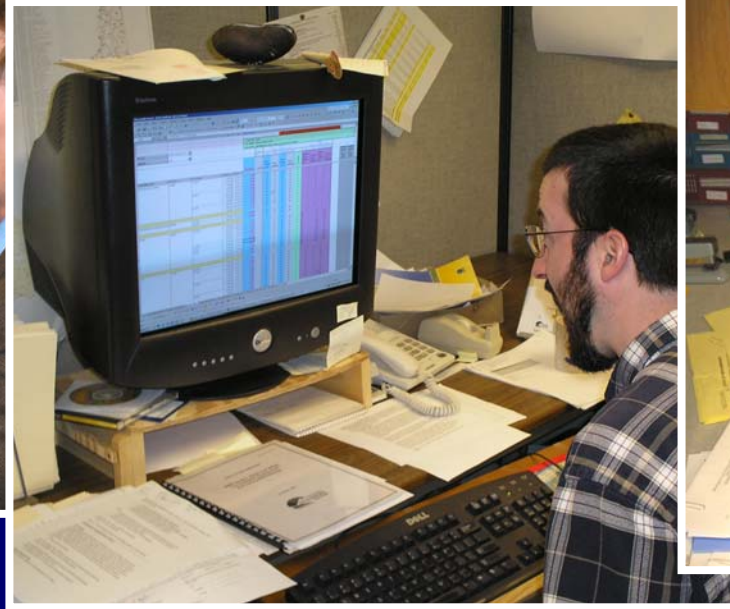Distinct AU based on presence of dam creating impoundment

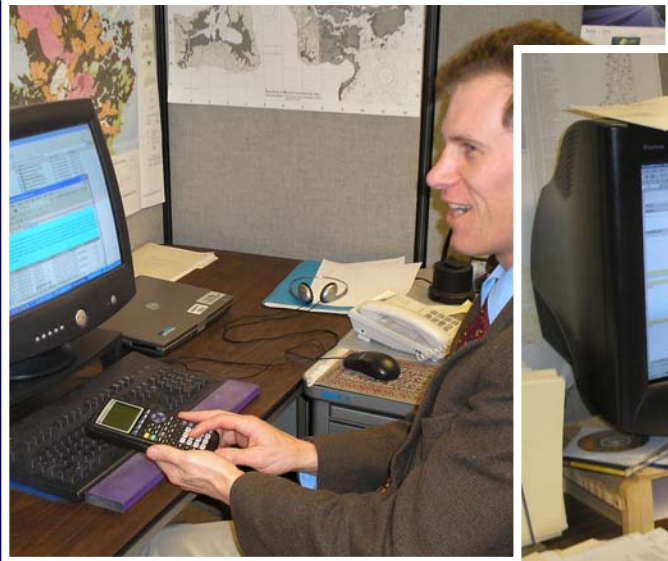**~ 5,200 assessment units statewide**

Assessment Process - The way it was

Calculators

Pivot Tables

Paper

- Difficult to retrieve the exact information used to make an assessment
- The "Bus Problem"

2002 – EPA's Assessment Database (ADB)

- New Hampshire started using the EPA-ADB for reporting.
- Designed to track water quality assessment data, including use attainment, and causes and sources of impairment.
- Limited as water quality management tool as it only tracks parameters that are impaired.

New Hampshire needed a tool that tracks the assessment status of all parameters to facilitate identification of impaired waters, assess data gaps and locations of potential water quality problems.

2003 -Birth of the New Hampshire DES Environmental Monitoring Database

- Warehouse of water quality data for NH.
- As of March 2006 the EMD contained 1,870,000 records.

The New Assessment Problem:

How do you assess *all* of the most recent data *fast* enough to meet the April 1st deadline.

January →June, 2005
Interrogation Sessions to Create the Business Plan

- Ability to go back in and determine what an assessment is based upon.

- Validate/invalidate and set data quality level for large datasets by defining project, parameter, and date range.

- Automate invalidation of specific records, calculate statistics, and modify records based on defined processes.

- Interact with EPA's ADB to extract previous cycle assessment data.

January →June, 2005
Interrogation Sessions to Create the Business Plan (cont.)

- Allow the attachment of images, documents etc. to one or more assessment units.

- Apply CALM criteria against records to determine if a result meets the designated use criteria.

- Summarize criteria comparisons by cycle, waterbody, designated use, and criteria comparison type.

- Track gradated use support levels for all parameters.

Some of the Automated Routines

- Lake Profiles – Select worst value in epilimnion or top 25% (dissolved oxygen).

- Depth Profiles – Select worst value in profile (all other parameters).

- Dissolved Oxygen from 2 tides - Generate average DO from DO readings taken at high and low tide on the same day.

- Calculate bacteria geometric means within a rolling 60 day window.

- Assign parent AU data to Beach AUs.

- Hardness – Determine correct hardness to apply to hardness dependent metal criteria.

Process for comparing sample records to the CALM criteria

- Unique criteria was developed in a "standards table" which identified each record's appropriate criteria based upon;

  - Parameter
  - Medium
  - Fraction
  - Statistic type
  - Water class
  - Fishery type

  - Beach (y/n)
  - Sample date
  - Sample time
  - Water type
  - Sample hardness*

- 6028 unique records created to translate the NH CALM
- Performance - 630,000 standard comparisons in 1-2 hours

Building & Testing

- Planned, June 2005 → November 2005
- Reality, June 2005 → January 2006

  - Oracle 8i back-end, Oracle forms 6i
  - 860,000 records were pulled in with the data snap-shot.
  - Scale of the large processes upset the servers.
  - The suite of waterbody type specific processes had unanticipated interactions.
  - When in doubt re-read the business plan.
  - Good working relationship between the primary user and programmer kept the process moving.

Go Button

January 6th 2006 → March 31st 2006, Using the Supplemental ADB

- One false start when a pH data logger problem was discovered.

- Built a side query to further summarize the parameter level interim counts.

- Monkey wrench - January 12th.

- February 23rd – The draft 303(d) went out for public comment.

- March 31st - 305(b)/303(d) submitted to EPA.

Reporting Capabilities

- ## With EPA's ADB

Assessment Unit ID	Assessment Unit Name and Description		Assessment Unit Size	Units	AU Category
NHRIV600030608-03	COCHECO RIVER		3.77	MILES	5

Use	Use Support Status	Threatened?	Cause	Suspected Sources	Impairment Category
Aquatic Life	Not Supporting		pH	Source Unknown	5
Drinking Water After Adequate Treatment	Fully Supporting				NA
Fish Consumption	Not Supporting		Mercury	Atmospheric Deposition - Toxics	5
Primary Contact Recreation	Not Supporting		Escherichia coli	Source Unknown	5
Secondary Contact Recreation	Fully Supporting				NA
Wildlife	Not Assessed				NA

Enhanced Reporting Capabilities
With New Hampshire's Supplemental ADB

Assessment Unit ID NHRIV600030608-03   Size   3.8   MILES
Assessment Unit Name Cocheco River   Beach N
          Primary Town DOVER   Assessment Unit Category 5-P

Use Desc	USE DES Category	EADB USE Threat	SADB Parameter Name	Pollutant Flag	SADB Parameter Threatened	Parameter DES Category	TMDL Schedule	Expected To Attain Date	Source Name
Aquatic	5-P		AMMONIA (UN-IONIZED)		N	2-G			
			ARSENIC		N	3-PAS			
			CHLORIDE		N	3-PNS			
			DISSOLVED OXYGEN SATURATION		N	2-G			
			IRON		N	3-PAS			
			OXYGEN, DISSOLVED		N	2-M			
			pH	Y	N	5-P	2016		Source Unknown
Drinking Water After Adequate Treatment	2-G								
Fish Consumption	2-G		Mercury	Y	N	5-M	2017		Atmospheric Deposition - Toxics
Primary Contact Recreation	5-M		ESCHERICHIA COLI	Y	N	5-M	2019		Source Unknown
Secondary Contact Recreation	2-M		ESCHERICHIA COLI		N	2-M			

Summary

- All of your data can be used to tell part of the assessment story.

- Evaluation of the Water Quality Standards and CALM criteria can be automated.

- The 305(b)/303(d) assessments can become more then an impairment tracking exercise.

- Local watershed managers now have a window into how every parameter collected in their AUs compare with water quality standards and where there are potential issues and data gaps.

Questions?

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Summary Table by Assessment Unit and Use

◀ ▶

Cycle 2006
Size 3.77
Units MILES
Waterbody Type RIVER/STREAM

AU ID NHRIV600030608-03
Waterbody Name COCHECO RIVER

Designated Use AQUATIC LIFE
Waterbody Description 010600030608, COCHECO RIVER, UNKNOWN FISHERY

ADB Category

Use Level DES Category 5-P
Class B
Fishery
Beach? N
Public Water Supply N

Use Comments
Assessment Unit DES Category 5-P
Assessment Unit Comments Fish Consumption - General NHDHHS fish consumption advisory (all species) for all

Summary Final Table

ADB Parameter Name	DES Category	Threatens Use	Parameter Comments	Year Expected to Meet Standards	DES Internal Comments	TMDL Priority	TMDL Schedule	DES Pollutant	Next Sample Date	In Prev. ADB	In Curr. ADB	Date Assessed	Date Modified	User
AMMONIA (UN-IONIZED)	2-G	N						Y		N	N	02/07/2006	02/07/2006	WSKJE
ARSENIC	3-PAS	N						Y		N	N	01/06/2006	02/07/2006	WSKJE
CHLORIDE	3-PAS	N						Y		N	N	01/06/2006	02/07/2006	WSKJE
DISSOLVED OXYGEN S.	2-G	N						Y		N	N	01/06/2006	02/07/2006	WSKJE
IRON	3-PAS	N						Y		N	N	01/06/2006	02/07/2006	WSKJE

Add   **Modify**   Save   **Delete**

Interim Summary Table

Comparison Counts per Highlighted Record

Full Comparison Description	Sample Year	Project ID	Use Data?	Comments	Number of Samples	10% Rule	Date Modified	User	Standard Name	Exceed-ences	Insuff. Info	Fully Support
AMMONIA-T-OR-D-GRAB-REVI	2001	VRAP	Y		1	2	01/27/2006	DBAWQD	FW_ACUTE	0	0	1
AMMONIA-T-OR-D-GRAB-REVI	2000	VRAP	Y		3	2	01/27/2006	DBAWQD	FW_ACUTE_MAGEX	0	0	1
ARSENIC_TOTAL-GRAB	2004	VRAP	Y		1	2	01/27/2006	DBAWQD	FW_CHRONIC	0	0	1
LORIDE BY SPC-COND-F-NCP	2005	VRAP	Y		1	2	01/27/2006	DBAWQD				
CHLORIDE BY SPC-COND-F-NC	2004	VRAP	Y		1	2	01/27/2006	DBAWQD				

Modify   Save

Enter Query   **Modify**   Save   **Items: 0**   **Main Menu**

Evaluate Assess Table by Assessment Unit and Use

Cycle 2006
AU ID NHRIV600030608-03
Designated Use AQUATIC LIFE
ADB Category
Use Level
DES Category 5-P

Size 3.77 Units MILES Waterbody Type RIVER/STREAM
Waterbody Name COCHECO RIVER
Waterbody Description 010600030608, COCHECO RIVER, UNKNOWN FISHERY

Class B Fishery Beach? N Public Water Supply N

DATA Used in Summary

	Parameter	Start Date	Start Time	Adjusted Result	Original Result	Statistic Type	Sample Size	Use for Summary	Depth	Depth Units	Hardness	Pr
▲	DISSOLVED OXYGEN	07/01/2002	08:30:00	7.64	7.64 MG/L			Y				VRA
	DISSOLVED OXYGEN	07/15/2002	10:30:00	7.36	7.36 MG/L			Y				VRA
	DISSOLVED OXYGEN	07/29/2002	08:30:00	8.09	8.09 MG/L			Y				VRA
	DISSOLVED OXYGEN	08/12/2002	08:52:00	9.13	9.13 MG/L			Y				VRA
	DISSOLVED OXYGEN	09/09/2002	10:35:00	4.92	4.92 MG/L			Y				VRA
▼	DISSOLVED OXYGEN	06/02/2003	08:44:00	9.6	9.6 MG/L			Y				VRA

Modify Save

DATA NOT Used in Summary

	Parameter	Start Date	Start Time	Adjusted Result	Original Result	Statistic Type	Sample Size	Use for Summary	Depth	Depth Units	Hardness	Pr
▲	DISSOLVED OXYGEN	08/25/2003	06:15:00	10.15	10.15 MG/			N				VRA
	PH	09/11/2000	09:50:00	6.84	6.84 UNITS			N				VRA
	PH	06/02/2003	08:44:00	6.28	6.28 UNITS			N				VRA
	PH	07/29/2003	10:30:00	6.89	6.89	MEDIAN	54	N	1.5	FT		VRA
▼	PH	07/29/2003	10:30:00	6.90778	6.90778	MEAN	54	N	1.5	FT		VRA

Modify Save

Comparison Counts per Highlighted Record

Full Comp Desc
DO-PPM-GRAB-NCT-CP

Standard Name	Comparison Result	Standard Value
STD	2	99
STD_MAGEX	2	99

KEY
0 = FS
1 = NS
2 = II

Back to Summary