

Designing a complex multi-objective water quality monitoring network: the New York City water supply example

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Essentially, looking at a re-design of an existing network for the Hydrology, Limnology, and Pathogens Programs

Problem: the network was somewhat amorphous—grown over time—measure everything, everywhere, as often as possible philosophy. Became inefficient and difficult to change.

Difficult to disentangle:

- why some sites were sampled
- why some measurements made
- why the sampling frequency

DOCUMENTATION for 'design' LACKING—the Objectives were not clearly enunciated.

New York City's Water Supply System



NYC Water Supply Watersheds

19 cascading reservoirs

Catchment—5,100 km²

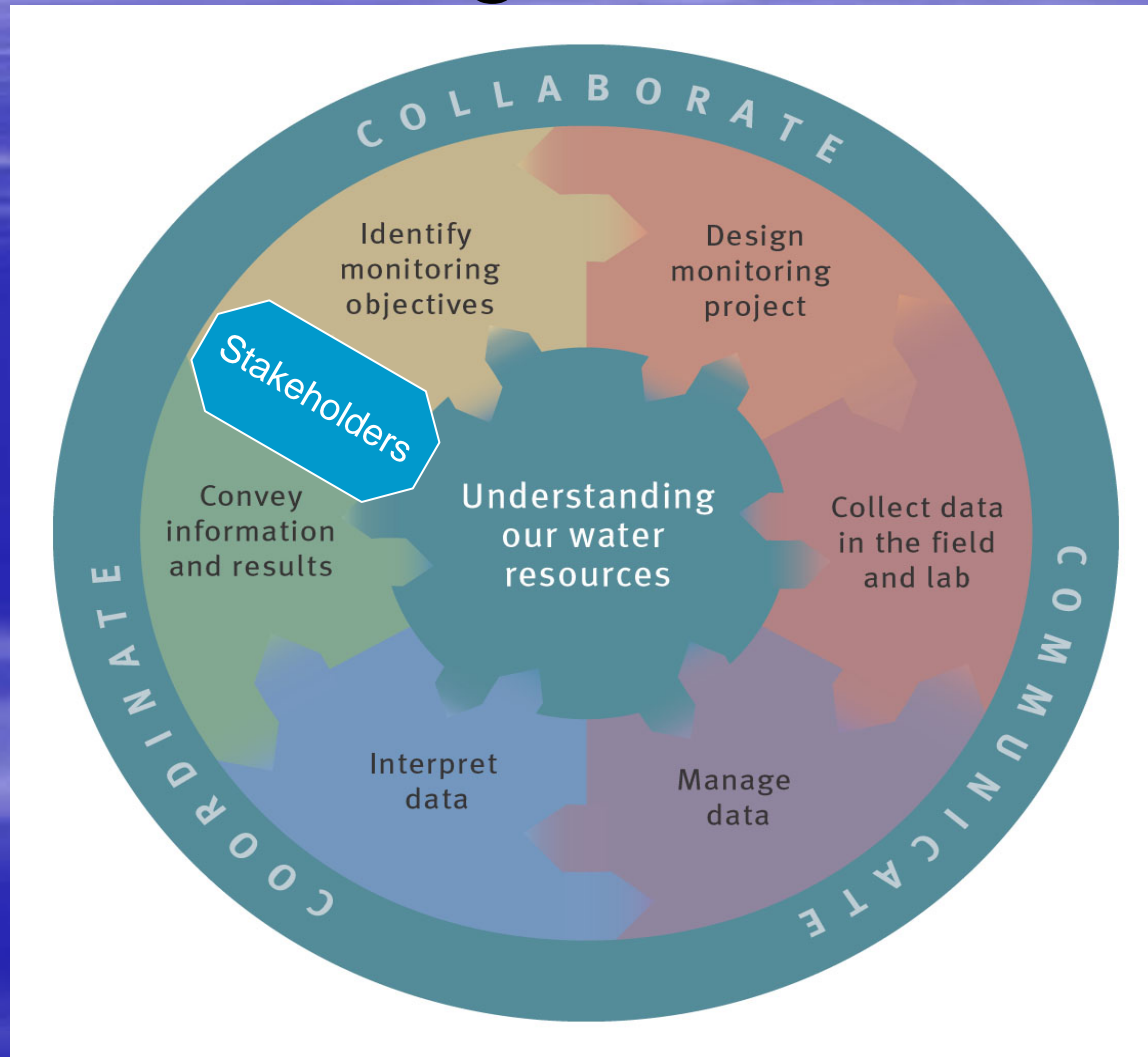
Storage— 2×10^9 m³

Mean daily flow to
City— $60 \text{ m}^3 \text{ s}^{-1}$

Population served— 9×10^6

Unfiltered supply

Proposed NWQMC National Monitoring Framework



New York City Water Supply

Main stakeholders

The people of the City of New York and other water users

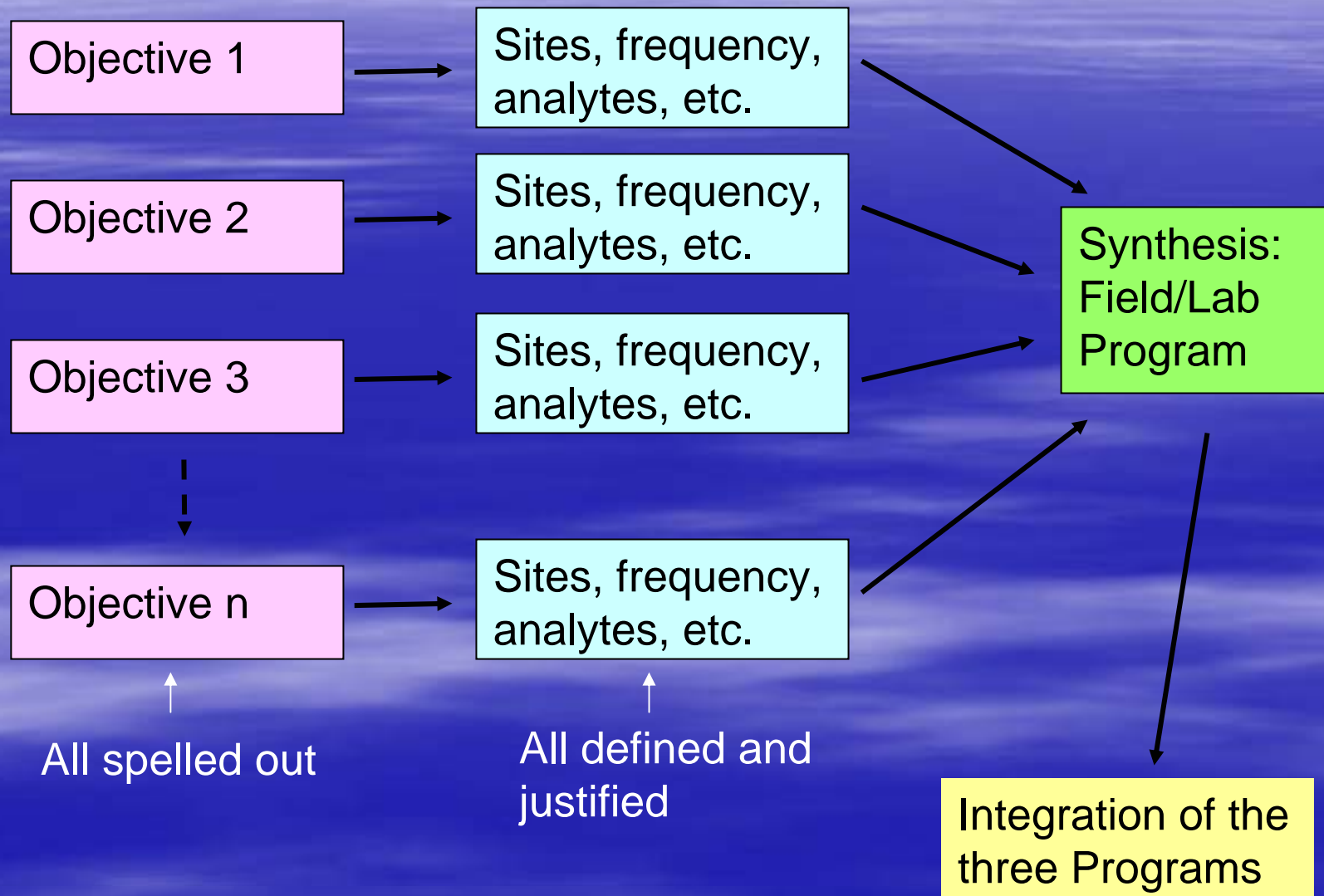


Stewardship entrusted to

Federal & State agencies
New York City agencies (includes
some DEP scientists)

Monitoring network designers—scientists—
'instruments' of the Stewards of the Stakeholders

Strategy for each of the three programs:



Ideally, one would start with a 'blank' sheet and design from scratch.

Not appropriate here because of the historic water quality record. For instance, stream sites with USGS gauges were kept.

A major difficulty was developing the steward's objectives, i.e., why they wanted monitoring data.

The overall goal of each Program:

- to establish a water quality monitoring network which provides scientifically defensible information regarding the understanding, protection, and management of the New York City water supply.



The Objectives of the Hydrology Program

- Trend Detection (and status)
- Landscape Scale Water Quality Monitoring
- Reservoir and Watershed Modeling Support
- Biological Monitoring Support
- The Effects on Stream Water Quality from Waste Water Treatment Plants
- Assessment of BMP effectiveness
 - Turbidity Reduction in the Batavia Kill Sub-basin
 - Two New Croton Reservoir Sub-basins
 - Kensico Reservoir Tributaries
- Policy and Management Based Surveillance Monitoring
 - Trace and Other Metal Occurrence Monitoring
 - Source Water Tributary Monitoring
 - Croton Watershed Consent Decree Monitoring

So what did we gain after the Hydrology Program re-design?

Excluding storm sampling there was:

- a field sampling effort reduction of around 50%
- a laboratory effort reduction of around 50%
- no real loss of information

Additionally, all 3 Programs are now integrated,
especially with respect to sampling timing

Main take home messages

- * Don't lose sight of the ultimate reason
why we design monitoring networks



the stakeholders and their requirements

- * Establish each individual objective
and design from there



This may lead to considerable savings