

**RECOMMENDATIONS FOR A STREAM
GAGING NETWORK IN RHODE ISLAND**
PREPARED BY THE DEM-WRB STREAMFLOW COMMITTEE
APRIL 2004

Streamflow Committee Members:

Alicia Good - RI Department of Environmental Management- Water Resources
Kathy Crawley – The Water Resources Board
Ralph Abele – US Environmental Protection Agency
Colin Apse – The Nature Conservancy
Jim Campbell – US Geological Survey
Steve Donohue – V.P. Tuckahoe Turf Farms, Inc.
Julie Lundgren – The Nature Conservancy
Herb Johnston – Hydrologist
Juan Mariscal – The Water Resources Board
Eugenia Marks – Audubon Society of Rhode Island
Veronica Masson – RI Department of Environmental Management – Fish and Wildlife
Eugene Pepper – RI Department of Environmental Management – Agriculture
Alisa Richardson – RI Department of Environmental Management – Water Resources
Elizabeth Scott – RI Department of Environmental Management – Water Resources
Mark Smith – The Nature Conservancy
Harold Ward – Brown University

Gaging Subgroup Members:

Jim Campbell, Herb Johnston, Julie Lundgren, Juan Mariscal, Eugenia Marks, Veronica Masson, Eugene Pepper, and Alisa Richardson.

Table of Contents:

1. Introduction4
2. Discussion of Data.....5
3. Recommendations.....5
4. Cost.....9

List of Tables and Figures:

Table 1 – Prioritization of Stream Gages for a Stream Gaging Network in Rhode Island6
Figure 1 - Map of Existing & Proposed Stream Gages8
Table 2 - Projected estimated costs for the proposed stream gaging network9

Appendices:

Appendix A - Table of Data Analysis and Management Uses for Stream GagesA-1

List of Acronyms:

- DEM: Rhode Island Department of Environmental Management
- HUC: Hydrologic Unit Code
- NRCS: US Department of Agriculture's Natural Resources Conservation Service
- WAPAC: Water Allocation Program Advisory Committee
- WRB: Rhode Island Water Resources Board
- USGS: United States Geological Survey

Introduction:

The importance of an comprehensive stream gaging network is recognized by many agencies as vital to the proper management of the State's water resources. Currently, the State has very little coverage with only 19 long-term continuous gages. One of the recommendations from the Streamflow Subcommittee's final report to the Water Allocation Program Advisory Committee (WAPAC) was to develop a comprehensive streamflow gaging network for RI. The subcommittee's initial recommendation called for **one continuous gage for each of the 57 subwatersheds** delineated by NRCS/USGS at the 12-digit HUC level. Upon further review, the committee refined these recommendations, as described below.

A comprehensive stream-gaging program provides hydrologic information needed to help define, use, and manage the State's water resources. A gaging program provides a continuous, well-documented, well-archived, unbiased, and broad-based source of reliable water data that may be used for a variety of purposes including:

- Drought Management
- Determining availability of water for municipal, industrial, and irrigation uses
- Setting permit requirements for discharge of treated wastewater
- Designing highway bridge and culverts
- Computing the loads of sediments and other pollutants
- Setting and monitoring instream flow requirements to provide health fisheries
- Determining water withdrawal information
- Licensing Hydropower Facilities
- Evaluating surface- and ground-water interaction
- Monitoring compliance with minimum flow requirements
- Evaluating interstate water-use issues
- Estimating streamflow in ungaged streams ¹

For more uses of stream flow data see Appendix A.

Although, the WAPAC ended its initial process in January 2004, the streamflow subcommittee requested that they continue to work together as a joint WRB-DEM Streamflow Committee to further refine a proposal for a comprehensive stream gaging network for Rhode Island. Eight members of the streamflow subcommittee formed the gaging subgroup. The group met several times and the results of their evaluation are outlined in this report.

¹ USGS in cooperation with WRB has undertaken a project to develop regression equations to estimate streamflows on ungaged streams.

Discussion of Data:

The gaging subgroup evaluated each of the 56-12 digit HUC watersheds within Rhode Island. The subgroup first reviewed the existing 19 gages and agreed that they provided valuable information and should remain part of the network. The subgroup then conducted a systematic review of each of the 56 watershed's characteristics, their existing and potential use/demand, and their environmental considerations as they relate to the importance of a stream gage within that watershed. After evaluating each watershed, each gaging subgroup member selected the 5 most important locations for new gages. The number of votes for each gage location was added and each watershed was placed in 1 of 8 groupings depending on the number of votes. The highest priority (1) gages received the most votes and the lowest priority (8) received the fewest votes. The subgroup determined that nine of the watersheds do not require stream gaging because they were tidal and thus not "gageable" or the watershed size within the State was so small that the gage was not necessary. On the other hand, they also determined that seven watersheds needed two gages to properly manage the water resources.

Recommendations:

In total, the group recommends that the 19 existing continuous gages be maintained and 35 additional gages be activated in the priority order presented in Table 1. Most of the proposed gages are USGS sites that were once temporary sites or were permanent sites with structures and have been discontinued. The attached map (Figure 1) identifies the locations and USGS ID's of the existing gages and proposed gages. The committee recommends that these recommendations be phased-in over a five year period.

Recognizing that there are many issues confronting the State's water resources, such as out-of-state activities, intra-basin transfers, pollutant loadings to Narragansett Bay, and the demand for new and contingency sources of public drinking water, the streamflow committee is recommending this comprehensive gaging network to support the water resource management functions of various State and local agencies.

Table 1 - Prioritization of Stream Gages for a Stream Gaging Network in Rhode Island

Priority	Watershed Location 12-digit HUC Name	Gage Status	Gage #	Potential Site Location	Existing Funding Source	Minimally Altered Flow	Potential Growth	Priority Natural Resources	Geographic Data Gap	Potential Interstate Issues	Water Quality (Significant Flow to the Bay)	Proximity to WWTF Discharge	Significant Water Demand
E	Beaver River	Perm.	01117468	Beaver River	WRB	✓	✓	✓					
E	Branch River	Perm.	01111500	at Forestdale	RIDEM	✓	✓	✓				✓	
E	Blackstone River - West River to Peters	Perm.	01112500	Blackstone @ Woonsocket	Ocean State Power		✓			✓	✓	✓	✓
E	Chipuxet River	Perm.	01117350	Chipuxet River	WRB		✓	✓					✓
E	Clear River	Perm.	01111300	Nipmuc River	RIDEM	✓		✓		✓			
E	Hunt River	Perm.	01117000	Hunt River	WRB		✓	✓			✓		✓
E	Millers River	Perm.	01113695	Catamint Brook	RIDEM	✓	✓	✓					✓
E	Moshassuck	Perm.	01114000	Moshassuck River	RIDEM						✓	✓	
E	Pawcatuck Mainstem	Perm.	01117500	Wood River Junction	USGS	✓	✓	✓				✓	✓
E	Pawcatuck(Lower)	Perm.	01118500	Westerly	WRB		✓	✓		✓		✓	✓
E	Pawtuxet River Mainstem	Perm.	01116500	Pawtuxet at Cranston	FEMA						✓	✓	
E	Pawtuxet River (South Branch)	Perm.	01116000	South Branch - Pawtuxet	WRB	✓	✓	✓				✓	
E	Ponnagansett and Barden Reservoirs	Perm.	01115187	Ponnagansett River	RIDEM	✓		✓					✓
E	Queen River	Perm.	01117370	Liberty Lane	WRB	✓	✓	✓					
E	Queen River	Perm.	01117420	Usquepaug	RIDEM		✓	✓					✓
E	Regulating and Moswansicut Reservoir	Perm.	01115098	Peeptoad Brook	Providence Water	✓		✓					✓
E	Ten Mile River	Perm.	01109403	Ten Mile River	RIDEM		✓			✓	✓		✓
E	Wood River(Upper)	Perm.	01117800	Arcadia	WRB	✓		✓					
E	Wood River (Lower)	Perm.	01118000	Hope Valley	WRB	✓	✓	✓					
E	Woonasquatucket	Perm.	01114500	Woonasquatucket River	RIDEM	✓	✓				✓	✓	
1	Pawcatuck(Upper)	Project	01117424	Chickashaen River			✓	✓	✓				✓
1	Pawcatuck(Lower)	Project	01117460	Pawcatuck Mainstem at Kenyon			✓	✓	✓				✓
2	Beaver River	Project	01117472	Lower Beaver			✓	✓					✓
2	Hunt River (Upper)	Temp.	01116910	Hunt River			✓	✓					✓
2	Pawcatuck Mainstem	Project	01118010	Burdickville			✓	✓	✓				
3	Westport	Discont.	01106000	Adamsville Gage		✓	✓	✓	✓				
4	Big River	Project	01115800	Big River		✓	✓	✓	✓				
4	Blackstone River - Peters to Mouth	Project	01113650	Roosevelt Avenue, Pawtucket			✓		✓	✓			✓
4	Pocasset River	Temp.	01116609	Pocasset Gage					✓				
4	Millers River	Temp.	01113760	Abbott Run			✓	✓	✓	✓			✓
4	Taunton River		H	Taunton				✓	✓	✓	✓		✓
5	Ashaway River	Project	01118360	Ashaway Gage		✓	✓	✓	✓	✓			
5	Saugatucket	Temp.	01117230	Saugatucket River		✓	✓	✓	✓				
5	Mill River	Project	01112382	Mill River			✓		✓				✓
5	West Passage(Lower)	Temp.	01112382	Annaquatucket below Belleville Pond			✓		✓				✓
6	Big River	Project	01115630	Nooseneck		✓	✓	✓					
6	Clear River	Temp.	01111267	Maybe move Nipmuc to Clear or add Clear		✓	✓	✓	✓				
6	Chepatchet	Temp.	01111265	Chepatchet River		✓	✓	✓	✓				
6	Pawtuxet (South Branch)	Temp.	01115970	Mishnock River				✓	✓				✓
6	Pawtuxet (North Branch)	Discont.	01115600	Fiskville					✓				✓
6	Sakonnet River		A	Borden Brook			✓	✓					✓
6	Sakonnet River		B	Maidford or Paradise		✓	✓	✓	✓				
7	Big River	Temp.	01115730	Carr River		✓	✓	✓					
7	East Passage (Upper)		D	Lawton Brook			✓		✓				✓
7	Greenwich Bay	Temp.	01116750	Maskerchugg River			✓		✓	✓	✓		

Table 1 - Prioritization of Stream Gages for a Stream Gaging Network in Rhode Island

Priority	Watershed Location 12-digit HUC Name	Gage Status	Gage #	Potential Site Location	Existing Funding Source	Minimally Altered Flow	Potential Growth	Priority Natural Resources	Geographic Data Gap	Potential Interstate Issues	Water Quality (Significant Flow to the Bay)	Proximity to WWTF Discharge	Significant Water Demand
7	Moosup River (Upper)	Temp.	01126224	Moosup River				✓	✓				✓
7	RI Sound		C	Dundry Brook		✓		✓	✓				
7	Woonasquatucket	Temp.	01115010	Valley Street or Dyerville			✓				✓	✓	
8	Barrington and Warren Rivers		E	Runnins River			✓		✓	✓			✓
8	Coastal Aquidneck		G	Bailey Brook					✓				✓
8	Flat River	Temp.	01115900	Upstream of Reservoir		✓		✓	✓				
8	Mount Hope Bay		F	Kickemuit			✓	✓	✓				
8	Narragansett Bay (Upper)	Temp.	01116635	Buckeye Brook				✓	✓			✓	
8	Pettaquamscutt River	Temp.	01117200	Gilbert Stewart		✓		✓	✓				
8	Scituate	Temp.	01115400	Dam Release			✓					✓	✓
X	Block Island												
X	East Passage (Lower)					✓							
X	Fivemile River (Lower)					✓			✓				
X	Fivemile River (Upper)					✓							
X	Lower Moosup River					✓							
X	Palmer River												
X	Point Judith Pond												
X	Quaduck Brook					✓							
X	Quequechan River					✓							
X	Seekonk and Providence River												
X	Southwest Coastal Waters												
X	Upper Pauchaug River					✓							
X	West Passage (Upper)					✓							

Notes:

E = Existing: Existing gages determined to have the highest priority.

X = No stream gaging required since stations are tidal or watershed size within RI is insignificant.

Perm. = Permanent Gage with structure built and monitoring ongoing

Disc. = Discontinued permanent gage with structure yet monitoring has ceased

Project = A temporary gage that has an established rating curve and is currently being monitored for a limited period of time associated with a special project

Temp. = A project gage that was discontinued. There is no structure at this site.

Minimally Altered Flow = Watersheds identified as having little to no withdrawals or diversions and these locations may provide valuable background information

Potential Growth = Watersheds identified as having significant potential for future water withdrawal demands

Priority Natural Resources = Watersheds identified as having natural resource value such as wild trout, conservation land, Ospreys, salmon or potential for salmon, fish ladders, Alewife and/or Herring runs.

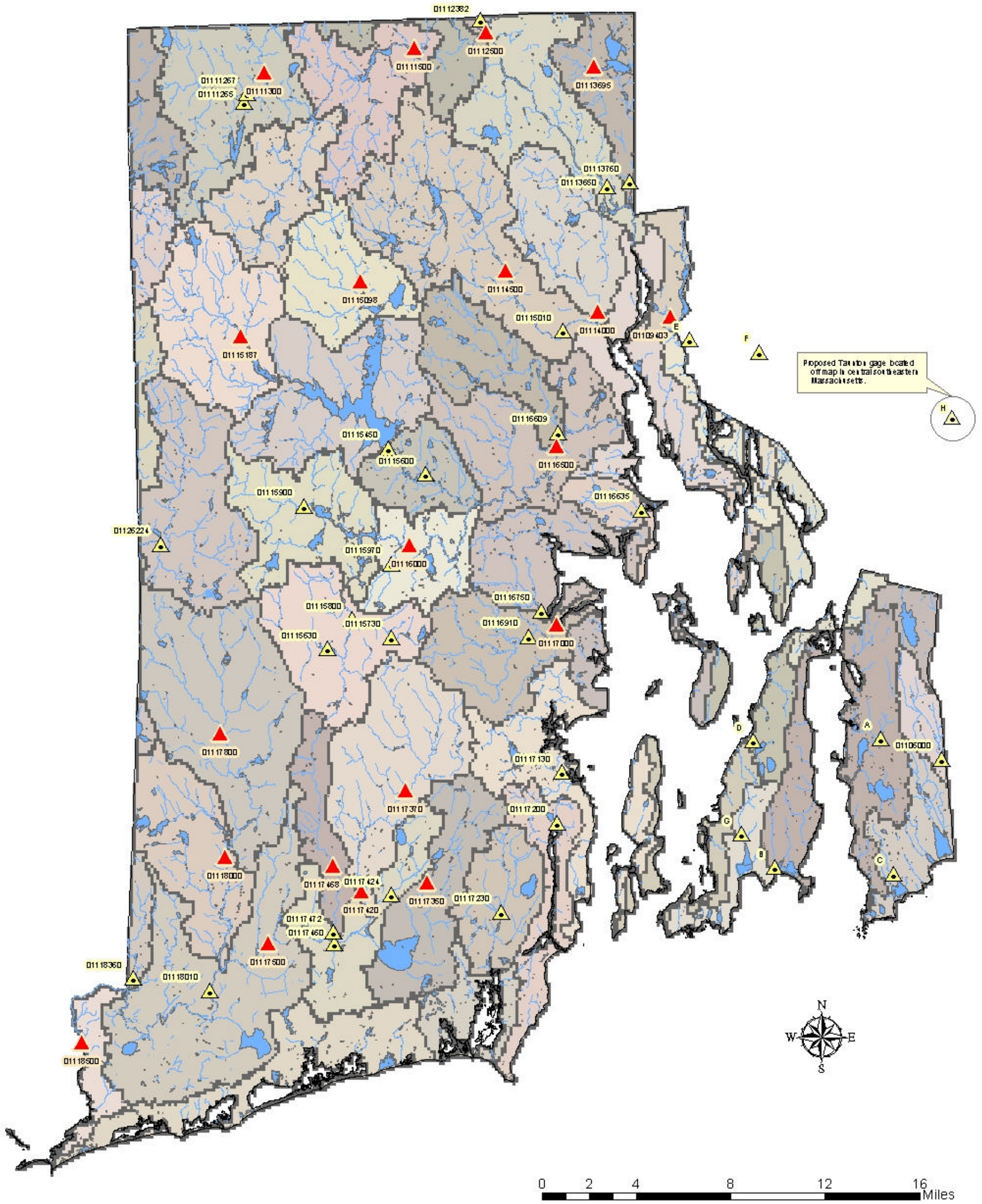
Geographic Data Gap = Watersheds that have no gaging data

Potential Interstate Issues = Watersheds where neighboring states are withdrawing water before it reaches state lines

Water Quality = Watersheds where water quality is measured or estimated and streamflow is needed to calculate loadings to the Bay

Proximity to WWTF = Watersheds where a wastewater discharge exists and the stream flows are needed to calculate dilution of the effluent.

Significant Water Demand = Watersheds where there is a high existing water withdrawal demand



EXISTING & PROPOSED STREAM GAGES

*Stream Gage Study
Conducted by the
Rhode Island Water Resources Board
Stream Flow Committee*

WATER MEASUREMENT GAGE

- ▲ Existing Gage Site
- ▲ Proposed Gage Site
- Rivers & Stream
- Lakes & Ponds

NOTE: Future gage sites A thru H indicate no previous USGS gage has been established on the waterbody.

E. B. Pepper, Principal Environmental Planner
U.S. Bureau of Reclamation
c:\pepper\hydrology_surface_gages.mxd
04/20/04



Costs:

USGS estimates the costs of new gages to include a one-time installation fee of \$24,000 per gage and a yearly operation and maintenance fee of \$10,000 per gage. If some of the discontinued permanent gages are re-established, a one-time installation fee is reduced because a structure exists. If a project gage is converted to a permanent gage, the one-time installation fee is reduced because the USGS may be able to provide the recording equipment that is used on the project site. If any gage is reestablished, the initial usefulness of the data is greater because the rating curves have already been developed and historical data is available to compliment the newly collected data.

Table 2 -Projected estimated costs for the stream gaging network:

Gage Type	#	Type of Cost	State/Private	USGS
Existing Continuous Gages	19	Installation	\$0	\$0
		Operation & Maintenance (O&M) (note: USGS fully funds 1 gage)	\$126,000 (\$7,000ea.)	\$64,000 (\$3,000ea.)
New Gages	24	Installation	\$550,000 (\$22,915ea.)	\$26,400 (\$1,100ea.)
		O&M	\$200,000 (\$8,333 ea.)	\$40,000 (\$1,666ea.)
Convert Existing Project Gages to Permanent Gages	9	Installation	\$72,000 (\$8,000 ea.)	\$126,000 (\$14,000 ea.) in equipment
		O&M	\$90,000 (\$10,000 ea.)	--
Re-establish Discontinued Permanent Gages	2	Installation	\$11,000 (\$5,500 ea.)	\$5,000 (\$2,500 ea.)
		O&M	\$20,000 (\$10,000 ea.)	--
TOTAL INSTALLATION COSTS	35	Installations	\$633,000	\$157,400
TOTAL ANNUAL COSTS	54	Operations and Maintenance	\$436,000	\$104,000

APPENDIX A

Streamflow Data Uses

Environmental Studies

- Non-point source pollution
- Channel morphology evolution
- Sediment studies
- Wetlands ecology
- Tidal gate studies
- Vegetation studies
- Wildlife studies
- Fish studies
- Benthic studies
- Instream flow analysis
- Aquatic habitat studies
- Wild & Scenic determination

Hydraulic Design

- Roadways
- Bridges and culverts
- Dams, spillways and reservoirs
- Channel modifications
- Flood-plain development
- Hydraulic modeling
- Urban beautification
- Navigable rivers for travel

Reservoir Management

- Routine operations
- Flood suppression
- Droughts
- Hydropower operation
- Scheduling bridge and dam inspections/repairs

Statistical Analysis

- Flood frequency
- Low flow frequency
- Flow duration
- Storage requirements
- Areal studies
- Safe yield analysis

Water Management

- Water supply, public and private
- Waste disposal
- Water use
- Irrigation
- Emergency flood alert
- Water diversion permits
- Compliance with instream flow requirements
- Tide monitoring

Urban Studies

- Storm run-off
- Flood inundation
- Zoning and design regulations
- Pollution studies
- Scenic and wildlife suitability assessments

Water Quality

- Assimilative capacity
- Cumulative impacts assessment
- Baseline conditions
- Long-term trends
- Point-source impacts
- Interstate pollution transport
- Surface water – ground water relationships
- Salinity studies
- Dissolved oxygen studies
- Vegetation studies
- Nutrient loading studies
- Recreation suitability
- Regulatory monitoring

Recreation

- Canoeing activities
- Scenic river tour operations
- Sport fishing
- Competition rowing, swimming, water-skiing ...
- Pleasure boating