Site Name /Project Name: ***Water Quality – Blackstone River***
Site Location: ***Woonsocket, Cumberland, Lincoln, Central Falls, Pawtucket, Rhode Island***

QUALITY ASSURANCE PROJECT PLAN

Lead Organization: Rhode Island Department of Environmental Management
February 15, 2005

Project Officer Lucinda M. Hannus

2/16/05
Date

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Project Manager B. J. H

2/18/05
Date

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USEPA QA Manager Steph DiMatt

02-22-05
Date

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Document Control Number: BRWQ-2005-001

2.0 TABLE OF CONTENTS AND DOCUMENT FORMAT

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LIST OF ABBREVIATIONS/ACRONYMS

Berger	The Louis Berger Group, Inc.
COC	Contaminant of Concern
CRM	Certified Reference Material
DQO	Data Quality Objectivess
HASP	Health and Safety Plan
ICP	Inductive Coupled Plasma
LFB	Laboratory Fortified Blank
MCL	Maximum Contamination Level
MDL	Method Detection Limit
mg/kg	milligrams per kilogram
MS	Matrix Spike
MSD	Matrix Spike Duplicate
NA	not applicable
NOAA	National Oceanographic and Atmospheric Administration
NTU	nephelometric turbidity unit
PAL	Project Action Limit
QAPP	Quality Assurance Project Plan
QA/QC	quality assurance/quality control
QL	Quantitation Limit
RIDEM	Rhode Island Department of Environmental Management
RPD	Relative Percent Difference
SAP	Sampling and Analysis Plan
SOP	standard operating procedure
SOW	Scope of Work
SRM	Standard Reference Material
SQL	Sample Quantitation Limit
TA	Total analyte
TMDL	Total Maximum Daily Load
TOC	total organic carbon
µg/kg	micrograms per kilogram
µg/l	micrograms per liter
UMass	University of Massachusetts
URI	University of Rhode island
USACE	U.S. Army Corps of Engineers
USEPA, EPA	U.S. Environmental Protection Agency
USGS	U.S. Geological Survey

2.2 Document Control Format

The following document control format has been used for this QAPP and is included in the header of each page:

Rhode Island Department of Environmental Management *Quality Assurance Project Plan*
Water Quality – Blackstone River (Phase 2)
Revision: Draft
Date: October 2004

2.3 Document Numbering System

Controlled copies of this QAPP will be distributed and maintained by Berger. It is the responsibility of the document holder to replace old versions with revised versions as they are issued. The distribution list of holders of controlled copies of this document will be maintained by Berger and will be provided to the USEPA and RIDEM. The control number is listed on the inside cover.

2.4 EPA-NE QAPP Worksheet #2

Site Name/ Project Name: Water Quality - Blackstone River (Phase 2)
Site Location: Blackstone River watershed in northern Rhode Island
Contractor Name: The Louis Berger Group, Inc.
Contract Number: 74D203832
Anticipated date of QAPP implementation: Immediately after approval

1. **Guidance used for QAPP:** Region I, USEPA-New England Compendium of Quality Assurance Project Plan Requirements and Guidance, Final October 1999, and Attachment A. USEPA NE QAPP Manual, Draft September 1998

2. **Identify EPA Program:** EPA's TMDL program

3. **Identify approval entity: EPA-NE or State**: EPA - New England and RIDEM

4. **Indicate if the QAPP is a generic program QAPP or <u>project-specific</u> QAPP**: Project-specific.

5. **List dates of scoping meetings that were held:** NA

6. **List Title of QAPP documents and approval dates written for previous site work, if applicable**: NA

7. **List organizational partners (stakeholders) and connection with USEPA and/or state:** See attached Table 2-1.

8. **List Data Users:** RIDEM

9. **Required QAPP Elements Not Applicable:** (Shown on table on pages 2-9 to 2-11)

Table 2-1

Technical Advisory Committee - Member List

RIDEM Project Team	Berger Team	Stakeholder	First Name	Last Name	Company	Job Title	Business Street	Business City	Business State	Business Postal Code	Business Phone	Email Address
●			Lucinda	Hannus	RIDEM	Project Officer	235 Promenade Street	Providence	RI	02908	(401) 222-4700 x7241	lhannus@dem.state.ri.us
●			Elizabeth	Scott	RIDEM	Supervisor	235 Promenade Street	Providence	RI	02908	(401) 222-4700 x7300	escott@dem.state.ri.us
●			Chris	Turner	RIDEM	QA Officer	235 Promenade Street	Providence	RI	02908	(401) 222-4700 x7229	cturner@dem.state.ri.us
	●		Chris	Feeney	The Louis Berger Group, Inc.	Regulatory Expert	295 Promenade Street	Providence	RI	02908	(401) 521-5980	cfeeney@louisberger.com
	●		Bernward	Hay	The Louis Berger Group, Inc.	Project Manager	75 Second Ave, Suite 700	Needham	MA	02494	(781) 444-3330	bhay@louisberger.com
	●		Brian	Howes	SMAST	Technical Advisor	706 Rodney French Blvd	New Bedford	MA	02744	(508) 910-6316	bhowes@umassd.edu
	●		Joseph	Pratt	The Louis Berger Group, Inc.	Principal-in-Charge	295 Promenade Street	Providence	RI	02908	(401) 521-5980	jpratt@louisberger.com
	●		Craig	Swanson	Applied Science Associates, Inc.	Modeling						cswanson@appsci.com
	●		Raymond	Wright	University of Rhode Island, Dept. of Civil and Env. Engineering	Technical Advisor	1 Lippitt Road	Kingston	RI	02881	(401) 874-2785	wrightr@egr.uri.edu
		●	Michael	Annarummo	City of Woonsocket	Director of Public Works	169 Main Street	Woonsocket	RI	02895	(401) 767-9209	lpalazini@woonsocketri.org
		●	Al	Basile	US EPA		1 Congress Street	Boston	MA	02114	(617) 918-1599	basile.alfred@epa.gov
		●	Eric	Beck	RIDEM		235 Promenade Street	Providence	RI	02908	(401) 222-4700 ext. 7202	ebeck@dem.state.ri.us
		●	Roger	Boltrushek	US Filter Woonsocket WWTP		11 Cumberland Hill Road	Woonsocket	RI	02895	(401) 762-5050 x236	rbwoon@cs.com
		●	Alan	Brodd	Town of Cumberland	Director of Public Works	45 Broad Street	Cumberland	RI	02864	(401) 728-2400 x41	abrodd@cumberlandri.org
		●	Jim	Campbell	USGS		275 Promenade Street	Providence	RI	02908	(401) 331-9050 x11	jcampbel@usgs.gov
		●	John	Carney	City of Pawtucket	Director of Public Works	137 Rosevelt Ave	Pawtucket	RI	02860	(401) 728-0500 ext.236	smtp:jcarney@pawtucketri.com
		●	Rick	Dunn	MA DEP		627 Main Street	Worcester	MA	01608	(508) 767-2874	dennis.dunn@state.ma.us
		●	Michael	Emond	US Filter Woonsocket WWTP		11 Cumberland Hill Road	Woonsocket	RI	02895	(401) 762-5050 x124	heymikee1@aol.com
		●	Wenley	Ferguson	Save The Bay		434 Smith Street	Providence	RI	02908	(401) 272-3540	wferguson@savebay.org
		●	Joseph	Nield	City of Central Falls	Director of Public Works	53 River Street	Central Falls	RI	02863	401-727-7466	cfhighwaydir@aol.com
		●	Johanna	Hunter	Blackst.-Woonasquatucket Amer. Heritage Rivers	River Navigator	c/o USGS 275 Promenade Street	Providence	RI	02908	(401) 331-9050 x13	hunter.johanna@epa.gov
		●	Karen	Mateleska	John H. Chafee Blackst. River Nat. Heritage Corridor		1 Depot Square	Woonsocket	RI	02895	(401) 762-0250	karen_mateleska@nps.com
		●	Dave	Newton	USEPA	RPM Peterson Puritan SF Site	1 Congress Street	Boston	MA	02114	(617) 918-1243	newton.dave@epa.gov
		●	Fred	Presley	RIDEM		235 Promenade Street	Providence	RI	02908	(401) 222-3434 x4417	fpresley@dem.state.ri.us
		●	Jan	Reitsma	Environmental Team Work		58 Third Street	Barrington	RI	02806	(401) 245-9858	janreitsma@cox.net
		●	Ed	Szymanski,	RI Dept. of Transportation Office of Environmental Programs	Chief	Two Capitol Hill	Providence	RI	02903	(401) 222-2481 ext.4253	esymanski@dot.state.ri.us
		●	David	Turin	EPA New England		1 Congress Street	Boston	MA	02114	(617) 918-1598	turin.david@epa.gov
		●	Christine	VanOrsouw	Blackstone River Watershed Council		175 Main Street	Pawtucket	RI	02860	(401) 724-2200	brwatershed@aol.com
		●	Tom	Walsh	Upper Blackstone WPAD		50 Route 20	Millbury	MA	01527	(508) 755-1286	tkwalsh@ubwpad.org
		●	Lynne	Welsh	MA EOEA		180 Beaman Street	W. Boylston	MA	02853	(508) 792-7423 x503	lynne.welsh@state.ma.us
		●	Kim	Weygand	Town of Lincoln	Town Engineer	100 Old River Road	Lincoln	RI	02865	(401) 333-8415	kwiegand@lincolnri.org
		●	Thomas	Uva	Narraganset Bay Commission		One Service Road	Providence	RI	02905	(401) 461-8848 , x381	jmariscal@narrabay.com

EPA-NE QAPP Worksheet #2 (cont.)

EPA QA/R-5 QAPP ELEMENTS	REQUIRED EPA-NE QAPP ELEMENTS and CORRESPONDING EPA-NE QAPP SECTIONS	EPA-NEW QAPP WORKSHEET #	REQUIRED INFORMATION	NOT APPLICABLE (NA)
Project Management and Objectives				
A1	1.0 Title and Approval Page	1	- Title and Approval Page	
A2	2.0 Table of Contents and Document Format 2.1 Table of Contents 2.2 Document Control Format 2.3 Document Control Numbering System 2.4 EPA-NE QAPP Worksheet #2	2	- Table of Contents - EPA-NE QAPP Worksheet	
A3	3.0 Distribution List and Project Personnel Sign-off Sheet	3 4	- Distribution List - Project Personnel Sign-off Sheet	
A4,A8	4.0 Project Organization 4.1 Project Organizational Chart 4.2 Communications Pathway 4.2.1 Modifications to Approved QAPP 4.3 Personnel Responsibilities and Qualifications **4.4 Special Training Requirements/ Certification**	5a 5b **6** **7**	- Organizational Chart - Communications Pathway - Personnel Responsibilities and Qualifications Table - **Special Personnel Training Requirements Table**	**NA (Not required)**
A5	5.0 Project Planning/Project Definition 5.1 **Project Planning Meetings** 5.2 **Problem Definition/Site History and Background**	**8a** **8b**	- **Project Scoping Meeting** - **Problem Definition/Site History and Background** - **EPA-NE DQO Summary Form** - Site Maps	**Project Definition was carried out in earlier phase of the project (Berger, 2004)**
A6	6.0 Project Description and Schedule 6.1 Project Overview 6.2 Project Schedule	9a 9b 9c 9d 10	- Project Description - Contaminants of Concern - Field and Quality Control Sample Summary Table - Analytical Services Table - System Designs - Project Schedule Timeline Table	Narrative
A7	7.0 Project Quality Objectives and Measurement Performance Criteria 7.1 Project Quality Objectives 7.2 Measurement Performance Criteria	11a 11b	- Project Quality Objectives/Decision Statements - Measurement Performance Criteria Tables	

EPA-NE QAPP Worksheet #2 (cont.)

EPA QA/R-5 QAPP ELEMENTS	REQUIRED EPA-NE QAPP ELEMENTS and CORRESPONDING EPA-NE QAPP SECTIONS	EPA-NEW QAPP WORKSHEET #	REQUIRED INFORMATION	NOT APPLICABLE (NA)
Project Management and Objectives				
B1	8.0 Sampling Process Design 8.1 Sampling Design Rationale	12a 12b	- Sampling Design and Rationale - Sampling Locations, Sampling analysis and methods Table - Sample Location Map	in Section 5 and Attachment B
B2, B6, B7, B8	9.0 Sampling Procedures and Requirements 9.1 Sampling Procedures **9.2 Sampling SOP Modifications** 9.2 Equipment Cleaning 9.3 Field Equipment Calibration and Maintenance 9.4 Inspection and Acceptance Requirements for Sampling Containers	13 **12b** 14 15	- Sampling SOPs - Project Sampling SOP Reference Table - Sample Container, Volumes and Preservation Table - **Field Sampling Equipment Calibration Table** - Cleaning and Decontamination SOPs - **Field Equipment Maintenance, Testing and Inspection Table**	**no modific.** See Section 8 **NA** **NA**
B3	10.0 Sample Handling, Tracking and Custody Requirements 10.1 Sample Collection Documentation 10.1.1 Field Notes 10.1.2 Field Documentation Management System 10.2 Sample Handling and Tracking	16	- Sample Handling, Tracking and Custody SOPs - **Sample Handling Flow Diagram** - **Sample Container Label** - Chain-of-Custody Form	**NA Small Project**
B4, B6, B7, B8	11.0 Field Analytical Methods Requirements 11.1 Field Analytical Methods and SOPs 11.2 Field Analytical Methods/SOP Modification 11.3 Field Analytical Instrument Calibration 11.4 Field Analytical Instrument/ Equipment Maintenance, Testing and Inspection Requirements 11.5 **Field Analytical Inspection and Acceptance Requirements for Supplies**	17 18 **19**	- Field Analytical Methods / SOP Reference Table - Field Analytical Instrument Calibration Table - **Field Analytical Instrument/ Equipment Maintenance, Testing and Inspection Table**	**NA**

EPA-NE QAPP Worksheet #2 (cont.)

EPA QA/R-5 QAPP ELEMENTS	REQUIRED EPA-NE QAPP ELEMENTS and CORRESPONDING EPA-NE QAPP SECTIONS	EPA-NEW QAPP WORKSHEET #	REQUIRED INFORMATION	NOT APPLICABLE (NA)
B4, B6, B7, B8	12.0 Fixed Laboratory Analytical Method Requirements	20 21	- Fixed Laboratory Analytic Methods - **Fixed Laboratory Instrument Maintenance and Calibration Table**	**in SOPs / small project**
B5	13.0 Quality Control Requirements 13.1 Sampling Quality Control 13.2 Analytical Quality Control	**22a** **22**b **23a** **23b** 24a **24b**	- Sampling - Analytical	**Narrative** **NA** **NA** **NA** **NA**
B9	14.0 Data Acquisition Requirements	25	- Non-Direct Measurements Criteria and Limitations Table	
A9, B10	15.0 Documentation, Records and Data Management	26	- Project Documentation and Records - Data Management	Narrative
		Assessment / Oversight		
C1	16.0 Assessment and Response Actions	**27a** 27b **27c**	- Assessment and Response Actions - Project Assessment Table - **Project Assessment Plan** - **Audit Checklist**	Narrative NA (small project)
C2	17.0 QA Management Reports	28	- QA Management Reports Table	
		Data Validation and Usability		
D1	18.0 Verification and Validation Requirements		- **Validation Criteria Documents**	Narrative
D2	19.0 Verification and Validation Procedures	**29a** **29b** **29c**	- **Data Evaluation Process** - **Data Validation Summary Table** - **Data Validation Modifications**	Narrative
D3	20.0 Data Usability/Reconciliation with Project Quality Objectives	**30**	- **Data Usability Assessment**	Narrative

3.0 DISTRIBUTION LIST AND PROJECT PERSONNEL SIGN-OFF SHEET

Personnel that will receive controlled copies of this QAPP are listed in Table 3-1.

Table 3-1: QAPP Distribution List

QAPP Recipients	Title	Organization	Telephone Number
Elizabeth Scott	Supervisor	RIDEM	(401) 222-4700 ext. 7300
Lucinda Hannus	Project Officer	RIDEM	(401) 222-4700 ext. 7241
Chris Turner	QA Officer	RIDEM	(401) 222-4700 ext. 7229
Steve DiMattei	EPA QA Quality Assurance Chemist	USEPA, Region 1	(617) 918-8369
Bernward Hay	Project Manager	Louis Berger Group, Inc.	(781) 444-3330 ext.282
Ray Wright	Technical Advisor	University of Rhode Island	(401) 874-2785
Brian Howes	Technical Advisor	University of Massachusetts - SMAST	(508) 910-6316
Raed El-Farhan	QA Officer	Berger	(800) 348-7313
Ed Lawler	Laboratory Manager	Mitkem	(401) 732-3400
Doug Cullen	Laboratory Manager	Microinorganics	(401) 782-8166
Dave Turin	EPA Project Officer	USEPA	(617) 918-1598

Table 3-2 provides an example of the project personnel sign-off sheet, which must be signed by all personnel working on the project. A signature on this form indicates that the person has read this QAPP and is familiar with the tasks that need to be performed. The complete field staff will be determined at the time of approval of the QAPP. Modifications of the field staff will be made as needed during the program. Signed sheets will be maintained in the project files and will be made available to USEPA and RIDEM upon request.

Table 3-2: Project Personnel Sign-off Sheet Worksheet #4

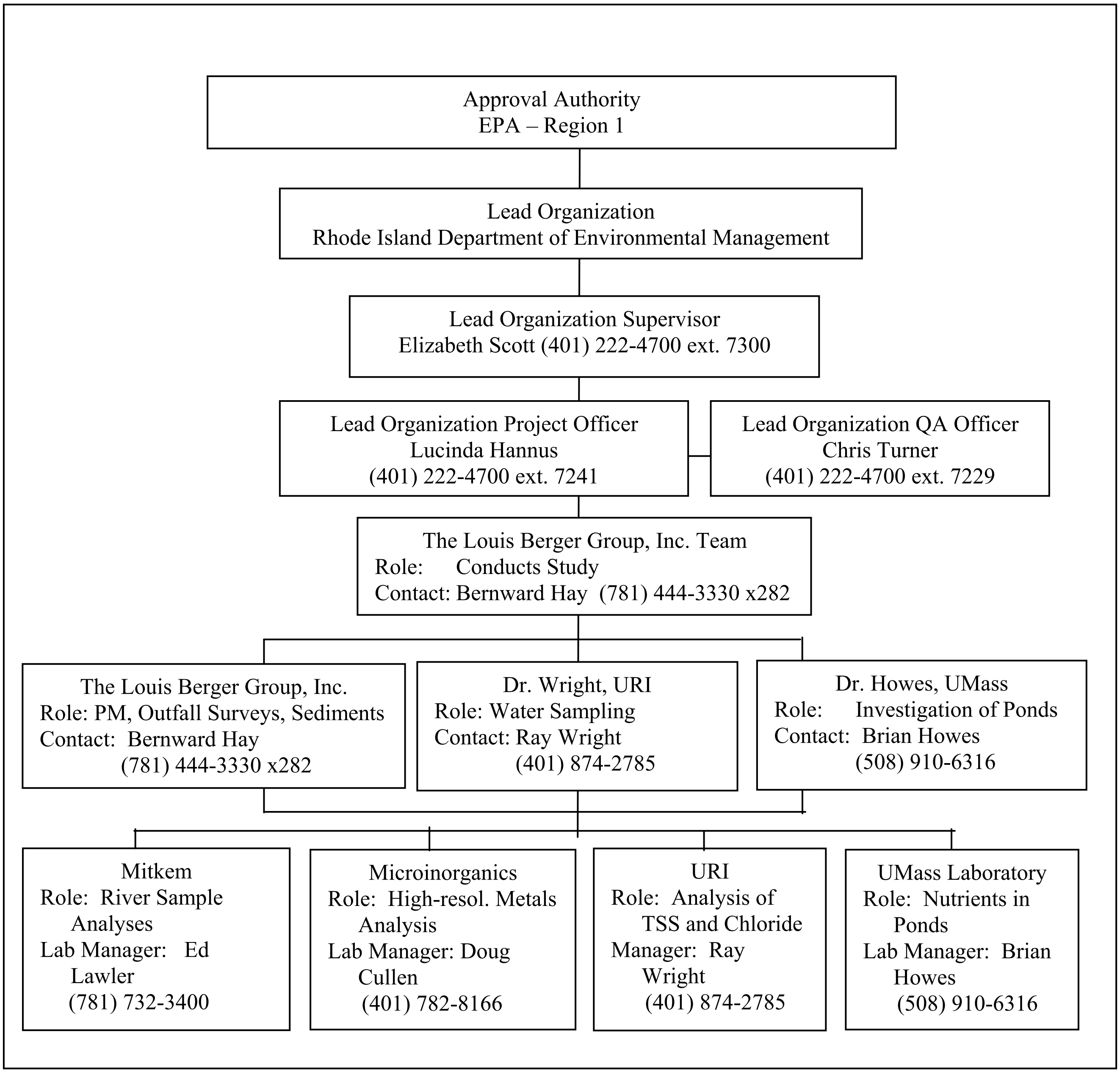
Project Personnel	Title	Affiliation	Tel. Number	Signature	Date QAPP read	QAPP accep-table
Jot Splenda	Field Staff	Berger	781-444-3330			yes

4.0 PROJECT ORGANIZATION

4.1 Project Organizational Chart

The project organization is listed in Figure 4-1.

Figure 4-1: Project Organization



4.2 Communication Pathways

All project related issues will be coordinated by Bernward Hay (Project Manager) with approval from RIDEM, as appropriate. Similarly, all laboratory data will be approved by Bernward Hay, or staff identified by him. The primary RIDEM contact is Cindy Hannus (Project Officer)

Field related issues regarding dry and wet weather water sampling (Tasks 3 and 4 of the project) will be coordinated by Ray Wright, with approval by Bernward Hay. Dr. Wright will be responsible for training of staff for this part of the project. He will also be responsible for monitoring the weather for sampling under these tasks. Prior to the beginning of the sampling season, he will contact the labs to obtain sample bottles. Dry and wet weather water sampling bottles will be kept with Dr. Wright/URI; bottles for all other sampling activities will be kept with Dr. Hay.

Bernward Hay will be responsible for training of staff for all other tasks aside from Tasks 3 and 4.

All communication with the public and stakeholders will be handled by Cindy Hannus (Project Officer).

4.2.1 Modifications to Approved QAPP

It may be necessary to make changes to the sampling plan due to the results of the dry and wet weather surveys, as well as the outfall reconnaissance survey. The Project Manager shall record the modifications to the sampling plan. The decision to add, drop or relocate stations will be made jointly by RIDEM's Project Officer and RIDEM's QA Officer. All changes to the Work Plan will be reported in the sampling Status Report and the Final Report.

4.3 Personnel Responsibilities and Qualifications

Field staff will have been trained and/or are qualified to conduct the field monitoring (Table 4-1). A copy of the Quality Assurance Project Plan (QAPP) will be provided to field staff for review, prior to conducting field work. The names and titles of participating field staff members will be recorded each time in the field notebooks.

4.4 Special Training Requirements and Certifications

Training will be conducted for the field staff to assure the proper procedures are followed, as discussed in Section 4.2.

Table 4-1: Personnel Responsibilities and Qualifications

Name	Title	Organi-zation	Responsibility	Education
Bernward Hay	Project Manager	Berger	Coordinates and oversees project. Oversees contractors. Provides QA for sample analyses for sediments.	Ph.D. MIT (Oceanography); M.S. Cornell University (Geology); Extensive project management and water quality assessment experience.
Raed El-Farhan	QA Officer	Berger	Reviews water quality data for TMDL development.	Ph.D. Clemens Univ. (Env. Engineering); M.S. Clemens Univ. (Env. Engineering); Extensive experience in TMDL development.
Ray Wright	Task Manager, Tasks 3 and 4	URI	Coordinates wet and dry weather sampling of rivers and tributaries. Provides QA for sample analyses for these tasks. Provides load calculations.	Professor at URI. Extensive experience in water quality analyses of the Blackstone River.
Brian Howes	Technical Advisor	UMass	Advises of field program for pond investigations. Provides QA for sample analyses for these pond samples. Evaluates data from the ponds.	Professor at UMass. Extensive experience in nutrient analyses in ponds and rivers in New England.
Ed Lawler	Laboratory Manager	Mitkem	Responsible for laboratory analyses in his lab.	Over 20 years of laboratory experience.
Karen Gavitt	Laboratory QA Manager	Mitkem	Responsible for QA of sample analyses in lab.	Over 10 years of laboratory experience.
Doug Cullen	Laboratory Manager	Micro-inorganics	Responsible for laboratory analyses and QA in his lab.	Over 20 years of laboratory experience.
Alynda Foreman	Macro-invertebrate Specialist	Berger	Responsible for macroinvertebrate study.	Over 10 years of experience in biological assessments including macroinvertebrate analyses.

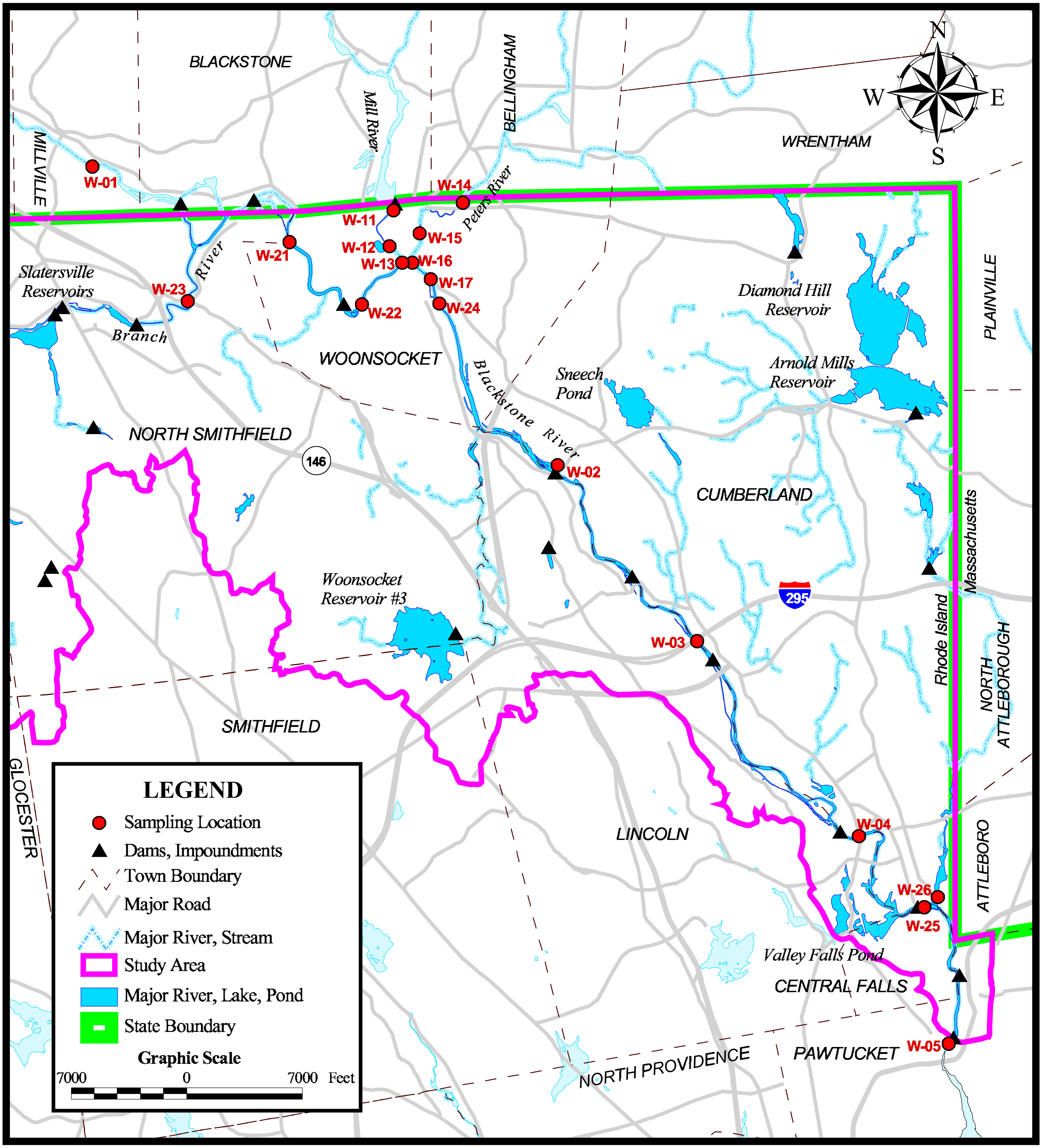
5.0 PROJECT PLANNING / PROBLEM DEFINITION

The project has been planned for over two years and is prepared in response to a report that synthesized relevant existing data (Berger, 2004, *Blackstone River – Water Quality, Final Report 1: Existing Data*). The report identified data gaps. On January 9, 2002, a stakeholder meeting was held prior to the preparation of the report. A second stakeholder meeting was held on July 12, 2004, where the project presented in this QAPP was discussed. Comments from stakeholders were integrated in the project design. The current stakeholder list is presented in Section 2 of this QAPP.

The goal of the project is to collect data and information to fill data gaps that allow for the preparation of TMDLs of the contaminants of concern (COCs) (see Table 5-1). TMDLs are required under Section 303(d) of the Clean Water Act and USEPA's Water Quality Planning and Management Regulations (40 CFR Part 130). The purpose of TMDLs is to reduce the pollutant loading to waterbodies from point and nonpoint sources in order to achieve water quality goals set for the waterbody. The Blackstone River project area, including the Mill River and Peters River tributaries, as well as water quality sampling locations, are presented in Figure 5-1. The Valley Falls Pond and Scott Pond project area is presented in Figure 5-2. Biological sampling locations are presented in Figure 5-3.

Table 5-1: Project Waterbodies and Impairments identified on the 303(d) List from 2002

Name	**Area / Length**	**Class**	**Cause of Impairment**
Blackstone River	15.7 miles	B1 / B1 {a}	Biodiversity impacts, pathogens, copper, lead
Mill River	0.082 miles	B	Lead
Peters River	0.469 miles	B	Pathogens, copper, lead
Valley Falls Pond	42.7 acres	B1 (E)	Biodiversity impacts, pathogens, phosphorus, hypoxia, excess algal growth, lead
Scott Pond	42.2 acres	B	Excess algal growth/ chlorophyll a, low dissolved oxygen, phosphorus



The Louis Berger Group, Inc.

Rhode Island DEM

Source: RIGIS, MASSGIS

File: bw-base.apr

Blackstone River Water Quality

Figure 5-1
WATER SAMPLING STATION LOCATIONS

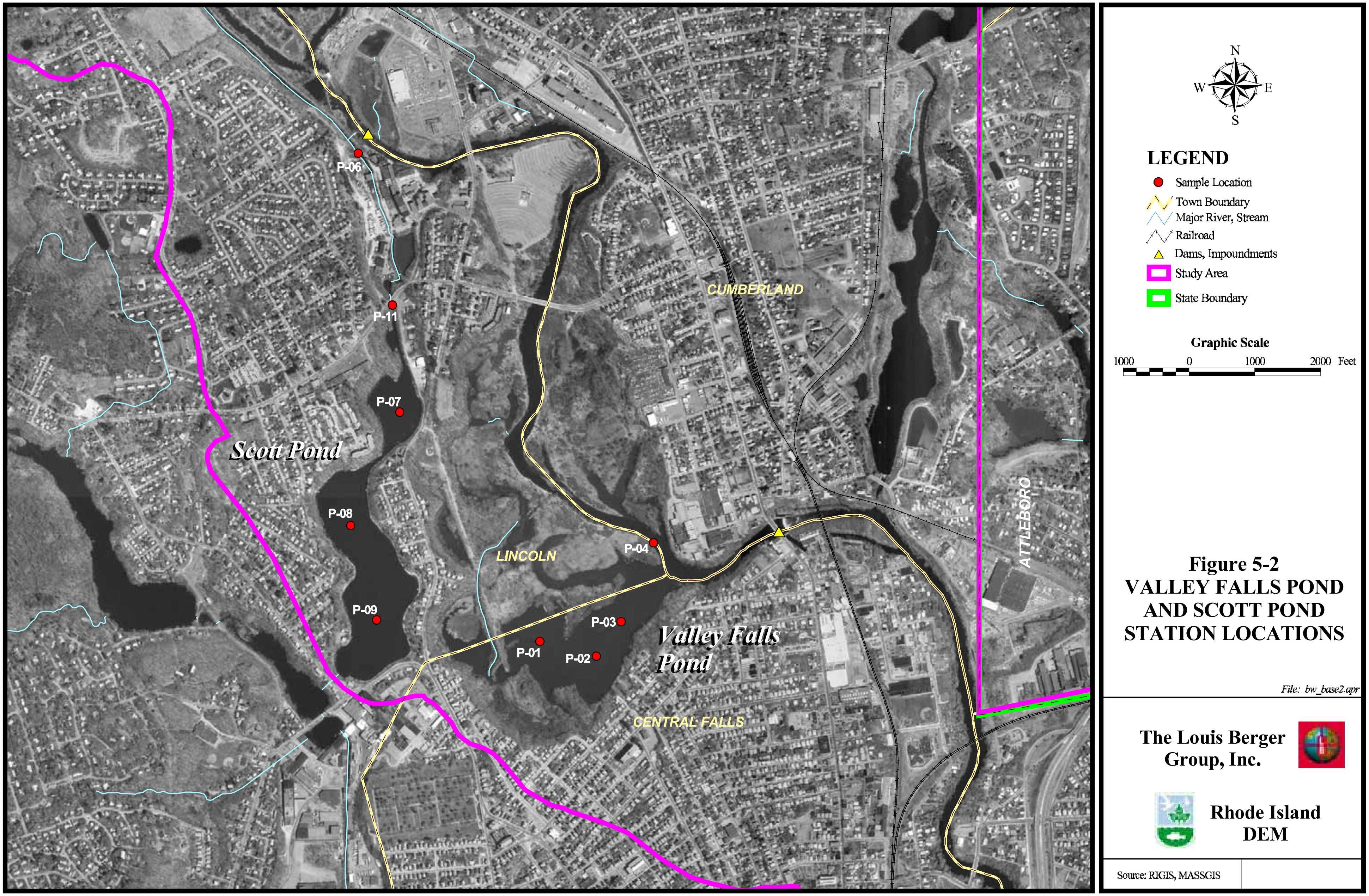


Figure 5-2
VALLEY FALLS POND AND SCOTT POND STATION LOCATIONS

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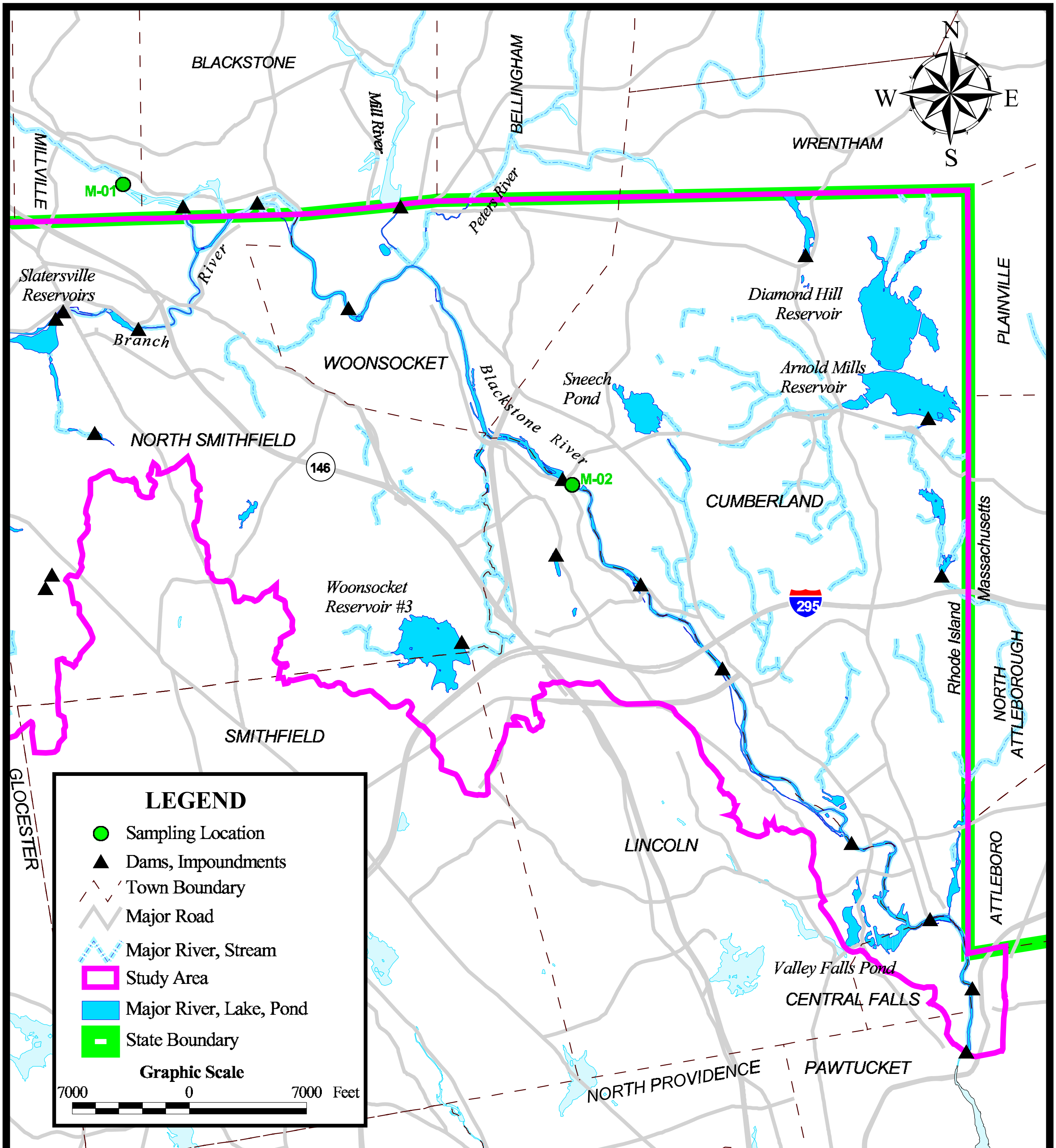
The Louis Berger Group, Inc.

Rhode Island DEM

Source: RIGIS, MASSGIS



The Louis Berger Group, Inc.

Rhode Island DEM

Source: RIGIS, MASSGIS

File: bw-base.apr

Blackstone River Water Quality

Figure 5-3
MACROINVERTEBRATE SAMPLING STATION LOCATIONS

6.0 PROJECT DESCRIPTION AND SCHEDULE

6.1 Project Overview

Attached as Attachment A is the Work Plan for this project, as approved by RIDEM. Sampling stations are presented in Figures 5-1 and 5-2, and in more detail in Attachment B. The work plan presents an overview of the project and defines its individual tasks in detail. This QAPP addresses the sampling and laboratory analysis components of the following tasks presented in the work plan:

- Task 2.4: Reconnaissance sampling of selected stormwater runoff sources
- Task 3: Dry weather water quality monitoring
- Task 4: Wet weather water quality monitoring
- Task 7: Biodiversity
- Task 9: Valley Falls Pond
- Task 10: Scott Pond

Task 11 (Fish tissue analysis) will be conducted by RIDEM under a separate QAPP. Task 5 (In-situ monitoring) and Task 6 (Impoundments) are optional and are not planned to be conducted at this time. Task 8 (Time of Travel) does not require QA/QC procedures for clarification.

Sampling rationale and sampling locations are based on the findings of a detailed existing data study of the project area (Berger, 2004, *Blackstone River – Water Quality, Final Report 1: Existing Data*). Data gaps identified in that study were also the basis for sampling frequency for this study. A copy of the Existing Data report can be made available upon request.

Contaminants of concern and other target analytes are listed in Table 6-1. The total number of samples for each task is listed in Table 6-2. This listing allow for a minimum of 10% duplicate field samples for QA/QC with the exception of the following:

- *Macroalgal Assay:* Two sediment samples will be collected.
- *Phytoplankton:* A total of four water column samples will be collected from two ponds (i.e., two samples per pond).

Sampling methods consist of established methodologies and analyses as follows:

- *Water sampling:* Mostly grab samples without the use of a water sampler. Some samples will be collected with a bucket; deep pond samples will be collected with a self-closing Niskin sampler.
- *Sediment:* Box corer.
- *Flow:* Flow meter, bucket.
- *In-situ monitoring for water quality:* Hand-held meters.

More details on sampling methodologies are provided in Section 9. Laboratories that will analyze the samples for the various constituents are listed in Table 6-3. Standard turnaround time is 2 weeks for these analyses. Data will be validated and verified (see Section 18 and 19 of the QAPP). Data assurance is discussed in Section 16. The data usability will be assessed as described in more detail in Section 20. Data and findings will be compiled at the end of the project in a Final Report; this report will include the laboratory data as Appendices.

Table 6-1: Contaminant of Concern and Other Target Analytes

	Parameter	Laboratory	Analytical Method	Units	Project Limit	Method Detection Limit	Achievable Laboratory Limits	
							MDL	Quantification Limits
Water	Fecal Coliform	Mitkem	SM 9221E	col/100 ml	<5 to >50,000	0 to 1,000,000	<5 to >50,000	
	Enterococci	Mitkem	SM 9230C	col/100 ml	<5 to >50,000	0 to 1,000,000	<5 to >50,000	
	Total Phosphorus (river)	Mitkem	E365.2	mg/l	0.05	0.007	0.007	0.033
	Total Kjeldahl Nitrogen (river)	Mitkem	SM 4500 - TKN	mg/l	0.75	0.54	0.54	1.6
	Ammonia (river)	Mitkem	SM4500 - NH3	mg/l	0.05	0.021	0.021	0.2
	Nitrate (river)	Mitkem	E 300	mg/l	0.1	0.0068	0.0068	0.025
	Total Phosphorus (ponds)	SMAST	SM (17th ed, 1989, p. 4-170)	mg/l	0.05	0.003	0.003	NA
	Orthophosphate (ponds)	SMAST	Molybdate ascorbic acid method	mg/l	0.01	0.003	0.003	NA
	Total Dissolved Nitrogen (ponds)	SMAST	Persulfate digestion, Cd reduction	mg/l	0.05	0.0007	0.001	NA
	Partic. Org. Carbon/Nitrogen (ponds)	SMAST	High-temperature Combustion	mg/l		0.001		
	Ammonia (ponds)	SMAST	Phenol hypochloride	mg/l	0.01	0.001	0.001	NA
	Nitrate (ponds)	SMAST	Cd reduction	mg/l	0.1	0.0007	0.001	NA
	Chlorophyll a / Phaeopigment	SMAST	Turner Auto Fluorometer	ug/l	1	0.05	0.100	NA
	Total Suspended Solids	Wright/URI	SM2540D	mg/l	0.5	0.010	0.001	NA
	Volatile Suspended Solids	Wright/URI	SM2540E	mg/l	0.5	0.010	0.001	NA
	Chloride	Wright/URI	Orion Electrode Procedure	mg/l	1.0	0.100	0.100	NA
	Dissolved Copper	Mitkem	SW6010 (*)	ug/l	3.5	3.15	3.15	15
	Dissolved Lead	Mitkem	SW6010 (*)	ug/l	0.5	0.23	0.2	5
	Dissolved Copper (alternative)	Micro-inorganics	EPA 1637	ug/l	3.5	0.087	0.058	0.10
	Dissolved Lead (alternative)		EPA 1637	ug/l	0.5	0.036	0.033	0.17
	Hardness	Mitkem	SM 2340B	mg/l	5	0.3	0.3	4
Sediment	Arsenic	Mitkem	SW6010	mg/kg	2	0.076	0.076	1
	Cadmium	Mitkem	SW6010	mg/kg	0.5	0.0055	0.0055	0.3
	Chromium	Mitkem	SW6010	mg/kg	5	0.014	0.014	1
	Copper	Mitkem	SW6010	mg/kg	5	0.21	0.21	1.5
	Lead	Mitkem	SW6010	mg/kg	2	0.041	0.041	0.5
	Mercury	Mitkem	SW7471	mg/kg	0.02	0.007	0.007	0.0033
	Nickel	Mitkem	SW6010	mg/kg	5	0.026	0.026	2.5
	Total Organic Carbon	SMAST	High temp. combustion	mg/g	5	1.0	1.0	NA
	Total Organic Nitrogen	SMAST	High temp. combustion	mg/g	5	0.5	0.5	NA
	Total Phosphorus	SMAST	SM (17th ed, 1989, p. 4-170)	mg/g	1	0.1	0.1	NA
	Grain size	Mitkem	Sieve analysis		<63 um to 5 cm	<63 um to 5 cm		

NA Not applicable.

(*) Samples will be pre-concentrationed to 50% of the original volume.

Table 6-2: Field and Quality Control Samples (by Task) (*)

	Parameter	Laboratory	SOP	Method	Task 2: Discharge Source Analyses Samples	Task 2: QA/QC	Task 3: Dry Weather Sampling Samples	Task 3: QA/QC	Task 4: Wet Weather Sampling Samples	Task 4: QA/QC	Task 9: Valley Falls Pond Samples	Task 9: QA/QC	Task 10: Scott Pond Samples	Task 10: QA/QC	No. of Samples	No. QA/QC Samples	Total No. of Samples
Water	Fecal Coliform	Mitkem	1,2,3,5	SM 9221E	67	8	162	27	396	41	40	10	40		705	86	791
	Enterococci	Mitkem		SM 9230C			132	21	210	23	40	10	40		422	54	476
	Total Phosphorus (river)	Mitkem	2,3	E365.2			162	27	354	36					516	63	579
	Total Kjeldahl Nitrogen (river)	Mitkem		SM 4500 - TKN			162	27	354	36					516	63	579
	Ammonia (river)	Mitkem		SM 4500 - NH3			162	27	354	36					516	63	579
	Nitrate (river)	Mitkem		E 300			162	27	354	36					516	63	579
	Total Phosphorus (ponds)	SMAST	5	SM (17th ed, 1989, p. 4-170)							24	6	54	6	78	12	90
	Orthophosphate (ponds)	SMAST		Molybdate ascorbic acid method							24	6	54	6	78	12	90
	Total Dissolved Nitrogen (ponds)	SMAST		Persulfate digestion, Cd reduction							24	6	54	6	78	12	90
	Partic. Org. Carbon/Nitrogen (ponds)	SMAST		High-temperature Combustion							24	6	54	6	78	12	90
	Ammonia (ponds)	SMAST		Phenol hypochloride							24	6	54	6	78	12	90
	Nitrate (ponds)	SMAST		Cd reduction							24	6	54	6	78	12	90
	Chlorophyll a / Phaeopigment	SMAST	2,5	Turner Auto Fluorometer			90	18			24	6	54	6	168	30	198
	Total Suspended Solids	Wright/URI	2,3	SM2540D			162	27	354	36					516	63	579
	Volatile Suspended Solids	Wright/URI		SM2540E			162	27	354	36					516	63	579
	Dissolved Copper	Mitkem	1,2,3,5	SW6010			194 (Cu & Pb)	32 (Cu & Pb)	396 (Cu & Pb)	41 (Cu & Pb)	24 (Cu & Pb)	6 (Cu & Pb)	54 (Cu & Pb)	6 (Cu & Pb)	735 (Cu & Pb)	93 (Cu & Pb)	828
	Dissolved Lead	Mitkem		SW6010													
	Dissolved Copper (alternative)	STI			67	8											
	Dissolved Lead (alternative)	STL			67	8											
	Dissolved Copper (alternative)	Micro-inorganics	2,3	EPA 1637 (1)													
	Dissolved Lead (alternative)			EPA 1637 (1)													
	Hardness	Mitkem	1,2,3,5	SM 2340B	67	8									67	8	75
Sediment	Arsenic	Mitkem	5	SW6010													
	Cadmium	Mitkem		SW6010													
	Chromium	Mitkem		SW6010													
	Copper	Mitkem		SW6010							2	1	3	part of Task 9 sample set	5	1	6
	Lead	Mitkem		SW6010													
	Mercury	Mitkem		SW7471													
	Nickel	Mitkem		SW6010													
	Total Organic Carbon	SMAST		High temp. combustion							2	1	3		5	1	6
	Total Organic Nitrogen	SMAST		High temp. combustion							2	1	3		5	1	6
	Total Phosphorus	SMAST		SM (17th ed, 1989, p. 4-170)							2	1	3		5	1	6
	Grain size	Mitkem		Sieve analysis							2	1	3		5	1	6
Macroalgal Assay		SMAST	6	Microscope							2				2		2
Phytoplankton		SMAST (Normandeau)	7	Microscope							2		2		4		4
Total Costs					**268**	**32**	**1906**	**319**	**3918**	**403**	**334**	**85**	**637**	**60**	**7063**	**899**	**7962**

(*) There will no trip blanks, bottle blanks, or equipment blanks.

Table 6-3: Analytical Services

Medium/ Matrix	Analytical Parameter	Concen-tration Level	Analytical Method /SOP	Data Package Turn-around Time	Laboratory / Organization Contact	Backup Laboratory / Organi-zation Contact
Water, sediment	Metals, Nutrients (from river sampling)	Low to high	SOP-12	2 weeks	Mitkem Corporation 175 Metro Center Blvd. Warwick, RI 02886 Tel: 401-732-3400	NA
Water	Metals	Low to high	SOP-11	2 weeks	Microinorganics, Inc. 16 Reactor Road Narragansett, RI 02882 Tel: 401-782-8166	NA
Water	Bacteria	Low to medium	SOP-12	2 weeks	RI Analytical Laboratories (subcontractor to Mitkem) 41 Illinois Avenue Warwick, RI 02888 Tel: 401-737-8500	NA
Water	Nutrient (from ponds), Chlorophyll, Macroalgae	Low to high	SOP-10	2 weeks	School of Marine Science and Technology Univ. of Massachusetts 706 Rodney French Bvld. New Bedford, MA 02744 Tel: 508-999-8193	NA
Water	Turbidity, Chloride	Low to medium	SOP-9	2 weeks	University of Rhode Island Department of Civil and Environmental Engineering Bliss Hall Kingston, RI 02881 Tel: 401-874-2785	NA
Sediment	Grain size	Clay to sand	Sieve Analysis	2 weeks	GeoTesting Express (subcontractor to Mitkem) 1145 Massachusetts Ave. Boxborough, MA 01719 Tel: 978-635-0424	NA
Water	Phytoplankton	NK	SOP-7	2 weeks	Normandeau Assoc., Inc. (subcontractor to UMass) 25 Nashua Road Bedford, NH 03110 Tel: 603-472-5191	NA

NK = Concentration levels not known. They will vary based on weather conditions and/or location.

NA = Not applicable.

6.2 Project Schedule

The project schedule is attached as Table 6-4. The Project Manager (Bernward Hay) will interact with RIDEM's Project Officer (Lucinda Hannus) regarding maintaining the schedule. The Project Manager will communicate with the project team regarding any changes in the schedule. Scheduling the wet weather sampling events (rain storms) will be determined initially by the Wet Weather Team Leader, Ray Wright, and approved by the Project Manager, Bernward Hay.

The main time constraint is weather, as storm sampling requires specific rainfall conditions. Given the fact that suitable rain events may not be identified until a few days prior to the storm, there may also be manpower and logistical constraints that affect the schedule at that time. All other tasks are of shorter duration and can therefore be easily accommodated in the overall schedule.

Table 6-4

Project Schedule *(estimate)*

Task No.	Task	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
	Month	Mar-04	Apr-04	May-04	Jun-04	Jul-04	Aug-04	Sep-04	Oct-04	Nov-04	Dec-04	Jan-05	Feb-05	Mar-05	Apr-05	May-05	Jun-05	Jul-05	Aug-05	Sep-05	Oct-05	Nov-05	Dec-05	Jan-06	Feb-06	Mar-06	Apr-06	May-06	Jun-06
Task 1: Development of Work Plan and QAPP																													
1.1	Meeting with RIDEM to discuss Phase 2 Goals	■																											
1.2	Preparation of Work Plan		■	■	■	■	■	■																					
1.3	Meeting with Technical Advisory Committee																												
1.4	Preparation of QAPP					■	■	■	■	■																			
Task 2: Inventory of Discharges of Stormwater Runoff Sources																													
2.1	Review of Stormwater Drainage Plans				■																								
2.2	Contact Municipalities for Updates of Existing Plans				■	■																							
2.3	Conduct Stormwater Source Inventory for Reaches					■	■	■	■	■	■																		
2.4	Reconnaissance Sampling of Discharge Sources									■	■					■	■	■											
2.5	Evaluation of Stormwater Runoff Sources									■	■	■					■	■	■										
Task 3: Dry Weather Water Quality Monitoring																													
3.1	Dry Weather Sampling - Primary stations													■	■	■	■	■	■	■	■	■	■	■	■				
3.2	Dry Weather Sampling - Intermittent stations													■	■	■	■	■	■	■	■	■	■	■	■				
3.3	Data Analysis and Monitoring Report																		■					■	■	■			
Task 4: Wet Weather Water Quality Monitoring																													
4.1	Storm 1															■	■	■	■	■	■								
4.2	Storm 2															■	■	■	■	■	■								
4.3	Storm 3															■	■	■	■	■	■								
4.4	Mill and Peters River Storm															■	■	■	■	■	■								
4.4	Data Analysis and Monitoring Report																				■	■	■	■					
Task 5: In-situ Monitoring (Conducted by DEM)																													
5.1	Deployment of Equipment																	■	■										
5.2	Recovery of Equipment																			■									
5.3	Data Analysis and Monitoring Report																			■	■								
Task 6: Impoundments (Optional)																													
6.1	Review of Existing Information																■												
6.2	Field Survey																■	■	■										
6.3	Sediment Sampling																	■	■										
6.4	Data Analysis and Monitoring Report																			■	■								
Task 7: Biodiversity Impact																													
7.1	Historic Data Review						■																						
7.2	Reconnaisance Site Visit						■																						
7.3	Deployment of Equipment						■	■	■										■	■									
7.4	Recovery of Equipment								■												■								
7.5	Sample and Data Analysis and Monitoring Report								■	■											■	■							
Task 8: Time of Travel																													
8.1	Time of Travel Assessment								■	■																			
Task 9: Valley Falls Pond																													
9.1	Wetland System Assessment							■																					
9.2	Water Elevations						■	■	■																				
9.3	Bathymetry								■																				
9.4	Watershed Assessment								■	■																			
9.5	Water Sampling						■	■									■	■	■	■									
9.6	Sediment Analysis																■												
9.7	Data Analysis and Report									■	■										■	■	■						
Task 10: Scott Pond																													
10.1	Watershed Assessment							■																					
10.2	Pond Elevation						■	■	■																				
10.3	Bathymetry								■																				
10.4	Water Sampling						■	■									■	■	■	■									
10.5	Sediments																■												
10.6	Groundwater Inflow								■																				
10.7	Data Analysis and Report									■	■										■	■	■						
Task 11: Fish Tissue Analysis																													
11.1	*(No labor is budgeted, only sample analyses costs)*																■	■	■										
Task 12: Determination of Loads																													
12.1	Determination of Loads																						■	■	■	■	■		
12.2																													
Task 13: Preparation of Final Report																													
13.1	Preparation of Draft Final Report																							■	■	■	■		
13.2	Integration of Data from recent & ongoing Studies																							■	■	■	■		
	Review by RIDEM																											■	
13.3	Preparation of Final Report																												■
Task 14: Meetings																													
14.1	Progress Meetings with RIDEM (5 meetings)				■								■							■				■					■
14.2	Meetings with the Public and/or TAC (3 meetings)				■																■								■
QA/QC		■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■

(*) The preferred time period for water quality sampling is summer and fall when water quality conditions in the river and ponds are most critical for aquatic life.
The most critical period for dissolved oxygen conditions is from July to September.

Review of reports by RIDEM and other agencies/organizations/stakeholders.

7.0 PROJECT QUALITY OBJECTIVES AND MEASUREMENT PERFORMANCE CRITERIA

Collecting high quality data is one of the most important goals of this project. Specific data quality objectives include method detection limits, precision, accuracy, representativeness, comparability, and completeness. The data quality objectives will be met if the data collected are sufficient to assist in developing TMDLs for the waterbodies of concern.

7.1 Project Quality Objectives

The key objective of this project is to develop data and information that will assist in ultimately achieving the following goals:

- Understanding the degree of contamination of the contaminants of concern (COCs; lead, copper, bacteria, nutrients) in the waterbodies of concern (Blackstone River, Mill River, Peters River, Valley Falls Pond, Scott Pond).
- Understanding biodiversity conditions at two stations in the river.
- Determine sources that contribute COCs to the identified waterbodies, resulting in their impairment.
- Provide information to develop TMDLs for these waterbodies for the COCs.
- Understand the stressors that affect the biodiversity in these waterbodies.

The study, as described in the Work Plan (see Attachment A), was designed toward these goals.

Data Needs: Data are needed from the water column, surface sediments (in ponds), and outfalls to achieve these goals. The data needs were developed based on a detailed synthesis of the existing data in the study area.

End Use of Data: Data will be synthesized to achieve the objectives stated above.

Collection Methods: Water samples from the river and outfalls will be collected by grab sampling. Sediment samples will be collected by box corer. In-situ measurements of water quality parameters and flow will be made by standard testing equipment as described further below.

Quality: The data need to be of sufficient quality to determine the degree of impairment and to allow for load calculations.

Quantity: We believe that the sampling approach was structured in a manner to provide for an adequate number of samples to achieve the goals of this study, based on our current understanding. The quantity was developed after review of the existing data. Input was further obtained from stakeholders who reviewed the work plan.

Data Reporting: Reported data will be compared against regulatory standards and guidelines. Further, loads will be calculated for most concentrations, as appropriate.

7.2 Measurement Performance Criteria

7.2.1 Precision

The precision of the analyses will be determined by comparing duplicate samples. Duplicate samples will be collected in the field (Table 6-1). Precision is expressed in terms of Relative Percent Difference (RPD) using the following equation:

$$RPD = (C1-C2) / [(C1+C2)/2] \times 100$$

where

C1 = the larger of the two concentrations.
C2 = the smaller of the two concentrations.

The performance criteria for precision are presented in Tables 7-1 to 7-21. Duplicate samples that do not meet these criteria will be flagged. Field observations recorded in the field notebooks will be reviewed to determine if the discrepancy between the data is potentially the result of laboratory errors or natural conditions (such as organic debris in the stormwater).

7.2.2 Accuracy/Bias

Accuracy is the degree of agreement of a measurement with an accepted reference or true value. The difference between the values is generally expressed as a percentage or ratio. Through quality control checks for accuracy, potential bias of reported sample concentrations is identified. Accuracy of field instrumentation is assured by appropriate initial calibration and calibration checks. The accuracy of laboratory analytical procedures is measured through a review of calibration, matrix spike, and laboratory control sample results.

The objective for field measurement accuracy initially is to successfully calibrate the associated instrumentation to the manufacturer's specifications and to then check the amount of deviation from the calibrated values at the end of day. The objective for accuracy of laboratory determinations is to demonstrate that the analytical instrumentation provides consistent measurements, which are within USEPA and statistically derived method specific accuracy criteria.

The laboratories will provide the accuracy of their analyses to Berger for each sampling event (i.e., for each batch of samples) for review. The performance criteria for accuracy are presented in Tables 7-1 to 7-21. Sample batches that not meet these criteria will be flagged, at a minimum. After discussing the discrepancy with the laboratory, the QA/QC Officer and the Project Manager will then decide (a) if the data batch should be rejected or (b) if, and to what extent, the data should be qualified. For example, matrix spikes may be reviewed to evaluate if inaccurate data could have been the result of elevated suspended solids concentrations in the sample or the result of analytical problems.

7.2.3 Representativeness

The representativeness of the data was addressed in part during the setup of the project. Specifically, an extensive data set was reviewed by Berger (2004). Data and findings were discussed with RIDEM. The selected stations and sampling frequency are considered the most representative for this study. In addition, the exact sampling point at each station was determined by field visits; the stations were chosen based on representativeness.

The final aspect regarding the representativeness of the data will consist of a review of the sampling times relative to the discharge rates. The goal is to capture representative concentrations of the specific analytical parameters prior to (1 sample) and during the storm. Given the wide range of variability of rainfall along with its low predictability of detailed rainfall patterns of individual storms, there is a chance that samples will be taken during periods of low discharge rates. However, our sampling approach includes collection of up to 50% more samples as will be analyzed by the laboratory. After sampling, samples will either be composited or the samples collected during the higher discharge rate will be submitted to the laboratory. This approach will be reviewed by the Project Manager, Field Team Leader, and the QA/QC Manager after each sampling event to determine if it provides the most representative data for each storm within the constraints of this project.

7.2.4 Comparability

To maximize the quality of the data collected, and to collect data that are comparable with other studies, accepted sampling procedures will be used during this study. All samples collected will be sent to laboratories that use Standard Methods. The data developed in this study will primarily be compared to (a) data summarized in the existing data report for the Blackstone River (Berger, 2004), and (b) other recent data collected over the last 3 years by URI, Massachusetts DEP, Brown University, and other relevant sources.

7.2.5 Sensitivity

Analytical methods were selected such that detection limits will not limit the usefulness of the data set.

7.2.6 Completeness

Completeness is a measure (percentage) of the amount of valid data obtained from a measurement system relative to the amount that would be expected to be obtained under correct, normal conditions. A completeness of at least 85% is acceptable. The 1996 USEPA document *Data Quality Objectives for Remedial Response Activities* states that Contract Laboratory Program data have been found to be historically 80-85% complete. The 85% completeness goal will be applied to the majority of screening and project data; however, a goal of 90-95% completeness will be applied to key data collected to define the water and sediment quality in the project area.

Further, if the data collected are sufficient to develop TMDLs, than the data are considered to be complete. Outfall data shall provide insight into potential sources of impairment; the identification of such sources through outfall data would render the data complete as well.

7.3 References

U.S. Environmental Protection Agency (USEPA) Region 1, 1996. *Region 1, USEPA - New England Data Validation Functional Guidelines for Evaluating Environmental Analyses*. December 1996.

Table 7-1: Measurement Performance Criteria - Bacteria

Medium/Matrix	Surface Water		
Analytical Parameter	Fecal Coliform, Enterococci		
Concentrations Level	Low to medium		
Sampling Procedure	SOP-1, SOP-2, SOP-3, SOP-5		
Analytical Method/SOP	SM 9221E (Fec. Colif.), SM 9230C (Enterococci)		
Data Quality Indicators (DQIs)	**Measurement Performance Criteria**	**QC Sample and /or Other Activity Used to Assess Measurement Performance**	**QC Sample assesses Error for Sampling (s), Analytical (A) or both (S/A)**
Precision	NA	Field Duplicate	S/A
Accuracy	NA	NA	
Accuracy/bias, Contamination	NA	NA	
Sensitivity	See Table 6-1		
Data Completeness	Data collected are determined to be usable	≥90-95%	A

Table 7-2: Measurement Performance Criteria – Total Phosphorus (river)

Medium/Matrix	Surface Water		
Analytical Parameter	Total Phosphorus		
Concentrations Level	Low to high		
Sampling Procedure	SOP-2, SOP-3		
Analytical Method/SOP	E365.2		
Data Quality Indicators (DQIs)	**Measurement Performance Criteria**	**QC Sample and /or Other Activity Used to Assess Measurement Performance**	**QC Sample assesses Error for Sampling (s), Analytical (A) or both (S/A)**
Precision	≤ 20% RPD	Field/Lab Duplicate	S/A
Accuracy	75-125%	Matrix Spike	A
Accuracy/bias, Contamination	NA		
Sensitivity	See Table 6-1		
Data Completeness	Data collected are determined to be usable	≥90-95%	A

Table 7-3: Measurement Performance Criteria – Total Kjeldahl Nitrogen, Ammonia (river)

Medium/Matrix	Surface Water		
Analytical Parameter	Total Kjeldahl Nitrogen, Ammonia		
Concentrations Level	Low to high		
Sampling Procedure	SOP-2, SOP-3		
Analytical Method/SOP	SM-4500		
Data Quality Indicators (DQIs)	**Measurement Performance Criteria**	**QC Sample and /or Other Activity Used to Assess Measurement Performance**	**QC Sample assesses Error for Sampling (s), Analytical (A) or both (S/A)**
Precision	≤ 20% RPD	Field/Lab Duplicate	S/A
Accuracy	75-125%	Matrix	A
Accuracy/bias, Contamination			
Sensitivity	See Table 6-1		
Data Completeness	Data collected are determined to be usable	≥90-95%	A

Table 7-4: Measurement Performance Criteria – Nitrate (river)

Medium/Matrix	Surface Water		
Analytical Parameter	Nitrate		
Concentrations Level	Low to high		
Sampling Procedure	SOP-2, SOP-3		
Analytical Method/SOP	E 300		
Data Quality Indicators (DQIs)	**Measurement Performance Criteria**	**QC Sample and /or Other Activity Used to Assess Measurement Performance**	**QC Sample assesses Error for Sampling (s), Analytical (A) or both (S/A)**
Precision	≥20% RPD	Field/Lab Duplicate	S/A
Accuracy	75-125%		A
Accuracy/bias, Contamination			
Sensitivity	See Table 6-1		
Data Completeness	Data collected are determined to be usable	≥90-95%	A

Table 7-5: Measurement Performance Criteria –Total Phosphorus (ponds)

Medium/Matrix	Surface Water		
Analytical Parameter	Total phosphorus		
Concentrations Level	Low to high		
Sampling Procedure	SOP-5		
Analytical Method/SOP	SM (17 ed. 1989, p. 4-170)		
Data Quality Indicators (DQIs)	**Measurement Performance Criteria**	**QC Sample and /or Other Activity Used to Assess Measurement Performance**	**QC Sample assesses Error for Sampling (s), Analytical (A) or both (S/A)**
Precision	$\leq$20% RPD (field) $\leq$10% RPD (lab)	Field/Lab Duplicate	S/A
Accuracy	75-125%	Matrix Spike	A
Accuracy/bias, Contamination	NA		
Sensitivity	See Table 6-1		
Data Completeness	Data collected are determined to be usable	$\geq$90-95%	A

Table 7-6: Measurement Performance Criteria – Orthophosphate (ponds)

Medium/Matrix	Surface Water		
Analytical Parameter	Orthophosphate		
Concentrations Level	Low to high		
Sampling Procedure	SOP-5		
Analytical Method/SOP	Molybdate ascorbic acid		
Data Quality Indicators (DQIs)	**Measurement Performance Criteria**	**QC Sample and /or Other Activity Used to Assess Measurement Performance**	**QC Sample assesses Error for Sampling (s), Analytical (A) or both (S/A)**
Precision	$\leq$20% RPD (field) $\leq$10% RPD (lab)	Field/Lab Duplicate	S/A
Accuracy	75-125%	Matrix Spike	A
Accuracy/bias, Contamination	NA		
Sensitivity	See Table 6-1		
Data Completeness	Data collected are determined to be usable	$\geq$90-95%	A

Table 7-7: Measurement Performance Criteria – Total Dissolved Nitrogen (ponds)

Medium/Matrix	Surface Water		
Analytical Parameter	Total Dissolved Nitrogen		
Concentrations Level	Low to high		
Sampling Procedure	SOP-5		
Analytical Method/SOP	Persulfate digestion, Cd reduction		
Data Quality Indicators (DQIs)	**Measurement Performance Criteria**	**QC Sample and /or Other Activity Used to Assess Measurement Performance**	**QC Sample assesses Error for Sampling (s), Analytical (A) or both (S/A)**
Precision	≤20% RPD (field) ≤10% RPD (lab)	Field/Lab Duplicate	S/A
Accuracy	75-125%	Matrix Spike	A
Accuracy/bias, Contamination	NA		
Sensitivity	See Table 6-1		
Data Completeness	Data collected are determined to be usable	≥90-95%	A

Table 7-8: Measurement Performance Criteria – Particulate Organic Carbon/Nitrogen (ponds)

Medium/Matrix	Surface Water		
Analytical Parameter	Particulate Organic Carbon/Nitrogen (ponds)		
Concentrations Level	Low to medium		
Sampling Procedure	SOP-5		
Analytical Method/SOP	High-temperature Combustion		
Data Quality Indicators (DQIs)	**Measurement Performance Criteria**	**QC Sample and /or Other Activity Used to Assess Measurement Performance**	**QC Sample assesses Error for Sampling (s), Analytical (A) or both (S/A)**
Precision	≤20% RPD (field)	Field Duplicate	S
Accuracy	± 0.5%	Internal Standard	A
Accuracy/bias, Contamination	NA		
Sensitivity	See Table 6-1		
Data Completeness	Data collected are determined to be usable	≥90-95%	A

Table 7-9: Measurement Performance Criteria – Ammonia (ponds)

Medium/Matrix	Surface Water		
Analytical Parameter	Ammonia		
Concentrations Level	Low		
Sampling Procedure	SOP-5		
Analytical Method/SOP	Phenol hypochlorite		
Data Quality Indicators (DQIs)	**Measurement Performance Criteria**	**QC Sample and /or Other Activity Used to Assess Measurement Performance**	**QC Sample assesses Error for Sampling (s), Analytical (A) or both (S/A)**
Precision	≤ 20% RPD (field) ≤10% RPD (lab)	Field/Lab Duplicate	S/A
Accuracy	75-125%	Matrix Spike	A
Accuracy/bias, Contamination	NA		
Sensitivity	See Table 6-1		
Data Completeness	Data collected are determined to be usable	≥90-95%	A

Table 7-10: Measurement Performance Criteria – Nitrate (ponds)

Medium/Matrix	Surface Water		
Analytical Parameter	Nitrate		
Concentrations Level	Low to medium		
Sampling Procedure	SOP-5		
Analytical Method/SOP	Cd reduction		
Data Quality Indicators (DQIs)	**Measurement Performance Criteria**	**QC Sample and /or Other Activity Used to Assess Measurement Performance**	**QC Sample assesses Error for Sampling (s), Analytical (A) or both (S/A)**
Precision	≤ 20% RPD (field) ≤10% RPD (lab)	Field/Lab Duplicate	S/A
Accuracy	75-125%	Matrix Spike	A
Accuracy/bias, Contamination	NA		
Sensitivity	See Table 6-1		
Data Completeness	Data collected are determined to be usable	≥90-95%	A

Table 7-11: Measurement Performance Criteria - Chlorophyll / Phaeopigment

Medium/Matrix	Surface Water		
Analytical Parameter	Chlorophyll / Phaeopigment		
Concentrations Level	Low to high		
Sampling Procedure	SOP-2, SOP-5		
Analytical Method/SOP	Turner Auto Fluorometer		
Data Quality Indicators (DQIs)	**Measurement Performance Criteria**	**QC Sample and /or Other Activity Used to Assess Measurement Performance**	**QC Sample assesses Error for Sampling (s), Analytical (A) or both (S/A)**
Precision	$\leq$ 20% RPD (field) $\leq$10% RPD (lab)	$\leq$ 20% RPD (field) $\leq$10% RPD (lab)	S/A
Accuracy	75-125%	Matrix Spike	A
Accuracy/bias, Contamination	NA		
Sensitivity	See Table 6-1		
Data Completeness	Data collected are determined to be usable	$\geq$90-95%	A

Table 7-12: Measurement Performance Criteria – Total Suspended Solids

Medium/Matrix	Surface Water		
Analytical Parameter	Total Suspended Solids		
Concentrations Level	Low to medium		
Sampling Procedure	SOP-2, SOP-3		
Analytical Method/SOP	SM2540		
Data Quality Indicators (DQIs)	**Measurement Performance Criteria**	**QC Sample and /or Other Activity Used to Assess Measurement Performance**	**QC Sample assesses Error for Sampling (s), Analytical (A) or both (S/A)**
Precision	Less than 20% RPD	Field Duplicates	SA
Accuracy	Less than 20% RPD	NA	NA
Accuracy/bias, Contamination	NA		
Sensitivity	See Table 6-1		
Data Completeness	Data collected are determined to be usable	$\geq$90-95%	A

Table 7-13: Measurement Performance Criteria – Volatile Suspended Solids

Medium/Matrix	Surface Water		
Analytical Parameter	Volatile Suspended Solids		
Concentrations Level	Low to medium		
Sampling Procedure	SOP-2, SOP-3		
Analytical Method/SOP	SM2540		
Data Quality Indicators (DQIs)	**Measurement Performance Criteria**	**QC Sample and /or Other Activity Used to Assess Measurement Performance**	**QC Sample assesses Error for Sampling (s), Analytical (A) or both (S/A)**
Precision	Less than 20% RPD	Field Duplicates	SA
Accuracy	Less than 20% RPD	NA	NA
Accuracy/bias, Contamination	NA		
Sensitivity	See Table 6-1		
Data Completeness	Data collected are determined to be usable	≥90-95%	A

Table 7-14: Measurement Performance Criteria – Chloride

Medium/Matrix	Surface Water		
Analytical Parameter	Chloride		
Concentrations Level	Low to medium		
Sampling Procedure	SOP-2, SOP-3		
Analytical Method/SOP	Orion Electrode Procedure		
Data Quality Indicators (DQIs)	**Measurement Performance Criteria**	**QC Sample and /or Other Activity Used to Assess Measurement Performance**	**QC Sample assesses Error for Sampling (s), Analytical (A) or both (S/A)**
Precision	Less than 20% RPD	Field Duplicates	
Accuracy			
Accuracy/bias, Contamination			
Sensitivity	See Table 6-1		
Data Completeness	Data collected are determined to be usable	≥90-95%	A

Table 7-15: Measurement Performance Criteria – Dissolved Copper and Lead (Lab: Mitkem)

Medium/Matrix	Surface Water		
Analytical Parameter	Copper, Lead (dissolved)		
Concentrations Level	Low to medium		
Sampling Procedure	SOP-1, SOP-2, SOP-3, SOP-5		
Analytical Method/SOP	SW6010 (Mitkem)		
Data Quality Indicators (DQIs)	**Measurement Performance Criteria**	**QC Sample and /or Other Activity Used to Assess Measurement Performance**	**QC Sample assesses Error for Sampling (s), Analytical (A) or both (S/A)**
Precision	≤25% RPD	Field/Lab Duplicates	S/A
Accuracy	80-120%	MS/MSD	A
Accuracy/bias, Contamination	80-120%		A
Sensitivity	See Table 6-1		
Data Completeness	Data collected are determined to be usable	≥90-95%	A

Table 7-16: Measurement Performance Criteria – Dissolved Copper (Lab: Microinorganics)

Medium/Matrix	Surface Water		
Analytical Parameter	Copper (dissolved)		
Concentrations Level	Low to medium		
Sampling Procedure	SOP-2, SOP-3		
Analytical Method/SOP	EPA 1637 / SOP-11		
Data Quality Indicators (DQIs)	**Measurement Performance Criteria**	**QC Sample and /or Other Activity Used to Assess Measurement Performance**	**QC Sample assesses Error for Sampling (s), Analytical (A) or both (S/A)**
Precision - overall	<20% RPD	Field Duplicates	S/A
Precision - Lab	<20% RPD	MS/MSD	A
Accuracy/bias	Recovery 51 - 145%	MS/MSD	A
Accuracy/bias	Recovery 51 - 145%	SRM or CRM	A
Sensitivity	Recovery 51 - 145%	LFB	S/A
Contamination	MDL – 1/3 AWQC	Field & Method Blanks	A
Data Completeness	Data collected are determined to be usable	≥90-95%	A

Table 7-17: Measurement Performance Criteria – Dissolved Lead (Lab: Microinorganics)

Medium/Matrix	Surface Water		
Analytical Parameter	Lead (dissolved)		
Concentrations Level	Low to medium		
Sampling Procedure	SOP-2, SOP-3		
Analytical Method/SOP	EPA 1637 / SOP-11		
Data Quality Indicators (DQIs)	**Measurement Performance Criteria**	**QC Sample and /or Other Activity Used to Assess Measurement Performance**	**QC Sample assesses Error for Sampling (s), Analytical (A) or both (S/A)**
Precision - overall	<20% RPD	Field Duplicates	S/A
Precision - Lab	<20% RPD	MS/MSD	A
Accuracy/bias	Recovery 60 - 120%	MS/MSD	A
Accuracy/bias	Recovery 60 - 120%	SRM or CRM	A
Sensitivity	Recovery 60 - 120%	LFB	S/A
Contamination	MDL – 1/3 AWQC	Field & Method Blanks	A
Data Completeness	Data collected are determined to be usable	$\geq$90-95%	A

Table 7-18: Measurement Performance Criteria - Hardness

Medium/Matrix	Surface Water		
Analytical Parameter	Hardness		
Concentrations Level	Low to medium		
Sampling Procedure	SOP-2, SOP-3, SOP-5		
Analytical Method/SOP	SM 2340B		
Data Quality Indicators (DQIs)	**Measurement Performance Criteria**	**QC Sample and /or Other Activity Used to Assess Measurement Performance**	**QC Sample assesses Error for Sampling (s), Analytical (A) or both (S/A)**
Precision	<20% RPD	Field/Lab Duplicates	S/A
Accuracy	NA		
Accuracy/bias, Contamination			
Sensitivity	See Table 6-1		
Data Completeness	Data collected are determined to be usable	$\geq$90-95%	A

Table 7-19: Measurement Performance Criteria – Metals in Sediment

Medium/Matrix	Sediment		
Analytical Parameter	Total Metals		
Concentrations Level	Low to medium		
Sampling Procedure	SOP-5		
Analytical Method/SOP	SW6010 (As,Cd,Cr,Cu,Ni,Pb) SW 7471 (Hg)		
Data Quality Indicators (DQIs)	**Measurement Performance Criteria**	**QC Sample and /or Other Activity Used to Assess Measurement Performance**	**QC Sample assesses Error for Sampling (s), Analytical (A) or both (S/A)**
Precision	< 20% RPD	Field/Lab Duplicates	S/A
Accuracy	80-120%	MS/MSD	A
Accuracy/bias, Contamination			
Sensitivity	See Table 6-1		
Data Completeness	Data collected are determined to be usable	≥90-95%	A

Table 7-20: Measurement Performance Criteria – Total Organic Carbon/Nitrogen in Sediment

Medium/Matrix	Sediment		
Analytical Parameter	Total Organic Carbon and Nitrogen		
Concentrations Level	Low to medium		
Sampling Procedure	SOP-5		
Analytical Method/SOP	SW8290		
Data Quality Indicators (DQIs)	**Measurement Performance Criteria**	**QC Sample and /or Other Activity Used to Assess Measurement Performance**	**QC Sample assesses Error for Sampling (s), Analytical (A) or both (S/A)**
Precision	≤20% RPD (field)	Field Duplicate	S
Accuracy	± 0.5%	Internal Standard	A
Accuracy/bias, Contamination	NA		
Sensitivity	See Table 6-1		
Data Completeness	Data collected are determined to be usable	≥90-95%	A

Table 7-21: Measurement Performance Criteria – Total Phosphorus in Sediment

Medium/Matrix	Sediment		
Analytical Parameter	Total Phosphorus		
Concentrations Level	Low to medium		
Sampling Procedure	SOP-5		
Analytical Method/SOP	High temperature combustion		
Data Quality Indicators (DQIs)	**Measurement Performance Criteria**	**QC Sample and /or Other Activity Used to Assess Measurement Performance**	**QC Sample assesses Error for Sampling (s), Analytical (A) or both (S/A)**
Precision	$\leq$ 20% RPD (field) $\leq$10% RPD (lab)	$\leq$ 20% RPD (field) $\leq$10% RPD (lab)	S/A
Accuracy	85% - 155%	Matrix Spike	A
Accuracy/bias, Contamination			
Sensitivity	See Table 6-1		
Data Completeness	Data collected are determined to be usable	$\geq$90-95%	A

8.0 SAMPLING PROCESS DESIGN

8.1 Sampling Design Rationale

The project contains several tasks. Each task with a field component has specific sampling frequencies. The frequency of sampling was determined during the preparation of the Work Plan (see Attachment A) and is based on data gaps identified in the existing data review (Berger, 2004).

8.2 Water Sampling

Water samples will be collected from rivers, tributaries, outfalls, Valley Falls Pond, and Scott Pond. Samples are designed to identify current concentrations at different weather conditions, assist in identifying sources, and allow the determination if regulatory water quality criteria are exceeded. The sampling frequency and interval varies considerably as discussed in the Work Plan. Table 8-1 summarizes the station locations and analysis methods; for the number of samples per analyte, please refer to Table 6-2 above. Duplicates samples will be collected at $\geq$10%.

Weather criteria for dry weather and wet weather are described in the Work Plan. Weather patterns will be monitored through the internet such as the following sites:

http://www.erh.noaa.gov/er/box/
http://www.weather.com/
http://www.intellicast.com

Dr. Ray Wright, the Task Manager for Dry Weather Sampling (Task 3) and Wet Weather Sampling (Task 4), will determine the sampling times and dates for each sampling event under both tasks.

Three (3) storms will be monitored for the Wet Weather Sampling. Establishing rainfall criteria is critical to the success of the monitoring program and the interpretation of the data. The basic objective is to isolate the effect of a discrete event to permit the characterization of runoff and the determination of the impact on receiving water quality. The following rainfall criteria are proposed for this field program:

- Minimum rainfall total of 0.5 inches
- Minimum rainfall duration of five (5) hours
- Minimum antecedent dry period (ADP) of three (3) days
- Minimum number of two (2) post-storm dry days.

These criteria are similar to those employed by the Narragansett Bay Commission and the Narragansett Bay Project in their recent efforts to quantify nonpoint source pollution to the Providence River and the recent work on the Blackstone River funded by USEPA and the U.S. Army Corps of Engineers. The rainfall amount of 0.5 inches is an assurance that there will be sufficient rainfall to cause a runoff event. The minimum duration of five (5) hours rules out short, high rainfall storms, like summer thunderstorms, and directs the storm collection to a more extensive storm system, which is somewhat easier to forecast and increases the probability of capturing a successful storm. It is necessary to have prestorm conditions (baseline) out of the influence of a previous storm or to be essentially steady-state. The selection of the three (3) day ADP assures for this although it is somewhat arbitrary. There can certainly be an argument developed for a longer ADP for larger dry weather buildup, but increasing this period can seriously reduce the number of storms which would be acceptable.

A dry day is defined as a day with rainfall totals no greater than 0.03 inches. This cutoff is also arbitrary in that it was based on the premise that this level of rainfall would result in minimal runoff. One could easily argue a higher or lower value, but setting the cutoff at zero (0) or trace amounts is far too restrictive and would again seriously reduce the number of acceptable storms.

The two (2) day post-storm criteria prevent back-to-back storms and avoid the problem associated with the separation of multiple storm signals in the data.

The success of the storm selection is often not known immediately since water quality data will take weeks to process and interpret. The strength of the storm signal relative to the baseline conditions is important if accurate interpretation of the wet weather contributions are to be made. Although storms with less than the minimum criteria may provide strong enough signals in the tributaries to be measured, the criteria is considered conservative and the storms selected should have a sufficient impact on the system preventing the collection and analysis of what might otherwise be useless data.

8.3 Sediment Sampling

Sediments will be sampled from Scott Pond and Valley Falls Pond. Samples will be collected by box corer (see SOP-6 in Attachment C). Sediment grain size is expected to be fine.

In Valley Falls Pond, three samples will be composited from the western (i.e., inner) part of the pond, and three samples will be composited from the eastern (i.e., outer) part of the pond. Compositing will be conducted by the laboratory.

In Scott Pond, a total of 6 samples will be collected and 3 samples will be analyzed. Two samples will be collected from the northern part of the pond composited into one sample. In addition, 2 samples will be collected from the northern half of the southern part of the pond and composited, and 2 samples will be collected from the southern half of the southern part of the pond and composited.

8.4 Macroalgae Analyses

Sediment samples collected will be sieved in the laboratory with 0.5 and 0.3 mm stacked sieves (see SOP-6 in Attachment C). The organic particles will be analyzed in the laboratory under a dissecting microscope to determine if the particles consist of wetland plants versus algae.

8.5 Phytoplankton Analyses

Phytoplankton will be collected in Valley Falls Pond in late summer to determine the biovolume and the trophic level of the water in the pond. The algal count will include phytoplankton and periphyton counts. Two samples will be collected, one from the western (inner) part of the pond (Station P-01), one from the central part of the pond (Station P-02). The biovolume will be determined. See SOP-7 in Attachment C for details.

Table 8-1: Sampling Locations, Sampling and Analysis Method/SOP Requirement

Station Loc.	Station Number	Matrix	Analytical Parameter	Conc. Level	Sampl. SOP	Anal. Method /SOP	Sample Vol.	Containers (number, size and type)	Preservation Requirements (chemical, temp., light protected)	Maximum Holding Time (preparation /analysis)
River, outfalls	W-01 to W-34	Surface water, Outfalls	Fecal Coliform Enterococci	Low to medium	SOP-1, 2, 3	SOP-12	100ml	2-specimen cup	none	6 hours
			Total Phosphorus	Low to medium	SOP-2 SOP-3	SOP-12	250 ml	1-250 ml Amber glass	H2SO4	7 days
			TKN, Ammonia	Low to medium	SOP-2 SOP-3	SOP-12	500ml	1-500 ml HDPE	H2SO4	28 days
			Nitrate	Low to high	SOP-2 SOP-3	SOP-12	500 ml	1-500 ml HDPE	Cool 2-6° C	48 hours/ 7 days
			Chlorophyll	Low to high	SOP-2	Acetone Extr. / SOP-10	1 liter	1 liter Nalgene dark/opaque	dark/opaque bottle	<24 h
			Total Susp. Solids	Low to high	SOP-2 SOP-3	SOP-9	1 Liter	1 Liter HDPE	4ºC	7 days
			Volatile Organic Solids	Low to high	SOP-2 SOP-3	SOP-9	1 Liter	1 Liter HDPE	4ºC	7 days
			Chloride	Low to high	SOP-2 SOP-3	SOP-9	100 ml	100 ml HDPE		28 days
			Dissolved Lead and Copper, Hardness *(Mitkem)*	Low to medium	SOP-1 SOP-2 SOP-3	SOP-12	500 ml	1- 500 ml HDPE	None	6 months
			Dissolved Lead and Copper *(Microinorganics)*	Low to medium	SOP-2 SOP-3	SOP-11	500 ml	LDPE, cleaned via SOP-11	4ºC	< 24h to filtration
Ponds	P-01 to P-11	Water column in ponds	Orthophosphate	Low to high	SOP-5	Molybdate/ Ascorbic Acid	60 ml	60 cc HDPE	4° C	<24 h
			Total Phosphorus	Low to high	SOP-5	Hot Acid Digestion	60 ml	60 cc HDPE	Acidify to pH <2	Indefinite
			Total Dissolved Nitrogen	Low to high	SOP-5	Persulfate, Cd Reduction	60 ml	60 cc HDPE	Frozen at -40° C	Indefinite
			Ammonia	Low to high	SOP-5	Phenol-hypochlorite	600 ml	60 cc HDPE	4° C	<24 h
			Nitrate	Low to high	SOP-5	Cd reduction	60 ml	60 cc HDPE	Frozen at -40° C	Indefinite
			Particulate Organic Nitrogen	Low to high	SOP-5	High Temp. Combustion	1 liter	1 liter Nalgene dark/opaque	<24 h	<24 h
			Fecal Coliform Enterococci	Low to medium	SOP-5	(Same as above for W-01 to W-34)				
			Chlorophyll	Low to high	SOP-5	(Same as above for W-01 to W-34)				
			Dissolved Lead & Copper, Hardness	Low to medium	SOP-5	(Same as above for W-01 to W-34)				

Station Loc.	Station Number	Matrix	Analytical Parameter	Conc. Level	Sampl. SOP	Anal. Method /SOP	Sample Vol.	Containers (number, size and type)	Preservation Requirements (chemical, temp., light protected)	Maximum Holding Time (preparation /analysis)
Sediment	P-01 & 02, P-07 to 09	Surface sedi- ment	Metals (As, Cs, Cr, Cu, Ni, Pb, Hg)	Low to medium	SOP-6	SOP-12	10 g	1- 4oz Amber wide-mouth	Cool to 2-6° C	28 days/6 months
			Total Organic Carbon and Nitrogen	Low to medium	SOP-6	High Temperature Combustion / SOP-10	100 g	100 ml HDPE	4º C	<24 h
			Total Organic Phosphorus	Low to medium	SOP-6	High Temperature Combustion / SOP-10	100 g	100 ml HDPE	4º C	<24 h
			Grain size	NA	SOP-6	Sieve Analysis / SOP-12	1 kg	1 liter container	None.	None

9.0 SAMPLING PROCEDURES AND REQUIREMENTS

9.1 Sampling Procedures

This section addresses water and sediment sampling. Standard Operating Procedures (SOPs) for field sampling are located in Attachment C of this report. A reference list of SOPs is provided in Table 9-1.

Water samples are collected either by placing the bottles directly into the water, by using a bucket (for samples collected from bridges), or by using a Niskin sampler (for deep pond samples). Sediment samples are collected by box corer.

9.2 Cleaning and Decontamination of Equipment/Sample Containers

Samplers: All sampler (water sampling bucket, Niskin sampler, box corer will be cleaned thoroughly prior to field work with brush and distilled water. In the field, each sampler will be rinsed twice at each station with in-situ water.

Bottles: The laboratory that performs the sample analyses will provide the appropriate sterile bottles for sample collection.

Table 9-1: Project Sampling SOP Reference Table

Ref. No.	Title	Originating Organization	Specific Equipment Identification	Modified for Project Work
SOP-1	Reconnaissance Monitoring	Berger	None	NA
SOP-2	Dry Weather Water Sampling	URI	By hand, bucket	NA
SOP-3	Wet Weather Water Sampling	URI	By hand, bucket	NA
SOP-5	Water Sampling in Valley Falls Pond and Scott Pond	Berger/ UMass	By hand, Niskin sampler	NA
SOP-6	Sediment Sampling in Valley Falls Pond and Scott Pond	Berger/ UMass	Box corer	NA
SOP-7	Phytoplankton Analysis in Valley Falls Pond	Berger	By hand	NA

9.3 Field Equipment Calibration and Maintenance

Calibration of samplers is not needed.

9.4 Inspection and Acceptance Requirements for Sample Containers

The Project Manager shall ensure that all sample containers are acceptable for use. Each respective laboratory shall provide sampling bottles as required. The Task Leader Ray Wright (Tasks 3 and 4; Dry and Wet Weather Sampling) and the Project Manager (all remaining tasks) are responsible for appropriately maintaining this bottle supply. A log shall be kept in the project notebook documenting receipt of each sample bottle. All certificates of cleanliness shall be retained in the project file.

10.0 SAMPLE HANDLING, TRACKING AND CUSTODY REQUIREMENTS

10.1 Sample Collection Documentation

10.1.1 Field Notes

The Task Leader for Tasks 3 and 4 (Dry and Wet Weather Sampling) shall maintain a three ring binder containing field sheets. Other field notes will be recorded in waterproof field notebooks in indelible ink. Aside from site descriptions and data entries, field notes shall include other site observations, changes in sampling locations, weather conditions, times of sampling, and names of staff. All entries shall have date and time of day (military time), entry time and exit times, GPS location for new stations, field staff, and site sketches as appropriate.

10.1.2 Field Documentation Management System

Photocopies of the field notebook entries will be made after each sampling event and provided to the Project Manager for the project file.

10.2 Sample Handling and Tracking System

Samples are tracked by station number and date. Each station has a unique number. For each station, two digits are to be used (e.g., Blackstone River water quality station 4 will be labeled "W-04"). Station numbers are identified in the Work Plan and in Figure 5-1 and 5-2.

Bottles are labeled on a label on the side of the container with permanent marker. In addition, the station location will be marked on the cap of the container. For stations with multiple samples in the water column (applies only to Scott Pond), the depth (in meter) is also provided (e.g., P-08 [7m]).

The label further contains the name of the analyte(s) to be analyzed from the container in the laboratory. The following is a list of the analytes and their abbreviations.

TP	Total phosphorus
PO4	Orthophosphate
Chloro	Chlorophyll a and Phaeopigment
NH4	Ammonia
NO3	Nitrate
TON	Total organic nitrogen
TKN	Total Kjeldahl nitrogen
TSS	Total suspended solids
FC	Fecal coliform
Ent	Enterococci
Diss Pb	Dissolved lead
Diss Cu	Dissolved copper
Hard	Hardness
Cl	Chloride

All samples will be taken according to the requirements outlined in the field sampling SOP for each analyte. The Field Team Leader or a designee shall deliver the samples to the appropriate laboratory for analysis. Copies of the chain-of-custody forms for each laboratory are included in Attachment D.

Table 10-1: Sample Handling System

Activity	Responsible Party	Samples
Sample Collection	URI	Dry and Wet Weather Samples from River, Tributaries, Outfalls (Tasks 3 and 4)
	Berger	All other samples
Sample Delivery	Berger or URI	
Sample Analysis	Mitkem, UMass, Microinorganics, URI	
Sample Archival	None	
Sample Disposal	Mitkem, UMass, Microinorganics, URI	

11.0 FIELD ANALYTICAL METHOD REQUIREMENTS

This section addresses in-situ measurements at sampling stations. During each water sampling event, the dissolved oxygen, pH, temperature, and conductivity will be analyzed in the field. In the Valley Falls Pond and Scott Pond, turbidity will also be determined. Field staff will record the sample location and all results of field measurements in the field notebook.

11.1 Field Analytical Methods and SOPs

Standard Operating Procedures (SOPs) for Field Analytical Methods are located in SOP-1 to 8 in Attachment C. A reference list of field SOPs, which include in-situ measurements, is provided in Table 11-1.

Table 11-1 Field Analytical Method/SOP Reference Table

Ref. No.	Title	Originating Organization	Analytical Parameter	Instrument	Modi-fied for Project Work
SOP-1	Reconnaissance Monitoring	Berger	Temperature, Conductivity Dissolved oxygen pH Flow Latitude, longitude	YSI-30 YSI-57 Oakton pH Testr Flow Probe, bucket GPS meter	NA
SOP-2	Dry Weather Water Sampling	URI	Temperature, Conductivity Dissolved oxygen Flow	YSI-33 YSI-57 Marsh McBirney Flo-Mate	NA
SOP-3	Wet Weather Water Sampling	URI	Temperature, Conductivity Dissolved oxygen Flow	YSI-33 YSI-57 Marsh McBirney Flo-Mate	NA
SOP-4	Biodiversity Impact: Artificial Substrate Sampling	Berger	Temperature, Conductivity Dissolved oxygen Turbidity Latitude, longitude	YSI-30 YSI-57 Oakton T-100 turbidity meter GPS meter	NA
SOP-5	Water Sampling in Valley Falls Pond and Scott Pond	Berger / UMass	Temperature, Conductivity Dissolved oxygen pH Turbidity Latitude, longitude	YSI-30 YSI-57 Oakton pH Testr Oakton T-100 turbidity meter GPS meter	NA
SOP-8	Calibration of Field Equipment Reconnaissance and Pond Surveys	Berger	Temperature, Conductivity Dissolved oxygen pH Turbidity Flow	YSI-30, YSI-33 YSI-57 Oakton pH Testr Oakton T-100 turbidity meter Marsh McBirney Flo-Mate	NA

11.2 Field Analytical Instrument Calibration

Procedures for the calibration of field equipment are provided in SOP-8. The Task Leader shall ensure that all field equipment is accurate. Calibration criteria are listed in Table 11-2. Calibration information will be recorded in field notebooks.

Table 11-2 Field Analytical Instrument Calibration

Equipment	Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action	SOP Ref.
YSI Model 30 YSI Model 33	See Owners Manual	Temperature: Once a year	+/- 0.1ºC	Record deviation	SOP-8
		Conductivity: Before/after each sampling season	+/- 1 uS/cm	Recalibrate	SOP-8
YSI Model 57	See Owners Manual	Dissolved Oxygen: Before and after each sampling event	+/- 0.1 mg/l	Recalibrate	SOP-8
Oakton pH Testr	See Owners Manual	pH: Before and after each sampling event	+/- 0.1 mg/l	Recalibrate	SOP-8
Oakton T-100	See Owners Manual	Turbidity: Before and after each sampling event	+/- 0.1 NTU	Recalibrate	SOP-8
Global Flow Probe	Factory-calibrated	NA	NA	NA	NA
Marsh McBirney	Factory calibrated	NA	NA	NA	NA
Garmin GPS unit	Compare with second unit	Prior to first sampling run, and once per year	+/- 10 m	Replace	
Secchi disc with calibrated weighted line	Check accuracy of line	Prior to first sampling run, and once a year	3 cm	Repair or replace	

11.3 Field Analytical Instrument/ Equipment Maintenance, Testing and Inspection Requirements

The field instrument will be calibrated regularly. Instruments will be replaced or recalibrated at the factory, as appropriate, if the calibration is off.

12.0 FIXED LABORATORY ANALYTICAL METHOD REQUIREMENTS

All samples shall be taken to the appropriate laboratory for analysis. These samples will be analyzed according to the attached SOPs from each of the laboratories (see SOP-9 to SOP-12 in Attachment C).

12.1 Fixed Laboratory Analytical Methods and Standard Operating Procedures

This section describes the analytical techniques that will be used by the laboratories (Mitkem, Microinorganics, UMass, URI).

Table 12-1: Fixed Laboratory Analytical Method/SOP Reference Table

Ref. No	Fixed Laboratory Performing Analysis	Title, Revision Date and/or Number	Definitive or Screening	Analytical Parameter	Method / Instrument	Modified for Work Project (Y or N)
Water Samples						
SOP-12	Mitkem (Subcontracted)		Definitive	Fecal Coliform	SM 9221E	N
SOP-12	Mitkem (Subcontracted)		Definitive	Enterococci	SM 9230C	N
SOP-12	Mitkem		Definitive	Total Phosphorus (river)	E365.2	N
SOP-12	Mitkem		Definitive	Total Kjeldahl Nitrogen, Ammonia (river)	SM 4500	N
SOP-12	Mitkem		Definitive	Nitrate (river)	E 300 / IC	N
SOP-10	UMass	Total Phosphorus/Total Dissolved Phosphorus by Digestion with Hot Sulfuric Acid/Nitric Acid, January 13, 2003	Definitive	Total Phosphorus (ponds)	Hot Acid Digestion: Standard Methods for the Examination of Water and Wastewater, 19th edition, 1995. Method 4500-P B. Molybdate ascorbic acid Standard Methods 19th Edition, Method 4500-P-E Murphy, J. and J. Riley. 1962. Analytica Chimica Acta 27:31-36.	N
SOP-10	UMass	Orthophosphate, January 13, 2003	Definitive	Orthophosphate (ponds)	Molybdate ascorbic acid Standard Methods 19th Edition, Method 4500-P-E Murphy, J. and J. Riley. 1962. Analytica Chimica Acta 27:31-36.	N
SOP – 10	UMass	Total Nitrogen/Total Dissolved Nitrogen, January 13, 2003	Definitive	Total Dissolved Nitrogen (ponds)	Persulfate digestion, Cd reduction Standard Methods 19th Edition, Method 4500-Norg-D D'Elia, C.F., P.A. Steudler and N. Corwin. 1977. Determination of total nitrogen in aqueous samples using persulfate digestion. Limnol. Oceanogr. 22:760-764. Standard Methods 19th Edition, Method 4500-NO3-F using Lachat Autoanalysis procedures based upon:	N

Ref. No	Fixed Laboratory Performing Analysis	Title, Revision Date and/or Number	Defini-tive or Screen-ing	Analytical Parameter	Method / Instrument	Modi-fied for Work Project (Y or N)
					Wood, E., F. Armstrong and F. Richards. 1967. J. Mar. Biol. Ass. U.K. 47:23-31. Bendschneider, K. and R. Robinson. 1952. J. Mar. Res. 11:87-96.	
SOP – 10	UMass	Particulate Organic Carbon and Nitrogen, January 13, 2003	Definitive	Particulate Organic Nitrogen	Perkin-Elmer Model 2400 CHN Analyzer Technical Manual.	N
SOP – 10	UMass	Ammonium, January 13, 2003	Definitive	Ammonia (ponds)	Phenol hypochloride Standard Methods 19th Edition, Method 4500-NH3-F and Schneider, D. 1976. Determination of ammonia and Kjeldahl nitrogen by indophenol method. Water Resources 10:31-36.	N
SOP – 10	UMass	Nitrate+Nitrite, January 13, 2003	Definitive	Nitrate (ponds)	Cd reduction Standard Methods 19th Edition, Method 4500-NO3-F using Lachat Autoanalysis procedures based upon: Wood, E., F. Armstrong and F. Richards. 1967. J. Mar. Biol. Ass. U.K. 47:23-31. Bendschneider, K. and R. Robinson. 1952. J. Mar. Res. 11:87-96.	N
SOP-10	UMass	Chlorophyll a	Definitive	Chlorophyll a	Acetone Extraction, Turner Auto Fluorometer Parsons, T.R., Y. Maita and C. Lalli. 1989. Manual of Chemical and Biological Methods for seawater analysis. Pergamon Press, 173 pp.	N
SOP-9	URI	Total Suspended Solids	Definitive	Total Suspended Solids	SM2540D	N
SOP-9	URI	Volatile Organic Solids	Definitive	Volatile Organic Solids	SM2540E	N
SOP-9	URI	Chloride	Definitive	Chloride	Ion Electrode	N
SOP-12	Mitkem		Definitive	Dissolved Copper and Lead	SW 6010/ICP (with preconcentration of sample by 50%)	N
SOP-11	Microinorganic s		Definitive	Dissolved Copper and Lead	EPA 1637	N
SOP-9	Mitkem		Definitive	Hardness	SM 2340B / Calculation from ICP Results	N
Sediments						
SOP-12	Mitkem		Definitive	Total Metals	SW 6010 /ICP	N
SOP-10	UMass	Particulate Organic Carbon and Nitrogen, January 13, 2003	Definitive	Total Organic Carbon, Nitrogen	High temperature combustion Perkin-Elmer Model 2400 CHN Analyzer Technical Manual.	N
SOP-10	UMass	Total Phosphorus/Total Dissolved Phosphorus by	Definitive	Total Organic Phosphorus	Hot Acid Digestion: Standard Methods for the	N

Ref. No	Fixed Laboratory Performing Analysis	Title, Revision Date and/or Number	Defini-tive or Screen-ing	Analytical Parameter	Method / Instrument	Modi-fied for Work Project (Y or N)
		Digestion with Hot Sulfuric Acid/Nitric Acid, January 13, 2003			Examination of Water and Wastewater, 19th edition, 1995. Method 4500-P B. Molybdate ascorbic acid Standard Methods 19th Edition, Method 4500-P-E Murphy, J. and J. Riley. 1962. Analytica Chimica Acta 27:31-36.	
	Mitkem		Definitive	Grain Size	Sieve analysis	N
Biological Samples						
SOP-4	Berger	NA	Definitive	Macroinvertebrate Analysis	See SOP-4	N
SOP-6	Berger	NA	Definitive	Macroalgae	See SOP-6	N
SOP-7	Berger	NA	Definitive	Phytoplankton	See SOP-7	N

13.0 QUALITY CONTROL REQUIREMENTS

13.1 Sampling Quality Control

Field duplicates will be collected during each sampling event. As a minimum, one duplicate will be collected for each batch of 10 samples.

Samples will be stored in a cooler after sampling containing ice. The ice will be placed in zip-lock bags. Bags will be taped. A temperature blank will be placed in each cooler.

13.2 Analytical Quality Control

Laboratory control requirements are presented in Tables 13-1 to 13-21.

Table 13-1: Fixed Laboratory Analytical QC - Bacteria

Medium / Matrix	Surface Water
Sampling SOP	SOP-2, SOP-3, SOP-5
Analytical Parameter	Fecal Coliform Enterococci
Concentration Level	Low to medium
Analytical SOP	SOP –12
Laboratory	Mitkem

Laboratory QC	Frequency / Number	Method/SOP QC Acceptance Limits	Corrective Action (CA)	Person (s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Method Blank	1 per batch	Non-detect	Reanalyze batch	Analytical Supervisor	Contamination	Non-detect
Reagent Blank	NA					
Storage Blank	Na					
Instrument Blank	NA					
Laboratory Duplicate	1 per batch	Exceedence by 2 orders of magnitude	Reanalyze batch	Analytical Supervisor	Precision	Exceed. by 2 orders of magnitude
Laboratory Matrix Spike	NA					
Matrix Duplicate Spikes	NA					
LCS	NA					
LFB	NA					
Surrogates	NA					
Internal Standards (ISs)	NA					

Table 13-2: Fixed Laboratory Analytical QC - Total Phosphorous (river)

Medium / Matrix	Surface Water
Sampling SOP	SOP-2, SOP-3
Analytical Parameter	Total Phosphorous
Concentration Level	Low to high
Analytical SOP	SOP-12
Laboratory	Mitkem

Laboratory QC	Frequency / Number	Method/SOP QC Acceptance Limits	Corrective Action (CA)	Person (s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Method Blank	1 per batch	TA≤QL	Reanalyze batch	Analytical Supervisor	Accuracy/Bias-Contamination	TA ≤ QL
Reagent Blank	NA	NA	NA	NA	NA	NA
Storage Blank	NA	NA	NA	NA	NA	NA
Instrument Blank	NA	NA	NA	NA	NA	NA
Laboratory Duplicate	1 per batch	RPD < 20	Qualify Data	Supervisor	Precision	RPD < 20
Laboratory Matrix Spike	1 per batch	75-125%	Qualify Data	Supervisor	Accuracy	75-125%
Matrix Duplicate Spikes	NA	NA	NA	NA	NA	NA
LCS	1 per batch	80-120%	Reprep./Reanalyze	Supervisor	Accuracy	80-120%
LFB	NA	NA	NA	NA	NA	NA
Surrogates	NA	NA	NA	NA	NA	NA
Internal Standards (ISs)	NA	NA	NA	NA	NA	NA

Table 13-3: Fixed Laboratory Analytical QC - Total Kjeldahl Nitrogen, Ammonia (river)

Medium / Matrix	Surface Water
Sampling SOP	SOP-2, SOP-3
Analytical Parameter	Total Kjeldahl Nitrogen, Ammonia
Concentration Level	Low to high
Analytical SOP	SOP-12
Laboratory	Mitkem

Laboratory QC	Frequency / Number	Method/SOP QC Acceptance Limits	Corrective Action (CA)	Person (s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Method Blank	1 per batch	$TA \leq QL$	Reanalyze batch	Analytical Supervisor	Accuracy/Bais-Contamination	$TA \leq QL$
Reagent Blank	NA	NA	NA	NA	NA	NA
Storage Blank	NA	NA	NA	NA	NA	NA
Instrument Blank	NA	NA	NA	NA	NA	NA
Laboratory Duplicate	1 per batch	RPD < 20	Qualify Data	Supervisor	Precision	RPD < 20
Laboratory Matrix Spike	1 per batch	75-125%	Qualify Data	Supervisor	Accuracy	75-125%
Matrix Duplicate Spikes	NA	NA	NA	NA	NA	NA
LCS	1 per batch	80-120%	Reprep./Reanalyze	Supervisor	Accuracy	80-120%
LFB	NA	NA	NA	NA	NA	NA
Surrogates	NA	NA	NA	NA	NA	NA
Internal Standards (ISs)	NA	NA	NA	NA	NA	NA

Table 13-4: Fixed Laboratory Analytical QC - Nitrate (river)

Medium / Matrix	Surface Water
Sampling SOP	SOP-2, SOP-3
Analytical Parameter	Nitrate
Concentration Level	Low to high
Analytical SOP	SOP-12
Laboratory	Mitkem

Laboratory QC	Frequency / Number	Method/SOP QC Acceptance Limits	Corrective Action (CA)	Person (s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Method Blank	1 per batch	TA≤QL	Reanalyze batch	Analytical Supervisor	Accuracy/Bais-Contamination	TA ≤ QL
Reagent Blank	NA	NA	NA	NA	NA	NA
Storage Blank	NA	NA	NA	NA	NA	NA
Instrument Blank	NA	NA	NA	NA	NA	NA
Laboratory Duplicate	1 per batch	RPD < 20	Qualify Data	Supervisor	Precision	RPD < 20
Laboratory Matrix Spike	1 per batch	75-125%	Qualify Data	Supervisor	Accuracy	75-125%
Matrix Duplicate Spikes	NA	NA	NA	NA	NA	NA
LCS	1 per batch	80-120%	Reprep./Reanalyze	Supervisor	Accuracy	80-120%
LFB	NA	NA	NA	NA	NA	NA
Surrogates	NA	NA	NA	NA	NA	NA
Internal Standards (ISs)	NA	NA	NA	NA	NA	NA

Table 13-5: Fixed Laboratory Analytical QC - Total Phosphorous (ponds)

Medium / Matrix	Surface Water
Sampling SOP	SOP-5
Analytical Parameter	Total Phosphorous
Concentration Level	Low to high
Analytical SOP	SOP-10
Laboratory	UMass

Laboratory QC	Frequency / Number	Method/SOP QC Acceptance Limits	Corrective Action (CA)	Person (s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Method Blank	NA					
Reagent Blank	5%	≤ 10X lowest sample concentration	Re-Run	Laboratory Manager	Accuracy/ contamination	
Storage Blank	NA					
Instrument Blank	NA					
Laboratory Duplicate	5%	10%RPD	Re-Run	Laboratory Manager	Precision	
Laboratory Matrix Spike	5/sample set	80% - 120% Recovery	Re-Run	Laboratory Manager	Accuracy/ contamination	
Matrix Duplicate Spikes	3/sample set	80% - 120% Recovery	Re-Run	Laboratory Manager	Accuracy/ contamination	
LCS	NA					
LFB	NA					
Surrogates	NA					
Internal Standards (ISs)	NA					

Table 13-6: Fixed Laboratory Analytical QC - Orthophosphate (ponds)

Medium / Matrix	Surface Water
Sampling SOP	SOP-5
Analytical Parameter	Orthophosphate
Concentration Level	Low to high
Analytical SOP	SOP-10
Laboratory	UMass

Laboratory QC	Frequency / Number	Method/SOP QC Acceptance Limits	Corrective Action (CA)	Person (s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Method Blank	NA					
Reagent Blank	5%	≤ 10X lowest sample concentration	Re-Run	Laboratory Manager	Accuracy/ contamination	
Storage Blank	NA					
Instrument Blank	NA					
Laboratory Duplicate	5%	10%RPD	Re-Run	Laboratory Manager	Precision	
Laboratory Matrix Spike	5/sample set	80% - 120% Recovery	Re-Run	Laboratory Manager	Accuracy/ contamination	
Matrix Duplicate Spikes	3/sample set	80% - 120% Recovery	Re-Run	Laboratory Manager	Accuracy/ contamination	
LCS	NA					
LFB	NA					
Surrogates	NA					
Internal Standards (ISs)	NA					

Table 13-7: Fixed Laboratory Analytical QC - Total Dissolved Nitrogen (ponds)

Medium / Matrix	Surface Water
Sampling SOP	SOP-5
Analytical Parameter	Total Dissolved Nitrogen
Concentration Level	Low to high
Analytical SOP	SOP-10
Laboratory	UMass

Laboratory QC	Frequency / Number	Method/SOP QC Acceptance Limits	Corrective Action (CA)	Person (s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Method Blank	NA					
Reagent Blank	5%	≤ 10X lowest sample concentration	Re-Run	Laboratory Manager	Accuracy/ contamination	
Storage Blank	NA					
Instrument Blank	NA					
Laboratory Duplicate	5%	10%RPD	Re-Run	Laboratory Manager	Precision	
Laboratory Matrix Spike	5/sample set	80% - 120% Recovery	Re-Run	Laboratory Manager	Accuracy/ contamination	
Matrix Duplicate Spikes	3/sample set	80% - 120% Recovery	Re-Run	Laboratory Manager	Accuracy/ contamination	
LCS	NA					
LFB	NA					
Surrogates	NA					
Internal Standards (ISs)	NA					

Table 13-8: Fixed Laboratory Analytical QC Particulate Organic Nitrogen (ponds)

Medium / Matrix	Surface Water
Sampling SOP	SOP-5
Analytical Parameter	Particulate Organic Nitrogen
Concentration Level	Low to high
Analytical SOP	SOP-10
Laboratory	UMass

Laboratory QC	Frequency / Number	Method/SOP QC Acceptance Limits	Corrective Action (CA)	Person (s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Method Blank	NA					
Reagent Blank	NA					
Storage Blank	NA					
Instrument Blank	1 per 8 samples	± 100 counts	Re-calibrate machine	Technician	Accuracy/ contamination	
Laboratory Duplicate	NA					
Laboratory Matrix Spike	NA					
Matrix Duplicate Spikes	NA					
LCS	NA					
LFB	NA					
Surrogates	NA					
Internal Standards (ISs)	1 per 8 samples	± 0.5%	Re-calibrate machine	Technician	Accuracy/ contamination	

Table 13-9: Fixed Laboratory Analytical QC - Ammonium (ponds)

Medium / Matrix	Surface Water
Sampling SOP	SOP-5
Analytical Parameter	Ammonium
Concentration Level	Low to high
Analytical SOP	SOP-10
Laboratory	UMass

Laboratory QC	Frequency / Number	Method/SOP QC Acceptance Limits	Corrective Action (CA)	Person (s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Method Blank	NA					
Reagent Blank	5%	≤ 10X lowest sample concentration	Re-Run	Laboratory Manager	Accuracy/ contamination	
Storage Blank	NA					
Instrument Blank	NA					
Laboratory Duplicate	5%	10%RPD	Re-Run	Laboratory Manager	Precision	
Laboratory Matrix Spike	5/sample set	80% - 120% Recovery	Re-Run	Laboratory Manager	Accuracy/ contamination	
Matrix Duplicate Spikes	3/sample set	80% - 120% Recovery	Re-Run	Laboratory Manager	Accuracy/ contamination	
LCS	NA					
LFB	NA					
Surrogates	NA					
Internal Standards (ISs)	NA					

Table 13-10: Fixed Laboratory Analytical QC - Nitrate (ponds)

Medium / Matrix	Surface Water
Sampling SOP	SOP-5
Analytical Parameter	Nitrate
Concentration Level	Low to high
Analytical SOP	SOP-10
Laboratory	UMass

Laboratory QC	Frequency / Number	Method/SOP QC Acceptance Limits	Corrective Action (CA)	Person (s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Method Blank	NA					
Reagent Blank	2 per sample set	≤ 10X lowest sample concentration	Re-Run	Laboratory Manager	Accuracy/ contamination	
Storage Blank	NA					
Instrument Blank	NA					
Laboratory Duplicate	1 per 5 samples	10%RPD	Re-Run	Laboratory Manager	Precision	
Laboratory Matrix Spike	1 per 9 samples	80% - 120% Recovery	Re-Run	Laboratory Manager	Accuracy/ contamination	
Matrix Duplicate Spikes	3/sample set	80% - 120% Recovery	Re-Run	Laboratory Manager	Accuracy/ contamination	
LCS	NA					
LFB	NA					
Surrogates	NA					
Internal Standards (ISs)	1 per 6 samples	90% - 110% of expected value	Re-Run	Laboratory Manager	Accuracy/ contamination	

Table 13-11: Fixed Laboratory Analytical QC - Chlorophyll / Phaeopigment

Medium / Matrix	Surface Water
Sampling SOP	SOP-2, SOP-5
Analytical Parameter	Chlorophyll *a* / Phaeophytin *a*
Concentration Level	Low to high
Analytical SOP	SOP-10
Laboratory	UMass

Laboratory QC	Frequency / Number	Method/SOP QC Acceptance Limits	Corrective Action (CA)	Person (s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Method Blank	NA					
Reagent Blank	5%	≤ 10X lowest sample concentration	Re-Run	Laboratory Manager	Accuracy/ contamination	
Storage Blank	NA					
Instrument Blank	NA					
Laboratory Duplicate	5%	10%RPD	Re-Run	Laboratory Manager	Precision	
Laboratory Matrix Spike	NA					
Matrix Duplicate Spikes	NA					
LCS	NA					
LFB	NA					
Surrogates	NA					
Internal Standards (ISs)	5 per sample set	80% - 120% Recovery	Re-Run	Laboratory Manager	Accuracy/ contamination	

Table 13-12: Fixed Laboratory Analytical QC - Total Suspended Solids

Medium / Matrix	Surface Water
Sampling SOP	SOP-2, SOP-3
Analytical Parameter	Total Suspended Solids
Concentration Level	Low to medium
Analytical SOP	SOP-9
Laboratory	URI

Laboratory QC	Frequency / Number	Method/SOP QC Acceptance Limits	Corrective Action (CA)	Person (s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Method Blank	NA					
Reagent Blank	NA					
Storage Blank	NA					
Instrument Blank	NA					
Laboratory Duplicate	1 per batch	Less than 20% RPD	Re-analyze	Lab Manager	Precision	NA
Laboratory Matrix Spike	NA					
Matrix Duplicate Spikes	NA					
LCS	NA					
LFB	NA					
Surrogates	NA					
Internal Standards (ISs)	NA					

Table 13-13: Fixed Laboratory Analytical QC - Volatile Suspended Solids

Medium / Matrix	Surface Water
Sampling SOP	SOP-2, SOP-3
Analytical Parameter	Volatile Suspended Solids
Concentration Level	Low to medium
Analytical SOP	SOP-9
Laboratory	URI

Laboratory QC	Frequency / Number	Method/SOP QC Acceptance Limits	Corrective Action (CA)	Person (s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Method Blank	1 per batch	MDL		Lab Manager	Contamination	
Reagent Blank	NA					
Storage Blank	NA					
Instrument Blank	NA					
Laboratory Duplicate	5%	20% RPD	Re-analyze	Lab Manager	Precision	
Laboratory Matrix Spike	1 per 10 samples	Recovery 80-120%	Re-analyze	Lab Manager	Accuracy	
Matrix Duplicate Spikes	NA					
LCS	NA					
LFB	NA					
Surrogates	NA					
Internal Standards (ISs)	NA					

Table 13-14: Fixed Laboratory Analytical QC - Chloride

Medium / Matrix	Surface Water
Sampling SOP	SOP-2, SOP-3
Analytical Parameter	Choride
Concentration Level	Low to medium
Analytical SOP	SOP-9
Laboratory	URI

Laboratory QC	Frequency / Number	Method/SOP QC Acceptance Limits	Corrective Action (CA)	Person (s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Method Blank	1 per batch	MDL		Lab Manager	Contamination	
Reagent Blank	NA					
Storage Blank	NA					
Instrument Blank	NA					
Laboratory Duplicate	1 per batch	Less than 20% RPD	Re-analyze	Lab Manager	Precision	NA
Laboratory Matrix Spike	NA					
Matrix Duplicate Spikes	NA					
LCS	NA					
LFB	NA					
Surrogates	NA					
Internal Standards (ISs)	NA					

Table 13-15: Fixed Laboratory Analytical QC - Dissolved Copper and Lead (Lab: Mitkem)

Medium / Matrix	Surface Water
Sampling SOP	SOP-2, SOP-3
Analytical Parameter	Dissolved Copper and Lead
Concentration Level	Low to medium
Analytical SOP	SOP-12
Laboratory	Mitkem

Laboratory QC	Frequency / Number	Method/SOP QC Acceptance Limits	Corrective Action (CA)	Person (s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Method Blank	1 per batch	TA≤QL	Reanalyze batch	Analytical Supervisor	Accuracy/Bais-Contamination	TA ≤ QL
Reagent Blank	NA	NA	NA	NA	NA	NA
Storage Blank	NA	NA	NA	NA	NA	NA
Instrument Blank	NA	NA	NA	NA	NA	NA
Laboratory Duplicate	1 per batch	RPD < 20	Qualify Data	Supervisor	Precision	RPD < 20
Laboratory Matrix Spike	1 per batch	75-125%	Qualify Data	Supervisor	Accuracy	75-125%
Matrix Duplicate Spikes	NA	NA	NA	NA	NA	NA
LCS	1 per batch	Per manufacturer's certified ranges	Reprep./Reanalyze	Supervisor	Accuracy	Per manufacturer's certified ranges
LFB	1 per batch	60-140%	Reprep./Reanalyze	Supervisor	Accuracy	60-140%
Surrogates	NA	NA	NA	NA	NA	NA
Internal Standards (ISs)	NA	NA	NA	NA	NA	NA

Table 13-16: Fixed Laboratory Analytical QC - Dissolved Copper (Lab: Microinorganics)

Medium / Matrix	Surface Water
Sampling SOP	SOP–2, SOP-3
Analytical Parameter	Dissolved Copper
Concentration Level	Low to medium
Analytical SOP	SOP-11
Laboratory	Microinorganics

Laboratory QC	Frequency / Number	Method/SOP QC Acceptance Limits	Corrective Action (CA)	Person (s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Method Blank	1 per 10 samples	MDL 1/3 AWQC	Re-prep Batch	Lab Manager	Contamination	Per method 1638
Reagent Blank	1 per batch		Reanalyze	Lab Manager	Contamination	Per method 1638
Storage Blank						Per method 1638
Instrument Blank	1 per batch		Reanalyze	Lab Manager	Contamination	Per method 1638
Laboratory Duplicate	1 per 10 samples	<20%RPD	Re-prep Batch	Lab Manager	Precision	Per method 1638
Laboratory Matrix Spike	1 per 10 samples	Recovery 51-145%	Re-prep Batch	Lab Manager	Precision	Per method 1638
Matrix Duplicate Spikes	1 per 10 samples	Recovery 51-145%	Re-prep Batch	Lab Manager	Precision	Per method 1638
LCS	1 per 10 samples	Recovery 51-145%	Re-prep Batch	Lab Manager	Accuracy/bias	Per method 1638
LFB	1 per 10 samples	Recovery 51-145%	Re-prep Batch	Lab Manager	Sensitivity	Per method 1638
Surrogates						
Internal Standards (ISs)						

Table 13-17: Fixed Laboratory Analytical QC - Dissolved Lead (Lab: Microinorganics)

Medium / Matrix	Surface Water
Sampling SOP	SOP–2, SOP-3
Analytical Parameter	Dissolved Lead
Concentration Level	Low to medium
Analytical SOP	SOP-11
Laboratory	Microinorganics

Laboratory QC	Frequency / Number	Method/SOP QC Acceptance Limits	Corrective Action (CA)	Person (s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Method Blank	1 per 10 samples	MDL 1/3 AWQC	Re-prep Batch	Lab Manager	Contamination	Per method 1637
Reagent Blank	1 per batch		Reanalyze	Lab Manager	Contamination	Per method 1637
Storage Blank						Per method 1637
Instrument Blank	1 per batch		Reanalyze	Lab Manager	Contamination	Per method 1637
Laboratory Duplicate	1 per 10 samples	<20%RPD	Re-prep Batch	Lab Manager	Precision	Per method 1637
Laboratory Matrix Spike	1 per 10 samples	Recovery 60-120%	Re-prep Batch	Lab Manager	Precision	Per method 1637
Matrix Duplicate Spikes	1 per 10 samples	Recovery 60-120%	Re-prep Batch	Lab Manager	Precision	Per method 1637
LCS	1 per 10 samples	Recovery 60-120%	Re-prep Batch	Lab Manager	Accuracy/bias	Per method 1637
LFB	1 per 10 samples	Recovery 60-120%	Re-prep Batch	Lab Manager	Sensitivity	Per method 1637
Surrogates						
Internal Standards (ISs)						

Table 13-18: Fixed Laboratory Analytical QC - Hardness

Medium / Matrix	Surface Water
Sampling SOP	SOP-2, SOP-3
Analytical Parameter	Hardness
Concentration Level	Low to medium
Analytical SOP	SOP-12
Laboratory	Mitkem

Laboratory QC	Frequency / Number	Method/SOP QC Acceptance Limits	Corrective Action (CA)	Person (s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Method Blank	1 per batch	TA≤QL	Reanalyze batch	Analytical Supervisor	Accuracy/Bais-Contamination	TA ≤ QL
Reagent Blank	NA	NA	NA	NA	NA	NA
Storage Blank	NA	NA	NA	NA	NA	NA
Instrument Blank	NA	NA	NA	NA	NA	NA
Laboratory Duplicate	1 per batch	RPD < 20	Qualify Data	Supervisor	Precision	RPD < 20
Laboratory Matrix Spike	1 per batch	75-125%	Qualify Data	Supervisor	Accuracy	75-125%
Matrix Duplicate Spikes	NA	NA	NA	NA	NA	NA
LCS	1 per batch	Per manufacturer's certified ranges	Reprep./Reanalyze	Supervisor	Accuracy	Per manufacturer's certified ranges
LFB	1 per batch	60-140%	Reprep./Reanalyze	Supervisor	Accuracy	60-140%
Surrogates	NA	NA	NA	NA	NA	NA
Internal Standards (ISs)	NA	NA	NA	NA	NA	NA

Table 13-19: Fixed Laboratory Analytical QC - Metals in Sediment

Medium / Matrix	Surface Water
Sampling SOP	SOP-5
Analytical Parameter	As, Cd, Cr, Cu, Ni, Pb, Hg
Concentration Level	Low to medium
Analytical SOP	SOP-12
Laboratory	Mitkem

Laboratory QC	**Frequency / Number**	**Method/SOP QC Acceptance Limits**	**Corrective Action (CA)**	**Person (s) Responsible for Corrective Action**	**Data Quality Indicator (DQI)**	**Measurement Performance Criteria**
Method Blank	1 per batch	TA≤QL	Reanalyze batch	Analytical Supervisor	Accuracy/Bais-Contamination	TA ≤ QL
Reagent Blank	NA	NA	NA	NA	NA	NA
Storage Blank	NA	NA	NA	NA	NA	NA
Instrument Blank	NA	NA	NA	NA	NA	NA
Laboratory Duplicate	1 per batch	RPD < 20	Qualify Data	Supervisor	Precision	RPD < 20
Laboratory Matrix Spike	1 per batch	75-125%	Qualify Data	Supervisor	Accuracy	75-125%
Matrix Duplicate Spikes	NA	NA	NA	NA	NA	NA
LCS	1 per batch	Per manufacturer's certified ranges	Reprep./Reanalyze	Supervisor	Accuracy	Per manufacturer's certified ranges
LFB	1 per batch	60-140%	Reprep./Reanalyze	Supervisor	Accuracy	60-140%
Surrogates	NA	NA	NA	NA	NA	NA
Internal Standards (ISs)	NA	NA	NA	NA	NA	NA

Table 13-20: Fixed Laboratory Analytical QC - Total Organic Carbon and Nitrogen in Sediment

Medium / Matrix	Sediments
Sampling SOP	SOP-5
Analytical Parameter	Total Organic Carbon and Nitrogen
Concentration Level	Low to high
Analytical SOP	SOP-10
Laboratory	UMass

Laboratory QC	Frequency / Number	Method/SOP QC Acceptance Limits	Corrective Action (CA)	Person (s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Method Blank	NA					
Reagent Blank	NA					
Storage Blank	NA					
Instrument Blank	1 per 8 samples	± 100 counts	Re-calibrate machine	Technician	Accuracy/ contamination	
Laboratory Duplicate	NA					
Laboratory Matrix Spike	NA					
Matrix Duplicate Spikes	NA					
LCS	NA					
LFB	NA					
Surrogates	NA					
Internal Standards (ISs)	1 per 8 samples	± 0.5%	Re-calibrate machine	Technician	Accuracy/ contamination	

Table 13-21: Fixed Laboratory Analytical QC - Total Phosphorous in Sediment

Medium / Matrix	Sediments
Sampling SOP	SOP-5
Analytical Parameter	Total Phosphorous
Concentration Level	Low to high
Analytical SOP	SOP-10
Laboratory	UMass

Laboratory QC	Frequency / Number	Method/SOP QC Acceptance Limits	Corrective Action (CA)	Person (s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Method Blank	NA					
Reagent Blank	5%	≤ 10X lowest sample concentration	Re-Run	Laboratory Manager	Accuracy/ contamination	
Storage Blank	NA					
Instrument Blank	NA					
Laboratory Duplicate	5%	10%RPD	Re-Run	Laboratory Manager	Precision	
Laboratory Matrix Spike	5/sample set	80% - 120% Recovery	Re-Run	Laboratory Manager	Accuracy/ contamination	
Matrix Duplicate Spikes	3/sample set	80% - 120% Recovery	Re-Run	Laboratory Manager	Accuracy/ contamination	
LCS	NA					
LFB	NA					
Surrogates	NA					
Internal Standards (ISs)	NA					

14.0 DATA ACQUISITION REQUIREMENTS

An extensive historic data review was conducted and presented in Berger (2004). This report addressed the impairments to this waterbodies in the project area. Findings of the data synthesis were used to make decisions regarding the planned sampling and analysis effort presented in this QAPP.

Other information that will be obtained from secondary sources as tools for analyzing the watershed is listed in Table 14-1.

Table 14-1: Non-Direct Measurements Criteria and Limitations

Non-Direct Measurement (Secondary Data)	Data Source	Data Generator	How Data Will Be Used	Limitations on Data Use
Rainfall	www.weather.com www.erh.noaa.gov/er/box/	Weather Channel NOAA	Assess rainfall pattern	None
Wastewater Effluent Loading	Veolia Water NA/Woonsocket	Veolia Water NA/Woonsocket	Determine loading of effluent to river	None
River Flow	US Geological Survey, Providence	Various gaging stations	Flow determination	None

15.0 DOCUMENTATION, RECORDS, AND DATA MANAGEMENT

Field notebooks including field logsheets will be kept by Task Manager Dr. Ray Wright (for Tasks 3 and 4; Dry and Wet Weather Sampling) and the Project Manager Dr. Hay (for all other tasks). After each sampling event, Dr. Wright will provide copies of the data sheets and field notes to the Project Manager for the project file.

The monitoring plan, as detailed within this QAPP, shall be adhered to while sampling. The Project Manager shall review and consult with the Project Quality Control Officer following each sampling event in order to identify any possible errors or omissions.

The field team leader for a specific sampling event, assigned by Dr. Hay or by Dr. Wright (Tasks 3 and 4), shall complete the chain-of-custody forms for each sampling event. The samples and chain-of-custody forms shall also be rechecked upon delivery of the samples to the laboratory. A copy of the chain-of-custody form will be provided to the Project Manager after each sampling event. This copy will be retained in the project file. After analysis is complete, sample results from the laboratory will be mailed to the Project Manager. A copy of the results will be mailed to the Project Officer at RIDEM, Lucinda Hannus.

Status Reports will be provided at the end of Year 2004 and Year 2005, as well as after each wet weather sampling event. Data Reports will be prepared. The status reports will document changes made to the monitoring plan. Data Reports will be prepared after completion of specific tasks. All information collected throughout the project will be summarized in the Final Report. Table 15-1 summarizes the records that will be generated throughout this project.

The Project Manager is responsible for maintaining a project file, and storage of all sampling data. All original documents or legible copies of original documents, including the field notebooks, shall be maintained in this file.

Table 15-1: Project Documentation and Records

Sample Collection Records	Field Analysis Records	Fixed Laboratory Records	Data Assessment Records
Field Notes / Log Sheets	Field Notes / Log Sheets	Chain-of-Custody Records	Status Reports
Chain-of-Custody Records		Tabulated Data Summary Forms: Draft and Final	Data Reports
Monitoring Plan			Final Report

16.0 ASSESSMENTS AND RESPONSE ACTIONS

The Project Manager shall be responsible for each of the project tasks and their associated quality assurance and quality control procedures. The Project Manager will provide consistency between sampling events. Continuous reports to the Project Quality Assurance Officer concerning the status of the project, sampling, quality assurance and quality control will highlight any problems that are encountered during sampling. Laboratory data will be periodically assessed to ensure that the collected data is usable for the purposes of this project. Laboratory results will be reviewed to verify that values are within the acceptable range of each parameter. Outlier data will be reported in the final report and potential sources of error will be described. If needed, the QA Officer and the Project Manager will halt sampling until problems are remedied.

Table 16-1: Project Assessment

Assessment Type	Frequency	Internal or External	Person Responsible for Performing Assessment and Implementing Corrective Actions	Person Responsible for Monitoring the Effectiveness of the Corrective Action
Field Team Audit (Task 3)	Start of Sampling	I	Ray Wright URI	Bernward Hay BERGER
Field Team Audit (Task 4)	Prior to first storm	I	Ray Wright URI	Bernward Hay BERGER
Field Team Audit (other tasks)	Start of Sampling	I	Bernward Hay BERGER	Bernward Hay BERGER

17.0 QA MANAGEMENT REPORTS

Table 17-1 lists the QA Management Reports that will be generated throughout this study.

As needed during the project, the Project Manager and the QA Officer will meet to discuss any issues related to sampling. These meetings will be verbal status reports. Problems encountered in the field will be discussed and any appropriate actions determined and implemented. Any changes and/or problems will be included in the final report.

After the stormwater surveys, the Project Manager will generate a Status Report. This Status Report will be the written record of any changes to the QAPP. If stations are changed it will be documented here. Issues discussed during the verbal status report can also be included.

Upon completion of the sampling the Project Manager will write a final report summarizing the sampling events. Information in this final report will include the following information:

- Brief description of each sampling event.
- Data tables of all data collected during each sampling event.
- Attachments
  - Status Reports
  - Sampling Logs
  - Chain-of-Custody Forms
  - Laboratory data sheets provided by the labs

Table 17-1: QA Management Reports

Type of Report	**Frequency**	**Person(s) Responsible for Report Preparation**	**Report Recipient**
Verbal Status Report	As needed	Bernward Hay BERGER	Lucinda Hannus RIDEM
Written Status Report	At the end of years 2004 and 2005, and after each storm sampling events	Bernward Hay BERGER	Lucinda Hannus RIDEM
Final Report	End of Project	Bernward Hay BERGER	Lucinda Hannus RIDEM

18.0 VERIFICATION AND VALIDATION REQUIREMENTS

The Task Manager for Tasks 3 and 4, as well as the Project Manager and the Project QA Officer will review data collected during this study to determine if the data meet QAPP objectives. Decisions to qualify or reject data will be made by the Project Manager and QA Officer. All accepted data collected will be included in the Final Report. To ensure correct interpretation of the data, all problems encountered in the field will be included in the Appendix to the Final Report and discussed in the general text of the report. Problems will also be documented in written Status Reports or included in the Field Notebook. To assist in data interpretation, statistical information on sampling events, including sampling size, and sample mean, minimum and maximum, will be reported, where applicable. A discussion on duplicate precision and accuracy criteria and results will also be discussed in the Final Report.

19.0 VERIFICATION AND VALIDATION PROCEDURES

All data collected during the sampling events will be included in the appendix of the Final Report. Once the data has been collected, it will be entered into Microsoft Excel reporting software. The Project Manager will proofread the data entries for errors, and will correct any discrepancies. Outliers and inconsistencies will be flagged for further review with the QA Officer. The decision to discard data will be made by the Project Manager and the Project QA Officer. Problems will be discussed in the Final Report. Table 19-1 discusses the data verification process.

Table 19-1: Data Verification Process

<table>
<tr><th>Verification Task</th><th>Description</th><th>Internal / External</th><th>Responsible for Verification</th></tr>
<tr><td>Field Notes</td><td>Field notes will be collected at the end of each sampling event. Any required corrective actions will be addressed and implemented prior to the next sampling session. Relevant information in the field notes will be transcribed into the final project report. Copies of the notes will be maintained with the project file.</td><td>I</td><td>Bernward Hay (Berger)
Ray Wright (URI)</td></tr>
<tr><td>Chain-of-Custody Forms</td><td>Chain-of-Custody forms will be reviewed when samples are collected for delivery to the laboratory in the field and at the laboratory. The forms will be maintained in the project file.</td><td rowspan="2">I/E</td><td rowspan="2">Bernward Hay (Berger)
Ray Wright (URI)
Evan Philo (Mitkem)
Doug Cullen (Microinorganics)
Brian Howes (UMass)
Raed El-Farhan (Berger)</td></tr>
<tr><td>Laboratory Data</td><td>All laboratory data packages will be verified internally by the laboratory performing the work for completeness prior to submittal. The data packages will also be reviewed by the Project Manager.</td></tr>
</table>

Data validation will utilize the measurement performance criteria documented in Tables 13-1 to 13-21 of this QAPP.

20.0 DATA USABILITY / RECONCILIATION WITH PROJECT QUALITY OBJECTIVES

As soon as possible after each sampling event, calculations and determination for precision, completeness, and accuracy will be made and corrective action implemented if needed. If data quality indicators meet those measurement performance criteria documented throughout this QAPP, the project will be considered a success. If there are data that do not meet the measurement performance criteria established in this QAPP, the data may be discarded and sampled again, if appropriate, or the data may be used with stipulations written about its accuracy in the Final Report. The cause of the error will be evaluated. If the cause is sampling error, additional training will be provided. Any limitations with the data will be documented in the Status Reports and the Final Report.

Attachment A

WORK PLAN

Blackstone River – Water Quality
Phase 2

Work Plan
(Final)

Submitted to:

Rhode Island Department of Environmental Management
Office of Water Resources
235 Promenade Street
Providence, Rhode Island 02908

Submitted by:

The Louis Berger Group, Inc.
295 Promenade Street
Providence, Rhode Island 02908

in association with:

Dr. Wright / University of Rhode Island – Dept. of Civil and Environmental Engineering
Dr. Howes / University of Massachusetts - School of Marine Science and Technology
Applied Science Associates, Inc.

November 9, 2004

OBJECTIVE

The primary goal of Phase 2 of the Blackstone River Water Quality project is to obtain the information needed to develop TMDLs to address identified water quality impairments within the Rhode Island portion of the watershed of the Blackstone River, Mill River, Peters River, Valley Falls Pond and Scott Pond (Table 1). A secondary goal is to collect nutrient data to evaluate nitrogen loads from both the Massachusetts and Rhode Island portions of the Blackstone River into the Seekonk/Providence Rivers and Upper Narragansett Bay while also evaluating current phosphorus loads and concentrations in the Blackstone River itself.

Table 1
Project Waterbodies and Impairments identified on the 303(d) List from 2002

Name	**Area/Length** (*)	**Class**	**Cause of Impairment** (**)
Blackstone River	15.7 mi	B1 / B1{a}	biodiversity impacts, pathogens, copper, lead
Mill River	0.082 mi	B	lead
Peters River	0.469 mi	B	pathogens, copper, lead
Valley Falls Pond	42.7 ac	B1 (E)	biodiversity impacts, pathogens, phosphorus, low dissolved oxygen, excess algal growth, lead
Scott Pond	42.1 ac	B	Excess algal growth, chlorophyll a, low dissolved oxygen, phosphorus

(*) Miles pertain to the RI portion of the river.
(**) For lead and copper, the impairment pertains to the dissolved phase.

This goal is to be achieved through the following steps:

- Identification of discharge points of stormwater runoff sources.
- Dry weather long-term sampling to characterize the water quality at significant boundaries and locations in the river.
- Wet weather short-term sampling to identify and quantify "hot spots" in specific reaches of the river.

- Surface sediment sampling in selected impoundments.
- In-situ water quality monitoring.
- Biodiversity impact assessment including stressors.
- Load determinations and analysis of the water quality data to define management strategies to reduce pollutant loadings and obtain program goals.
- Determination of nutrient contribution from Massachusetts and from Blackstone River to Seekonk River.

We identified three river reaches based on contaminant loading as identified during the Blackstone River Initiative (BRI; Wright et al., 2001). These river reaches are as follows:

- **Reach 1: Woonsocket Area** *(State line [near BRI station BLK13] to Manville Dam [at BRI station BLK18):* Reach 1 brackets the largest urban (Woonsocket) area along the Blackstone River in Rhode Island, as well as three of the four largest tributaries (Branch, Mill, and Peters Rivers) and the only municipal wastewater treatment facility. This is one of the reaches highlighted in the BRI (BLK13-18) as a significant contributor of contaminants.

- **Reach 2: Lincoln/Cumberland** *(Manville Dam to Lonsdale Ave):* Reach 2 covers the area between Reach 1 and 3. The area surrounding Reach 2 is more rural than the areas surrounding Reaches 1 and 3. As a result, the pollutant load contributed by these reaches is smaller, as also reflected in the data of the BRI. Therefore, the level of analysis is this reach will be less detailed than in Reach 1 and 3.

- **Reach 3: Central Falls/Pawtucket Area** *(from Lonsdale [BRI station BLK20] to the end of river at Slaters Mill [BRI station BLK21]):* Reach 3 brackets the second largest urban area along the Blackstone River in Rhode Island, as well as the fourth largest tributary (Abbott Run Brook) and the only CSOs on the river. This is the other reach highlighted in the BRI (BLK20-21). We will focus primarily on the stretch between the Lonsdale Avenue bridge and the confluence with Abbott Run Brook near Valley Falls Dam, as stormwater discharges within the urban stretch along the Blackstone River between Valley Falls Dam and Slaters Mill will be mitigated in future years by the CSO abatement program.

In addition to the primary goal, we plan to develop an understanding of the general hydraulic and nutrient dynamics of Scott Pond and Valley Falls Pond as a step toward the goal of a management plan for the pond. Finally, the work plan includes analyses of fish tissues from three locations; sampling will either be done by RIDFW or by volunteers outside of this work plan.

TASK 1: DEVELOPMENT OF WORK PLAN AND QAPP

1.1 Meeting with RIDEM to discuss Phase 2 Goals

A meeting was held with RIDEM on March 29, 2004, to discuss the goals for Phase 2 of the project. The meeting agenda is attached as Appendix 1 of the work plan. In essence, it was decided not to use a water quality model but to identify key sources of contamination for parameters of concern, and to develop load reduction measures for these sources.

1.2 Preparation of Work Plan

This work plan is developed as a result of the meeting. A revised draft copy of the work plan is hereby submitted to RIDEM for review. A final work plan will be submitted to RIDEM after receiving and addressing TAC comments.

1.3 Meeting with Technical Advisory Committee (TAC)

The existing data report will be distributed to the TAC members on a CD. Phase 2 of the project will be presented to the TAC to solicit comments for further refinement of the work plan, as appropriate.

1.4 Preparation of QAPP

A QAPP will be prepared consistent with the format required by USEPA and RIDEM. The draft QAPP will be submitted to RIDEM for review and approval. The revised and approved QAPP will then be submitted to USEPA for approval.

1.5 1.5 Deliverables

Completed Work Pan and QAPP at the end of the task.

TASK 2: INVENTORY OF MAJOR DISCHARGES OF STORMWATER RUNOFF

We will identify major sources of stormwater runoff entering the Rhode Island section of the Blackstone River, Peters River, and Mill River. The focus of this inventory will be the two key river reaches identified above. This investigation will consist of several components described below.

2.1 Review of Stormwater Drainage Plans

Plans will be reviewed from the following municipalities (from north to south) for the two key river reaches of concern. Maps were partially obtained in 2001. The level of completeness of the maps is listed in brackets.

- North Smithfield (spotty)
- Woonsocket (good)
- Lincoln (spotty)
- Cumberland (spotty)
- Central Falls (good)
- DOT (good)

In addition, the RIPDES Phase 2 Stormwater Management Plans for the respective communities will be reviewed for the three river reaches. Under the RIPDES Phase 2 program, communities are also required to identify stormwater outfalls. Efforts will be coordinated to the extent feasible.

2.2 Contact Municipalities for Updates of the Existing Plans

Municipalities will be contacted to obtain updates of existing plans for the river. In addition, staff knowledgeable at the municipalities will be asked about identifying and describing known drainage pipes/conduits that enter the river. This information sought will include size of drainage area, dimensions of pipes/conduits, discharge volume, etc. As appropriate, the characteristics of the drainage area will be field-checked. The goal is to maximize existing information and knowledge in order to increase the likelihood of finding the significant sources with regard to contaminant loads. This information will also have relevance for potential control structures that may be considered later in the project to be put at the outfall to control wet weather discharges to achieve the TMDLs of contaminants of concern.

2.3 Conduct Stormwater Source Inventory for River Reaches

Based on information obtained in the previous two steps, a field survey will be conducted to locate pipes and other surface drainage systems. The survey will focus on the following types of discharges:

- Larger drainage areas
- Larger impervious areas
- Larger commercial and industrial areas
- Highways and other larger roads with discharges to the river

The stormwater inventory survey will be conducted systematically for the key river reaches (Reaches 1 and 3) from north to south, starting with a car survey (i.e., access from land), followed by a boat survey in selected stretches, using either a canoe or inflatable workboat with an outboard engine. For Reach 2, the inventory will consist on individual outfall surveys, if appropriate based on the identification of outfalls from maps, discussions, and other sources.

Detailed notes will be taken during the surveys with the goal to be able to revisit the site at a later time. Field notes will enter the database. The following information will be obtained from relevant discharge points, as appropriate:

- Description of discharge point to the river (pipe, culvert, trench, etc.)
- Construction material of discharge point
- Dimensions
- Flow at the time of survey, if any
- Lat/Long, using a GPS unit and a map
- Photographs of discharge point and surroundings
- Other observations (trash, algae, odor, color of flow, etc.)

The survey will be conducted during dry weather conditions.

2.4 Reconnaissance Sampling of Selected Stormwater Runoff Sources

Reconnaissance sampling will be conducted at selected discharge points to better understand their contribution and to assist in the selection of a few discharge points for more systematic stormwater monitoring later.

Dry weather samples will be collected from the more significant discharge points (which have flow). Samples will be analyzed for fecal coliform, hardness, lead, and copper. In addition, the flow, pH, temperature, DO, and conductivity will be measured. Flows will be measured or estimated. Dry weather flow will be reported to RIDEM within a day.

A reconnaissance wet weather survey will be conducted at the larger discharge points expected including the collection of samples at key times during the runoff event (for instance, first flush and peak flow), assuming adequate access. Observations will be made that include color of the water, odor, etc. Flow will be measured or estimated, as feasible. Samples will be analyzed for fecal coliform, hardness, lead, and copper. In addition, the pH, temperature, DO, and conductivity will be measured. Information will be recorded about the storm characteristics including intensity, duration, and antecedent dry period to allow for appropriate interpretation of the sampling results using the rain gage information at the Woonsocket WWTF and web-based storm information. The goal of the sampling is not to quantify the load from the specific discharge points, but to further narrow the field in the identification of the more significant stormwater runoff sources.

A total of 75 samples are planned to be collected.

2.5 Evaluation of Stormwater Runoff Sources

The information collected about stormwater runoff sources will be evaluated. The goal of the evaluation is to identify the potentially more significant sources with regard to contaminant loading. These sources will be investigated further during more systematic stormwater monitoring (see Task 4 below).

2.6 Deliverable

A summary of the inventory will be submitted to RIDEM in summer of 2005 for the purpose of decision making of key discharge points. The complete stormwater inventory will be included as a section in the Final Report.

TASK 3: DRY WEATHER WATER QUALITY MONITORING

Dry weather is defined as total rainfall in the Blackstone River watershed of less than 0.1 inches per day for 3 days prior to sampling. Dry weather water quality monitoring will be conducted at the following stations (station abbreviation: "W"):

- *Primary Stations:* These are stations where continuous monitoring will be conducted.
- *Secondary Stations:* Sampling in summer and early fall, and quarterly thereafter.
- *Tertiary Stations:* Sampling in summer and early fall only.

The listing must remain flexible to be changed if data suggest it.

3.1 Primary Station Locations

Reach 1 (Woonsocket) will be bracketed by the following Primary Stations:

- **Station W-01:** W-01 will be located in Millville, MA, underneath the railroad bridge, upstream of the Tupperware Dam. This station will represent the beginning of the first reach and the water quality of the Blackstone River as it leaves Massachusetts. During the 1991/92 BRI in low flow summer conditions, there was no flow going through the gorge. Samples were collected at BLK13, which was in the Tupperware impoundment. This is no longer the case. In the 1990s, there was an agreement to maintain flow through the gorge at all times. In the more recent 2001/02 BAC study (Wright et al., 2004), samples were taken at the gorge.

- **Station W-02:** W-02 will be located just above the Manville Dam. This station was monitored in the BRI as BLK18. This location is the first bridge/dam below Woonsocket and will represent the end of the first reach. It is also sufficiently below the Woonsocket WWTF that water quality impacts from the facility will be at their greatest. The impoundment causes greater depths, lower velocities, and longer travel times.

Reach 2 (Lincoln/Cumberland) is bracketed by Stations W-02 and W-04. In addition it will contain the following station:

- **Station W-03:** W-03 will be located in Ashton in the vicinity of the new bike path crossing underneath the George Washington Highway bridge.

Reach 3 (Central Falls/Pawtucket) will be bracketed by the following Primary Stations:

- **Station W-04:** W-04 will be located above Valley Falls Pond at the Lonsdale Avenue bridge crossing. This station is located upstream of Central Falls and any CSOs. It represents the beginning of the second reach. This station was monitored in the BRI as BLK20.

- **Station W-05:** W-05 will be located above Slaters Mill Dam at the end of the Blackstone River. This station was monitored in the BRI as BLK21. This station is located downstream of Central Falls and Pawtucket and their CSOs. It represents the end of the third reach and represents the water quality of the Blackstone River as it enters the Seekonk River.

3.2 Secondary Station Location

Secondary stations in the three reaches consist of the following:

Reach 1 (Woonsocket):

- W-11 Mill River – at MA/RI border (BRI BLK15)
- W-12 Mill River – before entry into culvert in Woonsocket
- W-13 Mill River – at confluence with Blackstone River (at low stage height in Blackstone River)
- W-14 Peters River – at MA/RI border (BRI BLK16)
- W-15 Peters River – before entry into culvert in Woonsocket
- W-16 Peters River – at confluence with Blackstone River (at low stage height in Blackstone River)
- W-17 Hamlet Avenue (BRI BLK17)

Reach 2 (Lincoln/Cumberland)

Secondary stations are currently not planned for this reach.

Reach 3 (Central Falls/Pawtucket):

Secondary stations are currently not planned for this reach.

3.3 Tertiary Station Locations

Tertiary stations in the three reaches consist of the following:

Reach 1 (Woonsocket):

- W-21 Singleton Street (midway between the State line and the Thundermist Dam)
- W-22 Just below the Thundermist Dam
- W-23 Branch River – upstream of confluence with Blackstone River (BRI BLK14)
- W-24 Woonsocket Wastewater Treatment Facility effluent (BRI BLK24)
  (grab sample or 24 hour composite)

Reach 2 (Lincoln/Cumberland):

Tertiary stations are currently not planned for this reach, except possibly for a station for the canal discharges (see below).

Reach 3 (Central Falls/Pawtucket):

There has been considerable work done recently in the evaluation of the CSOs in these two cities. The abatement of the CSOs is scheduled to be completed by approximately year 2019. Since the current contaminant sources to this reach will change dramatically, no Tertiary Stations within the city limits will be sampled. Instead, the Tertiary Stations for this reach will focus on Abbott Run Brook and Valley Falls Pond area contributions to the Blackstone River.

- W-25 Broad Street just above the Valley Falls Dam
- W-26 Abbott Run Brook at the confluence with the Blackstone River

Pipe discharges / Canal: Pipe discharges will be primarily located in Reach 1. The discharges may include the overflow of the canal into the river, however, which is located in Reach 2.

- W-31 Pipe discharge #1 – if necessary.
- W-32 Pipe discharge #2 – if necessary.
- W-33 Pipe discharge #3 – if necessary.
- W-34 Pipe discharge #4 / Canal – if necessary.

3.3 Sampling Frequency

Primary Stations: Biweekly data collection for May to October (approximately 12 samples per station); once a month from November to April (6 samples per location). This frequency covers the entire year with more frequent sampling at the expected critical water quality time period from late spring to fall. Total number of samples per station is 18, or for five stations it is *90*. The sampling day of the week will vary.

Secondary Stations: The secondary dry weather sampling program will be conducted three times over the summer; once in July, August and September. In addition, these stations will be sampled in December, March, and June. These surveys will be taken in conjunction with the sampling of the Primary Stations. There are 7 river sampling locations. Therefore, there are a total of *42* samples from secondary stations (7 stations x 6 samples).

Tertiary Stations: The tertiary dry weather sampling program will be conducted three times over the summer; once in July, August and September along with the sampling for the primary and secondary stations. There are 6 river/WWTF sampling locations and 4 potential pipe discharges. Therefore, there are a maximum of 18 samples from the river/WWTF (6 stations x 3 samples), and 12 samples from pipes (4 stations x 3 samples), to be used as contingency if pipes with significant discharge were not identified. Therefore, the total number of samples from Intermittent Stations is *30*.

3.4 Analytical Parameters

The following parameters will be analyzed in the samples from the Primary, Secondary, and Tertiary Stations, in response to the 303(d) listing (Table 1):

Laboratory Analyses	Primary	Secondary	Tertiary
Fecal coliform	X	X	X
Enterococci	X	X	
Dissolved copper	X	X	X
Dissolved lead	X	X	X
Hardness	X	X	X
Total suspended solids	X	X	X
Volatile suspended solids	X	X	X
Total phosphorus	X	X	X
Total Kjeldahl nitrogen	X	X	X
Nitrate and nitrite	X	X	X
Ammonia	X	X	X
Chlorophyll	X		

Field Analyses (all Primary, Secondary, and Tertiary Stations)
Dissolved Oxygen
Temperature
Specific Conductance
Turbidity
pH
Chloride

3.5 Flow Data

Rivers: Flow data will be obtained from the nearest USGS gaging station. Aside from the stations in Northbridge, Quinsigamond, Woonsocket and the Branch River, the USGS plans to set up the following additional stations:

- Mill River at Harris Street, Woonsocket
- Peters River at Rt 114 bridge, Woonsocket
- Blackstone River at Roosevelt Street, Pawtucket
- Abbott Run Brook, Valley Falls

We will coordinate with the USGS to use the flow information from these stations to the extent possible. Flow will be modeled for stations, for which nearby gaging information does not exist. The procedure used in the BRI and BAC studies will be applied here (Wright et al., 2001; Wright et al., 2004). The USGS gage information will be used in conjunction with the Woonsocket WWTF flows to develop incremental inflows in cfs/square mile. The additional stations listed above will be used to support and validate this procedure. Chloride measurements taken during the time of each survey will also provide an independent confirmation of the flow profile.

If flow gaging stations are not set up in time at the Mill River, Peters River, and Abbott Run Brook, the stage-discharge relationship will be determined by our team.

Woonsocket WWTF: Flow information will be obtained from the facility for the time of sampling.

3.6 Deliverable

The results of the field monitoring work and laboratory analyses will be summarized in a report as one of the bases for Task 12 (Determination of Loads). This report will also become one of the sections in the Final Report (Task 13).

TASK 4: WET WEATHER WATER QUALITY MONITORING

The goal of this task is to assess the water quality during wet weather conditions. A storm shall have at least 0.5 inches of rain. A storm shall cover the entire Blackstone River watershed. There shall be three days of less than 0.1 inches of rain per day prior to a storm.

4.1 Sampling Frequency

Three storms will be sampled during the low-flow period.

4.2

4.2 Sampling Interval at Primary Stations

The goal is to monitor the river until the wet weather contribution from Worcester has arrived and essentially passed the state line and Slaters Mill. Constant monitoring of depth at the station, and flows/depths at the USGS gages at Northbridge and Woonsocket will help. A pre-storm sample will be necessary. Frequency intervals are typically set before the storm, but must remain flexible.

W-01 and W-02: The storm will be sampled over a minimum of 36 hours and a maximum of 72 hours with a total of 16 samples to be taken with between 10 and 16 samples to be analyzed based on the hydrograph.

W-03, W-04 and W-05: The storm will be sampled over a minimum of a 48 hour period and a maximum of 96 hours, starting at the same time as W-01 with a total of 24 samples to be taken with between 12 and 18 samples to be analyzed based on the hydrograph.

The total number of samples to be analyzed per storm is 56 to 86, or the total for the 3 storms would be *168 to 258.*

4.3 Sampling Interval at Intermittent (Secondary and Tertiary) Stations

We need to recognize that the purpose of the Intermittent Stations is to help refine the spatial sampling to better isolate the major sources of the contaminants in the reach and possibly redefine the frequency of sampling. Therefore, the first storm should proceed as outlined below, but the second and third storms may require modifications that might add or delete stations including river and storm water discharges.

Interestingly, at the Intermittent Stations, the Worcester contribution is not desirable. Instead, desirable is only the RI/Woonsocket/Valley Falls Pond contribution. Therefore, we are only interested in the period surrounding the storm and for several hours after its completion. For the first storm two samples will be collected in the river stations at or near the peak flow from local runoff. The end of pipe sampling should include one sample during first flush and the second at or near the peak flow from local runoff. The Task Manager, Dr. Ray Wright, will determine the best time of sampling for each of these stations. The problem is that we may not be sure when that will be. Therefore, just like the Primary Stations, we need to take more samples than we will have analyzed and make the decision on which samples to run based on the hydrographs. So, at a minimum, we should expect 3-5 samples per site with 2 samples to be analyzed. The maximum number of samples expected for the first storm would be 15 Intermittent Stations times 2 samples, or 30 samples.

For stations along the Mill River (W-11, W-12, W-13) and the Peters River (W-14, W-15, W-16), all 5 collected samples will be analyzed. These samples will consist of the following: pre-storm, first flush, and three other samples as the stormwater volume "tail off".

Since our plan is to quantify the sources, we must have more than 2 samples per location. Therefore, we would like to get to a point after evaluating the data from the first storm, that allows us to progressively modify the sampling plan to better isolate the source(s). This would decrease theoretically the number of stations and allow the freed up samples to increase the sampling frequency at or near the expected source and quantify the loading. Based on the 52 samples collected for the first storm (11 stations with 2 samples, the 6 Mill and Peters River stations with 5 samples each), we would set that number as the maximum to work toward in Storms 2 and 3. The total number of samples for the Intermittent Stations for all three storms would be *156*.

An additional *30* samples for the three storms is set for a sample contingency. This includes selected pre-storm samples from tributaries.

Logistics for sampling are of concern. For the river stations we will have access from the bridges or from the shore if necessary. But the stormwater discharges pose unique problems for each outfall; therefore it will have to be addressed on a case-by-case basis.

4.4 Parameters (3 storms)

The analyses to be performed for the samples from the Primary and Intermittent Stations are as follows:

Laboratory Analyses	Field Analyses
Fecal coliform	Dissolved oxygen
Enterococci (Primary Stations only)	Temperature
Dissolved copper	Specific conductance
Dissolved lead	Turbidity
Hardness	Chloride
Total suspended solids	
Volatile suspended solids	
Total phosphorus	
Total Kjeldahl nitrogen	
Nitrate and nitrite	
Ammonia	

4.5 Separate Storm Event - Mill and Peters River

A separate Storm event will be conducted on the Mill and Peters River at low-flow conditions in the Blackstone River. The goal of this survey is to determine the flow in the two tributaries that enters the closed culvert underneath part of the City of Woonsocket. Since low-flow conditions in the Blackstone River only occur during selected periods, such conditions may not exist during the "watershed-wide" storm sampling. Storm sampling will be triggered by monitoring the gage elevation at the confluence of these tributaries with the Blackstone River. At a gage height of 1.4 feet or lower, the two tributaries can be sampled. Gage elevations are available real time on the web. A total of up to 7 samples will be collected during the storm at each of the following stations: W-11 to W-13 (Mill River) and W-14 to W-16 (Peters River). The total number of samples is *42*. Samples will be analyzed for the following parameters:

- Fecal coliform
- Enterococci
- Dissolved lead
- Dissolved copper
- Hardness.

In-situ field analyses will consist of the following:
- Temperature
- Specific Conductance
- Turbidity
- pH

4.4 **4.6 Flow**

Flow estimates during each storm and for each sample must be made. The river station flows will be developed in the same way as indicated in the dry weather monitoring section. The concern will be with the stormwater discharges. There are several ways to estimate the flow, but the procedure that will be used will be specific to each site.

4.7 Deliverable

The results of the field monitoring work and laboratory analyses will be summarized in a report as one of the bases for Task 12 (Determination of Loads). This report will also become one of the sections in the Final Report (Task 13).

TASK 5: IN-SITU MONITORING (optional; potentially to be performed by RIDEM)

The goal of this monitoring assessment will be to develop long-term dissolved oxygen/temperature records at four Primary Stations (W-01, W-02, W-04, W-05).

The data will be collected with YSI 6600 EDS sondes with monitors for DO, pH, turbidity, specific conductance, and temperature. The sondes will be moored for a period of one month during low-flow conditions at a secure location. In recognizing that the current 303(d) list does not include any of the parameters to be measured by the sondes, why do this? The data will provide us with information concerning daily DO changes that may be important to understanding the results of Task 7 (Biodiversity).

Deliverable: The deliverable of this task would be a data presentation and synthesis, to be included as a section in the Final Report.

TASK 6: IMPOUNDMENTS (optional task at this time)

A reconnaissance assessment of the six impoundments, which bracket the key river reaches (Reaches 1 and 3), will be made to evaluate if the impoundments contribute to loading of lead and copper in the river.

- S-01: Above W-01 in the impoundment behind the dam at the RI gorge.
- S-02: Above W-02 in the impoundment behind the Manville Dam (no sampling planned or budgeted at this time)
- S-03: Above W-03 in the impoundment behind Ashton Dam (sampling may be conducted in 2005 after review of data from the summer of 2004; sampling was not budgeted at this time)
- S-04: Below W-04 and in the impoundment behind the Valley Falls Dam
- S-05: Above W-05 in the impoundment behind the Slaters Mill Dam.
- S-06: Inside Valley Falls Pond (budgeted as part of Task 9).

Information from other impoundments on the river will be assessed in general only (i.e., impoundments above the Albion, Ashton, and Pratt Dams).

6.1 Review of existing information

Information will be obtained about the impoundments from sources such as RIDEM, municipalities, and industries. This information will consist of bathymetry, dimensions, sediments, vegetation (as an indication of the stability of the substrate), as well as any anecdotal information about erosion or resuspension during high flow events. In addition, aerial photographs will be sought of the impoundments.

6.2 Field Survey

The impoundments within the two key river reaches will be investigated using a canoe or inflatable boat with outboard engine. Information recorded will consist of the following (this information is important to the TMDL work):

- Sediment type in the impoundments (grain size, color, organic content) based on visual observations of grab samples.
- Physical and hydraulic characterization (bathymetry using an echosounder or digital depth sounder, GPS location, selected cross-sections, and velocity estimates at the time of the survey).

6.3 Sediment Sampling

In the four impoundments, sediment samples will be collected using a box corer. Samples will be collected from the upper 2 cm of the sediment column. Approximately 6 subsamples will be composited to two samples (3 subsamples per sample) to define the lower and upper regions of each impoundment. The composite samples will be submitted to a laboratory for analysis of the following key parameters:

- Arsenic
- Cadmium
- Chromium
- Copper
- Lead
- Mercury
- Nickel
- Grain size

There are several other parameters that may be considered by RIDEM for analysis (unit prices are included in the budget tables but analyses for these parameters are not budgeted at this time):

- PCBs
- Organochlorine pesticides
- Dioxins

Depending on the results of the composite samples, the archived subsamples may be analyzed. The program calls for a minimum of 10 composite sediment samples (including the two Valley Falls Pond samples). The 6 uncomposited samples per site will be archived for potential analysis, depending of the results of composite sample analyses. Costs for the analyses of the uncomposited samples were not budgeted, however.

6.4 Assessment

The results of this task will be important in interpreting the biodiversity data from Task 7 and the wet weather water quality data from Task 4. Sediment quality concentrations will be compared to sediment data from other reservoirs in the Blackstone River watershed, including data from Massachusetts's impoundments.

6.5 Deliverable

The deliverable of this task would be a presentation of the collected data and information as well as a data synthesis, to be included as a section in the Final Report.

TASK 7: BIODIVERSITY

The 303(d) biodiversity impairment determination was for the Blackstone River was based on the following biological monitoring data (Connie Carey, RIDEM, pers. comm., June 1, 2004):

- Rapid Bioassessment Protocol (RBP) monitoring at Manville, carried out by Roger Williams University

- Artificial Substrate Monitoring (AS), carried out by Bob Richardson from RIDEM (now retired), at Millville (MA) and at the Manville Dam (RI).

The biodiversity impairment determination for Valley Falls Pond was made by extrapolation of the Manville data.

The Manville data were likely in part affected by discharges from the Woonsocket WWTF. The WWTF has now been upgraded and the water quality of the effluent has been improved. Therefore, it appears wise to revisit this station to assess if the river is still impaired.

Based on the existing data from the Manville station, the main stressor appears to be organic loading (Berger, 2004). However, other stressors can also play a role. Isolating the relevant stressors can be very expensive, as direct measurements cannot be performed. On the other hand, likely improvements to the water quality as part of the mitigation for other contaminants on the 303(d) list will also have a positive impact on the biodiversity in the river.

Considering these points, and considering the logic behind the bracketing approach planned for the water quality monitoring program (Tasks 2 to 5) and the assessment of the sediments in the impoundments (Task 6), we propose the following approach to assess the biodiversity impairment in the Blackstone River. The following monitoring reference stations:

- **Station M-01** *(AS):* At Millville (MA), upstream of the MA/RI border (same station as occupied by Bob Richardson).
- **Station M-02** *(AS):* Upstream of Manville Dam (same station as occupied by Bob Richardson).
- **Station M-03** *(RBP):* Downstream of Manville Dam in shallow wadeable riffle area (station of previous macroinvertebrate assessments; this station is also at Primary Station W-02)
- **Station M-04** *(RBP):* Wood River (reference station for RBP assessments; same station as currently occupied by ESS for monitoring and as occupied by Roger Williams University in the past).
- **Station M-05** *(AS):* Wood River (Skunk Hill Road; reference station for AS analyses (same station as occupied by Bob Richardson)

Stations M-01 to M-03 brackets Reach 1, the main reach of concern (Woonsocket). The macroinvertebrate survey will be coordinated with the In-situ Monitoring Survey (Task 5), both in terms of station location and schedule, to obtain an understanding of the effect of parameters such as dissolved oxygen.

The method of analysis will be determined based on actual depth of the river. RBP monitoring will be conducted at Stations M-03 and M-04. At all other stations, AS will be performed. RIDEM established protocols will be followed for biological sampling, taxonomic identification, determination of metrics, and evaluation of data.

We suggest (and budgeted) that the RBP surveys should be conducted by ESS, Inc., as they are already conducting assessments in other areas of the State; they are already assessing Station M-04. The AS survey will be conducted by our team. Surveys are planned for the summer of 2004 and the summer of 2005. If it appears after the 2004 survey that the biodiversity impairments are primarily occurring in RI, additional stations may be recommended for the 2005 survey for the bracketed areas, such as at Thundermist (below Branch River and above the Mill and Peters Rivers), and/or BLK17 (below Mill and Peters Rivers and above the Woonsocket WWTF); however, such additional stations are not budgeted at this time. Eventually, it is necessary to establish the direct link to the cause of the biodiversity impairment in order to be able to suggest remediation measures.

This task will also include a review of the historic data to understand to approach used to determine impairment. Based on the meeting with Connie Carey on June 17, 2004, files need to be reviewed and approaches need to be discussed with Mr. Richardson, as the approach was not recorded. This step is needed to allow for the determination of potential impairment using the data collected as part of this program.

Deliverables: Data from the summer 2004 monitoring surveys will be presented as a progress report in early 2005. Data and findings from the 2004 and 2005 monitoring surveys as well as a data synthesis will be included as a section in the Final Report.

TASK 8: TIME OF TRAVEL

The time of travel between key locations along the Blackstone River is essential to understand the hydrographs and pollutographs that occur for each storm. The sampling frequency, discussed above, is to be initially based on these estimates and will be modified in the field, if necessary, from observations of depth/flow changes during each storm. Therefore, in advance of the field program the following estimates of travel time will be developed from existing data:

(1) MA/RI state line (near BLK13) to mouth of the Blackstone River (near Slaters Mill BLK21).
(2) River reach of concern from the MA/RI state line to Manville Dam (BLK18).
(3) Worcester (near BLK01) to MA/RI state line.
(4) UBWPAD discharge to MA/RI state line.
(5) Fisherville Pond (near BLK06) to MA/RI state line.
(6) Rice City Pond (near BLK08) to MA/RI state line.

Time of travel for the Blackstone River was first assessed by the USEPA in 1964 and 1970 (USEPA, 1970). Additional time of travel information was obtained by the Civil and Environmental Engineering at URI (Wright, unpublished data) in the 1980's. Equations describing travel time on the Blackstone River have been used in recent modeling efforts (Wright et al., 2001; Wright et al., 2004).

A new study is not planned (or budgeted) at this time, assuming that the historic information provides a reasonable estimate of the time of travel in the Blackstone River for the purpose of this study. Should the data not be adequate, a more detailed investigation will be proposed.

Deliverables: The time of travel information will be provided to RIDEM as a brief report in early 2005. It will also be included as a section in the Final Report.

TASK 9: VALLEY FALLS POND

The goal of the Valley Falls Pond assessment is to obtain the information needed to allow for removal of the pond from the 303(d) list. At present there are two management approaches being considered:

- Increasing the flow of Blackstone River water through the pond
- Managing Valley Fall Pond as a wetland/pond system

To evaluate these two management alternatives requires the collection of field data to enhance the historical data to focus on the primary impairment of the system from nutrient enrichment (loss of diversity, phosphorus, nutrients, hypoxia and excess algal growth) as well as impairment by pathogens and lead. Analysis will focus on wetland and pond functions as they relate to system hydrodyamics and external (Blackstone River) versus internal (watershed, recycling) sources of nutrients and secondary nutrient parameters (DO, algae, etc.). In addition, both the levels and sources of lead and pathogens will be addressed.

9.1 9.1 Wetland System Assessment

The evaluation of the management of Valley Fall Pond as a wetland/pond system requires an assessment of the emergent wetland and channels. Aerial photographs will be used to map the wetland surrounding Valley Falls Pond (VFP) and prepare a vegetation map. The distribution of dominant plant assemblages will be confirmed with a site walkover. Further, the walkover wetland survey will be conducted to determine the following:

- Physical limits of the wetland system
- Functional value
- Hydraulic regime
- Major wetland plants/assemblages
- Wildlife (including birds)

9.2 Water Elevation

The rate and volume of water exchange between the Blackstone River and Valley Falls Pond is potentially the critical management parameter relative to each of the 303(d) impairments. At present, there is almost no information on the interaction between the River and the Pond. Water elevation will be continuously recorded within the Pond and in the adjacent River, to allow for determination of the timing and amount of volumetric exchange between VFP and the Blackstone River. Measurements will be made using continuously recording water elevation gages. The gage in VFP will be deployed within the main basin. The gage in the Blackstone River will be deployed opposite of the VFP. The gages will be surveyed in, XYZ planes. Gages will be installed for at least one month during the summer at sites that are safe from vandalism.

In addition, anecdotal information will be collected from the abutting neighbors about the following:

- Indications of flow between the Blackstone River and VFP
- Potential existence of a sill between the river and VFP
- Shoaling of VFP during low flow periods
- Variability in elevation of the pond water surface
- Presence of birds and other wildlife in the wetland
- Presence of aquatic vegetation in the summer
- Odor as a result of low oxygen in VFP

9.3 Bathymetry

A bathymetric map of Valley Falls Pond will be constructed using depth data collected by either an echosounder or a pole, depending on depth. Sounding locations will be recorded with a GPS unit.

9.4 Watershed Assessment

The watershed area will be assessed using topographic maps and a visual site survey. In addition, sources of contaminants will be sought by a site walkover and inquiries at the City of Pawtucket and local residents. These sources will include:

- Stormwater drainage pipes
- Septic systems
- Small stream/surface water inflows
- Other sources of contaminants draining into the pond

9.5 Water Sampling

Water samples will be collected over a 6-month period for nutrients, pathogens and lead. A total of 6 sampling events will be conducted. Samples will be collected from three stations in Valley Falls Pond from the center of the water column at total depths <1.5 meters and from surface and bottom if total water depth >1.5 meters. Sampling locations will be identified during the field survey, but will target the upper and mid-regions of the basin. Water sampling will be linked to the water sampling of the Blackstone River with a sample being collected at Station W-25 (upstream of confluence with Abbott Run Creek). Four of the sampling events will be conducted during dry weather; two sampling events will be conducted during wet weather. At least half of the events will be conducted during the summer. The wet weather events may be conducted at a time when maximum wet weather inflow into the pond is believed to have occurred, which may be toward the end of the storm or shortly thereafter.

Water samples will be analyzed for the following constituents:

- Total phosphorus
- Orthophosphate
- Chlorophyll a and Phaeopigment
- Ammonia
- Particulate organic nitrogen
- Total dissolved nitrogen (Note: TDN + PON = TN; TN – NO_3 = TKN)
- Nitrate
- Fecal coliform
- Enterococci
- Dissolved lead
- Dissolved copper
- Hardness

In addition, field measurements will be made for dissolved oxygen, temperature, conductivity, turbidity, and Secchi depth.

In addition to the six events, surface water samples will be collected from each of the four stations in December, March, and June for the following analyses:

- Fecal coliform
- Enterococci.

9.6 Sediments

The sediment will be analyzed in two ways:

- *Soft Sediment Thickness:* A 10 to 20 foot long pole will be used to probe the soft sediment depth along a transect extending from the east (Blackstone River) to the western end of VFP. The measurement locations will be recorded with a GPS unit.

- *Sediment Sampling:* Two sediment samples will be collected to determine the organic matter content. Samples will be collected by box corer from the upper 4 inches of the sediment column. Samples will be analyzed for the following parameters:
  - Total organic carbon
  - Total organic nitrogen
  - Total organic phosphorus
  - Total copper
  - Total lead
  - Grain size

- *Algal Species – Macroalgae:* Sediment samples collected will be sieved in the field. The sieve size will range from 0.3 to 0.5 mm, depending on the nature of the sediment. The organic particles will be analyzed in the laboratory under a dissecting microscope to determine if the particles consist of wetland plants versus algae.

- *Algal Species – Phytoplankton:* Phytoplankton will be collected for analysis in the laboratory to determine the types of algae in the water, including blue-green algae. Samples will be collected in late summer. Periphyton samples will not be collected as periphyton is typically associated with hard substrate (not expected in VFP).

9.7 Data Analysis

The information about VFP will be analyzed to identify options for removing VFP from the 303(d) list. Mitigation options for the pond consists of the following:

- *Manage VFP as a wetland:* The information provided by the surveys may indicate that VPF is part of a wetland system. Based upon the information collected on the wetland distribution, hydrology, and function and the bathymetry of the basin, an evaluation will be made as to the role of the pond area. The evaluation will focus on whether the pond is functioning (1) as an open water basin or pond exchanging with the Blackstone River, or (2) primarily as a site of exchange for nutrients and organic matter with the surrounding wetland. The bathymetry and hydrodynamics of the system, as well as the plant assemblages will be fundamental to this evaluation.

- *Increase the flushing in VFP:* A channel (with a control structure) between the western end of VFP and the Blackstone River (maybe in the vicinity of the radio tower) would increase the flow in the wetland increasing the flushing and thereby potentially improve the water quality. This management alternative is only viable if the exchange with VFP is currently restricted and the Pond is functioning primarily on its localized watershed inputs and internal recycling. The risk would be that it might alter the wetland system and/or cause erosion.

- *Improve the water quality in the Blackstone River:* It is likely that VFP acts as a sediment trap for sediments from the Blackstone River. Improving the water quality of the river should also improve the water quality in VFP.

9.8 Deliverables

Data from the 2004 surveys will be presented as a progress report in early 2005. Data and findings from the 2004 and 2005 surveys as well as a data synthesis will be included as a section in the Final Report.

TASK 10: SCOTT POND

Data from the URI Watershed Watch show that the water in Scott Pond becomes anoxic at depth in the summer. Further, the flow regime of the pond is not well understood. Scott Pond is connected to the Blackstone River through a long canal with control structures of uncertain quality. The exchange with the Blackstone River is unknown. Management alternatives for this system currently include either increasing the exchange with the Blackstone River or hydrologic isolation of the pond (only outflow) and focus on local watershed inputs. Therefore, a baseline survey will be conducted to better understand the dynamics of Scott Pond to allow for management decisions.

10.1 Watershed Assessment

The watershed area will be assessed using topographic maps and a visual site survey. In addition, sources of contaminants will be sought by a site walkover and inquiries at the Town of Lincoln and local residents. These sources will include:

- Stormwater drainage pipes
- Septic systems
- Small streams or surface water inputs
- Other sources of contaminants draining into the pond

10.2

10.2 Pond Elevation

Water elevations will be obtained from the Town of Lincoln. It is our understanding that, aside from stormwater runoff and groundwater inflow, water enters the pond from the Blackstone Canal. The flow from the canal is controlled by a structure. It is not certain at this time how this structure is controlled.

The goal of this survey is to assess the water exchange between Scott Pond and the Blackstone Canal. Two water elevation gages will be deployed to measure the elevation in Scott Pond. Gages will be surveyed in, XYZ planes. The location and time period of deployment will be determined after the initial assessment of the flow between the canal and the pond.

In addition, anecdotal information will be collected from the abutting neighbors about the following:

- Flow between the canal and Scott Pond
- Variability in elevation of the pond water surface
- Presence of aquatic vegetation in the summer
- Presence of birds and other wildlife on the pond

10.3 Bathymetry

A bathymetric map of Scott Pond will be sought at the Town of Lincoln. In case a map cannot be located, the bathymetry of the pond will be determined with a pole and echosounder, depending on depth.

10.4 Water Sampling

Water samples will be collected over a 6-month period for nutrients. A total of 6 sampling events will be conducted at the same time as in Valley Falls Pond. Samples will be collected from two stations in Scott Pond (Southern portion), and one station in Scott Pond - northern portion (also known as Cranberry Pond) and a station in the canal, if flow into the pond exists. In Scott Pond, samples will be collected at a depth of 2 meter, middle of the water column, and at a depth of 2 m above the bottom, as it is known that the pond stratifies. In Cranberry Pond, a sample will be collected at the top and one at the bottom. As for VFP, four of the sampling events will be conducted during dry weather; two sampling events will be conducted during wet weather. The wet weather events may be conducted at a time when maximum wet weather inflow into the pond is believed to have occurred, which may be toward the end of the storm or shortly thereafter.

Water samples will be analyzed for the following constituents:

- Total phosphorus
- Orthophosphate
- Chlorophyll a and Phaeopigment
- Total organic nitrogen
- Ammonia
- Nitrate
- Fecal coliform (surface water only)
- Enterococci (surface water only)
- Dissolved lead
- Dissolved copper
- Hardness

In addition, field measurements will be made for dissolved oxygen, temperature, conductivity, turbidity, and Secchi depth. These measurements will be made along a transect across the pond at 5 stations, which will include the two water quality stations.

In addition to the six events, surface water samples will be collected from each of the four stations in December, March, and June for the following analyses:

- Fecal coliform
- Enterococci.

10.5 Sediments

The sediments in the pond will be investigated in two ways:

- *Soft Sediment Thickness:* A long PVC pole will be used to probe the soft sediment depth in a transect from north to south. The measurement locations will be recorded with GPS.

- *Sediment Sampling:* Three sediment samples will be collected to determine the organic matter content. Samples will be collected by box corer from the upper 4 inches of the sediment column. Samples will be analyzed for the following parameters:
  - Total organic carbon
  - Total organic nitrogen
  - Total organic phosphorus
  - Total copper
  - Total lead
  - Grain size

10.6 Groundwater Inflow

The inflow of groundwater will be estimated based on the watershed information using a water balance method. In this approach the topographically determined watershed is outlined. The amount of water input and output from the watershed is determined with the freshwater discharge to the downgradient system (Scott Pond) being the focus. Primary freshwater input from rainfall and loss to evapotransiration will be determined from weather data and USGS data. Other sources will be identified and incorporated (potable water not discharged to sanitary sewers, runoff, etc.)

10.7 Data Analysis

The information about Scott Pond will be analyzed. The goal of the analysis is to obtain a better understanding of the dynamics of the pond to ultimately allow for the development of a management plan. Management options may include the following:

- *Optimize the inflow into the pond from the canal:* Develop an environmentally sensible approach for channeling water from the Blackstone Canal into the pond.

- *Reduce inflow of stormwater into the pond:* Develop strategies to reduce stormwater inflow from roads and abutting residential areas into the pond, which likely carry elevated nutrient loads.

- *Manage nutrients recycling within pond:* If the data indicate that the pond is phosphorus enriched from its watershed, phosphorus reduction strategies will be evaluated for pond restoration/management.

- *Reduce nutrient loading through septic sources* (if applicable):

10.8 Deliverables

Data from the summer 2004 surveys will be presented as a progress report in early 2005. Data and findings from the 2004 and 2005 surveys as well as a data synthesis will be included as a section in the Final Report.

TASK 11: FISH TISSUE ANALYSIS

This task consists of determining bioaccumulation levels of metals in fish tissues. The goal of this information is to determine the need for health advisories for recreational fishing in the respective sampling locations. The data may also be helpful for the sediment quality analysis.

At this time, RIDEM plans to sample three sites. Fish may be collected by either angling, seine net, or electrofishing boat. RIDEM either plans to enlist volunteers or will work directly with RIDFW to complete the task. We understand that RIFWS (Mr. Alan Libby) has and operates an electrofishing boat. Sampling and data analyses will be conducted outside of this work plan; in this work plan, only the fish tissue laboratory analyses are budgeted.

The Rhode Island Department of Health (RIDOH; Robert Vanderslice) and the USEPA (Al Basil, Jim Lake) were contacted about the sampling approach for the investigation. Composite analyses should be conducted from two types of fish. Fish species chosen for the analyses should depend on what types of fish are caught. Only individuals from the same species should be composited (USEPA, 2000):

- Predatory Fish (in order of significance):
  - Largemouth bass *Micropterus salmoides*
  - Smallmouth bass *Micropterus dolomieui*
  - Chain pickerel *Esox niger*
  - Yellow perch *Perca flavescens*
  - White perch *Morone americana*

- Benthic species (in order of significance):
  - White sucker *Catostomus commersoni*
  - Brown bullhead *Ameiurus nebulosus*
  - Common carp *Cyprinus carpio*

Following USEPA (2000), the composite samples should be comprised of skin-on-fillets (scales removed) from five fish from the water column (predatory species) and 5 fish from the bottom (benthic species). All five fish should be from the same species for the respective composite. Fish used in the composite should be weighed and their length should be measured. The size range used for the composite depends on the advisory for minimum size. The minimum size for largemouth and smallmouth bass is 12 inches; for chain pickerel it is 14 inches (RIFWS, 2004). There are no minimum size requirements for other freshwater species. For a composite, the smallest fish to be composited should be at least 75% of the largest individual. Therefore, for example, the size range for bass should be 12 to 16 inches for the composite sample. Larger (i.e., older) fish typically have higher contaminant concentration levels in their tissues, as contaminants have bioaccumulated over a longer period of time (Phillips, 1980); Voiland et al., 1991).

Fish tissues may be analyzed for the same parameters as sediments (unit prices are included in the budget tables; costs for 6 composite samples [3 predatory fish samples and 3 benthic fish samples] are included in the budget for all compounds):

- Cadmium
- Chromium
- Copper
- Lead
- Nickel
- Arsenic
- Mercury
- PCBs
- Organochlorine pesticides
- Dioxins (benthic samples only)

Results of the investigation should be compared to regulatory standards for the consumption of fish and biological guidance values for bioaccumulation (e.g., USEPA, 1993; Wood et al., 1997).

Deliverable: The sample analysis report issued by the laboratory will be provided to RIDEM.

TASK 12: DETERMINATION OF LOADS

As discussed with RIDEM during the meeting on March 29, 2004, the goal will be to reduce the loading of pathogens, lead, and copper within the Rhode Island portion of the Blackstone River watershed. The presently existing data as well as the results of the assessments of Task 2 to 9 above will be used to develop load reductions.

Pathogens: In-stream concentration approach based on fecal coliform data.
Metals: In-stream concentrations or load approaches.

12.1 Products for Reach 1 - Woonsocket Area

- The intermittent water quality stations will be used effectively to determine and measure the major sources of lead, copper, pathogens, and nutrients under both wet and dry weather.

- The water quality investigations in this study will lead to the completion of a TMDL for the Blackstone River in this reach, and the RI portion of the Mill and Peters Rivers, with respect to lead, copper, pathogens, and nutrients. This will include recommendations of potential remediation and an estimate of the water quality improvement in the river.

- The information at W-01 will provide a year-long water quality data set at the state line that will help define Massachusetts's loading into Rhode Island under wet and dry weather conditions. This data set will be combined with previous efforts, like the BRI and BAC, to provide both states with critical water quality information upon which to base future regulatory decisions. This work is essential. It makes a great deal of sense if a TMDL is to be developed in RI in order to understand the contaminant concentrations and loads delivered by MA. Without this knowledge the effectiveness of any remediation plan may not be clearly understood.

- The information at W-02 will provide a year-long water quality data set at one of the most critical water quality sections of the river in the entire RI Blackstone River. It is critical because of the location (downstream of the Woonsocket WWTF and the urban runoff from Woonsocket) and the hydraulic conditions (as an impoundment it has greater depths, slower velocities, higher times of travel).

- Biodiversity and sediment measurements at W-01 and W-02 will be used to describe the current environmental conditions in the Blackstone River as it relates to the major issues of Massachusetts's impact on Rhode Island and the impact of Woonsocket's urban runoff and Woonsocket WWTF. The data to be collected in this reach provide a good baseline to compare with data taken years from now when remediation is implemented.

12.2 Products for Reach 2 – Lincoln/Cumberland Area

- Stations W-02, W-03, and W-04 will be used to determine loads in this reach, both for wet and dry weather.

- The role of the canal on the flow in the river will be assessed. Flow from the canal into the river appears to be intermittent and partially controlled by man-made structures.

12.3 Products for Reach 3 - Central Falls/Pawtucket Area

- W-05 provides a year-long water quality data set for the end of the Blackstone River and its discharge into the Seekonk/Providence River. It has been shown that the Blackstone River is a major source of several pollutants to the Providence River. The long-term measurement of total nitrogen certainly has merit and will generate a considerable amount of interest from the TMDL developers in the Providence River. This station, once started, should be maintained by RIDEM or its consultant long after this study is complete.

- W-04 and W-05 bracket the second largest urban area on the Blackstone River in Rhode Island. This is a reach that had major additions of some parameters in the BRI study (Wright et al. 2001). A recent, separate study, completed by Louis Berger, will result in the reduction/elimination of the existing CSOs in Central Falls and Pawtucket. This is to be completed in the next few years. The work in this study will provide the baseline for a post-audit after the CSO changes. Specifically, four of this project's outcomes will be available for this post-audit: biodiversity, surface sediment quality, dry weather loads, and wet weather loads. The water quality investigations in this study will lead to the completion of a TMDL for the Blackstone River in the stretch of river between W-04 and W-25 (from Lonsdale to the Valley Falls Pond Dam, with respect to lead, copper, and pathogens. This will include recommendations of potential remediation and an estimate of the water quality improvement in the river. This TMDL will include Valley Falls Pond.

- Evaluation of nitrogen loads from both the Massachusetts and Rhode Island portions of the Blackstone River into the Seekonk/Providence Rivers and Upper Narragansett Bay.

12.4 Deliverables

Findings of this task will be prepared as a section in the Final Report.

TASK 13: PREPARATION OF FINAL REPORT

All data and information collected during Phase 2 of this study will be compiled in a report. A draft report will be submitted to RIDEM for review. A Final Report will be submitted after receiving comments.

The report preparation will include a review of data from other relevant ongoing studies and data that were collected since year 2002 (the year of completion of the Draft for the Existing Data report [Berger, 2004]).

TASK 14: MEETINGS

Progress Meetings: Progress meetings will be held with RIDEM at project milestones. The meeting schedule will be determined between RIDEM and the Berger team during the course of the project. At this time we plan for 5 meetings.

TAC meetings: A total of 3 TAC meetings are planned throughout the course of this project.

Other meetings will be scheduled as appropriate, to facilitate efficient communication and thought exchange. If appropriate, some of such additional meetings may be conducted via conference call.

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Wood, C.M., W.S. Adams, G.T. Ankley, D.R. DiBona, S.N. Luoma, R.C. Playle, W.C. Stubblefield, H.L. Bergman, R.J. Eriksen, J.S. Mattice, and C.E. Schlekat, 1997, Environmental toxicology of metals. In: Bergman, H.L. and E.J. Dorward-King (eds), *Reassessment of metals criteria for aquatic life protection,* p. 31-51.

Wright, R.M., P. Nolan, D. Pincumbe, E. Hartman, and O.J. Viator, 2001, *The Blackstone River Initiative: Water Quality Analysis of the Blackstone River Under Wet and Dry Weather Conditions.* Prepared for the USEPA New England, Boston, MA.

Wright, R., Viator, O. and Michaelis, B., 2004, Dry Weather Water Quality Sampling and Modeling Blackstone River Feasibility Study, Phase 1: Water Quality Evaluation and Modeling of the MA Blackstone River, Prepared for the U.S. Army Corps of Engineers, University of Rhode Island, Kingston, RI.

Personal Communication

Al Basil, USEPA, Region 1, Boston, May 18, 2004 (Tel: 617-918-1599).

Connie Carrie, RIDEM, June 1, 2004 (Tel: 401-222-4700 ext 7239).

Jim Lake, USEPA Narragansett Laboratory, May 20, 2004 (Tel: 401-782-3173).

Robert Vanderslice, Rhode Island Department of Health, May 16, 2004 (Tel: 401-222-3424)

APPENDIX 1

Agenda
29 March, 2004
Blackstone River dissolved metals and pathogens TMDLs

1. Goals

a) Update baseline water quality data for RI portion of the Blackstone River, Mill River, Peters, River, and other major tributaries.
   - Wet and dry weather conditions.
   - Measure sources: Upstream, WWTF, tribs, stormwater outfalls, characterizing resuspension.

b) Provide information for TMDL reductions.
   - Fecal Coliform Approach: In-stream concentration approach.
   - Metals: - In-stream concentrations or load approaches.
     - Use of hardness data to calculate limits.

2. Monitoring Plan Elements

- TMDL Parameters: bacteria and dissolved metals: zinc (*), lead and copper.
- Supplemental Parameters: Temperature, hardness, conductivity, dissolved oxygen, turbidity, TSS, nutrients.
- Discharge: Three instream locations, canal, tribs
- Time of travel
- Biodiversity characterization.
- Fish tissue analysis.

3. Valley Falls Pond Characterization.

(*) During the meeting, it was decided to remove zinc from the list of parameters to be monitored.

Attachment B

STATION LOCATIONS

Aerial photographs of station locations for all sampling stations in the Blackstone River watershed.

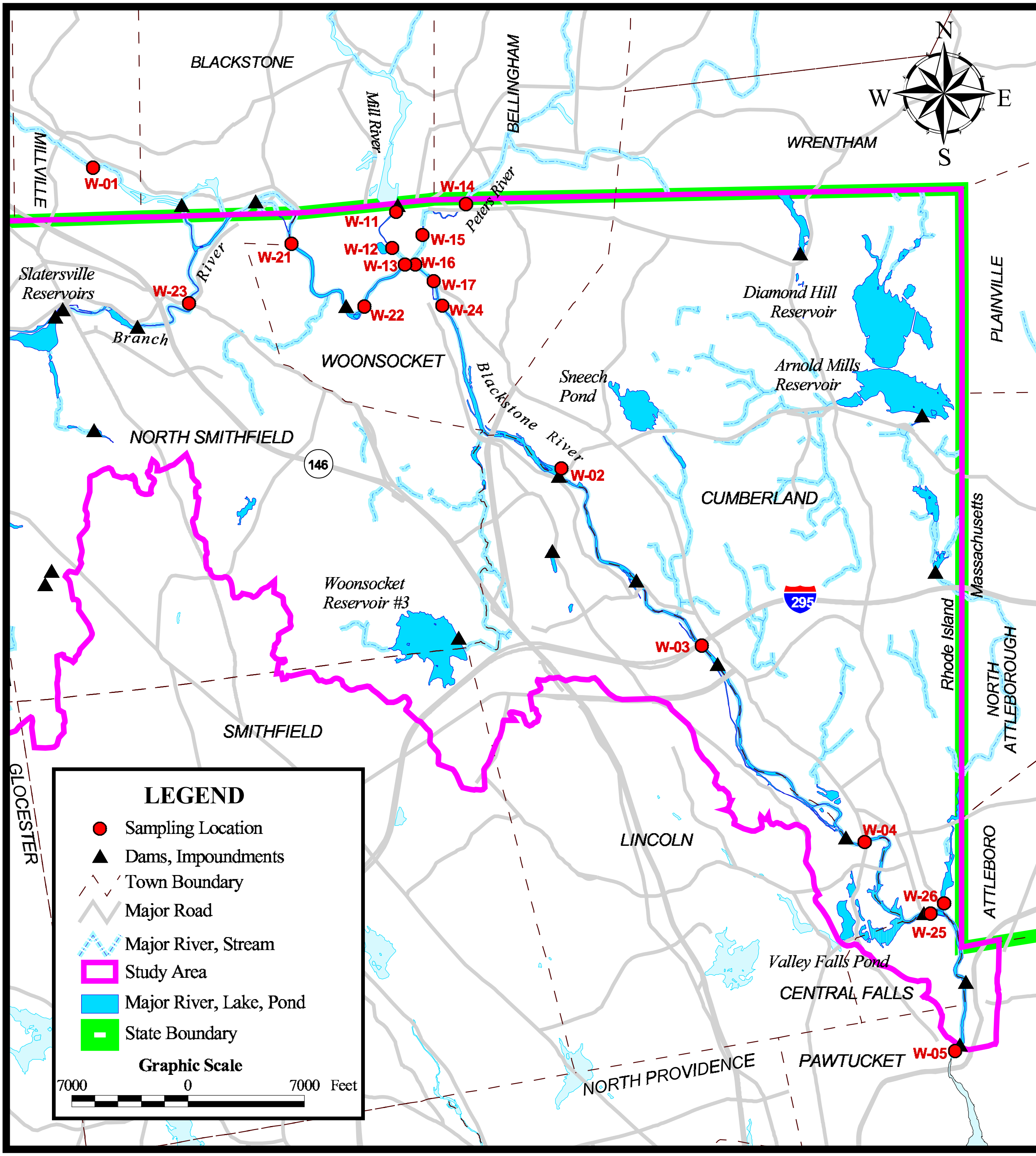
The attached aerial photographs provide information of the station locations for the water quality and macroinvertebrate samples to be collected along the river. Figure B-1 is an overview map to be used as reference for the photographs relative to roadways, cities and town. Water quality station numbers on the overview map match with the station numbers on the aerial photographs.

The aerial photographs start at the MA/RI border furthest to the north (Map 1) and extend downstream to the Slaters Mill just to the north of the confluence between the Blackstone River and the Seekonk River (Map 18). These photographs cover the entire course of the mainstem of the Blackstone River within Rhode Island. Due to spacing of the sampling stations, three maps do not have sampling stations, but were included for completeness (Maps 3, 5, and 12).

Major features are shown on the following maps:

- **Tributaries**
  - Branch River: Map 2 and Map 3 (on Map 3, just the confluence is shown in the south)
  - Mill River: Map 7 (Stations W-11 to W-13)
  - Peters River: Map 7 (Stations W-14 to W-16)
  - Abbot Run Brook Map 17 (Station W-26 is located at the confluence with the Blackstone River)

- **Ponds**
  - Valley Falls Pond: Map16 and Map 17 (Stations P-01 to P-03)
  - Scott Pond: Map 16 (Stations P-07 to P-09)



The Louis Berger Group, Inc.

Rhode Island DEM

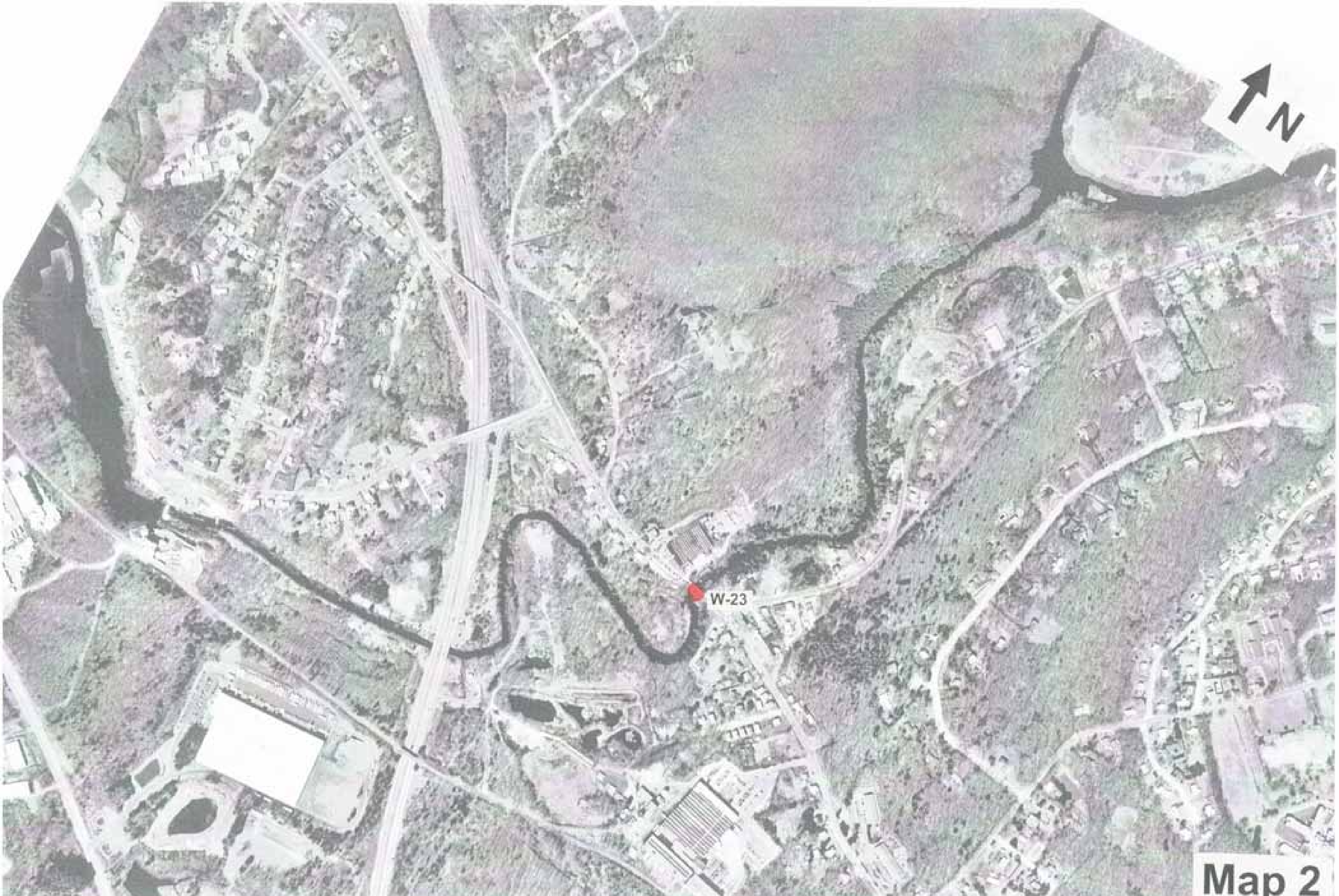
Source: RIGIS, MASSGIS

File: bw-base.apr

Blackstone River Water Quality

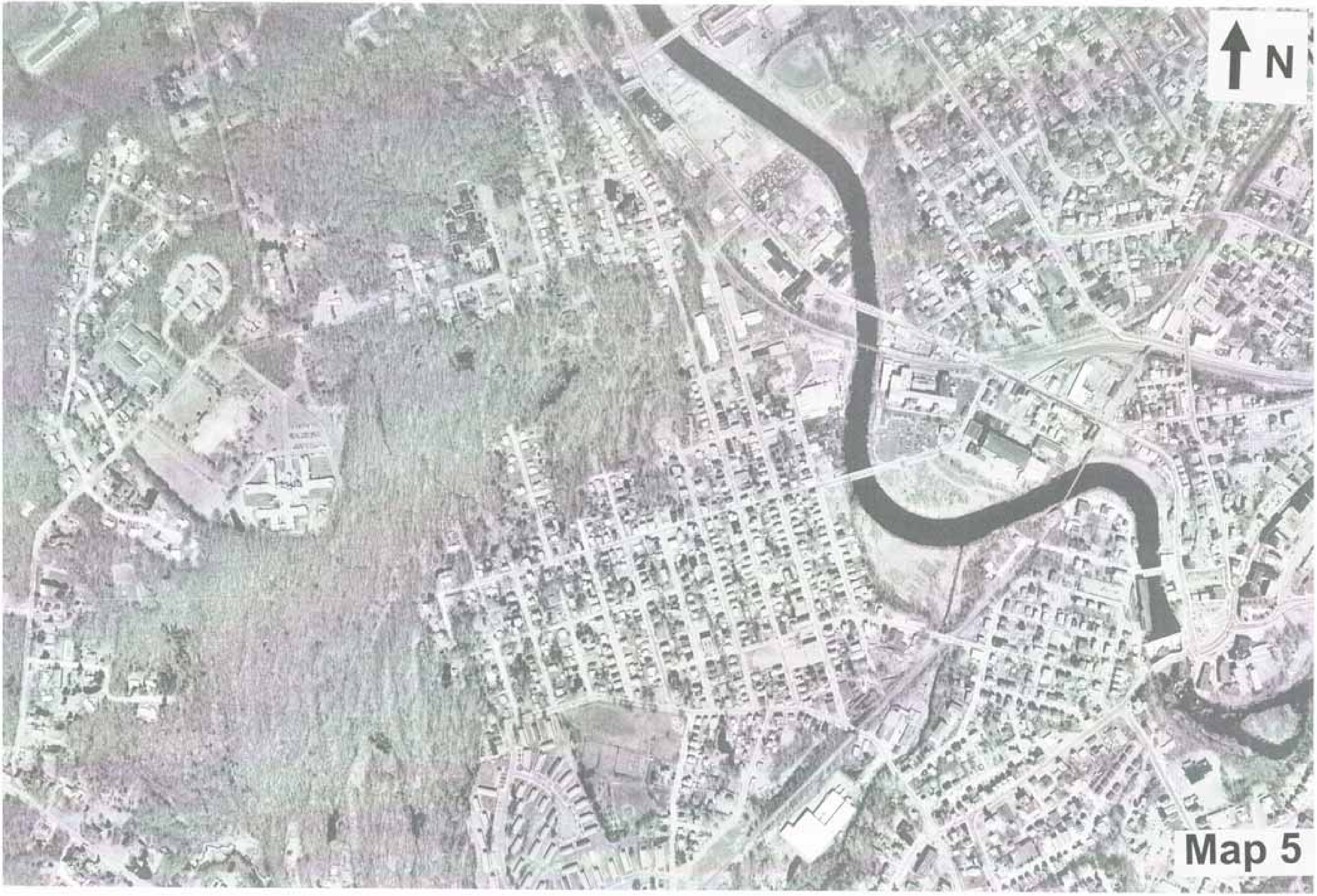
Figure B-1
WATER SAMPLING STATION LOCATIONS

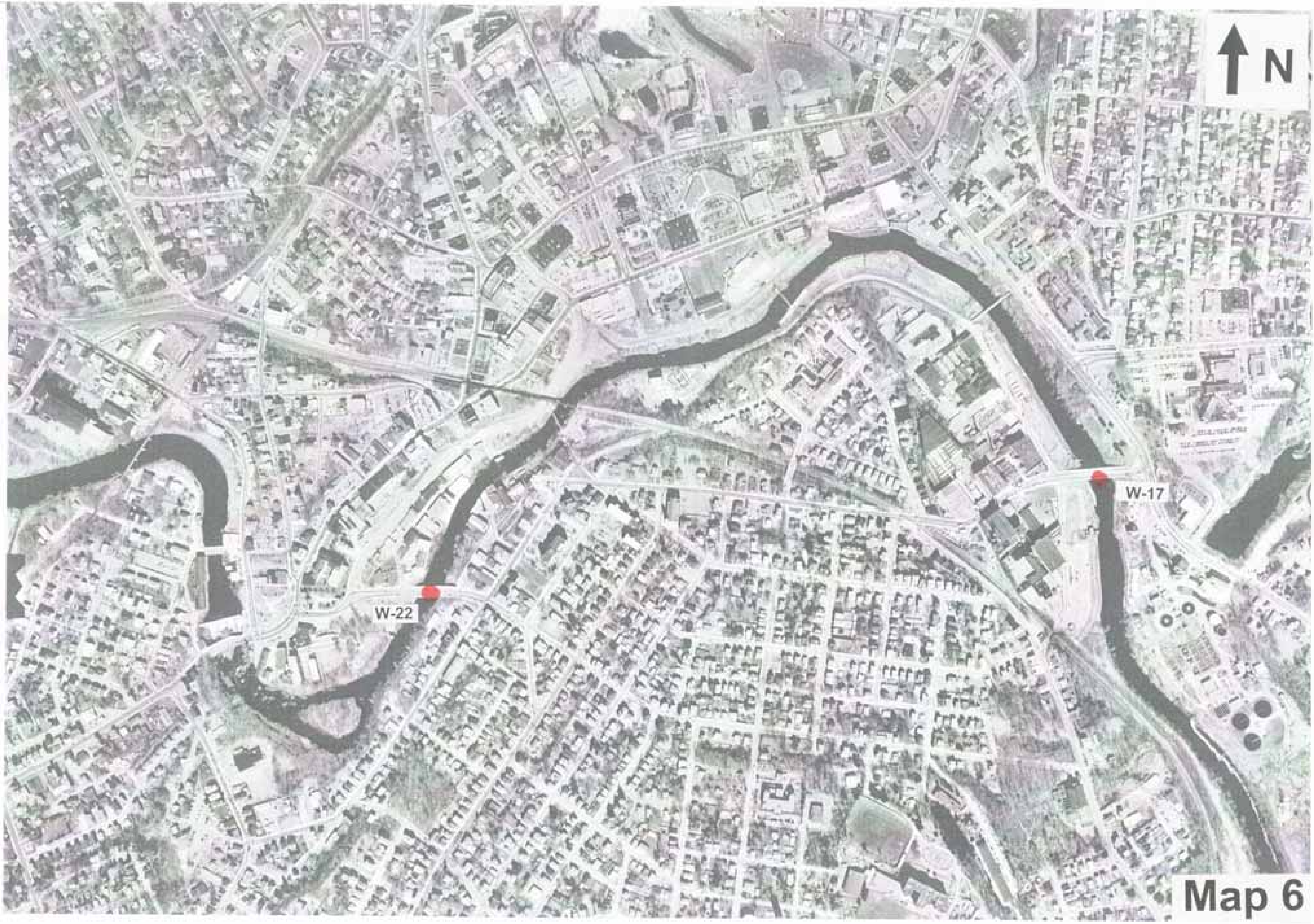

N
W-01
M-01
Map 1

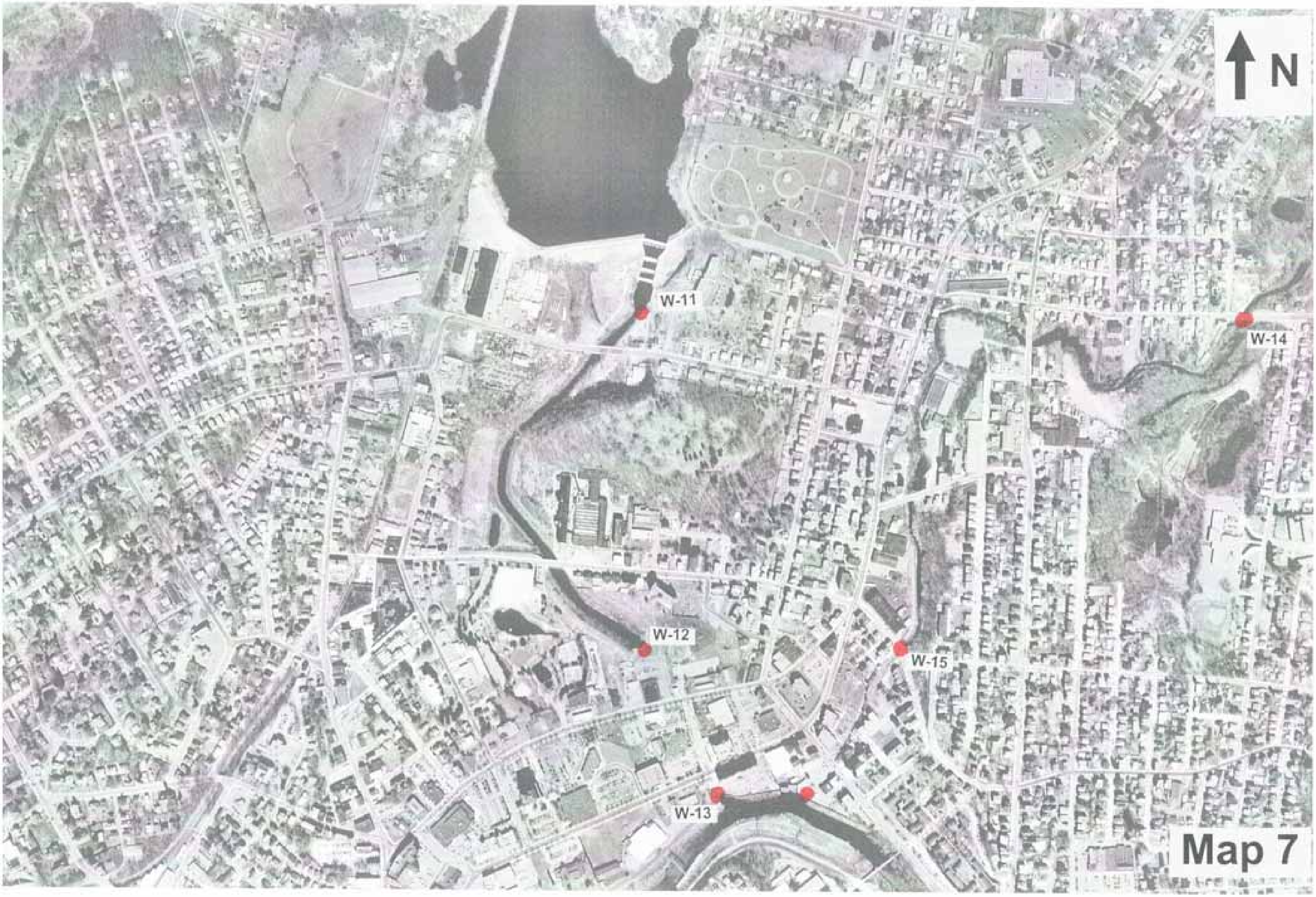

N
W-23
Map 2


3-26-99
N
Map 3

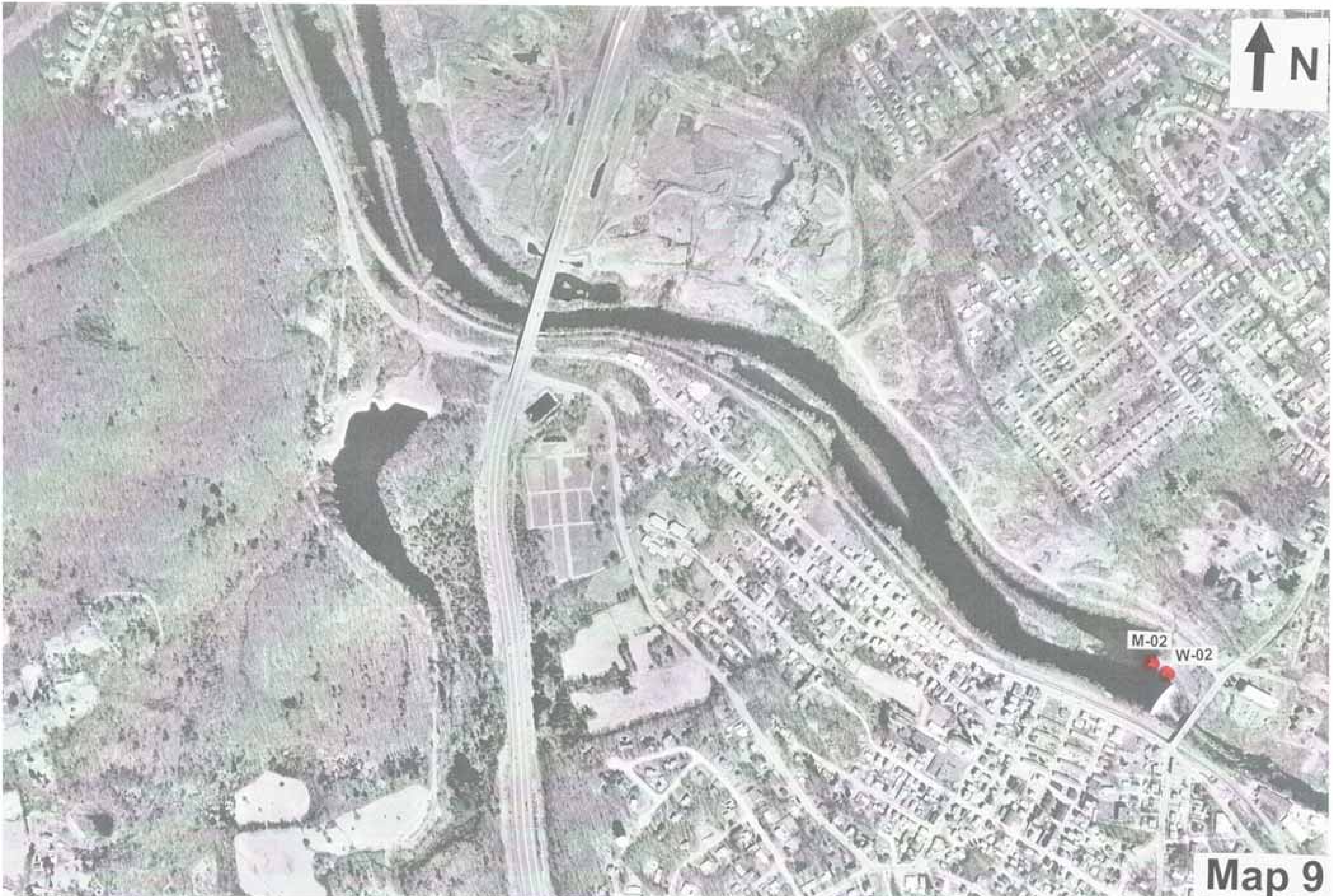

N
Map 4

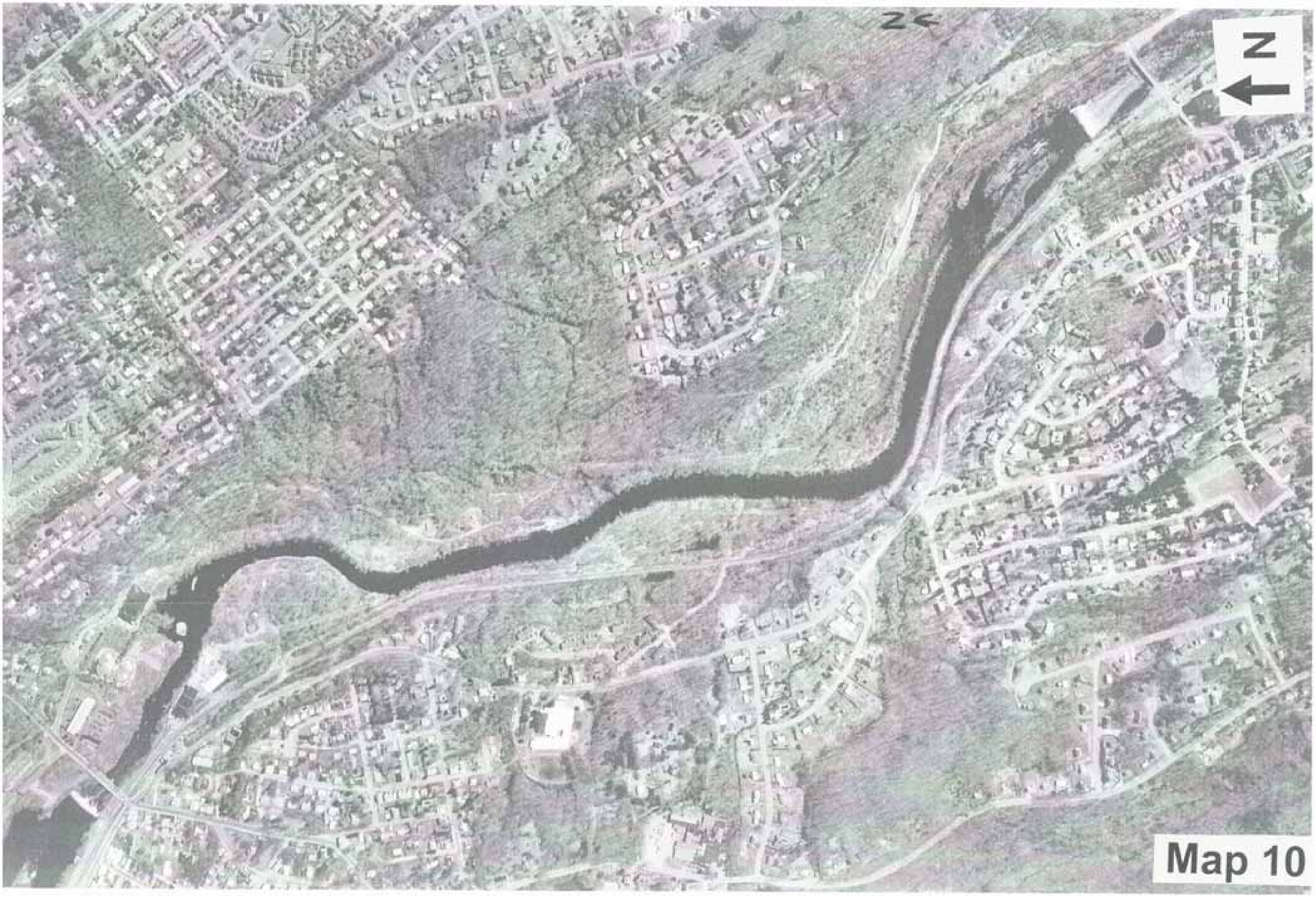

N
Map 5


N
W-17
W-22
Map 6


N
W-11
W-14
W-12
W-15
W-13
Map 7


N
Map 8


N
M-02
W-02
Map 9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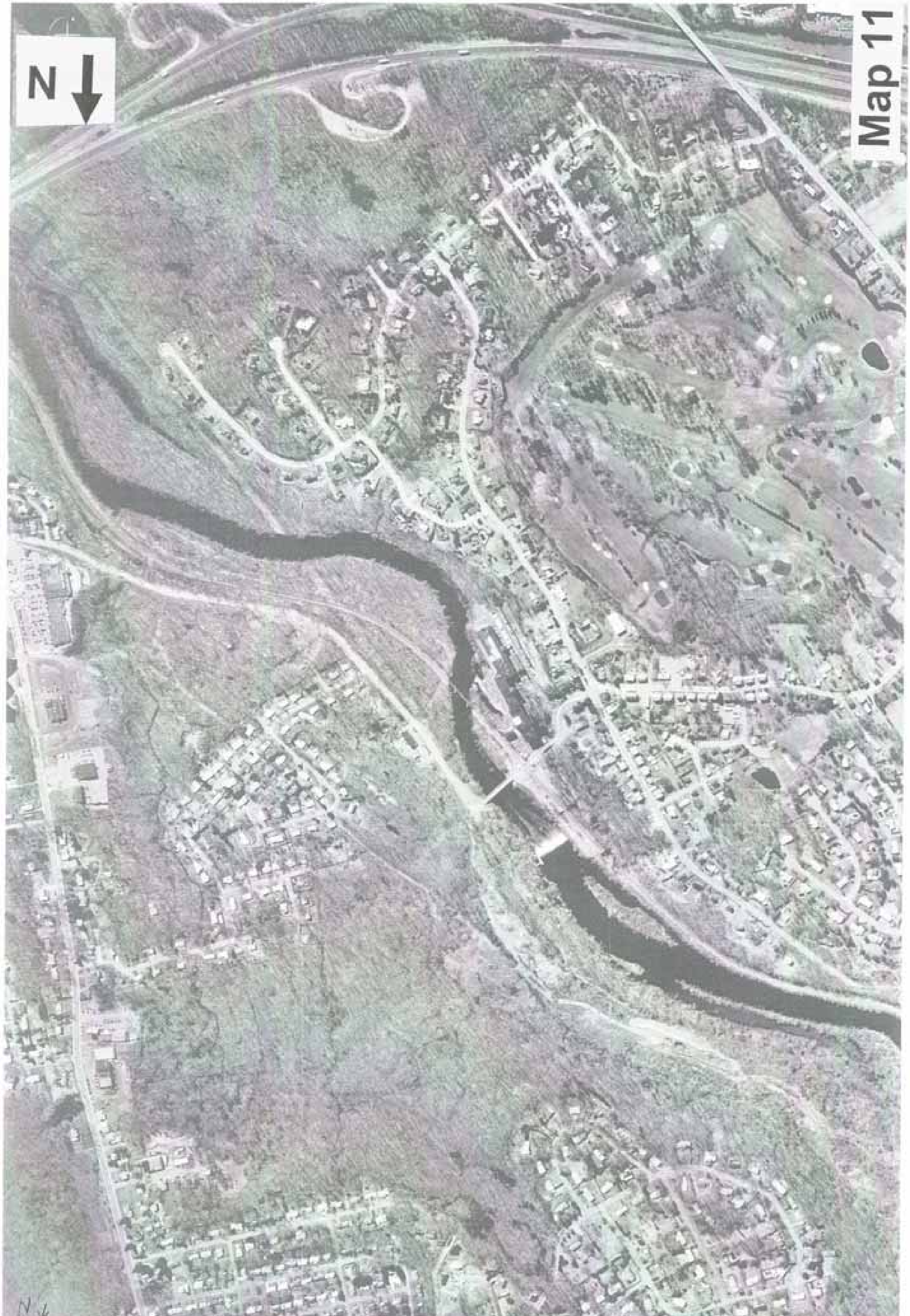
Map 10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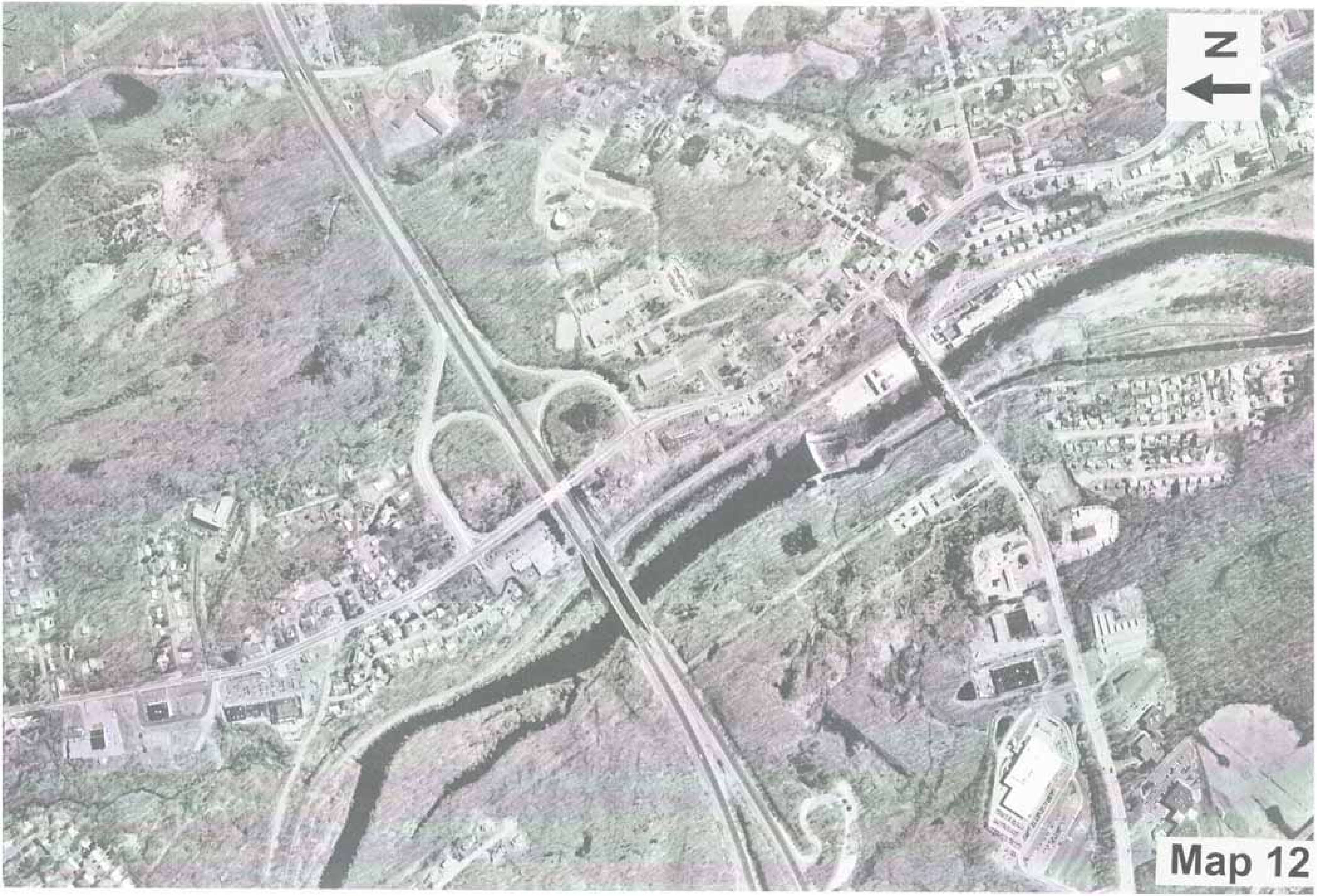
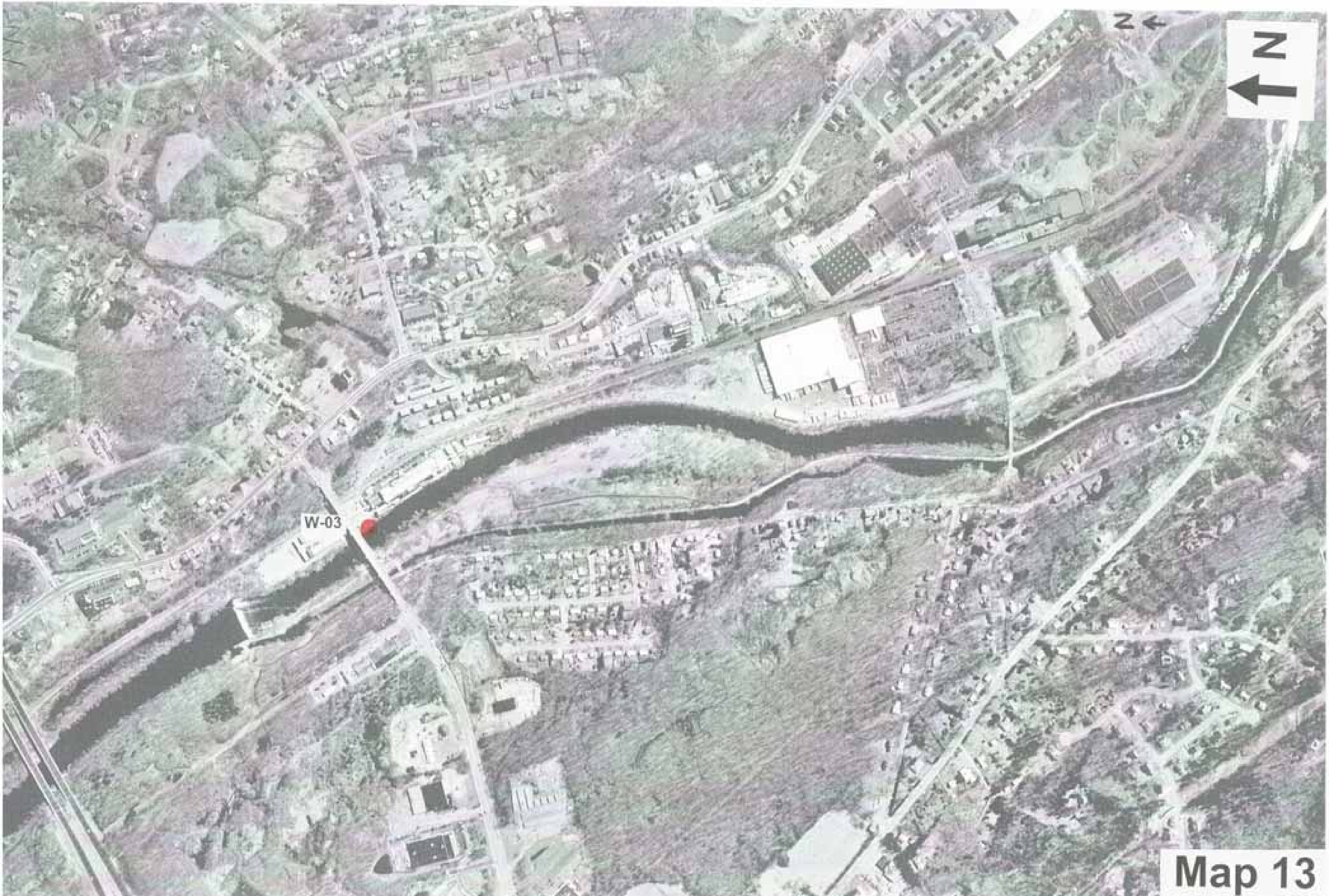
Map 11


N
Map 12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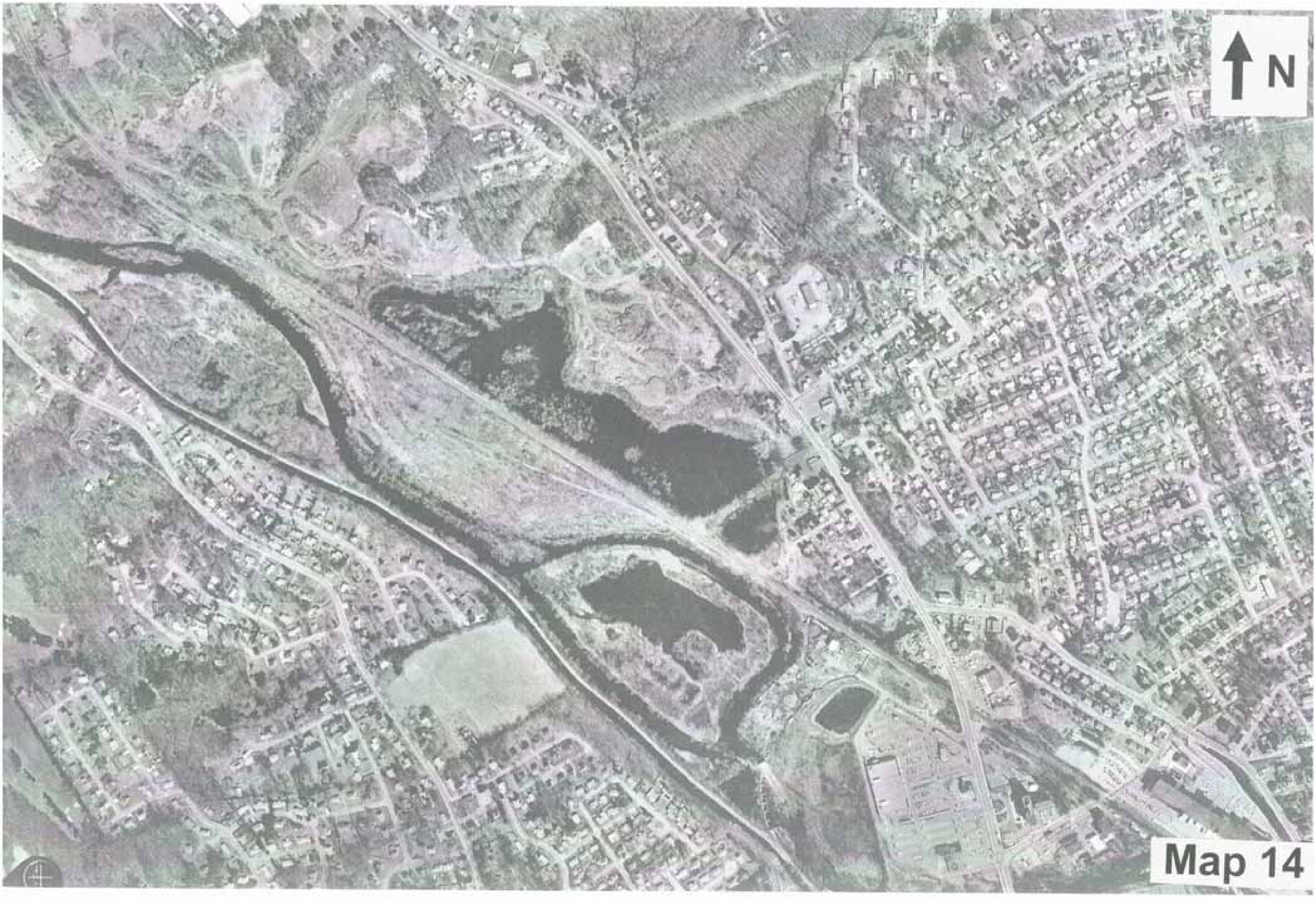
W-03
Map 13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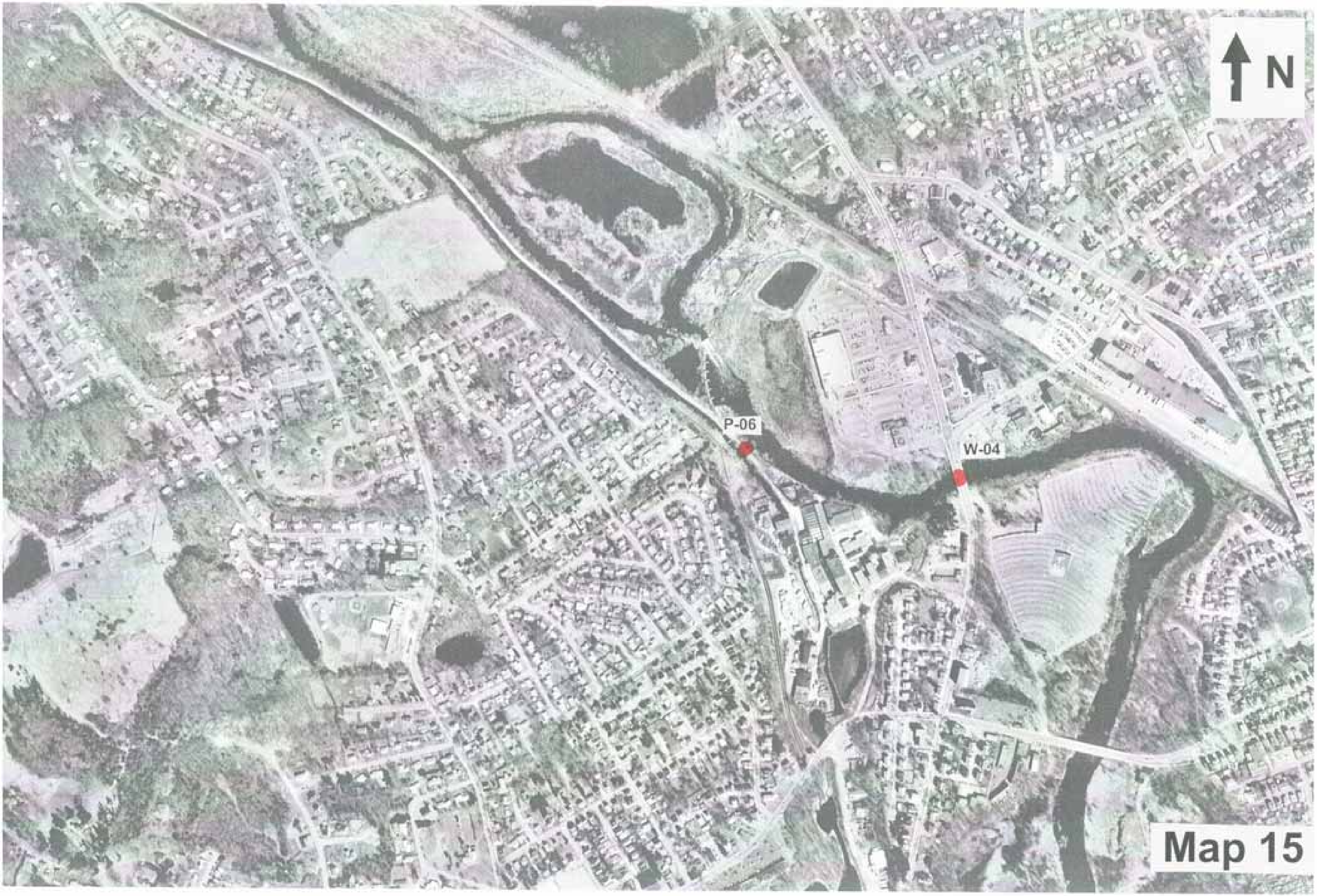
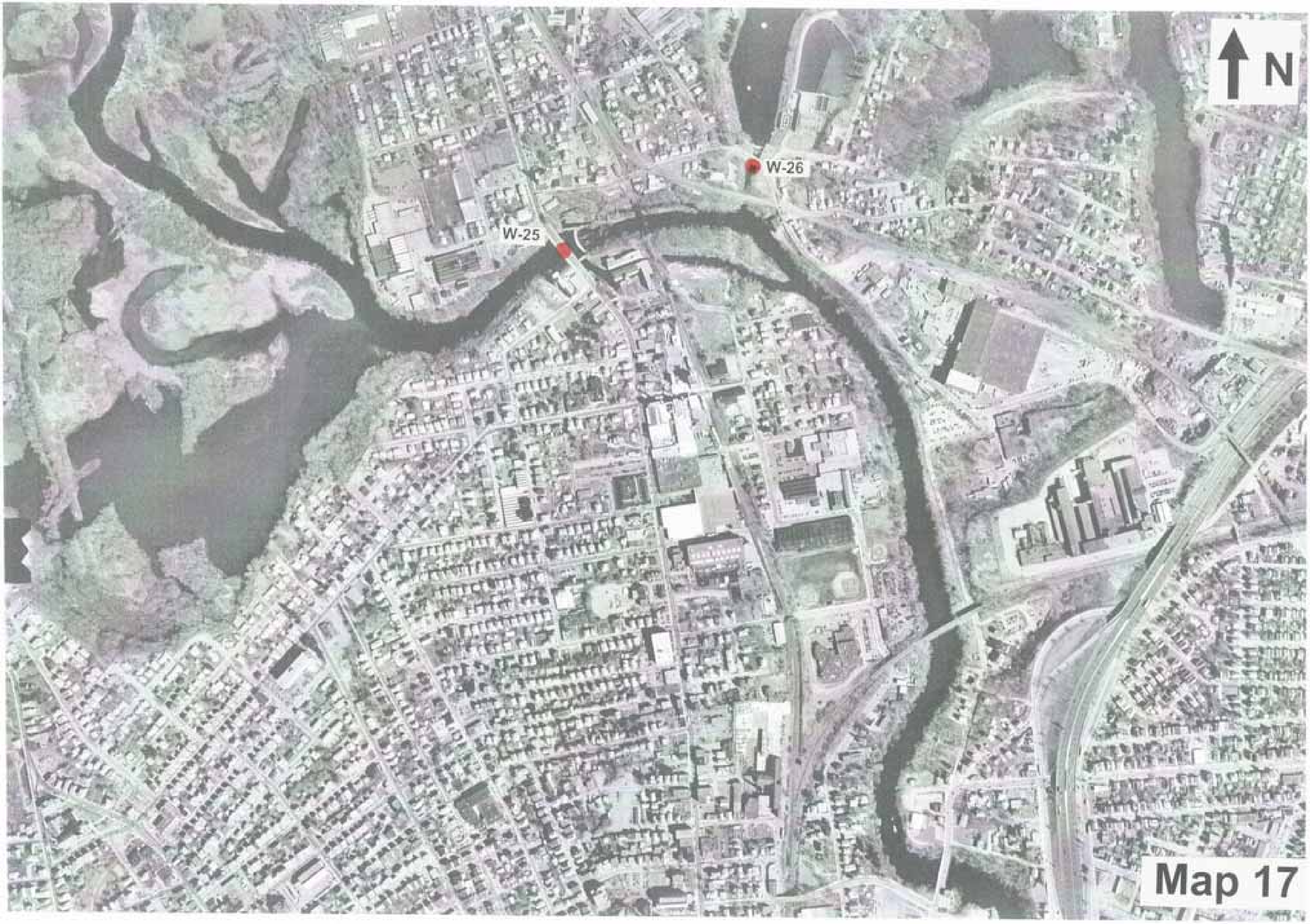
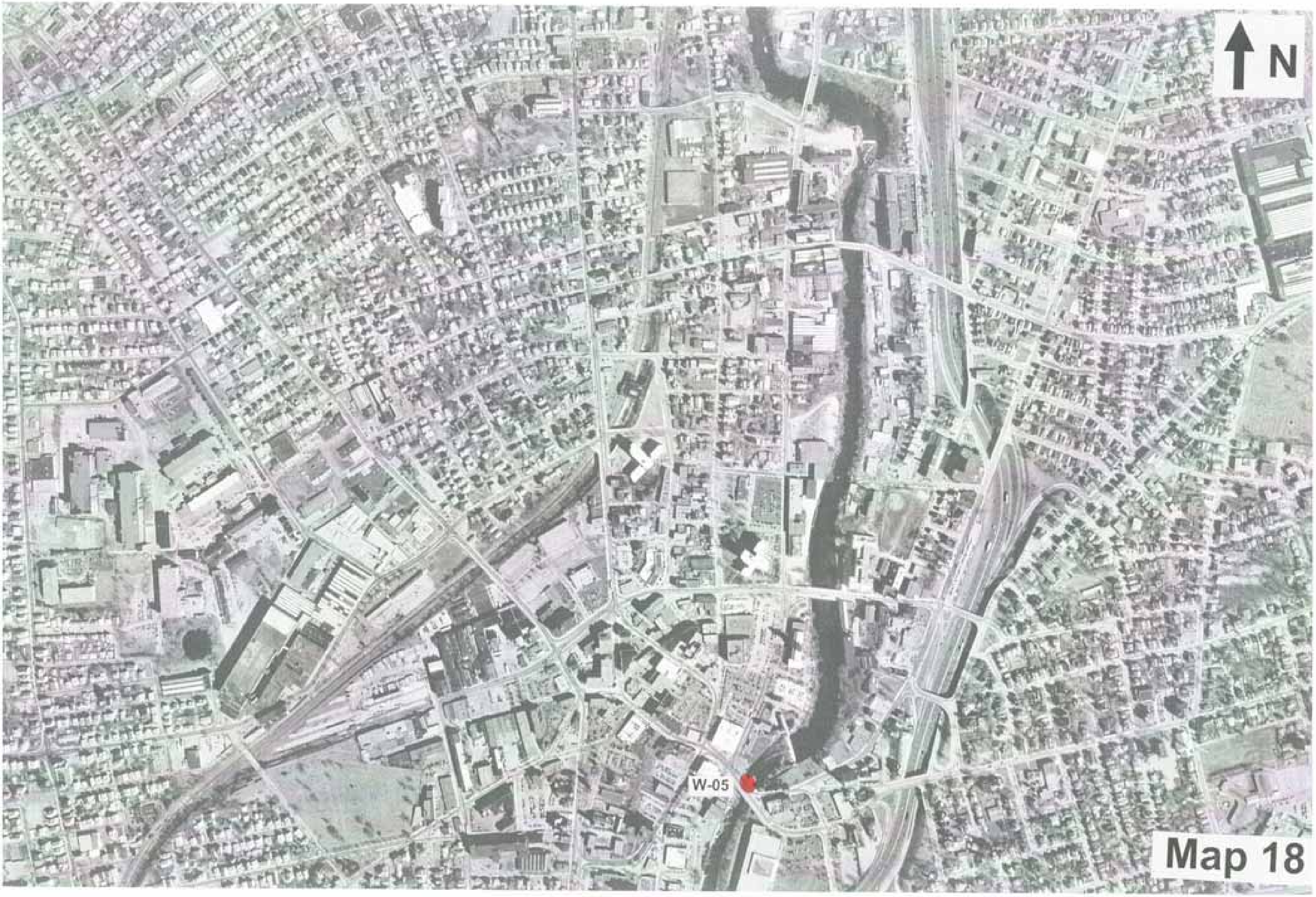
Map 14


N
P-06
W-04
Map 15


N
P-11
P-07
P-08
P-09
P-04
P-01
P-03
P-02
Map 16



Map 17


N
W-05
Map 18

Site Name /Project Name: ***Water Quality – Blackstone River***
Site Location: ***Woonsocket, Cumberland, Lincoln, Central Falls, Pawtucket, RI***

QUALITY ASSURANCE PROJECT PLAN
ADDENDUM 1

Lead Organization: Rhode Island Department of Environmental Management
July 21, 2005

Project Officer

_______________________________________ _______________

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Date

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_______________________________________ _______________

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Date

USEPA QA Manager

_______________________________________ _______________

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Date

Document Control Number: BRWQ-2005-001

Overview of Modification to QAPP

The following modification will be made to the project:

- **Addition of analysis for lead and copper using the ICP-MS methodology.**

As specified under the present QAPP, lead and copper are currently analyzed by ICP using EPA method 200.7 (Mitkem) and by EPA 1637 (Microinorganics). As a result of (a) the lower detection limit of Method 200.8 (ICP-MS) compared to Method 200.7, and (b) the lower costs compared to EPA 1637, the intention is to ultimately conduct all dissolved lead and copper analyses using Method ICP 200.8. This method achieves reporting limits that are below the regulatory standard. The total number of samples and sampling events as specified in the Work Plan of the QAPP (Appendix A) remains unchanged.

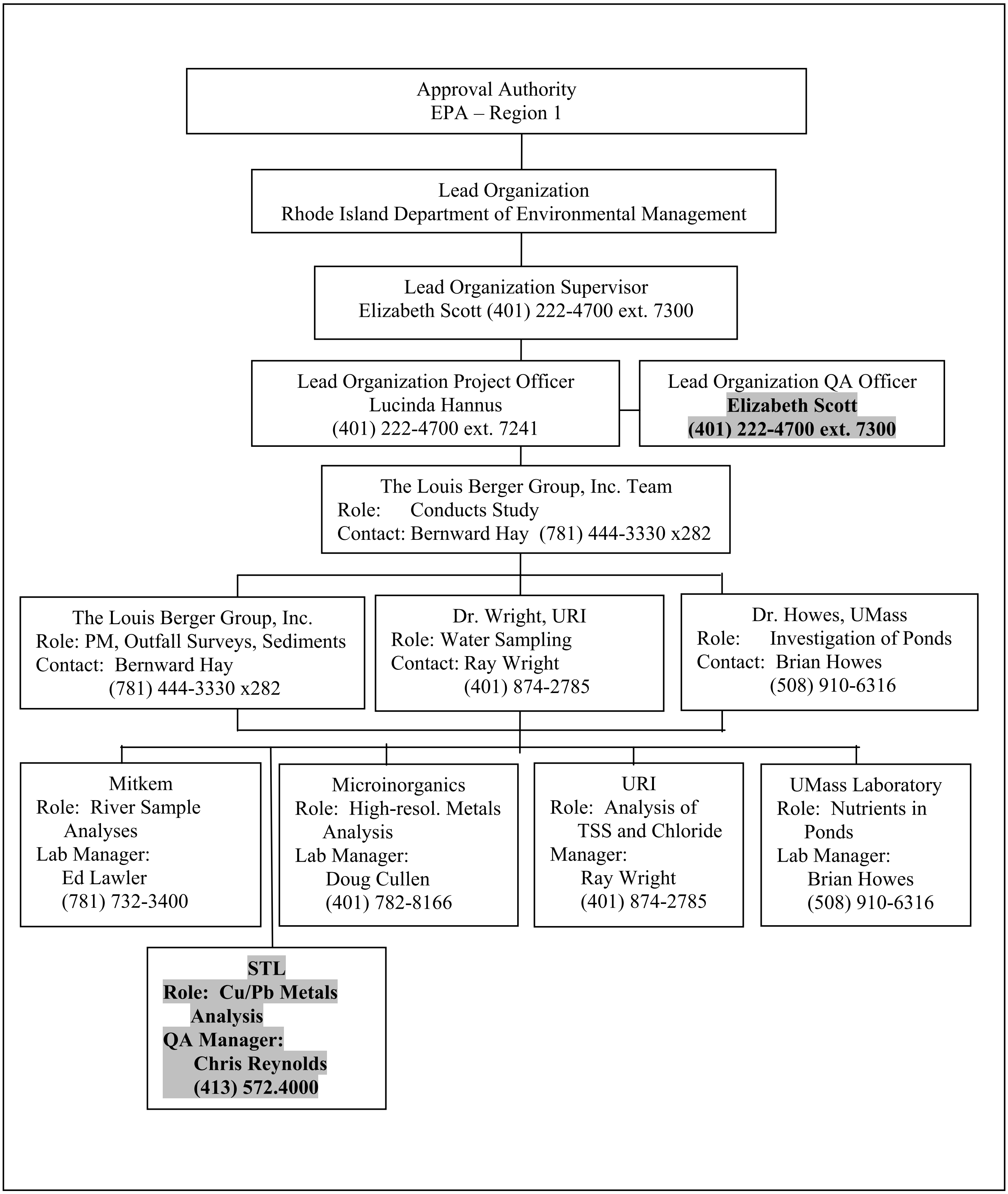
The next dry weather sampling event will utilize all three methods/laboratories for purposes of intercomparison of the results. Thereafter, the Method 200.8 is planned to be used exclusively.

Attached are updated data sheets of the QAPP that change as a result of this modification. Changes are flagged in highlights or in **red**.

Updated Table 3-1: QAPP Distribution List

QAPP Recipients	Title	Organization	Telephone Number
Elizabeth Scott	Supervisor **QA Officer**	RIDEM	(401) 222-4700 ext. 7300
Lucinda Hannus	Project Officer	RIDEM	(401) 222-4700 ext. 7241
Steve DiMattei	EPA QA Quality Assurance Chemist	USEPA, Region 1	(617) 918-8369
Bernward Hay	Project Manager	Louis Berger Group, Inc.	(781) 444-3330 ext.282
Ray Wright	Technical Advisor	University of Rhode Island	(401) 874-2785
Brian Howes	Technical Advisor	University of Massachusetts - SMAST	(508) 910-6316
Raed El-Farhan	QA Officer	Berger	(800) 348-7313
Ed Lawler	Laboratory Manager	Mitkem	(401) 732-3400
Doug Cullen	Laboratory Manager	Microinorganics	(401) 782-8166
Dave Turin	EPA Project Officer	USEPA	(617) 918-1598
Chris Reynolds	**QA/QC Manager**	**STL**	**(413) 572-4000**

Updated Figure 4-1: Project Organization



Updated Table 4-1: Personnel Responsibilities and Qualifications

Name	Title	Organi-zation	Responsibility	Education
Bernward Hay	Project Manager	Berger	Coordinates and oversees project. Oversees contractors. Provides QA for sample analyses for sediments.	Ph.D. MIT (Oceanography); M.S. Cornell University (Geology); Extensive project management and water quality assessment experience.
Raed El-Farhan	QA Officer	Berger	Reviews water quality data for TMDL development.	Ph.D. Clemens Univ. (Env. Engineering); M.S. Clemens Univ. (Env. Engineering); Extensive experience in TMDL development.
Ray Wright	Task Manager, Tasks 3 and 4	URI	Coordinates wet and dry weather sampling of rivers and tributaries. Provides QA for sample analyses for these tasks. Provides load calculations.	Professor at URI. Extensive experience in water quality analyses of the Blackstone River.
Brian Howes	Technical Advisor	UMass	Advises of field program for pond investigations. Provides QA for sample analyses for these pond samples. Evaluates data from the ponds.	Professor at UMass. Extensive experience in nutrient analyses in ponds and rivers in New England.
Ed Lawler	Laboratory Manager	Mitkem	Responsible for laboratory analyses in his lab.	Over 20 years of laboratory experience.
Karen Gavitt	Laboratory QA Manager	Mitkem	Responsible for QA of sample analyses in lab.	Over 10 years of laboratory experience.
Doug Cullen	Laboratory Manager	Micro-inorganics	Responsible for laboratory analyses and QA in his lab.	Over 20 years of laboratory experience.
Alynda Foreman	Macro-invertebrate Specialist	Berger	Responsible for macroinvertebrate study.	Over 10 years of experience in biological assessments including macroinvertebrate analyses.
Chris Reynolds	**QA Manager**	**STL**	**Responsible for QA of sample analyses in lab.**	**Over 17 years of laboratory experience.**

Table 6-1: Contaminant of Concern and Other Target Analytes

	Parameter	Laboratory	Analytical Method	Units	Project Limit	Method Detection Limit	Achievable Laboratory Limits	
							MDL	Quantification Limits
Water	Fecal Coliform	Mitkem	SM 9221E	col/100 ml	<5 to >50,000	0 to 1,000,000	<5 to >50,000	
	Enterococci	Mitkem	SM 9230C	col/100 ml	<5 to >50,000	0 to 1,000,000	<5 to >50,000	
	Total Phosphorus (river)	Mitkem	E365.2	mg/l	0.05	0.007	0.007	0.033
	Total Kjeldahl Nitrogen (river)	Mitkem	SM 4500 - TKN	mg/l	0.75	0.54	0.54	1.6
	Ammonia (river)	Mitkem	SM4500 - NH3	mg/l	0.05	0.021	0.021	0.2
	Nitrate (river)	Mitkem	E 300	mg/l	0.1	0.0068	0.0068	0.025
	Total Phosphorus (ponds)	SMAST	SM (17th ed, 1989, p. 4-170)	mg/l	0.05	0.003	0.003	NA
	Orthophosphate (ponds)	SMAST	Molybdate ascorbic acid method	mg/l	0.01	0.003	0.003	NA
	Total Dissolved Nitrogen (ponds)	SMAST	Persulfate digestion, Cd reduction	mg/l	0.05	0.0007	0.001	NA
	Partic. Org. Carbon/Nitrogen (ponds)	SMAST	High-temperature Combustion	mg/l		0.001		
	Ammonia (ponds)	SMAST	Phenol hypochloride	mg/l	0.01	0.001	0.001	NA
	Nitrate (ponds)	SMAST	Cd reduction	mg/l	0.1	0.0007	0.001	NA
	Chlorophyll a / Phaeopigment	SMAST	Turner Auto Fluorometer	ug/l	1	0.05	0.100	NA
	Total Suspended Solids	Wright/URI	SM2540D	mg/l	0.5	0.010	0.001	NA
	Volatile Suspended Solids	Wright/URI	SM2540E	mg/l	0.5	0.010	0.001	NA
	Chloride	Wright/URI	Orion Electrode Procedure	mg/l	1.0	0.100	0.100	NA
	Dissolved Copper	Mitkem	SW6010 (*)	ug/l	3.5	3.15	3.15	15
	Dissolved Lead	Mitkem	SW6010 (*)	ug/l	0.5	0.23	0.2	5
	Dissolved Copper (alternative)	**STL**	**EPA 200.8**	**ug/l**	**3.5**	**0.75**	**0.75**	**1.0**
	Dissolved Lead (alternative)	**STL**	**EPA 200.8**	**ug/l**	**0.5**	**0.35**	**0.35**	**1.0**
	Dissolved Copper (alternative)	Micro-inorganics	EPA 1637	ug/l	3.5	0.087	0.058	0.10
	Dissolved Lead (alternative)		EPA 1637	ug/l	0.5	0.036	0.033	0.17
	Hardness	Mitkem	SM 2340B	mg/l	5	0.3	0.3	4
Sediment	Arsenic	Mitkem	SW6010	mg/kg	2	0.076	0.076	1
	Cadmium	Mitkem	SW6010	mg/kg	0.5	0.0055	0.0055	0.3
	Chromium	Mitkem	SW6010	mg/kg	5	0.014	0.014	1
	Copper	Mitkem	SW6010	mg/kg	5	0.21	0.21	1.5
	Lead	Mitkem	SW6010	mg/kg	2	0.041	0.041	0.5
	Mercury	Mitkem	SW7471	mg/kg	0.02	0.007	0.007	0.0033
	Nickel	Mitkem	SW6010	mg/kg	5	0.026	0.026	2.5
	Total Organic Carbon	SMAST	High temp. combustion	mg/g	5	1.0	1.0	NA
	Total Organic Nitrogen	SMAST	High temp. combustion	mg/g	5	0.5	0.5	NA
	Total Phosphorus	SMAST	SM (17th ed, 1989, p. 4-170)	mg/g	1	0.1	0.1	NA
	Grain size	Mitkem	Sieve analysis		<63 um to 5 cm	<63 um to 5 cm		

NA Not applicable.
(*) Samples will be pre-concentrationed to 50% of the original volume.

Table 6-2: Field and Quality Control Samples (by Task) (*)

	Parameter	Labora-tory	SOP	Method	Task 2: Discharge Source Analyses		Task 3: Dry Weather Sampling		Task 4: Wet Weather Sampling		Task 9: Valley Falls Pond		Task 10: Scott Pond		No. of Samples	No. QA/QC Samples
					Sam-ples	QA/ QC	Sam-ples	QA/ QC	Sam-ples	QA/ QC	Sam-ples	QA/ QC	Sam-ples	QA/ QC		
Water	Fecal Coliform	Mitkem	1,2,3,5	SM 9221E	67	8	162	27	396	41	40	10	40		705	86
	Enterococci	Mitkem		SM 9230C			132	21	210	23	40	10	40		422	54
	Total Phosphorus (river)	Mitkem	2,3	E365.2			162	27	354	36					516	63
	Total Kjeldahl Nitrogen (river)	Mitkem		SM 4500 - TKN			162	27	354	36					516	63
	Ammonia (river)	Mitkem		SM 4500 - NH3			162	27	354	36					516	63
	Nitrate (river)	Mitkem		E 300			162	27	354	36					516	63
	Total Phosphorus (ponds)	SMAST	5	SM (17th ed, 1989, p. 4-170)							24	6	54	6	78	12
	Orthophosphate (ponds)	SMAST		Molybdate ascorbic acid method							24	6	54	6	78	12
	Total Dissolved Nitrogen (ponds)	SMAST		Persulfate digestion, Cd reduction							24	6	54	6	78	12
	Partic. Org. Carbon/Nitrogen (ponds)	SMAST		High-temperature Combustion							24	6	54	6	78	12
	Ammonia (ponds)	SMAST		Phenol hypochloride							24	6	54	6	78	12
	Nitrate (ponds)	SMAST		Cd reduction							24	6	54	6	78	12
	Chlorophyll a / Phaeopigment	SMAST	2,5	Turner Auto Fluorometer			90	18			24	6	54	6	168	30
	Total Suspended Solids	Wright/URI	2,3	SM2540D			162	27	354	36					516	63
	Volatile Suspended Solids	Wright/URI		SM2540E			162	27	354	36					516	63
	Dissolved Copper	Mitkem	1,2,3,5	SW6010			194 (Cu & Pb)	32 (Cu & Pb)	396 (Cu & Pb)	41 (Cu & Pb)	24 (Cu & Pb)	6 (Cu & Pb)	54 (Cu & Pb)	6 (Cu & Pb)	735 (Cu & Pb)	93 (Cu & Pb)
	Dissolved Lead	Mitkem		SW6010												
	Dissolved Copper (alternative)	**STL**	**1,2,3,5**		67	8										
	Dissolved Lead (alternative)	**STL**			67	8										
	Dissolved Copper (alternative)	Micro-inorganics	2,3	EPA 1637 (1)												
	Dissolved Lead (alternative)			EPA 1637 (1)												
	Hardness	Mitkem	1,2,3,5	SM 2340B	67	8									67	8
Sediment	Arsenic	Mitkem	5	SW6010							2	1	3	part of Task 9 sample set	5	1
	Cadmium	Mitkem		SW6010												
	Chromium	Mitkem		SW6010												
	Copper	Mitkem		SW6010												
	Lead	Mitkem		SW6010												
	Mercury	Mitkem		SW7471												
	Nickel	Mitkem		SW6010												
	Total Organic Carbon	SMAST		High temp. combustion							2	1	3		5	1
	Total Organic Nitrogen	SMAST		High temp. combustion							2	1	3		5	1
	Total Phosphorus	SMAST		SM (17th ed, 1989, p. 4-170)							2	1	3		5	1
	Grain size	Mitkem		Sieve analysis							2	1	3		5	1
Macroalgal Assay		SMAST	6	Microscope							2				2	
Phytoplankton		SMAST (Normandeau)	7	Microscope							2		2		4	
Totals					**268**	**32**	**1906**	**319**	**3918**	**403**	**334**	**85**	**637**	**60**	**7063**	**899**

Updated Table 6-3: Analytical Services

Medium/ Matrix	Analytical Parameter	Concen-tration Level	Analytical Method /SOP	Data Package Turn-around Time	Laboratory / Organization Contact	Backup Laboratory / Organi-zation Contact
Water, sediment	Metals, Nutrients (from river sampling)	Low to high	SOP-12	2 weeks	Mitkem Corporation 175 Metro Center Blvd. Warwick, RI 02886 Tel: 401-732-3400	NA
Water	Metals	Low to high	SOP-11	2 weeks	Microinorganics, Inc. 15 Reactor Road Narragansett, RI 02882 Tel: 401-782-8166	NA
Water	Bacteria	Low to medium	SOP-12	2 weeks	RI Analytical Laboratories (subcontractor to Mitkem) 41 Illinois Avenue Warwick, RI 02888 Tel: 401-737-8500	NA
Water	Nutrient (from ponds), Chlorophyll, Macroalgae	Low to high	SOP-10	2 weeks	School of Marine Science and Technology Univ. of Massachusetts 706 Rodney French Bvld. New Bedford, MA 02744 Tel: 508-999-8193	NA
Water	Turbidity, Chloride	Low to medium	SOP-9	2 weeks	University of Rhode Island Department of Civil and Environmental Engineering Bliss Hall Kingston, RI 02881 Tel: 401-874-2785	NA
Sediment	Grain size	Clay to sand	Sieve Analysis	2 weeks	GeoTesting Express (subcontractor to Mitkem) 1145 Massachusetts Ave. Boxborough, MA 01719 Tel: 978-635-0424	NA
Water	Phytoplankton	NK	SOP-7	2 weeks	Normandeau Assoc., Inc. (subcontractor to UMass) 25 Nashua Road Bedford, NH 03110 Tel: 603-472-5191	NA
Water	**Lead, copper**	**Low to medium**	**SOP-13**	**2 weeks**	**STL Westfield 53 Southhampton Road Westfield, MA 01085 Tel: 413-572-4000**	**NA**

NK = Concentration levels not known. They will vary based on weather conditions and/or location.

NA = Not applicable.

New Table 7-22: Measurement Performance Criteria – Dissolved Copper and Lead (Lab: STL)

Medium/Matrix	Surface Water		
Analytical Parameter	Copper, Lead (dissolved)		
Concentrations Level	Low to medium		
Sampling Procedure	SOP-1, SOP-2, SOP-3, SOP-5		
Analytical Method/SOP	EPA 200.8 (ICP-MS)		
Data Quality Indicators (DQIs)	**Measurement Performance Criteria**	**QC Sample and /or Other Activity Used to Assess Measurement Performance**	**QC Sample assesses Error for Sampling (s), Analytical (A) or both (S/A)**
Precision	≤ 20% RPD	Field/Lab Duplicates	S/A
Accuracy	70-130%	MS/MSD	A
Accuracy/bias, Contamination	85-115, ≤ 20% < RL	LCS/LCD Method Blk	A
Sensitivity	See Table 6-1		
Data Completeness	Data collected are determined to be usable		

Updated Table 8-1: Sampling Locations, Sampling and Analysis Method/SOP Requirement

Station Loc.	Station Number	Matrix	Analytical Parameter	Conc. Level	Sampl. SOP	Anal. Method /SOP	Sample Vol.	Containers (number, size and type)	Preservation Requirements (chemical, temp., light protected)	Maximum Holding Time (preparation /analysis)
River, outfalls	W-01 to W-34	Surface water, Outfalls	Fecal Coliform Enterococci	Low to medium	SOP-1, 2, 3	SOP-12	100ml	2-specimen cup	none	6 hours
			Total Phosphorus	Low to medium	SOP-2 SOP-3	SOP-12	250 ml	1-250 ml Amber glass	H2SO4	7 days
			TKN, Ammonia	Low to medium	SOP-2 SOP-3	SOP-12	500ml	1-500 ml HDPE	H2SO4	28 days
			Nitrate	Low to high	SOP-2 SOP-3	SOP-12	500 ml	1-500 ml HDPE	Cool 2-6° C	48 hours/ 7 days
			Chlorophyll	Low to high	SOP-2	Acetone Extr. / SOP-10	1 liter	1 liter Nalgene dark/opaque	dark/opaque bottle	<24 h
			Total Susp. Solids	Low to high	SOP-2 SOP-3	SOP-9	1 Liter	1 Liter HDPE	4ºC	7 days
			Volatile Organic Solids	Low to high	SOP-2 SOP-3	SOP-9	1 Liter	1 Liter HDPE	4ºC	7 days
			Chloride	Low to high	SOP-2 SOP-3	SOP-9	100 ml	100 ml HDPE		28 days
			Dissolved Lead and Copper, Hardness *(Mitkem/**STL**)*	Low to medium	SOP-1 SOP-2 SOP-3	SOP-12 (Mitkem) SOP-13 (STL)	500 ml	1- 500 ml HDPE	None	6 months
			Dissolved Lead and Copper *(Microinorganics)*	Low to medium	SOP-2 SOP-3	SOP-11	500 ml	LDPE, cleaned via SOP-11	4ºC	< 24h to filtration
Ponds	P-01 to P-11	Water column in ponds	Orthophosphate	Low to high	SOP-5	Molybdate/ Ascorbic Acid	60 ml	60 cc HDPE	4° C	<24 h
			Total Phosphorus	Low to high	SOP-5	Hot Acid Digestion	60 ml	60 cc HDPE	Acidify to pH <2	Indefinite
			Total Dissolved Nitrogen	Low to high	SOP-5	Persulfate, Cd Reduction	60 ml	60 cc HDPE	Frozen at -40° C	Indefinite
			Ammonia	Low to high	SOP-5	Phenol-hypochlorite	600 ml	60 cc HDPE	4° C	<24 h
			Nitrate	Low to high	SOP-5	Cd reduction	60 ml	60 cc HDPE	Frozen at -40° C	Indefinite
			Particulate Organic Nitrogen	Low to high	SOP-5	High Temp. Combustion	1 liter	1 liter Nalgene dark/opaque	<24 h	<24 h
			Fecal Coliform Enterococci	Low to medium	SOP-5	(Same as above for W-01 to W-34)				
			Chlorophyll	Low to high	SOP-5	(Same as above for W-01 to W-34)				
			Dissolved Lead & Copper, Hardness	Low to medium	SOP-5	(Same as above for W-01 to W-34)				

Station Loc.	Station Number	Matrix	Analytical Parameter	Conc. Level	Sampl. SOP	Anal. Method /SOP	Sample Vol.	Containers (number, size and type)	Preservation Requirements (chemical, temp., light protected)	Maximum Holding Time (preparation /analysis)
Sediment	P-01 & 02, P-07 to 09	Surface sedi-ment	Metals (As, Cs, Cr, Cu, Ni, Pb, Hg)	Low to medium	SOP-6	SOP-12	10 g	1- 4oz Amber wide-mouth	Cool to 2-6° C	28 days/6 months
			Total Organic Carbon and Nitrogen	Low to medium	SOP-6	High Temperature Combustion / SOP-10	100 g	100 ml HDPE	4º C	<24 h
			Total Organic Phosphorus	Low to medium	SOP-6	High Temperature Combustion / SOP-10	100 g	100 ml HDPE	4º C	<24 h
			Grain size	NA	SOP-6	Sieve Analysis / SOP-12	1 kg	1 liter container	None.	None

Table 12-1: Fixed Laboratory Analytical Method/SOP Reference Table

Ref. No	Fixed Laboratory Performing Analysis	Title, Revision Date and/or Number	Defini-tive or Screen-ing	Analytical Parameter	Method / Instrument	Modi-fied for Work Project (Y or N)
Water Samples						
SOP-12	Mitkem (Subcontracted)		Definitive	Fecal Coliform	SM 9221E	N
SOP-12	Mitkem (Subcontracted)		Definitive	Enterococci	SM 9230C	N
SOP-12	Mitkem		Definitive	Total Phosphorus (river)	E365.2	N
SOP-12	Mitkem		Definitive	Total Kjeldahl Nitrogen, Ammonia (river)	SM 4500	N
SOP-12	Mitkem		Definitive	Nitrate (river)	E 300 / IC	N
SOP-10	UMass	Total Phosphorus/Total Dissolved Phosphorus by Digestion with Hot Sulfuric Acid/Nitric Acid, January 13, 2003	Definitive	Total Phosphorus (ponds)	Hot Acid Digestion: Standard Methods for the Examination of Water and Wastewater, 19th edition, 1995. Method 4500-P B. Molybdate ascorbic acid Standard Methods 19th Edition, Method 4500-P-E Murphy, J. and J. Riley. 1962. Analytica Chimica Acta 27:31-36.	N
SOP-10	UMass	Orthophosphate, January 13, 2003	Definitive	Orthophosphate (ponds)	Molybdate ascorbic acid Standard Methods 19th Edition, Method 4500-P-E Murphy, J. and J. Riley. 1962. Analytica Chimica Acta 27:31-36.	N
SOP – 10	UMass	Total Nitrogen/Total Dissolved Nitrogen, January 13, 2003	Definitive	Total Dissolved Nitrogen (ponds)	Persulfate digestion, Cd reduction Standard Methods 19th Edition, Method 4500-Norg-D D'Elia, C.F., P.A. Steudler and N. Corwin. 1977. Determination of total nitrogen in aqueous samples using persulfate digestion. Limnol. Oceanogr. 22:760-764. Standard Methods 19th Edition, Method 4500-NO3-F using Lachat Autoanalysis procedures based upon: Wood, E., F. Armstrong and F. Richards. 1967. J. Mar. Biol. Ass. U.K. 47:23-31. Bendschneider, K. and R. Robinson. 1952. J. Mar. Res. 11:87-96.	N
SOP – 10	UMass	Particulate Organic Carbon and Nitrogen, January 13, 2003	Definitive	Particulate Organic Nitrogen	Perkin-Elmer Model 2400 CHN Analyzer Technical Manual.	N
SOP – 10	UMass	Ammonium, January 13, 2003	Definitive	Ammonia (ponds)	Phenol hypochloride Standard Methods 19th Edition, Method 4500-NH3-F and Schneider, D. 1976. Determination of ammonia and Kjeldahl	N

Ref. No	Fixed Laboratory Performing Analysis	Title, Revision Date and/or Number	Defini-tive or Screen-ing	Analytical Parameter	Method / Instrument	Modi-fied for Work Project (Y or N)
					nitrogen by indophenol method. Water Resources 10:31-36.	
SOP – 10	UMass	Nitrate+Nitrite, January 13, 2003	Definitive	Nitrate (ponds)	Cd reduction Standard Methods 19th Edition, Method 4500-NO3-F using Lachat Autoanalysis procedures based upon: Wood, E., F. Armstrong and F. Richards. 1967. J. Mar. Biol. Ass. U.K. 47:23-31. Bendschneider, K. and R. Robinson. 1952. J. Mar. Res. 11:87-96.	N
SOP-10	UMass	Chlorophyll a	Definitive	Chlorophyll a	Acetone Extraction, Turner Auto Fluorometer Parsons, T.R., Y. Maita and C. Lalli. 1989. Manual of Chemical and Biological Methods for seawater analysis. Pergamon Press, 173 pp.	N
SOP-9	URI	Total Suspended Solids	Definitive	Total Suspended Solids	SM2540D	N
SOP-9	URI	Volatile Organic Solids	Definitive	Volatile Organic Solids	SM2540E	N
SOP-9	URI	Chloride	Definitive	Chloride	Ion Electrode	N
SOP-12	Mitkem		Definitive	Dissolved Copper and Lead	SW 6010/ICP (with preconcentration of sample by 50%)	N
SOP-11	Microinorganics		Definitive	Dissolved Copper and Lead	EPA 1637	N
SOP-9	Mitkem		Definitive	Hardness	SM 2340B / Calculation from ICP Results	N
SOP-13	**STL**		**Definitive**	**Dissolved Copper and Lead**	**EPA Method 200.8 (ICP-MS)**	**N**
Sediments						
SOP-12	Mitkem		Definitive	Total Metals	SW 6010 /ICP	N
SOP-10	UMass	Particulate Organic Carbon and Nitrogen, January 13, 2003	Definitive	Total Organic Carbon, Nitrogen	High temperature combustion Perkin-Elmer Model 2400 CHN Analyzer Technical Manual.	N
SOP-10	UMass	Total Phosphorus/Total Dissolved Phosphorus by Digestion with Hot Sulfuric Acid/Nitric Acid, January 13, 2003	Definitive	Total Organic Phosphorus	Hot Acid Digestion: Standard Methods for the Examination of Water and Wastewater, 19th edition, 1995. Method 4500-P B. Molybdate ascorbic acid Standard Methods 19th Edition, Method 4500-P-E Murphy, J. and J. Riley. 1962. Analytica Chimica Acta 27:31-36.	N
	Mitkem		Definitive	Grain Size	Sieve analysis	N

Biological Samples						
SOP-4	Berger	NA	Definitive	Macroinvertebrate Analysis	See SOP-4	N
SOP-6	Berger	NA	Definitive	Macroalgae	See SOP-6	N
SOP-7	Berger	NA	Definitive	Phytoplankton	See SOP-7	N

New Table 13-22: Fixed Laboratory Analytical QC - Dissolved Copper and Lead (Lab: STL)

Medium / Matrix	Surface Water
Sampling SOP	SOP-2, SOP-3
Analytical Parameter	Dissolved Copper and Lead
Concentration Level	Low to medium
Analytical SOP	SOP-13
Laboratory	STL

Laboratory QC	Frequency / Number	Method/SOP QC Acceptance Limits	Corrective Action (CA)	Person (s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Method Blank	1 per batch	TA≤RL	Reanalyze batch	Analytical Supervisor	Accuracy/Bias-Contamination	TA ≤ RL
Reagent Blank	NA	NA	NA	NA	NA	NA
Storage Blank	NA	NA	NA	NA	NA	NA
Instrument Blank	Beginning and after every 10 samples	TA≤RL	Reanalyze	Analytical Supervisor	Accuracy/Bias-Contamination	TA ≤ RL
Laboratory Duplicate	1 per batch	85-115%, RPD <20	Qualify Data	Supervisor	Precision	85-115, RPD < 20
Laboratory Matrix Spike	1 per batch of ten	70-130%	Qualify Data	Supervisor	Accuracy	70-130%
Matrix Duplicate Spikes	1 per batch of ten	70-130% RPD < 20	Qualify Data	Supervisor	Accuracy	70-130% RPD <20
LCS	1 per batch	85-115%	Reprep./Reanalyze	Supervisor	Accuracy	85-115%
LFB	All samples and QC	60-125%	Reanalyze	Supervisor	Instrument and sample response	60-125%
Surrogates	1 per batch	TA≤RL	Reanalyze batch	Analytical Supervisor	Accuracy/Bias-Contamination	TA ≤ RL
Internal Standards (ISs)	NA	NA	NA	NA	NA	NA