Indian Run Brook
Dissolved Metals
Total Maximum Daily Loads

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

May 2008

Indian Run Brook at the School Street Outfall, Peacedale-Wakefield, RI

2006 303(d) listings addressed in this study:

Indian Run Brook (RI0010045R-02): Copper (Cu), Lead (Pb), Zinc (Zn)

Table of Contents

List of Figures

List of Tables

List of acronyms and terms

Best Management Practices (BMP) means schedules of activities, prohibitions of practices, maintenance procedures, and other management practices to prevent or reduce the pollution of and impacts upon waters of the State. BMPs also include treatment requirements, operating procedures, and practices to control site runoff, spillage or leaks, sludge or waste disposal, or drainage from raw material storage.

CFR is the Code of Federal Regulations.

Clean Water Act (CWA) refers to the Federal Water Pollution Control Act (33 U.S.C. § 1251) et seq. and all amendments thereto.

Copper (Cu) is ubiquitous in the rocks and minerals of the earth's crust. In nature, Cu occurs usually as sulfides and oxides and occasionally as metallic Cu. Weathering and solution of these natural Cu minerals results in background levels of Cu in natural surface waters at concentrations generally well below 20 ug/l (USEPA 1980). Higher concentrations of Cu are usually from anthropogenic sources such as WWTF, industrial facilities, and urban runoff. These sources include corrosion of brass and Cu pipe by acidic waters, industrial effluents and fallout, sewage treatment plant effluents, and the use of Cu compounds as aquatic algicides. The levels of Cu able to remain in solution are directly dependant on water chemistry. Generally, Cu is more soluble in low pH, acidic waters and less soluble in high pH, alkaline waters. Concentrations of 1 to 10 ug/l are usually reported for unpolluted surface waters however concentrations in the vicinity of municipal and industrial outfalls, particularly from refining, smelting, or metal plating industries may be much higher (USEPA 1980).

DEM or RIDEM refers to the Rhode Island Department of Environmental Management.

Designated uses are those uses specified in water quality standards for each waterbody or segment whether or not they are being attained. In no case shall assimilation or transport of pollutants be considered a designated use.

DOT refers to the Rhode Island Department of Transportation.

EPA refers to the United States Environmental Protection Agency.

Fecal coliform are a specific subgroup of the total coliform bacteria. These organisms may be separated from the total coliform group by their ability to grow at elevated temperatures and are associated only with the fecal material of warm-blooded animals. The presence of fecal coliform bacteria in aquatic environments indicates that the water has been contaminated with the fecal material of man or other animals. At the time this occurred, the source water may have been contaminated by pathogens or disease producing bacteria or viruses, which can also exist in fecal material. The presence of fecal contamination is an indicator that a potential health risk exists for individuals exposed to this water. Fecal coliform bacteria may occur in ambient water as a result of the overflow of domestic sewage or nonpoint sources of human and animal waste.

Lead (Pb) reaches the aquatic environment through precipitation, fallout of Pb dust, street runoff, and both industrial and municipal wastewater discharges (USEPA 1980). Pb is used in electroplating, metallurgy, and the manufacture of construction material, plastics, and electronics equipment. Pb compounds have very low solubility and are not commonly found in natural, un-impacted waters. Where present, Pb compounds are often adsorbed to suspended solids and are transported through aquatic systems this way. Pb compounds have been used for batteries, additives in gasoline, pigments and paint, and other metal products. Mining, smelting and other industrial emissions and combustion sources and solid waste incinerators are now the primary sources of Pb in the environment. Pb reaches water bodies either through urban runoff or discharges such as sewage treatment plants and industrial plants. It also may be transferred from the air to surface water through precipitation (rain or snow). Lead's toxicity depends on its solubility, which is dependent on pH and other available ions.

Load allocation is the portion of the receiving water's loading capacity that is allocated to each existing and future nonpoint source of pollution (NPS). Nonpoint source pollution, unlike pollution from industrial and sewage treatment plants, comes from many diffuse sources. NPS pollution is caused by rainfall or snowmelt moving over and through the ground. As the runoff moves, it picks up and carries away natural and human-made pollutants, finally depositing them into lakes, rivers, wetlands, coastal waters, and even our underground sources of drinking water. These pollutants include- excess fertilizers, herbicides, and insecticides from agricultural lands and residential areas; oil, grease, and toxic chemicals from urban runoff and energy production; sediment from improperly managed construction sites, crop and forest lands, and eroding streambanks; salt from irrigation practices and acid drainage from abandoned mines; bacteria and nutrients from livestock, pet wastes, and faulty septic systems; atmospheric deposition and hydro-modification are also sources of nonpoint source pollution.

Loading Capacity means the maximum amount of pollutant loading that a surface water can receive without violating water quality standards.

MS4 is a municipal separate storm sewer system. The Town of South Kingstown and RIDOT are operators of MS4s in the Indian Run watershed.

MOS refers to the Margin of safety, which accounts for the uncertainty about the relationship between pollutant loads and the quality of the receiving water.

Natural background conditions are all prevailing dynamic environmental conditions in a waterbody or segment thereof, other than those human-made or human-induced.

Nonpoint Source (NPS) means any discharge of pollutants that does not meet the definition of Point Source in section 502.(14) of the Clean Water Act and associated regulations. Such sources are diffuse, and often associated with land-use practices, and carry pollutants to the waters of the State, including but not limited to, non-channelized land runoff, drainage, or snowmelt; atmospheric deposition; precipitation; and seepage.

Point source means any discernible, confined, and discrete conveyance, including but not limited to any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container, rolling stock, concentrated animal feeding operation or vessel, or other floating craft, from which pollutants are or may be discharged. This term does not include return flows from irrigated agriculture.

Primary Contact Recreational Activities means any recreational activities in which there is prolonged and intimate contact by the human body with the water, involving considerable risk of ingesting water, such as swimming, diving, water skiing, and surfing.

Rhode Island Pollutant Discharge Elimination System (RIPDES) is the Rhode Island system for issuing, modifying, revoking and reissuing, terminating, monitoring and enforcing point source discharge permits and imposing and enforcing pretreatment requirements pursuant to Title 46, Chapter 12 of the General Laws of Rhode and the Clean Water Act.

Runoff means water that drains from an area as surface flow.

Secondary Contact Recreational Activities are those activities in which there is minimal contact by the human body with the water, and the probability of ingestion of the water is minimal, such as boating and fishing.

Stormwater is that portion of precipitation that does not naturally percolate into the ground or evaporate, but flows via overland flow, interflow, pipes and other features of a stormwater drainage system into a defined surface waterbody, or a constructed infiltration facility. Stormwater can also refer to rainwater that hits the ground, does not infiltrate at that location and travels to local surface waters without entering a stormwater conveyance system, and 2) rainwater that is collected in stormwater collection systems (pipes or ditches) and is then conveyed to local surface waters.

Total Maximum Daily Load (TMDL) means the amount of a pollutant that may be discharged into a waterbody and still maintain water quality standards. The TMDL is the sum of the individual wasteload allocations for point sources and the load allocations for nonpoint sources and natural background taking into account a margin of safety.

URI-CVE refers to the University of Rhode Island Department of Civil and Environmental Engineering.

Wasteload allocation or WLA is the portion of the receiving water's loading capacity that is allocated to each existing and future point source of pollution. This form of pollution, called point-source pollution, includes pollution that enters waterbodies at specific, detectable points. Examples include stormwater outfalls, combined sewer outfalls (stormwater outfalls that also carry sewage), discharges from industrial and municipal wastewater treatment plants, and hydroelectric cooling waters.

Water quality criteria means elements of the State water quality standards, expressed as constituent concentrations, levels, or narrative statements, representing a quality of water that supports a particular use.

Water quality standard means provisions of State or Federal law, which consist of designated use(s) and water quality criteria for the waters of the State. Water Quality Standards also consist of an anti-degradation policy.

Zinc (Zn) is found naturally in many rock-forming minerals. Because of its use in the vulcanization of rubber, it is generally found at higher levels near highways. It also may be present in industrial discharges. It is used to galvanize steel, and is found in batteries, plastics, wood preservatives, antiseptics, and in rat and mouse poison (Zn phosphide). Zn reaches water bodies either through urban runoff or discharges such as sewage treatment plants and industrial plants. Most of the Zn introduced into the aquatic environment is partitioned into the sediments by sorption onto hydrous iron and manganese oxides, clay minerals, and organic minerals. Variables affecting the mobility of Zn include the concentration and composition of suspended and bed sediments, dissolved and particulate iron and manganese concentrations, pH, salinity, concentration of complexing ligands, and the concentration of Zn.

Executive Summary

Indian Run Brook is located in the Town of South Kingstown and flows through the villages of Wakefield and Peacedale. The brook, classified as B, originates as a swamp that is adjacent to Indian Lake and runs approximately 4.5 miles in length before its confluence with the Saugatucket River. Indian Run Brook, waterbody ID RI0010045R-02, is currently on Group 1 of the State's 2006 303(d) list of impaired waters for dissolved Copper (Cu), Lead (Pb), and Zinc (Zn), and on Group 5 for pathogens. Group 5 listings include those impairments where "*A TMDL or a control action functionally equivalent to a TMDL has been developed for these waters. Implementation is underway which will result in attainment of the standards. However, the standards will not be met within the next two years*". A separate TMDL, *Pathogen TMDL for Saugatucket River, Mitchell Brook, Rocky Brook and Indian Run Brook*, was completed by RIDEM in 2003 to address the pathogen impairment.

Water quality monitoring was conducted in 1996, 1997, and during the summer and fall of 2001 for dissolved copper, lead, and zinc. Monitoring was conducted during dry, low flow conditions, and during wet weather conditions to obtain representative samples of the dissolved metal concentrations. Monitoring results revealed that the wet weather exceedances greatly outnumbered dry weather exceedances for copper and zinc, and dry weather exceedances outnumbered wet weather exceedances for lead. The majority of metals criteria violations occurred at or downstream of a three-foot by seven-foot box culvert that drains the Dale Carlia Corner catchment area. The Dale Carlia Corner subwatershed is 124 acres in size, of which 91 acres, or 73% are impervious. Therefore, the majority of dissolved metal water quality criteria violations can be traced to activities associated with imperviousness and related stormwater runoff in the Dale Carlia Corner subwatershed.

Recommended implementation activities focus on stormwater management. Achieving water quality standards will require that both the volume of storm water and dissolved metals (and bacteria) concentrations in the stormwater reaching Indian Run Brook be reduced. Follow-up monitoring will be required to evaluate the effectiveness of the recommendations of the TMDL in restoring designated uses and attaining water quality standards.

1.0 INTRODUCTION

Under the Clean Water Act, each state establishes water quality standards designed to protect, restore, and preserve water quality. Water quality standards consist of designated uses, such as swimming and aquatic life support, and class specific criteria, usually numeric values, to achieve those uses. When a waterbody fails to meet water quality standards after application of required technology-based controls, the Clean Water Act requires the state to place the waterbody on a list of "impaired" waterbodies, referred to as the 303(d) list, and to develop an analysis called a Total Maximum Daily Load (TMDL).

A TMDL includes a written, quantitative assessment of both water quality impairments and sources of the impairments. The TMDL determines the loading capacity, which is the amount of a given pollutant that can be discharged to the waterbody and still meet standards, and the load and wasteload allocated among various sources. If the pollutant comes from a discrete source (referred to as a point source), such as a wastewater treatment plant discharge or RIPDES regulated stormwater outfall, that share of the loading capacity is called a wasteload allocation. If it comes from a diffuse source (referred to as a nonpoint source), such as sheet runoff from agricultural or land development activities, that share is called a load allocation.

The TMDL must also consider seasonal variations and include a margin of safety that takes into account any lack of knowledge regarding the causes of the water quality impairment or loading capacity of the waterbody. The sum of the load and wasteload allocations and the margin of safety must be equal to or less than the loading capacity of the system.

1.1 Study Area

Indian Run Brook flows from northeast to southwest through South Kingstown and is located within the Saugatucket River watershed (Figure 1.1). The stream originates in a swamp east of the length of Route 1 that is adjacent to Indian Lake (Figure 1.2), and has an approximate length of 4.5 miles. The middle and upper portion of Indian Run Brook is located within forest and wetland habitat, while the lower portion runs through suburban sections of Wakefield before its confluence with the Saugatucket River, approximately 300-feet south of the Palisades mill complex. Indian Run Brook has one major impoundment, Indian Run Reservoir. The Reservoir is located east of Kingstown Road in Wakefield and is immediately adjacent to Old Mountain Field Recreational Area.

Indian Run Brook has a second, smaller impoundment, located immediately north of Saugatucket Road. This impoundment has no name, and is 1.43 acres in size. It is accessible from a dirt parking/turnaround area adjacent Saugatucket Road. Although a crude dam made of fieldstone is present near its outlet under Saugatucket Road, it is more a function of backup due to an undersized culvert running under the road. Further, the road appears to be originally built in the swamp that is associated with the stream, possibly causing further hydrological backup.

Figure 1.1 Saugatucket River Watershed

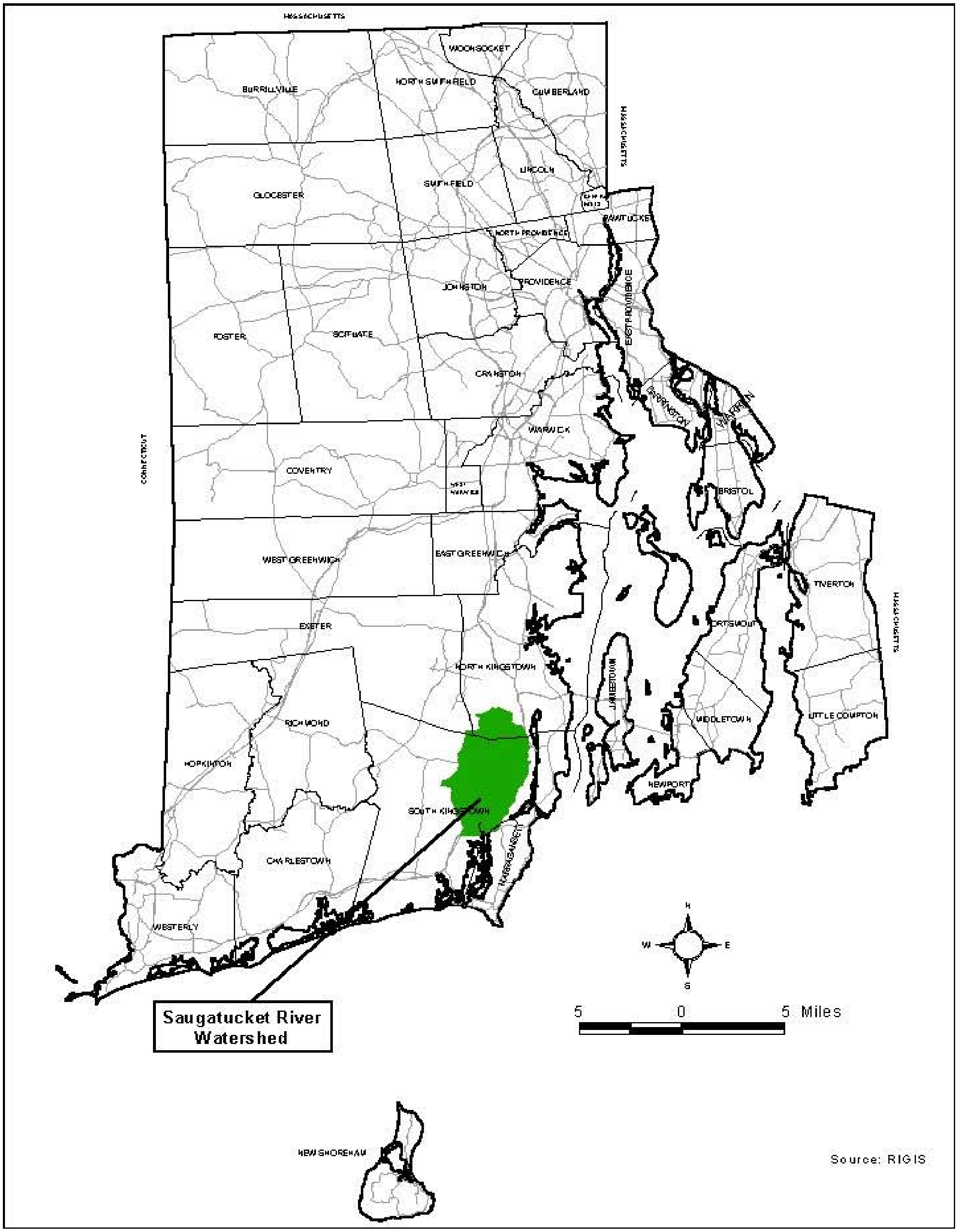
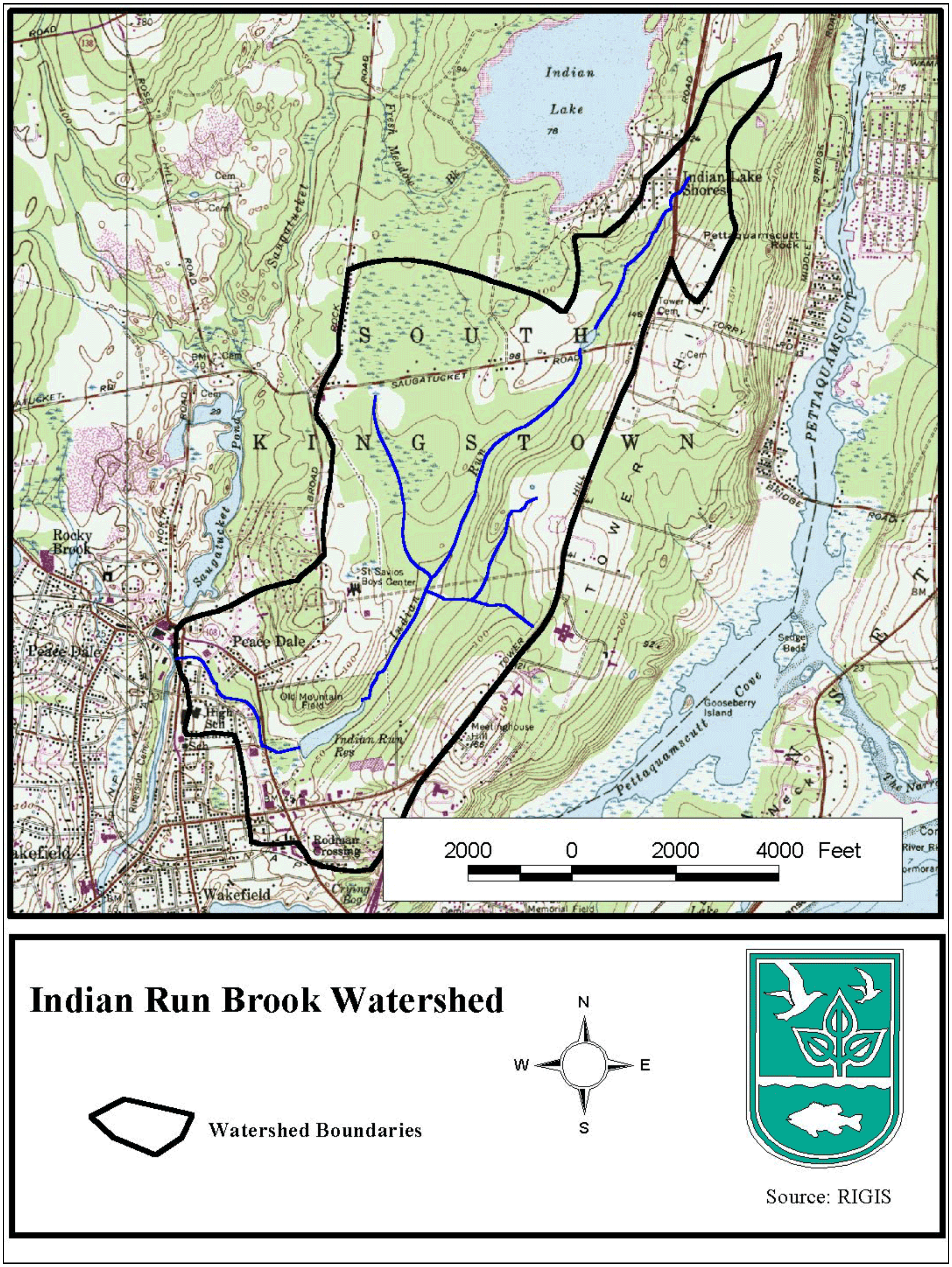


Figure 1.2 Indian Run Brook Watershed



1.2 Pollutants of concern

Water quality monitoring conducted by the RIDEM and the University of Rhode Island (URI-CVE) indicates that the Indian Run Brook is impaired for fecal coliform bacteria, dissolved copper, zinc, and lead. A separate TMDL "Pathogen TMDL for Saugatucket River, Mitchell Brook, Rocky Brook and Indian Run Brook" was completed in 2003 and addresses the fecal coliform impairment.

Metals occur as particulate-bound or dissolved; total metals concentration represents a sum of both the dissolved and particulate phases. The dissolved phase of a metal is biologically available and thus more detrimental to ecosystem health than the particulate-bound fraction that is stable, and therefore, less toxic (Engstrom 2004). Consistent with this finding, state water quality regulations were revised in 1997 changing the ambient water quality and aquatic life criteria for metals from the total to the dissolved fraction[1].

1.3 Priority Ranking

With the exception of the pathogen impairment, Indian Run Brook is listed as a Group 1 (highest priority) waterbody on the State of Rhode Island's 303(d) List of Impaired Waters.

1.4 Applicable Water Quality Standards

1.4.1 Water Quality Classifications and Designated Uses

Designated uses and water quality standards vary depending on the water quality classification of a waterbody. Indian Run Brook is classified as a Class B waterbody, listed below. Further, the Saugatucket River, of which Indian Run Brook is a tributary, is also a Class B waterbody.

Class B – These waters are designated for fish and wildlife habitat and primary and secondary contact recreational activities. They shall be suitable for compatible industrial processes and cooling, hydropower, aquacultural uses, navigation, and irrigation and other agricultural uses. These waters shall have good aesthetic value.

1.4.2 *Water Quality Criteria*

Rule 8.D of the Water Quality Regulations (RIDEM 2006), establishes the physical, chemical, and biological criteria necessary to support the water use classifications of Rule 8.B. In particular, Rule 8.D (2) establishes class-specific criteria for fresh waters of the State that are Class B. The following chemical constituent criteria apply:

a. *None in concentrations or combinations that could be harmful to humans or fish and wildlife for the most sensitive and governing water class use, or unfavorably alter the biota, or which would make the waters unsafe or unsuitable for fish and wildlife or their propagation, impair the palatability of same, or impair waters for any other existing or designated use. None in*

[1] Because of the potential for the particulate fraction of the metals to become dissolved, RIPDES discharge permit limits continue to be expressed as total metals.

such concentrations that would exceed the Water Quality Criteria and Guidelines as found in Appendix B.

b. *The ambient concentration of a pollutant in a water body shall not exceed the Ambient Water Quality Criteria and Guidelines, (Appendix B) for the protection of aquatic organisms from acute or chronic effects, unless the criteria or guidelines are modified by the Director based on results of bioassay tests conducted in accordance with the terms and conditions provided in the RIDEM Site Specific Aquatic Life Water Quality Criteria Development Policy.*

Part II of Appendix B describes the specific aquatic life criteria in relation to copper, lead, and zinc and is summarized below:

- The one-hour average concentration of a pollutant should not exceed the acute criteria more than once every three years on the average. The four-day average concentration of a pollutant should not exceed the chronic criteria more than once every three years on the average. The acute and chronic aquatic life criteria for freshwaters shall not be exceeded at or above the lowest average 7 consecutive day low flow with an average recurrence frequency of once in 10-years (7Q10).

The chronic and acute criteria of these metals apply to the dissolved form and are calculated using water hardness (in mg/l as $CaCO_3$) based on equations in Table 2-Appendix B of Rhode Island's Water Quality Regulations and shown below in Table 1.1.

Table 1.1 Applicable Freshwater Criteria Equations and Base e Exponential Values

Parameter	**ACUTE (ug/l)** $CF \times e^{(m_a [\ln Hardness] + b_a)}$			**CHRONIC (ug/l)** $CF \times e^{(m_c [\ln Hardness] + b_c)}$		
	CF =	**m_a =**	**b_a =**	**CF =**	**m_c =**	**b_c =**
Copper	0.96	0.9422	-1.700	0.96	0.8545	-1.702
Lead	#	1.273	-1.46	#	1.273	-4.705
Zinc	0.978	0.8473	0.884	0.986	0.8473	0.884

= Lead Conversion Factors: acute and chronic CF= 1.46203 – [(ln H) x 0.145712]

Both chronic and acute aquatic life criteria for several metals are a function of hardness. Hardness is a measure of the concentration of cations in solution (Minton 2002), with hardness usually measured as calcium carbonate ($CaCO_3$) equivalents in mg/l. An increase in hardness decreases the toxicity of metals, because calcium and magnesium cations compete with the metal ions for complexing sites, allowing fewer metal complexes to form and therefore resulting in a lower level of toxicity (Minton 2002).

In order to determine the applicable numeric water quality criteria for dissolved Cu, Pb, and Zn, the freshwater criteria equations were solved using ambient hardness derived from available water quality data collected by the RIDEM in 2001 and URI-CVE in 1996-1999. The selection of appropriate hardness values is discussed in section 5.1.

1.4.3 *Anti-degradation policy*

Rhode Island's anti-degradation policy requires that, at a minimum, the water quality necessary to support existing uses be maintained (see Rule 18, Tier 1 in the State of Rhode Island's Water Quality Regulations). If water quality for a particular parameter is of a higher level than necessary to support an existing use (i.e. bacterial levels are significantly below Class B standards), that improved level of quality should be maintained and protected (see Rule 18, Tier 2 in the State of Rhode Island's Water Quality Regulations). Tier 2 does not apply to the Indian Run Brook because fecal coliform bacteria and dissolved metals concentrations are greater than the water quality standards.

1.4.4 *Numeric water quality target*

This TMDL assesses compliance with Cu, Pb, and Zn criteria and sets numeric concentration targets for dissolved Cu, Pb, and Zn specific criteria, based on a river specific average hardness of 17.2 mg/$CaCO_3$ and are shown in Table 1.2.

Table 1.2. Acute and chronic water quality criteria for copper, lead, and zinc

ACUTE CRITERIA (calculated using average dry and wet weather hardness values)		**CHRONIC CRITERIA (calculate using average dry and wet weather hardness values)**	
WATERBODY ID NUMBER		**WATERBODY ID NUMBER**	
Parameter	**RI0010045R-02**	**Parameter**	**RI0010045R-02**
Hardness (mg/L $CaCO_3$)	17.2	Hardness (mg/L $CaCO_3$)	17.2
Copper (ug/l)	2.56	Copper (ug/l)	1.99
Lead (ug/l)*	8.68	Lead (ug/l)	0.34
Zinc (ug/l)	26.37	Zinc (ug/l)	26.59

*When an ambient hardness of less than 25 mg/l is used the hardness dependent Conversion Factor (CF) should not exceed one.

2.0 BACKGROUND

2.1 Watershed Description and Location

The Indian Run Brook is a sub-watershed of the Saugatucket River Basin, which is south-centrally located in Rhode Island on the west side of Narragansett Bay (Figure 1.1). The Saugatucket River watershed drains approximately 16.5 square miles (10,560 acres) and includes parts of four Rhode Island communities: Exeter, Narragansett, North Kingstown, and South Kingstown. Besides Indian Run Brook, the watershed includes the Saugatucket River and its other major tributaries, Rocky Brook, and Mitchell Brook. The Saugatucket River watershed is located in the South Shore Coastal Region and is a sub-watershed of the Point Judith Pond watershed, which drains to Block Island Sound.

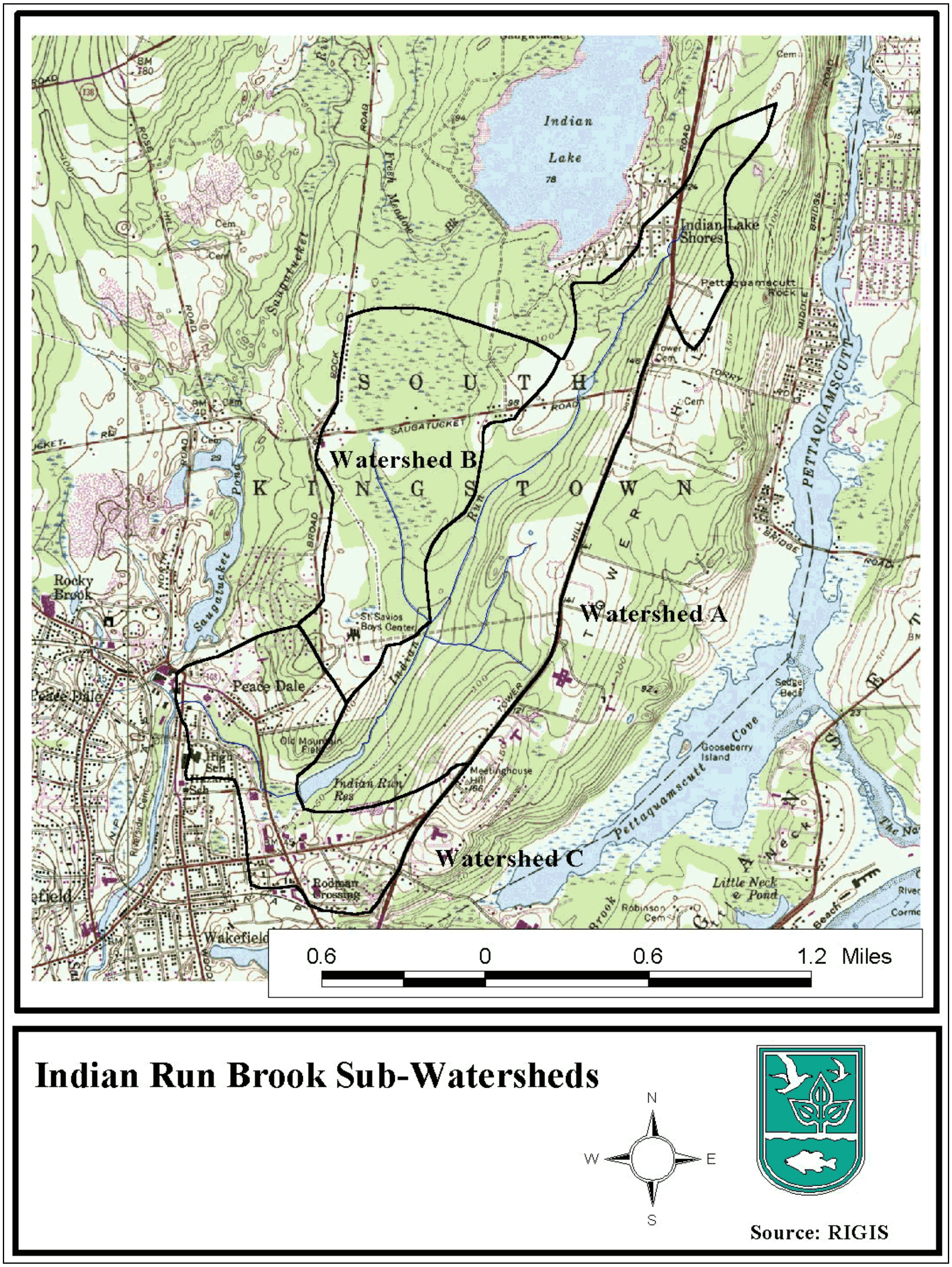
The portion of the Saugatucket River Basin addressed in the current TMDL is Indian Run Brook. The Indian Run Brook watershed is located in the eastern portion of the Saugatucket Basin and has a drainage area of 2.37 square miles (Pare, 1982). This portion of the watershed consists entirely of freshwater, non-tidal habitats. The watershed is irregularly shaped and has differences in times of concentration due to landuse/ cover types. Therefore, the watershed has been divided into three hydraulically uniform sub-watersheds (Figure 2.1) based on similar land use/ cover as used in the 1982 Pare study. This subdivision of the watershed also aids the determination of pollutant source type, (i.e. stormwater vs. agricultural runoff) locations, and recommendations for BMPs.

Sub-watershed A or Upper Indian Run East is 1.20 square miles in size, and spans from the headwater area northeast of Route 1 to the Indian Run Brook reservoir. The three most prevalent land use types in this sub-watershed are wetlands (35%), deciduous forest (34%), and roads (7.5%).

Sub-watershed B or Upper Indian Run West is 0.70 square miles in size and spans from a swamp north of Saugatucket Road to a point south of St. Dominic Boys Center. Its' eastern boundary is sub-watershed A, and its western boundary, for the most part, is Broad Rock Road. The three most prevalent land use types in this sub-watershed are wetlands (43%), deciduous forest (34%), and institutional (10%). The institutional facilities include St. Dominic's Catholic Center, Broad Rock Middle School, South Kingstown's Senior Center and the YMCA.

Sub-watershed C or Lower Indian Run Peacedale-Wakefield Center is 0.47 square miles in size and is located downstream of Indian Run Reservoir, but includes runoff coming from Old Tower Hill Road, portions of Route 1, Kingstown Road, and Main Street. The three most prevalent land use types in this sub-watershed are commercial (27%), medium high-density residential (24%), and medium density residential (16%).

Figure 2.1 Indian Run Brook Subwatersheds



2.2 Topography

The topography of the area is generally flat with gently rolling hills. This is typical for the coastal low lands of the northeastern United States. Elevations within the Indian Run Brook watershed range from 12-feet at its mouth in Peacedale, to a hill in the northern corner of the watershed just north of Torry Road that is 180-feet above mean sea level (MSL), for a total relief of 168-feet. Slopes are generally less than 3%. Indian Run Brook falls approximately 80-feet from the headwaters near Route 1 to 12-feet at the stream's mouth.

2.3 Climate

The climate in the Saugatucket River basin is variable. The following temperatures, precipitation, snowfalls, and growing season days (freeze-free periods) are based on a thirty year period (1951-1980) of weather data collected at the Agricultural Experimental Station, a National Oceanic and Atmospheric Administration (NOAA) weather station, located at the University of Rhode Island (URI). This station has recorded weather data since 1889 and is located in the northwest portion of the Saugatucket River watershed. The following data was obtained from an URI-Civil and Environmental Engineering (URI-CVE) study on the Saugatucket River (Wright et. al., 1999).

Highest monthly temperature average = 70 ^{o} F
Lowest monthly temperature average = 28^{o} F
Average annual temperature = 49.2 ^{o} F
Average yearly precipitation = 48 inches
Average yearly snowfall = 32 inches
Average growing season = 138 days

There are normally no seasonal patterns in the frequency and amounts of precipitation during the year however two major storm patterns exist. Storms that occur between October and May are primarily extra-tropical cyclones. The most famous are the "northeasters": low-pressure systems that typically develop off the North and South Carolina coasts and move northeast along the Atlantic seaboard, occasionally colliding with colder and drier air (from Canada) in the New England region. This results in the development of heavy rain and/or snow. The second type of storm, occurring between June and October, are primarily tropical cyclones. The biggest storms are hurricanes, which have hit Rhode Island 71 times during the last 350 years. In the summer, most precipitation results from thunderstorms and smaller convective systems. These typically produce short-duration, high-intensity, precipitation events.

2.4 Ecology and Geology

For more information on the ecology and geology of Indian Run Brook and the surrounding area see sections 3.4 Ecology and 3.5 Geology of the Saugatucket Bacterial Total Maximum Daily Load Report. The report can be accessed at:
http://www.dem.ri.gov/programs/benviron/water/quality/rest/pdfs/saugatuc.pdf

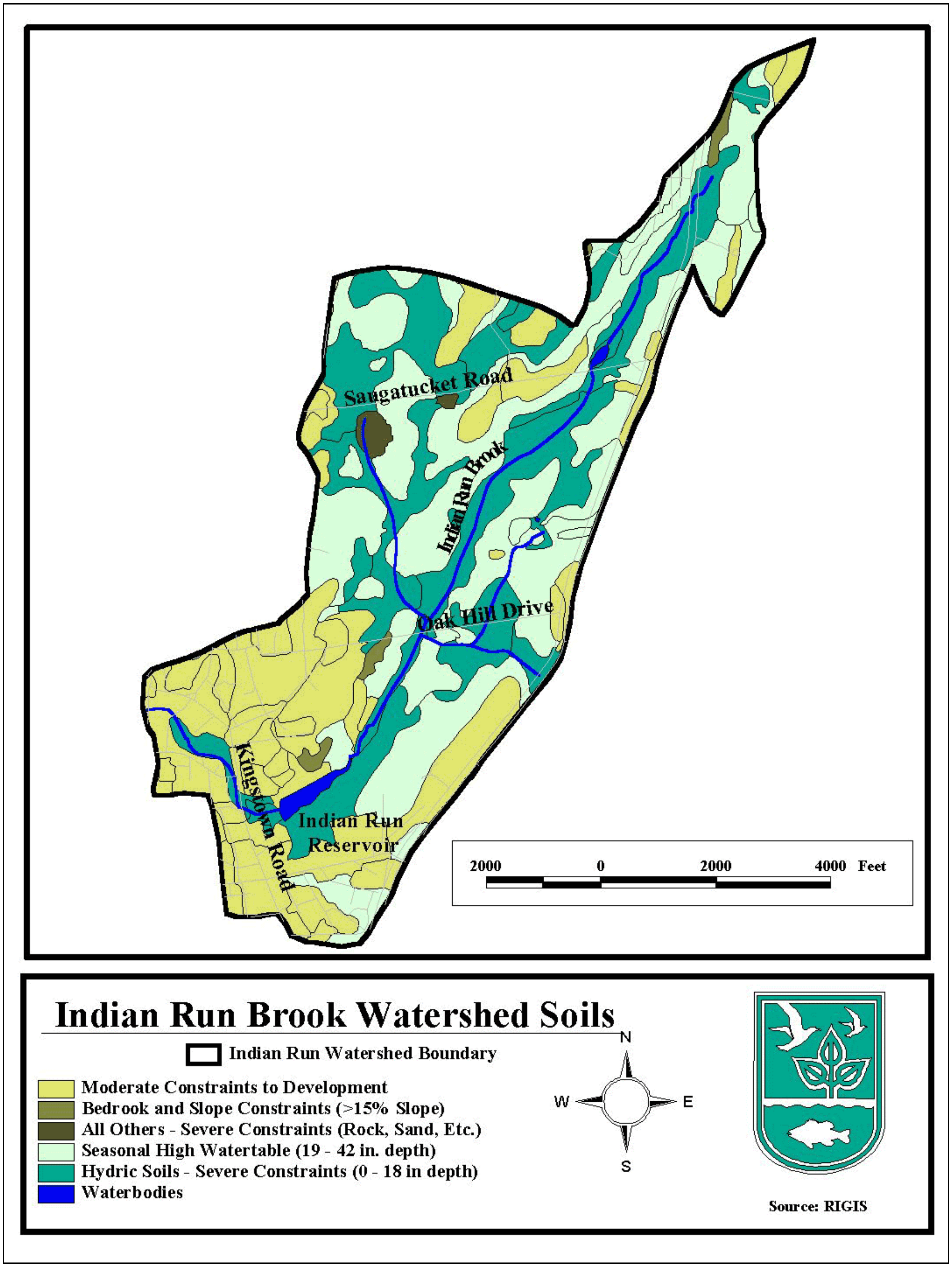
2.4.1 *Soils*

Most of the soils in Rhode Island have formed from material that was transported from the site of the parent rock, and redeposited at the new location through the action of ice, water, wind, or gravity. Glacial ice was particularly important in transporting and depositing parent materials from which Rhode Island soils, including those in the Indian Run Brook watershed, are formed.

The principal parent materials of the Saugatucket watershed soils are glacial till and glacial outwash. A small percentage of soils have developed from organic deposits. Organic deposits form the parent materials for peat and muck soils. These organic deposits generally occur in small, poorly drained depressions, and are particularly thick in large lowland swamps.

Soils are classified into four hydrologic soil groups (U.S. Soil Conservation Service 1964). These groupings give an indication of soil characteristics and infiltration/runoff potentials. Figure 2.2 displays the different hydrological property groups in the Indian Run Brook watershed.

Figure 2.2. Soils



2.5 Land Use

2.5.1 *RIGIS*

The Rhode Island Geographic Information System (RIGIS) provides various land use information, including various topographical, infrastructure, and demographic data. For this project, land uses in the watershed were categorized into different classes of populated areas (i.e. medium high residential), deciduous forest, wetland, commercial, institutional, roads, idle agricultural, pasture, and other (land uses that make up less than one percent of all land uses individually). These groups were selected to highlight factors that influence water quality. For example, cropland and pastures have different runoff coefficients and contribute different pollutants than densely populated or commercial areas. Figures 2.3-2.5 show the distribution of land uses from 2001 within the Indian Run Brook sub-watersheds. It should be noted that Lower Indian Run Peacedale-Wakefield Center, which includes Tower Hill Road and Dale Carlia Corner, has the highest proportion of commercial, institutional, residential areas and roads (representing 77.24% of land area) normally associated with imperviousness and stormwater runoff. It is also noted that fairly large parcel on the eastern edge of the watershed delineated as “idle agriculture” is now the site of the South County Commons development – a mix of residential, commercial and institutional land uses.

2.5.2 *Changes in Land Use*

Changes in land use in the Indian Run Brook watershed are those typically associated with the conversion of rural land to urban land resulting in an increase in impervious area that is usually accompanied by increases in the discharge and volume of storm runoff, as well as any associated pollutants. Impervious surfaces include roads, parking lots, and buildings. Natural flow paths in the watershed may be replaced or supplemented by paved gutters, storm sewers, or other elements of artificial drainage. The net effect of urbanization is an increase in pollutant export to receiving waterbodies. For example, article 6 of "Watershed Protection Techniques" states that cars and other vehicles were found to produce over 50% of the total loadings for copper and zinc in the Lower San Francisco Bay (WPT Technical Note #13.1(1):28). This number was based on water quality data gathered from the urban stormwater system, and was generated without accounting for tailpipe emissions that produce further atmospheric deposition of metals. Furthermore, 50% of the total copper load was attributed solely to brake pad wear. This information, coupled with the conclusions of the RIDEM 2001 water quality monitoring data and RIDOT 2001 traffic study data (Section 2.6.4), suggests that urban runoff is a likely source of elevated dissolved metal concentrations in the Indian Run Brook watershed.

Figure 2.3. Upper Indian Run East Land Use

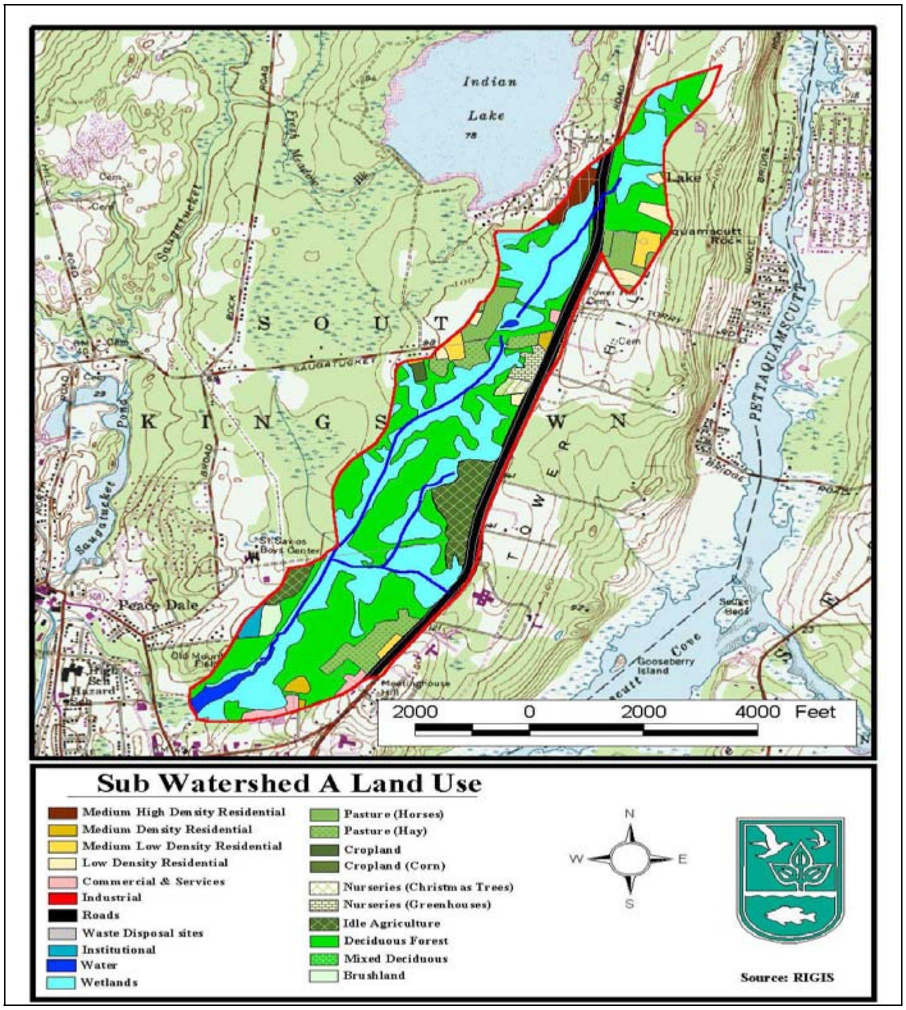


Table 2.1 Upper Indian Run East Land Use Chart

Land Use Description	Total Acres	% of Total Area
600 Wetland (not to be classified)	248.7	34.8
310 Deciduous Forest (>80% hardwood)	244.9	34.3
141 Roads (divided highways >200 ft plus related facilities)	53.0	7.4
250 Idle Agriculture (abandoned fields and orchards)	34.9	4.9
214 Pasture (horses)	28.9	4.0
212 Pasture (hay)	24.7	3.5
114 Medium Low Density Residential (1 to 2 acre lots)	12.5	1.7
115 Low Density Residential (>2 acre lots)	11.2	1.6
120 Commercial (sale of products and services)	8.5	1.2
112 Medium High Density Residential (1/4 to 1/8 acre lots)	8.5	1.2
500 Water	8.4	1.2
400 Brushland (shrub and brush areas, reforestation)	7.8	1.1
Other Land Uses	22.2	3.1
Total Watershed Area	**714.2**	**100**

Figure 2.4 Upper Indian Run West Land Use

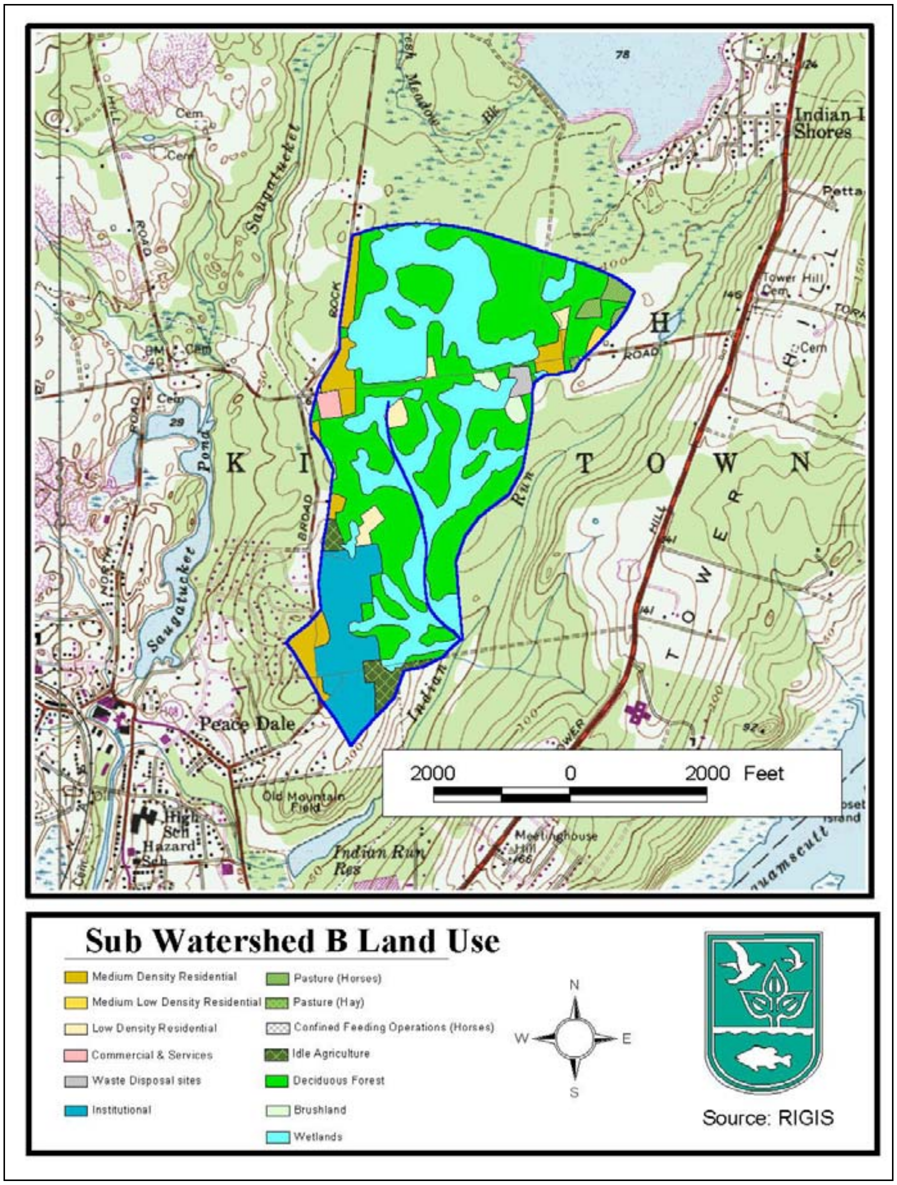


Table 2.2 Upper Indian Run West Land Use Chart

Land Use Description	Total Area	% of Total Area
310 Deciduous Forest (>80% hardwood)	191.5	43.0
600 Wetland (not to be classified)	149.5	33.6
170 Institutional (schools, hospitals, churches, etc.)	43.2	9.7
113 Medium Density Residential (1 to 1/4 acre lots)	26.9	6.0
250 Idle Agriculture (abandoned fields and orchards)	9.2	2.1
115 Low Density Residential (>2 acre lots)	7.9	1.8
212 Pasture (horses)	5.5	1.2
Other Land Uses*	11.6	2.6
Total Watershed Area	**445.3**	**100**

Figure 2.5 Lower Indian Run Peacedale-Wakefield Center Land Use

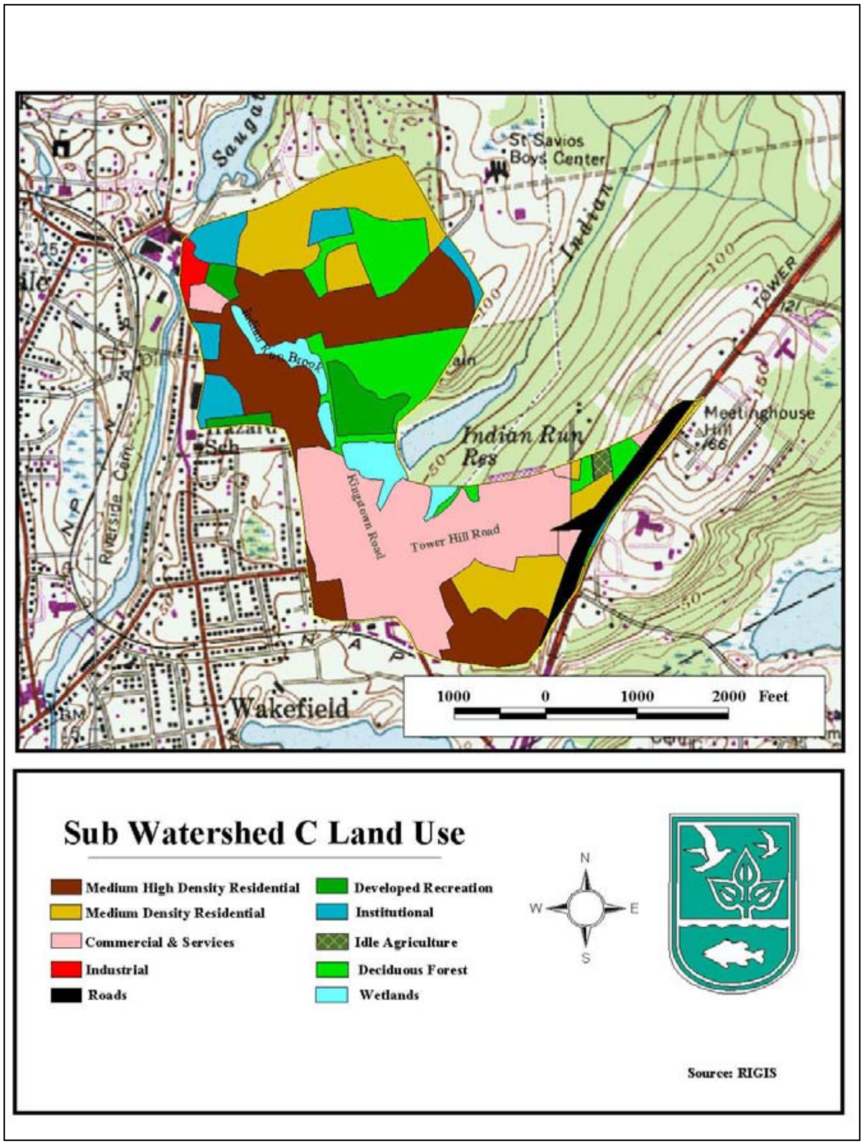


Table 2.3 Lower Indian Run Peacedale-Wakefield Center Land Use Chart

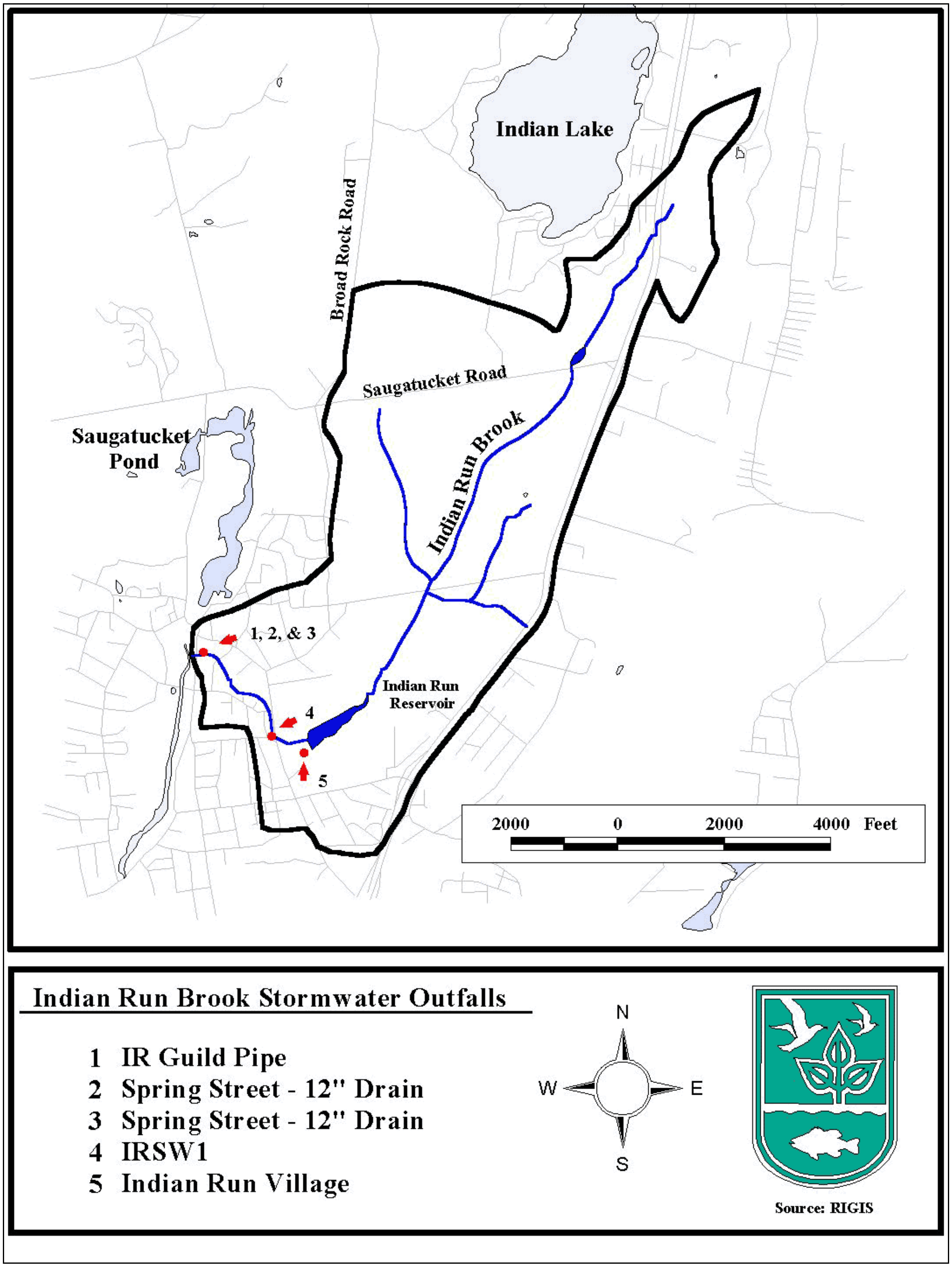
Land Use Description	Total Acres	% of Total Acres
120 Commercial (sale of products and services)	86.3	27.07
112 Medium High Density Residential (1/4 to 1/8 acre lots)	78.7	24.68
113 Medium Density Residential (1 to 1/4 acre lots)	52.1	16.34
310 Deciduous Forest (>80% hardwood)	40.9	12.83
170 Institutional (schools, hospitals, churches, etc.)	17.8	5.58
600 Wetland (not to be classified)	14.0	4.39
161 Developed Recreation (all recreation)	13.7	4.28
141 Roads (divided highways >200 ft plus related facilities)	11.4	3.57
Other Land Uses*	4.1	1.27
Total Watershed Area	**318.8**	**100**

2.6 Stormwater Drainage Systems

2.6.1 *Stormwater Drainage Systems*

The Indian Run Brook watershed contains a mostly undocumented stormwater system. A stormwater flow investigation by RIDEM, accompanied by a 1982 report by Pare Engineering, Inc. on the Dale Carlia Corner stormwater system in Wakefield, indicates that approximately 73 of 104 impervious acres drains to a single seven-foot by three-foot outfall on Indian Run Brook (Figure 2.7 catchment area 1). Figure 2.6 shows the locations of outfalls in the watershed that RIDEM has identified. Stormwater outfalls 1,2, and 3 are shown as one location due to the map's scale.

Figure 2.6 RIDEM Identified Stormdrain Outfall Locations



2.6.2 *Pare Engineering Flood Study*

An April 1982 report by Lee Pare & Associates, Inc. titled "The Effect of the Dale Carlia Corner Reconstruction on the Indian Run Flood Plain" was published in order to support drainage impacts regarding the reconstruction of the Dale Carlia Corner in Wakefield. Dale Carlia Corner is located at the intersection of Kingstown Road (RI Rt. 108), Main Street, and Old Tower Hill Road. Traffic flow was altered, roads were widened, a new storm sewer system was installed, and a single 7-foot by 3-foot box culvert was proposed and permitted by RIDEM adjacent to Indian Run Brook at the intersection of Kingstown Road, School Street, and Indian Run Road (subsequently referred to as the School Street outfall or station IRSW1). This area is located within Lower Indian Run Peacedale-Wakefield Center, as described in section 2.1. The study was flood oriented and did not focus on water quality. Runoff curve number computations and 10 and 100-year hydrographs were calculated for Lower Indian Run Peacedale-Wakefield Center. The results of the study showed that peak runoff for the total Indian Run Watershed would decrease by ten percent for the 10 and 100-year storms. The ten percent reduction in runoffs of both storms is attributed to the proposed drainage system that would be put into use. The new drainage system would decrease the concentration time of Lower Indian Run Peacedale-Wakefield Center from 2.1-hours to 0.6-hours. By decreasing the time of concentration, the major portion of flow from the downstream area (Lower Indian Run Peacedale-Wakefield Center) will have passed before the runoff from the large upstream watersheds (Upper Indian Run East and West) approach their peak.

2.6.3 *RIDEM Stormwater Flow Study*

In March 2001, RIDEM conducted a wet weather study of the Dale Carlia Corner area as a follow up to the URI-CVE study. The study was performed to determine what streets, sidewalks, and parking lots in the Dale Carlia Corner contributed runoff to the box culvert, School Street Outfall, constructed as a result of the Pare study. Four catchment areas were discovered within this area, and are shown in Figure 2.7 and described in Table 2.4.

Figure 2.7. Dale Carlia Corner Catchment Areas

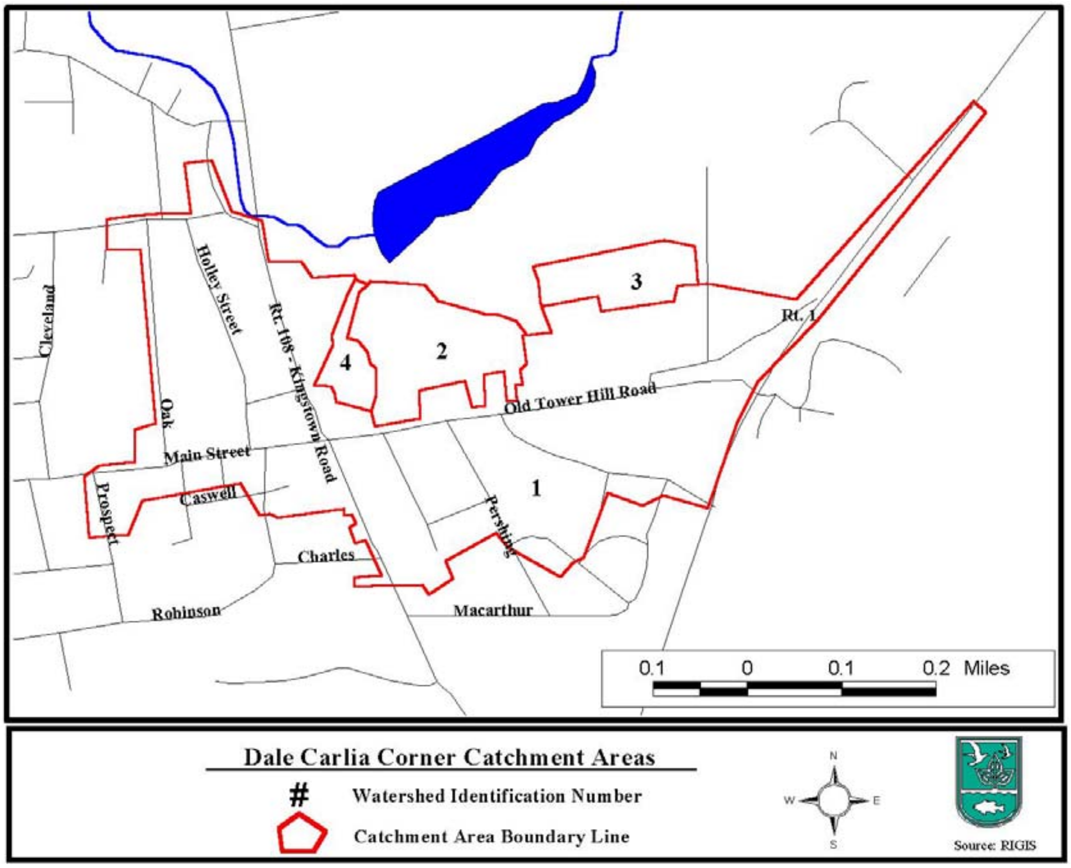


Table 2.4 Pervious and impervious coverage in the Dale Carlia Corner

Catchment Area ID	Total Acres	Acres - Pervious Surfaces	Percent Pervious	Acres - Impervious Surfaces	Percent Impervious
1	103.97	30.78	29.6	73.19	70.4
2	11.43	2.49	21.8	8.94	78.2
3	6.31	0	0.0	6.31	100.0
4	2.66	.59	22.2	2.07	77.8
Total Area	**124.37**	**33.86**	**27.2**	**90.51**	**72.8**

2.6.4 *RIDOT Dale Carlia Corner Traffic Study*

On June 14, 2001, a traffic study was conducted to determine the number of vehicles using the Dale Carlia Corner intersection. This included Route 108 north and southbound, Main Street eastbound, and Old Tower Hill road, westbound. The study lasted from 6:00 a.m. to 9:45 p.m. Vehicle totals are shown in Table 2.5. June 14, 2001 was a Thursday during a school year and when URI was not in session. This date is likely to be a low estimate on traffic volume since weekend traffic, beach traffic, URI traffic, or holiday traffic would all likely exceed the estimates.

Table 2.5. RIDOT Traffic Study

Route 108 Southbound	Old Tower Hill Road Westbound	Route 108 Northbound	Main Street Eastbound	TOTAL VEHICLES
9,049	10,386	8,226	6,985	34,646

3.0 PRESENT CONDITION OF THE WATERBODY

Recent efforts to monitor water quality in the Saugatucket River watershed began with a RIDEM-funded water quality study by the URI Department of Civil and Environmental Engineering (URI-CVE) from 1996-1999. The results of that study led to the identification of various water quality impairments in the Saugatucket River, Indian Run Brook, Rocky Brook, and Mitchell Brook, which were subsequently included on the 1998 List of Impaired Waters. More recently, RIDEM conducted supplemental monitoring in 2001 to support the development of this TMDL.

3.1 Current Water Quality Conditions

The database used for this TMDL utilizes over 150 dissolved metal samples collected by both URI-CVE (1996-1997) and RIDEM (2001).

3.1.1 *1996-1999 URI-CVE Study*

The URI Civil and Environmental Engineering Department conducted a comprehensive water quality study of the Saugatucket River watershed in 1996 and 1997. One of the objectives of the URI-CVE Saugatucket River study was the determination of spatial and seasonal trends of trace metals in the river system, and the identification of reach hot spots within the system. The total and dissolved portions of six trace metals were analyzed: chromium, nickel, copper, lead, cadmium, and zinc. Of those six, dissolved copper, lead and zinc concentrations in Indian Run Brook were found to exceed water quality criteria thus are the focus of this TMDL assessment. Analysis of this data allowed RIDEM to conduct a more focused sampling program aimed at identifying dissolved metal sources in the Indian Run Brook watershed, as well as establish links between dissolved metal sources and instream water quality.

The main objectives of the URI-CVE study were as follows:

- To monitor the water quality of the Saugatucket River for both dry and wet weather conditions using three water quality surveys for each condition.
- To measure key water quality constituents during these surveys including dissolved oxygen (DO), nutrients, trace metals, and fecal coliform.
- To develop stage-discharge relationships at each water quality station.
- To calibrate and validate a dissolved oxygen and nutrient fate and transport model.
- To obtain information about the time of concentration through dye studies for the mainstem of the Saugatucket River.
- To estimate sediment oxygen demands for the mainstem of the Saugatucket River at five sites.
- To calculate existing pollutant loadings and identify significant environmental problems.
- To calculate annual pollutant loading rates.

3.1.1.1 URI-CVE Dry Weather Characterization

Dry weather monitoring was conducted in 1996 to assess steady state ambient dissolved metal concentrations throughout the Saugatucket River basin, including one station, (IR01), on Indian Run Brook at the Peacedale Guild (Figure 3.1). Pre-storm samples from three wet weather surveys are included in this data set. The pre-storm samples were included in the dry weather samples as well since they were taken before the start of runoff and are representative of baseflow conditions in the stream. A total of 45 dry weather samples (12 dry plus 3 pre-storm samples each for copper, lead, and zinc) were taken at the Indian Run Brook station, along with 45 corresponding hardness samples.

Dry weather data were collected in March, July, and October of 1996 and the pre-storm samples collected in April, August and September 1997. Appendix A, tables A-1 through A-3 show dry weather metals monitoring results from the URI-CVE study. The wet and dry weather averaged hardness (17.2 mg/l as $CaCO_3$) was used to determine the acute and chronic criteria for copper, lead and zinc, per Table 2 of Appendix B of the 2006 RIDEM Water Quality Regulations. An explanation of this relationship can be found in Section 5.1.

Acute copper criterion was exceeded three times; once each during runs 1,2 and 3 of the 7/10/1996 survey. Chronic copper criterion was exceeded the day of the 7/10/1996 survey. Dissolved zinc exceeded water quality criteria once for acute and chronic criteria during the pre-storm sample of the 9/29/1997 survey. Chronic lead criterion was exceeded three times; once during the pre-storm run of the 9/29/1997 survey, and the day of the 3/25/1996 and 7/10/1996 surveys; no exceedances of the acute lead criteria were observed.

3.1.1.2 URI-CVE Wet Weather Characterization

Wet weather monitoring was conducted throughout the Saugatucket River basin in 1997, including station IR01 on Indian Run Brook at the Peacedale Guild.

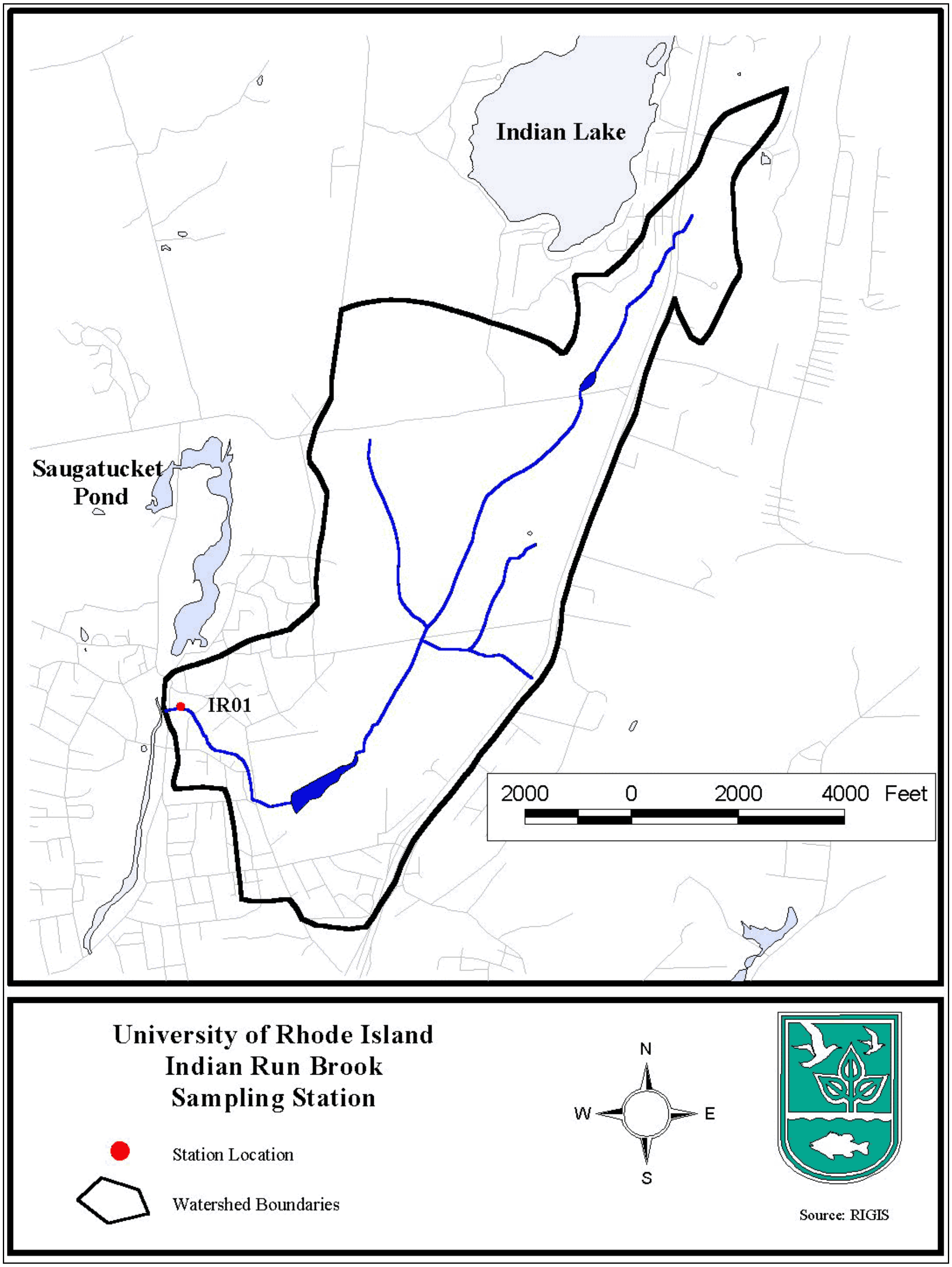
Three wet weather events were monitored: April 28, 1997 (WWS1), August 21, 1997 (WWS2), and September 29, 1997 (WWS3). The total rainfall and duration for each storm was 0.64 inches/14 hrs, 2.39 inches/23.5 hrs, and 0.38 inches/12.5 hrs, respectively. There was an antecedent dry period to the 9/29/1997 rainfall with only 0.04” of rain in the 17 days prior to the storm event. All samples from Indian Run Brook were taken at the station located at the Peacedale Guild. A total of 90 samples were collected at IR01 (30 copper, 30 lead, and 30 zinc) for the three wet weather events, along with 90 corresponding hardness samples. Appendix A contains the results of the analysis from the URI-CVE wet weather studies for copper (Table A-4), lead (Table A-5) and zinc (Table A-6). These tables show that 11 runs were completed for WWS1 and WWS2, and 8 runs were done for WWS3. The pre-storm or base runs are not included in these tables since they were evaluated as dry weather runs. Run 1 in each table represents the start of runoff when the stream system begins to receive the storm flows from the event.

The averaged dry and wet hardness value of 17.2 mg/l as $CaCO_3$ was used to determine the acute and chronic criteria for copper, lead and zinc. However, as per Appendix B of the RIDEM Water Quality Regulations (Ambient Water Quality Guidelines for Toxic Pollutants), when lead criteria was calculated, a value of 1.0 was used for the Conversion Factor because the hardness value used was less than 25 mg/l as $CaCO_3$.

Dissolved copper acute criteria were exceeded 10 times during wet weather surveys. Most notably, copper violations occurred for six of the eight runs for the 9/29/1997 survey. The chronic copper criterion was exceeded the day of the 9/29/1997 survey. Dissolved lead acute and chronic criteria were not exceeded during any wet weather event for the URI-CVE surveys. Dissolved zinc had seven acute criteria violations during the wet weather surveys, with one exceedance occurring during the 4/28/1997 survey, and six exceedances (of the eight runs) during the 9/29/1997 event. The 9/29/1997 survey date was also a chronic zinc exceedance.

Tables A-4 through A-6 shows the data taken during these monitoring events. While each water quality station was sampled twelve times for the first two storms, and nine times for the third storm, the pre-storm samples that were taken prior to the start of each storm were not included in these tables. The pre-storm samples are included with the dry weather data tables and were not used in the evaluation of the wet weather data. Therefore, only eleven runs are shown for the first two storms and eight runs shown for the third storm.

Figure 3.1. URI-CVE Water Quality Monitoring Station



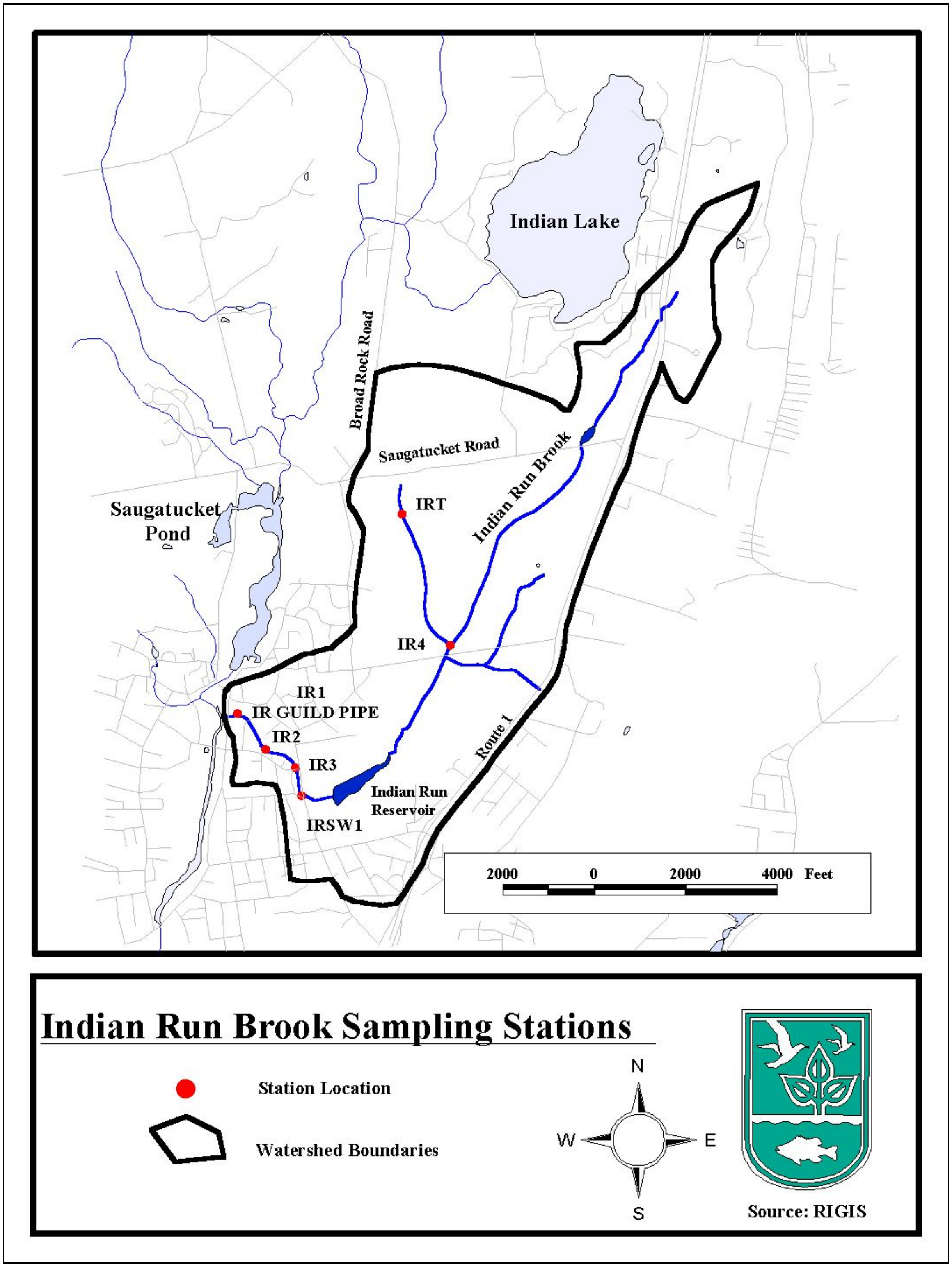
3.1.2 RIDEM Supplementary Monitoring (2001)

The most recent assessment of Indian Run Brook (RIDEM 2001) included ambient monitoring for dissolved metals at a total of four sampling stations (IR1, IR2, IR3, IR4) located along the mainstem of Indian Run Brook, with station IR1 duplicating the URI-CVE station IR01 (Figure 3.2). One station located on a tributary (IRT) was monitored during the dry weather event, but could not be monitored during the wet weather event due to a dry streambed. Two stormwater outfalls located at School Street and the Neighborhood Guild parking lot, identified as IRSW1 and IR Guild Pipe respectively, were monitored during wet weather in order to evaluate stormwater runoff entering Indian Run Brook. Corresponding hardness samples were also collected at each station.

Each station was sampled once during dry weather on 7/25/2001, with a duplicate sample taken at station IR3. The data are presented in Appendix A (Tables A-7 through A-9). Wet weather samples were collected for one storm: 9/21/2001. The total rainfall and duration for that monitoring event was 1.27-inches/ 15.3 hours. Tables A-10 through A-12 in Appendix A contain the data from the storm monitored by RIDEM. While the data are insufficient to characterize compliance with metals criteria, they do provide information on sources of metals to the river.

With the exception of zinc, metals concentrations during dry weather were largely below detection limits and in the case of zinc, did not exceed applicable criteria. One exceedance was observed at station IRT; the lead chronic criterion was exceeded. By contrast, wet weather metals concentrations exceed criteria for most metals at most stations in the center of Peacedale-Wakefield (IR1 – IR3). In fact, the significance of stormwater and in particular the School Street outfall (IRSW1) is evident by comparing wet weather metals concentrations at the upstream station (IR4) with those located downstream of the School Street outfall (IR1 – IR3). No exceedances of criteria were observed at the upstream station during wet or dry weather conditions. However, exceedances of all criteria were observed at the stations located downstream of the School Street outfall, which exhibited elevated concentrations of copper, lead, and zinc.

Figure 3.2 RIDEM Water Quality Monitoring Stations



4.0 POLLUTION SOURCES

The supplementary RIDEM water quality investigation performed in the Indian Run Brook watershed documents that dissolved trace metal impairments in the Saugatucket River are primarily due to discharges from municipal stormwater sewer systems (MS4's). These discharges occur entirely within subwatershed C (Peacedale-Wakefield center), which is the most built up portion of the watershed. Specifically, stormwater discharging from catchment area one (see Figure 2.7 for catchment area) to the 7-foot by 3-foot stormwater outfall, the School Street Outfall, appears to be the largest contributor to trace metal concentrations in the watershed.

Both dry and wet weather data were used to characterize water quality conditions in the Saugatucket River watershed. Dry weather data was used to assess steady state conditions and wet weather data were used to assess worst-case conditions and in the case of the DEM study, to help locate pollution hot spots in the watershed.

The URI-CVE water quality investigation on the Saugatucket River included one station in Indian Run Brook, at the bridge on Columbia Street downstream of the Neighborhood Guild. This station is upstream of the river's confluence with the Saugatucket River. This location, which was also sampled by RIDEM, provided the metals data used in this TMDL to determine which metals were in violation of the Water Quality Regulations. Follow up testing by RIDEM throughout the mainstem of Indian Run Brook provided more information to identify possible pollution sources. One dry weather and one wet weather assessment was completed. This information is provided in sections 6.1-6.3.

In seeking to identify sources of trace metal contamination, RIDEM staff reviewed aerial photos, topographic maps, RIGIS land use data and conducted extensive wet and dry weather field reconnaissance. Additionally, local area residents were interviewed for information regarding potential sources of trace metal pollution.

The most evident source of metals contamination to Indian Run Brook is stormwater runoff. Groundwater and sediment contamination may also be a potential source of dissolved metals to the river.

4.1 Stormwater Runoff

Stormwater runoff is a significant source of pollution to Indian Run Brook, particularly in the more urbanized areas of Peacedale-Wakefield center (subwatershed C). Storm sewers within the watershed rapidly collect, concentrate and route polluted runoff from streets and highways directly to the brook. Stormwater generated from urban areas, parking lots, and commercial and industrial areas is conveyed directly to Indian Run Brook via overland flow or other conveyance.

Three separate storm events were sampled by URI-CVE in 1997 and one by the RIDEM in 2001. The 2001 RIDEM sampling locations included two stormwater outfalls, both within Peacedale-Wakefield center. Figure 2.6 details the location of these outfalls within the basin and Table 4.1 provides a summary of pollutant concentrations measured by RIDEM during all storm events.

Table 4.1 RIDEM Wet Weather Stormwater Outfall Sampling Locations and Data Summary

Outfall	Location	Predominant Catchment Area	Diss. Cu (ug/l)	Diss. Pb (ug/l)	Diss. Zn (ug/l)
IRSW1	7 ft by 3 ft stormwater outfall at Dale Carlia Corner – School Street Outfall.	Drains the Dale Carlia Corner catchment area	**Max** 37.8 **Mean** 22.85	**Max** 1.82 **Mean** 1.22	**Max** 251 **Mean** 156
IR Guild Pipe	8-inch stormwater outfall at Peacedale Neighborhood Guild	Drains the Peacedale Neighborhood Guild	**Conc.** 1.33	**Conc.** 0.26	**Conc.** 9.64

Many studies have been conducted to identify the sources of metals in stormwater runoff. Muschack (1990) identified metal sources in urban runoff that included automotive exhaust gasses, tire abrasion particles, brake lining abrasion dust, lubricating oils and greases, and abrasion of roadways. The various sources of metals found in an urban watershed were detailed in a 1992 study in Santa Clara Valley by Woodward-Clyde (1992). Major sources of several metals, including copper, lead, and zinc, were identified and a percentage of the total annual load for each metal was attributed to each major source. The top sources of copper were found to be brake pads, POTWs (or Publicly Owned Treatment Works), natural erosion, reservoir releases, and corrosion of water supply infrastructure. Major sources of lead were tailpipe emissions, natural erosion, brake pads, reservoir releases, and POTWs. The primary sources of zinc were POTWs, tires, natural erosion, industry with metal processes, and brake pads.

4.2 Natural Background Conditions

Based on field observations and review of land use information, natural background loads are *not* thought to make up a significant portion of the dissolved trace metal load in the Indian Run Brook watershed. However, due to the limited amount of data regarding dissolved trace metal loadings in a natural setting, natural background loads were not separated from the overall water quality calculations.

4.3 Groundwater and Sediment Contamination

Groundwater may be a natural and/or anthropogenic source of metals to the Indian Run Brook. Subterranean flows may seep directly through the riverbed or surface at other points within the floodplain. Although groundwater flows and their contribution to the Indian Run Brook are poorly characterized, the hydric soils have been mapped which represent flow paths for contaminants when water tables are high. Groundwater may contain naturally occurring dissolved metals concentrations, or enriched concentrations from overlying metals contaminated soils that contribute to exceedances of metals water quality criteria in the Indian Run Brook.

Local residents described an historic landfill on Saugatucket Road, however the Office of Waste Management has no information on file concerning this landfill allegedly operated on Saugatucket Road. Further discussion on this potential landfill is discussed in Section 6.2. This would be the only potential known source contributing to contaminated groundwater or sediments in the watershed. Groundwater discharges to storm drains or directly to the river provide an uninterrupted pathway for dissolved metals to the river, which would be most evident in dry weather samples. Since the dry weather samples show fewer exceedances than the wet weather samples and the values just exceed the applicable criteria, this would imply that groundwater discharges of metals are insignificant.

Sediment release of toxic metals to the water column represents another potential source of contamination to the Indian Run Brook. The fate of toxic metals in river sediments depends on a combination of the physical, chemical, and biological conditions. These conditions may vary dramatically, both spatially and temporally, in response to factors ranging from seasonal changes and storm events to human activities such as dredging or remediation efforts. Since the dry weather samples show fewer exceedances than the wet weather samples and the values just exceed the applicable criteria, this would imply that sediment release of metals are insignificant. In addition, the movement of contaminants, including pesticides, heavy metals, etc., is influenced by factors such as sorption, redox gradients, and pH, which in turn are greatly influenced by microbial communities and their activities (Ford et al. 2005). The bacterial community metabolism can affect valence states of metals via oxidation/reduction reactions, thereby altering the chemical speciation, fate, and the ultimate toxicity of the contaminant (Ford et al. 2005).

4.4 Illegal Sources

Copper, lead, and zinc contributions from automotive coolant and oil dumping are possible in the Indian Run Brook watershed. Observations by RIDEM staff include motor oil and coolant containers in the mainstem, as well as parking lots, vacant lots, and commercial areas located adjacent to the river in the lower and more urbanized portions of the watershed. Since wet weather samples show more exceedances than dry weather samples, illegal sources are not likely a significant contributor to metals contamination in the Brook.

5.0 TMDL ANALYSIS

A TMDL represents the amount of pollutant loading that a waterbody can receive without violating water quality standards. For many pollutants, TMDLs are expressed as mass loading (e.g. pounds per day). The TMDL establishes a level of pollutant loading not to be exceeded by the sum of contributions from all sources (point and nonpoint) plus a suitable margin of safety.

The TMDL is often expressed as:

$$\textbf{TMDL} = \textbf{WLA} + \textbf{LA} + \textbf{MOS}$$

Where:

WLA = Waste Load Allocation
LA = Load Allocation
MOS = Margin of Safety.

5.1 Selection of Appropriate Hardness Values

RIDEM evaluated existing water quality data available for Indian Run Brook at station IR01, the Peacedale Guild, to determine appropriate hardness levels to use in calculating water quality criteria and establishing water quality goals for the TMDL. The analysis resulted in several observations. First, no correlation could be seen between hardness values and flow, which generally show an inverse correlation. Second, using the RIDEM data, no increase or decrease of hardness was observed in the downstream direction of Indian Run Brook. Third, only slight differences existed between mean dry and wet weather hardness values. The average dry weather hardness was 19.4 mg/l as $CaCO_3$ versus the average wet weather hardness was 16.5 mg/l as $CaCO_3$.

Based on these numbers, RIDEM used a mean dry and wet weather combined hardness value to calculate numeric concentration targets (Table 1.2) for Indian Run Brook. The hardness used was 17.2 mg/l as $CaCO_3$. Since little difference is seen between dry and wet weather mean hardness values, the choice of a “mean” hardness value was felt to be representative of conditions in the brook under dry weather, baseflow conditions when dilution is limited. The use of mean hardness value results in TMDL that is protective and is reflective of actual data collected in the waterbody during a range of flows, given that there is little difference between dry and wet weather mean hardness values.

For the RIDEM data, since there was only one sample collected for dry weather and wet weather at each station, individual hardness values were used to calculate the criteria for each station. The RIDEM data is being used for source identification purposes only.

5.2 Critical Conditions and Seasonal Variation

Clean Water Act Sections 303(d)(1)(C) requires that TMDLs "be established at a level necessary to implement the applicable water quality standards with seasonal variations…" The current regulation also states that determination of "TMDLs shall take into account critical conditions for stream flow, loading, and water quality parameters" [40 CFR 130.7(c)(1)].

5.2.1 *Seasonal Variation*

The Indian Run Brook TMDL is protective of all seasons, since the trace metal data were collected during the summer and early fall, when stream flows are the lowest, and trace metal concentrations are the highest.

5.2.2 *Critical Conditions*

In general, stream flows tend to dissipate during the summer months when evapotranspiration is high. Due to this effect, ambient concentrations of pollutants, including trace metals, tend to be higher than during the winter months when evapotranspiration is low.   Acute and chronic exceedances of dissolved Cu, Zn, and Pb occur under low and high flow conditions. Monitoring conducted in support of this TMDL focused on the critical summer season and included both wet and dry weather conditions.

Furthermore, both first flush and peak flow conditions were sampled as part of this survey. The first flush sample was taken when the stormwater began to create a rise in water elevations within the waterbody, or in the case of a stormwater outfall, when water was first discharged into the waterbody. First flush normally carries the highest concentration of pollutants, thereby posing the greatest risk to aquatic life. The peak flow sample was taken at the highest rate of discharge within the waterbody or stormwater outfall. Although it does not have the highest concentration of pollutants per sample, the concentration of pollutants in or entering the waterbody at this time may exceed the loadings of pollutants during the first flush. Therefore, first flush and peak flow conditions present the most critical times for aquatic life.

5.3 Margin of Safety (MOS)

The TMDLs must contain a margin of safety (MOS) to account for uncertainty in the analysis. The MOS for the Indian Run Brook metals TMDL are implicit and are listed below.

- Violations of acute metal criteria were based on individual sample concentrations, not average concentrations, which would have lowered the concentration below the trace metal criteria.

- To calculate the required percent reductions, the maximum metal concentrations in each dataset were used to represent existing dry and wet weather conditions.

- The most protective numeric standard (the chronic aquatic life support standard) is used to set TMDL targets. In the case of zinc, the acute criteria are slightly lower than the chronic criteria, therefore the most protective numeric standard for zinc is the acute aquatic life support standard.

- Use of the assumption that data collected during the storm events was representative of four days is highly conservative since it is commonly observed that the falling portions of stormflow hydrographs may last an additional 2 days-thus providing an implicit margin of safety.

5.4 Technical Analysis

The technical analyses are based on water quality data collected at the confluence of Indian Run Brook with the Saugatucket River by URI-CVE between 1996 and 1997.

The TMDL endpoints (acute and chronic criteria) must be met during a range of flows in order for a waterbody to maintain water quality standards and meet its designated uses. In cases where pollutant concentrations in a waterbody are dominated by point source loadings, the critical flow is typically a low flow, since the highest concentrations associated with specific point source loads would be expected under low flow conditions. Conversely, elevated nonpoint source pollutant loadings generally correspond to storm events. Consistent with EPA's Technical Support Document for Water Quality-based Toxics Control (1991), this dissolved metals TMDL is evaluated under both steady state and wet weather conditions.

This TMDL is evaluated under conditions that reflect worst-case (critical) conditions for both point and nonpoint source loadings (i.e. low flow and high flow conditions). Determination of the TMDL under these two scenarios identifies the lower of the two loading capacities of the waterbody. The lower capacity is necessary to protect the waterbody. Data were evaluated under both conditions to ensure that the final loading capacity is protective of water quality and will support all uses during critical conditions.

The total assimilative capacity, or loading capacity, is the maximum amount of pollutant that a waterbody can assimilate while maintaining water quality standards. The loading capacity is a function of different hydrodynamic processes that affect the environmental fate and transport of dissolved metals as they move through the system. For this TMDL, the allowable load or loading capacity is expressed as a concentration set equal to the applicable state water quality standard for each dissolved metal. This concentration is considered to apply daily, in that daily values are used to compare against the acute and chronic criteria. The allowable daily load is the criteria concentration times the flow in the receiving water. For the purposes of implementation, it is recommended that the concentration and percent reduction dissolved metals TMDL targets be used.

The dissolved metals dataset used in this TMDL analysis contains a combination of data collected during baseflow and high flow conditions. Data characteristics such as overall quantity of samples and frequency of sample collection, do not allow for direct comparison against either acute or chronic criteria. The URI-CVE samples were not taken in one-hour increments and the time of sample is not known, therefore each sample concentration will be compared to the acute criteria. The URI-CVE samples were all taken within a 24-hour period. Therefore the average of all the samples taken on each sample day will be averaged for comparison with the chronic criteria.

5.5 Dry Weather Low Flow Analysis

5.5.1 *Chronic Criteria Evaluation*

RIDEM evaluated the dry weather dataset for compliance with chronic criteria by comparing the average value from each survey to the chronic criteria. There were four samples taken on each survey date, within a 24-hour period. The average daily value is compared with the chronic criteria to ensure compliance with the four-day average regulations in accordance with the State's water quality regulations (WQRs). Because the data were collected under sustained low flow conditions, the data is representative of steady state conditions for that particular baseflow. One exceedance of the chronic criteria is acceptable given that the State's WQRs stipulate, "the four-day average concentration of a pollutant should not exceed the chronic criteria more than once every three years on the average". However, more than one exceedance would constitute a violation of chronic criteria and thus would necessitate calculating a percent reduction. Although the State's WQRs provide the basis for evaluating whether or not a violation has occurred, in cases where RIDEM has knowledge of an actual or potential upstream pollution source, which would be expected to result in additional exceedances within a three-year period, one exceedance of the chronic criteria would constitute a violation.

5.5.2 *Acute Criteria Evaluation*

Each dry weather survey consisted of four dry weather samples taken sporadically within a 24-hour period. Since under steady state conditions, any given sample should be representative of water quality within that segment for such a short period of time as one hour, each data value is compared to the acute criteria.

One exceedance of the acute criteria is acceptable given that the State's WQRs stipulate "the one-hour average concentration of a pollutant should not exceed the acute criteria more than once every three years on the average". However, more than one exceedance would constitute a violation of acute criteria and would necessitate calculating a percent reduction. As stated earlier, existing language in the WQRs provides the basis for evaluating whether or not a violation has occurred. However, in cases where RIDEM has knowledge an actual or potential upstream pollution source, one exceedance of the acute criteria would constitute a violation.

5.5.3 *Low Flow Reductions*

The dissolved metals TMDLs are concentration-based. The allowable concentration is equal to the chronic criteria, which is typically more protective than the acute criteria. In this case, the exception is zinc where the acute criterion is more protective (26.37 versus 26.59). The difference is two-tenths of a ug/l and inconsequential to the TMDL's outcome and therefore use of the chronic criteria is considered protective of both acute and chronic criteria. The existing concentration is calculated as the maximum dry weather dissolved metal concentration during any dry weather survey. The allowable and existing concentrations under low flow conditions are expressed as follows and are reported in Table 5.1.

Allowable Dry Weather metal concentration = Chronic Criteria (concentration in ug/l)
Existing Dry Weather metal concentration = Maximum Dry Weather Concentration (ug/l)

Table 5.1 Low Flow Allowable and Existing Concentrations in Indian Run Brook

Waterbody	Cu Allowable Conc. (ug/l)	Cu Existing Conc. (ug/l)	Pb Allowable Conc. (ug/l)	Pb Existing Conc. (ug/l)	Zn Allowable Conc. (ug/l)	Zn Existing Conc. (ug/l)
RI0010045R-02	1.99	3.42[2]	0.34	1.58[1]	26.59	27.45[2]

1 Considered a violation of criteria (multiple low flow exceedances)
2 Considered a violation of criteria (multiple low and high flow exceedances)

To determine the necessary concentration reductions, the allowable concentration is subtracted from the existing dry weather concentration. Expressed as percent reduction, the necessary dissolved metals load reductions at each station are:

Percent Reduction = ((Existing conc. – Allowable conc.)/Existing conc.) x 100%

Reductions are required under low flow conditions for dissolved Cu, Pb and Zn. Required reductions are presented below in Table 5.2.

Table 5.2 Low Flow Condition Percent Reductions in Indian Run Brook

Metal	Required Reduction
Cu	42%
Pb	79%
Zn	3%

5.6 Wet Weather High Flow Analysis

5.6.1 *Chronic Criteria Evaluation*

In some cases, aquatic life may be exposed to wet weather-related pollutants for a long enough period of time (> 4 days) whereby chronic effects may be seen. A detailed analysis of both precipitation and flow records would be required to determine the exact conditions where this may occur. In addition, two key assumptions would need to be made in order for this analysis to be used in TMDL development. One key assumption is that point and nonpoint pollution sources are constant during the duration of elevated flows. This runs counter to the widely accepted concept of "first-flush", whereby the majority of pollutant load enters a waterbody during the rising limb of the hydrograph. The second key assumption is that reported daily precipitation values represent an actual intensity of rainfall that could produce runoff. In reality, a reported daily rainfall value may be spread out over a long enough period of time whereby surface runoff is minimal.

Given these restrictions, and in order to satisfy the four-day chronic requirement, RIDEM chose to evaluate all data available within the stormflow portion of the hydrograph, and conservatively assume that these conditions represent a four-day average. Assuming that these data represent four days is highly conservative since it is commonly observed that the falling portions of stormflow hydrographs may last an additional 2 days-thus providing an implicit margin of safety.

If the chronic criteria were exceeded once during a wet weather event with a recurrence interval of three years or less, then RIDEM considers it likely that the criteria would be exceeded again within the three-year period, and therefore the data would represent a violation of water quality standards. Therefore, under these assumptions, only one exceedance of the chronic criteria during wet weather is needed in order to represent a violation of the chronic criteria.

5.6.2 *Acute Criteria Evaluation*

The existing wet weather dataset contains numerous samples collected before, during, and after a rainfall event. Existing data include approximately 10 samples for station IR01, Peacedale Guild, that were collected during high flows, with the remainder of values representing either a pre- or post-storm condition. Appendix B of the State's WQR states that *"the one-hour average concentration of a pollutant should not exceed the acute criteria more than once every three years on the average"*.

EPA's Technical Support Document for Water Quality-Based Toxics Control (1991) states that the one-hour averaging period was derived primarily from data on response time for toxicity to ammonia, a fast-acting toxicant. Additionally, the document state's that "the 1-hour averaging period is expected to be fully protective for the fastest-acting toxicants (i.e. ammonia) and even more protective for slower-acting toxicants." Therefore, in this case, it seems appropriate that values of slower-acting toxicants such as (Cu, Pb, and Zn) spaced a few hours apart would be sufficient to characterize the 1-hour averaging period and satisfy that portion of the criteria.

As stated above, wet weather samples were collected a few hours apart during the high-flow portion of the sampling event. The time of sample was not recorded however it is known that approximately 11 samples were collected within a 24-hour period. Each data value collected under high-flow conditions is considered to be representative of a concentration in that waterbody for a period of one hour. Therefore, all data collected within the stormflow portion of the hydrograph is compared to the acute criteria and the maximum value is considered to conservatively represent existing conditions.

If the acute criteria were exceeded once during a wet weather event then RIDEM considers it likely that the criteria would be exceeded again within a three-year period and therefore, the data would represent a violation of water quality standards. Under these assumptions, only one exceedance of the acute criteria during wet weather is needed in order to represent a violation of the acute criteria.

5.6.3 *High Flow Reductions*

Wet weather allowable concentrations are set equal to the acute and chronic criteria and are presented in Table 5.3 – along with existing concentrations for wet weather.

The existing wet weather condition for Indian Run Brook is evaluated from the available wet weather data as:

1. Maximum wet weather value (for comparison to acute criteria)
2. Average of storm event values (for comparison to chronic criteria)

Table 5.3 High Flow Allowable and Existing Concentrations in Indian Run Brook

Criteria	Cu Allowable Conc. (ug/l)	Cu Existing Conc. (ug/l)	Zn Allowable Conc. (ug/l)	Zn Existing Conc. (ug/l)	Pb Allowable Conc. (ug/l)	Pb Existing Conc. (ug/l)
Acute	2.56	10.47[1]	26.37	43.36[1]	8.68	ND*
Chronic	1.99	6.39[2]	26.59	32.09[2]	0.34	ND*

1 Considered a violation of criteria (multiple low flow exceedances)
2 Considered a violation of criteria (multiple low and high flow exceedances)
*ND = Not Detected, Detection Limit = 0.2

The resulting concentration reductions in dissolved Cu, Pb and Zn for each station for acute evaluation are calculated as:

Percent Reduction = ((Maximum Concentration-Acute Criteria)/Maximum Concentration) x 100%

For the chronic evaluations, the resulting equation is:

Percent Reduction = ((Average Event Concentration-Chronic Criteria)/Average Concentration) x 100%

Based on Tables 5.1 and 5.3, all the metals require a percent reduction for Indian Run Brook. The highest of the required acute and chronic reductions are used as the final reduction for each station. Table 5.4 summarized the percent reductions required during high flow conditions.

Table 5.4 High Flow/Wet Weather Percent Reductions in Indian Run Brook

Metal	Required Reduction
Cu	76%
Zn	39%
Pb	0%

5.7 Final Reductions

The final required reductions are based on the largest of the dry and wet weather reductions (Tables 5.2 and 5.4). Table 5.5 presents the final segment reductions for dissolved Cu, Pb and Zn.

Table 5.5 Metals TMDLs Expressed as Percent Reductions to Meet Concentration Targets

Waterbody ID	Dissolved Cu	Dissolved Pb	Dissolved Zn
RI0010045R-02	76%	79%	39%

5.8 TMDLs, Wasteload and Load Allocations

A TMDL is the combination of a total wasteload allocation (WLA) that allocates loadings for point sources, a total load allocation (LA) that allocates loadings for nonpoint sources and background sources and a Margin of Safety (MOS). In TMDL development, allowable WLA and LA from pollutant sources that cumulatively amount to no more than the TMDL must be established; this provides the basis to establish water quality-based controls. TMDLs can be expressed on a mass-loading basis or as a concentration in accordance with provisions in federal regulations [40 CFR 130.2(1)]. As described in Section 5.4, the TMDL and consequently the WLAs and LAs are expressed as concentration targets and the percent reductions required to meet standards.

The LAs are assigned to nonpoint sources and natural background sources in the watershed. These sources include air deposition of metals and groundwater contributions and may or may not include anthropogenic sources. As discussed in the Source Analysis section (Section 4.0), these sources are not considered significant at this time. These sources may be re-evaluated at a future date if any additional data become available.

Since it is not possible to separate out the load allocation, it is included in the WLA and the MOS is implicit, therefore the TMDL equals the WLA.

5.9 Strengths and Weaknesses in the Technical Approach

The Indian Run Brook TMDL was developed using URI-CVE 1996 and 1997 (Wright et al. 1999) and RIDEM 2001 water quality and hydrologic data, collected through extensive wet and dry weather field surveys, land use investigations, and utilizing past meteorological records. Numerous site visits to the watershed solidified the link between pollution sources and the high trace metal concentrations identified by RIDEM field monitoring.

Strengths:

- Approach utilized extensive knowledge of land use in the watershed.
- The TMDL is based on actual data collected in the watershed.
- Runoff and recovery parameters were derived from extensive databases, validated with field observations, and determined to be appropriate, yet conservative, for this application.
- The TMDL endpoints presented in the load allocation sections allow water quality standards to be met in critical conditions.
- The water quality criteria assume that trace metals are in 100 percent toxic/available form and that the duration of exposure to aquatic life and other beneficial uses is for an extended period of time, thereby allowing water quality standards to be met in critical conditions.

- The phased approach allows an emphasis on mitigation strategies rather than on modeling and more complex monitoring issues to keep the focus on removing sources.
- The watershed is small and fairly accessible; therefore RIDEM was able to visually inspect nearly the entire length of the brook.
- "Clean" sampling and analytical procedures were used to determine trace metal concentrations, thereby making the concentration data more accurate.

Weaknesses:
- Absence of flow data and stage-discharge relationships for the Indian Run watershed.
- Due to relatively dry seasonal conditions in the watershed, flow conditions for the wet weather event was not ideal. Even though the minimum rainfall amount (0.3 inches) was reached, some areas of the watershed did not collect enough water to sample.
- The RIDEM study only incorporates one dry and one wet weather event, with only two data points for each station.
- Does not account for impacts associated with the altered flow regime of the lower, urban portion of Indian Run Brook.

5.10 Supporting Documentation

Recent water quality studies considered significant to this TMDL are presented in Table 5.6. These references were used to characterize the present water quality conditions or identify water quality trends.

Table 5.6 Supporting Documentation

Primary Organization or Authors	Title	Date of Report	Approximate Date of Study
URI Civil and Environmental Engineering Department	Saugatucket River Water Quality Investigations: Water Quality Report	1999	1996 & 1997
Lee Pare & Associates, Inc.	The Effect of the Dale Carlia Corner watershed Reconstruction on the Indian Run Flood Plain	1982	1981
RI Department of Environmental Management	Saugatucket Fecal Coliform Total Maximum Daily Load	2003	2000

6.0 IMPLEMENTATION

This section describes the actions necessary to implement the TMDL to attain and maintain dissolved copper, lead and zinc water quality criteria in the Indian Run Brook. The plan describes implementation responsibilities assigned to cooperating agencies and other responsible parties. The goal of the Implementation Plan is to ensure that the Indian Run Brook meets water quality criteria for dissolved copper, lead and zinc at all times and in all points of the river.

Eliminating dissolved metals impairments in the Indian Run Brook and its watershed requires a reduction in both dry and wet weather inputs. Sources of dissolved Cu, Pb and Zn are mainly from stormwater runoff. In the lower segments of Indian Run Brook, untreated stormwater runoff from roads, streets, and residential/commercial land uses impacts water quality. The cumulative impacts of stormwater runoff degrade water quality and necessitate a watershed-wide pollution reduction approach directed at both point and nonpoint sources of pollution.

Recommended implementation activities and current pollution reductions strategies for the Indian Run Brook are detailed in the following sections. Several key projects in the watershed are expected to reduce pollution in the Indian Run Brook. Other activities focus on litter and waste management controls, and other good housekeeping measures. This TMDL relies upon phased implementation to reach its water quality goals. As recommended measures are taken, the corresponding response in trace metal concentrations will be measured.

RIDEM continues to respond to environmental complaints, conduct inspections, and issue NPDES permits as part of its responsibilities under state and federal laws and regulations. RIDEM will continue to work with RIDOT, town of South Kingstown, private property owners, and watershed groups to identify funding sources, and evaluate locations and designs for stormwater control BMPs throughout the watershed.

6.1 Sub-watershed A, Upper Indian Run East

There were no exceedances of the water quality criteria within sub-watershed A for the dry and wet weather events, and no apparent sources of metals contamination. Therefore, no actions are recommended.

6.2 Sub-watershed B, Upper Indian Run West

The section of the Indian Run Brook from Station IRT to Station IR4 make up subwatershed B or Upper Indian Run West. A low level exceedance of the chronic lead criteria was detected from the one dry weather grab sample collected at Station IRT. The streambed was dry before, during, and after the wet weather event. Downstream of this station, at Station IR4, there are no impairments. This suggests that any elevations in dissolved lead levels found at Station IRT are mitigated through natural processes before it reaches subwatershed A. There is no lead violation for this section of the brook.

Upper Indian Run West is the most rural of the three sub-watersheds and no sources have been identified. A historical landfill that is believed to have existed sits approximately 1,700 feet north of station IRT, however it is not thought to have been active in 40-50 years. The Department of Waste Management has no record of this landfill. Currently a house resides at the site. The one sample documenting a low level exceedance of the lead criteria could be related to the historic use at this site. Stormwater runoff was not observed to impact this section of the river. At this time, no actions are recommended for this watershed.

6.3 Sub-watershed C, Lower Indian Run Peacedale-Wakefield Center

All sampling stations within Lower Indian Run were observed to exceed at least one portion of the applicable metals criteria. The focus of the implementation section is on this section of the brook.

The School Street outfall (IRSW1) is located the furthest upstream in sub-watershed C and was sampled twice during the wet weather survey. Station IR3 is located 50-feet downstream of IRSW1 and was sampled during the dry and wet weather surveys.

The stormwater outfall has very high levels of Cu and Zn. Fifty feet downstream of this outfall, station IR3 also has wet weather impairments for Cu and Zn, however all concentrations are lower at station IR3 than they are at the outfall. There are also no dry weather impairments at station IR3. The source of metals contamination for this section of the river is stormwater runoff. No other point sources exist in this section of the river.

RIDEM encourages cooperation from RIDOT and the Town of South Kingstown to seek to attenuate stormwater runoff through the use of BMPs that promote the treatment and infiltration of runoff to reduce wet weather trace metal loads draining to these stations to the maximum extent practicable. As described in greater detail in the following section, RIDOT and the Town of South Kingstown should specifically focus on the construction of BMP(s) to mitigate impacts from the School Street outfall that drains the majority of the Dale Carlia Corner area. This area includes Old Tower Hill Road, Kingstown Road, and Main Street. The Town should focus on establishment of development and re-development ordinances to reduce the volume of runoff and load of trace metals from the developed lands draining to the School Street outfall. The stormwater outfall identified as station IRSW1 drains a 104-acre area, of which 73 acres, or 70% of the drainage area, is impervious (Figure 2.7 catchment area 1).

Comprehensive Environmental Incorporated (CEI) has written a report, *Dale Carlia Corner Conceptual Best Management Practices South Kingstown, RI*, dated October 25 2006, that will assist the Town of South Kingstown in developing these BMPs. This project, funded by the federal 104b(3) Water Quality Grant administered by RIDEM, involves the development of a source reduction strategy that includes capturing and infiltrating up to 1” of runoff from impervious areas in the Dale Carlia Corner area tributary to the School Street stormwater outfall to Indian Run Brook. The report provides design concepts for each parcel in the catchment area that will restore natural recharge to the level that existed prior to development through the implementation of stormwater BMPs.

A related area of concern noted within Lower Indian Run is the abundance of sand in the stream channel downstream of the School Street outfall in the vicinity of station IR3. The Phase II Storm Water Management Program Plan states, “The Town will continue to clean all of the streets once per year for the duration of this plan. Critical environmental areas will be swept twice per year if resources are available.” (Beta Group) More frequent street sweeping than the required once per year to collect accumulated sand applied to streets in the winter must be conducted on town and state roads to minimize the amount of sand and sediment being introduced to the stream.

Station IR2 is located approximately 100-feet south of the terminal end of Amos Street, this station is the next downstream station after station IR3. Cu, Pb and Zn exceedances occurred during wet weather and no dry weather violations occurred. All metal wet weather concentrations were higher at station IR2 than at Station IR3. No anthropogenic sources of pollution between IR3 and IR2 have been identified by RIDEM. Elevated wet weather trace metal levels are thought to be primarily a result of loadings from the stormwater outfall indicated at School Street (Station IRSW1).

A second area of concern is that the high volumes of water discharged from the outfall at School Street have eroded the streambank from that station to the Church Street Bridge. Efforts to reduce runoff volumes through use of infiltration BMPs may mitigate the problem somewhat. It is recommended that the Town of South Kingstown research and implement streambank stabilization measures in this segment of Indian Run Brook.

RIDEM Station IR1 and URI-CVE Station IR01 are located where Indian Run Brook flows under the Columbia Street Bridge. This station is the most downstream station and is within Lower Indian Run. Station IR Guild Pipe, which is an 8-inch stormwater outfall immediately downstream of Station IR1, shows no wet weather violations. IR Guild Pipe drains the parking lot for the Peacedale Neighborhood Guild. This outfall was only sampled once during the RIDEM wet weather event. The Town of South Kingstown must make efficient removal of debris, litter, and accumulated sediments and pollutants of concern on streets a priority and tailor street sweeping activities accordingly. Street sweeping must be conducted more than the once-annual schedule to prevent sand and other matter from entering Indian Run Brook. Additional street sweeping of the parking lot at the Peacedale Guild would be beneficial.

Station IR1 shows both dry and wet weather exceedances. The RIDEM data shows concentrations of Cu, Pb, and Zn increase between station IR2 and station IR1. There are two outfalls between these two stations. The first outfall, located approximately 250 feet upstream of Station IR1, drains Spring Street, while the drainage area for the second outfall, approximately 200 feet upstream of Station IR1, cannot be determined. These two outfalls were not sampled because they were submerged at the time RIDEM was conducting the wet weather sampling. Possible sources of contamination in this section of river are stormwater discharges, illicit discharges to storm drains, illegal sources, and groundwater and sediment contamination. It is recommended that changing of motor oil, coolant and other car additives or car repairs not be performed in parking lots, vacant lots, and commercial areas where runoff could carry these contaminants into stormwater drains thereby polluting Indian Run Brook.

6.4 Stormwater Management

6.4.1 *Phase II – Six Minimum Measures*

As discussed previously, stormwater is the primary source of dissolved metals and cause of copper, lead and zinc violations on Indian Run Brook. Large volumes of stormwater are generated on RIDOT and town owned roadways and the developed lands within the lower Indian Run watershed. The Town of South Kingstown and the RI Dept. of Transportation operate small Municipal Separate Storm Sewer Systems (MS4s) that discharge to the surface waters of the Indian Run Brook. These entities have applied for and obtained coverage under the RIPDES General Permit and have developed and submitted the required Storm Water Management Program Plans (SWMPPs). The plans contain implementation schedules that include interim milestones, frequency of activities and reporting of results. The SWMPPs describe BMPs for the six minimum measures and include measurable goals and schedules for each measure:

- A public education and outreach program to inform the public about the impacts of storm water on surface water bodies,
- A public involvement/participation program,
- An illicit discharge detection and elimination program,
- A construction site storm water runoff control program for sites disturbing 1 or more acres,
- A post construction storm water runoff control program for new development and redevelopment sites disturbing 1 or more acres, and
- A municipal pollution prevention/good housekeeping operation and maintenance program.

Because stormwater systems frequently have multiple interconnections between MS4s, DEM encourages cooperation between operators of MS4s (including RIDOT) in developing and implementing the six minimum measures and constructing Best Management Practices throughout the drainage area contributing to a discharge, by the way of inter-agency agreements.

Post-construction storm water management in areas undergoing new development or redevelopment is necessary because runoff from these areas has been shown to significantly affect receiving waterbodies. To meet the requirements of the Phase II minimum control measure relating to Post Construction Runoff Control, the operator of a regulated small MS4 will need to at a minimum:

- Develop and implement strategies, which include a combination of structural and/or nonstructural BMPs;
- Develop an ordinance or other regulatory mechanism requiring the implementation of post-construction runoff controls to the extent allowable under State or local law;
- Ensure adequate long-term operation and maintenance of controls;
- Determine appropriate best management practices (BMPs) and measurable goals for this minimum control measure.

RIDOT, in conjunction with RIDEM, has signed an agreement with the University of Rhode Island Cooperative Extension (URI) for a Public Education and Outreach Program. This program will provide participating MS4s the opportunity to use prepared education and outreach programs for their individual use, which could be easily tailored to the TMDL public education recommendations. To date, each of the MS4 designated in the TMDL studies are participating in the Program, except Coventry. More information may be found on the URI NEMO website http://www.uri.edu/ce/wq/RESOURCES/STORMWATER/index.htm

6.4.2 Required Amendments to Phase II Stormwater Management Program Plans

Part IV.D of the General Permit states that the operator must address the TMDL provisions in the SWMPP if a TMDL has been approved for any waterbody into which storm water discharges from the MS4 contribute directly or indirectly the pollutants(s) of concern (Part II.C3). Accordingly, upon approval of this TMDL, the RI Department of Transportation and the Town of South Kingstown will be required to submit SWMPP amendments addressing the TMDL provisions within one hundred and eighty (180) days of the date of written notice from the RIPDES Program (Rule 31 (f)(8)(iii)), as described in greater detail below.

More specifically, the SWMPPs must be revised to describe the six minimum measures and other additional controls that are or will be implemented to address the TMDL pollutants of concern [copper, lead and zinc (for sites contributing to MS4s which discharge directly to Indian Run Brook)] including any specific provisions described herein. The operators must provide measurable goals for the development and/or implementation of the six minimum measures and additional structural and non-structural BMPs that will be necessary to address provisions for the control of storm water identified in this TMDL including an implementation schedule, which includes all major milestone deadlines including the start and finish calendar dates, the estimated costs and proposed or actual funding sources, and the anticipated improvement(s) to water quality. These requirements apply to any operators of MS4s contributing to specifically identified outfalls, regardless of outfall ownerships. If no structural BMPs are recommended, the operator must evaluate whether the six minimum measures alone (including any revisions to ordinances) are sufficient to meet the TMDL's specified pollutant reduction targets. The revised SWMPP must specifically address the following:

1. Determine the land areas contributing to the discharges identified in TMDL using sub-watershed boundaries as determined from USGS topographic maps or other appropriate means;
2. Address all contributing areas and the impacts identified by the Department;
3. Assess the six minimum control measure BMPs and additional controls currently being implemented or that will be implemented in the SWMPP and describe the rationale for the selection of controls including the location of the discharge(s), receiving waters, water quality classification, shellfish growing waters, and other relevant information;
4. Identify and provide tabular description of the discharges identified in the TMDL including:
   a. the location of discharge (latitude/longitude and street or other landmark);
   b. size and type of conveyance (e.g. 15" diameter concrete pipe);
   c. any existing discharge data (flow data and water quality monitoring data);
   d. impairment of concern and any suspected sources(s);
   e. interconnections with other MS4s within the system;
   f. TMDL provisions specific to the discharge;

g. any BMP(s) that have or will be implemented to address TMDL provisions and pollutants(s) of concern;
h. schedule for construction of structural BMPs including those for which a Scope of Work is to be prepared, as described below.

Among the six minimum measures described earlier is the requirement for operators to establish post construction storm water runoff control programs for new land development and redevelopment sites disturbing one or more acres. It is imperative that land development and re-development projects utilize best management practices if Indian Run Brook is to be successfully restored. To ensure consistency with the goals and recommendations of the TMDL, the revised SWMPP must also address revisions to the local ordinances to ensure that:

1. **new land development** employ stormwater controls to prevent any net increase in those pollutant(s) of concern [copper, lead and zinc]; and
2. **redevelopment projects** employ stormwater controls to reduce those pollutant(s) of concern [copper, lead and zinc] for sites contributing to MS4s which discharge directly to Indian Run Brook.

The Town should consider expanding these ordinances town-wide and lowering the threshold of applicability for these ordinances to less than 1 acre, and that the more stringent requirements apply to discharges to all surface waters within the watershed. The revised plan must include an assessment of impacts of imposing these requirements on lower threshold developments.

This TMDL has determined that structural BMPs are necessary, therefore all operators of MS4s identified herein must also prepare and submit a **Scope of Work** describing the process and rationale that will be used to select BMPs and measurable goals to ensure that the TMDL provisions will be met. The Scope of Work must also be accompanied with a schedule prioritizing outfalls for the construction of structural stormwater BMPs. A targeted approach to construction of stormwater retrofit best management practices (BMPs) at state and locally-owned stormwater outfalls is recommended. Specifically identified priority areas for BMP construction is the stormwater outfall at School Street. RIDOT and the Town must work to identify other outfalls discharging to Indian Run Brook – downstream of Indian Run Reservoir.

For those operators for which specific outfalls or discharges are identified in the TMDL, the Scope of Work must:

1. Describe the tasks necessary to design and construct BMPs that reduce the loads of pollutants of concern (zinc, lead and copper) and stormwater volumes to *the maximum extent feasible* including:
   a. the delineation of the drainage or catchment area;
   b. determination of interconnections within the system and the approximate percentage of contributing area served by each operator’s drainage system, as well as a description of efforts to cooperate with owners of the interconnected system, and;
   c. completion of catchment area feasibility analyses to determine drainage flow patterns (surface runoff and pipe connectivity), groundwater recharge

potentials(s), upland and end-of-pipe locations suitable for siting BMPs throughout the catchment area, appropriate structural BMPs that address the pollutants(s) of concern, any environmental (severe slopes, soils, infiltration rates, depth to groundwater, wetlands or other sensitive resources, bedrock) and other siting (e.g. utilities, water supply wells, etc.) constraints, permitting requirements or restrictions, potential costs, preliminary and final engineering requirements.

2. Establish a schedule to identify and assess all remaining discharges not identified in the TMDL (owned by the operator) contributing to the impaired waters addressed by the TMDL, to delineate the drainage or catchment areas to these discharges, and as needed to address water quality impairments, to design and construct structural BMPs. To determine the prioritization for BMP construction, the assessment of identified discharges shall determine the relative contribution of each to the pollutant(s) of concern taking into consideration pollutant loads (i.e. concentrations and flows) as indicated by drainage area, pipe size, land use, known hot spots and/or sampling data.

As noted previously, TMDL provisions apply to any MS4 operators contributing stormwater to the identified outfall regardless of outfall ownership.

7.0 PUBLIC PARTICIPATION

The public participation portion of this TMDL includes public meetings and a public review and comment period. DEM presented the draft TMDL plan to stakeholders and the general public on November 28, 2007. The public meeting began the 30-day public comment period, which ended on January 3, 2008. Letters were sent to key stakeholders in advance of the meeting. In addition, the meeting was publicized in a press release and public notices - which were posted at the Peacedale Library and the South Kingstown Town Hall. The meeting was held at the South Kingstown Neighborhood Guild and was well attended by area residents and public officials. DEM received several comments during the public comment period. These are presented in Appendix B.

8.0 COMPLIANCE MONITORING

Considering the highly variable nature of nonpoint source pollutant loads, a phased approach to implementation is appropriate for this TMDL. This approach requires that monitoring be conducted to track the response of instream water quality as load reductions are made over time. RIDEM, in coordination with the entities responsible for BMP implementation, will monitor water quality at key locations in the Indian Run Brook watershed in order to assess BMP effectiveness.

Post-implementation monitoring is necessary to assess the effectiveness of applied controls, and whether or not standards are attained. RIDEM will seek to have the performance of other BMPs monitored as they are installed throughout the Indian Run Brook watershed.

To monitor the effect that implementation activities throughout the watershed will have on water quality in the river, RIDEM will conduct follow-up monitoring at key locations in the watershed. These may include IR1, IR2, and/or IR3. Monitoring would begin once a significant number of BMPs have been implemented and become fully functional.

Once significant improvements in water quality are observed and the dry weather concentrations meet standards, the decision can be made whether to conduct more intensive monitoring to determine if the waterbody is no longer impaired. If the trend is negative or if there is no improvement in water quality seen over time, then follow-up assessments will be made and additional BMPs recommended.

9.0 REFERENCES

Beta Group, Inc., "Town of South Kingstown Rhode Island, Phase II Storm Water Management Program Plan". March 2003.

Comprehensive Environmental Incorporated (CEI). 2006. "Dale Carlia Corner Conceptual Best Management Practices South Kingstown, RI".

Engstrom. 2004. Characterizing Water Quality of Urban Stormwater Runoff: Interactions of Heavy Metals and Solids in Seattle Residential Catchments. Thesis. University of Washington Department of Civil and Environmental Engineering.

Ford, T. and Ryan, D. 2005. Toxic Metals in Aquatic Ecosystems: A Microbiological Perspective. In: Environmental Health Perspectives. Volume 113. No. 3.

Metcalf and Eddy, 1994. "Remedial Investigation Final Report" for the Rose Hill Landfill.

Minton, G.R., 2002. Stormwater Treatment: Biological, Chemical, and Engineering Principles. Gary Minton, Seattle, Washington, 416 pp.

Muschack, W., 1990. Pollution of Street Runoff by Traffic and Local Conditions. The Science of the Total Environment 93:419-431.

Pare, Lee & Associates. 1982. "The effect of the Dale Carlia Corner Reconstruction on the Indian Run Floodplain".

RIDEM. 2001. Quality Assurance Project Plan: Dry and Wet Weather Metals (Copper, Lead, and Zinc) Water Quality Sampling of Indian Run Brook and Sources, Office of Water Resources. Providence, RI.

RIDEM. 2003. Pathogen TMDL for Saugatucket River, Mitchell Brook, Rocky Brook and Indian Run Brook: May 16, 2003. Rhode Island Department of Environmental Management, Office of Water Resources, Providence, RI.

RIDEM. 2006. State of Rhode Island 2006 Water Quality Regulations: July 2006. Rhode Island Department of Environmental Management, Office of Water Resources, Providence, RI.

US EPA *Guidance for Water Quality-Based Decisions: The TMDL Process*. EPA 440/4-91-001. Office of Water Regulations and Standards, Criteria and Standards Division, Washington, D.C. 20460.

U.S. EPA. 1980. Ambient Water Quality Criteria for Copper. EPA 440/5-80-030. Office of Water Regulations and Standards. Criteria and Standards Division. Washington, D.C. 20460.

U.S. EPA. 1980. Ambient Water Quality Criteria for Lead. EPA 440/5-80-057. Office of Water Regulations and Standards. Criteria and Standards Division. Washington, D.C. 20460.

U.S. EPA. 1980. Ambient Water Quality Criteria for Zinc. EPA 440/5-80-079. Office of Water Regulations and Standards. Criteria and Standards Division. Washington, D.C. 20460.

U.S. EPA. 1991. Technical Support Document for Water Quality-Based Toxics Control. EPA#: 505/2-90-001.

US Soil Conservation Service, 1964

Watershed Protection Techniques. The Practice of Watershed Protection Article 6: "Cars Are Leading Source of Metal Loads in California." Watershed Protection Techniques Technical Note # 13. 1(1):28.

Woodward-Clyde Consultants. Source Identification and Control Report prepared for the Santa Clara Valley Nonpoint Source Pollution Control Program. Oakland, CA. December 1, 1992.

Wright et. al. 1999. "Saugatucket River Water Quality Investigations: Water Quality Data Report".

Appendix A
Water Quality Data

Table A-1. Dry Weather Dissolved Copper Data and Criteria

Quantitation Limit = 1.0

Survey Date	Run	Concentration (ug/L)	Acute Criteria	Mean Concentration (ug/L)	Chronic Criteria	Total Hardness
3/25/1996	1	ND	2.56			14.0
3/25/1996	2	ND	2.56			13.6
3/25/1996	3	ND	2.56			14.4
3/25/1996	4	ND	2.56			14.0
3/25/1996				ND	1.99	
7/10/1996	1	**2.78**	2.56			24.8
7/10/1996	2	**3.41**	2.56			25.5
7/10/1996	3	**3.42**	2.56			25.2
7/10/1996	4	1.98	2.56			26.5
7/10/1996				**2.90**	1.99	
10/27/1996	1	ND	2.56			11.6
10/27/1996	2	ND	2.56			12.1
10/27/1996	3	ND	2.56			11.4
10/27/1996	4	ND	2.56			14.5
10/27/1996				ND	1.99	
4/28/1997	Base	ND	2.56	ND	1.99	12.6
8/21/1997	Base	1.72	2.56	1.72	1.99	20.3
9/29/1997	Base	1.76	2.56	1.76	1.99	29.2

ND= Not Detected, Detection Limit = 0.2
Values in bold represent a violation of the water quality criteria.
Numbers with a strikethrough are below the quantitation limit and are considered unreliable.

Table A-2. Dry Weather Dissolved Lead Data and Criteria

Quantitation Limit = 0.8

Survey Date	Run	Concentration (ug/L)	Acute Criteria	Mean Concentration (ug/L)	Chronic Criteria	Total Hardness
3/25/1996	1	ND	8.68			14.0
3/25/1996	2	~~0.53~~	8.68			13.6
3/25/1996	3	1.58	8.68			14.4
3/25/1996	4	ND	8.68			14.0
3/25/1996				**0.53**	0.34	
7/10/1996	1	~~0.30~~	8.68			24.8
7/10/1996	2	ND	8.68			25.5
7/10/1996	3	1.28	8.68			25.2
7/10/1996	4	ND	8.68			26.5
7/10/1996				**0.43**	0.34	
10/27/1996	1	ND	8.68			11.6
10/27/1996	2	ND	8.68			12.1
10/27/1996	3	ND	8.68			11.4
10/27/1996	4	ND	8.68			14.5
10/27/1996				ND	0.34	
4/28/1997	Base	ND	8.68	ND	0.34	12.6
8/21/1997	Base	ND	8.68	ND	0.34	20.3
9/29/1997	Base	0.9	8.68	**0.9**	0.34	29.2

ND= Not Detected, Detection Limit = 0.2
Values in bold represent a violation of the water quality criteria.
Since an ambient hardness of less than 25 mg/L was used to establish criteria for lead, the hardness dependent Conversion Factor is equal to one.
Numbers with a strikethrough are below the quantitation limit and are considered unreliable.

Table A-3. Dry Weather Dissolved Zinc Data and Criteria

Quantitation Limit =2.5

Survey Date	Run	Concentration (ug/L)	Acute Criteria	Mean Concentration	Chronic Criteria	Total Hardness
3/25/1996	1	7.20	26.37			14.0
3/25/1996	2	7.26	26.37			13.6
3/25/1996	3	7.57	26.37			14.4
3/25/1996	4	7.24	26.37			14.0
3/25/1996				7.3	26.59	
7/10/1996	1	23.36	26.37			24.8
7/10/1996	2	19.69	26.37			25.5
7/10/1996	3	17.40	26.37			25.2
7/10/1996	4	15.21	26.37			26.5
7/10/1996				18.92	26.59	
10/27/1996	1	12.00	26.37			11.6
10/27/1996	2	12.64	26.37			12.1
10/27/1996	3	11.23	26.37			11.4
10/27/1996	4	13.99	26.37			14.5
10/27/1996				12.47	26.59	
4/28/1997	Base	7.08	26.37	7.08	26.59	12.6
8/21/1997	Base	15.34	26.37	15.34	26.59	20.3
9/29/1997	Base	**27.45**	26.37	**27.45**	26.59	29.2

ND= Not Detected, Detection Limit = 1.0

Values in bold represent a violation of the water quality criteria.

Table A-4. URI-CVE Wet Weather Dissolved Copper Data and Criteria

Quantitation Limit = 1.0

Survey Date	Run	Concentration (ug/L)	Acute Criteria	Mean Concentration	Chronic Criteria	Total Hardness
4/28/1997	1	ND	2.56			12.60
4/28/1997	2	2.01	2.56			12.80
4/28/1997	3	**2.99**	2.56			11.70
4/28/1997	4	**2.85**	2.56			7.80
4/28/1997	5	2.31	2.56			7.90
4/28/1997	6	1.42	2.56			9.50
4/28/1997	7	1.00	2.56			10.50
4/28/1997	8	ND	2.56			10.80
4/28/1997	9	ND	2.56			10.50
4/28/1997	10	ND	2.56			10.00
4/28/1997	11	ND	2.56			10.00
4/28/1997				1.14	1.99	
8/21/1997	1	**2.96**	2.56			20.00
8/21/1997	2	1.47	2.56			5.50
8/21/1997	3	1.61	2.56			8.50
8/21/1997	4	1.03	2.56			8.10
8/21/1997	5	1.13	2.56			15.10
8/21/1997	6	**3.60**	2.56			19.70
8/21/1997	7	ND	2.56			21.60
8/21/1997	8	ND	2.56			22.40
8/21/1997	9	~~0.93~~	2.56			23.20
8/21/1997	10	ND	2.56			24.60
8/21/1997	11	ND	2.56			26.20
8/21/1997				1.18	1.99	
9/29/1997	1	1.76	2.56			26.70
9/29/1997	2	**10.47**	2.56			20.30
9/29/1997	3	**7.70**	2.56			16.10
9/29/1997	4	**9.14**	2.56			12.70
9/29/1997	5	**6.81**	2.56			18.20
9/29/1997	6	**5.62**	2.56			20.20
9/29/1997	7	**3.22**	2.56			24.10
9/29/1997	8	~~0.91~~	2.56			26.90
9/29/1997				**6.39**	1.99	

ND = Not Detected, Detection Limit = 0.2
Values in bold represent a violation of the water quality criteria.
Numbers with a strikethrough are below the quantitation limit and are considered unreliable.

Table A-5. Wet Weather Dissolved Lead Data and Criteria

Quantitation Limit = 0.8

Survey Date	Run	Concentration (ug/L)	Acute Criteria	Mean Concentration	Chronic Criteria	Total Hardness
4/28/1997	1	ND	8.68			12.6
4/28/1997	2	ND	8.68			12.8
4/28/1997	3	ND	8.68			11.7
4/28/1997	4	ND	8.68			7.8
4/28/1997	5	ND	8.68			7.9
4/28/1997	6	ND	8.68			9.5
4/28/1997	7	ND	8.68			10.5
4/28/1997	8	ND	8.68			10.8
4/28/1997	9	ND	8.68			10.5
4/28/1997	10	ND	8.68			10.0
4/28/1997	11	ND	8.68			10.0
4/28/1997				ND	0.34	
8/21/1997	1	ND	8.68			20.0
8/21/1997	2	ND	8.68			5.5
8/21/1997	3	ND	8.68			8.5
8/21/1997	4	ND	8.68			8.1
8/21/1997	5	ND	8.68			15.1
8/21/1997	6	ND	8.68			19.7
8/21/1997	7	ND	8.68			21.6
8/21/1997	8	ND	8.68			22.4
8/21/1997	9	ND	8.68			23.2
8/21/1997	10	ND	8.68			24.6
8/21/1997	11	ND	8.68			26.2
8/21/1997				ND	0.34	
9/29/1997	1	ND	8.68			26.7
9/29/1997	2	ND	8.68			20.3
9/29/1997	3	ND	8.68			16.1
9/29/1997	4	ND	8.68			12.7
9/29/1997	5	ND	8.68			18.2
9/29/1997	6	ND	8.68			20.2
9/29/1997	7	ND	8.68			24.1
9/29/1997	8	ND	8.68			26.9
9/29/1997				ND	0.34	

ND= Not Detected, Detection Limit = 0.2

Since an ambient hardness of less than 25 mg/L was used to establish criteria for lead, the hardness dependent Conversion Factor is equal to one.

Numbers with a strikethrough are below the quantitation limit and are considered unreliable.

Table A-6. Wet Weather Dissolved Zinc Data and Criteria

Quantitation Limit = 2.5

Survey Date	Run	Concentration (ug/L)	Acute Criteria	Mean Concentration	Chronic Criteria	Total Hardness
4/28/1997	1	3.16	26.37			12.6
4/28/1997	2	7.42	26.37			12.8
4/28/1997	3	21.61	26.37			11.7
4/28/1997	4	**28.11**	26.37			7.8
4/28/1997	5	21.76	26.37			7.9
4/28/1997	6	9.90	26.37			9.5
4/28/1997	7	6.56	26.37			10.5
4/28/1997	8	6.03	26.37			10.8
4/28/1997	9	5.02	26.37			10.5
4/28/1997	10	5.77	26.37			10.0
4/28/1997	11	5.13	26.37			10.0
4/28/1997				10.95	26.59	
8/21/1997	1	14.30	26.37			20.0
8/21/1997	2	17.21	26.37			5.5
8/21/1997	3	17.16	26.37			8.5
8/21/1997	4	13.68	26.37			8.1
8/21/1997	5	22.24	26.37			15.1
8/21/1997	6	14.72	26.37			19.7
8/21/1997	7	8.64	26.37			21.6
8/21/1997	8	14.56	26.37			22.4
8/21/1997	9	16.10	26.37			23.2
8/21/1997	10	18.47	26.37			24.6
8/21/1997	11	20.86	26.37			26.2
8/21/1997				16.18	26.59	
9/29/1997	1	17.69	26.37			26.7
9/29/1997	2	**43.36**	26.37			20.3
9/29/1997	3	**34.37**	26.37			16.1
9/29/1997	4	**38.30**	26.37			12.7
9/29/1997	5	**38.85**	26.37			18.2
9/29/1997	6	**35.47**	26.37			20.2
9/29/1997	7	**28.92**	26.37			24.1
9/29/1997	8	19.75	26.37			26.9
9/29/1997				**32.09**	26.59	

ND = Not Detected, Detection Limit = 1.0
Values in bold represent a violation of the water quality criteria.

Table A-7. RIDEM Dry Weather Dissolved Copper Data and Criteria.

Station	Survey Data	Concentration (ug/L)	Hardness	Acute Criteria	Chronic Criteria
IR1	7/25/2001	~~0.8~~	40.7	5.76	4.15
IR2	7/25/2001	~~0.67~~	36.1	5.15	3.75
IR3	7/25/2001	~~0.98~~	32	4.59	3.38
IR3 Dup	7/25/2001	~~0.89~~	35.8	5.11	3.72
IR4	7/25/2001	~~0.3~~	41	5.8	4.18
IRT	7/25/2001	~~0.52~~	30.6	4.4	3.26

ND= Not detected, Detection Limit = 0.2
Quantitation Limit = 1.0

Table A-8. RIDEM Dry Weather Dissolved Lead Data and Criteria.

Station	Survey Data	Concentration (ug/L)	Hardness	Acute Criteria	Chronic Criteria
IR1	7/25/2001	~~0.05~~	40.7	23.97	0.93
IR2	7/25/2001	~~0.2~~	36.1	20.97	0.82
IR3	7/25/2001	~~0.25~~	32	18.32	0.71
IR3 Dup	7/25/2001	~~0.27~~	35.8	20.77	0.81
IR4	7/25/2001	~~0.39~~	41	24.17	0.94
IRT	7/25/2001	**1.72**	30.6	17.42	0.68

ND= Not detected, Detection Limit = 0.2
Values in bold represent a violation of the water quality criteria.
Quantitation Limit = 0.8

Table A-9. RIDEM Dry Weather Dissolved Zinc Data and Criteria.

Station	Survey Data	Concentration (ug/L)	Hardness	Acute Criteria	Chronic Criteria
IR1	7/25/2001	9.25	40.7	54.71	55.16
IR2	7/25/2001	16.8	36.1	49.42	49.83
IR3	7/25/2001	6.62	32	44.62	44.99
IR3 Dup	7/25/2001	6.36	35.8	49.07	49.48
IR4	7/25/2001	6.22	41	55.05	55.5
IRT	7/25/2001	12.28	30.6	42.96	43.32

Detection Limit = 1.0
Quantitation Limit = 2.5

Table A-10. RIDEM Wet Weather Dissolved Copper Data and Criteria.

Station	Survey Data	Concentration (ug/L)	Hardness	Acute Criteria	Chronic Criteria
IR1	9/21/2001	**3.74**	21.4	3.14	2.4
IR1 Dup	9/21/2001	**4.1**	21.2	3.12	2.38
IR2	9/21/2001	**4.56**	17.9	2.66	2.06
IR3	9/21/2001	**4.22**	19.4	2.87	2.21
IRSW1-1	9/21/2001	**37.8**	18.8	2.78	2.15
IRSW1-2	9/21/2001	**7.9**	n/a*	2.78	2.15
IR4	9/21/2001	0.47	36.5	5.2	3.79
IR-Guild Pipe	9/21/2001	1.33	n/a**	3.3	2.51

*Used IRSW1-1 first flush hardness
**Used RIDEM wet weather average hardness = 22.53 mg/L as $CaCO_3$
Values in bold represent a violation of the water quality criteria**.** Detection limit = 0.2; Quantitation Limit = 1.0

Table A-11. RIDEM Wet Weather Dissolved Lead Data and Criteria.

Station	Survey Data	Concentration (ug/L)	Hardness	Acute Criteria	Chronic Criteria
IR1	9/21/2001	**1.47**	21.4	11.65	0.45
IR1 Dup	9/21/2001	**1.48**	21.2	11.53	0.45
IR2	9/21/2001	**1.02**	17.9	9.52	0.37
IR3	9/21/2001	**0.72**	19.4	10.43	0.41
IRSW1-1	9/21/2001	**1.82**	18.8	10.06	0.39
IRSW1-2	9/21/2001	**0.61**	n/a*	10.06	0.39
IR4	9/21/2001	0.31	36.5	21.23	0.83
IR-Guild Pipe	9/21/2001	0.26	n/a**	12.35	0.48

*Used IRSW1-1 first flush hardness
**Used RIDEM wet weather average hardness = 22.53 mg/L as $CaCO_3$
Values in bold represent a violation of the water quality criteria**.** Detection limit = 0.2; Quantitation Limit = 0.8

Table A-12. RIDEM Wet Weather Dissolved Zinc Data and Criteria.

Station	Survey Data	Concentration (ug/L)	Hardness	Acute Criteria	Chronic Criteria
IR1	9/21/2001	23.7	21.4	31.73	31.99
IR1 Dup	9/21/2001	25.6	21.2	36.94	37.24
IR2	9/21/2001	**35**	17.9	27.28	27.5
IR3	9/21/2001	**43.75**	19.4	29.2	29.44
IRSW1-1	9/21/2001	**251**	18.8	28.43	28.67
IRSW1-2	9/21/2001	**61**	n/a*	28.43	28.67
IR4	9/21/2001	8.04	36.5	49.89	50.29
IR-Guild Pipe	9/21/2001	9.64	n/a**	34.06	34.34

*Used IRSW1-1 first flush hardness
**Used RIDEM wet weather average hardness = 22.53 mg/L as $CaCO_3$
Values in bold represent a violation of the water quality criteria**.** Detection limit = 2.5; Quantitation Limit = 1.0

APPENDIX B

Response To Comments Document

Comments from Robert Shawver, RI Department of Transportation

This letter constitutes RIDOT's written comments regarding the Indian Run Brook TMDL report. RIDOT has reviewed the report, attended the November 28, 2007 Public Meeting, and offers the following:

- Page 29, 1st Paragraph: The significance (or lack thereof) of sediment release of toxic metals to Indian Run Brook is not stated.

RIDEM Response:
On page 29, 1st paragraph, RIDEM has added the statement "Since the dry weather samples show fewer exceedances than the wet weather samples and the values just exceed the applicable criteria, this would imply that sediment release of metals are insignificant."

- Page 29, 2nd Paragraph: The significance (or lack thereof) of illegal source contamination to Indian Run Brook is not stated.

RIDEM Response:
On page 29, 2nd paragraph, RIDEM has added the statement "Since wet weather samples show more exceedances than dry weather samples, illegal sources are not likely a significant contributor to metals contamination in the Brook."

- Page 40, Section 6.3, 4th Paragraph: "...RIDOT should specifically focus on construction of BMP(s) to mitigate.... School Street outfall... The Town should focus on establishment of development/re-development rights..." TMDL requirements apply to any operators of MS4s contributing to specifically identified outfalls, regardless of outfall ownership. Both RIDOT and the town of South Kingstown should be held responsible for implementing BMPs for the School Street outfall discharge.

RIDEM Response:
RIDEM agrees with the RIDOT that the Town should also focus on the School Street outfall as operators of contributing MS4s. They have been added to the above-mentioned statement. "As described in greater detail in the following section, RIDOT and the Town of South Kingstown should specifically focus on the construction of BMP(s) to mitigate impacts from the School Street outfall that drains the majority of the Dale Carlia Corner area."

Also, on page 43 first paragraph states:

> Part IV.D of the General Permit states that the operator must address the TMDL provisions in the SWMPP if a TMDL has been approved for any waterbody into which storm water discharges from the MS4 contribute directly or indirectly the pollutants(s) of concern (Part II.C3). Accordingly, upon approval of this TMDL, the RI Department of

Transportation and the Town of South Kingstown will be required to submit SWMPP amendments addressing the TMDL provisions within one hundred and eighty (180) days of the date of written notice from the RIPDES Program (Rule 31 (f)(8)(iii)), as described in greater detail below.

This statement reiterates both the Town of South Kingstown and RIDOT are responsible for the School Street outfall.

- RIDOT, RIDEM, and the URI Cooperative Extension have entered into a multi-year agreement for URI to provide stormwater public education and outreach support and materials to participating MS4s. Public education regarding illicit discharges, pet waste, motor vehicle repair/maintenance waste, etc. are all anticipated to be addressed through this Agreement. The RIDEM RIPDES Program has a copy of this agreement, or it may be found on RIDOT's Stormwater webpage at http://www.dot.ri.gov/programs/enviro/index.html within the 2007 Revised SWMPP Attachments.

RIDEM Response:

On page 42, in section 6.4.1 *Phase II – Six Minimum Measures*, the paragraph has been added: "RIDOT, in conjunction with RIDEM, has signed an agreement with the University of Rhode Island Cooperative Extension (URI) for a Public Education and Outreach Program. This program will provide participating MS4s the opportunity to use prepared education and outreach programs for their individual use, which could be easily tailored to the TMDL public education recommendations. To date, each of the MS4 designated in the TMDL studies are participating in the Program. More information may be found on the URI NEMO website http://www.uri.edu/ce/wq/RESOURCES/STORMWATER/index.htm"

RIDOT will continue to work with the Office of Water Resources and interconnected MS4s in both the Storm Water Retrofit Program and the Storm Water Management Program. RIDOT will also implement each of the 6 Phase II Minimum Measures within the Indian Run Brook TMDL area, to the maximum extent practicable, and will report on progress in the RIPDES Annual Report. An amended SWMPP will be submitted after the acceptance and finalization of the TMDL.

Should you have any questions regarding this matter, please contact Ms. Allison LeBlanc within the Natural Resources Unit at 222-2023, Extension 4097. Thank you.

Additional Technical Comments (no response necessary):

- Page 4, 1st Paragraph: It should be mentioned that the fecal coliform bacteria impairment of Indian Run Brook is addressed in the 2003 Saugatucket River TMDL, and the current TMDL addresses the dissolved metals impairment.
- Page 10, 1st Paragraph: RIDEM TMDL url should be provided for the Saugatucket River TMDL. The Saugatucket River TMDL should also be listed in the section 9.0 REFERENCES.
- Figure 2.6: The combined use of outfalls and sampling stations in the map legend is confusing.
- Page 18, 1st Paragraph: "7-foot by 3-foot box culvert....subsequently referred to as the School Street outfall". This box culvert is not consistently referred to as the "School Street Outfall". It is also referred to as "7-foot by 3-foot outfall on Indian Run Brook (Section 2.6.1), 'IRSW1' (Figure 2.6), 'the box culvert' (Section 2.6.3), stormwater outfall at Dale Carlia Corner (Table 4.1).

- Page 18, 2nd Paragraph: "Four catchment areas.....shown in Figure 2.8". The reference should be to Figure 2.7.
- Page 19, Table 2.4: Title of table – Remove "catchment area 1" from title, table references all 4 catchment areas that discharge to the School Street box culvert.
- Page 19, 1st Paragraph: It may be noted that June 14th is likely to be a low estimate of traffic volume. June 14th, 2001 was a Thursday during a school year and when URI was not in session. Weekend traffic, beach traffic, URI traffic, or holiday traffic would all likely exceed the estimates.
- Page 22, 2nd Paragraph: Reference Appendix A for "Tables A-1 through A-3..."
- Page 27, 5th Paragraph: "Actual and potential sources are summarized in Table 4.1..." Table 4.1 does not summarize sources – it is the RIDEM Wet Weather Stormwater Outfall Sampling Locations and Data Summary (and is correctly referenced in the 2nd paragraph of Section 4.1)
- Page 27, Section 4.0, 1st Paragraph: Reference Figure 2.7 for catchment area 1
- Page 27, Section 4.1, 2nd Paragraph: Reference outfall IDs in 2nd sentence
- Page 27, Section 4.1, 2nd Paragraph: Four storm events (3 by URI-CVE; 1 by RIDEM) are reference in the 1st sentence; 3rd sentence references 2... "Figure 2.6 details.... measured by RIDEM during <u>both</u> storm events".
- Page 28, Table 4.1: 'Predominance Catchment Land Use' column data does not describe land use
- Page 28, 1st Paragraph: POWTs should be defined or included in Glossary
- Page 33, Section 5.5.3: "The allowable and existing concentrations...... reported in Table 6.4". The reference should be to Table 5.1.
- Page 36, Table 5.3: Why are allowable and existing lead concentrations for high flow not included?
- Page 40, Section 6.3, 4th paragraph: "The stormwater outfall...IR3SW... drains 102-acres... 73-acres (70%) impervious". These values do not coincide with values stated in the Executive Summary (pg. viii), Section 2.6.1 (pg. 16), and Table 2.4 (pg. 19). It is unclear if all four catchment areas, or just catchment area 1, drain to the School Street box culvert.
- Page 41, 1st Paragraph, 2nd sentence: "The Phase II Storm Water Management Program Plan states..." The specific program plan (the town of South Kingstown's) should be referenced.

RIDEM Response:

All comments have been incorporated; the TMDL has been revised accordingly.

Comments from Steve Winnett, US EPA

Here is our review of the draft TMDL for metals in Indian Run Brook. Thank you for the opportunity to comment on it.

One overall comment is about the age of the data. The data used to set the allocations is more than ten years old, and younger data was used to identify sources of pollution within the water body. Can you add an explanation of why you think these data are still representative of current conditions?

RIDEM Response:

The watershed's land use and potential sources of metals have remained relatively constant over the last ten years. There are no new discharges to the Brook. Although there has been some new development within the watershed and an incremental increase in the miles of roads, the major sources of metals remain unchanged and therefore RIDEM believes that the compiled data are still representative of current conditions.

Other comments

On page 29, paragraph 1, it states that "... Since the dry weather samples show fewer exceedances than the wet weather sample and the values just exceed the applicable criteria, this would imply that groundwater discharges of metals are insignificant." [underline is mine] Since dry weather samples do exceed criteria (if only just), are they significant enough that in the absence of wet weather discharges the stream might still exceed criteria because of ground water discharges? That implies that even if you eliminated wet weather discharges completely, the water body may still exceed criteria because of the groundwater and you would still need to address that source to meet standards. You might want to reconsider so definitively writing off ground water in the final TMDL.

RIDEM Response:

One sample was collected at station IRT, the sample location this paragraph is discussing. Lead was the only metal found to exceed its criteria during dry weather sampling at this location. The sample concentration was 1.72 ug/L, acute criteria is 17.42 ug/L and chronic criteria is 0.68 ug/L. This lead exceedance is the only dry weather exceedance for all metals throughout the entire watershed and it slightly exceeds the chronic criteria. As seen in Figure 2.2 in the TMDL document, the soil in this location is rock and sand, which promotes high infiltration rates. The sand will act as a filter to the metals, as the metals will likely be adsorbed to the sand particulates. Furthermore, RIDEM has not identified any land use activities in the area that could be a source of lead to the groundwater. For these reasons, the RIDEM does not consider groundwater to be a significant contributor of metals to Indian Run Brook.

On page 32, last paragraph, you explain the reasoning for using dry weather samples to compare to the acute criteria, and for using the weather samples to compare to the chronic criteria. While we understand your reasoning here, it would be good to give a fuller, point by point explanation of your reasoning so that the public could understand it more easily.

RIDEM Response:

All of the dry weather samples and wet weather samples were compared to both the acute and chronic criteria. Section 1.4.2 further describes the water quality criteria. The last paragraph on page 32 has been changed to the following:

> The URI-CVE samples were not taken in one-hour increments and the time of sample is not known, therefore each sample concentration will be compared to the acute criteria. The URI-CVE samples were all taken within a 24-hour period. Therefore the average of all the samples taken on each sample day will be averaged for comparison with the chronic criteria.

On p. 31, Margin of Safety, the first two elements of the implicit MOS are really not significant. Please remember that the MOS is supposed to confer protection beyond what the data say is necessary to meet standards. As far as we know, trace metal decay is insignificant and has not come up before as a factor. Citing the use of individual samples concentrations as MOS only implies protection equal to the calculated loading capacity, not beyond it. We suggest the use of an explicit MOS, such as an additional 5-10% increase in the required load reduction beyond what the data indicate is necessary, which would be simple and effective as a MOS.

RIDEM Response:
The first bullet in 5.3 Margin of Safety relating to trace metal decay has been removed from the document. Two bullets have been added to clarify the implicit margin of safety:

- To calculate the required percent reductions, the maximum metal concentrations in each dataset were used to represent existing dry and wet weather conditions.

- The most protective numeric standard (the chronic aquatic life support standard) is used to set TMDL targets. In the case of zinc, the acute criteria are slightly lower than the chronic criteria, therefore the most protective numeric standard for zinc is the acute aquatic life support standard.

With the addition of these two protective measures, along with the existing factors, consistent with other TMDL documents approved by USEPA, we feel the implicit margin of safety is sufficient in this situation.

Comments from Stephen Alfred, Town of South Kingstown

The Town of South Kingstown has carefully reviewed the draft TMDL for zinc, copper and lead for Indian Run Brook, as prepared by the RI Department of Environmental Management (RIDEM). South Kingstown continues to be a strong advocate for environmental protection in our community. Our commitment to the environment is clearly demonstrated by the Town's open space protection program, innovative on-site wastewater management program, and award winning Regional wastewater treatment plant, to name a few. Although the Town wishes to work jointly with RIDEM in protecting and enhancing environmental quality in our community, we have several questions and concerns relative to the Indian Run Brook proposed TMDL for response by RIDEM.

Source of Pollutants

The RIDEM Indian Run Brook Dissolved Metals Total Maximum Daily Loads technical paper identifies stormwater runoff as "The most evident source of metals contamination…," (Page 27, Section 4.0, paragraph 5). However, this statement is not correct as stormwater runoff is the conveyance mechanism for pollutants, not the source. As detailed in the RIDEM technical paper, pollutant source of dissolved metals appears to be primarily from motor vehicles, or components thereof.

Given that it is unlikely that motor vehicles will be prohibited in the watershed, the Town is concerned whether the proposed TMDL reduction for each metal is attainable. Although any effective remedial steps should serve as an improvement to the water body, we question the total attainable amount of dissolved (soluble) metal reduction based upon the implementation strategies as proposed.

RIDEM Response:
RIDEM agrees that stormwater runoff serves to convey pollutants from a variety of sources and is not in a strict sense "the source" of pollutants. Construction of impervious surfaces and drainage systems serve to enhance the delivery of pollutants conveyed by stormwater and exacerbate the impact on waterbodies. Pursuant to the Federal Clean Water Act and the Federal NPDES Regulations, the owner of the outfall is responsible for the pollutants discharges from the outfall.

Quantifying Each Source of Pollutant

Quantifying the percent of each metal contaminant source is paramount in order to calculate and assess the effectiveness of the proposed implementation strategy. As such, the Town requests that RIDEM determine each metal pollutant loading per source at each stormwater outfall designated for treatment (in addition to various locations in the impaired water body, where "hot spots" have been identified) to the impaired water body prior to final promulgation of the TMDL. In addition, due to limited financial resources available to all governmental bodies, RIDEM needs to conduct a cost benefit analysis to evaluate properly the effectiveness of proposed strategies and the cost associated with these remedies.

RIDEM Response:
The sources of metals to Indian Run Brook are varied, intermittent, and unpredictable. As such, it is not feasible to accurately quantify loadings from each source nor is it necessary for the development and implementation of an appropriate mitigation strategy. The TMDL identifies all actual and potential sources/inputs and outlines the recommended abatement measures to address identified sources. In general these measures can be divided into those that directly reduce contamination of stormwater (illegal sources, etc) and those that treat/reduce the quantity of storm water discharged. RIDEM believes that phased implementation of mitigation measures, resolving the largest sources/inputs first – especially since reduction or removal of the pollution sources would be expected to have an immediate and positive effect on water quality, is the most appropriate use of public resources. The TMDL has prioritized stormwater outfalls for water quality improvements based upon either wet weather monitoring results and/or size of outfalls (used as a proxy representing relative pollutant loads). Towns and/or RIDOT, as the responsible parties, may choose to further refine this prioritization based upon more site specific information including the determination of each outfalls' hydraulic load. These parties would also be expected to evaluate cost versus benefits when studying the design feasibility of and selecting the appropriate stormwater BMP option.

Implementation Strategies

The Town questions the method of metal pollutant reduction and the amount that will be achieved based upon implementation strategies that recommend subsurface stormwater injection via infiltration structures or “rain gardens.” Such strategies only displace dissolved metals such as copper, zinc, and lead into the subsurface soil mantle and groundwater.

As such, the Town of South Kingstown respectfully requests RIDEM to investigate further what impact the proposed TMDL metals will have on the localized soil mantle and groundwater prior to promulgating the TMDL.

The RIDEM Indian Run Brook Dissolved Metals TMDL technical paper also identifies high volumes of stormwater runoff from the School Street outfall as the source of riverbank erosion between the outfall and Church Street Bridge (Page 41, Section 6.3, paragraph 3). As with any watercourse, significant storm events can have an adverse impact, including flooding and erosion, on surrounding areas. The erosion in question is a result of existing drainage patterns in the watershed and appears to be unrelated to the proposed TMDL for dissolved lead, copper, and zinc. As such, the Town objects to implementing streambank stabilization measures since they appear unrelated to the proposed TMDL.

RIDEM Response:
RIDEM is committed to investigating ways to address metal pollutant reduction. The implementation strategies that are recommended, such as infiltration structures, do displace dissolved metals into the subsurface soil mantle. In Rhode Island, most of the soils have formed from material that was transported from the site of the parent rock, and redeposited at the new location through the action of ice, water, wind, or gravity. This material can act as a filter through which metal contaminants can adsorb to the soil particulates and therefore will not reach the groundwater. RIDEM feels that subsurface stormwater injection, which requires a 3-foot minimum separation from the groundwater, will have little to no impact on the localized soil mantle or groundwater. Additionally, pretreatment of stormwater prior to entering the UIC system is required for all designs, further helping to remove contaminants. Precautionary measures are in place through the Well Drilling Program and Underground Injection Control Program to prevent contamination of private and public wells and all drinking water sources. All UIC structures are regulated, requiring applicants to obtain a permit prior to construction. This allows for further protection by ensuring that the system is designed properly.

We agree that the observed streambank erosion along Indian Run Brook is a result of existing drainage patterns in the watershed. It is noted that implementation of the recommended infiltrating BMPs to address the metals and pathogen impairments will have the added benefit of reducing runoff volume and thus should help prevent further streambank erosion. The TMDL’s recommendation for streambank stabilization measures will prevent further erosion and sedimentation, and thus possible downstream flooding and further degradation of the stream’s ecology. It is made as a recommendation for preventive action and is not a required action.

State of Rhode Island Reimbursable Costs

The Town believes that the costs associated with compliance of the proposed TMDL are reimbursable by the State. The implementation actions imposed by RIDEM are a ‘state mandate' subject to reimbursement under RI General Laws §45-13-6 through §45-13-10. Pursuant to RIGL §45-13-7, state mandated costs include costs to a municipality resulting from any state-initiated regulation or policy (i.e. the TMDL) adopted by a state department (RIDEM) "that requires a local government to establish, expand, or modify its activities in a way as to necessitate additional expenditures from local government revenue sources where the expenditures are not otherwise reimbursed in whole."

The Clean Water Act (CWA) does not mandate Water Quality Standards (WQS) for non-point sources but gives RIDEM complete discretion in setting the pollutant caps. 40CFR131.12 "Antidegradation Policy" states in pertinent part:

"(a) The State shall develop and adopt a statewide antidegradation policy and identify the methods for implementing such policy pursuant to this subpart [of the Act]. The antidegradation policy and implementation methods shall, at a minimum, be consistent with the following: (1) Existing in-stream water uses and the level of water quality necessary to protect the existing uses shall be maintained and protected. (2) Where the quality of the waters exceeds levels necessary to support propagation of fish, shellfish, and wildlife and recreation in and on the water, that quality shall be maintained and protected…."

The Act does not set forth specific reduction levels, which the State must match or exceed with its WQS. In fact, the CWA provides no federal authority for requiring non-point sources to reduce pollutant loadings. Furthermore, the TMDL's required by the CWA are simply a source of information for a given water body, which includes a selection of management measures or implementation efforts that need to be applied to achieve the specific load reduction necessary to protect the existing uses of a water body.

RIGL §45-13-7 specifically addresses state regulations and policies that are intended to achieve compliance with federal statutes or regulations. The section requires "Where the federal statute or regulation … is discretionary, the state … action shall be considered a state mandate for the purposes of §45-13-7 - §45-13-10.

In light of the above, we request that prior to adoption RIDEM address the issue of mandated costs associated with implementation of the proposed TMDLs.

RIDEM Response:

The TMDL program is a state-administered program but not a state-initiated program. The federal Clean Water Act (and implementing regulations found in 40 CFR Part 130.7) requires that once a waterbody has been identified as impaired (ie polluted) that a schedule be established for development of a TMDL to address that impairment (as found in the state's 303(d) list). Federal regulations further require that TMDLs establish the pollutant reductions necessary to attain water quality standards and that the "allowable load" be allocated amongst the identified point and non point sources of pollution. As you have noted TMDLs are not in themselves enforceable or self-implementing. State and federal regulations however require that point source permits (NPDES or RIPDES) be modified to address relevant TMDL findings. More specifically relating to stormwater, 40 CFR Part122 states that NPDES permit holders (ie: Town of South Kingstown and other MS4 operators) "comply with any more stringent effluent limitations in your permit, including permit requirements that modify, or are in addition to, the minimum control measures based on an approved total maximum daily load (TMDL) or equivalent analysis that determines such limitations are needed to protect water quality." (paragraph 122.34 (e)(1))

In response to other points raised, Water Quality Standards (WQS) apply to all waters of the state regardless of pollution sources impacting these waters – as described in the excerpted paragraph from 40 CFR 130.0 which describes water quality planning and management requirements including the definition of Water Quality Standards:

(b) Water quality standards (WQS) are the State's goals for individual water bodies and provide the legal basis for control decisions under the Act. Water quality monitoring activities provide the chemical, physical and biological data needed to determine the present quality of a State's waters and to identify the sources of pollutants in those waters.

The antidegradation language referenced in your comment appears out of context and does not apply in this case since the antidegradation provisions apply to waterbodies that meet water quality standards, which is not the case with the impaired waters of Indian Run Brook.

For the reasons stated above, it is RIDEM's position that the TMDL recommendations do not represent a "state mandate for the purposes of RIGL §45-13-7 - §45-13-10." However, that is not to say that monetary considerations are not a concern to RIDEM. Wherever feasible, RIDEM provides technical and/or financial assistance to municipalities and others responsible for implementation of TMDL recommendations. The agency has worked very closely with the governor's office and state legislature to ensure that state bond funds are available to assist with the costs of implementing TMDLs. In addition to the Narragansett Bay and Watershed Restoration Bond Funds, RIDEM also makes federal 319 Non-Point Source Grants funds available for nonpoint source pollution abatement activities. As was done on the Dale Carlia Stormwater Attenuation Project (where RIDEM applied for and received a federal 104(b)3 grant for the Town of South Kingstown which required no local match), RIDEM also works to get other federal grants to assist municipalities and others in implementing TMDL recommendations.

Your attention to the Town's concerns regarding the draft TMDL for zinc, copper, and lead for Indian Run Brook is appreciated. Please do not hesitate to contact me directly should you have any additional questions relative to this matter.