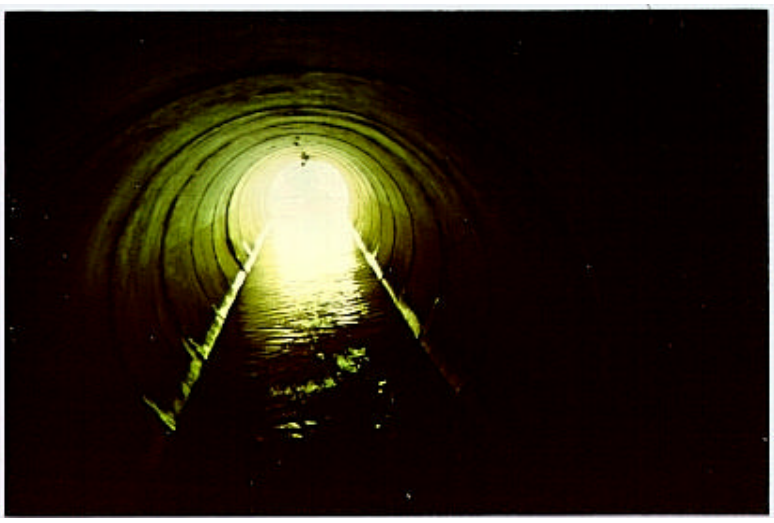


GOOSEFARE BROOK TMDL

Final Report

September, 2003

Thomas Woodcock
Dept. of Biological Sciences
University of Maine at Orono

&

Melissa Evers
Bureau of Land and Water Quality
Maine Dept. of Environmental Protection

Goosefare Brook TMDL Table of Contents

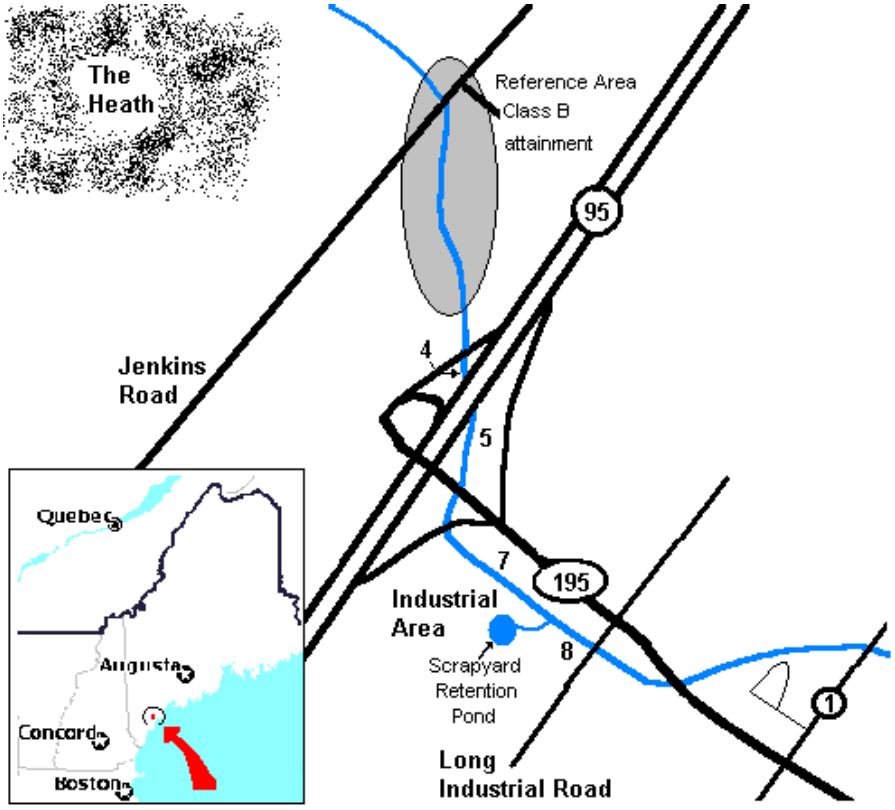
1. DESCRIPTION OF WATERBODY, POLLUTANT OF CONCERN, POLLUTANT SOURCES AND PRIORITY RANKING

Description of Waterbody and Watershed

Goosefare Brook is a small brownwater stream located on the coastal plain in York County, Maine (43°32'N, 70°27'W). Approximately 4000 acres of the watershed are located in the city of Saco, with 1000 acres of the lower watershed in the Town of Old Orchard Beach. The headwaters drain Saco Heath, a raised peatland, and the stream discharges to Saco Bay between Old Orchard Beach and Ferry Beach State Park. Appendix V contains a set of descriptive photos of the stream.

The study reach is the first-order portion of the stream, within four kilometers of its source, and drains an area of approximately 1.8km^2. The stream drains the Saco Heath, a raised peatland, and flows east into the Atlantic Ocean. The banks of the stream are forested with oak (*Quercus* spp.), hemlock (*Tsuga canadensis* (L.) Carr.), and red maple (*Acer rubrum* L.), and there is a thick understory of ferns and herbaceous plants. The width of the stream channel varies from 1-3 meters, and average discharge ranges from a summer base flow of approximately 10 L/second to 100 L/second in the spring. The channel form of the stream is low-gradient, meandering, and sandy, with frequent roots and woody debris incorporated into the streambed.

Figure 1. Schematic diagram of the study area and sampling stations treated in this document.



Descriptive Land Use Information

Land use in the watershed was quantified using Maine Gap Analysis Program (GAP) data provided by the Maine Department of Inland Fisheries and Wildlife (Table 1). Goosefare Brook flows through Interchange 5 of the Maine Turnpike and two Turnpike connector interchanges, which has resulted in extensive culverting and relocation of the original streambed. Downstream of the Turnpike the stream flows through an industrial development that includes Saco Steel and Saco Defense Inc., and then through the commercial Route 1 corridor.

Table 1 presents a summary of catchment land use in Goosefare Brook, determined from Maine GAP data, Department of Inland Fisheries and Wildlife. Land use categories have been grouped for ease of interpretation. "Upstream" refers to the catchment upstream of the Turnpike, "Downstream 1" refers to the catchment downstream of the Turnpike but upstream of Saco Steel, and "Downstream 2" refers to the catchment of the entire study reach. Forest categories are subdivided, and all values are percent of total area.

Table 1. Summary of catchment land use in Goosefare Brook.

	Percent of total watershed area		
Land Use	**Upstream**	**Downstream 1**	**Downstream 2**
Agricultural	**14.4**	**24.7**	**29.3**
Clearcut	4.9	4.1	
Partial Cut	0.3	0.2	3.3
Regenerating	1.6	1.4	0.6
Transitional Forest	**6.8**	**5.7**	**5.1**
Coniferous	1.8	1.5	1.2
Deciduous	3.9	3.2	2.6
Mixed Forest	64.9	55.6	47.9
Forest	**70.6**	**60.3**	**51.7**
Wetland	**1.4**	**1.1**	**0.9**
Urban/Residential	**6.8**	**8.2**	**13.0**

Pollutants of Concern & Pollutant Sources

Impairments to the aquatic fauna in Goosefare Brook are documented in the Maine DEP's Biomonitoring Retrospective (1999). Storm water runoff from paved roadways, residential development and heavy metals from industrial sources impair the stream. Saco Steel, a major industrial source, contributes heavy metals to the stream through stormwater discharges from a detention pond on site and possibly groundwater discharge. The relative contribution of metals from Saco Steel and upstream roadways (the Maine Turnpike, Interstate 195 and a highway interchange) are compared in Table 2. This comparison indicates that metals concentrations are 4 times higher downstream of Saco Steel than above.

The City of Saco Department of Public Works, received a 319 NPS grant in 2001 to conduct a watershed survey to identify traditional non-point pollution sources. The results of that survey and an implementation plan are due for completion in 2003.

This TMDL addresses seven heavy metals (Cd, Cr, Cu, Fe, Ni, Pb, Zn), which were monitored in the stream sediments from 1998-2000 as part of an ongoing ecological assessment of development impacts on streams. Other water quality parameters were measured, including aqueous nutrients (NO_3, NH_4, total P), dissolved O_2, and total suspended solids (TSS), but no impairment is listed for these parameters, and no water quality issues were apparent from the data.

Distribution of Metal Concentrations Above and Below Saco Steel

- Water quality metals were sampled by MDEP on March 15, 2002, not as part of the original study
- Copper was chosen to compare concentrations between sites, since copper was a sentinel metal and consistently exceeded criteria in Goosefare studies (at all impaired sites)
- 2 upstream sites with urban, road and highway runoff were compared to 2 sites receiving runoff from Saco Steel in Goosefare Brook

Table 2. *Distribution of Metal Concentrations Above and Below Saco Steel*

Upstream of Saco Steel		***Downstream of Saco Steel***	
Sites below the Highway & above Saco Steel	Copper Conc PPM	Sites Downstream of Saco Steel Runoff	Copper Conc PPM
Goosefare Brk, above Saco Steel	0.0007	Goosefare Brk, adjacent to Saco Steel	0.0048*
Highway Storm Drain Channel, Near Saco Steel	0.0008	Goosefare Brk, Below Saco Steel Detention Pond Runoff	0.0011
Average Concentration	0.00075	Average Concentration	0.0029

*exceeds CCC- Criteria Continuous Concentration

- Comparison Results- Downstream is 4 times greater concentration than the Upstream

Impaired Stream Segment & Study Area

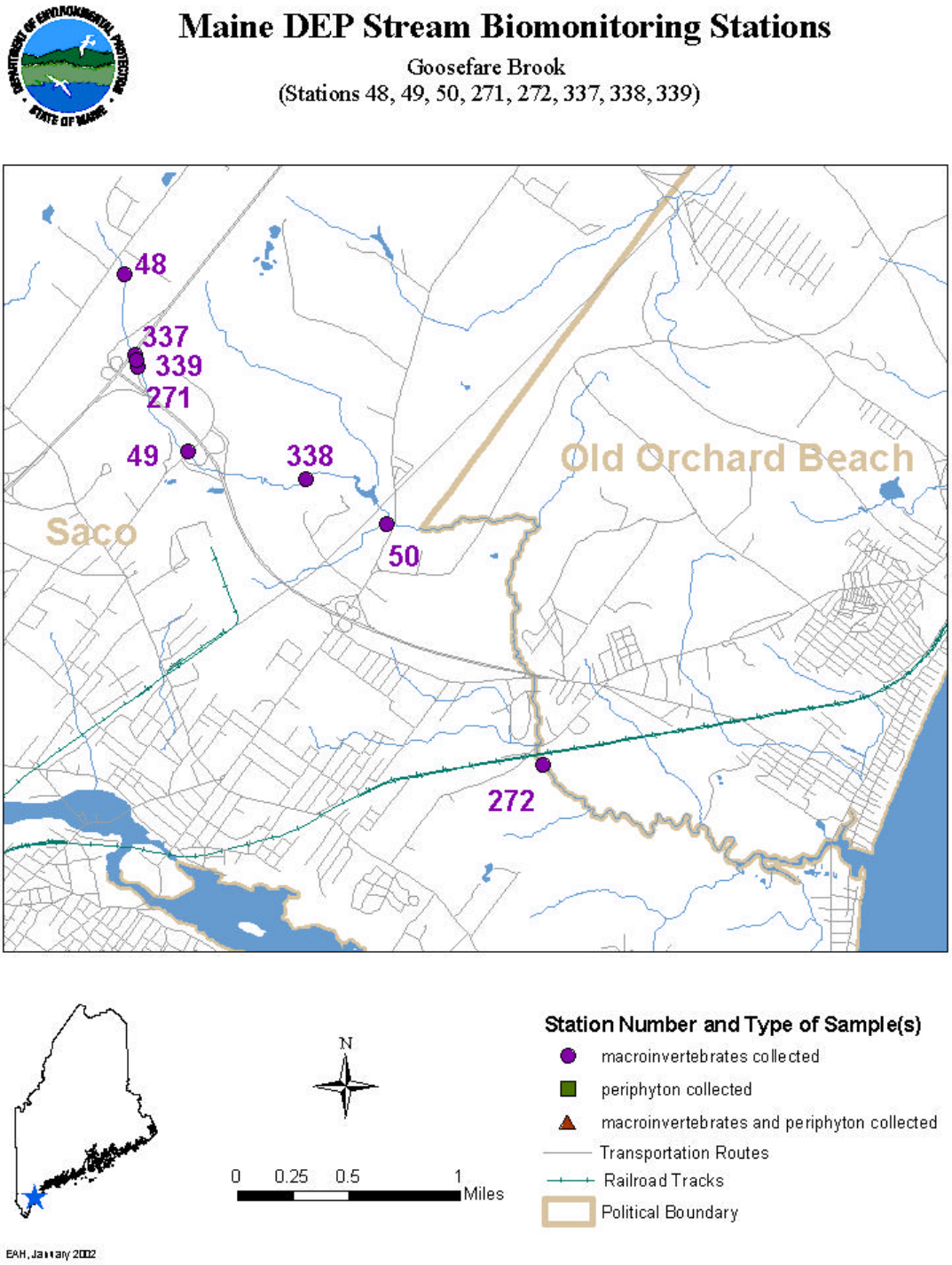
The 303 (d) listed impaired stream segment is based on MDEP's macroinvertebrate sampling in Goosefare Brook in the 1980's and 1990's to determine compliance with Class B aquatic life standards. MDEP sampling sites are summarized in Figure 2 and Table 3. The Class B standard is consistently attained upstream of the Maine Turnpike (station 48), which represents the reference condition in this sandy-bottomed stream. The stream degrades to Class C in the area receiving runoff from the Saco Steel property (station 339), approximately 0.2 miles below the Maine Turnpike. The site downstream of the discharge from the Saco Steel stormwater collection pond (station 271) is the most severely impacted location, and fails to meet minimum standards due to low abundance of organisms. The furthest downstream site (station 272 at Old Orchard Rd.) revealed a significant recovery, but still fails to attain Class B. Approximately 3.2 miles of Goosefare Brook are listed as impaired, from downstream of the Maine Turnpike to below the Route 1 crossing.

The reach addressed in this document runs from the source in the Saco Heath to immediately upstream of Long Industrial Road in the Town of Saco (Figure 1). While there are additional input concerns, for example further urban runoff and industrial inputs downstream, water quality is sufficiently degraded over the study reach that detection of impacts downstream would not be possible without first addressing problems within the study reach.

Table 3. MDEP Stream Biomonitoring sampling locations and results, Goosefare Brook.

Sampling Station	Site Description and Location (ordered upstream to downstream)	Sampling Result (minimum standard is Class B)	Dates Sampled
48	75 m below Jenkins Rd. crossing	Class B	84, 86, 94, 95, 98
337	Below Maine Turnpike crossing	Class B	98
339	Adjacent to Saco Steel	Class C	98
271	80 m above Long Industrial Rd. crossing; downstream of Saco Steel	Does not attain Class C	95, 98
49	500 m below I-195, below Saco Defense	Class C	84, 86, 94, 95
272	20 m below Old Orchard Rd. crossing	Class C	95

Figure 2.


Maine DEP Stream Biomonitoring Stations
Goosefare Brook
(Stations 48, 49, 50, 271, 272, 337, 338, 339)
48
337
339
271
49
338
50
272
Saco
Old Orchard Beach
N
0 0.25 0.5 1
Miles
Station Number and Type of Sample(s)
macroinvertebrates collected
periphyton collected
macroinvertebrates and periphyton collected
Transportation Routes
Railroad Tracks
Political Boundary
EAH, January 2002

Priority Ranking and Listing History

The large numbers of streams listed for nonpoint source pollution on the 303(d) list requires Maine to set priority rankings based on a variety of factors. Factors include the severity of degradation, the time duration of the impairment, and opportunities for remediation. Maine has set priority rankings for 303(d) listed streams by TMDL completion date, and has designated Goosefare Brook for completion by 2003.

Atmospheric Deposition

Atmospheric deposition of metals that fall within a watershed will reach a stream through: runoff that contains wash off from land deposited material, direct contact with rain and dry airborne material that settles on the stream surface. It is assumed that the soil buffers and adsorbs most atmospherically deposited metals before they reach the stream through the runoff processes (except in watersheds sensitive to acidification). The other potential source is direct contact with rain and this is a nondetectable load, given the small surface area of the stream that directly receives rain. Regionally, our knowledge of trace metal deposition in flowing freshwaters is relatively limited.

Natural Background Levels

Saco Heath is the headwater of Goosefare and the stream emerges from the heath less than 0.1 miles above Jenkins Rd. Saco Heath is owned by the Nature Conservancy, who investigated past sources of environmental contaminates before acquiring the heath. All disturbances and potential problems identified in Saco Heath were in regions that drain to other streams (personal communication, Nancy Sferra, Nature Conservancy). The metals in Goosefare Brook at the upstream site at Jenkins Rd, where Class B standards are attained, may represent the natural background levels. Even with the detailed site-specific environmental inventories available for Goosefare headwaters, nonpoint source loading may have resulted from human related activities. It is very difficult to separate natural background from the total nonpoint source load[1.] and the information would not add value to the analysis for these TMDLs.

1. U.S. Environmental Protection Agency. 1999. Regional Guidance on Submittal Requirements for Lake and Reservoir Nutrient TMDLs. US-EPA Office of Ecosystem Protection, New England Region, Boston, MA.

2. DESCRIPTION OF THE APPLICABLE WATER QUALITY STANDARDS AND NUMERIC WATER QUALITY TARGET

Maine State Water Quality Standard

Goosefare Brook is classified as a Class B stream under Maine's Water Classification Program. Water quality standards and water quality classification of all surface waters of the State of Maine have been established by the Maine Legislature (Title 38 MRSA 464-467). By definition, discharges to Class B

waters shall be of sufficient quality to support all aquatic species indigenous to the receiving water without detrimental changes in the resident biological community.

Designated Uses and Antidegradation Policy

Goosefare Brook is listed as Class B water and does not attain classification due to pollution from toxics and nonpoint sources. Class B and its designated uses are defined under Maine's Water Quality Classification Program, Maine Revised Statutes, Title 38, Article 4-A. Class B waters are generally designated for: water supply; primary/secondary contact recreation (swimming and fishing); hydro-electric power generation; navigation; and habitat for fish and aquatic life. Additionally, "The habitat shall be characterized as unimpaired." Maine's anti-degradation policy requires that "existing in-stream water uses and the level of water quality necessary to sustain those uses, must be maintained and protected."

Numeric Water Quality Target

Numeric metals targets were chosen from Maine's Statewide Water Quality Criteria (SWQC). SWQC are the maximum allowable amounts of specified toxic pollutants allowed instream to protect designated uses specified through Maine's Water Classification Program. These aqueous or water column criteria were adopted from EPA and designed to protect aquatic life. SWQC lists both Criteria Chronic Concentration (CCC) and Criteria Maximum Concentration (CMC) and the CCC are typically lower than CMC and chosen as a conservative basis for TMDL loading comparisons. Using the CCC as TMDL endpoints should insure the stream will achieve Class B benthic community standards.

Table 4. Metals criteria from Maine's Statewide Water Quality Criteria (SWQC), these criteria are based on a hardness standard of 20 mg/L. Criteria Chronic Concentration (CCC) and Criteria Maximum Concentration (CMC) are aqueous values in ppm or mg/L.

Criteria Type-	**Cd**	**Cr**	**Cu**	**Fe**	**Ni**	**Pb**	**Zn**
CCC	0.000321	0.0554	0.00299	1	0.0404	0.00041	0.0271
CMC	0.000638	*	0.00389	NC	0.3634	0.010523	0.0299

*complex, see MDEP's Gold Book

3. LOADING CAPACITY - LINKING WATER QUALITY AND POLLUTANT SOURCES

Loading Capacity & Linking Pollutant Loading to a Numeric Target

The loading capacity is the mass, of metal, that Goosefare Brook can receive over time and still meet numerical water quality targets. Loading capacity is expressed as an annual load rather than a daily load to account for the spatial and temporal variation associated with instream metal concentrations. Combinations of several calculations link the water column values from sample measurements to the

calculated load capacity based on numeric targets. Table 5 lists the loading targets for comparisons in subsequent TMDL analysis, the annual load assimilative capacity is a combination of streamflow volume and Maine's Criteria Chronic Concentration. Appendix I describes the calculation used to convert concentrations into a loading value. Basing the loading capacity on Maine's SWQC sets the metal allotment for existing and future nonpoint sources to ensure support for existing and designated uses.

Table 5. The loading capacity is based on numerical water quality targets which are expressed in kg/yr for each TMDL metal and is the product of the average volume of flow and Maine's Statewide Water Quality Criteria, Criteria Chronic Concentration (SWQC-CCC).

			Metals						
		Units	Cd	Cr	Cu	Fe	Ni	Pb	Zn
SWQC-CCC Allowable Concentration		***mg/L***	0.0003	0.0554	0.003	1	0.0404	0.0004	0.0271
Load Capacity									
	Station								
Saco Steel Runoff [1.]	7	***kg/yr***	0.4	68	3.7	1230	50	0.5	33
Downstream Saco Steel[2.]	8	***kg/yr***	0.4	76	4.1	1372	55	0.6	37
Average Capacity		***kg/yr***	0.4	72	3.9	1301	53	0.5	35

1. Based on measured annual mean discharge of 39 L/s
2. Based on measured annual mean discharge of 43.5 L/s

Supporting Documentation - TMDL Approach

The TMDL approach includes measuring various environmental parameters and developing a water quality model to predict pollutant loadings and reductions that will insure attainment of Maine's water quality standards.

The Goosefare Brook TMDL metals analysis is based primarily on data collected by a University of Maine (UM) research project on the effects of roadways on stream ecosystems and aquatic life, (Woodcock, T.S., 2002, Effects of Roadway-Related Physical and Chemical Habitat Alterations on Stream Ecosystems, PhD Thesis, 256 pgs, University of Maine, Orono, Maine). The UM project was designed to identify the effects of urban born toxics on aquatic invertebrate assemblages. Sediment metals concentrations were chosen for measurement in the study, since the sediment provides habitat for the growth and development of benthic organisms. Sampling procedures and TMDL calculations are contained in Appendix I. Appendix II contains the sediment metal sampling results and discharges used to calculate existing loads for the TMDL equation.

Maine has no formal water quality criteria for sediment values; therefore measured sediment metals concentrations were then converted to aqueous values for the TMDL analysis, using the model MINEQL+ v3.01. This model is described in Appendix III. The converted aqueous metal concentrations provide a mechanism to compare measured values to the aqueous values listed in Maine's Statewide Water Quality Criteria. The TMDL analysis calculates the existing metals load based on the converted aqueous concentrations and measured annual mean flow. The TMDL spreadsheet model then compares the existing metals load to the allocated load and computes the reduction needed to achieve water quality criteria for all nonpoint source pollutants of concern.

Strengths and Weaknesses

The TMDL uses the results of the MINEQL+ v3.01 model for sediment and water chemistry and a spreadsheet analysis of existing and target loads. Metals loads and reductions for Goosefare Brook were computed using basic conversions and spreadsheet comparisons. It was assumed that each parameter was lognormally distributed, which is a standard practice when analyzing environmental data.

Strengths:

- Spreadsheet comparisons are a commonly accepted practice in water quality management
- Makes best use of available water quality monitoring data
- Sediments metals represent concentrations in benthic habitat where invertebrates live
- Sediment metal concentrations result from sorption processes during repeated runoff events and better represent chronic exposure conditions.

Weaknesses:

- Metals concentrations are extremely variable in flowing conditions
- Conversion of sediment to aqueous metals only provides an estimate and may not be identical to actual water sample values.
- Water samples may include suspended particulate material, which would not be included in the converted aqueous phase.

Critical Conditions

The loading capacity for Goosefare Brook is set to protect water quality and support uses during critical conditions, which are defined as environmental conditions that induce a stress response in macroinvertebrates and other aquatic life. Environmentally stressful conditions may occur throughout the year and depend on the biological requirements of the life stage of resident aquatic organisms. Traditionally, summer low flow periods are considered critical for aquatic organisms due the combination of low velocity, high temperatures and low dissolved oxygen. While organisms are under stress due to these conditions, their community may not be able to withstand the addition of toxic metals.

All aquatic organisms reside in the stream overwinter and winter often determines the success or failure of native salmonid species, such as Brook trout, which have been observed in Goosefare. Seasonally low flows occur in the winter and native fish are under stress as they compete for limited

winter habitat, as defined by water velocity and unembedded substrate. Additionally trout eggs are incubating in the gravel during the winter and have specific velocity and dissolved oxygen requirements that may be compromised by low flow conditions. Some species of stoneflies emerge and develop during the winter and remain vulnerable. The addition of toxic metals during otherwise stressful conditions diminishes survival.

Low pH, or acidic event below 5 pH units, also creates a critical condition that stresses biological organisms and contributes to the cumulative effect of other stressful environmental conditions, such as the chronic presence of metals. Low pH can occur in Goosefare Brook, with any large storm event that causes a discharge from Saco Heath, but typically occurs during the spring and fall. The fluctuation of pH causes considerable variability in metal solubility through time (see section below on seasonal variation). Critical condition is complex in flowing water and a major consideration in using an average annual load approach for these metal TMDLs.

TMDL Loading Calculations

The loads for all existing sources of (including stormwater) metals in the impaired segment of Goosefare Brook are listed in Table 6. The annual loads, based on measured instream values, are derived by combining streamflow volume with the converted aqueous concentrations. The site-specific loads are then averaged into one load for the purposes of further TMDL analysis. Appendix I lists the TMDL calculations used for the results presented in Tables 6, 7 and 9. An annual time frame provides a mechanism to address the daily and seasonal variability associated with non-point source loads. As previously mentioned, it was not possible to separate natural background from nonpoint pollution sources in this watershed because of the limited and general nature of the available information.

Table 6. Summary of metal concentrations converted from sediment samples and the calculated nonpoint source loads based on the annual mean flow, for biologically impaired sites.

Aqueous Concentrations* = *mg/L* Calculated Existing Loads = *kg/yr*									
		Conc	**Metals**						
Station	#	***Load***	Cd	Cr	Cu	Fe	Ni	Pb	Zn
Saco Steel Runoff	7	***mg/L***	0.0008	0.016	0.087	0.002	0.060	0.000008	0.140
		kg/yr	0.9	20	107	2.0	74	0.010	172
Downstream Saco Steel	8	***mg/L***	0.003	0.006	0.240	0.002	0.067	0.000007	0.250
		kg/yr	3.6	8	329	3.3	92	0.009	343
Average Load		***kg/yr***	2.3	14	218	2.6	83	0.010	258

***(converted from sediment using MINEQL model)**

The following table compares these existing metal loads to the loading capacities, or TMDL endpoints listed in Table 5. The comparison results in an estimate of the metals reductions needed to achieve compliance with Maine's SWQC at nonattainment sites. The percent reductions will be applied to load and waste load allocations.

Table 7. Comparison of TMDL load allocations and the measured or existing metal loads in Goosefare Brook, and the percent reductions required to achieve SWQC.

	Loads in kg/yr						
	Metals						
	Cd	Cr	Cu	Fe	Ni	Pb	Zn
Existing Loads	2.3	14	218	2.6	83	0.010	258
Load Capacity	0.4	72	3.9	1301	53	0.5	35
% Reduction*	81%	0	98%	0	37%	0	86%

***%Reduction= [(Exisitng Load- Load Capacity)/Existing Load] * 100**

4. LOAD ALLOCATIONS (LA's)

The load allocation (LA) for each of the candidate metals in Goosefare Brook is listed in Table 9. On an annual basis, the LA represents the streams assimilative capacity allocated to only non-point sources of metals.

All pollutant sources in these calculations are assigned LAs, representing non-point sources from roadways or development activities in areas with unregulated stormwater runoff, for which there are no associated discharge or general permits. Unregulated stormwater runoff comes from locations not identified as urbanized regulated areas on maps produced by EPA, Region 1, designating MS4 areas under NPDES Phase II Stormwater Program (Appendix VI). This portion of the stream flows under Jenkins Road and includes the watershed of Saco Heath and the undeveloped lands cited in Table 1. It should be noted that aquatic life samples from this unregulated area consistently meet Maine's Class B Standards for macroinvertebrates (Table 3.). Table 8 compares the average sedimentary metals concentration for Copper between unregulated and regulated sites to deduce the relative contribution of the load allocation towards the TMDL.

Comparison of Sediment Metal Concentrations

- Sediment samples were collected as part of the original University of Maine study
- Copper was chosen to compare concentrations between sites, since copper was a sentinel metal and consistently exceeded criteria in Goosefare studies (at all impaired sites)

Table 8. Comparison of Sediment Metal Concentrations from Unregulated versus Regulated Stormwater Areas.

Unregulated Area		***Regualted Stormwater Area***	
Sites adjacent to Jenkins Road, receiving runoff from Saco Heath	Average Copper Conc mg/kg	Sites receiving runoff from the Turnpike, 195, Interchange and Saco Steel	Average Copper Conc mg/kg
# samples = 13	1.4	# samples = 41	5.7

- ***Comparison Results- Downstream is 4 times greater concentration than the Upstream***
- ***The Load Allocation (LA) from unregulated areas is approximately 25% of the TMDL allocation***
- ***The Waste Load Allocation (WLA) from regulated areas is approximately 75% of the TMDL***

5. WASTE LOAD ALLOCATIONS (WLA's)

For the purposes of the TMDL, stormwater discharges from regulated areas are considered as point sources and are allocated as waste loads. The waste load allocation (WLA) for each of the candidate metals in Goosefare Brook is listed in Table 9. On an annual basis, the WLA represents the streams assimilative capacity allocated to only regulated point sources of metals. The town of Saco occupies the Goosefare Brook watershed above the impaired sites and a portion of this area is regulated under NPDES Phase II Stormwater Program (Appendix VI). The runoff from the Saco Steel site qualifies as a WLA since it is regulated under the existing multi-sector permit for industrial activities. The Turnpike and 195 borders a regulated area that is designated MS4 and treated as a WLA. Table 8 compares the average sedimentary metals concentration for Copper between unregulated and regulated sites and estimates that WLA is 75% of the total TMDL allocation.

Table 9. Load Allocations and Waste Load Allocations for each metal in the TMDL.

TMDL= LA +WLA	**Loads in kg/yr**						
	Metals						
	Cd	Cr	Cu	Fe	Ni	Pb	Zn
Load Allocations (LA)	0.1	18	1.0	325	13	0.1	9
Waste Load Allocations (WLA)	0.3	54	2.9	976	39	0.4	26
Loading Capacity (TMDL)	0.4	72	3.9	1301	53	0.5	35

6. MARGIN OF SAFETY (MOS)

An implicit margin of safety was incorporated into the Goosefare Brook TMDL through the selection of Maine's SWQC for the numeric water quality target, which is designed to protect the spectrum of aquatic life. Additionally, the choice of Criteria Chronic Concentration (CCC), which are typically lower than Criteria Maximum Concentration (CMC) from the SWQC provides the most conservative basis for the TMDL loading capacity. Using the CCC as TMDL endpoints should insure the stream will achieve Class B benthic community standards.

The use of sediment metals for the calculations also represents a margin of safety over using water column measurements. The presence of high concentrations of iron precipitates in the sediment has the effect of attracting other metals in the water column, because of the greater adsorption surface presented by the iron. Sediment metals represent the component of aquatic metals that are sorbed in the sediments and these adsorption processes also tend to accumulate metals. Therefore sediment metals concentrations will tend to be higher than the water column values, so the converted sediment metals may over estimate the aqueous values. The high-end estimate of instream aqueous values means that the TMDL comparisons result in percent metals reductions which maximize the stream protection recommendations.

An additional implicit margin of safety is provided by modeling the metals individually, which represents a conservative modeling assumption.

7. SEASONAL VARIATION

Seasonal variation is considered because the allowable annual loads of metals are developed to be protective of macroinvertebrates and other aquatic life, which are influenced by seasonal fluctuations in environmental conditions such as flow, runoff and pH. All unregulated streams in Maine experience seasonal fluctuations in flow, which influences the concentration of metals. Typically high flows occur during spring and fall and low flows occur during the summer and winter. Snow and rainfall runoff

may contribute metals, while large volumes of runoff may also dilute instream metals concentrations, depending on the source.

The Saco Steel property contains a stormwater detention pond that discharges to Goosefare Brook and the volume of runoff from the pond is heavily influenced by seasonal rainfall. In 2002 MDEP sampled this pond and measured levels of lead, copper, and zinc that exceeded Maine's SWQC Criteria Maximum Concentration and cadmium and iron that exceed the Criteria Continuous Concentration. Surface water discharges from this pond travel less than a few hundred feet to reach Goosefare Brook and contribute high concentrations of metals.

The major consideration for impact on aquatic life is the seasonal fluctuation of pH, which causes considerable variability in metal solubility through time, although this variability is greater for some metals (Cu, Ni, Zn) than for those that are less mobile (Pb, Cr). The iron concentration in the system is such that the dissolved concentration is saturated at all sites, and thus dependent on the pH, and that a large proportion of other metals are adsorbed to the iron precipitates. The pH fluctuates seasonally based on watershed processes, rainfall and increases in flow. In the fall, the sphagnum in Saco Heath dies, the ensuing rainfall flushes out low pH water that results from sphagnum decomposition. Water discharged from peat bogs during runoff events is generally low pH.

Iron concentration clearly increases in the sediment along the study reach, and sources are visible near Saco Steel, yet the TMDL for iron shows a reduction of 0% because of the low toxicity properties of iron. This has the additional effect of reducing concentrations of other metals in the water column, because of the greater adsorption surface presented by the increased concentration of iron precipitates. Further reductions are attributable to the increase in pH and alkalinity observed at stations further downstream, possibly due to passage through cement culvert structures, that decreases solubility of iron and increases its affinity for other metals due to deprotonation of sorption sites on the precipitate.

8. MONITORING PLAN FOR TMDLS DEVELOPED UNDER THE PHASED APPROACH

Addressing the problems described in the TMDL will require future assessments of individual sites, such as Saco Steel and the Maine Turnpike, to develop specific engineering design criteria. These assessments should include stream monitoring to develop standards for post and pre-application comparisons. Water quality monitoring will be conducted to gauge effectiveness of any BMP's or engineered design solutions, as recommended in the 'Implementation Plans' section.

As restoration plans proceed, Maine DEP will check on the progress towards attainment of Maine's SWQC with both aqueous samples and biological monitoring evaluations. Also, Maine DEP's Biomonitoring Unit will check on water quality status or improvement in the future under the existing rotating basin sampling schedule.

9. IMPLEMENTATION PLANS and REASONABLE ASSURANCES

The goal of this TMDL assessment on Goosefare Brook is to use existing water quality data to determine the source of impairments and provide a catalyst to restore water quality conditions in accordance with Maine's Class B Standards. The benthic community in Goosefare Brook meets water quality classification standards at upstream sites and declines as the stream passes through highway and industrial development. The benthic community impairments coincide with nonpoint source runoff from highways and an industrial site, called Saco Steel (currently owned by Earth Waste Systems). Metal concentrations at these impaired sites were elevated over allowable concentrations in Table 6, TMDL Allocations. The percent reductions listed in the TMDL Allocations, in Table 7, represent averages over the year (given the seasonal variation of runoff and ambient pH conditions), and demonstrate the need to reduce aqueous metal concentrations as the key to water quality restoration. The load reductions provide a guide for future assessments that will identify site specific remediation and engineered solutions to lower the content of metal in runoff reaching the brook.

The site assessments will provide the necessary information to design solutions and BMP's that will result in effective abatement of metal laden runoff. The following recommendations should initiate the necessary steps towards water quality attainment:

- **Recommendation: Saco Steel (Earth Waste Management) needs a hazardous material site assessment and a remediation plan.** The assessment will determine the surface water and groundwater delivery conduits into Goosefare Brook. Along with metals, the site is contaminated with PCB's and other petroleum products that will require a remediation plan under Maine's Uncontrolled Hazardous Substances Site Law (38MRSA Section 1361 et seq).

The Uncontrolled Sites Division of MDEP's Bureau of Remediation & Waste Management is currently reviewing existing data reports and sampling results from the Saco Steel site. A description of the responsibilities of the Uncontrolled Sites Program can be found at http://www.state.me.us/dep/rwm/index.htm. Saco Steel has been assigned a project manager and progress is being made towards a potential remediation plan. Attached in Appendix IV is a letter written by the Bureau of Remediation, VRAP Program (see the above website for a program description) to a prospective buyer, which describes site specific problems and future assessment needs. The site is currently in transition and the owner is negotiating with a prospective buyer who would remediate the site under the VRAP Program. The buyer will conduct a site assessment in October, 2003 and if the sale aborts, the site remediation will fall back to the Uncontrolled Sites Program.

- **Recommendation: Assess the runoff and runoff delivery conduits associated with Exit 5 of the Maine Turnpike and Interstate Highway 195. Design BMP's to divert and absorb the first flush of runoff and restore habitat in stream segments adjacent to the highway.**

Evaluating the impact of the Turnpike and Interstate 195 requires a landscape assessment of stormwater drains, the quality of riparian buffers and problems associated with stream channelization. The Maine Department of Transportation (MDOT) and the Maine Turnpike Authority (MTA) will receive copies of this TMDL and a letter requesting their cooperation in stream restoration.

Since the study was conducted from 1998-2000, the Maine Turnpike has undergone widening and reconstruction in the vicinity of Goosefare Brook. The reconstruction included improvements to stormwater management of highway runoff and may have made considerable progress towards achieving this recommendation. To demonstrate compliance with this recommendation, MDEP would be willing to collaborate with the Turnpike Authority to design a follow up monitoring plan on Goosefare Brook.'

- **Recommendation: Put the watershed survey implementation into action to stabilize the erosion problems and protect future stream habitat quality.**

This TMDL focused on aqueous metals as the cause of water quality problems on Goosefare Brook, but other, less toxic forms of non-point source pollution exist within the drainage. A watershed survey was conducted by the City of Saco, Department of Public Works, and should be finalized in 2003, (personnel changes have hindered finalization during 2002). The final report will include an implementation plan to address the nonpoint source erosion problems identified during the survey.

"Point sources" (regulated stormwater) are not given a less stringent WLA based on any assumption that NPS load reductions will occur. Reasonable assurance that reductions in regulated stormwater will happen includes the fact that M DEP now regulates phase II stormwater with Maine NPDES general permits, and that MDOT, MTA, and City of Saco are all actively involved in activities to address the stormwater runoff problems.

10. PUBLIC PARTICIPATION

Public participation in the Goosefare Brook TMDL development is ensured through the following avenues. Maine DEP personnel, Melissa Evers attended meetings with representatives of the City of Saco and the City of Old Orchard Beach concerning the TMDL and 319 watershed surveys. A preliminary review draft TMDL was prepared and distributed to associated environmental state agencies, including Hank Aho (Maine DEP, Bureau of Remediation and Waste Management), Don Kale (Maine DEP, Bureau of Land & Water Quality, Southern Maine Regional Office), Conrad Welzel, (Maine Turnpike Authority) and Chris Olson, (Maine Department of Transportation) as well as watershed stakeholder organizations, Ron Kiene, (City of Saco, Department of Public Works), Tad Redway, (Old Orchard Beach), Debbie St. Pierre, (York County Soil & Water Conservation District) and Kevin Elinicki (Earth Waste Systems, Inc., formerly Saco Steel). Paper and electronic forms were made available of the Public Review draft TMDL report, including 'legal' advertising in local newspapers and posting on the Maine DEP Internet Web site. The following ad was printed in the Sunday editions of the Kennebec Journal (Augusta), the Portland Press Herald (Cumberland & York County editions) and the Journal Tribune (Biddeford) on October 13th and October 20th, 2002. The U.S. Environmental Protection Agency (Region I) and interested public was provided a 30-day period to respond with draft comments (Thursday, October 10th through November 9th, 2002).

PUBLIC NOTICE FOR GOOSEFARE BRK-In accordance with Section 303(d) of the Clean Water Act, and implementation regulations in 40 CFR Part 130 – the Maine Department of Environmental Protection has prepared a Total Maximum Daily Load (TMDL) report (DEPLW 2002- 0544) for toxic metals found in Goosefare Brook, located in the towns of Saco and Old Orchard Beach, within York County. This TMDL report estimates non-point source loadings of metals and the reductions needed to restore the resident aquatic biological community.

A Public Review draft of the report may be viewed at the Maine DEP Offices in Augusta (Ray Building, Hospital St., Rt. 9) or on-line at: http://www.state.me.us/dep/blwq/comment.htm.

Send all written comments – by November 9, 2002, to Melissa Evers, Stream TMDL's, Maine DEP, State House Station #17, Augusta, ME 04333 or email: melissa.evers@state.me.us

Only the MTA responded with substantive written comments to the previous draft, which are attached in Appendix VII, along with MDEP's response. MTA's comments primarily address TMDL recommendations that target assessing highway runoff. Only EPA reviewers commented on the TMDL analysis. The TMDL analysis in this final version of the Goosefare Brook TMDL has changed primarily in response to EPA comments, but the recommendations remain virtually the same.

Appendix I. Sampling Procedures & Computational Methods for Allocations

Sampling stations were chosen for their proximity to nonpoint source discharge areas and as representative of the available habitat in the stream reaches sampled. Samples were taken in flowing flatwater typical of low gradient streams and the habitat ranged from a slow run to a deadwater.

Sediment samples were taken at each station by pressing a length of 1" PVC pipe into the substrate to a depth of ~2cm, in order to measure the most labile pool of metals in the surficial sediments, and to avoid any confounding effects of a redox gradient. Additionally, a shallow sampling depth was chosen because these are the sediments most likely to influence the benthic community structure. Each core was transferred to a rinsed, acid-washed amber plastic bottle. This was repeated several times at each station (left, right, and center of channel at three or four randomly determined locations within the station) and composited in a single bottle. This sampling procedure was selected to represent study reaches in which sampling for other community- and ecosystem-level measurements were being carried out. All samples were stored on ice until their delivery to the Maine State Analytical Laboratory (5722 Deering Hall, University of Maine, Orono ME, 04469-5722) for analysis. The sediment was analyzed for total concentration of seven heavy metals (Cd, Cr, Cu, Fe, Ni, Pb, and Zn) using strong HCl extraction. This analytical methodology was approved by USEPA during the proposal review process for the ongoing ecosystem study (Ecosystem Effects of Road Runoff, Quality Assurance Project Plan, 1999).

Sampling of discharge and DOC was carried out only in one year of the sampling (1999-2000). It will be assumed in this study that this 11-sample hydrograph represents the average hydrograph from 1998-1999. This assumption is necessary, since no other discharge monitoring exists for Goosefare Brook and the TMDL makes use of the available data. DOC varies seasonally due to the large autumnal influx of organic material from the Saco Heath, and the seasonal values seen in 1999-2000 sampling shall be assumed for 1998-1999 for the purposes of modeling metal concentrations.

Computational Methods for Allocations

All pollutant sources are initially calculated as one existing load, representing non-point and stormwater sources from roadways, industrial or general watershed runoff. The allocations for a given station will include the entire watershed, upstream of that point. Aqueous concentrations for measured samples were estimated by modeling sediment and water chemistry using MINEQL+ v3.01a. A detailed explanation of this procedure including a list of assumptions and an example calculation is presented in Appendix III.

For all metals in the TMDL, loads were calculated for aqueous concentrations from both measured samples and Maine's Statewide Water Quality Criteria, Criteria Chronic Concentration.

Load Calculations:

- **Aqueous Concentration (mg/L) * Discharge (L/seconds) = Load (mg/seconds)**
- Load in 'mg/seconds' converts to 'kg/year'

Load Reduction Calculation:

- **[(EL-LC)/EL] * 100 = % Reduction**
  EL = Existing, Measured Stream Load
  LC = Loading Capacity from Maine's SWQC

TMDL Allocations:

- **TMDL = LA + WLA + MOS**
  TMDL = LC = Loading Capacity
  LA = Non-Point Source Load Allocations = 25% LC
  WLA = Point Source or Regulated Stormwater Waste Load Allocations = 75% LC

Appendix II. Sampling Data used in TMDL calculations.

Table A1. Total sedimentary metal concentrations and water chemistry parameters used in sediment sorption models for estimates of aqueous concentrations presented in Tables 4 through 7.

Station	Date	pH	Alkalinity ($mgCaCO_3$ L^{-1})	DOC (mgC L^{-1})	Cd (mg kg^{-1})	Cr (mg kg^{-1})	Cu (mg kg^{-1})	Fe (mg kg^{-1})	Ni (mg kg^{-1})	Pb (mg kg^{-1})	Zn (mg kg^{-1})
7	5-98	7.5	38.5	11.3	0.090	12.4	5.26	12149	7.59	3.27	22.0
	6-98	7.5	38.5	11.0	0.060	26.2	12.0	23982	14.3	10.9	70.7
	7-98	6.9	36.5	8.2	0.132	8.96	2.50	10996	11.2	73.4	32.7
	8-98	7.3	27.0	5.4	0.183	21.8	9.07	18850	19.6	12.8	66.0
	9-98	6.9	19.5	2.6	0.362	21.4	9.28	22418	0.820	15.3	61.3
	11-98	7.0	22.0	18.0	0.305	8.78	3.19	11621	11.1	3.56	25.2
	12-98	6.5	26.0	17.5	0.075	12.9	6.04	12637	7.33	2.75	26.7
	2-99	6.6	10.0	16.5	0.113	20.2	9.37	20157	15.6	15.1	71.9
	4-99	6.4	16.0	10.8	0.135	15.2	5.64	14146	8.05	9.18	35.7
8	5-98	7.2	36.5	11.3	0.958	68.1	75.2	277728	55.4	95.2	442
	6-98	7.2	36.5	11.0	0.039	18.5	12.3	46681	15.8	16.0	82.5
	7-98	6.9	36.0	8.2	0.174	8.83	4.77	17118	11.5	19.5	49.6
	8-98	7.5	35.0	5.4	0.368	20.5	19.3	26123	19.5	22.4	83.1
	9-98	6.4	11.5	2.6	0.209	10.3	2.24	15427	0.900	14.8	38.7
	11-98	6.5	12.0	18.0	1.165	15.7	6.95	21822	14.7	12.9	46.5
	12-98	7.2	4.2	17.5	0.075	13.0	8.26	17698	7.58	10.5	50.7
	2-99	7.0	20.0	16.5	0.115	16.7	5.28	15499	12.1	8.56	42.4
	4-99	6.6	20.0	10.8	0.153	11.0	6.39	11066	10.3	12.8	34.6
	10-99	6.8	0.0	19.5	0.104	5.54	3.18	6156	5.70	8.99	23.3
	3-00	6.0	2.0	16.0	0.137	4.10	3.11	5785	3.29	7.14	26.8
	8-00	6.4	35.0	5.4	0.322	3.76	2.11	5158	2.62	4.61	18.3

Table A2. Temperature and discharge data used in sediment sorption models for estimates of aqueous concentrations presented in Tables 4 through 7.

Date	Temperature (^{o}C)	Discharge (L s-1) Upstream of Turnpike (Ref, Station 4)	Downstream of Turnpike (Stations 5 and 7)	Downstream of Saco Steel (Station 8)
5-98	10.5	87.5	60.3	69.2
6-98	14.2	36.5	39.4	36.5
7-98	16.3	36.5	39.4	36.5
8-98	14.0	14.1	19.6	18.4
9-98	11.1	14.4	12.4	6.9
11-98	4.9	32.7	20.6	32.2
12-98	4.0	28.4	68.9	45.5
2-99	0.6	21.8	41.9	40.6
4-99	6.4	66.4	55.4	59.5
10-99	7.0	32.7	20.6	32.2
3-00	1.0	21.8	41.9	40.8
8-00	14.5	14.1	19.6	18.4
Annual Mean	**7.5**	**36.3**	**39.0**	**43.5**

Appendix III. Example of Aqueous Metal Estimation using MINEQL+ v3.01a

Estimates of aqueous metal concentration using the sediment chemistry data were obtained using chemical equilibrium modeling software (MINEQL+ v3.01a). The software is in the public domain, and can be obtained from Environmental Research Software, 16 Middle St, Hallowell ME 04347. A double-layer adsorption model was adopted for the systems (Dzombak and Morel 1990), based on the assumptions listed below. Metals were modeled individually, which is a valid assumption because metals are not present in sufficient quantities to compete for $Fe(OH)_3$ and DOC binding sites, and is also the most conservative method for the TMDL construction. The aqueous concentration of Fe is determined in the absence of all other metals.

A. System is at equilibrium

While natural waters are rarely at chemical equilibrium, the kinetic aspects of chemical reactions are poorly known, and difficult to model in these complex systems. These models shall assume equilibrium for adsorption-desorption reactions of metals over the long stretches of streambed sampled in this study. While the atmosphere shall not be considered in the models, alkalinity shall be used to determine the background concentration of ions, taken literally as $mgCaCO_3\ L^{-1}$.

B. $Fe(OH)_3$ controls metal sorption in sediments

It is assumed that total Fe measured in sediment equals the total Fe in the system. For these purposes the aqueous concentration of Fe can be safely ignored, because it will not significantly influence the number of sorption sites on $Fe(OH)_3$ present in the sediment. Due to the large quantity of sedimentary Fe at all stations, the quantity of surface area available for adsorption on amorphous $Fe(OH)_3$ ($600 m^2$ mol Fe^{-1}) and affinity of these surfaces for metals is likely to render such surfaces as clay minerals and sorbed organics inconsequential for the purposes of this model.

C. Generalized behavior of dissolved organic material

The dissolved organic material in Goosefare Brook varies widely according to the season, and is present in sufficient quantities to have a strong influence on metal dynamics in the system. In general, organic material is difficult to characterize, and thus the generalized model humate of Morel and Hering (1993, p.385) was used. While large quantities of organic material are deposited in the sediments through adsorption and co-precipitation processes, the assumption of equilibrium dictates that aqueous DOC and sorbed carbon molecules have also equilibrated, and that those metals associated with sorbed organics in the sediments are considered as being in the sediment fraction. It is assumed that the mass of dissolved organic matter is 2x the measured quantity of carbon.

D. Sample calculation

The following is a step-by-step guide through setting up and running one of the MINEQL+ models used in this document. The example chosen is Cu at station 5 in April 1999; actual calculations are shown following each step.

1. Enter as system components H_2O, H^+, Ca^{2+}, CO_3^{2-}, Fe^{3+}, coul, $Fe_{st}OH$, $Fe_{wk}OH$, and the metal for which the model is being constructed (hereafter referred to as M). The ligands used to model organic matter and their complexation stability constants with H^+, Ca^{2+}, Fe^{3+}, and M must be entered separately in the table of complexes following component selection (Table A3).

Table A3. Summary of cation-ligand stability constants for the model humate used in the construction of MINEQL+ models. Values are expressed as log K, "L" represents the ligand in question. Acetate is not included in this table, because it already exists in the MINEQL+ thermodynamic database.

Ligand	H^+	Ca^{2+}	Cd2+	Cr^{3+}	Cu^{2+}	Fe^{3+}	Ni^{2+}	Pb^{2+}	Zn^{2+}
"Malonate"	H_2L 4.5	CaL 2.4	CdL 3.2	CrL 9.6	CuL 5.7	FeL 9.3	NiL 4.1	PbL 4.0	ZnL 3.8
	HL^- 4.5	CaHL 6.6	CdL_2 4.0		CuL_2 8.2		NiL_2 5.8	PbL_2 4.5	ZnL_2 5.4
			CdHL 6.9		CuHL 8.3		NiHL 7.2		ZnHL 7.1
"Catechol"	H_2L 9.4	n/a	CdL 8.2	n/a	CuL 13.6	FeL 8.0	NiL 8.9	n/a	ZnL 9.8
	HL^- 12.6		CdL_2 17.4		CuL_2 24.9	FeL_2 13.5	NiL_2 14.4		
					CuHL 0.9				

Data taken from Morel and Hering (1993) and Martell and Smith (1982).

2. Concentrations of the components are entered on the complexes table, according to the following procedure:

- Concentration of total Ca^{2+}, total CO_3^{2-} (from measured alkalinity), molar concentrations of Fe and M, and molar concentrations of organic ligand functional groups, calculated from DOC concentration in the following manner (Morel and Hering 1993),
    - "Acetate" [(mgC L^{-1}) x 2 mgOrganics mgC^{-1}] x $4e^{-6}$ mol $mgOrganics^{-1}$
    - "Malonate" [(mgC L^{-1}) x 2 mgOrganics mgC^{-1}] x $1e^{-6}$ mol $mgOrganics^{-1}$
    - "Catechol" [(mgC L^{-1}) x 2 mgOrganics mgC^{-1}] x $5e^{-7}$ mol $mgOrganics^{-1}$

In the example calculation, the following molar concentrations are thus entered on the table of complexes,

- $Ca^{2+} = CO_3^{2-} = 1.7e^{-4}$ mol L^{-1}
- Fe(total) = 0.017 mol L^{-1}
- Cu(total) = $2.65e^{-5}$ mol L^{-1}
- "Acetate" = $8.64e^{-5}$ mol L^{-1}
- "Malonate" = $2.16e^{-5}$ mol L^{-1}
- "Catechol" = $1.08e^{-5}$ mol L^{-1}

3. In the fixed solids table, alter log K to fix the equilibrium pH to the measured value (the default value is pH 7). Delete the CO_2 gaseous phase, which is not considered in these models.

In the example calculation, pH is entered as log K on table of fixed solids,

- pH = 6.50

4. "Run" the model. Input the measured temperature, turn ON activity constants, and select "2-layer FeOH" under surface models.

- In the example calculation, temperature is 6.4^oC.

5. Examine the output under "Output Manager". If 100% of M is adsorbed to the solid phase, then the aqueous concentration must be read as the sum of aqueous complexes listed in the output. If some quantity is in the aqueous phase, then increase the concentration of the metal in the system and re-run the model. Repeat this procedure until the total concentration of M in the sediment is the same as the measured value, and take the difference as the aqueous concentration. In the example calculation, the estimated aqueous [M] is $2.7e^{-6}$ mol L^{-1}, or 0.17 mg L^{-1}.

References

Dzombak, D.A. and F.M.M. Morel. 1990. Surface complexation modeling: hydrous ferric oxide. John Wiley and Sons, Inc., New York NY.

Martell, A.E. and R.M. Smith. 1982. Critical stability constants. Plenum Press, New York NY.

Morel, F.M.M. and J.G. Hering. 1993. Principles and applications of aquatic chemistry (2^{nd} edition). John Wiley and Sons, Inc., New York, NY.

Schecher, W.D. and D.C. McAvoy. 1994. MINEQL+: A chemical equilibrium program for personal computers, user's manual v3.01a. Environmental Research Software, Hallowell ME.

Appendix IV. Bureau of Remediation & Waste Management Letter

August 10, 2000

Mr. Archie St. Hilaire
BBI Waste Industries
P.O. Box 510
Old Orchard Beach, Maine 04064

Re: Former Saco Steel Facility-Saco, Maine

Mr. St. Hilaire:

I'm writing this letter as a follow-up to our recent phone conversation regarding the former Saco Steel facility on the Lund Road in Saco, Maine. You had inquired about the potential for the site to participate in the Maine Department of Environmental Protection's Voluntary Response Action Program ("VRAP"), and specifically what further actions are necessary to appropriately investigate and remediate the site.

I've reviewed the information we have in our files regarding the property and have found the previous investigations to be deficient in a number of areas. The previous investigations identify a number of potential problem areas at the site, but do not define the source areas or the potential impacts to the environment.

The petroleum contamination identified in MW-1S is significant, and probably indicative of free-product accumulation on the groundwater. In addition, the level of petroleum contamination in MW-4S is also elevated. This data indicates the presence of significant petroleum contamination at the site, although the source area has yet to be identified. Also, the amount of cleanup necessary in this area is dependent upon the site setting. If there are other potential receptors (i.e. private wells other than the onsite well or surface water bodies), cleanup may need to be done at a more stringent level than typically associated with industrial properties.

In addition, the current placement of monitoring points (wells) may not be optimal for identifying impacts to the site and migration of contamination from the site. Additional monitoring well couplets should be installed with guidance from the Department. Any discharges not identified at the site are not covered in the assurances provided by VRAP, therefore representing an unquantified liability to a purchaser. Therefore, a comprehensive investigation is advantageous to a potential purchaser.

In a recent visit to the site, the Department's Lynne Cayting noticed that the "retention pond" area was dry, and had plant growth indicating that it seldom held any appreciable quantities of water. Our understanding of this system was that it was the outlet for stormwater runoff at the site. Since it appears to receive little stormwater, the effectiveness of the stormwater management system should be investigated. The adjacent stream, Goosefare Brook, has been studied by the Department's Bureau of Land and Water Quality and does not meet the attainment criteria for its surface water classification.

Past reports document significant staining of surface soils at the site. Unfortunately, much of the site is now covered by impervious surface (concrete, paving, etc.) and the Department does not have reliable data on the existence of contaminants beneath these surfaces.

Based on these gaps in information, the Department recommends the following actions:

- The installation of three additional well couplets (shallow and deep) in the locations noted on the attached map.
- The collection of at least one soil sample from the borings for each monitoring well and the installation of six additional soil sample borings (to 4 feet depth or until photoionization detector (PID) readings are below 50 and/or no staining or odor is observed). The soil interval with the highest PID readings or visible staining should be submitted to the laboratory for diesel range organics (DRO), gasoline range organics (GRO), volatile organic compounds (VOC), polychlorinated biphenyls (PCB) and the RCRA-8 metals analyses. Refer to the attached map for the proposed locations of the soil samples.
- The investigation of the stormwater discharge system at the site by dye-testing to determine if it discharges to the retention pond (as intended) or if it discharges directly to the nearby stream.
- Sampling of all onsite monitoring wells (MW-1 through MW-5, shallow and deep), including the three additional wells for VOC, DRO, GRO, and the RCRA-8 metals.
- Research information regarding the presence (or absence) of private wells in the area.

- Collection of sediment samples from three locations on Goosefare Brook for VOC, DRO, GRO, RCRA-8, and PCB.

Given the results of this work, the Department, specifically the VRAP, should be able to establish remedial objectives for the property. However, additional investigation activities may be necessary as a follow-up to quantify and characterize contaminant sources, enabling efficient and cost-effective remedial decisions.

The scope of work I outlined in this letter is largely conceptual; I have not visited the site. If you choose to pursue investigation at the property, I would be happy to meet your consultant at the site for a "walkover". During the walkover, we could discuss specific locations and details of the investigation before they put together an actual workplan.

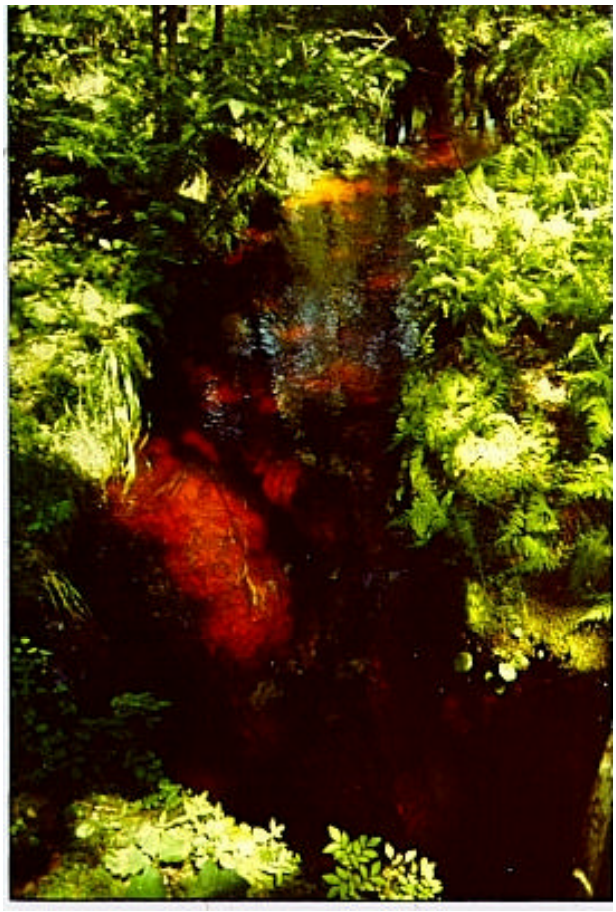
If you have questions regarding this letter, please feel free to call me at 207-287-4854.

Sincerely,

Nicholas J. Hodgkins
Voluntary Response Action Program
Division of Remediation

Pc: Lynne Cayting, Maine DEP

Appendix V. Goosefare Brook Descriptive Photographs



Goosefare Brook Reference Stations (consistent Class B attainment)

The culverts under Jenkins Road (Saco)

Station 5 downstream of

Station 7
Runoff from Saco Steel

View of Goosefare Brook channel near Station 7 and Saco Steel.

Station 8
Downstream of Saco Steel pond

Appendix VI. Regulated Areas under NPDES Phase II Stormwater Program

Appendix VII. Goosefare Brook TMDL Comments and Response to Comments

Please see the attached comments from the Maine Turnpike Authority.

Response to the Attached Comments from the Maine Turnpike Authority-

The Maine Turnpike Authorities comments are in italics and quotes.

The goal of Maine's Stream TMDL's are to restore stream habitat and native aquatic species. The recommendations in the TMDL provide an opportunity to achieve stream restoration goals, beyond the narrow technical focus of the report. The stream does meet classification for macroinvertebrates just downstream of the Turnpike, but that is not the only measure of stream quality that MDEP uses. Our narrative standards state 'habitat shall be characterized as unimpaired', so some of the TMDL recommendations address habitat concerns for altered stream segments.

- '*Thus, the document does not demonstrate that the Turnpike is causing the problem in the brook.'*

The Turnpike is not identified as the primary source of metals, but the intent of the document is to identify potential sources of metals and it has been demonstrated the Turnpike does contribute metals, in other studies. While this is not the focus of the report, the impaired Site 7, is below the Turnpike's discharge and actually above the discharge from Saco Steel's stormwater detention pond. The source of impairment at this site is not clear. The site does not receive direct discharge from Saco Steel, but is directly downstream of the Turnpike.

- '*Thus it is reasonable to conclude that the controls associated with the widening satisfy the recommendation.'*

While it is reasonable to assume the controls may result in the desired effect of minimizing runoff and controlling metals, it is not conclusive. The effectiveness of these controls can only be demonstrated through a targeted water quality monitoring program on Goosefare Brook.

- '*With respect to the recommendation to restore habitat in the stream segments adjacent to the highway, no restoration adjacent to the Turnpike is warranted since the classification is not impaired adjacent to the Turnpike.'*

The focus of the TMDL is impairment of the macroinvertebrate community as a result of metals contamination, but this does not mean the problems are solely limited to metals. The stream has been straightened in several locations as a result of road development and these segments lack adequate riparian cover and limit macroinvertebrate productivity. Restoring the streams requires eliminating metals and restoring a natural stream channel with riparian cover that will support an optimum population of macroinvertebrates. This population will provide the recruitment for impaired sites undergoing the recovery processes; and channel restoration would facilitate the process. A hydro-geomorphologist or stream biologist can confirm that the stream habitat in Goosefare is impaired by road development and warrants restoration. It would be clearly beneficial to have the Turnpike participate in fixing environmental problems caused by past development practices and aid in restoring Goosefare Brook.

- '*The DEP should provide the Authority with the appropriate credit and recognition for the considerable improvements made to stormwater management…*'

This is a good point, that new engineering designs associated with reconstruction may have already abated stormwater runoff problems. We have acknowledged this in the 'Implementation' section of the report-

- 'Since the study was conducted from 1998-2000, the Maine Turnpike has undergone widening and reconstruction in the vicinity of Goosefare Brook. The reconstruction included improvements to stormwater management of highway runoff and may have made considerable progress towards achieving this recommendation. To demonstrate compliance with this recommendation, MDEP would be willing to collaborate with the Turnpike Authority to design follow up monitoring on Goosefare Brook.'