EAST POND

Somerset and Kennebec Counties

TOTAL MAXIMUM DAILY (ANNUAL) LOAD

Final Lakes TMDL Report

DEPLW 2001 - 10

Maine Department of Environmental Protection

6 September 2001

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Maine Lake TMDLs - What, Why, Where, and When?

You are probably wondering what the acronym 'TMDL' represents and what it is all about. TMDL is actually short for 'Total Maximum Daily Load.' This information, no doubt, does little to clarify TMDLs in most people's minds. However, when we drop 'maximum', replace 'daily' with 'annual' and insert 'total phosphorus' before 'load' = *Annual Total Phosphorus Load* - it begins to make more sense to more people.

Simply stated, excess nutrients, or phosphorus in lakes, promote nuisance algae growth/blooms - resulting in the violation of water quality standards as measured by water clarity depths of less than 2 meters. A lake TMDL is prepared to estimate the total amount of total phosphorus that a lake can accept on an annual basis without harming water quality. Historically, development of TMDLs was first mandated by the Clean Water Act in 1972, and was applied primarily to *point sources* of water pollution. As a result of public pressure to further clean-up water bodies - lake and stream TMDLs are now being prepared for watershed-generated *Non-Point Sources* (NPS) of pollution.

Nutrient enrichment of lakes through excess total phosphorus originating from watershed soil erosion has been generally recognized as the primary source of NPS pollution. Major land use activities contributing to the *external* phosphorus load in lakes include residential-commercial developments, roadways, agriculture, and commercial forestry. Statewide, there are 38 lakes in Maine which do not meet water quality standards due to excessive amounts of in-lake total phosphorus.

The first Maine lake TMDL was developed (1995) for Cobbossee Lake by the Cobbossee Watershed District (CWD) - under contract with Maine DEP and US-EPA. Recently, TMDLs have been approved by US-EPA for Madawaska Lake (Aroostook County), and Sebasticook Lake (Penobscot County). TMDLs are presently being prepared by Maine DEP, with assistance from the Maine Association of Conservation Districts (MACD) & Soil and Water Conservation District (SWCD) and Natural Resources Conservation Service (NRCS) County offices - for China Lake (public review draft), and Mousam Lake (in prep.). A non-MACD supported TMDL for Unity Pond (Waldo County) is also being developed. New TMDL lake studies in Cumberland County include: Highland (Duck) Lake in Falmouth; Long and Highland lakes in Bridgton; and Webber and Threemile ponds in Kennebec County. TMDL studies are also being initiated for Annabessacook Lake & Pleasant Pond (Kennebec County) - under contract with CWD.

Lake TMDL reports are based in part on available water quality data including seasonal measures of total phosphorus, chlorophyll-a, Secchi disk transparencies, and dissolved oxygen-water temperature profiles. Actual reports include: a lake description; watershed GIS assessment & estimation of NPS pollutant sources; selection of a total phosphorus target goal (acceptable amount); allocation of watershed/land-use phosphorus loadings - and a public participation component to allow for stakeholder review.

TMDLs are important tools for maintaining and protecting acceptable lake water quality. They are primarily designed to 'get a handle' on the magnitude of the NPS pollution problem and to develop plans for implementing Best Management Practices (BMPs) to address the problem. *Development of phosphorus-based lake TMDLs are not intended by Maine DEP to be used for regulatory purposes*. Landowners and watershed groups are eligible to receive technical and financial assistance from state and federal natural resource agencies to reduce watershed total phosphorus loadings to the lake.

TMDL Summary Overview

This summary overview provides **East Pond** watershed stakeholders with a brief accounting of facts and figures from the attached East Pond TMDL technical report, prepared by the Maine Department of Environmental Protection (Maine DEP) with MACD (Maine Association of Conservation Districts) assistance.

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NOTE - Phosphorus-based lake TMDLs are primarily designed to 'get a handle' on the magnitude of the Non-Point Source (NPS) pollution problem and to develop plans to implement Best Management Practices (BMPs) to address the problem. Landowners (residential, commercial, agricultural, silvicultural, municipal) and watershed/lake groups are eligible to receive further technical and financial assistance to effectively reduce lake watershed phosphorus loads to susceptible lakes (US-EPA and ME-DEP Project 319 funding and support).

Unique Properties - **East Pond** (698 hectares) is a relatively shallow, wind-driven, slow-flushing, spring-fed **groundwater seepage lake** with no permanent flowing inlets and a single outlet - Serpentine Stream. On occasion, during hurricanes and high-wind and storm events, this primary outlet can backflush phosphorus-rich waters into East Pond proper. The lake watershed is heavily developed on the southeastern shores with residential homes and commercially operated recreationally-based youth summer camps. The shoreline population of East Pond almost doubles in size with the addition of summer campers. Colby College (Waterville) has studied and characterized the East Pond and Serpentine Stream watershed (land use) both in 1991 and 1999, relative to existing water quality, algae blooms, and suggested strategies for remediation.

Historical vs. Current Water Quality - the water quality of East Pond has deteriorated over the past decade - with intense blue-green nuisance algae blooms prevalent during the summers of 1993-95 and 1998-99. Based on minimum water transparencies (2.7 - 3.4 meters), intense algae blooms were not evident during the summers of 1996-97, nor during the past summers of 2000 and 2001. A combination of internal (sediment) and external (watershed/shoreline) sources account for the in-lake nutrient (total phosphorus) loadings.

Water Quality Standards and Lake Target Goals - an in-lake total phosphorus (TP) concentration summertime target goal for East Pond of 15 ppb was selected to ensure the future attainment of water quality standards (Secchi disk transparencies 2 m or more and the absence of nuisance level, summer-time blue-green algae blooms).

Selection of Total Phosphorus Loading Coefficients - estimates of phosphorus export loadings (kg TP per hectare per year) were determined using local and regionally published export coefficients for representative land uses. Selection of actual values, ranging from low to high, reflect the relative effects of applied BMPs - as evaluated by best professional judgement. In the final analysis, high-level residential total phosphorus loadings were chosen to reflect the high-density residential and commercial summer-camp shoreline use. Generally, moderate-level estimates were selected for non-residential and commercial land uses (e.g., septic systems and roadways).

Watershed Land Use and TP Load Allocation - The **East Pond** watershed, excluding the Serpentine Stream indirect (outlet) drainage - is dominated (45%) by **non-cultural land areas** (non-commercial forests, wetlands, and scrub-shrub) - which contribute only 6% of the non-point source TP load (30 kg). Atmospheric (lake surface area) sources comprise 38% of the watershed area and 23% of the TP load (112 kg). **Cultural NPS sources** (17% area - 71% TP load - 341 kg) include: East Pond shoreline development (residential and summer camp recreational 10% area - 31% load - 148 kg, septic systems 1% area - 10% TP load - 47 kg, and total roadways 2% area - 20% TP load - 96 kg); and developed non-shoreline (5% area - 10% TP load - 50 kg), e.g., low-density residential, commercial, and timber harvesting (Note: non-shoreline roads were accounted for in total roadways).

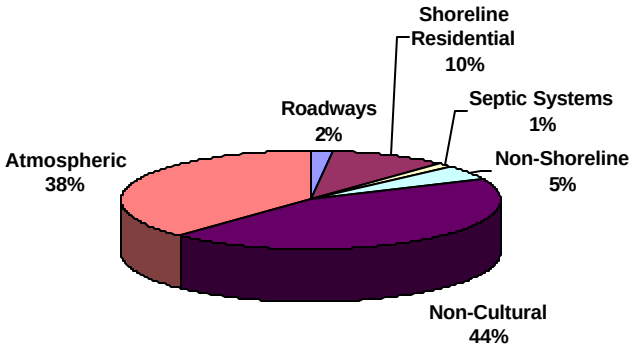
Lake Loading Capacity, Internal-External Pollutant Sources - the East Pond loading capacity, based on a phosphorus retention model, equals 389 kg of total phosphorus annually - at a target goal of 15 ppb. In contrast, **external** (watershed) total phosphorus export approximates 483 kg per year and **internal** (sediment) TP load models output 400+ kg annually. Combined, the East Pond internal and external total phosphorus loads approximate 900 kg annually - less the 389 kg from in-lake processing capacity equals ca. 500 kg annually as the amount of TP needed to be reduced to attain water quality standards. This reduction in total phosphorus may be attained over time given continued reductions in external watershed TP loadings leading to the required reductions in internal sediment TP loadings in East Pond.

Water Quality Problem Solving Approach - East Pond is very fortunate in having very active and responsible organizations in place to deal with water quality issues and years of land use and water quality data compiled as a result of volunteer monitoring efforts. As a result of much hard work and directed efforts by watershed stakeholders (East Pond Association and - more recently, Belgrade Regional Conservation Alliance), including extensive studies conducted over the past decade by the Environmental Biology classes at Colby College - the water quality and watershed conditions in East Pond and Serpentine Stream are fairly well known and potential problem areas are being addressed to eliminate watershed phosphorus sources. During the summer months, the Belgrade Lakes Conservation Corps offers assistance to East Pond land owners with implementing nonpoint source best management practices to control soil erosion. Further reductions in phosphorus loads need to be achieved to meet and maintain targeted water quality standards for East Pond. Implementation of a combination of BMPs will effectively reduce both the external and ultimately the internal phosphorus load. Nonpoint source pollution BMPs designed to further control soil erosion and NPS pollution from culturally derived sources - such as roadways, residential and commercial developments, and the improvement and upgrading of shoreline septic systems - will need to be implemented in an effective and timely fashion.

NPS-BMP Implementation - a lakeshore watershed survey was conducted in 1999 under the direction of Maine DEP and through the efforts of the East Pond Association and the Belgrade (Lakes) Regional Conservation Alliance (*East Pond Watershed Non-point source Pollution Survey* 2000 Report). Existing 319-NPS projects include a phase I Load Abatement for the Salmon-McGrath and East Pond Watersheds - through the Kennebec County Soil and Water Conservation District (Summer 2001-January 2002). The BRCA has also applied for funding to the Maine DEP for nonpoint pollution source remediation projects, both in the East Pond and North Pond watersheds.

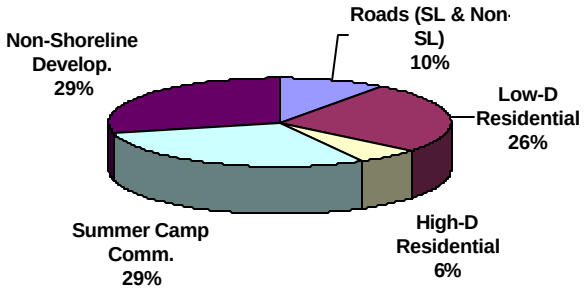
FIGURE 1a - 1d: East Pond % Land Use Areas and % Phosphorus Loads

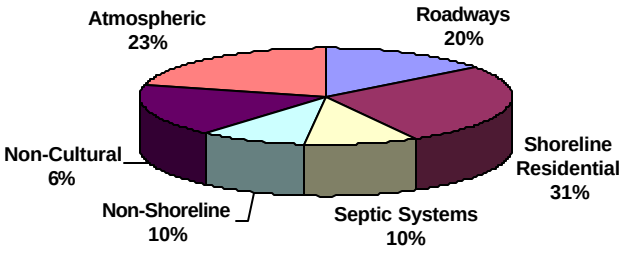
EAST POND Watershed - Total Land Use Area



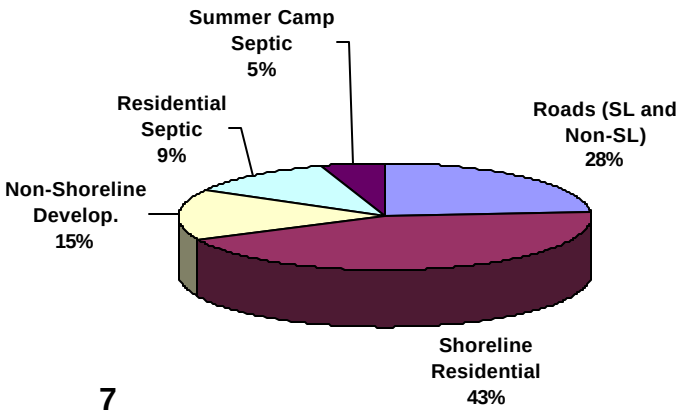
EAST POND Watershed - Total Phosphorus Load

EAST POND - Cultural Land Use Area





EAST POND - Cultural Phosphorus Load



EAST Pond TMDL (Somerset & Kennebec Counties) Maine

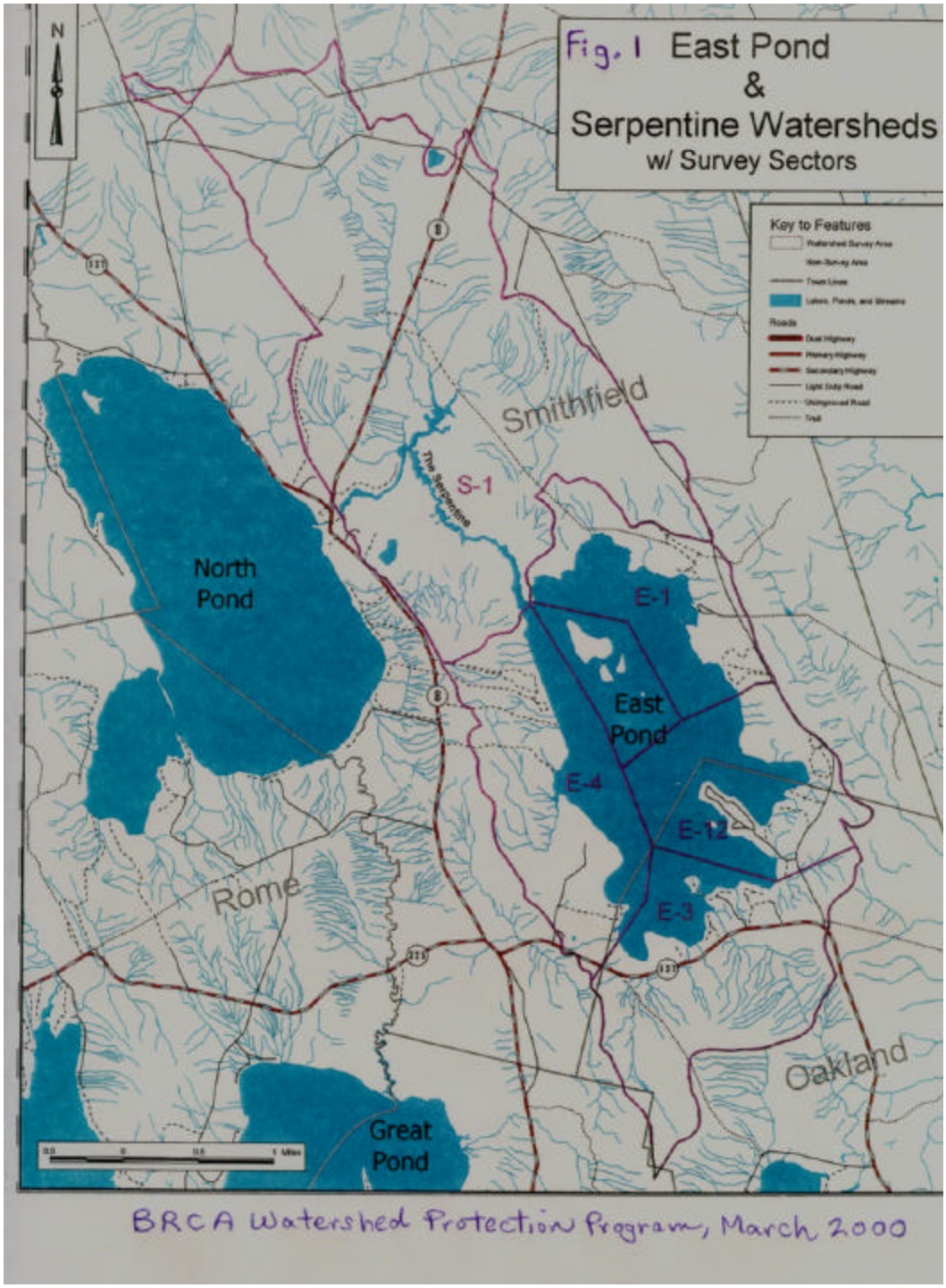
1. DESCRIPTION of WATERBODY and WATERSHED, Priority Ranking, Pollutant of Concern, Pollutant Sources - Relative to Natural Background Levels

Description of Waterbody

East Pond (*MIDAS #5349*) is a moderate-sized 698 hectare (1,725 acre or 7 km^2), single basin waterbody located in the Belgrade Lakes region of central Maine (DeLorme Atlas, Map 20), within Somerset & Kennebec counties. It has a direct drainage area of 1,123 hectares (4.3 square miles). The East Pond watershed is shared between the two towns of Smithfield (54%) and Oakland (46%). East Pond is a shallow lake with a mean depth of only 5.5 meters and an estimated flushing rate of 0.25 flushes per year (once every 4 years). East Pond has a broad basin with northwest to southeast orientation and is subject to the prevailing effects of high winds (Bachmann et al. 2000, Guss et al. 2000) and frequent lake mixing. East Pond is a **spring-fed groundwater seepage lake** with no permanent flowing inlet(s) and a single outlet - Serpentine Stream, located between East Pond and North Pond (Figure 2). Notably, during periods of heavy precipitation (spring floods and summer-fall hurricanes) - the Serpentine Stream outlet flow is reversed and flows back into East Pond (Colby College 2000).

Serpentine Stream, located primarily in Smithfield, comprises a 1,628 ha (6.2 square mile) watershed with 164 acres of open water interspersed with a marsh dominated wetland area (BRCA 2000). Two small, slow-flowing streams (Sucker and Clark brooks) feed into Serpentine Stream in the northeastern corner of the watershed. Clark Brook drains agricultural lands, while Sucker Brook - which passes under Rte. 8, drains forested areas and is lined by residential areas in several locations. Due to probable influences on East Pond water quality, the Serpentine Stream drainage complex will be briefly discussed in terms of potential for (East Pond outlet) backflushing.

Figure 2. Map of East Pond depicting Serpentine Stream and the upper Belgrade lakes drainage system.



East Pond Outlet Backflushing - Serpentine Stream typically flows north out of East Pond, reaching the top of the T section and heading west through the Coffin dam and into North Pond. Following heavy rainfall (2.5" during a six-hour period), water from the this section (Clark and Sucker Brooks) backflows south toward East Pond (Colby College 2000). The effect of backflushing on East Pond water quality has been thought to increase nutrient loading and has been considered by Colby College in their 1991 and 2000 study reports. The flow from the Serpentine includes flow from Clark and Sucker Brooks, which flow - in part - through agricultural areas and then, following heavy precipitation events - directly into North Pond. The 1991 Colby College study included the Serpentine within its study based on findings of the ME-DEP regarding the 1987 algae bloom. Specifically, that "the DEP investigated the algae bloom of 1987 and determined the cause to be an external input of phosphorus. It was speculated that the Serpentine Stream, which was normally an outlet for East Pond, may have backed into the lake as a result of high precipitation levels during the April flood of 1987" (Colby College 1991, pages 44-45).

During the 1991 Colby College study, water sampling was conducted during back flow and normal flow. Results suggested that storm activity plays an important role in the nutrient input and water flow from the Serpentine Stream into East Pond. Comparisons between data for back flow and normal flow conditions "clearly indicate an increase in phosphorus loading to the Serpentine Stream and East Pond during a storm" (Colby College 1991). Also, "nutrient loading by Clark and Sucker Brooks and increases in turbidity within the wetland appear to be the primary sources for increased phosphorus levels" (Colby College 1991).

In the more recent Colby College study (based on a September 13, 1999 aerial photo taken after a rainstorm), backflushing of the Serpentine into East Pond was evident. The 2000 study documented that backflushing of Serpentine Stream into East Pond following storms greater than 2.5" during a six-hour period

- appeared to increase nutrient loading into East Pond. Water samples taken during the algae bloom of 1999 suggest that wetlands surrounding Serpentine Stream function as a filtration system. The wetland samples were at a (relatively) low phosphorus level, indicating that increased phosphorus contributing to the algae bloom was being taken up by wetland vegetation. The latest Colby study concluded that backflushing has not been a significant source of phosphorus to East Pond and could potentially benefit East Pond water quality (Colby College 2000). The mixed findings of the two Colby College studies suggest that more research needs to be conducted regarding the total phosphorus loading effects of the Serpentine Stream backflushing into East Pond (Figure 2).

Drainage System – East Pond is located at the top of the Belgrade Lakes chain, and flows directly into North Pond via the Serpentine Stream outlet (Coffin) dam. North Pond and Salmon Pond both drain into Great Pond, which then flows into Long Pond (North and South basins), and into Belgrade Stream before emptying into Messalonskee Lake (a.k.a. Snow Pond) - and finally draining into the Kennebec River via Messalonskee Stream in Gardiner (Colby College 2000).

Limited water level control is maintained at the Coffin dam, located in Smithfield Village and constructed in 1947 by Central Maine Power. Shortly after dam construction, a committee was created within the East Pond Association to oversee and maintain the dam. Flashboards are used to regulate water levels by 12-inches, between 263 - 264 feet above sea level (East Pond Association internet website). Historically, the flashboards are placed on the dam by May 5th and removed Labor Day weekend. During 2000, flashboards were placed on May 5th and removed on September 4th, with an average flow over the dam of 1.9 million gallons per day (East Pond Association internet website).

A state-operated public boat launch is located on the southeast end of East Pond in the town of Oakland, just to the south of Brickett Point. The major human use of East Pond is residential (both seasonal and year-round) and recreational - including boating, fishing, camping, and beach/residential use.

There are four commercial camps located on the shores of East Pond, including two youth camps and two cottage rental business ventures. Commercial shoreline development is estimated to comprise 87 hectares (MACD 2001).

Human Development – East Pond is highly developed along the eastern and southern shores, with both seasonal camps (70%) and year-round residences (MACD 2001). In contrast, seasonal camp use in 1991 was estimated to be 80% (Colby College 1991). Based on recent inventories (Colby College 2000 and town tax records), there are 408 total residences in the East Pond and Serpentine Stream watersheds, with approximately 222 shoreline houselots on East Pond. Brickett Point is an area of concentrated (high-density) residential development, with 90 homes of which only 18 are year-round residences (Cindy Reese - East Pond Assoc., personal communication and Oakland tax records).

Based on 1998 estimates from the Maine State Planning Office, a total population of 6,186 people reside within the towns of Oakland (5,273) and Smithfield (913). Human populations are on the increase in these towns, and projected 2015 population estimates for Oakland and Smithfield are estimated at 8,000 and 1,200, respectively (KVCOG 2000). These numbers are for the entire town areas, not just the East Pond watershed area. The Colby College (2000) study identified a total of 408 residences in the East Pond and Serpentine Stream watersheds combined. There are an average of 2.7 and 2.9 persons per household in the towns of Oakland and Smithfield, respectively (KVCOG 1990). Using an average of 2.8 persons per household, and multiplied by 408 - the total summer population would be 1,142 people (342 year-round and 800 seasonal). Notably, an additional maximum of 1,000 people would be added by the influx of summer visitors and staff to the commercial camping operations (Matoaka 450, Manitou 380, Alden 105, Sadulsky 55).

Priority Ranking, Pollutant of Concern, and Algae Bloom History - East Pond is listed as targeted (high priority) on the 1998 303(d) list and the East Pond TMDL has been developed for total phosphorus, the major limiting nutrient to algae growth in freshwater lakes in Maine. According to historical records

(ME-DEP 2000), water quality in East Pond has deteriorated over the past decade - with intense blue-green algae blooms occurring during 1993-95 and 1998-99. Based on minimum Secchi disk transparencies (2.7 m and 3.4 m), intense blue-green algae blooms were not evident during 1996-97, nor during the past summer of 2000 (ME-DEP field observation).

Pollutant Sources - This current water quality assessment for East Pond is based on 26 years of bi-monthly Secchi disk water transparency measures (1975-2000), combined with 13 years of in-lake growing season total phosphorus data and 8 years of chlorophyll-a and associated chemistry monitoring data. The existing total phosphorus load was estimated on the basis of the East Pond watershed land use class loadings and atmospheric deposition. A combination of internal and external sources of total phosphorus accounts for the majority of in-lake nutrient loadings (Colby College 2000).

Natural Background Levels for East Pond were not separated from the total nonpoint source load because of the limited and general nature of available information. Without more and detailed site-specific information on nonpoint source loading, it is very difficult to separate natural background from the total nonpoint source load (US-EPA 1999).

Descriptive Land Use Information

Based on aerial photograph analysis from 1965 and 1999 - residential land area in the East Pond watershed has more than doubled in the past 35 years (Colby College 2000). Overall, since the 1960's, land use patterns within these watersheds (+Serpentine Stream) have exhibited a decrease in the amount of land used for agriculture and an increase in residential development - inclusive of transitions from seasonal to year-round residences (Colby College 2000).

Estimates of total phosphorus export from different land uses found in the East Pond watershed are presented in Table 1 and represent the extent of external phosphorus loading to the lake. These measures are expressed as a

range of values to reflect the degree of uncertainty associated with such relative estimates (Walker 2000). The watershed total phosphorus loadings were primarily determined using literature-derived export coefficients as found in Schroeder (1979), Reckhow et al. (1980), ME-DEP (1981 and 1989), Dennis (1986), Dennis et al. (1992), and Bouchard et al. (1995) for low and high-density residential properties; roadways; and others types of developments (recreational, commercial, and timber harvesting).

Shoreline Camp and Residential Lots may have one of the largest estimated impacts, in terms of total phosphorus loading to lakes, in comparison to its relatively small percentage of the watershed. This is particularly true for East Pond, where significant population increases (+ 1,000 maximum) occur during the summertime resulting from high-density recreational youth camps and lakeshore rental camps. Seasonal and year-round shoreline camp and home lots on East Pond comprise only 10 percent of the total watershed area, however, these areas contribute an average of 148 (49 to 187) kg of total phosphorus - approximating 31 percent of the estimated total phosphorus load (Table 1).

This land use category was divided into low and high-density residential and recreational landuse areas (Table 1). The range of total phosphorus loading coefficients used for low-density houselots (0.25 - 0.98 kg/ha/yr) and high-density houselots (0.35 - 1.40 kg/ha/yr) were adopted from those used for China Lake in Kennebec County, Maine (ME-DEP 1989), Long Lake, Aroostook County, Maine (Bouchard et al. 1995), and the previously accepted Cobbossee Lake TMDL - 0.98 to 1.40 (Monagle 1995, ME-DEP 1999).

Table 1. Estimated total phosphorus export by land use class for the East Pond direct watershed in Oakland and Smithfield.

LAND USE Human Cultural **Development**	**Total Area** Ha	**% Total** Area	**TP Coeff. Avg.** kg/P/ha	**TP Exp. Avg.** kg TP	**TP Exp. Avg.** %	**TP Coeff. Range** kg/P/ha	**TP Export Range** kg TP
Low-Density Residential	80	4.4	0.98	78	16.1	0.25 - 0.98	20 - 78
High-Density Residential	18	1.0	1.4	25	5.2	0.35 - 1.40	6 - 25
SummerCampRecreational	87	4.8	0.52	45	9.3	0.26 - 0.96	23 - 84
Shoreline Development	**185**	**10**		**148**	**30.6**		**49 - 187**
ResidentialSepticSystems			EP Model	29	6.0	EP Model	17 - 51
CommercialSepticSystems			EP Model	18	3.7	EP Model	11 - 33
Total Septic Systems	**1**	**0**	**EP Model**	**47**	**9.7**	**EP Model**	**28 - 84**
Shoreline Roads	**14**	**1**	**3.9**	**55**	**11.4**	**3.9**	**55**
East Pond SHORELINE	**200**	**11**		**250**	**51.8**		**132 - 326**
Low-Density Residential	56	3.1	0.62	35	7.2	0.25 - 0.98	14 - 55
Commercial*	2	0.1	1.44	3	0.6	0.96 - 1.92	2 - 4
Timber Harvesting	30	1.6	0.4	12	2.5	0.06 - 0.75	2 - 23
Non-Shoreline Roads	14	0.8	2.9	41	8.5	2.9	41
NON-SHORELINE	**102**	**6**		**91**	**18.8**		**59 - 123**
TOTAL-CULTURAL	**302**	**17**		**341**	**70.6**		**191 - 449**
Forests	630	34.6	0.04	25	5.2	0.02 - 0.09	13 - 57
Wetlands	93	5.1	0.02	2	0.4	0.01 - 0.03	1 - 3
Scrub Shrub	98	5.4	0.03	3	0.6	0.03	3
NON-CULTURAL	**821**	**45**		**30**	**6.2**		**17 - 63**
ATMOSPHERIC	**698**	**38**	**0.16**	**112**	**23.2**	**0.11 - 0.21**	**77 - 147**
TOTAL WATERSHED	**1,821**	**100**		**483**	**100**		**285 - 659**
*Commercial includes a gas station and rock crushing /gravel pit operation							

Septic Systems - Currently, there are no public sewer services for the land areas within the East Pond watershed (KVCOG 2000, Oakland Town Office). The 1991 Colby College study suggested the potential for septic system-related problems due to the high number of grandfathered homes in close proximity to East Pond. The 2000 Colby study included a septic suitability GIS map and concluded that the majority of the East Pond watershed has a moderate to high septic suitability rating with almost the entire shoreline rated moderate to high. The study suggests that "as long as septic systems are in good repair, organic matter from leach fields should not be reaching the groundwater or East Pond" (Colby 2000). Areas with low or very low suitability include the southwest corner (Camp Matoaka and Benson Cove) due to hydric soils similar to those found near the Serpentine Stream watershed.

In December of 2000, the East Pond Association - with guidance from ME-DEP, conducted a septic system questionnaire survey by direct mailing (see East Pond Association Spring 2001 Newsletter Article in Appendix C). Goals of the survey were to obtain up-to-date information on the status of shoreline septic systems and to educate landowners about septic system maintenance. A cover letter, two-page survey, and general educational information on septic system maintenance and funding sources were mailed to all East Pond Association newsletter recipients (330 total, including 222 shoreline residents).

Overall, 104 responses were received for a shoreline response rate of approximately 46%. Ninety surveys were used in the septic model to determine phosphorus loading (non-shoreline and undeveloped lots were not included). Data for each shoreline lot was entered into a spreadsheet and ratings were assigned based on the following selected attributes:

- distance to lake (100' or less = 1.2, 101' – 200' = 1.1, > 200' = 1)
- age of system (pre-1972 = 0.15, post-1972 = 0.05)
- problems reported with system = 0.25

- average number of occupants per household
- approximate number of days occupied per year (seasonal vs. year-round)
- total phosphorus loading to septic system (groundwater) range (kg per day per capita) - based on low (0.8 = .0022) to moderate (1.4 = .0038) to high (2.5 = .0068) estimates.

Rating = (# occupants) (# days/yr) (system age factor) (distance factor) (GW-LMH)

Based on septic system survey data, the average number of occupants per dwelling is 3.1; average number of days per year of occupancy is 158; and the average age of septic systems is 12.6 years. Only 3% of the respondents reported having some problems with their septic systems (i.e., lush green lawns over septics and odor).

Computation of septic system impacts, in terms of total phosphorus load estimates, was based on a residential shoreline dwelling figure of 90, which was then expanded to include non-respondents. Estimates of the phosphorus loading from residential septic systems on East Pond ranged from a low of 17 to a high of 51 kg total phosphorus per year, which approximates an average total watershed TP export of 6 percent or 29 kg TP annually (Table 1). Using a similar approach to derive septic system loadings from high-density recreational youth camps (380-450 per capita maximum day-use) and groupings of multiple lakeshore rental cottages - the numbers are increased by over 1/3 (28 to 84 kg total phosphorus yearly), and the total watershed TP export (47 kg) is estimated to be 10% (Table 1).

Roadways were initially divided into three sub-classes: state public highway, town public highway, and private camp roads. Actual road miles were measured using a map wheel from USGS 7.5' topographic maps and field measurements of road widths (ave. 18 m state, 12 m town, 6.5 m camp) as delineated from the outer edge of roadside ditches. Roadways (total of 28 hectares) were assigned total phosphorus loading rates of 3.9 kg per hectare per year for shoreline roads and 2.9 kg per hectare per year for non-shoreline roads. These TP loadings are fairly conservative, based on preliminary studies of rural Maine highways (Dudley

et al. 1997). Similar to camp and home lots, the combined roadways category of land use accounted for a much greater percentage of the total phosphorus load (20%) vs. its 2% area in the East Pond watershed (Table 1).

Other Properties - Non-shoreline cultural (low-density residential, commercial, timber harvesting, and non-shoreline roads) – comprised 102 hectares and 15 percent of the total phosphorus load of the East Pond watershed (Table 1).

Total Cultural - A total of 71 percent (341 kg, range 191 to 449 kg) of the phosphorus loading to East Pond is estimated to have been derived from the cumulative effects of the preceding four cultural land use classes: residential, including **shoreline camps - home lots** (31% - 148 kg); residential/commercial **septic systems** (10% - 47 kg); **non-shoreline** (10% - 50 kg); and near-shore, primarily camp-type **roadways** (20% - 96 kg), - as depicted in Table 1.

Indirect Drainage Area: Agriculture – The following discussion pertains primarily to the Serpentine Stream drainage system, located within the town of Smithfield. In 1965, 22% of the land in the Serpentine watershed was devoted to agriculture compared to 16% in 1991 (Colby College 1991). For the East Pond direct watershed - 4% of the land was devoted to agriculture compared to 2% in 1991 (Colby College 1991). To date, there is no agriculturally derived total phosphorus loading which can be directly attributed to the groundwater seepage area of East Pond.

Today, there is one small livestock operation (dairy farm) in the Serpentine Stream watershed, (none in the East Pond direct drainage area), which drains directly to the Sucker Brook and into the Serpentine Stream (BRCA 2000). Inclusive of the indirect drainage of the Serpentine Stream outlet - 6 percent of the total land area (207 ha), is agricultural - which can potentially (see outlet backflow discussion) and on occasion, contribute an additional 15 percent of the total phosphorus load (152 kg).

NON-CULTURAL NPS SOURCES

Forest Practices – Of the total land area within the East Pond watershed, 35 percent (630 ha) is forested (Table 1), most of which are privately owned deciduous and mixed forest plots (MACD 2001). Notably, the median values for total phosphorus export from forested watersheds - nationally, is 0.21 kg/ha/yr (Reckhow et al. 1980). A total of 5 percent of the phosphorus load (25 kg TP/yr, 13-57 range) is estimated to be derived from these forested watersheds within the East Pond direct drainage area (Table 1).

Other Non-Cultural - combined wetlands and old field scrub shrub comprise 10.5 percent of the East Pond watershed, which accounts for the remaining 1 percent (5 kg) of the total non-cultural total phosphorus export load (30 kg).

Atmospheric Deposition and Dry Fallout - is estimated to account for an estimated 112 (77 to 147) kg of total phosphorus, representing 23% of the total load entering the East Pond watershed, with lake surface waters (698 ha) comprising 38 percent of the total watershed area (1,821 ha). The lower total phosphorus loading coefficient chosen (0.11 kg TP/ha) is similar to that used for the Cobbossee and Sebasticook lake TMDLs, and the upper range (0.21 kg TP/ha) generally reflects a watershed which is 50 percent forested, combined with agricultural areas interspersed with urban/suburban land uses (Reckhow et al. 1980). An intermediate loading of 0.16 kg TP/ha was chosen to represent average conditions within the East Pond basin (Table 1).

Total Phosphorus External Loading Summary

It is our best professional opinion that the selected export coefficients are appropriate for the East Pond watershed. Results of the land use analysis indicate that a best estimate of the present total phosphorus loading from **external** nonpoint pollution sources averages **483 kg TP/yr** (range 285 to 659).

This 'average' external loading to East Pond generally equates to a total phosphorus loading modeled at 19 ppb (492 kg) - approximately 100 kg in excess of the TMDL target goal of 15 ppb (389 kg TP/yr).

2. WATER QUALITY STANDARDS & WATER QUALITY TARGET

Maine State Water Quality Standards for nutrients which are narrative, are as follows *(July 1994 Maine Revised Statutes Title 38, Article 4-A*): "Great Ponds Class A (GPA) waters shall have a stable or decreasing trophic state (based on appropriate measures, e.g., total phosphorus, chlorophyll a, Secchi disk transparency) subject only to natural fluctuations, and be free of culturally induced algae blooms which impair their potential use and enjoyment."

ME-DEP's functional definition of nuisance algae blooms include episodic occurrence of Secchi disk transparencies (SDTs) < 2 meters for lakes with low levels of apparent color (<26 SPU) and for higher color lakes where low SDT readings are accompanied by elevated chlorophyll a levels. East Pond is a non-colored lake (average color 16 SPUs), with characteristically low late summer minimal SDT readings (overall average of 1.7 meters), at times in association with highly elevated chlorophyll a levels (23-28 ppb 1999 and 1994). From a functional perspective, ME-DEP views clearly negative trends in seasonal SDT means or minima as an indication of increasing trophic state condition. This interpretation uses historic documented conditions as the primary basis for comparison. Given the context of "impaired use and enjoyment," along with a realistic interpretation of Maine's goal-oriented Water Quality Standards, we have determined that episodic, non-cyanophyte based algae blooms (e.g., diatoms), limited to the fall or spring periods only, are in WQS attainment for GPA waters.

Designated Uses and Antidegradation Policy

East Pond is designated as a GPA (Great Pond Class A) water in the ME-DEP state water quality regulations. Designated uses for GPA waters in general include: water supply (after disaffection); primary/secondary contact recreation (swimming and fishing); hydroelectric power generation; navigation; and fish and

wildlife habitat. No change of land use in the watershed of a Class GPA water body may, by itself or in combination with other activities, cause water quality degradation that would impair designated uses of downstream GPA waters or cause an increase in their trophic state.

Numeric Water Quality Target

The numeric (in-lake) water quality target for East Pond is set at 15 ppb total phosphorus (389 kg TP/yr). Since numeric criteria for phosphorus do not exist in Maine's state water quality regulations - and would be less accurate targets than those derived from this study - we employed best professional judgement to select a target in-lake total phosphorus concentration that would attain the narrative water quality standard. **Springtime** total phosphorus levels in East Pond averaged 14-16 ppb during 1999-2000. In-lake (epilimnion core) total phosphorus **summertime** (June through August) measures averaged 20 ppb. In summary, the numeric water quality target goal of 15 ppb for total phosphorus in East Pond was based on available water quality data (average epilimnion grab/core samples) corresponding to **non-bloom conditions**, as reflected in suitable (water quality attainment) measures of both Secchi disk transparency (> 2.0 meters) and chlorophyll-a (< 8.0 ppb).

3. LINKING WATER QUALITY and POLLUTANT SOURCES

Loading Capacity - the East Pond basin loading capacity is set at 389 kg TP/yr of total phosphorus. As indicated, the East Pond TMDL is expressed as an annual load as opposed to a daily load. As specified in 40 C.F.R. 130.2(i), TMDLs may be expressed in terms of either mass per unit time, toxicity, or other appropriate measures. It is thought appropriate and justifiable to express the East Pond TMDL as an annual load because the lake basin has a relatively long hydraulic residence time (0.25 = flushes once every four years).

Linking Pollutant Loading to a Numeric Target - the basin loading capacity for East Pond was set at 389 kg/yr of total phosphorus to meet the numeric water quality target of 15 ppb of total phosphorus. A phosphorus retention model,

calibrated to in-lake phosphorus data, was used to link phosphorus loading to the numeric target (see below).

Supporting Documentation for the East Pond TMDL Analysis –includes the following: ME-DEP and VLMP water quality monitoring data; watershed/landuse maps using GIS derived data layers; literature derived export coefficients; and specification of phosphorus retention model – including both empirical models and observed retention coefficients.

Phosphorus Retention Model (after Dillon and Rigler 1974 and others)

L = P (A z p) / (1-R) where,

389 = **L** = external total phosphorus load capacity (kg TP/year)

15.00 = **P** = spring overturn total phosphorus concentration (ppb)
6.98 = **A** = lake basin surface area (km^2)
4.90 = **z** = mean depth of lake basin (m) **A z p = 8.55**
0.25 = **p** = annual flushing rate (flushes/year)
0.33 = **1- R** = phosphorus retention coefficient, where:
0.67 = **R = 1 / (1+ sq.rt. p)** (Larsen and Mercier 1976)

Previous use of the Vollenwieder, Dillon and Rigler type empirical model for Maine lakes, e.g., Cobbossee, Madawaska, and Sebasticook TMDLs (ME-DEP 2000-2001) has shown this approach to be effective in linking watershed total phosphorus loadings to existing in-lake total phosphorus concentrations.

Strengths and Weaknesses in the Overall TMDL Analytical Process

The East Pond TMDL was developed using existing water quality monitoring data, derived watershed export coefficients (Reckhow et al. 1980, ME-DEP 1981 and 1989, Dennis 1986, Dennis et al. 1992, Bouchard et al. 1995, Soranno et al. 1996, and Mattson and Isaac 1999) and a phosphorus retention model which

incorporates both empirically derived and observed retention coefficients (Vollenwieder 1969, Dillon 1974, Dillon and Rigler 1974 a and b, and 1975, Kirchner and Dillon 1975). Use of the Larsen and Mercier (1976) phosphorus retention term, based on localized data (northeast and north-central U.S.) from 20 lakes in the US-EPA National Eutrophication Survey (US-EPA-NES) provides a more accurate model for northeastern regional lakes.

Strengths:

- Approach is commonly accepted practice in lake management
- Made best use of available water quality monitoring data
- Export coefficients were derived from extensive data bases, and were determined to be appropriate for the application lake.
- Based upon experience with other lakes in the northeastern U.S. region, the empirical phosphorus retention model was determined to be appropriate for the application lake.

Weaknesses:

- Inherent uncertainty of TP load estimates (Reckhow 1979, Walker 2000)

Critical Conditions in East Pond occur during the summertime, when the potential (frequency and occurrence) of nuisance algae blooms are greatest. The loading capacity of 15 ppb of total phosphorus was set to achieve desired water quality standards during this critical time period, and will also provide protection throughout the year (see Seasonal Variation section).

4. LOAD ALLOCATIONS (LA's)

The load allocation (lake capacity) for all existing and future non-point pollution sources for East Pond is 389 kg TP/yr, as derived from the empirical phosphorus retention model based on a target goal of 15 ppb (see Loading Capacity discussion). Reductions in nonpoint source phosphorus loadings are expected from the continued implementation of Best Management Practices for camp roads and shoreline stabilization, as well as improved shoreline residential

septic systems (see BMP implementation plan summary). 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. As in other Maine TMDL lakes (see Sebasticook Lake TMDL), in-lake nutrient loadings originate from a combination of external and internal sources of total phosphorus. External TP sources, averaging 483 kg annually (range 285 - 659 kg) have been identified and accounted for in the land-use breakdown portrayed in Table 1.

Internal Lake Sediment Phosphorus Load - the relative contribution of internal sources of total phosphorus within East Pond - in terms of sediment recycling - were analyzed (using **lake volume-weighted mass differences** between early and late summer) and estimated on the basis of Maine DEP water column TP data from 1987-1988-2000 and Colby College water column TP data from 1999. These were the only years for which adequate lake profile TP concentration measures were available to derive estimates of internal lake loads. Amongst these years, **nuisance algae blooms were experienced** in the summers of *1987 and 1999*, when internal total phosphorus load estimates ranged from 264 *(1987)* to 547 *(1999)* kg (average 406 kg). In contrast, internal TP load estimates from the summers of *1988 and 2000* - **non-nuisance algae bloom summers**, ranged from 187 *(2000)* to 318 *(1988)* kg (average 253 kg). It appears that the internal TP loading within the sediments of East Pond (253 to 406 kg) generally approximate the lakes capacity for in-lake total phosphorus processing (389 kg) - or approximately 400 kg annually.

The East Pond (combined) internal and external total phosphorus loads approximate 900 kg annually - less the 400 kg from in-lake processing capacity, which equals ca. 500 kg as the amount of TP needed to be reduced to attain suitable water quality standards. This reduction in total phosphorus may be attained over time given continued reductions in external watershed TP loadings leading to the necessary reductions in internal sediment TP loadings within East Pond.

5. WASTE LOAD ALLOCATIONS (WLA's)

As there are no known existing point sources of pollution in the East Pond watershed, the waste load allocation for all existing and future point sources is set at 0 (zero) kg/year of total phosphorus.

6. MARGIN OF SAFETY (MOS)

An **implicit** margin of safety was incorporated into the East Pond TMDL through the conservative selection of the numeric water quality target, as well as the selection of relatively conservative phosphorus export loading coefficients for cultural pollution sources (Table 1). Based on both East Pond historical records and a summary of statewide Maine lakes water quality data for non-colored or < 26 SPU lakes - the target of 15 ppb (389 kg TP/yr in East Pond) represents a fairly conservative goal to assure attainment of Maine DEP water quality goals of non-sustained and repeated blue-green summer-time algae blooms due to NPS pollution or cultural eutrophication. The statewide data base for naturally colored Maine lakes indicate that nuisance algae blooms (plankton growth of algae which causes Secchi disk transparency to be less than 2 meters) are more likely to occur at 18 ppb or above. A range of 15 to17 ppb (389 to 440 kg TP/yr in East Pond) is unlikely to result in nuisance algae blooms, as was evidenced during the summer of 2000. The difference between the in-lake target of 15 ppb and 17 ppb represents a 12% implicit margin of safety (440 - 389 = 51/440 = 11.6).

7. SEASONAL VARIATION

The East Pond TMDL is protective of all seasons, as the allowable annual load was developed to be protective of the most sensitive time of year – during the summer, when conditions most favor the growth of algae and aquatic macrophytes. With an average hydraulic retention time of 4 years, the average **annual** phosphorus loading is most critical to the water quality in East Pond. ME-DEP lake biologists, as a general rule-of-thumb, use more than five to six flushes annually (bi-monthly) as the cutoff for considering seasonal variation as a major factor in the evaluation of lake total phosphorus loadings to lakes in Maine. Also, the Best Management Practices (BMPs) already implemented and proposed for the East Pond watershed have been designed to address total phosphorus loading during all seasons.

8. TMDL WATER QUALITY MONITORING PLAN

Historically, the water quality of East Pond has been monitored via measures of Secchi disk transparencies during the open water months since 1975 (Bob Joly, VLMP and East Pond Association). Water chemistry data (pH, total alkalinity, specific conductance, color, dissolved oxygen-temperature/depth profiles, and chlorophyll-a) were collected in eight of the years, while phosphorus grabs were collected in one-half of the 26 years of record. Continued long-term water quality monitoring within East Pond will be conducted, between the months of May to September, through the continued efforts of VLMP in cooperation with Maine DEP. Beginning in the late spring – early summer of 2001, deep hole basin parameters will be monitored on a monthly basis, including: Secchi disk water transparencies, dissolved oxygen and temperature profiles, total phosphorus, and chlorophyll-a. Under this planned water quality-monitoring scenario, sufficient data will be acquired to adequately track seasonal and inter-annual variation and long-term trends in water quality in East Pond.

9. NPS/BMP IMPLEMENTATION PLAN and REASONABLE ASSURANCES

East Pond is a waterbody whose water quality is currently impaired mostly by nonpoint sources (see LA's and WLA's), hence, reasonable assurances that total phosphorus load reductions will be achieved are not required for the TMDL to be approved by EPA (U.S. EPA 1999). However, States and Tribes are strongly encouraged to provide reasonable assurances regarding achievement of load allocations in their implementation planning efforts. An updated listing of high priority non-point source (NPS) problem sites found during the Maine DEP - Belgrade Regional Conservation Alliance watershed survey and MACD watershed inventory is available from Maine DEP and the Belgrade Regional Conservation Alliance (BRCA 1999). **Specific recommendations** (Best Management Practices or BMPs) and actions taken for the reduction of external total phosphorus loadings to improve water quality conditions in the East Pond and Serpentine Stream watersheds are as follows:

1) Residential - Thirty-four residential sites (including 5 driveways and 6 beaches) contributing phosphorus runoff have been identified through NPS watershed survey work (Belgrade Regional Conservation Alliance) during the spring and summer months of 1999. Of these 34 sites, 13 are considered to have a medium impact while the remaining 21 are considered to have a low impact. However, since many (23) of these sites have direct flow to lake, the cumulative impact of these sites may require consideration for a high impact rating. Problems that are typical for residential sites include lack of adequate buffers, patches of bare soil, shoreline erosion, slight to moderate surface erosion on driveways and clogged driveway culverts. Twenty-seven of the 34 residential BMPs are low cost and need minimal technical guidance.

To date (February 2001), 9 low-tech residential buffer strip projects and two shoreline demonstration buffer strip projects have been implemented by the Belgrade Lakes Conservation Corps and the East Pond Association. Other efforts to address NPS pollution by the Association include public education efforts through a buffer strip workshop, an educational newsletter and web site, and by working closely with the Conservation Corps on BMP implementation. Association objectives for 2001 include mitigating residential sites identified in the 2000 watershed survey using available funding sources, including the East Pond Association's "Preservation Fund", landowner contributions and 319 monies. In order to address the remaining residential sites, efforts should continue to educate East Pond watershed residents as well as making landowner contacts and marketing the availability of Conservation Corps labor and potential 319 monies.

2) Shoreline Septic Systems - Old and poorly designed and installed septic systems within the shoreland zone may contribute significantly to water quality problems, adding to the cumulative phosphorus load to the lake. To identify problematic systems, the Association's Septic Task Force conducted a septic system survey (December 2000) to ascertain the current state of septic systems on the shoreline. The mailing included informational publications to further

educate property owners about system maintenance and its effects on water quality. Educational efforts should continue as well as providing incentives to encourage replacement of inadequate systems or system upgrades. Based on response rates and data collected, the East Pond Association Task Force may decide to follow up with a door-to-door survey and/or hire a professional site evaluator to address potential septic system problems.

3) Roadways - Of the 62 potential NPS pollution sites identified in the combined East Pond and Serpentine watershed survey work, 14 relate to state (4), town (3), and camp or private (7) roads. Specific roadway problems include inadequate design and maintenance causing surface, shoulder and ditch erosion, unstable culvert inlets and outlets, and clogged culverts. Of the 16 road sites, 1 site was determined to have a high impact on East Pond, 5 with a medium impact, and the remaining 10 sites potentially have a low impact.

State and Town Roads

Problems that are encountered on roadways in the East Pond watershed are generally more complex and costly to repair than residential sites. Suggested mitigation work includes culvert maintenance, reshaping ditches and erosion controls, i.e., rip-rapping culverts and ditches. To date (February 2001), one town (medium impact) and the two state road sites (one medium, one high impact) identified during the East Pond watershed survey have been mitigated. The remaining town road site in the East Pond watershed has been identified by the BRCA as a potential NPS demonstration BMP site with available 319 monies.

Private and Camp Roads

Camp/private roads can contribute significant amounts of phosphorus and sediments to waterbodies. Most were designed for seasonal use and are now being used year-round, with gravel surfaces and significant slopes for at least a portion of their length. The most prevalent problem with camp roads is chronic erosion due to poor location, design and maintenance. The East Pond Association has formed a Roads Task Force that has worked to educate private/camp road owners on proper design and maintenance by distributing

copies of the Camp Road Manual (KCSWCD). Mitigation on private/camp roads to date (February 2001) has been limited. Educational efforts about proper road design and maintenance should continue. Also, efforts should be made to communicate with residents about identified private road sites with the potential for cost-share 319 monies. The KCSWCD and the BRCA have both earmarked 319 funds for NPS demonstration sites to include medium to high impact sites and to include town and private roads for NPS mitigation.

4) Shoreline Commercial - Two youth camps and two rental cottage operations are located on the shores of East Pond and are areas of high-intensity use. During the watershed survey, 8 commercial sites were identified as potentially having low (2), medium (5), and high (1) impacts on East Pond. The sites vary in land use and include beaches (3), a boat ramp (1), a camp (1), a basketball court (1), a driveway (1) and patches of bare land (1). At least 3 sites (2 medium, 1 high) have been mitigated with the help of the Conservation Corps. All of the commercial camp owners are receptive to working on BMP implementation for identified sites. To ensure continued cooperation and BMP implementation, additional communication efforts should be made with summer recreational camp owners to be sure they are aware of the identified sites as potentially impacting East Pond and the potential for 319 cost-share funds and labor provided by the Conservation Corps.

5) Agriculture - The East Pond and Serpentine watershed survey identified one agricultural site, and the MACD (2000) identified one additional agricultural site as potentially contributing excess amounts of phosphorus in the Serpentine watershed. Potential problems related to both agricultural sites involve direct livestock access to tributaries. Recommended BMPs include fencing to control livestock from directly accessing surface waters. The sites have a potentially high impact to Sucker Brook, a tributary to Serpentine Stream. The cost to implement BMPs on these sites will most likely fall in the “medium” range with a technical level in the “low” range.

Mitigation of soil erosion problems may be accelerated through the efforts of the Somerset County Soil and Water Conservation District (SCSWCD) and the USDA Natural Resources Conservation Service (NRCS). Landowners of identified sites are not currently "active" cooperators with the District. Therefore, efforts will be made by the NRCS to consult with and direct them to available assistance and potential funding for implementation, and to offer technical assistance to aid in the installation of BMPs.

6) Other - This category includes the remaining multiple land uses that have been identified as contributing NPS pollution to the watershed. The other 5 identified sites include boat ramps (2), a snowmobile trail (1), a man-made pond (1), and a stream bank (1). These sites have a medium to low impact on East Pond. The cost and technical level to install BMPs depends entirely on each individual site, but none of the 5 sites rank as high cost or high technical level to install. Potential BMPs recommended include various erosion controls, including rip-rap, seeding/mulching and new surface material, and slope stabilization for the boat ramps. To date, mitigation work has not commenced on any of the "other" sites within the watersheds. Again, landowner contacts should be made with potential 319 cost-share funding.

Relative to External Phosphorus Loading: Maine DEP is confident that a combination of these NPS/BMPs, taking into account continued implementation of shoreline residential BMPs - and improved septic system management in high density residential areas - will provide a significant overall reduction in the total phosphorus loading to East Pond - to help achieve and maintain water quality standards. Agriculturally-based BMPs should also be implemented in the indirect drainage of Serpentine Stream to minimize the further deleterious effects of periodic backflushing. This contention is strongly supported by Maine DEP's existing Nonpoint Source Pollution (NPS) Control Program Upgrade and 15 Year Strategy Plan, which was approved by EPA-New England on October 13, 1999. This plan, recognized by the EPA Washington office as "among the best" in the nation, outlines many realistic, yet aggressive, short and long-range goals and

actions aimed at the reduction of pollution from major nonpoint sources, including forestry, transportation, agriculture, and development. This statewide NPS/BMP plan relies on strong partnerships and offers a commitment to provide outreach and technical assistance in priority NPS watersheds. East Pond is on both the 1998 303(d) TMDL list and Maine's NPS priority watersheds list, and has been given priority for funding under the implementation of Maine's 319 portion of the NPS program.

East Pond Shoreline Erosional Survey

The 2000 Colby College study conducted a shoreline evaluation of buffer strip composition using a rating system. Shoreline segments were evaluated in terms of vegetated buffer depth from shore, percent lakeshore coverage, slope between shoreline and house, composition of buffer strip (trees, shrubs, grass, flowers), necessity of riprap, and lot - shoreline distance. Buffer strips were rated on a scale of high to low risk. Out of 183 properties surveyed, 50 were evlauated as high risk, 74 as moderate risk, and 59 as acceptable or low risk. Areas of immediate concern included shorelines surrounding Brickett Point, the west side of Libby Point, and the north side of East Pond (= Serpentine Stream drainage). Areas of concern due to high-risk roadways combined with high-risk buffer areas included the shoreline of Brickett Point, just northeast of Brickett Point, and a significant portion of the south and northwest shorelines (Colby College 2000).

Current 319- NPS/BMP Projects

- #2000R-36 Load Abatement for the Salmon-McGrath and East Pond Watersheds - Phase I, through the KC-SWCD. 319-funded soil erosion BMPs for identified NPS sites from watershed surveys, to begin summer of 2001 through January of 2002.

- The BRCA has applied for funding to the Maine DEP for Nonpoint Source Pollution Remediation Projects in the East Pond and North Pond Watersheds. The grant monies will be used to address remediation projects on specific

sites that will correct serious problems and serve as BMP Demonstration Sites for educational purposes. The project is proposed to begin in April 2001 and run through April 2003. There has been preliminary approval of $60,000 matching grant, to be shared with North Pond (Mike Little proposal, 9/13/00). The Great Pond Watershed Management Plan is to be completed by the BRCA by April 2001.

10. PUBLIC PARTICIPATION

Adequate ('full and meaningful') public participation in the East Pond TMDL development process was ensured through the following avenues:

1. ME-DEP Lakes TMDL Project Manager (Dave Halliwell) participated in the annual 1999 East Pond Association summer meeting attended by 50 or so lakeshore residents and provided a general briefing on the lake TMDL developmental process.

2. ME-DEP Lakes TMDL Project Manager (Dave Halliwell) and MACD project personnel (Jodi Michaud) participated in the annual 2000 East Pond Association summer meeting attended by 40 to 50 lakeshore residents. A general briefing was provided on the status of the East Pond TMDL process and in-lake water quality monitoring updates. TMDL and Watershed Inventory project information sheets were distributed as well (Appendix D).

3. During the summer and fall of 2000, MACD project personnel - particularly East Pond coordinator Jodi Michaud - paid numerous visits to town offices in the watershed and to the BRCA as well as numerous contacts with members of the East Pond Association and both the Somerset and Kennebec County SWCD-NRCS offices in order to compile necessary watershed inventory information.

4. A meeting at the ME-DEP was attended by members of the East Pond Association Septic Task Force along with ME-DEP Lakes TMDL Project Manager (Dave Halliwell), DEP staff member Richard Green, and MACD East

Pond coordinator Jodi Michaud, to discuss a septic system survey and potential funding sources.

5. An East Pond Association Board meeting was held on January 17, 2001, and was attended by Jodi Michaud (MACD personnel) to discuss status of the TMDL report and, more specifically, the data obtained with the December 2000 septic system mail survey.

A preliminary review draft TMDL was prepared and distributed to selected East Pond watershed stakeholder groups, inclusive of the following: East Pond Association (Cindy Reese, Jerry Tipper, and Bob Joly); Somerset County SWCD (Nate Sylvester) and NRCS (Kevin White); Kennebec County SWCD (Melissa Halsted); and the Belgrade Regional Conservation Alliance (Mike Little), as well as Dr. David Firmage of Colby College. Following preliminary review, paper and electronic forms were made available of the final draft TMDL report, including 'legal' advertising in local newspapers, posting on the ME-DEP Internet Web site, and through normal ME-DEP advertising procedures (information and education). The following ad was printed in the Waterville Morning Sentinel, the Kennebec Journal, and Bangor Daily (Weekend) News over the weekend: April 7-8, 2001:

> 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-Annual Load (TMDL) nutrient report (DEPLW 2001-10) for total phosphorus for East Pond, located in Oakland, Kennebec County and Smithfield, Somerset County. This report identifies and estimates point and non-point source total phosphorus loadings within the East Pond watershed and reductions required to establish and maintain acceptable water quality standards. A final review draft of the report may be viewed at the Maine DEP Central Offices in Augusta (Ray Building) or on-line at: http://www.state.me.us/dep/blwq/update.htm. Click on "Public Comment Opportunities." Send any comments, in writing by May 4, 2001, to David Halliwell, Lakes TMDL Project Leader, ME-DEP, State House Station #17, Augusta, ME 04333. 207-287-7649 or e-mail: david.halliwell@state.me.us.

East Pond TMDL Project Summary

East Pond is very fortunate - it has active organizations in place to deal with water quality issues, and years of land use and water quality data compiled as a result of volunteer monitoring efforts, in addition to studies conducted by Colby College. These latter studies offer a wealth of detailed land use information for the past decade (1991-1999). The East Pond Association is an impressive and very active group that does a good job of promoting water quality issues. The Belgrade Regional Conservation Alliance, staffed by a Watershed Program Coordinator, offers a framework for future implementation of BMPs. The BRCA has been working on a Belgrade Lakes Watershed Management Plan, with 319 funding, that includes East Pond. There is also a Belgrade Lakes Conservation Corps, which offers assistance with implementing BMPs during the summer months. Everyone contacted in the development of this lakes TMDL report was helpful and knowledgeable about East Pond and lake water quality in general.

Acknowledgments

In addition to Maine DEP and US-EPA Region I staff (guidance), the following individuals and groups were instrumental in the preparation of this **East Pond Total Maximum Daily Load** report: MACD - Jodi Michaud and Forrest Bell; Kennebec and Somerset County SWCD and NRCS offices and personnel - with a special thanks to Rob Mohlar (KC-SWCD) for assistance with GIS applications; Mike Little (BRCA) and Ilana Hobson (BLCC); East Pond Association (Cindy Reese, Bob Joly, Jerry Tipper, Paul Lenfest, Ed Cornwall); Carter Minkel and Martha Kaiser (Alden Camps for their hospitality and volunteer lake sampling and dam monitoring efforts); watershed town managers, CEOs, and office personnel - including: Nicki Clark (Smithfield), Virginia Joseph and Bob Ellis (Oakland). Also, thanks to Dr. David Firmage and his Colby College students for their excellent East Pond research and reporting efforts in 1991 and 1999.

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APPENDIX A

East Pond 2001 VLMP
Maine DEP Water Quality Update

APPENDIX B

BRCA East Pond & Serpentine Stream
Nonpoint Source Pollution Survey

MACD Watershed Stakeholder Groups

APPENDIX C

East Pond Association
Septic System Survey
Newsletter Article (Spring 2001)
(Non-Digital Format Only)

APPENDIX D

MACD Watershed Inventory
&
NPS/BMP Feasibility Study

APPENDIX E

Preliminary Stakeholder and
Final Public Review
Comments Summary

APPENDIX A

WATER QUALITY SUMMARY

East Pond, Smithfield and Oakland
Midas: 5349, Basin: Primary

The Maine Department of Environmental Protection (ME-DEP) and the Volunteer Lake Monitoring Program (VLMP) have collaborated in the collection of lake data to evaluate present water quality, track algal blooms, and determine water quality trends. This dataset does not include bacteria, mercury, or nutrients other than phosphorus.

Water quality monitoring data for East Pond has been collected since 1975. During this period, 12 years of basic chemical information was collected, in addition to Secchi Disk Transparencies (SDT). In summary, the water quality of East Pond is considered to be below average to poor, based on measures of SDT, total phosphorus (TP), and Chlorophyll-a (Chla). The potential for nuisance algal blooms in East Pond is moderate to high.

Water Quality Measures: East Pond is a non-colored lake (average color 16 SPU) with an average SDT of 4.4m (15.5ft); some readings hit bottom. The range of water column TP for East Pond is 12-29 parts per billion (ppb) with an average of 20 ppb, while Chla ranges from 1.7-23.0 ppb with an average of 8.3 ppb. Recent dissolved oxygen (DO) profiles show minimal DO depletion in deep areas of the lake, however, East Pond is not a very deep nor strongly thermally stratified lake. The potential for TP to leave the bottom sediments and become available to algae in the water column (internal recycling) is high, due primarily to the effects of wind disturbance.

The flushing rate is the amount of time required for the lake water to be renewed each year. The average flushing rate is about 1-1.5 flushes per year for Maine lakes. The flushing rate for East Pond is 0.25 flushes per year (flushes once every 4 years).

Comments: East Pond is at the top of the Belgrade lakes drainage system and flows directly into North Pond via the Serpentine Stream outlet dam. It is on the DEP-TMDL list of lakes most at risk from developmental pressures and has been intensively studied by the Colby College biology program in 1991 and 1999. Their 1999 study includes recommendations for addressing land use impacts and lake improvements. Belgrade Regional Conservation Alliance (BRCA) with help from DEP conducted a watershed survey in 1999. BRCA, through funding from EPA, will be developing a watershed management plan for the Great Pond

watershed which includes East Pond. ME-DEP, with assistance from MACD, will be completing a lakes TMDL study on East Pond during the spring of 2001.

APPENDIX B

East Pond Watershed Survey - March 2000

This survey is part of a larger effort by the BRCA to develop a Watershed Management Plan for the Belgrade chain of lakes - with funding from the ME-DEP to conduct the survey and to develop the watershed plan. The survey was conducted during the spring, summer and fall of 1999 - with the report issued in March of 2000, under the guidance of the BRCA Watershed Program. This survey covered both the East Pond and Serpentine Stream watersheds. The Serpentine Stream is technically the outflow for East Pond, which drains into North Pond, but due to backflushing, it was included in the watershed survey for East Pond. The area was divided into five sectors, four in East Pond and one in the Serpentine Stream watershed. Survey teams of 2 to 3 people conducted the survey during May, June and July with follow-up by BRCA staff in the fall. The watershed report on the survey outlines problems and suggests remedies for erosion sites identified around the lake.

East Pond

Fifty-five sites were identified in the EP watershed as potentially contributing to the decline in water quality. Site breakdown: 21 residential, 5 driveways, 6 beaches, 7 private roads, 2 state roads and 2 town roads, 2 boat ramps, 8 commercial, 2 “other”. Over two-thirds of the sites are directly associated with residential development in the watershed. Of the 54 sites identified, 49 are considered a low technical level for remediation, with the remaining sites at the medium technical level. On 38 of the sites (70%), remediation costs were estimated to be less than $500, 14 sites estimated to cost between $500 and $2500, the remaining 3 (all private roads) were estimated to cost more than $2500. Total dollar estimate placed on all remediation to be approximately $70,000. There were about 20 sites that the technical staff was unable to follow-

up on due to gated roads and no trespassing signs. The survey concluded that the greatest source of P-containing runoff is from residential development.

Serpentine Stream

The Serpentine Stream watershed is located primarily in Smithfield, but its drainage area also stretches into Norridgewock. This area is mostly upland and wetland with no shoreline on East Pond. Seven sites identified as potentially contributing to declining water quality, all rated as low priority. **Site breakdown**: 1 agricultural, 1 "other" (earthen dam), 2 residential, 2 state roads, 1 town road. All roads were rated at a medium technical level, all other sites were rated as low. Total dollar estimate placed on all remediation to be at $7,500.

East Pond Association

The East Pond Association (the Association) has 184 paying members (W. Hamm, Assn. treasurer). One-third to one-half of the Association membership is actively involved, either on the board, various committees or as volunteers for numerous tasks. There are various task force committees as part of the Association, including committees for roads, septic, buffer strips, in-lake remediation and the dam.

After Colby issued its 2000 study and the BRCA released the results of the 2000 Watershed Survey, 15-16 members of the EPA board members attended a weekend retreat. The purpose of the retreat was to review the findings of the two reports and report back to the membership. The EPA also hosted a buffer strip workshop, attended by 30-35 people, and conducted by a paid speaker from the Volunteer Lake Monitoring Program.

The Association does a good job of promoting lake water quality issues by maintaining an informative web site and publishing a newsletter at least quarterly. The newsletter is mailed to 358 residences, regardless of whether or not they are members of the Association (Seaman, pers. comm.). The mailing list includes municipal officials and homes not on the shoreline. An estimated 50% of

shoreline landowners are members of the EPA (Cindy Reese, personal communication).

Due to growing concerns with lake water quality, the Association began fund-raising efforts in December of '98 for its Preservation Fund. Donations were mostly made by members of the Association, totaling $35,000 by the spring of 1999. The Fund is used for anything related to remediation; for example, the Colby study undertaken in 1999, anchors for wake buoys to slow the boats, efforts to remove the algae from the lake during the 1999 bloom, and buffer strips along the shoreline. To date, approximately 12 to $15,000 have been spent and donations are made ongoing as members pay their annual dues. Future funds will be made available for possible septic system updates as they are identified with the upcoming survey scheduled for the fall of 2000 and for possible in-lake remediation.

During the summer of 2000, the Association worked on addressing low-tech buffer strip projects, and hoped to complete six demonstration projects and to address as many residential sites as possible by the end of the summer. While the Conservation Corps worked on various projects in the East Pond watershed (11), East Pond residents also took the initiative to plant buffer strips without the help of the Conservation Corps. At least a dozen landowners on Brickett Point alone had done buffer strip plantings (Reese, pers. comm). The Association has been very active addressing issues raised in the watershed survey report and bringing attention to other problems that have arisen since the reports were written (Mike Little, 9/13/00 Proposal).

The EPA is exploring various in-lake remediation techniques. This will involve analyzing water and lake sediment to explore the efficacy of vegetative mats and the potential for biological remediation (Jerry Tipper, personal communication).

Belgrade Regional Conservation Alliance (BRCA)

The BRCA works throughout the Belgrade Lakes chain and is in the process of developing a watershed management plan for the upper third of the chain - 5 lakes - to be completed by January 2001. The 5 lakes are in five towns, with each lake being shared by at least two towns. It is the goal of the BRCA to encourage these towns to look beyond town borders and to think in terms of watershed boundaries. The BRCA works with the individual lake associations and the towns, and is currently trying to pull together a commission that will focus on land use and watershed issues. This Lakes Commission would be made up of people representing the selectmen from each town within the watershed and would be facilitated by the BRCA (Mike Little, personal communication).

Belgrade Lakes Conservation Corps (BLCC)

The Belgrade Lakes Conservation Corps was formed in 1994 and is sponsored by the Belgrade Regional Conservation Alliance. The BLCC is funded primarily through volunteer fundraising efforts as well as funds from each town within the watershed, as well as each lake association. For East Pond, donations to the BLCC were generated from the Towns of Smithfield and Oakland and the East Pond Association. Local support for the Corps has exceeded $120,000 in the past five years (for all the Belgrade Lakes). The BLCC hires high school students during the summer to work on NPS BMPs. The cost of installation is on a cost-share basis with the landowner paying for materials and the BLCC providing the labor. During the summer of 2000, the BLCC installed 100 BMPs on 57 properties within the Belgrade Lakes, with 11 located on East Pond. The BLCC is a provider of technical information and an educator for NPS issues.

APPENDIX C

East Pond Association

Septic System Survey

Newsletter Article (Spring 2001)

(Non-Digital Format Only)

APPENDIX D

EAST POND and SERPENTINE STREAM

Watershed Inventory and Best Management Practices Feasibility Study for Reducing NonPoint Source (Phosphorus) Pollution in Selected Maine Lakes

This study is funded through US-EPA and implemented by ME-DEP to supplement current landuse and watershed survey information - to help us characterize the entire watershed and better define what the sediment and phosphorus sources are, where they are located in the watershed, and to evaluate the potential for implementation of BMPs.

This study will be carried out by highly trained natural resource professionals working with the Maine Association of Conservation Districts (MACD) in cooperation with area County Soil and Water Conservation Districts, Town Offices, and Lake Associations.

The lake-watershed related information gathered in this study is needed to complete Total Maximum Daily/Annual Load (TMDL) reports, including total phosphorus export loadings/models and provisions for reasonable assurances in meeting load reductions through implementation of BMPs.

An additional six lakes will be studied this spring and summer, including: China Lake, Androscoggin Lake, Mousam Lake, Unity Pond, Androscoggin Lake, and Pleasant Pond. The draft TMDL for East Pond - Serpentine Stream is scheduled for completion by mid-March 2001, so has top priority.

Initial objectives are to complete partial watershed surveys, including: type and extent of agricultural/forestry practices, density of human habitation (residential use) around the lakeshore, measures of types of roads (paved and dirt) & septic system - shoreline erosion phosphorus loading estimates.

All lakes-watershed information gathered will be handled in a confidential manner, similar to previous ME-DEP sponsored watershed survey projects. The object of this project is to promote longterm lake protection efforts.

APPENDIX E

Preliminary Stakeholder & Final Public Review Summary

Aside from the U.S. EPA official review, only a few minor written comments were received during both the 10-day (March 22 to April 4) preliminary stakeholder and the 30-day (April 7-8 to May 4) final public review period from the following individuals and groups.

Mike Little, BRCA Watershed Program Coordinator - reviewed the preliminary draft and provided minor informational edits.

Mike Roy, Oakland Town Manager (April 10, 2001 e-mail correspondence) Telephone conservation 4-24-01. Did not wish to submit official comments, however, stated that "they were very willing to work closely with Maine DEP and EPA in implementing NPS/BMPs to reduce total phosphorus loading to East Pond and restoring suitable water quality conditions".

The East Pond TMDL also stimulated an indirect response (in reference to a DEP draft 305b report) from the Maine Department of Conservation - Forest Service (see attached letter) and a general overview and critique of the lakes TMDL process relative to the derivation of total phosphorus (estimates) from forested areas in Maine & the Northeast - see attached e-mail correspondence. In the final analysis, fairly low total phosphorus loading coefficients of 0.04 kg/ha were used for unmanaged (non-commercial) forest lands - similar to what was used in previous Maine lake TMDL studies (i.e., Sebasticook Lake 2001).