APPENDIX B

Crosswalk between the Vermont Phase 1 Plan and EPA's BMP scenario identifying achievable phosphorus reductions

This document includes the following information:

1) A description of the level and type of BMPs simulated in the TMDL Scenario, presented in the form of a matrix with some additional text explanation;
2) References to where in the Phase 1 Plan are the bases for the level and types of BMPs simulated; and
3) The estimated phosphorus reductions from the scenario used by EPA to determine what level of reductions was achievable in each watershed.

A matrix summarizing the level of BMP implementation simulated in the Scenario Tool for each phosphorus source sector is included near the end of this appendix (Table B1). The basis in the Phase 1 Plan for the type and level of BMP implementation entered into the Scenario Tool to estimate phosphorus reductions is described for each sector below. A summary of the resulting phosphorus reductions generated by the Scenario Tool for each lake segment watershed (Table B2) is included just below Table B1.

Developed Lands

The Phase 1 Plan (and the new Vermont Clean Water Act) establishes several new permit programs that will require retrofits to reduce loadings from existing developed lands.

Roads

One permit program will address loads from all municipal roads, and another permit program will address loads from all state roads. The road permit programs will require retrofits to "achieve the necessary level of pollutant reduction to meet TMDL targets." For municipal roads, the Phase 1 Plan further indicates that the permit will require a management plan that will design BMP requirements that take into account factors such as hydrologic connectivity to waterbodies. The permit for state roads will similarly require development of a management plan specifying the type and extent of BMPs needed. Given these provisions in the Phase 1 Plan, EPA simulated the effect of retrofitting 100% of hydrologically connected portions of unpaved roads (a subset of the roads to be addressed by the municipal roads permit) in all lake segment watersheds. For paved roads, in all lake segment watersheds other than Missisquoi Bay and South Lake B, EPA simulated surface infiltration retrofits to 25% of paved roads on A and B soils assuming treatment for a 0.5 inch runoff depth (note that some segment watersheds don't include any paved roads on A and B soils), which is a moderate level of retrofits considered well within the range of effort anticipated for the roads permit programs. For South Lake B, EPA simulated retrofits to 25% of paved roads on A and B soils (using the surface infiltration practice), and assumed a runoff depth of 0.9 inches. For Missisquoi Bay, EPA simulated retrofits to 50% of paved roads on A and B soils (using the surface infiltration practice), and assumed a 0.9 inch runoff depth, as greater phosphorus reductions are needed in this lake segment watershed. The Phase 1 Plan's statement that both road permit programs will "achieve the necessary level of pollutant reduction to meet TMDL targets" provides assurance that phosphorus load reductions equivalent to this level of retrofits will be required by the permit.

Non-road impervious

The existing developed lands general permit included in the Phase 1 Plan will require retrofits to all existing impervious surface parcels 3 acres or greater, and can include smaller parcels as needed to meet the TMDL allocations. Initial analyses indicate that the 3 acre and greater parcel universe specified in the Phase 1 Plan (and Act 64) represents about 13% of the non-road impervious surface (Tetra Tech, 2015e). This level of retrofits aligns well with the 10% of non-road impervious area simulated for retrofits in the Scenario Tool for the following lake segment watersheds: Otter Creek, Main Lake, Shelburne Bay, Burlington Bay, Mallets Bay, and St. Albans Bay. The following small direct drainage lake segment watersheds contain very little non-road impervious area and contain very few (if any) parcels that meet the 3 acre parcel definition in Act 64 and the Phase 1 Plan: Isle LaMotte, Northeast Arm, Port Henry, and South Lake A. Accordingly, EPA did not simulate any non-road impervious cover retrofits for these segments, and the developed land WLAs for these segments were set at a level that would require retrofits to reduce only the amount of phosphorus projected to be generated by new growth – a level significantly less than that equivalent to retrofitting 10% of impervious area in all cases. For South Lake B and Missisquoi Bay, EPA simulated a higher level of impervious area retrofits, as more overall reductions are needed in those lake segment watersheds. EPA simulated retrofits to 25% of impervious area in the South Lake B watershed and 60% for Missisquoi Bay, on A, B, and C soils, and assumed treatment of the 0.9 inch runoff depth. While this level of reduction will likely require retrofits of parcels smaller than 3 acres, Act 64 directs the VTANR to require permits (and retrofits) for any size impervious parcel needed to achieve the wasteload allocation of a TMDL, and directs the agency to require permits for stormshed areas (more densely developed areas outside MS4 areas) as needed as well. Note that the State also has the option of adjusting the amount of reductions needed through any individual permit program as long as the total reductions achieved across all stormwater permit programs results in the developed land wasteload allocations being met. As an example, the State could choose to achieve more reductions than EPA simulated from the permit programs that address paved roads, by choosing to include retrofit requirements for some road segments over C soils.

Agricultural Land

For all lake segment watersheds other than Missisquoi Bay, EPA simulated reductions from agricultural land using the following suite of practices and levels of treatment, referred to as the Enhanced BMP Scenario.

1. Non-clay soils: the combination of cover crops, conservation tillage, grassed waterways, ditch buffers, and riparian buffers applied to 80% of cropland in continuous corn and corn-hay on A, B, and C soils.

2. Non-clay and clay soils: riparian buffer applied to to 80% of hay areas.

3. Non-clay and clay soils: livestock exclusion and riparian buffer applied to 80% of pasture lands.

4. Clay soils: cover crops, conservations tillage, grassed waterways, ditch buffers and riparian buffers applied to 40% of corn and corn-hay cropland.

5. Clay soils: changes in crop rotation, grassed waterways, ditch buffers, and riparian buffers applied to another 40% of corn and corn-hay cropland.

6. Barnyard management applied to 90% of farmsteads.

7. Crop to hay (conversion of cropland to continuous hay) for 20% of the corn and corn-hay HRUs on clay soil with slopes above 5%.

Definitions of these practices and explanations of the phosphorus reduction efficiency selected are included in Tetra Tech (2015c).

Linkage of the simulated agricultural practices to the Phase 1 Plan

The Phase 1 Plan includes a suite of new required agricultural practices (“RAPs”, including 10 foot ditch buffers, 25 foot riparian buffers, gully erosion control, livestock exclusion from waterways, and reduced field erosion tolerance. The ditch buffer and riparian buffer practices were directly plugged into the scenario tool, assuming application to 80% of cropland fields as a conservative estimate. The livestock exclusion practice was also directly entered into the scenario, assuming application to 80% of pasture land, based on the provision in the Phase 1 Plan that requires livestock exclusion wherever livestock access is creating erosion and at all production areas, which the Phase 1 Plan indicates will address a “major portion” of the phosphorus load associated with livestock access to streams. EPA represented this major portion in the scenario run by applying livestock exclusion to 80% of applicable areas. The effect of the new gully erosion requirement was simulated with application of the grassed waterways practice to 80% of cropland. While grassed waterways are sometimes used to stabilize fields and prevent gully erosion, the new RAP requirements may often require more elaborate stabilization practices that will control phosphorus runoff more effectively than grassed waterways. So the use of grassed waterways in this context is a conservative assumption. The reduced field erosion tolerance to “T”, is a new more stringent requirement pertaining to the amount of soil allowed to erode off fields. The Phase 1 Plan also includes a new requirement for nutrient management (of varying types) on all farms. In order to comply with these new requirements, practices such as cover crops and conservation tillage will often be needed, along with other practices. EPA simulated the use of cover crops and conservation tillage on 80% of the cropland in non-clay soils, and 40% of the cropland in clay soils (where these practices are more difficult to implement) to estimate the effect of these new requirements. The crop to hay practice was simulated on a very small percentage of fields (just 20% of those on clay soils with slopes above 5%) as another potential outcome of the new erosion control requirements. Lastly, EPA simulated the effect of runoff from 90% of barnyards (also referred to as farmsteads) being better managed. The basis for this practice is in several sections of the Phase 1 Plan. The new certification requirement for small farms, combined with small farm inspections, is expected to result in much greater compliance with the previously existing elements of the required agricultural practices that address barnyard management. In addition, the medium farm operation permit program, which was implemented toward the end of the TMDL modeling period (2001-2010), requires the barnyard management practice as part of permit compliance. EPA (in consultation with federal NRCS and VTAAFM staff in VT) interpreted combination of these requirements to result in approximately 90% of barnyards being managed in accordance with the RAPs between the TMDL modeling period and the end of the TMDL implementation period.

EPA simulated the following increase in the level of practice application for the Missisquoi Bay lake segment watershed: riparian buffer and livestock exclusion were applied to 100% of pasture (rather than 80%), and riparian buffer was applied to 100% (rather than 80%) of continuous hay on C and D soils. There are several bases for these increases in the Phase 1 Plan. First, the Plan indicates that the Secretary of the Agency of Agriculture, Food and Markets may require livestock exclusion not only where there is an erosion problem but also wherever livestock access are causing a water quality problem. Given the magnitude of the reductions needed in this watershed, the fact that livestock access to waterways almost always causes a water quality problem (due to direct deposits of manure into the water, among other impacts) and the State's commitment in the Plan to assess every livestock operation in the Missisquoi watershed for water quality impacts, it is reasonable to conclude that livestock exclusion will eventually be implemented throughout the watershed. Similarly, based on the State's commitment in the Plan to assess every livestock operation, it is reasonable to assume that riparian buffers will be implemented everywhere they are required throughout the watershed.

EPA also simulated the effects of three more changes to the level of agricultural practices implementation in Missisquoi Bay: The use of ditch buffers on continuous hay fields, the use of 25 foot ditch buffers in some cases, and the use of the "reduced phosphorus manure" practice on all cropland. The basis for the ditch buffer simulation is in the Phase 1 Plan (one of the new RAPs), but the practice had not been simulated previously on continuous hay areas. The use of 25 foot ditch buffers is indicated as an option in the Phase 1 Plan where the 10 foot buffer width is deemed to be insufficient. EPA simulated this wider ditch buffer only on fields in corn-hay rotations on clayey soils (D soils), and fields -in continuous corn on C and D soils. The reduced phosphorus manure practice involves applying (in this case) 20% less phosphorus to cropland by either reducing the amount of manure applied, or by reducing the phosphorus content in the manure (as through livestock dietary changes). The implementation of practices comparable to this is anticipated to result from the nutrient planning requirements in the Phase 1 Plan.

The assumptions and calculations used to estimate the phosphorus load reductions from the practices simulated in the Scenario Tool are described in Tetra Tech (2015c).

Stream Corridors

As described in Tetra Tech (2015c), phosphorus reduction from streambank erosion was simulated by comparing the present load from eroding stream reaches with the estimated load associated with these same reaches once they are brought back to the more stable, equilibrium condition. For all lake segment watersheds other than Missisquoi Bay, EPA simulated the effects of restoring eroding reaches above either the 25th or the 50th phosphorus loading percentile. The basis for the simulation of restoration of eroding reaches at both these levels is in the commitments to stream corridor protection and restoration in the Phase 1 Plan. The Plan includes numerous measures that will enhance the natural evolution of unstable stream systems to the equilibrium condition, including floodplain protection and improved regulation of stream alterations. In Missisquoi Bay, EPA simulated the restoration of all reaches in the watershed. EPA concluded that all reaches in the Bay watershed were in need of restoration/stabilization because an analysis of stream evolution stage of each reach indicated that virtually all reaches were in an unstable evolution stage and not yet at equilibrium conditions (Tetra Tech, 2015c). The basis for the assumption that all reaches will, in fact, eventually be restored is in the State's additional commitments specific to Missisquoi Bay included in the Phase 1 Plan. For Missisquoi Bay, the Plan indicates that, in addition to the measures that apply state-wide, the State will: 1) put extra resources/effort into identification of opportunities for re-establishing connections to floodplains, and working with landowners to make these reconnections happen; and 2) invest extra resources/effort into identification of opportunities where active intervention in bank erosion processes could be most effective, and then implement practices as further described in Chapter 5, Section J of the revised Phase 1 Implementation Plan.

The assumptions and calculations used to estimate the phosphorus load reductions from the practices simulated in the Scenario Tool are described in Tetra Tech (2015c).

<u>Forest land</u>

EPA simulatedassumed a phosphorus reduction of 5% from forests in all lake segment watersheds other than South Lake B and Missisquoi Bay. It has been well documented that the primary sources of phosphorus export within the forest land sector are forest roads and harvest areas. The Phase 1 Plan specifies revisions to the accepted management practices (AMPs), which are required practices for forest activities. The revisions include practices that require improved erosion control at forest roads, and better management of harvest areas to avoid water quality impacts. The literature reports significant phosphorus reduction efficiencies for these types of practices (see discussion below on South Lake B and Missisquoi Bay); the 5% reduction assumed by EPA is easily supported by these measures.

For the South Lake B and Missisquoi Bay lake segment watersheds, where forest loads represent a large portion of the total phosphorus loads, EPA took a close look at the break-down of this load among sub-categories within the forest sector, and then at the effectiveness of forest management practices to address these sources. Once the potential reduction amounts were estimated for each watershed, EPA looked to commitments in the Phase 1 Plan to ensure that the needed BMPs were specified for these watersheds. The details of this analysis are described below for both of these lake segment watersheds. More detail is included here for this forest sector analysis than for the other source sectors (such as agriculture and stream corridors) because this analysis was conducted after the Tetra Tech (2015c) report was completed. That report (Tetra Tech, 2015c) includes the details of the how the reduction efficiencies were derived and applied for the other source sectors.

South Lake B: Partitioning forest phosphorus loads, and estimating achievable phosphorus reductions

The SWAT model developed for the Lake Champlain TMDLs by Tetra Tech (2015b) provided estimates of the total load from the forest sector in each lake segment watershed, but was not able to partition this total load into the forest sub-categories of forest roads, harvest areas, and undisturbed areas. The Total P base load from forests in the South Lake B watershed, estimated by the SWAT model = 16,345 kg/ha/yr. The total area of forestland in the South Lake B watershed is 44,985 ha. Based on Gucisky et al. (2001), it was assumed that 4.5% of the total forest area is made up of some type of forest road. Applying 4.5% to 44,985 ha yields 2,024 ha in forest roads. Using the same loading rate used for unpaved roads in the TMDL analysis for the South Lake B watershed (derived from Wemple, 2013), a phosphorus load from roads was calculated as follows: 2,024 ha x 5.6 kg/ha/yr = 11,334 kg/yr. The total base load of 16,345 kg/ha/yr – 11,334 kg/ha/yr = 5,011 kg/ha/yr. This leaves 5,011 kg/ha/yr to be split among “undisturbed” and harvest areas. Based on the VT Department of Forests, Parks and Recreation estimate that 1% of forest area is harvested in any given year, and the rule of thumb that harvest areas typically continue to generate elevated P loads for a period of two years after the harvest year (Dennis, 2015) -- especially when BMPs are not adequately implemented -- the amount of effective harvest area (or area that acts like harvest area in terms of P loading rates) was assumed to be 3% of the total, or 1,350 ha. Subtracting the effective harvest area (1,350 ha) and the road area (2,024 ha) from the total forest area = 41,611 ha of “undisturbed” forest (1,350 ha + 2,024 ha = 3,374 ha; 44,985 ha – 3,374 ha = 41,611 ha). The literature suggests that P loading rates from harvested areas without adequate BMP installation can be about 3 times the loading rates of “undisturbed” forests (Wynn et al., 2000). Based on ranges in the literature, 0.11 kg/ha/yr was selected as the loading rate for the undisturbed portion, and 0.33 kg/ha/yr for the harvested portion. These rates generate loadings of 4,577 kg/yr for the undisturbed forest (0.11 x 41,611 ha = 4,577 kg/yr), and 445 kg/yr for the harvest areas (0.33 x 1,350 ha = 445 kg/yr). The total estimated loads from roads, harvest areas and undisturbed area add up to 16,356 kg/yr, which closely matches (by intention) the SWAT estimated load of 16,345 kg/yr. Note that while there are some skid trails and small segments of truck roads in harvest areas, any double-counting of loads from forest roads would be minimal because the high forest road loads are caused mostly by the more established roads with some type of ditching, and there are typically very limited amounts of these type of roads in the harvest areas. In addition, the low loading rates used for harvest areas ensure that the effect of any double-counting would be very modest, and the slight increase in estimated loading would be within the literature range for forest road loading estimates.

The next step was to estimate reductions achievable from the road and harvest area portions, as the literature is clear that these are the areas within forests that contribute the bulk of the sediment and phosphorus loading to waterbodies. The total load from harvest and road areas within the South Lake B watershed is 11,779 kg/yr (11,334 kg/yr from roads + 445 kg/yr from harvest areas). The few controlled watershed studies in forested watersheds that measured the effectiveness of BMPs on phosphorus reduction have found that a comprehensive application of forest management BMPs to harvest areas has resulted in an 85 – 86% reduction of phosphorus loads from these areas (Edwards and Williard, 2010). Comparable controlled watershed studies have not been conducted specifically to evaluate the effectiveness of the combined effects of multiple forest road BMPs. However, a number of studies have measured the effectiveness of individual forest road BMPs, and many of these BMPs were found to achieve similar reduction efficiencies to the harvest area BMPs. While most of these studies evaluated sediment reductions rather than nutrients, studies that have assessed the effectiveness of both sediment and phosphorus have found a high correlation between the two (Wynn et al., 2001; Arthur et al., 1998). As reported in a synthesis compiled by Edwards et al. (2015), Witt et al. (2011) found an 84% efficiency for portable bridges, McLaughlin et al. (2009) found a 99% efficiency for fiber check dams, Wright (2010) found an 80% efficiency for rock check dams, and Kaighn and Yu (1996) found efficiencies ranging from 73 to 100% for vegetated swales with check dams. The efficiencies of forest buffers between forest roads and waterbodies have not been well studied, but Packer (1967) calculated that forest buffers from 9 to 46 meters could retain 85% of sediment flows from cross drains. The combined efficiencies would likely be higher than the individual BMP efficiencies, so an overall efficiency of 85% was used in the TMDL analysis both for forest roads and harvest areas. Applying the 85% efficiency rate to the 11,779 kg/yr from road and harvest areas reduces the load to 1,767 kg/yr. Combined with the undisturbed load, the total post-BMP load from the forested portion of the South Lake B watershed would be 6,344 kg/yr, which is a 61% reduction from the total original baseload of 16,345 kg/yr. In the Scenario Tool, a 60% reduction level was selected, as this was the closest reduction level available to choose in the Tool.

Missisquoi Bay: Partitioning forest phosphorus loads and estimating achievable phosphorus reductions

The same procedure was applied to the total forest load in the Missisquoi watershed, starting with the overall existing source load of 22,222 kg/yr coming from 118,441 ha of forest. The same percentages were used for forest roads (4.5%) and harvest areas (3%), and the existing loads were apportioned among road, harvest, and undisturbed areas as described for the South Lake B watershed. Applying the same reduction efficiencies yielded an overall percent reduction of approximately 60% as well.

Examples of BMPs employed/simulated

BMPs used in the controlled watershed projects to achieve the 85% reduction from harvest areas included: streamside buffer strips (at least 15 meters wide), minimization of road building impacts, use of water control structures (such as water bars) to divert water from skid trails to areas of undisturbed litter, seeding log landings with grass until replanting, retirement of roads and skid trails after logging, and use of a pre-harvest plan developed with the state forest agency

Examples of BMPs expected to achieve the 85% reduction from forest roads (when applied as part of a comprehensive forest road BMP program) based on the literature synthesis prepared by Edwards et al. (2015) include: portable bridges, fiber and rock check dams, vegetated swales with check dams, forest buffers, and properly constructed water control structures.

Linkage to the Phase 1 Plan

The revisions to the AMPs will require more effective use of water control structures on skid trails and truck roads, improved mulching and seeding procedures following soil disturbance, improvements to the forest buffer strip requirements (which are a minimum of 50ft, and hence well aligned with the 15m buffer width referenced above), and a host of more stringent standards pertaining to stream crossings. In addition, the Phase 1 Plan indicates the State's portable bridge program (which provides portable skidder bridges to loggers) now has capacity to cover the needs of the entire Missisquoi Bay watershed, and the State is increasing the capacity for other watersheds such as South Lake B. The State has also committed to an innovative LIDAR-based effort to identify erosion sites at abandoned forest roads, and prioritize these areas for restoration funding through NRCS or other sources. The program is being piloted in the Missisquoi watershed. The State is also committing two foresters to focus on the Missisquoi Bay and South Lake B watersheds to conduct outreach on the AMPs and improve compliance. This suite of new or improved forest management requirements or initiatives includes many of the practices found to be 85% effective either individually or as part of a comprehensive forest BMP program

<u>Wastewater Treatment Facilities</u>

The wastewater treatment facility loads used in the TMDL scenario were summed by lake segment watershed, based on the allocations proposed for each facility. The loads were calculated at design flow using effluent concentration limits described in the TMDL document and summarized in Table B1.

Table B1. Description of BMP level used in the scenario supporting the TMDL allocations

Lake Segment	Waste water	Developed Land	Back Roads*	Forest	Streams	Ag Prod. Areas	Agriculture**
1. South Lake B	Currently permitted loads	Retrofit treatment to 25% of non-road impervious cover (A, B and C soils), 25% of paved roads treated (A and B soils), all using the 0.9 inch runoff depth. Infiltration practice for A & B soils; wet ponds for C soils.	Treatment of 100% of hydrologically connected unpaved roads	60% reduction from forest land based on focused AMP impl. + measures as described in text	Streambank erosion control (management to the equilibrium condition) for eroding reaches above the 25th percentile P loading level	80% reduction based on barnyard manage ment BMP	Enhanced BMP scenario (see description in text) Assoc. P reduction: 60%
2. South Lake A	Currently permitted loads	Retrofits for 25% of paved roads on A and B soils using infiltration practice and 0.5 inch runoff depth, Retrofits for non-road impervious cover would apply only to the amount of impervious area needed to account for the future growth allocation	Treatment of 100% of hydrologically connected unpaved roads	5% reduction from forest land – see text	N/A	80% reduction based on barnyard manage ment BMP	Enhanced BMP scenario (see description in text) Assoc. P reduction: 62%
3. Port Henry	Currently permitted loads	Retrofits for 25% of paved roads on A % B soils, using infiltration practice and 0.5 inch runoff depth. r Retrofitsfor non-road impervious cover would apply only to the amount of impervious area needed to account for the future growth allocation	Treatment of 100% of hydrologically connected unpaved roads	5% reduction from forest land – see text	N/A	80% reduction based on barnyard manage ment BMP	Enhanced BMP scenario (see description in text) Assoc. P reduction: 70%
4. Otter Creek	Currently permitted loads	Retrofit treatment for 10% of non-road impervious area , and	Treatment of 100% of hydrologically	5% reduction from forest	Streambank erosion control (or management	80% reduction based on	Enhanced BMP scenario (see description in text)

		25% of paved roads on A and B soils, using infiltration practice and 0.5 in runoff depth	connected unpaved roads	land – see text	to the equilibrium condition) only for eroding reaches above the 50th percentile P loading level	barnyard manage ment BMP	Assoc. P reduction: 50%
5. Main Lake	Annual load limits calculate d at 0.2/0.8 mg/L	Retrofit treatment for 10% of non-road impervious area and 25% of paved roads on A and B soils, using infiltration practice and 0.5 in runoff depth	Treatment of 100% of hydrologically connected unpaved roads	5% reduction from forest land – see text	Streambank erosion control (or management to the equilibrium condition) only for eroding reaches above the 50th percentile P loading level	80% reduction based on barnyard manage ment BMP	Enhanced BMP scenario (see description in text) Assoc. P reduction: 56%
6. Shelburne Bay	Annual load limits calculate d at 0.2/0.8 mg/L	Retrofit treatment for 10% of non-road impervious area, and 25% of paved roads on A and B soils, using infiltration practice and 0.5 in runoff depth	Treatment of 100% of hydrologically connected unpaved roads	5% reduction from forest land – see text	Streambank erosion control (or management to the equilibrium condition) for eroding reaches above the 25th percentile P loading level	80% reduction based on barnyard manage ment BMP	Enhanced BMP scenario (see description in text) Assoc. P reduction: 61%
7. Burlington Bay	Annual load limits calculate d at 0.2/0.8 mg/L	Retrofit treatment for 10% of non-road impervious area in both CSO and direct drainage areas, and 25% of paved roads on A and B soils, using infiltration practice and 0.5 in runoff depth	Treatment of 100% of hydrologically connected unpaved roads	N/A	N/A	N/A	N/A
9. Malletts Bay	Currently permitted loads	Stormwater retrofits for 10% of non-road impervious area on A and B soils, and 25% of paved roads on A and B soils. All using infiltration	Treatment of 100% of hydrologically connected unpaved roads	5% reduction from forest land – see text	Streambank erosion control (or management to the equilibrium condition) only for eroding	80% reduction based on barnyard manage ment BMP	Enhanced BMP scenario (see description in text) Assoc. P reduction: 55%

		practice and the 0.5 inch runoff depth			reaches above the 50th percentile P loading level		
10. Northeast Arm	Currently permitted loads	Retrofits for 25% of paved roads on A and B soils using infiltration practice and the 0.5 inch runoff depth. Retrofits for non-road impervious cover would apply only to the amount of impervious area needed to account for the future growth allocation	Treatment of 100% of hydrologically connected unpaved roads	5% reduction from forest land – see text	N/A	80% reduction based on barnyard manage ment BMP	Enhanced BMP scenario (see description in text) Assoc. P reduction: 64%
11. St. Albans Bay	Annual load limits calculate d at 0.2/0.8 mg/L	Stormwater retrofits for 10% of non-road impervious area, and 25% of paved roads on A and B soils. Using infiltration practice and the 0.5 inch runoff depth	Treatment of 100% of hydrologically connected unpaved roads	5% reduction from forest land – see text	Streambank erosion control (or management to the equilibrium condition) for eroding reaches above the 25th percentile P loading level	80% reduction based on barnyard manage ment BMP	Enhanced BMP scenario (see description in text) Assoc. P reduction: 75%
12. Missisquoi Bay	Annual load limits calculate d at 0.2/0.8 mg/L	Stormwater retrofits to 60% of non-road impervious cover on A, B and C soils, and 50% of paved roads treated on A and B soils, all at the 0.9 inch runoff depth. Infiltration practice for A & B soils; wetponds for C soils.	Treatment of 100% of hydrologically connected unpaved roads	60% reduction from forest land based on focused AMP impl. + measures as described in text	Extra streambank erosion efforts such that a 68% reduction is achieved from highly eroding reaches (above the 25th percentile) and also a 40% reduction from less eroding reaches (below the lowest 25th percentile)	80% reduction based on barnyard manage ment BMP	Enhanced BMP scenario, with the following additions: Livestock exclusion and riparian buffer applied to 100% of pasture (rather than 80%); riparian buffer applied to 100% of continuous hay on C and D soils (85% previously); Greater application of ditch buffers and reduced P manure practices, as described in text Assoc. P reduction: 78%

13. Isle LaMotte	Currently permitted loads	Retrofits for 25% of paved roads on A and B soils using infiltration practice and the 0.5 inch runoff depth. Retrofit treatment for non-road impervious cover would apply only to the amount of impervious area needed to account for the future growth allocation	Treatment of 100% of hydrologically connected unpaved roads	5% reduction from forest land – see text	N/A	80% reduction based on barnyard manage ment BMP	Enhanced BMP scenario (see description in text) Assoc. P reduction: 71%

*Back roads are part of the developed land category, but described separately in this chart for ease of displaying the scenario information

**Used to determine maximum feasible reductions. Actual agricultural load allocations were set to the amount needed to attain standards, taking into account reductions from other sectors.

Table B2. Percent Phosphorus reductions generated by the TMDL scenario summarized in Table B1. Note that these reductions are not always identical to the allocations in the TMDL: They are the reductions generated by the scenario, and were used to help derive the allocations. For example, the developed land reductions were adjusted using the results of the future growth analysis completed by VTDEC, as described in the TMDL document.

Lake Segment	Total Overall	Wastewater[1]	CSO	Developed Land	Forest	Streams	Agriculture
01. South Lake B	43.4%	0.0%		23.2%	60.0%	30.5%	60%
02. South Lake A	52.7%	0.0%		20.9%	5.0%		62%
03. Port Henry	15.8%			10.6%	5.0%		70%
04. Otter Creek	24.7%	0.0%		19.8%	5.0%	40.1%	50%
05. Main Lake	21.3%	61.1%		19.7%	5.0%	28.9%	56%
06. Shelburne Bay	12.5%	64.1%		12.9%	5.0%	55.0%	61%
07. Burlington Bay	30.5%	66.7%	10.0%	10.7%	0.0%		0.0%
09. Malletts Bay	17.6%	0.2%		22.4%	5.0%	44.9%	55%
10. Northeast Arm	13.0%			8.6%	5.0%		64%
11. St. Albans Bay	24.3%	59.4%		7.9%	5.0%	55.0%	75%
12. Missisquoi Bay	64.3%	51.9%		28.1%	60.0%	65.3%	78%
13. Isle La Motte	12.4%	0.0%		10.0%	5.0%		71%
TOTAL	33.8%	42.1%	10.0%	20.7%	23.4%	43.4%	63%

[1]Percent change from current permitted loads

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