ATTACHMENT 3 TO FACT SHEET
BASIS FOR PHOSPHORUS REDUCTION REQUIREMENT

Introduction

This attachment to the Fact Sheet provides the basis for the Phosphorus Reduction Requirement specified in Section IV and Appendix D of the draft permit.

One of the central requirements of the permit is that permittees reduce the phosphorus load in storm water discharging from DD Sites by 65%. This reduction is grounded in two NPDES legal requirements found at 40 CFR §122.44(d)(vii)(B): that NPDES permits contain effluent limits developed to protect narrative and numeric water quality criteria; and that such permits must be consistent with the assumptions and requirements of any available wasteload allocation for the discharge. The requirement is also supported by the scientific data and conclusions presented in the Lower Charles Phosphorus TMDL (the TMDL).

Based on the TMDL and other data, a 65% reduction in phosphorus loads from commercial and industrial properties (and dense residential properties to the extent they are covered by the residual designation) is necessary for the permit to assure compliance with water quality standards and to achieve consistency with the assumptions and requirements of the Wasteload Allocations in the TMDL.

The following topics are addressed in this attachment:
(A) The TMDL and Phosphorus Reduction Requirement as Water-Quality Based Controls;
(B) Background Information on the Charles River Watershed and the Municipalities of Milford, Bellingham and Franklin, Massachusetts;
(C) Overview of Massachusetts Surface Water Quality Standards that Relate to Water Quality Impairments Caused by Excessive Phosphorus Loading;
(D) Causal Relationship between Phosphorus and Aquatic Plant/Algal Growth in the Charles River;
(E) Water Quality Assessments of the Charles River relating to non-attainment of Massachusetts water quality standards and excessive phosphorus loading;
(F) The Effects of Watershed Imperviousness on Storm Water Runoff Volume and Storm Water Associated Phosphorus Loading; and
(G) Waste Load Allocation and Needed Reductions for Storm Water Discharges

(A) The TMDL and Phosphorus Reduction Requirement as Water-Quality Based Controls

A TMDL for a given pollutant and waterbody is composed of the sum of individual wasteload allocations (WLAs) for NPDES-regulated point sources--such as wastewater treatment facilities, combined sewer overflows, and certain storm water discharges through point sources-- and load allocations (LAs) for nonpoint sources, non-regulated point sources and natural background levels. In addition, a TMDL includes a margin of safety (MOS) to account for uncertainty in the relationship between pollutant loads and the quality of the receiving waterbody. In TMDL development, allowable loadings from all pollutant sources that cumulatively amount to no more than the loading capacity of the receiving water must be established and thereafter become the basis for establishing water quality-based controls applied through the NPDES permitting

process. On October 17, 2007, EPA approved a TMDL relating to phosphorus discharges to the Lower Charles River (the TMDL).

Regulations governing issuance of NPDES permits at 40 CFR §122.4(d) state that a permit may not be issued where its conditions do not ensure compliance with the applicable water quality requirements of affected states. Regulations at 40 CFR §122.44(d)(1)(vii)(B) also require that effluent limits developed to protect a narrative water quality criterion, a numeric water quality criterion, or both, be consistent with the assumptions and requirements of any available wasteload allocation for the discharge. Consistent with those requirements, the draft permit requires a 65% reduction in annual phosphorus loading from DD Sites. The rationale for selecting the 65% reduction in annual phosphorus loading comes directly from the TMDL analysis and is discussed in greater detail below in Section G of this Attachment. Both the technology based and water quality based effluent limitations proposed in this permit are non-numeric effluent limitations expressed in the form of control measures and BMPs.

With respect to the permit's water-quality based requirements, Section IV and Appendix D of the draft permit require the permittee to develop a Final Phosphorus Reduction Plan that, when implemented, will satisfy its Phosphorus Reduction Requirement through one or any combination of the following: implementing enhanced on-site non-structural BMPs; implementing on-site structural BMPs; and participating in a Certified Municipal Phosphorus Program ("CMPP") in the municipality in which the DD site is located or, if the municipality in which the site is located does not have a CMPP, through participation in a CMPP in a municipality that discharges to the Charles River at a location upstream of the DD Site.

While a major focus of the Phosphorus Reduction Requirement is to develop and implement control measures reducing phosphorus discharges to the Charles River system, the controls are also expected to address discharges of bacteria in storm water. At present, discharges of storm water containing phosphorus and bacteria from separate storm water sewer systems impair water quality in much of the Charles River and its tributaries. Therefore, the Phosphorus Reduction Requirement along with the baseline requirements in Section III of the permit are intended to ensure that a permittee undertakes a comprehensive set of activities that will both reduce phosphorus and bacteria at their source.

(B) Background Information on the Charles River Watershed and the Municipalities of Milford, Bellingham, and Franklin, Massachusetts

The entire Charles River drains a watershed area of 310 square miles. Two hundred and sixty-eight square miles of that watershed area drain over the Watertown Dam into the Lower Charles River. The remaining 42 square miles drain directly into the Lower Charles River. There is also a combined sewer drainage area near the downstream end of the Lower Charles River.

Milford, Franklin and Bellingham, Massachusetts drain, in whole or in part, into the Charles River upstream of the Watertown Dam. As indicated in Figure 1 of the Fact Sheet, these communities are located near the headwaters of the Charles River and are the first places where the Charles River shows significant signs of excessive aquatic plant and algal growth. Continuing downstream from these communities, evidence of cultural eutrophication exists at numerous locations along the length of the Charles River, including the downstream-most segment, the Lower Charles River, which flows into Boston Harbor.

(C) Overview of Massachusetts Surface Water Quality Standards that Relate to Water Quality Impairments Caused by Excessive Phosphorus Loading

A summary of the Massachusetts water quality criteria applicable to the Charles River and phosphorus loading are presented in Table 1. There are no specific, numeric criteria for phosphorus, but there are narrative nutrient criteria. In addition, excessive phosphorus causes violations of other numeric criteria, such as those for pH and dissolved oxygen (DO).

Table 1: Applicable Massachusetts surface water quality criteria

Pollutant	Criteria	Source
DO	Shall not be less than 5.0 mg/L in warm water fisheries unless background conditions are lower; natural seasonal and daily variations above these levels shall be maintained; and levels shall not be below 60 percent of saturation in warm water fisheries due to a discharge.	314 CMR: 4.05: Classes and Criteria (3)(b) 1
pH	Shall be in the range of 6.5 - 8.3 standard units and not more than 0.5 units outside of the background range. There shall be no change from background conditions that would impair any use assigned to this Class.	314 CMR: 4.05: Classes and Criteria (3)(b) 3
Solids	These waters shall be free from floating, suspended, and settleable solids in concentrations and combinations that would impair any use assigned to this Class, that would cause aesthetically objectionable conditions, or that would impair the benthic biota or degrade the chemical composition of the bottom.	314 CMR: 4.05: Classes and Criteria (3)(b) 5.
Color and Turbidity	These waters shall be free from color and turbidity in concentrations or combinations that are aesthetically objectionable or would impair any use assigned to this Class.	314 CMR: 4.05: Classes and Criteria (3)(b) 6
Aesthetics	All surface waters shall be free from pollutants in concentrations or combinations that settle to form objectionable deposits; float as debris, scum or other matter to form nuisances; produce objectionable odor, color, taste or turbidity; or produce undesirable or nuisance species of aquatic life.	314 CMR: 4.05: Classes and Criteria (5)(a)
Nutrients	Unless naturally occurring, all surface waters shall be free from nutrients in concentrations that would cause or contribute to impairment of existing or designated uses and shall not exceed the site specific criteria developed in a TMDL or as otherwise established by the Department.	314 CMR: 4.05: Classes and Criteria (5)(c)

Source: 314 Code of Massachusetts Regulations (CMR) 4.05 DEP (2006).

(D) Causal Relationships between Phosphorus and Aquatic Plant and Algal Growth in the Charles River

The causal relationship between excessive phosphorus loads and water quality impairments is well understood and is covered extensively in research literature. Analyses of water quality data collected from the Charles River indicate that aquatic plant and algae growth during the critical

warm-weather growing season is largely controlled by the availability of nutrients: a scarcity of nutrients will limit growth while their abundance will stimulate growth. These analyses indicate that phosphorus is usually the nutrient that controls the amount of algal and aquatic plant growth during the middle to later summer period in the Charles River when recreational use of the river peaks.

During this period, phosphorus abundance in the Charles River coincides with water quality and climatic conditions, including warm ambient temperatures, high sunlight intensity, and lower river flows (which increase water residence times) that are optimal for algal and aquatic plant growth. During these optimal growth conditions, high phosphorus levels in the Charles River cause dramatic increases in plant biomass, which in turn cause and contribute to non-attainment of water quality standards.

(E) Water Quality Assessments of the Charles River relating to non-attainment of Massachusetts water quality standards and excessive phosphorus loading

Periodically, Massachusetts issues a list in accordance with Section 303(d) of the CWA that identifies all surface waters that do not meet applicable state water quality standards and that require pollution controls that are more stringent than those currently required. Based on water quality data available for the Charles River and applicable State water quality standards, DEP included many segments of the Charles River on the State's 2002, 2004, 2006, and 2008 Section 303(d) lists for several pollutants and conditions that it determined caused violations of those standards. Among these 303(d) listed pollutants and conditions are several related to excessive phosphorus loading:

- Nutrients
- Organic enrichment/Low DO
- Taste, odor, and color
- Noxious aquatic plants
- Turbidity

DEP's analyses also indicate that phosphorus in storm water runoff is a significant cause of water quality impairments in almost all of the Charles River segments. Table 2 summarizes the assessment results relating to phosphorus, as provided by DEP's assessment report, for all of the Charles River segments. As noted, almost all segments of the Charles River, with the single exception of the uppermost, headwater segment, is impaired, at least in part, because of elevated phosphorus, excessive aquatic plant growth and/or algae. In addition to these river segment assessments, DEP has determined that Milford Pond is impaired due to excessive aquatic plant growth and Populatic Pond is impaired due to excessive algal growth. These ponds are impoundments in the mainstream of the Charles River.

The first indications that phosphorus is degrading water quality because of excessive aquatic plant and algae growth appear as the river flows through the communities of Milford, Bellingham, and Franklin. Starting with Milford Pond and moving downstream to Boston Harbor, especially in impounded and slow moving sections of the river, there is documented evidence of impairments resulting from excessive phosphorus.

Table 2. Summary of DEP water quality assessments for the mainstem of Charles River related to phosphorus (excerpted from the Charles River Watershed 2002-2006 Water Quality Assessment Report, DEP, April, 2008)

Charles River Segment No.	Charles River Mainstem Segment Description	Use impairment related to phosphorus	Suspected source contributing to phosphorus-related impairment
(MA72-01)	Outlet of Echo Lake to just upstream of Milford Pond, 2.5 miles, Hopkinton/Milford	None identified	None identified
(MA72-33)	Outlet of Milford Pond to the Milford WWTF discharge, 2.0 miles, Milford/Hopedale	Aquatic life	Urban runoff/storm water
(MA72-03)	Milford WWTF discharge to Outlet of Box Pond, 3.4 miles, Hopedale/Bellingham	Aquatic life, primary contact, secondary contact, and aesthetics	Municipal WWTF, urban runoff/storm water
(MA72-04)	Outlet Box Pond to inlet to Populatic Pond, 11.5 miles, Bellingham, Norfolk/Medway	Aquatic life (7.5 miles)	Municipal WWTF in upstream segment, urban runoff/storm water
(MA72-05)	Outlet of Populatic Pond to South Natick Dam, 18.1 miles, Norfolk/Medway/Natick	Aquatic life, primary contact, secondary contact, and aesthetics	Municipal WWTF, urban runoff/storm water, nonpoint sources
(MA72-06)	South Natick Dam to the Chestnut St. Needham, 8.4 miles, Natick/Needham	Aquatic life, primary contact, secondary contact, and aesthetics	Municipal WWTFs in upstream segments, urban runoff/storm water, nonpoint sources
(MA72-07)	Chestnut St. Needham to Watertown Dam**,** 24.8 miles, Needham/Watertown	Aquatic life, primary contact, secondary contact, and aesthetics	Municipal WWTFs in upstream segments, urban runoff/storm water, nonpoint sources
(MA72-36)	Watertown Dam to Boston University Bridge, 6.1 miles, Watertown/Boston/Cambridge	Aquatic life, primary contact, secondary contact, and aesthetics	Municipal WWTFs in upstream segments, urban runoff/storm water
(MA72-38)	Boston University Bridge to New Charles River Dam, 3.1 miles, Boston/Cambridge	Aquatic life, primary contact, secondary contact, and aesthetics	Municipal WWTFs in upstream segments, urban runoff/storm water

(F) The Effects of Watershed Imperviousness on Storm Water Runoff Volume and Storm Water Associated Phosphorus Loading

The urban and suburban landscape contains a variety of phosphorus sources. These include dust and dirt, atmospheric deposition, decaying organic matter (such as leaf litter and grass clippings), fertilizers, exhaust from internal combustion engines, detergents, and pet waste. Intensive uses, including high traffic volume (particularly of trucks and busses), increase pollutant loading to the impervious surfaces, including surfaces adjacent to roadways, loading areas and parking lots.

Impervious surfaces collect phosphorus deposited on them from these sources. Wind, runoff from rain and snowmelt, landscaping and other human activities and natural mechanisms mobilize and then convey phosphorus from impervious surfaces to waters such as the Charles River.

Numerous scientific studies document that impervious cover both increases the volume of rainfall that becomes runoff and amplifies the loads of pollutants flowing to surface waters. There are several reasons for this: 1) rain falling on impervious cover runs off without infiltrating into the ground, thus creating a higher volume of runoff per unit area; 2) unlike pervious areas that trap and filter pollutants through soils and surface retention, impervious areas allow greater amounts of pollutants to be carried away by runoff; and 3) pollutants such as phosphorus on impervious surfaces are particularly susceptible to transport by runoff because of their tendency to adhere to very small particles, which are easily washed off hard surfaces by rainfall. These small particles (< 100 microns) account for much of the phosphorus storm water load that discharges to receiving waters. These three factors operating simultaneously dramatically increase phosphorus loadings from impervious surfaces.

Generally, and in the Charles River watershed specifically, the extent of imperviousness differs by land use. As land has been developed from its natural state, impervious surfaces, such as roadways, parking lots and roof tops, have proliferated. The relationship between land use, imperviousness and consequent phosphorus loading is illustrated by Table 3. The first column in Table 3 identifies land use categories typically studied in storm water research; the second column indicates the export loading rates (a measure of phosphorus in storm water discharges expressed in terms of kilograms per hectare per year (kg/ha-yr) from land use-based research collating numerous storm water studies; the third column provides the phosphorus export loading rates from the various land uses based on a simple model widely used in the field of storm water management; the fourth column identifies the range of imperviousness in various land uses based on general storm water research; and the fifth column identifies the percent of imperviousness in various land uses based on an analysis specific to the Charles River. This last column indicates that the percent of imperviousness in the Charles River watershed is, on a land-use basis, in general agreement with that in numerous storm water studies. Taken as a whole, the data presented in Table 3 establish two key points: the amount of phosphorus in storm water discharges from various land uses (excepting agricultural, forest and open space land uses) is directly and proportionally related to the amount of imperviousness of that land use; and the Charles River watershed is reflective of general trends when considering the relationship between land use and degree of imperviousness.

Just as impervious cover discharges high loads of phosphorus to surface waters, so too does impervious cover contribute to excessive loadings of other pollutants such as heat, metals, and pathogens. The types of control technologies that will reduce phosphorus loads will provide the added benefit of reducing loads of these other pollutants.

In summary, storm water discharges, particularly storm water discharges from impervious surfaces, carry high annual phosphorus loads to the Charles River where they contribute to eutrophication. This eutrophication contributes to violations of numerous Massachusetts water quality standards.

Table 3. Phosphorus loading export factors by land use

Land Cover	Literature reported phosphorus export rate kg/ha-yr (source)	Annual phosphorus export rate developed using the Simple Method, Schueler,1987 (4) kg/ha-yr	Ranges in percent impervious values typical for various land uses (Schueler 1987)	Charles River watershed percent impervious by land use (MassGIS 1999, 2005)
Commercial	1.679 (1)	1.29 - 2.57	60-90%	79%
Industrial	1.455 (1)	1.29 - 2.57	60-90%	71%
High Density Residential	1.12 (1)	0.80 - 1.76	35-60%	49%
Medium Density Residential	0.56 (1)	0.50 - 1.09	20-35%	25%
Low Density Residential	0.30 (3)	0.21 - 0.69	5-20%	20%
Agriculture (crop land)	0.50 (2)	not applicable	0-5%	not calculated
Forest	0.13 (3)	0.11 - 0.28	0-5%	not calculated
Open Space	0.30 (3)	0.11 - 0.28	0-5%	not calculated

1. Shaver, E., Horner R., Skupien J., May C., and Ridley G. 2007 Fundamentals of urban runoff management: technical and institutional issues. Prepared by the North American Lake Management Society, Madison, WI, in cooperation with the U.S. Environmental Protection Agency.
2. Budd, Lenore F.and Donald W. Meals. February 17, 1994. Draft Final Report. Lake Champlain Nonpoint Pollution Assessment.
3. Mattson, Mark D. and Russell A. Isaac. 1999. Calibration of phosphorus export coefficients for Total Maximum Daily Loads of Massachusetts's lakes. Lake Reservoir. Management, 15:209-219.
4. Schueler, Thomas R. July 1987. Controlling urban runoff; a practical manual for planning and designing urban BMPs.

Table 4 below presents the average annual total phosphorus loads to the Lower Charles River during the 1998-2002 study period and the reductions needed to meet the TMDL's 10 µg/l seasonal average chlorophyll *a* water quality target. Based on 1998-2002 data, the TMDL estimates that the Lower Charles River receives an average annual phosphorus load of 40,050 kg/year. Based on analyses using a calibrated water quality model, the average annual phosphorus load must be reduced by approximately 54 percent in order for the Lower Charles River to not exceed the chlorophyll *a* target and to attain the Massachusetts water quality standards. The summary of the total phosphorus TMDL for the Lower Charles River is presented in Table 4 and indicates that needed phosphorus loading reductions to the Lower Charles River range from 48% (upper watershed) to 96% (CSOs).

Table 4. Summary of phosphorus TMDL for the Lower Charles River (excerpted from final Lower Charles River TMDL

Source	Existing P Load (1998-2002) kg/yr	WLA kg/yr	LA kg/yr	TMDL kg/yr	% Reduction
Upstream Watershed at Watertown Dam[a]	28,925	15,109	0	15,109	48
CSOs[b]	2,263	90	0	90[c]	96
Stony Brook Watershed	5,123	1,950	0	1,950	62
Muddy River Watershed	1,549	590	0	590	62
Laundry Brook Watershed	409	155	0	155	62
Faneuil Brook Watershed	326	125	0	125	62
Other Drainage Areas	1,455	550	0	550	62
Explicit Margin of Safety	-	-	-	979	-
TOTAL	40,050	18,565	0	19,544[d]	54

[a] The aggregate allocation for sources in the upstream watershed includes all point and nonpoint sources in the upstream watershed, including WWTFs. For the TMDL period (1998-2002), 23% of the total phosphorus load at Watertown Dam was attributable to the WWTFs in the upper watershed. Therefore 77% of the total phosphorus load at Watertown Dam was due to other sources such as storm water. Many of those storm water discharges are currently controlled by the small MS4 NPDES general storm water permit and a few additional sources are covered by the Multi-Sector General Permit (MSGP) for storm water. Those permits will be made consistent with the TMDL on their next reissuance.

[b] The 96% reduction is based on required CSO volume reductions in the Long Term CSO Control Plan.

[c] This value represents an estimate that would be needed under 1998-2002 conditions. The TMDL however is based on a typical year and compliance with the approved long-term control plan.

d This number includes 979 kg/yr that represents the margin of safety.

(G) Waste Load Allocation and Needed Reductions for Storm Water Discharges

The TMDL indicates that the existing load of 40,050 kg/yr must be reduced by 21,485 kg/yr (53.6%) to achieve the TMDL of 18,565 kg/year. The required reduction from CSOs, all located below the Watertown Dam, is 2,263 kg/yr, reflecting the court ordered reduction based on the CSO Long Term Control Plan. The required reduction from WWTFs, all located above the Watertown Dam, totals 2,162 kg /yr (see Table 4). Once these reductions are accounted for, the vast bulk of the remaining phosphorus load reductions both above and below the Watertown Dam must be achieved through controls on storm water discharges. Table 5 presents the

reductions needed from storm water system discharges based on various land uses in the watershed, as discussed below.

Table 5 Summary of land cover phosphorus loading and TMDL loading for the Charles River Watershed from TMDL Report

Land Cover/Source Category	Area (square miles)	1998-2002 phosphorus Loading (kg/yr)	TMDL phosphorus Loading (kg/yr)	Percent Load Reduction
Commercial	8.36	3,676	1,286	65%
Industrial	15.01	5,718	1,972	65%
High Density Residential	35.62	10,437	3,600	65%
Medium Density Residential	36.00	5,278	1,820	65%
Low Density Residential	42.73	503	276	45%
Agriculture	7.96	1,042	672	35%
Forest	119.09	4,018	4,018	0%
Open Land	32.52	289	187	35%
WWTF	-	6,825	4,663	32%
CSO	-	2,263	90[1]	96%
Total	**297.20**	**40,050**	**18,565**	**53.6%**

The TMDL described in the Final Report, ***[Final Total Maximum Daily Load for Nutrients in the Lower Charles River Basin Massachusetts CN 1301.0, June 2007],*** calculated in a multi-step process the recommended load reductions from storm water discharges in each land use. The first step involved performing a land cover analysis that evaluated the percentage of the watershed devoted to each of the eight land use categories shown above. The phosphorus load from each of the different land use categories was then calculated by taking the amount of area in the watershed devoted to each of the land uses and multiplying that area by export phosphorus loading factors representative of that land use. These factors were derived from research of extensive scientific literature. Applying phosphorus loading export factors to estimate watershed phosphorus loading is a common practice used in developing TMDLs for eutrophic waters.

Once calculated, the reductions from the land use categories were evaluated for feasibility while keeping the total reduction in mind. Based on this evaluation, the TMDL Report concluded that the substantial areas of forested lands within the watershed (38% of watershed area) are, for the most part, in a natural condition with relatively low phosphorus export rates. Consequently, it was determined that assigning load reductions for forested areas would not be reasonable or appropriate.

Because the agricultural areas in the Charles River watershed are generally not regulated and because agricultural storm water discharges are beyond the scope of NPDES regulation it was determined that a relatively high percentage reduction was not likely to be achieved from agricultural discharges. However, since agricultural areas are known to contribute nutrients, and because the control of some agricultural areas using low-cost practices such as pollution prevention is feasible and desirable, a percent reduction of 35 percent was recommended.

Feasibility was also considered in developing a reduction level for low density residential and open space land uses. Because export loading rates for these land uses are already low compared to the rates for the uses with higher imperviousness, achieving high load reductions was determined to raise implementability challenges. As with the agricultural land use, these sources were identified in the TMDL Report so that communities could take them into account in zoning restrictions, and development planning and requirements. Addressed prospectively, phosphorus loads created by development may be reduced at relatively low cost.

Finally, in order to achieve the remaining needed reduction of 16,431 kg/yr, a reduction of 65 percent was assigned to the major sources (commercial, industrial, high density residential and medium density residential land uses). These sources together represent about 62 percent of the total phosphorus storm water load to the Lower Charles River.

Table 6. Phosphorus loading and TMDL reductions by land use for the Charles River watershed in Bellingham, Franklin, and Milford, MA

Charles River Watershed Community	Comm.	Industrial	High Density Residential	Medium Density Residential	Low Density Residential	Agricul.	Forest	Open land	Total	Percent Reduction Required
Bellingham										
Drainage Area (ha)	58.8	212.0	134.2	240	212.2	57.1	1,315.9	245.0	2,475.3	
1998-2002 Loading (kg/yr)	99.8	311.7	151.9	135.9	9.7	28.8	171.6	8.4	917.8	
TMDL Loading (kg/yr)	34.4	107.5	52.4	46.9	5.3	18.6	171.6	5.4	442.1	51.8%
Franklin										
Drainage Area (ha)	87.5	351.2	110.5	1,455.0	597.6	119.8	2,966.7	600.3	6,288.6	
1998-2002 Loading (kg/yr)	148.6	516.4	125.0	823.5	27.2	60.6	386.8	20.6	2,108.7	
TMDL Loading (kg/yr)	51.2	178.1	43.1	284	14.9	39.1	386.8	13.3	1,010.6	52.1%
Milford										
Drainage Area (ha)	80.3	328.9	270.7	647.7	243.4	3.1	149.1	265.2	3,278.4	
1998-2002 Loading (kg/yr)	136.4	483.7	306.3	366.6	11.1	1.6	187.6	9.1	1,502.3	
TMDL Loading (kg/yr)	47	166.8	105.6	126.4	6.1	1.0	187.6	5.9	646.5	57.0%

As part of the TMDL implementation plan, an analysis of land use in each of the communities upstream of Watertown was performed and a calculation of the reductions needed from each community estimated. The results of those calculations for Milford, Bellingham and Franklin are provided in Table 6. As indicated, reductions in annual total phosphorus loads of 57.0, 51.8, and 52.1 percent are needed in the communities of Milford, Bellingham and Franklin, respectively, in order to be consistent with the wasteload allocations.

The draft permit proposes requiring permittees to achieve the equivalent of a 65% reduction in annual phosphorus loading from the DD Site through implementing BMPs at the DD Site and/or participating in a CMPP. The selection of the 65% reduction proposed in the draft permit is consistent with the assumptions used in developing the WLAs for the Lower Charles TMDL, and in particular, with the WLA of 48% phosphorus load reduction for the upper Charles River watershed above the Watertown Dam. First, as described above, the TMDL analysis included a land-use based loading assessment to evaluate the magnitude of reductions needed among the land-based sources that contribute phosphorus to the Lower Charles River.

A critical feature of the land-use based loading analysis was to recognize that some sources are more or less "controllable" than others. For example, the TMDL postulated that forested areas, which typically have very low phosphorus export rates, offer limited opportunities for reducing phosphorus loads because these areas are assumed to be in a more natural, stable condition and generate relatively low phosphorus loads per unit area. However, because forested areas account for a substantial portion of the watershed area (38%), the net loading from forested areas is significant at approximately 13% of the average annual land-based phosphorus loading to the Lower Charles River. Consequently, other sources that have more opportunities for control, particularly those that have high phosphorus export rates, were estimated to need reductions of 65% in order to achieve the WLA for the upper watershed.

As required for TMDLs, WLAs and LAs must be set at levels that do not exceed the loading capacity of the receiving water after a margin of safety has been taken into account. While the Lower Charles River TMDL set only WLAs (because it was not feasible at the time of TMDL development to separate unregulated point sources and nonpoint sources from regulated point sources), the assignment of land-use based load reductions focused on assigning the bulk of the needed phosphorus load reductions to land use categories that were likely to deliver much of their respective phosphorus load via point source.

As described in the TMDL, the land-used based loading analysis assigned some reductions to the agriculture, open space, and low-density residential uses to acknowledge that there may be some relatively easy low-cost options for reducing loadings from these source categories. However, even if a uniform load reduction rate were applied to all of the potentially controllable land-based sources (all categories except forested) the reduction rate would still need to be approximately 64%.

In any event, reductions on the order of 65% would be needed for properties with the land use categories that are subject to the residual designation in order to achieve the WLA of a 48% reduction in average annual phosphorus load at the Watertown Dam. A lower reduction would

simply be inconsistent with the assumptions used in the TMDL and would result in putting greater reduction burden on sources that have a greater potential to be unregulated point sources and/or non point sources and for which there are not reasonable assurances that controls will be implemented.

In determining whether the proposed phosphorus reduction requirements are appropriate to address phosphorus-related water quality impairments in the upper segments of the Charles River, EPA has considered the analyses conducted for the development of the draft phosphorus TMDL for the upper and middle segments of the Charles River. This TMDL is being developed to address the phosphorus-related water quality impairments that occur in the segments of the Charles River upstream of the Watertown Dam. The results of these analyses indicate that land-use based load reductions are consistent with those determined to be needed for achieving the upper watershed WLA at Watertown Dam. The development of the draft TMDL for the upstream watershed relied on the use of watershed and receiving water models to simulate water quality conditions throughout the Charles River upstream of the Watertown Dam and to estimate total average annual phosphorus loading to the Lower Charles River.

EPA's Residual Designation Record of Decision noted that the Agency's designation was not precluding additional designations that may be needed to address continuing impairments. The designation set a threshold for the designation at two acres of imperviousness and a TMDL-based reduction requirement for designated properties of 65% as an appropriate starting point for phosphorus control in the Charles River.