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MEMORANDUM TO THE ENVIRONMENTAL APPEALS BOARD

Attachment to Petition

Re: City of Marlborough, Massachusetts
Westerly Wastewater Treatment Facility
NPDES Permit No. MA0100480

OARS, the petitioner in this Appeal to the Environmental Appeals Board, submits this Memorandum as an Attachment to the Petition as background and to provide important analysis and facts referred to in the Petition. At the end of this Memorandum we share our calculations that show that switching from concentration-based phosphorus discharge limits to load-based limits is a consequential change. The Assabet River is designated as Class B waters, capable of providing and supporting habitat for fish and other aquatic wildlife, and for primary and secondary contact recreation.

OARS was established in 1986 by local fishermen, boaters, hunters, conservationists, and others to restore what was locally known as the "cesspool of Massachusetts"—the Assabet River. Our approach rests fundamentally on science to uncover the causes of environmental degradation and using science to seek solutions with our communities that have the best chance of succeeding. This is the reason we started our quality-controlled citizen science-based water quality monitoring program in 1999—to provide data for the development of the TMDL that would chart a map to restore the river's health. Our water quality monitoring program continues to provide data used by MassDEP in developing their Integrated List of Waters under Sections 303(d), 314 and 305(b) of the Clean Water Act, by Region 1, by municipalities and by scientists and the public. It is the Clean Water Act that has made possible all the progress we have seen

thus far. Within that framework, the municipalities, non-profits, citizens and state and federal government have all invested a tremendous amount of effort and money to get us to this point today.

The Assabet is part of a three-river system is known as the Sudbury, Assabet and Concord Watershed, commonly referred to as the "SuAsCo Watershed." Of the three, the Assabet has the worst nutrient pollution and is considered "effluent dominated." After decades of neglect, the Assabet began to come back to life in the late 1980s, when wastewater treatment facilities began primary sewage treatment and stopped discharging raw sewage into the river. Residents have since discovered and enjoyed the river's recreational value. In 1999 the Assabet, along with the Sudbury and Concord Rivers, was added to the nation's federal Wild and Scenic River System. In 2000, the Assabet River National Wildlife Refuge, which borders the river, was created.

As the river's popularity as a recreational resource has grown, area residents have become increasingly active in its stewardship, as evidenced by the sustained participation in OARS's annual river cleanup, which attracts up to 200 participants in 13 municipalities in one day. OARS collaborates with local businesses to stock trout each year for fly fishing in the lower Assabet in Acton and Concord. A fruitful collaboration among OARS, volunteers and municipal staff from Westborough, Marlborough, Northborough, and Hudson produced the Upper Assabet Riverway Plan, a habitat study of the Upper Assabet. OARS provides popular printed maps and online recreation guides to all three rivers. In 2008-09 OARS convened eight focus groups with 63 Assabet River stakeholders, and held two workshops with 100 participants on the science of river restoration, including benefits and costs of dam removal. In addition, active use of public boat launches in Marlborough, Northborough, Stow, and Acton attest to the river's value to these

communities as a recreational resource. Since those workshops, OARS has collaborated with watershed cities and towns to form a SuAsCo Climate Resiliency Coalition to assist municipalities in addressing cross-border climate change impacts to reduce their vulnerability to droughts, floods, and extreme heat.

Recreational Enjoyment of the Assabet River, 2015

Despite this work, much of the Assabet still suffers each summer and early fall from severe eutrophication – excessive nuisance plant growth, bad odors, and degraded wildlife habitat and recreation – as a result of an overload of nutrients, primarily phosphorus, from the wastewater treatment plants that discharge to the river. These segments of the river persistently remain on the Impaired Waters List, as discussed below.

Severe Eutrophication of the Assabet River, 2020

TMDL Implementation

OARS participated as a stakeholder in the TMDL development along with the "Assabet Consortium" of municipalities with POTWs, with the common understanding that it made more sense to develop the basis for permitting all facilities at the same time and according to the same logic and rules. Recognizing that water quality standards could not be achieved within a single five-year permit, an Adaptive Management approach was used that resulted in a two-phase permitting process. Region 1 and MassDEP jointly issued Phase 1 NPDES discharge permits in 2005 to the four POTWs on the Assabet River to implement the phosphorus TMDL. The 2005 permits attempted to address the eutrophication problem as follows: The permits contained the same phosphorus discharge concentration limits at all four facilities based on an interim Waste Load Allocation (WLA) for the river determined by the TMDL. These 2005 permits substantially reduced the phosphorus discharge limit of 0.75 mg/L that the prior NPDES permits

set for all four POTWs during the growing season. Instead, the 2005 Phase 1 NPDES permits required that, for the April-October season (referred to as the "growing season" for aquatic plants), the permittees were required to meet a 0.1 mg/L total phosphorous discharge concentration limit no later than 54 months from the date of issuance (approximately April 2010). From November through March (referred to as the "winter months"), the discharge limit set was set at 1.0 mg/L total phosphorus. The TMDL assumed, and the Phase 1 permits required, that the design flow for each POTW would remain as it had been in the prior permits.

Three of the four permits were appealed, including the permit for the Marlborough Westerly Facility. As a result of negotiations, the appeals were subsequently withdrawn. Immediately following the withdrawal of appeals, EPA and MassDEP sent letters dated April 28, 2006, to the four municipal permittees informing them that, "[c]onsistent with the TMDL implementation schedule, EPA and DEP will initiate development of Phase 2 permits in Spring 2008. If we determine that sediment remediation is unlikely to achieve necessary phosphorus reductions based upon the information available at that time, the agencies will establish new Phase 2 phosphorus effluent limits designed to ensure compliance with water quality standards." (EPA/DEP Letter, Attachment 7) "[S]ediment remediation" in this letter refers to dam removal, encapsulation, and/or sediment dredging that **might** obviate the need for more stringent phosphorous discharge limits in the Phase 2 permits than those in the 2005 (Phase 1) permits.

New Information about Sediment Flux, Dam Removal and Dredging

As noted above, the TMDL concluded that the only way that Water Quality Standards could be met in the Assabet River was by dramatically reducing phosphorous discharges from the POTWs – to levels significantly below those allowed by the 2005 permits – or, possibly, by holding the POTWs to the 2005 discharge levels in the 2009 (Phase 2) permits **and** eliminating

ninety percent of the "sediment phosphorous flux" in the river (TMDL, p. 13). Accordingly, the TMDL recommended that there be a study to assess the feasibility of eliminating 90% of sediment phosphorus flux (*i.e.,* phosphorus in sediment which is re-circulated in the water column) in the river. Such a study was carried out by the Army Corps of Engineers ("ACOE") for MassDEP to determine the feasibility of removing sediment and/or dams to reduce sediment phosphorus flux. *See* Assabet River Sediment and Dam Removal Feasibility Study, September 2009, ("ACOE Study"), Executive Summary in Attachment 8.

In June 2008, Camp Dresser & McKee ("CDM") completed the cornerstone of the ACOE study, the "Assabet River Sediment and Dam Removal Study, Modeling Report, June 2008" ("CDM Report" in Attachment 9, excerpts), which was included unchanged in the final ACOE Report. (The full ACOE Study and the CDM Report are found at: https://www.nae.usace.army.mil/Missions/Projects-Topics/Assabet-River-Study/). The CDM Report concluded that the reduced loading of phosphorus by the amounts specified in the 2005 permits would result in reductions in the phosphorus flux from the sediments downstream but that these reductions would not be sufficient to achieve water quality standards:

> "Of the alternatives evaluated in this study, no alternative or combination of alternatives is projected to result in a 90 percent reduction in phosphorus flux."
>
> CDM Report, p. ES-2.

Moreover,

> "This study also resulted in significant findings regarding the seasonality of sediment phosphorus flux. An additional consideration to meet the TMDL target of 90% reduction in sediment phosphorus flux is winter phosphorus discharge limits for at [sic] WWTFs. Based on results of this modeling effort, it was concluded that winter limits for the WWTFs, below the current planned limit of 1 mg/L would contribute significantly to the reduction in sediment phosphorus flux."
>
> "If no other improvements were implemented, further reductions in summer P discharge limits, below 0.1 mg/L, would not contribute significantly to further reduction in

> sediment phosphorus flux. *This is because the winter instream phosphorus concentration has such a strong effect on the P flux the following summer.*"
>
> CDM Report 6-7 (Emphasis added.)

The Ben Smith Dam and Sediment Remediation

The ACOE Study found that "The removal of Ben Smith dam [in Maynard] is a key component to achieving water quality goals through reductions in sediment-phosphorus flux." (p. 13). This old Assabet River mill dam is located in the Town of Maynard, and it creates a nearly 5-mile long impoundment upstream in the Town of Stow that suffers from eutrophic conditions during the growing season, especially during low flows.

However, no steps have been taken by the four POTWs discharging to the Assabet or anyone else to remove the Ben Smith Dam, and none are currently anticipated. In Massachusetts, dams can be removed by the owner, or the Commissioner of the Department of Conservation and Recreation can compel an owner to repair or mitigate an unsafe condition if the dam is structurally deficient. *See* MGL Ch. 253, § 47. However, the Ben Smith Dam is in good condition[1] and is owned by a private third party. It is now generally accepted that the key TMDL component of ninety percent phosphorus flux reduction will **not** be attained anytime soon through sediment remediation, encapsulation, or dam removal. The Region admits in its Fact Sheet that "EPA is not aware of any effort underway towards removing any dams or other means of reducing the total phosphorus sediment load." Fact Sheet, p. 27. As a result, and as EPA states in the Fact Sheet, "The sediment phosphorus flux has not been reduced, as required in the 2004 Total Phosphorous TMDL." Fact Sheet, p. 28.

[1] ACOE Study (p. 19, Table 3)

The Phase 2 Permits

With all this information in hand, Region 1 proceeded to prepare the Phase 2 permits for the four Assabet POTWs. Unfortunately, due to a series of circumstances at EPA headquarters and at Region 1, these Phase 2 permits were significantly delayed beyond their expiration date of November 25, 2010. Here is the current status of Phase 2 permitting for the four municipal POTWs that discharge to the Assabet River:

Hudson – Final Permit issued on March 1, 2019

Maynard – Final Permit issued on July 2, 2019

Marlborough Westerly – Final Permit issued on October 25, 2021

Westborough – *Draft Permit pending* after Comment Period ended November 9, 2020

All four Draft Phase 2 Permits specified concentration-based discharge limits for Total Phosphorus: 0.1 mg/L for the growing season (April-October) and 0.2 mg/L for the winter months. Furthermore, the Hudson and Maynard Final Permits both contain these same concentration-based limits for Total Phosphorus. As discussed in the OARS Petition for Review, in the Marlborough Final Permit the discharge limits for Total Phosphorus were switched to load-based limits: 2.4 lbs/day for the growing season months and 4.8 lbs/day for the winter months. OARS had no ability to comment on it this change since it was not contained the Draft Permit or even mentioned as a possibility in the Fact Sheet. OARS also had received no other information about this possible change from the Permittee or any other source.

We would like to point out here that the pending Draft Permit for the Westborough POTW is very consequential in terms of precedent: The Westborough POTW, at a permitted flow of 7.68 MGD, has a larger discharge than all the others combined. It lies at the headwaters of the Assabet River. For the first time ever, the 2020 Westborough POTW's Draft Permit

calculates a low-flow 7Q10 of 0 (zero) cfs at the Westborough POTW, a consequence of more frequent droughts and lower river flows in this part of Massachusetts. This means that there would be no dilution of its discharge. Hence, during low flows, the discharge from the Westborough POTW **is** the headwaters of the river. What would occur if the Westborough Final Permit were to contain the same unconstrained load-based limit as in the Marlborough Final Permit? The phosphorous concentrations in the river during low flows could increase by 70% downstream of the Marlborough Westerly POTW. *See* calculations at the end of this Memorandum.

As detailed in the Petition, the average monthly load-based phosphorus limits set in the Final Permit for the Marlborough facility apply regardless of the discharge flow volume or the phosphorus concentration in that flow. OARS does not understand why there is any need to change the concentration-based phosphorus discharge limits to load-based limits since the plant is generally achieving the existing concentration-based limits in the summer and easily achieving them in the winter. In 2018/2019/2020, the plant only exceeded the 0.1 mg/L summer permit limit three times. In the winter, the maximum concentration was only 0.16 mg/L and the average was 0.10 mg/L.

This switch is also not supported by the 401 Water Quality Certification submitted by MassDEP. That certification indicates clearly that it was based on the terms of the Draft Permit, upon which OARS commented, which contained only concentration-based limits.

Climate Change Must Be Considered

One new factor that needs to be considered going forward is climate change. Massachusetts state climate projections show an increasing number of severe droughts and an

increasing number of days with temperatures over 90 degrees F. The primary climate change impacts on the Assabet that OARS has observed over the past decade are (1) increasing periods of summertime low flow that can reach extremely low levels, and (2) increasingly frequent heat waves that cause the Assabet's water temperature to increase.

Low river flows, and low dissolved oxygen levels due to excessive aquatic plant growth and heat, create extremely stressful conditions for aquatic life. During a three-day heat wave in July 2013 OARS documented a major fish kill on the Assabet in the Ben Smith impoundment, and another one during the 2020 drought in Acton just downstream.

In addition to the Westborough 7Q10 of zero cfs cited above, the low flow (7Q10) calculations for the rest of the Assabet River reflect this increasingly stressed flow condition. The 2005 permit and TMDL show a 7Q10 low flow for the Assabet River at the Maynard USGS gage as 15.1 cfs. In contrast, the 2021 permit shows a 7Q10 flow at Maynard of 11.7 cfs. This is a 23% decrease in the flow of the receiving water and hence loss of dilution of any effluent added. The discharge from the Marlborough Westerly plant during the July 1999 drought period was 1.92 MGD (3.0 cfs) but had dropped to 1.4 MGD (2.2 cfs) during the July 2016 drought.

Thus, this permit should also be understood in light of the fact that accepted models show that the drought conditions in Massachusetts, and specifically the low flows in the SuAsCo basin, will worsen with climate change. See Siddique *et al*., 2020, Hydrological extremes across the Commonwealth of Massachusetts in a changing climate, *J. Hydrol.Reg.Stud.* (https://doi.org/10.1016/j.ejrh.2020.100733).

Antidegradation Review

An Antidegradation Review of the proposed changes found in the Final Permit should have been undertaken under the Antidegradation Provisions of the Massachusetts Surface Water Quality Standards. According to the Fact Sheet at p. 6, Federal regulations found at 40 CFR § 131.12 require states to develop and adopt a statewide antidegradation policy that maintains and protects existing in-stream water uses and the level of water quality necessary to protect these existing uses. Massachusetts' statewide antidegradation policy, entitled "Antidegradation Provisions" is found in the State's Surface Water Quality Standards at 314 CMR 4.04. Massachusetts guidance for the implementation of this policy is in an associated document entitled "Implementation Procedure for the Anti-Degradation Provisions of the State Water Quality Standards," dated October 21, 2009. According to the policy, no lowering of water quality is allowed, except in accordance with the antidegradation policy, and all existing in-stream uses, and the level of water quality necessary to protect the existing uses of a receiving water body must be maintained and protected.

Over the recent history of improvements in phosphorus removal at the four Assabet River POTWs, thanks to effluent treatment upgrades required to meet the Phase 1 permits, there has been progress in improving the condition of the Assabet River and the Concord River (which receives approximately 40% of its flow from the Assabet River). This progress was officially recognized in the approved Massachusetts Year 2016 Integrated List of Waters ("303d List"; at 181-183 Category 5, Concord (SuAsCo) found at: https://www.mass.gov/doc/final-massachusetts-year-2016-integrated-list-of-waters/download) which is currently in effect. In that List, MassDEP removed Total Phosphorus impairment from three segments of the Concord River. These are essentially free-flowing segments that have shown improvement since the more

stringent phosphorus limits were put in place for the four Assabet River POTWs and the two Concord River POTWs (Concord and Billerica). The Draft 2018/2020 Integrated List of Waters (303d list) (pp. 159-160, Attachment 2, and in its entirety at: https://www.mass.gov/doc/draft-massachusetts-integrated-list-of-waters-for-the-clean-water-act-20182020-reporting-cycle/download) removes Total Phosphorus impairment from all free-flowing (non-impounded) segments of the Assabet River. OARS supported these decisions (see Comment Letters in Attachment 2). Note, however, that the Assabet River impairments for "Algae," "Nutrient/Eutrophication Biological Indicators," and "Dissolved Oxygen" (a result of eutrophication and essential for aquatic life) remain—the river is still impaired for nutrients and its impoundments in particular remain eutrophic. *See* Attachment 2, Integrated Lists, Year 2016 pp. 181-183 and Years 2018/2020 (draft) pp. 159-161.

"Eutrophication occurs when a body of water receives an excessive nutrient load, particularly phosphorus and nitrogen. This often results in an overgrowth of algae. As the algae die and decompose, oxygen is depleted from the water, and this lack of oxygen in the water causes the death of aquatic animals, like fish." (U.S. Geological Survey at: https://www.usgs.gov/centers/wetland-and-aquatic-research-center-warc/science-topics/eutrophication)

In the Assabet and Concord Rivers, nutrient pollution due to phosphorus damages aquatic systems and water quality through two processes: by elevating instream phosphorus concentrations in the water column that fuel aquatic biomass growth, and through the accumulation of phosphorus in the sediments that recycles through repeated biomass growth and senescence. These two processes annually fuel the observed excessive biomass growth in the Assabet River. The two-phase Adaptive Management approach laid out in the TMDL worked

with this reality, addressing both the sediment recycling of phosphorus and the constant new additions by the POTWs.

During the season when algae and other aquatic biomass is growing, the critical factor for eutrophication is the concentration of phosphorus in the water column. If this is increased, it provides an immediately available and ample supply of nutrients that algae and other aquatic plants need to increase their growth. When this biomass dies it settles to the bottom of the impoundment and adds phosphorus to the sediment. Over the winter, additional phosphorus from the POTWs is adsorbed from the water column onto the sediment, adding to the loading in the sediment. In the spring, the phosphorus contained in the sediment is used by directly by rooted aquatic plants and indirectly by algae and duckweed in the water column and at the surface to grow rapidly. Within a short period of time the impounded sections of the river (behind dams) are covered with plant growth that damages aquatic life and makes boating and scenic enjoyment nearly impossible.

A higher concentration of phosphorus will have a more deleterious impact on eutrophication and water quality during the summer/growing season. Our analysis (below) shows that the Final Permit would not have maintained and protected the existing in-stream uses, nor the level of water quality necessary to protect the existing uses of the Assabet River (and possibly also the Concord River). Thus the degradation of these modest gains would not be allowed under the State's Antidegradation Policy.

The gradual improvement of river conditions cited above, which happened without the benefit of direct sediment remediation by dredging or dam removal, is due to the initial effects of the strict controls on TP concentrations in POTW effluent. If loading and low-flow concentrations of TP were to increase, as allowed by the current permit, it would effectively roll

the rivers' water quality back in time to a more highly eutrophic condition. The improved segments delisted in 2016 and proposed to be delisted for 2018/2020 could revert to an impaired condition that would require the State to re-listed these segments as Impaired Waters.

The impact of this change

Lastly, we share our calculations that show that switching from concentration-based phosphorus discharge limits to load-based limits is a consequential change, particularly with no requirement to "obtain the lowest effluent concentration possible," which was removed from the Draft and Final Permit. Below, we provide three specific analyses that support the matters raised in the Petition, followed by the relevant calculations:

A. Comparison of 2021 and 2005 Marlborough permits – Potential impact of new permit on discharged load based on 2015-2019 flows. New load limit vs. Old concentration limit – summer (44% potential increase in effluent load)
B. Using the Region's method from Ashland, NH – Based on low summer flow events, what should the permitted load limit be? (51% lower than the new permit load limit)
C. Examining the impact of precedent – Potential impact of new permit on downstream concentration during low summer flow events (70% potential increase in concentration)

Analysis and Calculations

A. Comparison of 2021 and 2005 permits: The TMDL clearly states that the load limit of 2.4 lb/day is only the limit at the design flow of 2.89, not at lower flows. However, as shown in the table below, the facility rarely discharges at the design flow—the daily average flow in the summer is only 2.0 MGD. The TMDL was primarily based on models using low flows. The average summer flow for the five-year period starting April 2015 (2.00 MGD per the table below) multiplied by the concentration limit set by the TMDL and 2005 permit (0.1 mg/L) would result in an average daily load of 1.67 lb/day. Changing to a discharge limit of 2.4 lb/day under the new permit regardless of concentration, would represent a load increase of 44%.

WESTERLY WASTEWATER TREATMENT FACILITY Total Phosphorus

Actual Flow at Permit Concentration

	Average Daily Flow (MGD)	Average Concentration (mg/L)	Permitted Average Conc. (mg/L)	Average Daily Load at 0.1 mg/L (lb/day)	Monthly Load at 0.1 mg/L (lbs)
4/30/15	3.04	[illegible]	0.1	2.5	76
5/31/15	2	0.09	0.1	1.7	52
6/30/15	1.92	0.10	0.1	1.6	48
7/31/15	1.87	0.08	0.1	1.6	48
8/31/15	1.51	0.13	0.1	1.3	39
9/30/15	1.43	0.13	0.1	1.2	36
10/31/15	1.52	0.11	0.1	1.3	39
4/30/16	2.4	[illegible]	0.1	2.0	60
5/31/16	1.96	0.08	0.1	1.6	51
6/30/16	1.61	0.17	0.1	1.3	40
7/31/16	1.4	0.20	0.1	1.2	36
8/31/16	1.39	0.20	0.1	1.2	36
9/30/16	1.42	0.06	0.1	1.2	36
10/31/16	1.67	0.06	0.1	1.4	43
4/30/17	3.15	[illegible]	0.1	2.6	79
5/31/17	2.43	0.12	0.1	2.0	63
6/30/17	2.43	0.09	0.1	2.0	61
7/31/17	2.03	0.09	0.1	1.7	53
8/31/17	1.93	0.11	0.1	1.6	50
9/30/17	1.63	0.08	0.1	1.4	41
10/31/17	1.63	0.12	0.1	1.4	42
4/30/18	3.03	[illegible]	0.1	2.5	76
5/31/18	2.38	0.07	0.1	2.0	62
6/30/18	1.87	0.08	0.1	1.6	47
7/31/18	1.87	0.06	0.1	1.6	48
8/31/18	1.88	0.05	0.1	1.6	49
9/30/18	2.04	0.09	0.1	1.7	51
10/31/18	2.41	0.06	0.1	2.0	62
4/30/19	2.93	[illegible]	0.1	2.4	73
5/31/19	2.63	0.06	0.1	2.2	68
6/30/19	1.91	0.06	0.1	1.6	48
7/31/19	1.76	0.05	0.1	1.5	46
8/31/19	1.66	0.06	0.1	1.4	43
9/30/19	1.51	0.1	0.1	1.3	38
10/31/19	1.64	0.07	0.1	1.4	42
April 2015 - October 2019					
max summer	3.15	0.20	0.10	2.63	79
avg summer	2.00	0.10	0.10	1.67	51
total summer					1781

New Permit Limit

New permitted Daily Load (lb/day)	Monthly Load at 2.4 lb/day (lbs)	Potential Monthly Load Increase (lbs)	Potential Monthly Load Increase (%)
2.4	72	(-4)	(-5%)
2.4	74	23	44%
2.4	72	24	50%
2.4	74	26	54%
2.4	74	35	90%
2.4	72	36	101%
2.4	74	35	89%
2.4	72	12	20%
2.4	74	24	47%
2.4	72	32	79%
2.4	74	38	105%
2.4	74	38	107%
2.4	72	36	102%
2.4	74	31	72%
2.4	72	(-7)	(-9%)
2.4	74	12	18%
2.4	72	11	18%
2.4	74	22	42%
2.4	74	24	48%
2.4	72	31	76%
2.4	74	32	76%
2.4	72	(-4)	(-5%)
2.4	74	13	21%
2.4	72	25	54%
2.4	74	26	54%
2.4	74	26	53%
2.4	72	21	41%
2.4	74	12	19%
2.4	72	(-1)	(-2%)
2.4	74	6	9%
2.4	72	24	51%
2.4	74	29	63%
2.4	74	31	73%
2.4	72	34	90%
2.4	74	32	75%
2.40	74	(-4)	(-6%)
2.40	73	22	44%
	2568	787	44%

B. Using the Region's method to calculate a load-based limit in the 2021 Ashland, NH, NPDES Permit: In the draft permit issued for the Ashland Wastewater Treatment Plant in Ashland NH (Permit No. NH0100005), Region 1 specified a phosphorus concentration limit but sought comment on an alternative mass-based approach, stating "A mass-based limit must be calculated to be protective of the same instream Gold Book threshold of 0.100 mg/L. To ensure a mass-based limit is protective under critical flow conditions, the limit is calculated using the lowest expected receiving water flow and lowest expected warm weather effluent flow." In other words, in the Ashland permit, Region 1 explicitly recognized the implications of summertime low flow in setting the permit mass loading. If this approach was applied to the Marlborough permit, using the July 2016 low flow discharge, the load limit for Marlborough would be 1.18 lb/day, instead of 2.4 lb/day. The mass-based formula given in the Ashland permit is:

$$Md = (Qr*Cr*ReserveFactor - Qs*Cs) * 8.345$$

Where:
Md = mass-based phosphorus limit (lb/day)
Qs = 7Q10 flow upstream of the discharge (MGD)
Cs = upstream river phosphorus concentration (mg/L = ppm)
Qr = downstream 7Q10 flow (MGD)
Cr = downstream river phosphorus concentration (mg/L = ppm)

The following summarizes the application of this formula to the Marlborough Westerly Plant assuming that the upstream flow comes entirely from the upstream Westborough POTW. This is consistent with the 7Q10 of zero used in the 2020 Draft Permit for the Westborough POTW.

		At 7Q10 low flow July 2016		
Qs	Upstream Flow	4.86	MGD	Equals Westborugh flow during 7Q10
Cs	Upstream Concentration	0.10	mg/L	Equals Westborough concentration limit
Qd	Effluent Flow	1.40	MGD	Equals Marlborough flow during 7Q10
Cd	Effluent Concentration		mg/L	To be calculated
Qr	Downstream Flow	6.26	MGD	Sum of upstream and discharge
Cr	Downstream Concentration	0.10	mg/L	Target Gold Book concentration

		At 0% assimilitive capacity		At 10% assimilitive capacity	
	Mass Based TP Limit @ July '16 Flow	1.18	lb/day	0.65	lb/day
Cd	TP Concentration	0.10	mg/L	0.06	mg/L

C. Examining the in-stream impact of setting a precedent: If the Marlborough plant discharges 2.4 lbs/day at design flow (2.89 MGD), then the phosphorus concentration in the effluent would be 0.1 mg/L. However, if the plant discharges the same load at low flow, such as that during July 2016 7Q10 conditions (effluent discharge of 1.40 MGD), then the phosphorus concentration in the effluent would be 0.21 mg/L. Similar calculations for the Westborough POTW return 0.1 mg/L at design flow and 0.16 mg/L at low flow. Based on these concentrations, and assuming that during 7Q10 low-flow periods Westborough effluent constitutes the entire river flow upstream of Marlborough, phosphorus concentrations can be calculated for the river downstream of Marlborough as shown in the table below. If both plants discharge at the 2005 concentration limit (0.1 mg/L), then downstream concentration would logically also be at 0.1 mg/L. However, if both plants discharge at loads based on design flow during low flow, then downstream in-river concentration would increase to **0.17 mg/L**. If only Marlborough discharges at the 2021 load limit during low flow, then downstream in-river concentration would be **0.12 mg/L**. In both cases, in-river phosphorous concentration would be exceeding the guidance laid out in the Assabet River TMDL of 0.1 mg/L for free-flowing streams and would be significantly exceeding the guidance of 0.05 mg/L for streams entering reservoirs.
(Low-flow values come from the Region's electronic document for the Marlborough Final Permit, Pg. 234 (Pg. 16 of Fact Sheet))

Analysis of impact of discharging design flow load during low flow periods

		Marlborough West			Westborough	
		At Design Flow	During July 2016 Low Flow		At Design Flow	During July 2016 Low Flow
Load @ design flow	lbs/day	2.4	2.4		6.4	6.4
Flow	MGD	2.89	1.40 (2.17 cfs)		7.68	4.86 (7.52 cfs)
Calculated Concentration	mg/L	0.10	0.21		0.10	0.16

Analysis of resulting downstream concentration during 7Q10 low flow period similar to July 2016, if Marlborough discharges at load limit of 2.4 lbs/day.

Assumes that 7Q10 upstream flow is almost entirely Westborough discharge

		Westborough at concentration limit Marlborough at concentration limit		Westborough at concentration limit Marlborough at July 2016 Flow and load limit		Westborough at July 2016 flow and load limit Marlborough at July 2016 Flow and load limit
Upstream Flow	MGD	4.86		4.86		4.86
Upstream Concentration	mg/L	0.10		0.10		0.16
Effluent Flow	MGD	1.40		1.40		1.40
Effluent Concentration	mg/L	0.10		0.21		0.21
Downstream Flow	MGD	6.26		6.26		6.26
Downstream Concentration	mg/L	0.10		0.12		0.17

**Same result for low flow or design flow*