Idaho Pollutant Discharge Elimination System Effluent Limit Development Guidance

Supplemental



State of Idaho
Department of Environmental Quality
February 2019

Acknowledgments

The Association of Idaho Cities assisted the Idaho Department of Environmental Quality with developing the content of the *Idaho Pollutant Discharge Elimination System Effluent Limit Discharge Guidance Supplemental* in the interest of Idaho's citizens, to protect the water resources of the state, and to promote the advancement of our communities.

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1 Introduction

This *Idaho Pollutant Discharge Elimination System Effluent Limit Development Guidance Supplemental* supports the Effluent Limit Development Guidance (ELDG; DEQ 2017) by addressing special topics not covered within the ELDG. The Idaho Pollutant Discharge Elimination System (IPDES) Program faces challenging issues (e.g., nutrients, temperature, and toxics) and every circumstance and permit is unique. This Supplemental provides additional tools for permit writers to use when developing effluent limits that appropriately address protecting beneficial uses and comply with the water quality standards. In permits, writers may include the innovative approaches described in this Supplemental for the following:

- Requests by permittees that DEQ deems are appropriate for the conditions
- Approaches in the ELDG are determined insufficient to meet water quality standards.

This Supplemental supports implementation of the Clean Water Act (CWA), Idaho Code and administrative rules, federal regulations, and state and national policies, guidance, and standards and complies with Idaho's "Water Quality Standards" (IDAPA 58.01.02), "Wastewater Rules" (IDAPA 58.01.16), and "Rules Regulating the IPDES Program" (IDAPA 58.01.25). This document does not replace, supplant, or change any requirements under state or federal rules and regulations.

Special Topics

Using the ELDG and Supplemental as references, permit writers can make reasonable assumptions and consider innovative approaches (i.e., special topics) to develop permits for the following:

- Nutrients
- Temperature
- Select toxics
- Offsets
- Bubble/watershed permitting
- Adaptive management
- Integrated planning

The special topics pertain to water quality-based effluent limits (WQBELs) and not technology-based effluent limits. WQBELs in IPDES permits are a mechanism to achieve and maintain water quality standards in specific receiving waters, and the special topics generally are a function of both the effluent and receiving water. These topics should be considered through the perspective of effectively supporting and attaining protective water quality goals. Applying special topic approaches may result in changes to the magnitude, duration, and/or frequency of effluent limits with the effect of providing a more practicable and effective permit for both the State of Idaho and the permittee while still attaining and supporting water quality criteria.

DEQ believes the special topics may impact effluent limits and are beyond the scope of straightforward calculations. Each special topic is discussed with suggestions on how permit writers can address the topics and incorporate relevant limits, if necessary, in the permit. Using

special topics may result in differences in how the effluent limitations are expressed and/or special conditions in a permit such as requirements for additional monitoring or special studies, best management practices, or compliance schedules. The permit writer is not required to use the special topics within a permit; however, if special topics are necessary, the tools to meet these objectives are provided.

2 Nutrients (Nitrogen and Phosphorus)

Nutrients, except ammonia, are not toxic pollutants under the CWA so the need for effluent limits can be evaluated differently than toxics. In some cases suspected water quality problems due to nutrients may best be handled by the total maximum daily load (TMDL) process. Because permit effluent limits must be consistent with an existing TMDL, the process for addressing nutrients may require coordination with the surface water program to determine the best path forward. It is important to consider variability and reliability of effluent performance from advanced nutrient removal facilities. These technologies are highly effective in nutrient removal despite their inherent variability in effluent quality, particularly at low phosphorus and nitrogen concentrations (WERF 2010, 2011, and 2016). Permits may include water quality trading or offsets to improve water quality and meet nutrient discharge limitations.

Nitrogen and phosphorus can be subdivided into various compounds. Nitrogen compounds are represented as organic nitrogen, ammonia, nitrate, and nitrite. Phosphorus compounds are represented as organic phosphorus and dissolved phosphorus. These compounds may be further defined as labile (biologically available) or refractory (biologically unavailable). Some of these compounds, including ammonia and nitrite/nitrate, can be both plant nutrients and toxic to aquatic species. The ELDG, section 3.7.1.1, addresses nutrient speciation (DEQ 2017).

Nutrient speciation is an important consideration in monitoring programs and an area of potential confusion in vocabulary and laboratory analysis, especially at low concentration levels. A comparison of commonly used terminology in wastewater effluent monitoring and ambient receiving water quality monitoring and modeling is shown in (WERF 2016)

Nutrient speciation and bioavailability may be an important factor when:

- A receiving water body has low nutrient concentration targets;
- Management scenarios are planned with nutrient reductions, especially those approaching the limits of treatment technology; or
- Enhanced nutrient removal processes are currently used.

In these circumstances, the implications of nutrient speciation on treatment options and impact on the effluent limits may be assessed by the permittee. If the permittee choses to study the speciation of their effluent, technical evidence demonstrating refractory speciation must be submitted to DEQ for review and approval. This evidence will be made available for public comment as part of the draft permit and fact sheet if the results of the analysis are used as a basis for nutrient effluent limits.

Not all of the information to define nutrient species is available from conventional laboratory analysis. For nitrogen, a majority of the fractions may be analyzed in the laboratory with the remaining fractions calculated from the analyzed values, or estimated. Estimations may be

necessary for the labile and refractory fractions. For phosphorus, a minority of the fractions may be analyzed in the laboratory with the remaining fractions calculated from the analyzed values, or estimated. A different approach should be taken when very low nutrient concentrations become more important and understanding refractory compounds is necessary. For refractory compounds, the analysis methods are more complex and may use newly evolving methods (Brett 2015; Li and Brett 2013; and Sedlak 2003). When no sufficiently sensitive US Environmental Protection Agency (EPA)-approved method is available, DEQ may recommend suitable methods to evaluate refractory compounds.

DEQ may develop nutrient effluent limits using a ratio of refractory-to-total to adjust the total nutrient concentration and/or load. For example, if the current total nutrient effluent limit is 1 milligram per liter (mg/L) but 50% is refractory, the preliminary adjusted total nutrient effluent limit may be 2 mg/L because half the concentration is not immediately available to the environment. To ensure nutrient speciation is protective of the receiving water and a net increase in water quality is attained, the permit writer should incorporate a factor of uncertainty.

The permit should require as a condition that the operational treatment process that produced a certain refractory percentage be maintained, and any changes to the operational treatment process affecting nutrient treatment require a restudy of the speciation. The speciation restudy must be performed with each permit renewal application.

If the permittee pursues nutrient speciation in the permit, DEQ may require the permittee to provide a trophic state classification study as described in EPA's *Nutrient Criteria Technical Guidance Manual: Rivers and Streams* (EPA 2000b), and *Nutrient Criteria Technical Guidance Manual: Lakes and Reservoirs* (EPA 2000a). DEQ will consider the classification study when evaluating the applicability of a nutrient speciation plan.

As part of the study, the permittee may also be required to provide the following:

- Identify the stability of effluent nutrients using these measures:
  - Refractory nature of each nutrient
  - Conversion of nutrients from refractory to available.
- Submit proposed test methods to identify the individual nutrient species so monitoring and reporting ensure the actual loads discharged.

Further investigation into the system of concern may be necessary to better understand the potential impacts of both labile and refractory forms of nutrients may have on the system. EPA has developed stressor and response modeling guidance (EPA 2010) that may be helpful in this process.

Nutrient speciation applicability should be evaluated on a case-by-case basis. The amount of bioavailable nutrient discharged should in some cases be considered the sum of the currently bioavailable nutrient form and nutrient forms that have the potential to be bioavailable in the future. Simply monitoring for a nutrient species that is of concern may be appropriate for a localized immediate impact on the receiving water, but it may not be appropriate when considering far field impacts in a freshwater system. A study examining the bioavailability of varying forms of phosphorus in freshwater found "The rate of orthophosphate mobilization from different P compounds is highly variable depending on the type of mobilization mechanism

involved. Bioavailability must thus be determined and discussed with a certain time perspective in mind" (Boström et al. 1988).

3 Temperature—§316(a) Variance Approach

Sections 3.3.2.1.2 (water quality standards), 3.4.3.7.2 (thermal plumes), and 3.7.2 (WQBELs) of the ELDG provide the permit writer with specific temperature guidance.

This section provides the permit writer with the technical aspects of implementing a §316(a) demonstration to assist in early consultation and screening of a permittee's §316(a) application and review of the submitted demonstration. The example provided is based on the City of Boise's (2018) §316(a) demonstration for the Boise River and applies to thermal discharges from publicly owned treatment works (i.e., municipal facilities).

Temperature is not a toxic pollutant under the CWA, and the need for effluent limits can be evaluated differently than toxics. IDAPA 58.01.02.250 requires the permit writer to evaluate temperature impacts of the discharge on beneficial uses of the receiving waters and within a mixing zone (IDAPA 58.01.02.060). Additionally, specific requirements for point source wastewater treatment discharges must be considered (IDAPA 58.01.02.401).

In some situations, no cost-effective treatment options exist for temperature. Cooling towers and chillers are expensive and can be environmentally suboptimal. In some situations, the permit writer may choose to use the upcoming permit cycle to collect enough temperature data during the critical season to evaluate thermal discharge effects on beneficial uses. Data should be collected to characterize effluent and background receiving water temperatures and the available dilution during critical conditions. Water quality variances can also address temperature requirements.

CWA §316(a) provides that EPA (and delegated state agencies) may authorize alternate thermal conditions in National Pollutant Discharge Elimination System (NPDES) permits where the effluent limit is more stringent than necessary to ensure the protection and propagation of a balanced, indigenous population (BIP)[1] of shellfish, fish, and wildlife in and on the body of water into which the thermal discharge is made. Permittees seeking the thermal variance must demonstrate a variance is justified. For the permitting agency to determine whether a variance is warranted, the permit permittee must conduct scientific investigations to predictively or empirically demonstrate a BIP is currently protected, and will be maintained under a 316(a) temperature variance.

3.1 Receiving Water Considerations for §316(a)

Hydrologic alteration, in many cases, substantially changes the natural temperature regime. One common situation in Idaho is water stored in large reservoirs that thermally stratify, with release from low-level outlets during the summer irrigation season. This water management shifts water temperatures downstream on a seasonal basis because the reservoirs act as *thermal capacitors*,

[1] Balanced Indigenous Population (BIP) and Balanced Indigenous Community (BIC) are used interchangeably in §316(a) variation studies and both are used in DEQ and EPA rules and guidance (40 CFR 125.71 (c)).

storing cold snow melt runoff in spring and early summer, releasing colder hypolimnetic (bottom) water during the summer, and then releasing warmer water than would be present naturally during the fall and early winter seasons when air temperatures fall faster than released water temperatures. Another common hydromodification in Idaho is diverting water from rivers and streams for various uses, including domestic and industrial water supplies and irrigation. Reduction in stream and river flow may allow more solar warming than would otherwise occur naturally. Thus, hydromodifications can either decrease or increase water temperatures compared to natural conditions, or even both on a seasonal basis (MacCoy 2005). Another critical consideration for temperature is many streams and rivers naturally warm longitudinally as water flows downstream due to solar radiation inputs and hot air temperatures in a semiarid and hot climate (especially southern Idaho).

Because temperature is a *nonconservative* pollutant, thermal discharges tend to equilibrate to ambient temperatures downstream of the discharge. The following provides a discussion from Washington State Department of Ecology's (2010) guidance, *Procedures to Implement the State's Temperature Standards through NPDES Permits*:

> Non-conservative pollutants are defined as those that are mitigated by natural biodegradation or other environmental decay or removal processes in the receiving stream after in-stream mixing and dilution has occurred. The concentration of non-conservative pollutants is reduced after they are discharged into the receiving stream as a result of these removal processes.
>
> The temperature in effluent is considered a non-conservative pollutant and is reduced (i.e., cooled) after it is discharged into a cooler receiving stream. Cooling happens as a result of the transfer of thermal energy from the warmer effluent to the cooler stream and the thermal energy loss associated with evaporation of the effluent/ receiving water mixture. The rate of effluent temperature reduction is dependent upon many factors: dew point, radiant energy from the sun, receiving water surface temperature, flow, and currents and tides.
>
> It is important to remember that thermal energy is not "in" the water in the same sense that copper atoms and ammonium ions are in water. Thermal energy is absorbed by the water molecules, which is manifested as temperature and a property of the water.

3.2 §316(a) Process

The regulatory process followed in a §316(a) variance demonstration is summarized in Figure 1. The left side of the figure pertains to the short-term applicability of the §316(a) process for existing and near-term effluent discharges (i.e., for the next permit cycle or so). This short-term, Type I demonstration is based on EPA regulations for existing discharges to demonstrate, based on field studies, that *no appreciable harm* has occurred to the BIP from a discharge (40 CFR 125.73(c)(1)). The right side of the figure pertains to the longer-term, Type II demonstration of the §316(a) process for future growth and development expected to occur in a city over time to the point where design flows are treated at each publically owned treatment work. The modeling for the thermal mixing zones and far-field thermal modeling at design flow conditions are integrated with the biothermal assessment to demonstrate the BIP, as characterized by representative important species (RIS), will be protected at these future conditions for the thermal component of those discharges.

Figure 1 also shows the interrelationship between the short-term process and longer-term process, and the concept that the longer-term implementation of the process involves periodic monitoring and potential reassessment (e.g., for each 5-year permit cycle).

Both a Type I and II demonstration may not be needed at the time of permit issuance or reissuance. For example, if a particular municipality does not expect substantial growth over the next several permit cycles, the Type I, current condition, analysis alone may be sufficient for many years. The same could be true for an industrial discharger that does not anticipate a future increase in production, discharge flow, or temperature.

One outcome of a §316(a) demonstration is to develop alternative thermal effluent limits (ATELs) included in the permit. Typically, these are numeric temperature and/or thermal load limits and may include standards of performance, per EPA regulations as summarized in the ELDG.

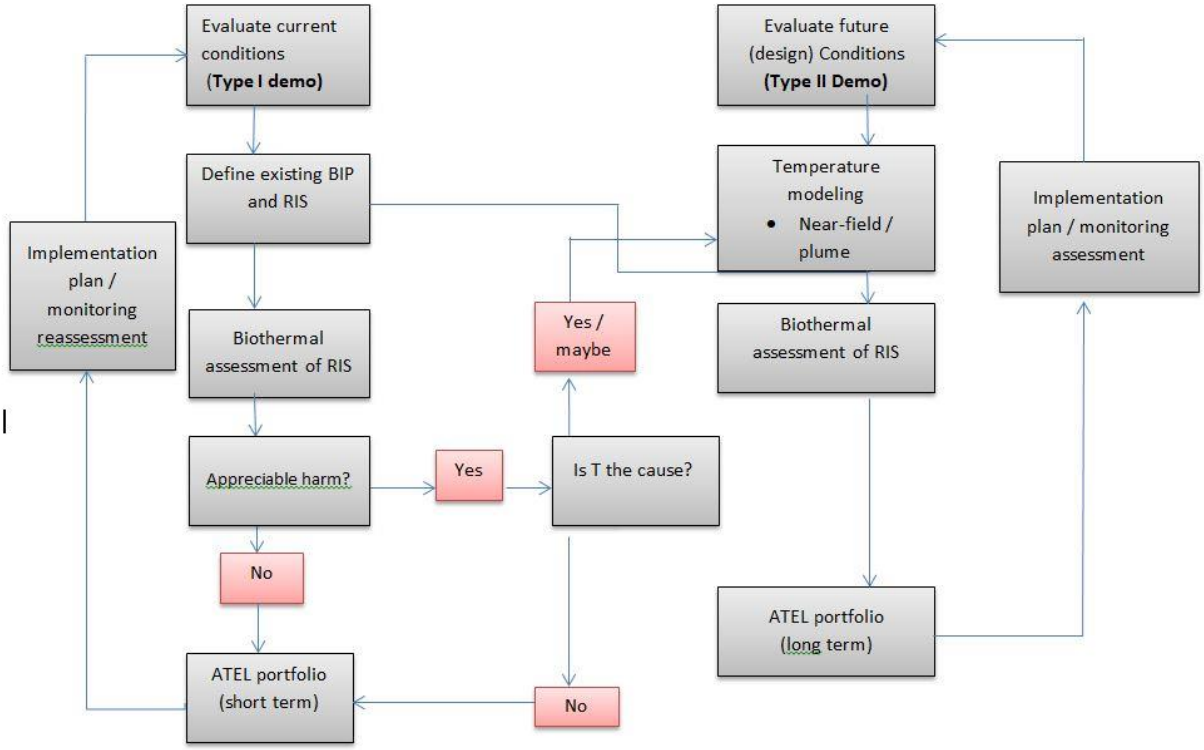


Figure 1. §316(a) bioassessment methodology.

In the City of Boise's §316(a) application, a portfolio of temperature management actions was incorporated into the demonstration and implementation process, as summarized below.

Boise City §316(a) Demonstration Study (2018)

In the winter, snowmelt and runoff from the upper Boise River watershed are stored in three large reservoirs (Anderson Ranch, Arrowrock and Lucky Peak). During summer, water released from Lucky Peak to the lower Boise River is much cooler than would naturally occur (promoting a productive cold water fishery for many miles downstream). Although cold water biota criteria

are usually met during this period, they may be exceeded or nearly exceeded a small percentage of the time (a low enough percentage of the time that this section of the river is not considered impaired for temperature and a TMDL is not required to be developed or implemented). Similarly, during the fall, water released is sometimes warmer than would naturally occur and may at times approach or exceed applicable salmonid spawning temperature criteria (not often enough to prompt an impairment listing or TMDL). This situation occurred when EPA issued NPDES permits in 2012 to the city for the Lander Street and West Boise Water Renewal Facilities (WRFs). The WQBELs were lower than existing WRF discharge temperatures and could only be met using effluent cooling and chilling technology, which was cost prohibitive and environmentally unsustainable. Consequently, the city developed a §316(a) variance demonstration.

The City of Boise's draft demonstration using the methodology in Figure 1 is summarized below:

- The Type I demonstration for current conditions involved the following:
  - The BIP was defined as fish and macroinvertebrate communities that exist in the river upstream and downstream of the water renewal facilities.
  - The RIS was defined as a subset of the BIP, specifically fish genera and species of resident trout and whitefish (Salmonidae), sculpin (Cottidae), suckers (Catostomidae), and dace (Cyprinidae).
  - The BIP evaluation of *no appreciable harm* consisted of applying and interpreting RIS longitudinal distribution and fish and BIP attributes (using DEQ bioassessment indices and temperature-specific community metrics) for the BIP and RIS upstream and downstream of each water renewal facility.
- The Type I demonstration was based on the following evidence:
  - Comparison of RIS presence:
    - No longitudinal trends except for the mottled sculpin and shorthead sculpin
    - Shorthead sculpin consistent reduction in presence going downstream
  - Comparison of fish and benthic macroinvertebrate community condition:
    - No longitudinal trend in River Fish Index.
    - Mixed results of longitudinal trend in River Macroinvertebrate Index.
  - Comparison of temperature-specific community metrics:
    - Trending towards warm-water species, but the trend is incremental and not punctuated at the water renewal facilities.
- Potential stressors
  - Nonpoint thermal load from multiple sources could have led to incremental trending of temperature-specific community metrics.
  - Increased embeddedness, decreased habitat connectivity, and decreased habitat complexity may have led to decreased sculpin presence.
- The Type II demonstration for future effluent design flow conditions involved the following:
  - The river temperatures in the near-field and far-field were modeled with EPA-approved models to show how the increased future discharges affected the river.
  - Biothermal criteria specific to the RIS (i.e., RIS thermal limits) were compared to the modeled river temperatures to assess if the RIS would be adversely affected.

- The Type II demonstration was based on the following evidence:
  - Comparison of far-field modeling
    - No exceedance of RIS thermal limits
    - Some incremental warming during *shoulders* of spawning season
  - Comparison of near-field modeling design flows meets DEQ's Mixing Zone Guidance:
    - The thermal effluent from both the Lander Street and West Boise water renewal facilities is less than 32 °C.
    - Less than 5% of the cross-sectional areas of both mixing zones are greater than 25 °C.
    - Less than 25% of the cross-sectional areas of both mixing zones are greater than 21 °C.
    - In spawning and incubation areas, the river temperatures do not exceed 13 °C more than 10% of the time.

The example above provides useful information to the permittee and permit writer about demonstrations in Idaho. Hydrological, thermal, and biological conditions vary considerably for each receiving water, and the permittee and DEQ must confer on the prospective methods in each case before submitting a formal demonstration. On a case-by-case basis, the permit writer will work closely with the DEQ's Surface Water Program to determine how to best approach temperature considerations and the applicability of §316(a) variances.

4 Select Toxics

Toxics encompass a large group of compounds that for the most part are covered by the ELDG; however, some unique scenarios are not addressed and are described here. A key challenge is the detection levels of some toxics are below what is achievable from a treatment technology standpoint.

4.1 Arsenic

Section 2.2.2.7.3 (effluent limit guidelines variances, waivers, and intake credits) of the ELDG (DEQ 2017) addresses approaches to parameters such as arsenic. Arsenic is common throughout Idaho due to the geology and occurs in many minerals and is present naturally in many Idaho surface waters. Subsurface anoxic conditions release naturally occurring arsenic from sediments into the ground water. Ground water is commonly used as a water supply, and arsenic can be present in the drinking water.

4.2 Phthalates (Bis (2-ethylhexyl) phthalate)

Bis (2-ethylhexyl) phthalate is a manufactured chemical commonly added to plastics to make them flexible (EPA 2015). The prevalence of plastics in the environment and even sampling equipment and laboratory analysis can result in random detections of concentrations in monitoring results. It may take additional resources and extra precautions to achieve reliable

samples without contamination. In the response to comments on the City of Meridian's draft permit, EPA wrote:

> The EPA has determined that there is insufficient information to demonstrate that the facility has the reasonable potential to cause or contribute to excursions above water quality standards for this pollutant. The EPA has determined that it is possible that the bis (2ethylhexyl) phthalate measurements upon which the reasonable potential finding was based could have been biased due to contamination during sample collection and analysis (EPA 2016).

In 2016, EPA replaced EPA Method 625 with EPA Method 625.1, which raised the minimum level for Bis (2-ethylhexyl) phthalate from 0.5 microgram per liter (µg/L) to 7.5 µg/L. This new minimum level accounts for sample contamination. The facilities should be aware of the potential for sample contamination and take steps to ensure proper sampling techniques are followed. Facilities should also use field and method blanks to assess test validity.

The permit writer is cautioned in using only one or two detection values of a parameter such as bis (2-ethylhexyl) phthalate when making a reasonable potential determination. As a national issue, permit writers should understand random detection of parameters such as bis (2-ethylhexyl) phthalate and carefully examine the data. The ELDG (DEQ 2017) addresses data in Section 1.5 "Data Analysis and Considerations" and references Section 12 "Data Analysis and Considerations" of DEQ's *Idaho Pollutant Discharge Elimination System User's Guide to Permitting and Compliance Volume 1—General Information*. If the permit writer concludes issues exist with data, the permit should contain language about additional monitoring. Example fact sheet language includes "The permit requires more frequent effluent monitoring to determine if water quality-based effluent limits are necessary."

4.3 Chlorinated Hydrocarbons

Chlorinated hydrocarbons are organic compounds containing at least one covalently bonded atom of chlorine that has an effect on the chemical behavior of the molecule. Chlorinated hydrocarbons face the same issues as described in section 4.2 with additional monitoring challenges, including low detection level method not approved, blank correction issues, and multiple congeners to assess.

Polychlorinated biphenyls (PCBs) are a subset of the broad family of chlorinated hydrocarbons. PCBs are a group of man-made organic chemicals consisting of carbon, hydrogen, and chlorine atoms. PCBs, even at low concentrations, are of concern based on the biomagnification properties and potential health risks involved with this pollutant. PCBs are not one constituent, but 209 constituents (congeners) comprising a total, and the analytical methods needed to detect each of these constituents at low concentrations are costly, which may become an expensive challenge for Idaho's dischargers, especially many of the smaller entities. Although the criteria are based on total PCBs, to reduce the source, the 209 congeners must be investigated.

Where PCBs are present, the permit writer should work with the permittee to explore source tracing through adaptive management and a toxic management plan. In general, for minor facilities (i.e., < 1 million gallons per day [mgd]) and on case-by-case basis for major facilities, DEQ may apply EPA Method 608. When no sufficiently sensitive EPA-approved method is available, DEQ will specify a sufficiently sensitive method to monitor pollutants (40 CFR 122.44(i)(1)(iv)(B)). However, testing for chemicals at low concentrations can be challenging and source tracing

efforts are not always successful. Any monitoring plan developed to trace PCB sources will require extensive forethought to account for each system's unique circumstances. Additionally, some industrial facilities have multiple wastewater streams that combine before the monitored outfall. In such cases, it may be required to limit PCBs at internal monitoring locations where concentrations are expected to be greatest (IDAPA 58.01.25.303.08). Permit requirements should identify and reduce the sources of greatest concern and concentration.

EPA Method 1668 may be used for PCB monitoring because it is the most sensitive method available and analyzes for all 209 of the individual PCB congeners (EPA 2013b,c). As stated in 40 CFR 136, "Method 1668C may be useful for determination of PCBs as individual chlorinated biphenyl congeners." EPA Method 1668 is appropriate for monitoring but not for determining compliance with limits.

> EPA methods 1668 and 8082 are not approved methods under 40 CFR Part 136, thus, if effluent limits for total PCBs are established in the future, methods 1668 or 8082 could not be used to determine compliance with such effluent limits unless those methods are approved under 40 CFR 136 for either nationwide or limited use at the time such limits are established (EPA 2013c).
>
> EPA regulations require that samples and measurements taken for purposes of monitoring shall be representative of the monitored activity. [40 CFR 122.41(j)(1) & 122.48(b)] EPA has approved test methods under 40 CFR Part 136 for use as compliance monitoring requirements in an NPDES permit. [40 CFR 122.41(j)(4)] Where an authorized State wants to include in an NPDES permit requirements to monitor for informational purposes with methods more sensitive than the measurement capabilities of methods approved in Part 136, the State may specify the suitable method. Under these circumstances, the State is not bound to require the use of a Part 136 method because no such method exists to provide data at required levels. The NPDES permitting authority is responsible for ensuring that the specified test method will yield results at concentrations of concern that are reliable enough to meet the needs for permit monitoring under the Clean Water Act. In addition, if an appropriate non-136 method is required for the use in the permit, the NPDES permitting authority should specify in the permit Fact Sheet/Statement of Basis not only the selected method but also state the rationale for specifying the selected method. (Virginia DEQ 2009)

When water quality criteria are lower than the approved methods for permit compliance, the permit writer should consider using a practical quantitation level or minimum level as the compliance level until analytical methods capable of measuring down to the potential effluent limits are approved. The IPDES User's Guide to Permitting and Compliance Volume 1 (DEQ 2016a) explains this scenario in sections 12.3.2 (sufficiently sensitive methods) and 12.4 (compliance with WQBELs below MDL or ML).

5 Water Quality Trading

Idaho's water quality trading guidance (DEQ 2016b) outlines the basic requirements for water quality trading but does not provide sufficient detail on incorporating water quality trading into permits. Detailed trading specifics must be identified in a DEQ-approved trading framework as outlined in the water quality trading guidance (DEQ 2016b). In the permit, the permit writer may outline specific trading compliance requirements. This trading language may be inserted under the permit conditions, special considerations, and/or compliance schedule sections. The permit may reference other documents and agreements between entities, such as point and nonpoint source relationships with the required accounting and banking of credits; however, the permit writer has the flexibility to outline the details on the specific trade within individual permits.

Key topics to address in a permit may include the following:

- Compliance plans
- Schedules of compliance
- Credit project plans
- Trading ratios
- Special conditions such as authorized activities, trading limitations, contingency provisions, monitoring, and reporting

As nonpoint sources are not always regulated or monitored, any point/nonpoint source water quality trading might require provisions in the permit for third-party monitoring and reporting on nonpoint source projects used for permit compliance (DEQ 2016b).

TMDLs typically provide the basis for water quality trading by setting a cap on a specific pollutant and developing waste load allocations (WLAs). If a TMDL is not in place, a similar analysis of pollutant load is required for DEQ review, approval, and public comment. Nutrients, temperature, and suspended solids may be considered for trading. DEQ does not anticipate trades involving bacteria and bioaccumulative toxics.

For example, the State of Virginia allows a permittee to operate under an umbrella permit for total nitrogen and total phosphorus discharges and trading, while maintaining individual permits referencing the watershed permit for total nitrogen and total phosphorus discharges and nutrient trading. This approach allows for limited text in individual permits (VAC 2018). Every facility owner is required to submit annual compliance plan updates to Virginia Department of Environmental Quality (Virginia DEQ), either individually or cooperatively, through the Virginia Nutrient Credit Exchange Association. These updates outline capital improvements and implementation schedules to achieve nitrogen and phosphorus reductions to comply with individual and combined WLAs. Virginia DEQ requires each permittee to maintain annual trading ledgers compiled for each basin (Exchange 2017). These trading ledgers provide the delivered WLA for all participants and the declared load, or the maximum-delivered load a facility can discharge and still meet its commitments to either supply or purchase credits. For a credit seller, the declared load is the delivered WLA minus the credits supplied. For a credit buyer, the declared load is the delivered WLA plus the credits purchased (Exchange 2017). The expected load is also provided to forecast the aggregate load of all participating facilities, neglecting the credit exchange, and provides a more comprehensive depiction of the nutrient reduction trends in the basin as a whole.

6 Offsets

A water quality offset occurs when a permittee implements or finances the implementation of controls for point and/or nonpoint sources to reduce the levels of a parameter discharged by the permittee to provide capacity equivalent to, or greater than the discharge parameter (WAC 2018). The purpose of a water quality offset is to sufficiently reduce the discharge of the parameter to levels in a water body so that the permittee's actions do not cause or contribute to a violation and results in a net environmental benefit. A single entity may offset a discharge through actions alternative to traditional treatment to achieve greater results.

6.1 Permit Examples

Examples of offsets in Idaho and other states where it has been implemented are discussed below.

- The 2012 NPDES permit for the West Boise Wastewater Treatment Facility (ID-002398-1) included an off-site treatment project called the Dixie Drain offset. The permit language stated "The permittee may meet the final effluent limits for total phosphorus through a combination of removal of total phosphorus at the West Boise Wastewater Treatment Facility and from the Dixie Drain at the Dixie Drain Treatment Facility" (EPA 2012a).
- The 2011 NPDES permit for the Spokane County Regional Water Reclamation Facility (WA-0093317) included an offset. The permit language stated "The Permittee may use the 'offset' total phosphorus from septic tank eliminations identified in the approved wastewater facilities plan as amended in November 2011, to offset the dissolved oxygen depleting value of CBOD5, total ammonia, or total phosphorus up to the value of the total phosphorus used in the approved offset scenario submitted to and approved by Ecology" (Ecology 2011). Spokane County provided sewer service to areas using septic systems. These septic systems were contributing a load of total phosphorus to the Spokane River. By treating and reducing this load, Spokane County earned a reduction credit that was then used to offset loads from the water reclamation facility during its initial permit.
- The City of Twin Falls was allocated a WLA for total suspended solids in the 2000 EPA-approved Upper Snake Rock Subbasin TMDL (DEQ 2000). The city in cooperation with DEQ proposed allocating a portion of the nonpoint source sediment load allocation to the city as a WLA. In return, the city agreed to implement nonpoint source reduction programs, specifically, two projects to construct wetlands where agricultural return drains discharge into the Middle Snake River. The wetlands filter out a sufficient quantity of sediment to offset the additional amount the point source discharges. Additionally, the wetlands provide treatment such as pathogen and nutrient reduction. This project demonstrates how offset projects can be developed to reduce the financial burden on the permittee while reducing the overall pollutant load entering the receiving water.
- The 2013 permit for the City of Santa Rosa incorporated a nutrient offset program via resolution and attachments to the permit (NCRWQCB 2013). The city conducted stream stabilization projects and worked with farmers to reduce nonpoint source loads into the system. The permit language stated "If the mass discharged is greater than the mass controlled, then the Permittee may use nutrient offset credits generated via the Regional Water Board Resolution No. R1-2008-0061 approving the Santa Rose Nutrient Offset Program (Attachment H)" (NCRWQCB 2013). The permittees calculated the loads controlled and discharged to achieve a combined limit through the use of the offsets.

6.2 Offset Requests

Requests for offsets must be submitted by the permit permittee because these are unique projects undertaken by the permittee. DEQ will review and approve the technical analysis demonstrating the equivalency in the requested pollutant offset. DEQ will need to develop unique permit language to include within the permit to address the offset.

The most likely constraint to developing an offset is opportunities within the same watershed, water body, and discharge entity. The further the facilities are apart the more challenging it will be to demonstrate equivalency. For example, a company with two industrial facilities in nearby but different watersheds will be unlikely to demonstrate equivalency. However, if the two facilities are near the downstream end of a watershed and the receiving waters converge into the same downstream water body, the possibility exists to demonstrate equivalency.

7 Watershed/Bubble Permitting

Watershed-based NPDES permitting is a process that addresses a variety of related water quality stressors within a hydrologic drainage basin, rather than individually addressing pollutant sources. Watershed-based permitting can encompass a variety of activities such as synchronizing permits within a basin; using WQBELs from multiple discharger modeling and analysis (e.g., TMDLs); or apportioning a total (*bubble*) load among multiple facilities to foster intramunicipal trading (section 5). The ultimate goal of watershed permitting is to develop and issue NPDES permits that better protect entire watersheds (EPA 2014).

Suitable applications for watershed permitting may exist in a number of Idaho watersheds and provide advantages over preparing and renewing individual permits. In most cases, the goal of watershed permitting is to implement TMDLs, water quality trading, adaptive management, surface water monitoring strategies, source water protection, or other programs (WDNR 2014). Watershed permitting provides compliance and implementation flexibility while applying creative approaches that meet entire watershed goals. Opportunities to collaborate and optimize management efforts can be supported with watershed permitting for individual entities interested in shared responsibility for watershed-based bubble limits.

7.1 Implementation

Initiating a bubble or watershed permit would generally be at the request of a permittee or group of permittees. A permittee with multiple facilities discharging to the same water body may request a bubble permit. Two or more permittees discharging to the same water body may agree to work together to use their facilities to meet a single watershed permit. The permittees must demonstrate to DEQ that such a request is technically and operationally feasible.

For example, for dischargers to the Boise River, the City of Boise could request a *mini* bubble permit that incorporates all three permitted facilities. To allow flexibility, the effluent limits tables could include protective maximums for each facility but also provide a combined maximum to allow the city to vary discharges from the facilities. The combined permit would maintain the individual facility effluent limits for parameters such as acute toxics.

Bubble or watershed permits benefit DEQ by reducing the total number of permits and creating coordinated efforts to protect water bodies as a whole and benefits permittees by providing additional flexibility in operations. The advantages of considering the entire water body aligns with other DEQ programs such as TMDLs. Merging permits when appropriate supports an entire water body rather than evaluating a single point source discharge. However, the effluent limits will be more complex and require additional technical analysis (e.g., using a water quality model

and/or other tools used for determining the TMDL but simulated with the proposed alternative conditions) by the permittee and DEQ. The permittee must submit technical evidence supporting proposed combined effluent limits for DEQ's review and approval.

7.2 EPA Policy

EPA published a significant amount of information about the watershed approach to permitting (EPA 1996; EPA 2003a, b; EPA 2007c) and released four policy statements about watershed-based NPDES permitting from 2002 to 2003.

- *Committing EPA's Water Program to Advancing the Watershed Approach*—a memorandum in Appendix A of EPA's watershed-based NPDES permitting implementation guidance (EPA 2003a) discussed although the watershed approach had been embraced by EPA for nearly a decade, substantial gaps in actual implementation existed. The memorandum also requested accelerated efforts to develop and issue NPDES permits on a watershed basis.
- "Watershed-Based National Pollutant Discharge Elimination System (NPDES) Permitting Policy Statement" (Mehan 2003) emphasized the memorandum recommendations are not binding and are not substitute for provisions or regulations.
- *Watershed-Based NPDES Permitting: Rethinking Permitting as Usual* (EPA 2003b) is a summary fact sheet describing the process and differs from the memoranda because specific nutrient case studies are mentioned.
- *Watershed-Based National Pollutant Discharge Elimination System (NPDES) Permitting Implementation Guidance* (EPA 2003a) provided implementation guidance as an attachment, focusing on program implementation but not technical, procedural, or administrative actions related to permit issuance.

These documents provide a framework for NPDES permitting with flexibility for state permit writers but without dictating a *one size fits all* approach. Watershed goals are often mentioned, implying that TMDLs and/or water quality standards are necessary and suggesting a given state has developed TMDLs and/or water quality standards that result in the need for discharge permitting to focus on a specific issue in a given watershed.

7.3 Watershed Permitting Case Studies

EPA provided several case studies of watershed-based NPDES permitting (EPA 2014). Nationwide, a number of widely recognized receiving waters where watershed permitting has been applied in creative ways illustrates potential approaches to consider in Idaho. The case studies below highlight key features in watershed permitting for nutrients:

- Tualatin River, Oregon (ODEQ 2016)
- Jamaica Bay, New York (NYSDEC 2015a, b, c, d)
- Chesapeake Bay, Virginia (Virginia DEQ 2014)
- Las Vegas Wash, Nevada
- San Francisco Bay, California (SFBRWQCB 2014)
- Mississippi River-Lake Pepin, Minnesota (MPCA 2015)

Watershed permitting has been an attractive approach to stakeholders in diverse watersheds across the country. The following sections discuss the unique nature of watershed permitting as it applies to individual watersheds, similarities in watershed characteristics, and broader watershed considerations. Descriptions of the resulting individual permit structures are found in the permits and in *Water Environment & Reuse Foundations Final Report : Nutrient Management Volume III* (WERF 2016).

7.3.1 Tualatin River, Oregon

Clean Water Services of Washington County operates four treatment plants in the suburban Portland, Oregon, area with innovative discharge permits. In 1988, TMDLs were established for ammonia and total phosphorus to address low dissolved oxygen and high pH levels in the Tualatin River, a subbasin of the Willamette River in Oregon. The TMDLs were updated in 2001 and expanded to include new parameters (water temperature, bacteria, and dissolved oxygen in tributaries).

In the late 1990s and early 2000s, several individual NPDES permits were expiring, allowing a unique opportunity for the Oregon Department of Environmental Quality (ODEQ) to consolidate Clean Water Services' (CWS) permits for four wastewater facilities and their storm water discharges with the Municipal Separate Storm Sewer System (MS4) permit into a single watershed NPDES permit (ODEQ 2016). ODEQ issued a single, watershed-based, integrated NPDES permit to CWS. This permit incorporated the NPDES requirements for four advanced wastewater treatment facilities, one MS4 permit and individual storm water permits for the Durham and Rock Creek Advanced Wastewater Treatment Facilities.

In 2012, a revised TMDL to address dissolved oxygen and phosphorus also included the creation of a new phosphorus trading program (ODEQ 2012). Phosphorus WLAs for the treatment facilities were revised, and trading phosphorus loads among the facilities was implemented under the watershed permit reissued in April 2016. The 2012 TMDL update provided a bubble allocation for the Forest Grove, Hillsboro, and Rock Creek facilities, which placed a ceiling on the combined allowable discharge load from the three facilities. The bubble allocation provides CWS with the flexibility to adopt innovative treatment at one or more of the upstream treatment facilities (Forest Grove and Hillsboro), knowing that minor variations in phosphorus treatment at the upstream facilities can be offset by proven advanced treatment technology already in place at the downstream facility (Rock Creek) (ODEQ 2012). While the Forest Grove and Hillsboro facilities were online at the time of the 2001 TMDL, they had not been discharging during the summer months. Instead, during the summer, raw wastewater from these treatment facilities was conveyed to the Rock Creek facility. As the population in the Tualatin Basin increases, CWS proposes (ODEQ 2012) to increase treatment capacity by maintaining the current capacity at its Rock Creek and Durham facilities, and by commencing summertime discharges at its Forest Grove and Hillsboro facilities (along with proposed plant upgrades to reduce nutrients prior to summer discharge). The Rock Creek and Durham facilities will increase capacity as needed once Forest Grove and Hillsboro are operating at full capacity during the summer.

For the initial implementation of the 2012 TMDL, CWS elected to apply the bubble concept to the Forest Grove and Rock Creek facilities. In addition, CWS recently implemented a natural treatment system at the Forest Grove facility to provide additional tertiary treatment and other environmental benefits for the watershed.

This intramunicipal trading allows CWS to manage multiple discharges as a system, apportioning a total load among multiple facilities. In this case, ODEQ had already issued a watershed permit that includes all four discharges under a single permit order.

This example shows how a permit writer can incorporate intramunicipal trading into watershed permits for facilities that have a nutrient WLA as a bubble load in the TMDL. One requirement for this type of trade is demonstrating that localized impacts are not expected at any of the discharge locations (ODEQ 2012). ODEQ demonstrated this by extensive water quality modeling and assessment for the 2012 TMDL and 2016 permit reissuance.

The phosphorus bubble limits in the 2016 permit are shown Table 1.

Table 1. Phosphorous limits in Clean Water Services Watershed Permit (ODEQ 2016).

Outfall Number	Parameter	Monthly Median Limit	Seasonal Median Limit	Applicable Time Period
D001	Total Phosphorus	0.11 mg/L	Not Applicable	May 1 – October 15**
R001	Total Phosphorus	0.10 mg/L	Not Applicable	May 1 – September 30**
F001A	Total Phosphorus	81.6 lbs/day – (calculated monthly median total phosphorus mass load from R001 [lbs/day])*	66.1 lbs/day – (calculated seasonal median total phosphorus mass load from R001 [lbs/day])*	May 1 – September 30**

* Phosphorous limitations for F001A based upon Table 2-13 in Chapter 2 of 2012 Tualatin TMDL. The monthly median limit at F001A will be calculated as follows: [Monthly median load (81.6 pounds per day) - ((Monthly median Rock Creek discharge concentration of total P mg/L) × (Actual monthly median Rock Creek effluent volume MGD) × (8.34 conversion factor))]. The seasonal median limit at F001A will be calculated as follows: [Seasonal median load (66.1 pounds per day) - ((Seasonal median Rock Creek discharge concentration of total P mg/L) × (Actual seasonal median Rock Creek effluent volume MGD) × (8.34 conversion factor))].

** Phosphorus limitations do not apply after September 15th provided diversions to Lake Oswego have ceased and the 7-day-average river flow at the Farmington Gauge is ≥ 130 cfs.

Notes: Outfall D001 is Durham, R001 is Rock Creek, and F001A is the Forest Grove facility.

7.3.2 Jamaica Bay, New York

Jamaica Bay is located at the southern end of Brooklyn and Queens and abuts the John F. Kennedy airport. The bay experienced dissolved oxygen water quality standard violations associated with ongoing hypoxia issues. The primary driver of the hypoxia is nitrogen input from the watershed. Four major New York City wastewater treatment plants discharge into Jamaica Bay (Coney Island, Jamaica, Rockaway, and 26th Ward). To address the hypoxia issue, the four treatment plants are subject to a total nitrogen limit imposed through the First Amended Nitrogen Consent Judgment (NYSC 2011). As an aggregate 12-month rolling average, the performance-based total nitrogen limits were implemented incrementally after completing treatment plant upgrades to provide biological nitrogen removal (Table 2). The performance-based total nitrogen limits incrementally step down in phases 19 months after operations start at the upgraded facilities. The wastewater treatment plant upgrades are outlined in a compliance schedule (NYSC 2011), which anticipates completing upgrades for the Jamaica and 26th Ward plants by 2016, and completing upgrades for the Rockaway and Coney Island plants by 2020.

Table 2. Total nitrogen interim effluent limits for Jamaica Bay (NYDEC 2015b).

Effective Date	Jamaica Bay Limits[a]
November 1, 2009	41,600 lb/day
January 1, 2012 (19 months after starting operation of the Level 2 upgrade at the 26th Ward WWTP on June 1, 2010).	36,500 lb/day
19 months after starting operation of the interim chemical addition facility for AT#3 at the 26th Ward WWTP.	Performance-based limit
19 months after starting operation of the last (a) Level 3 (Biological Nitrogen Removal) BNR upgrades at the 26th Ward WWTP, or (b) the Level 2 BNR upgrades at the Jamaica WWTP.	Performance-based limit
19 months after construction is completed for the (a) Level 1 BNR upgrade at Coney Island WWTP; or (b) Level 1 BNR upgrade at the Rockaway WWTP.	Performance-based limit

a. Step-down aggregate limits for all four Jamaica Bay WWTPs expressed as a 12-month rolling average.

A final aggregate nitrogen limit of 7,400 pounds (lb) per day was established for the four Jamaica Bay treatment plants (NYSDEC 2015a, b, c, d). A comprehensive report (NYCDEP 2006) determined the nitrogen discharges from the four treatment plants would have to be equal, or close to zero, to attain water quality standards for dissolved oxygen. The aggregate limit was calculated from the current technology limit for nitrogen treatment for a concentration of 3.0 mg/L and a projected flow of 296 mgd for the four Jamaica Bay plants in 2045. Therefore, the four plants have one combined nitrogen limit. The report was approved by the New York State Department of Environmental Conservation, and the projected 2,045 flows were used in additional performance modeling efforts including impacts from population increases.

7.3.3 Chesapeake Bay, Virginia

In 2000, the states in the Chesapeake Bay watershed signed an agreement to reduce nitrogen and phosphorus loads into the bay (CBP 2000), with WLAs assigned to major river basins in each state. The Virginia DEQ developed strategies for each of its tributaries entering the bay (Eastern Shore, Potomac, Rappahannock, York, and James), assigning nutrient load allocations to both point and nonpoint sources. A watershed-based general permit was developed to encompass 125 dischargers in 2006 (EPA 2007a; Virginia DEQ 2014), as well as a nutrient trading program.

A *delivery factor* was assigned to each of the dischargers to address each facility's distance to the water body of concern and the fate of the pollutant on its way there. For a given facility, different delivery factors were assigned for total nitrogen and total phosphorus. To date, all five river basins met the WLAs assigned in the general permit for total nitrogen, total phosphorus, and TSS. Virginia DEQ anticipates the existing general permit will be extended.

Dischargers have two basic options for compliance, either directly meet their annual WLA for nitrogen and phosphorus in their discharge, or obtain nitrogen and phosphorus credits to offset nitrogen and phosphorus loads exceeding their WLAs. Effluent limits in the permit are set as annual WLAs (i.e., lb/year of total nitrogen and total phosphorus). Concentration limits typically are included in individual Virginia Pollutant Discharge Elimination System (VPDES) permits when the treatment plant has received state Water Quality Improvement fund grants or revolving load funds to construction nutrient removal upgrades. The technology-based concentration limits

are set as annual average (mg/L) limits and depend upon what the wastewater utility indicates to the state the treatment process is designed to achieve. The concentration limits ensure the facility is operating the nutrient removal process as intended. As most discharge flows are below the plant design flow (WLA based), concentration-based limits also ensure that dischargers can generate nitrogen and phosphorus credits for trading.

In 2010, EPA finalized the Chesapeake Bay TMDL for nitrogen, phosphorus, and sediment (Virginia DEQ 2010). As part of compliance requirements, each state in the watershed is required to develop Phase I and Phase II Watershed Implementation Plans (WIPs), which describe how each state intends to implement TMDL provisions in their permitting programs and consider trading and other strategies. For example, the Virginia Phase I WIP (Virginia DEQ 2010) created a watershed cap on nutrient loads from significant point source dischargers. The Virginia Phase II WIP (Virginia DEQ 2012) focuses primarily on agricultural, storm water, and septic issues but also reports on expanding the nutrient credit trading program. For wastewater, the Phase II WIP provides some technical changes to Phase I WIP strategies and presents an updated permitting approach for combined sewer overflows (CSOs).

7.3.4 Las Vegas Wash, Nevada

Wastewater facilities serving City of Las Vegas, Clark County Water Reclamation District, and the City of Henderson discharge into the Las Vegas Wash, which ultimately flows into Lake Mead and the Colorado River. TMDLs were developed for total ammonia as nitrogen and phosphorus in 1989. Seasonal phosphorus and ammonia limits apply to the dischargers, and mass load allocations to the Las Vegas Wash are shared between three wastewater utilities. The dischargers were assigned individual WLAs and a cumulative total load, as shown in Table 3.

Table 3. Las Vegas Wash wasteload allocations for phosphorus and ammonia (WERF 2016).

Constituent	City of Las Vegas IWLA	Clark County Sanitation District IWLA	City of Henderson IWLA	Sum of Waste Load Allocations ΣWLA
Total phosphorus	123 lb/day	173 lb/day	38 lb/day	334 lb/day WLA applies March 1–October 31; no limit applies the rest of the year. Nonpoint source load is 100 lb/day.
Total ammonia	358 lb/day	502 lb/day	110 lb/day	970 lb/day WLA applies April 1–September 30; no limit applies the rest of the year. No nonpoint source load.

Note: IWLA = individual waste load allocation

The associated NPDES permits allow allocation trading between the dischargers. This permit condition constitutes a cooperative agreement between the utilities to allow discharge flexibility. Each facility has an individual waste load allocation (IWLA) and a sum of waste load allocations (∑WLA) is defined for all three facilities.

Annually, the dischargers may modify their individual allocations by transferring or receiving loads from another discharger. The annual reallocation must be documented and signed by all three dischargers and submitted to the state by May 31. The notification must include the flow,

waste load discharged, and treatment plant removal efficiency. An annual reallocation is considered a minor modification to the permit as long as the cumulative total load allocation is not changed.

Temporary trading of loads is allowed and must be documented in writing and signed by all three dischargers. The documentation must include the amount of the individual load allocation transferred, length of time the transfer is effective, and basis for the transfer to identify the last monthly flows and waste load discharged for each discharger. Transfers are binding on the parties and cannot be revoked without a notification signed by all three dischargers. The transferred load reverts back to the original permittee at the end of the specified time.

7.3.5 San Francisco Bay, California

The San Francisco Bay estuary has long been known to be nutrient-enriched. Despite this, the abundance of phytoplankton in the estuary is lower than expected due to a number of factors, including strong tidal mixing; high turbidity, which limits light penetration; and high filtration by clams. The estuary ecosystem is quite complex, with food web components influenced by both anthropogenic and natural drivers over decadal time scales (Cloern and Jassby 2012). While nutrient discharges to the San Francisco Bay have not yet resulted in impairment problems (e.g., excessive algal growth), recent studies show the bay's historic resilience to nutrient load may be weakening. As a result, nutrients are a growing concern for the health of the ecosystem.

Since 2006, the California State Water Resources Control Board and the San Francisco Bay Regional Water Quality Control Board (SFBRWQCB) have facilitated development of nutrient numeric endpoints for the bay. Additional activities include examining nutrient management strategies (SFBRWQCB 2012) and developing a nutrient assessment framework (Sutula et al. 2013).

The Bay Area Clean Water Agencies (BACWA) is a joint powers agency formed under the California Government Code by the five largest wastewater treatment agencies in the San Francisco Bay Area (BACWA 2014). The BACWA, SFBRWQCB, and the San Francisco Estuary Institute (SFEI) have had a strong working relationship for many years. In an initial effort to better understand the nutrient loads to the bay, SFEI compiled data showing municipal wastewater treatment plants represent about 63% of the annual nitrogen load to the bay (SFEI 2013). About 90% of the annual nitrogen load from municipal wastewater treatment plants is from facilities with a permitted design flow of 10 mgd or greater.

In 2012, BACWA requested a nutrient watershed permit concept evaluation (Grovhoug et al. 2012a), which considered seven different regulatory approaches, five different overarching frameworks, and several evaluation criteria. The three best alternatives met the regulatory approach to nutrient management (individual NPDES permits, nutrient watershed permit, and narrative objective implementation) and two met the overarching framework (basin plan amendment and memorandum of agreement/memorandum of understanding [MOA/MOU]). A follow-up evaluation (Grovhoug et al. 2012b) examined a narrative objective implemented in a nutrient watershed permit (i.e., regulatory approach) with an MOA/MOU and subsequent basin plan amendment (i.e., overarching framework).

BACWA approached SFBRWQCB and proposed a nutrient watershed permit, and BACWA and SFBRWQCB discussed the NPDES permit, with little EPA involvement. The nutrient watershed permit was signed in April 2014 (SFBRWQCB 2014) with an effective date of July 1, 2014, and an expiration date of June 30, 2019. Thirty-seven dischargers with a cumulative permitted discharge capacity nearing 860 mgd participate in this permit. Table 4 summarizes the design flows and existing nutrient loads from the five largest dischargers (BACWA principal members) out of 37 dischargers.

Table 4. Design flows and existing nutrient loads from BACWA principal members.

Discharger	Design Flow (mgd)	Average Annual Load (kilograms per day)	
		Total Nitrogen	Total Phosphorus
San Jose/Santa Clara Water Pollution Control Plant	167	5,233	332
City and County of San Francisco (southeast plant)	150	8,307	101
East Bay Municipal Utility District	120	10,583	973
East Bay Dischargers Authority	107.8	8,641	555
Central Contra Costa Sanitary District	53.8	4,187	138

Special provisions of the nutrient watershed permit require each facility to conduct or support three main areas that address nutrient reduction and receiving water quality:

1. Evaluate potential nutrient discharge reduction by focusing on options and costs for nutrient discharge reduction and optimizing current treatment works and side-stream treatment opportunities.
    - Describe the treatment plant, treatment plant process, and service area.
    - Evaluate site-specific alternatives, with associated nitrogen and phosphorus removal levels, to reduce nutrient discharges through methods such as operational adjustments to existing treatment systems, process changes, or minor upgrades.
    - Evaluate side-stream treatment opportunities with associated nitrogen and phosphorus removal levels.
    - Describe where optimization, minor upgrades, and side-stream treatment have already been implemented.
    - Evaluate beneficial and adverse ancillary impacts associated with each optimization proposal, such as changes in the treatment plant's energy usage, greenhouse gas emissions, or sludge and biosolids treatment or disposal.
    - Identify planning level costs of each option evaluated.
    - Evaluate the impact on nutrient loads due to treatment plant optimization implemented in response to other regulations or requirements.

2. Evaluate potential nutrient discharge reduction by identifying options and costs for potential treatment upgrades for nutrient removal or by other means.
    - Identify potential upgrade technologies for each treatment plant category with associated nitrogen and phosphorous removal levels.
    - Identify site-specific constraints or circumstances that may cause implementation challenges or eliminate any specific technologies from consideration.

- Include planning level capital and operating cost estimates associated with the upgrades and for different levels of nutrient reduction, applying correction factors associated with site-specific challenges and constraints.
- Describe where dischargers have upgraded existing treatment systems or implemented pilot studies for nutrient removal and document the level of nutrient removal the upgrade or pilot study is achieving for total nitrogen and total phosphorus.
- Evaluate the impact on nutrient loads due to treatment plant upgrades implemented in response to other regulations and requirements.
- Evaluate beneficial and adverse ancillary impacts associated with each upgrade, such as changes in the treatment plant's energy use, changes in greenhouse gas emissions, changes in sludge and biosolids treatment or disposal, and reduction of other pollutants (e.g., pharmaceuticals) through advanced treatment.

Nutrient removal by other means evaluates methods to reduce nutrient load through alternative discharge scenarios, such as water recycling or use of wetlands, combined with, or in-lieu of, the treatment plant upgrades to achieve similar levels of nutrient load reductions.

- Reduce potable water use through enhanced reclamation.
- Create additional wetland or upland habitat.
- Change energy use, greenhouse gas emissions, and sludge and biosolids quality and quantities.
- Reduce other pollutant discharges.
- Determine impacts to existing permit requirements related to alternative discharge scenarios.
- Determine implications to the discharge brine or other side-streams associated with advanced recycling technologies.

3. Evaluate monitoring, modeling, and embayment studies.
    - Develop and implement science plan to monitor nutrients in receiving waters.
    - Conduct receiving water monitoring for nutrients.

The NPDES permit allows wastewater facilities to perform the permit tasks as a group, or individually. All 37 participating facilities decided to perform the efforts as a group. A consulting firm performed two initial tasks, and each facility will receive a report to address the requirements for nutrient removal optimization and upgrade.

The third task, supporting the science plan, is an on-going effort led by SFEI. The key elements of the science plan are as follows:

- Monitoring special studies (e.g., algal toxin pigment studies).
- Modeling San Francisco Bay.
- Load analysis (e.g., moored sensors data).
- Develop a water quality assessment framework.
- Integrate across plans to develop an overarching nutrient strategy framework for San Francisco Bay.

7.3.6 Mississippi River–Lake Pepin, Minnesota

The Mississippi River–Lake Pepin watershed extends over 205,747 acres and includes the metropolitan Minneapolis area. Lake Pepin is 21 miles long and is the naturally widest part of the Mississippi River bordered by Minnesota and Wisconsin. Lake Pepin is impaired by high levels of nutrients that cause excessive growth of algae and high levels of sediment. The Minnesota Pollution Control Agency (MPCA) prepared Lake Pepin Site Specific Eutrophication Criteria, which were adopted as amendments to state water quality standards:

- Total phosphorus—100 µg/L
- Chlorophyll *a*—28 µg/L

The Metropolitan Council Environmental Services (MCES) operates seven wastewater treatment facilities in the Minneapolis metropolitan area that discharge to the Mississippi River–Lake Pepin watershed. Over the past 15 years, MCES made improvements to these facilities that dramatically reduced effluent phosphorus loads discharged to the river. Biological phosphorus removal at the Metropolitan Wastewater Treatment Plant (Metro Plant) decreased the phosphorus effluent load by approximately 90% between 2000 and 2011. Metro Plant performance has been at, or below 0.6 mg/L, operating under the historical effluent discharge limit of 1 mg/L total phosphorus.

7.3.6.1 Metropolitan Council Total Phosphorus Permit

In September 2015, the MPCA issued a total phosphorus discharge permit for five MCES wastewater facilities discharging to, or upstream of, the Mississippi River Pools 2, 3, and 4 and Lake Pepin. This permit defined specific conditions to implement a combined total phosphorus WQBEL for the five wastewater facilities covered by the permit.

The total phosphorus WQBEL covers the following MCES wastewater facilities: Eagles Point WWTP, Empire WWTP, Hastings WWTP, Metropolitan WWTP, and Seneca WWTP. Table 5 summarizes the wastewater facilities covered by the phosphorus bubble permit.

Table 5. MCES wastewater facilities covered in Mississippi River bubble discharge permit for phosphorus.

Facility Name	Average Wet Weather Design Flow (mgd)	Treatment Process Description
Eagles Point WWTP	11.9	Biological phosphorus removal
Empire WWTP	28.6	Biological phosphorus removal
Hastings WWTP	2.69	Conventional activated sludge
Metropolitan WWTP	314	Biological phosphorus removal
Hastings WWTP	38	Biological phosphorus removal

The permit authorizes MCES to aggregate the total phosphorus limit among the five wastewater facilities with the total mass load limits shown in Table 6. The permit covers only the discharge of phosphorus. Individual permits for the five facilities address all other conditions associated with the discharges to the Mississippi River.

Table 6. MCES total phosphorus limits for five facilities[a].

Parameter	Limit	Limit Type	Effective Period	Sample Frequency
Total phosphorus	159,349 kilograms per year	12-month moving total	Jan—Dec	1 per month
Total phosphorus	916.8 kilograms per year	Calendar month average	Jan—Dec	1 per month

a. Combined limit for five MCES wastewater facilities included in Mississippi River bubble discharge permit for phosphorus.

7.3.6.2 Bubble Permit Appeal

In May 2015, MPCA published a draft of the total phosphorous bubble permit for the five MCES facilities and the Minnesota Center for Environmental Advocacy (MCEA) submitted comments opposing the permit. MPCA responded to the MCEA comments and issued the permit in September 2015. MCEA petitioned to challenge the permit's issuance. MCEA argued the MPCA's decision to issue the permit was arbitrary and capricious because the effluent limits relied on voluntary reductions in unregulated nonpoint source pollution and that the permit violated federal law by allowing discharges in excess of water quality standards.

The Minnesota Court of Appeals issued a ruling in June 2016 that affirmed the permit as issued by MPCA (MCEA, Realtor, vs. Minnesota Pollution Control Agency 2016). The appeals court found that while MPCA must consider point and nonpoint sources of pollution in setting effluent limits, the fact that the permit by itself does not ensure meeting water quality standards does not render the permit arbitrary and capricious. The appeals court found substantial evidence that voluntary reductions from nonpoint source have occurred in the past and can be reasonably expected to occur in the future. A nutrient reduction strategy report was cited that found phosphorus pollution from nonpoint sources had been reduced by 8% in the Mississippi River basin since 2000. The appeals court also found since the MPCA based the phosphorus limit on long-term summer concentrations, the intent was not to focus on a single summer, and therefore MPCA did not act arbitrarily and capriciously in issuing the permit.

8 Adaptive Management in Permits

Adaptive management is an iterative process that implements certain controls to reduce pollutant loads, allows time to evaluate the effectiveness of the controls and obtain additional information, and uses the new knowledge to guide the next implementation step. In a successive process to improve water quality, adaptive management uses a phased approach of monitoring water quality responses to management activities. Adaptive management allows permit adaptability and advancement if receiving water objectives are achieved at an intermediate level. The process allows for significant results by providing the permittee with the flexibility to employ many different approaches to achieve the desired outcome. Adaptive management processes may be used on a case-by-case basis, but a compliance schedule is better suited to adequately protect beneficial uses as quickly as possible.

The relationship between nutrients in streams and aquatic life indices is not entirely linear or predictable. To accomplish water quality objectives, permit writers may use an adaptive management approach to plan and track successive permit iterations, particularly in locations

with insufficient data and limited ability to modify receiving water conditions. Rather than requiring a treatment facility to comply with new effluent requirements as final limits in a single step, interim limits and a compliance schedule provide an adaptive management approach to reaching final compliance in an optimal manner. A phased approach that initiates effluent discharge reductions and provides time to monitor the effectiveness of treatment and the water quality response can then be used to determine if additional improvement phases are necessary. More information on this approach is available from EPA (2007b), MDEQ (2017), and WERF (2016).

When a facility discharges to a nutrient-impaired water body, the permit should require monitoring of effluent nutrient discharges, as well as upstream and downstream receiving water conditions to establish a basis for assessing the influence of the discharge. These facilities must develop a study that evaluates the technical and financial capability of reducing nutrients to various levels from the facility. This study will be used to develop a plan for pollution reduction in the receiving water and must be submitted to DEQ for approval and implementation.

The permit will require receiving water to be consistently monitored and, at predetermined times, assessed for attainment of water quality standards. After assessment, if it is determined the goals have not been attained further treatment improvements can be implemented and/or the permittee may propose alternate reduction strategies to achieve future reductions. The strategies could include point source and nonpoint source trading, point source and point source trading, habitat restoration offsets, physical watershed alterations, or other approved nutrient management/reduction strategies.

Adaptive management examples are found implicitly in many permits, although they may not be stated as such explicitly. The term *'adaptive management*' can be found in permits for storm water MS4 and combined permits that include municipal and storm water discharges. For example, the Clean Water Services permit in Washington County, Oregon (ODEQ 2016) uses the term adaptive management.

> The permittee must follow an adaptive management approach to annually assess, and modify as necessary, existing SWMP components, and adopt new or revised SWMP components to achieve reductions in stormwater pollutants to the MEP, including applicable 303(d) and TMDL pollutants. The adaptive management approach must include, but is not limited to, the following...

More commonly the principles of adaptive management are incorporated in some fashion into the permit development and/or implementation such as in the following examples.

The term '*adaptive management*' is not found in the September 30, 2014 Coeur d'Alene WWTP (ID0022853) permit, but the concept is incorporated into many aspects of the permit. The Coeur d'Alene permit incorporates adaptive management by connecting the schedules in the compliance section and the interim requirements for schedules of compliance (Coeur d'Alene permit sections I.C and I.D.) The Coeur d'Alene permit uses annual compliance reports to ensure accountability for performance and to inform future decisions about the progress of subsequent treatment technology improvements. (EPA 2013b)

The Coeur d'Alene NPDES permit includes a 10-year compliance schedule spanning two, 5-year permit cycles. Table 7 highlights the permit's compliance requirements by year with comments on the decisions to be made in three potential improvement phases. The Spokane River dissolved

oxygen TMDL resulted in very restrictive wasteload allocations for phosphorus, carbonaceous biochemical oxygen demand, and ammonia nitrogen. The allocations were so challenging that treatment technology pilot studies were undertaken to determine the best approach to compliance. The permit compliance schedule provided the time necessary to ramp up pilot testing results to full scale, monitor the performance of the initial improvements, and revise the design and sizing criteria for subsequent improvement phases.

Table 7. Example compliance schedule with adaptive management features from the Coeur d'Alene Wastewater Treatment Plant NPDES permit.

Year	Final NPDES Permit December 1, 2014	Facilities Capital Improvement Plan	Comments
1 2014–2015	Preliminary engineering report, cost, and schedule submitted to EPA and DEQ—November 30, 2015	Design and build Phase 1 tertiary improvements	Revise/improve facility plan to take advantage of 2010/12 pilot testing findings; near-term ammonia compliance and new BOD limits
2 2015–2016	Submit progress reports—November 30, 2016	Complete Phase 1 tertiary improvements, operate, and gather data	Assess nitrifier seeding and tertiary membrane filter (TMF) performance
3 2106–2017	Notify EPA and DEQ of pilot testing—November 30, 2017	Performance assessment and design of Phase 2 tertiary improvements	Decisions: more TMFs, membrane bioreactors (MBR) or full-phase tertiary improvements
4 2017–2018	Submit progress reports—November 30, 2018	Build Phase 2 tertiary improvements	Match capacity to existing flows
5 2018–2019	Design completion and bid award—November 30, 2019	Build Phase 2 tertiary improvements	Permit expires—November 30, 2019
6 2019–2020	Annual report to EPA and DEQ Submit progress reports—November 30, 2020	Design Phase 3 tertiary improvements (only if necessary based on flows and loads, or treatment performance)	Decisions: more TMFs, MBR ,or full-phase 1, 2, and 3 tertiary improvements (full facility plan)
7 2020–2021	Annual report to EPA and DEQ Submit progress reports—November 30, 2021	Build Phase 3 tertiary improvements	Triggered based on growth in flows and loads, or treatment performance
8 2021–2022	Notify EPA and DEQ construction completion—November 30, 2022	Design and build additional facilities for 6 mgd	Implement final Phase 3 tertiary improvements
9 2022–2023	Submit progress reports—November 30, 2023	Performance assessment and optimization	City operations to focus on optimization for 2-year period before final limits
10 2023–2024	Report to EPA and DEQ on completed start-up and optimization (2-years operating data)—November 30, 2024	Performance assessment and optimization	Full compliance required with new NPDES permit limits (ammonia and phosphorus)

For example, the interim requirements in the permit are as follows:

1. "The permittee must provide a preliminary engineering report to EPA and IDEQ outlining estimated costs and schedules for completing capacity expansion and implementation of technologies to achieve final effluent limitations." The facilities plan section design and build Phase 5C.1 was revised and improved to take advantage of pilot testing findings.

2. "The permittee must provide written notice to EPA and DEQ that pilot testing of the technology that will be employed to achieve the final limits has been completed and must submit a summary report of results and plan for implementation." The City completes facilities plan item 5C.1 including operating and gathering data to assess nitrifier seeding and the tertiary membrane filter.

Additional reporting is required to be submitted to EPA and DEQ. The city decided to add more TMFs, MBR, or go to full phase, followed by ramping up the treatment abilities to match capacity to existing flows. The annual reporting continues to demonstrate advancement along the compliance schedule. As a result, the city was able to take incremental steps, monitor progress, and make smart decisions on how to upgrade the treatment process. This adaptive management approach will result in full compliance with new ammonia and phosphorus limits at the end of the compliance schedule.

9 Integrated Planning

In June 2012, EPA released an *Integrated Municipal Stormwater and Wastewater Planning Approach Framework* (EPA 2012b) to help local governments meet CWA water quality objectives and prioritize capital investments.

> An integrated planning approach offers a voluntary opportunity for a municipality to propose to meet multiple CWA requirements by identifying efficiencies from separate wastewater and stormwater programs and sequencing investments so that the highest priority projects come first. This approach can also lead to more sustainable and comprehensive solutions, such as green infrastructure, that improve water quality and provide multiple benefits that enhance community vitality. (EPA 2017)

In developing the framework, EPA offers communities the operating principles and integrated plan elements to justify prioritizing local implementation actions that are relevant to storm and wastewater facilities (Figure 2).

The National Association of Clean Water Agencies described EPA's Integrated Planning Framework as "…a pragmatic yet effective path for communities to more affordably address water quality obligations" (NACWA 2017). Integrated planning allows a community to prioritize its obligations and spend their limited resources on the most pressing water quality challenges first, develop innovative ways of doing business, and achieve net environmental outcomes that protect water quality and public health at an efficient cost.

Permittees should work with DEQ before undertaking an integrated plan because without collaboration there is no guarantee IPDES permits will be developed to facilitate the planning. As a key component of integrated planning, scheduling must be reflected in interim effluent limits, compliance schedules, and in the timing of other aspects of IPDES permits. A permittee must submit an integrated plan with the supporting technical analysis for DEQ's review and approval before any changes to the permits may occur. The integrated plan must demonstrate with assurances that the proposed schedule of activities can be met.

All or part of an integrated plan can be incorporated into an IPDES permit as appropriate. Consider the following:

- Compliance schedules that incorporate integrated plan components with the most sensitive uses prioritized.
- Green infrastructure approaches and related innovative practices that provide more sustainable solutions for managing storm water as a resource, where appropriate, and for municipal wet weather control.

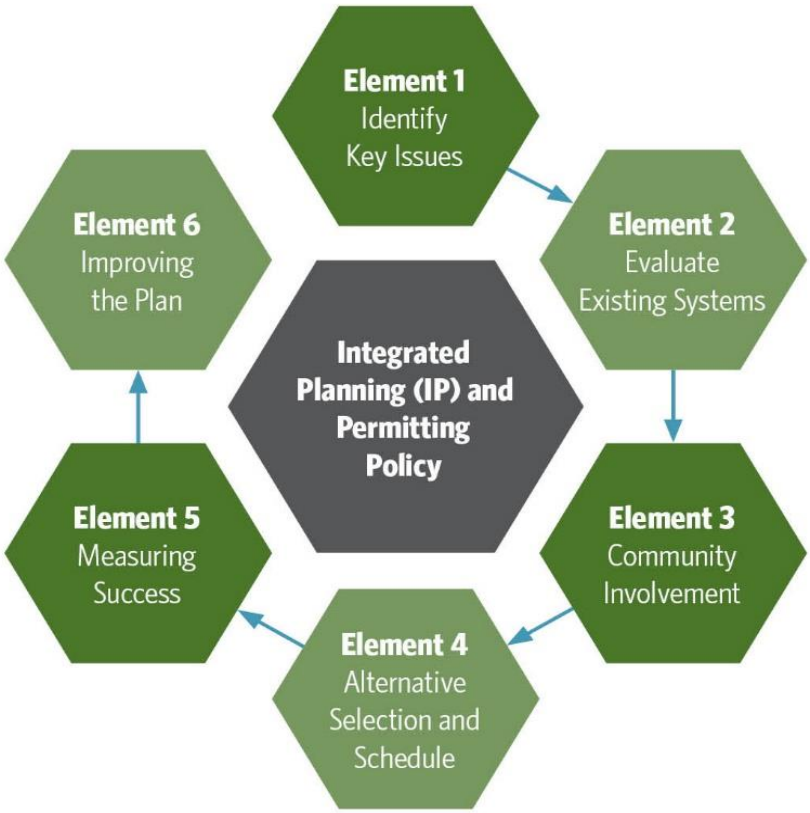


Figure 2. Integrated planning and permitting policy approach provides flexibility to make smart decisions based on community priorities (HDR 2016).

9.1 Connecting Elements into an Integrated Plan

Integrated planning encourages sustainable and comprehensive solutions, such as green infrastructure, to protect human health, improve water quality, manage storm water as a resource, and support other economic benefits. In integrated planning, solutions are prioritized and consider stakeholder input and community values, the cost and benefits of water quality improvement projects, and the community's ability to afford these costs over time (HDR 2016).

After a discussion with the U.S Conference of Mayors (USCM) about the ability of communities to afford water quality improvements based on median household income (MHI), EPA (2013a) issued the memorandum, *Assessing Financial Capability for Municipal Clean Water Act Compliance*, which allows a broader scope for assessing affordability. In collaboration with the American Water Works Association and Water Environment Federation, USCM published the Affordability Assessment Tool for Federal Water Mandates to further define alternative ways affordability can be viewed in communities (HDR 2016).

Adopting an integrated approach to CWA obligations is a voluntary and locally driven process, requiring collaboration between the permitted agency, local permit authorities, EPA, and local enforcement officials. This approach helps a permittee manage budget and schedule to reduce delays in improvements that benefit the environment and water quality.

9.2 Integrated Planning and Permits in the Northwest

Integrated planning may provide the basis for a compliance schedule that reflects local priorities and affordability in ways that link the timing of technical studies and construction of infrastructure improvements in a logical and interconnected way. The order and schedule of infrastructure improvements is important because that may inform the pace at which necessary improvements can be accomplished for compliance with discharge permit requirements. In such cases, discharge permits may include a compliance schedule and interim effluent limits that characterize what needs to be attained at various stages of a program. The following sections provide are examples of integrated planning in the Northwest that may influence discharge permits.

9.2.1 Seattle Public Utilities

Seattle Public Utilities' (SPU) integrated plan lays out CSO and storm water projects from now until 2030. The small CSO projects have a high cost per gallon to implement. The integrated plan concludes that alternate storm water projects will yield higher value in terms of pollution avoided. SPU expects to meet or exceed the integrated plan pollutant removal estimates based on conservative assumptions using a Monte Carlo simulation.

SPU's integrated plan proposes to delay correcting six low-frequency, low-volume CSOs for 5 years. In exchange, SPU will implement a near-term storm water project and two programs to remove a substantially greater pollutant load from area waters. The storm water project consists of the South Park Water Quality Facility (WQF) removing pollutants that enter the Lower Duwamish from a 250-acre basin. The South Park WQF takes part in a local flood control project whose pump station will deliver storm water flows to the treatment facility. As part of the integrated plan, SPU will monitor the project to ensure project goals are met. The two programs implemented as large pollution reducers in the integrated plan are the Natural Drainage Solutions and the Street Sweeping for Water Quality programs. In the Natural Drainage Solutions Program, SPU partnered with the Seattle Department of Transportation, Office of Sustainability and Environment, and community groups to develop roadside rain gardens that also serve as traffic-calming facilities. This program aligns with the city's Green Goal and Neighborhood Greenways Initiative. The successful Street Sweeping for Water Quality program, initiated in 2011, doubles the frequency of arterial sweeping to weekly, and extends the number of weeks of sweeping each year. An unexpected benefit from this program is that facilities not scheduled for construction in the future will now be implemented because of the water quality benefits they will deliver, drawing praise from the Washington State Department of Ecology for innovation.

9.2.2 City of Billings

The City of Billings faces many water management challenges. First, their discharge permit from the central wastewater treatment plant to the Yellowstone River is due for renewal; three major

local industries asked for connection to city sewer service; and multiple TMDLs are scheduled for the Yellowstone River. Second, their drinking water treatment facility is nearing capacity, and third, the city faces new storm water quality regulations from the Montana Department of Environmental Quality's Phase 2 MS4 program. Rather than handle these issues independently, the city looked at these issues together and contemplated ways the water-related utilities could work together to meet multiple objectives through integrated planning.

This integrated plan blended the city's goals with stakeholder input to identify potential programs and actions to provide enhancements to future utility operations and address present and future regulatory challenges. Six overall water management alternatives were developed and each included wastewater, drinking water, and storm water components. A stakeholder group helped develop the criteria and weighting to evaluate alternative water management approaches. The stakeholder group included political interests (city council, utilities board, and county), economic interests (Chamber of Commerce, large local industries/refineries, and realtors), and the regulatory community (Montana Department of Environmental Quality and EPA). The permit renewal is still under development, so incorporating the integrated planning results into the permit is pending.

10 Summary

This Supplemental provides tools for permit writers to use when developing effluent limits that may be appropriate on a case-by-case basis. The permit writer will document in the fact sheet how the final limits in the permit were determined and how those limits meet both technology and water quality standards (including antidegradation) and, where appropriate, how an antibacksliding analysis was applied to the final effluent limits.

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