Development of a Conceptual Nutrient Trading Program for San Francisco Bay

Phoebe Grow*, East Bay Municipal Utility District
Yun Shang, East Bay Municipal Utility District
Bennett Horenstein, East Bay Municipal Utility District *(retired)*
Alex Johnson, The Freshwater Trust
Erik Ringelberg, The Freshwater Trust
Chris Thomas, The Freshwater Trust

**corresponding author: phoebe.grow@ebmud.com*

ABSTRACT

As part of a U.S. EPA grant-funded study, East Bay Municipal Utility District (EBMUD) worked with U.S. EPA to develop a scope of work to develop a conceptual nutrient trading program for the San Francisco Bay (Bay). Water quality trading, in coordination with ongoing water quality studies and modeling efforts, could allow for regional nutrient management solutions that are more economical and environmentally beneficial than the aggregate impact of implementing upgrades at individual Wastewater Treatment Plants (WWTPs).

The objective of this work was to develop a common understanding among key stakeholders of what a regional nutrient trading program could look like for the Bay. The focus of this work was on trading nutrient "credits" between point sources (WWTPs specifically), but the potential inclusion of nonpoint sources was also examined.

INTRODUCTION

Over seven million people live in the San Francisco Bay area, generating a significant amount of nutrient loading to the Bay through wastewater discharges. A growing body of evidence suggests that the historic resilience of the San Francisco Bay (Bay) to nutrient enrichment could be weakening. This has generated increased concern for regulators and stakeholders, and has prompted the development of strategies to manage nutrient loads. WWTPs (**Figure 1**) are estimated to contribute over 60% of the nitrogen load to San Francisco Bay.

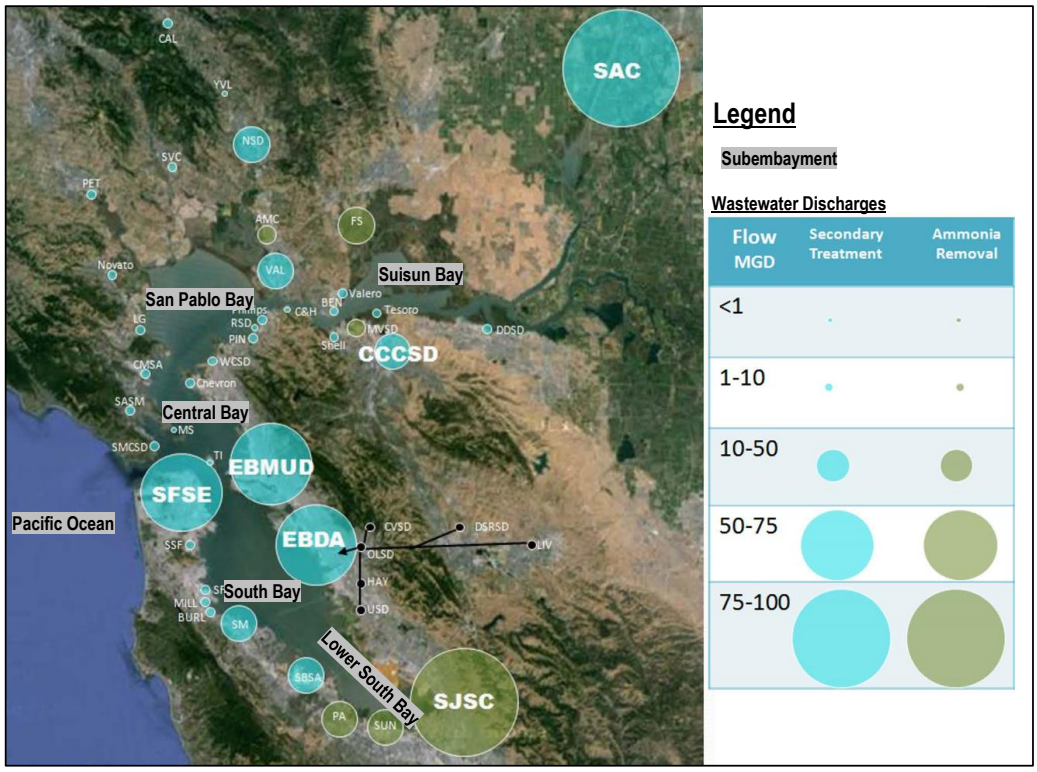


Figure 1 - San Francisco Bay Subembayments and Wastewater Discharges

CURRENT REGULATORY STATUS OF NUTRIENT DISCHARGES TO THE SAN FRANCISCO BAY

In 2014, the San Francisco Bay Regional Water Quality Control Board adopted Order No. R2-2014-0014, which established Waste Discharge Requirements (WDRs) for nutrient discharges to the Bay from 34 outfalls for treated municipal wastewater.[1] That order, commonly referred to as the Nutrient Watershed Permit, sets forth a regional framework to facilitate collaboration on studies that will inform future management decisions and regulatory strategies.

The 2014 Nutrient Watershed Permit contains effluent monitoring requirements but does not include effluent limits. It stated that in future reissuances of the Watershed Permit:

> *…the Regional Water Board anticipates considering the establishment of performance-based effluent limits for nutrients and may require implementation of treatment optimization or other means to reduce loads or increase assimilative capacity if scientific studies show results that warrant such activities. The Regional Water Board will also consider load offsets between Dischargers with and between subembayments if permissible.*

As such, nutrient trading (or "load offsets between Dischargers") has already been acknowledged as a potential compliance strategy if nutrient effluent limitations are enacted in future permits.[2]

The Nutrient Watershed Permit also requires that the dischargers evaluate the cost of treatment upgrades for nutrient control and support region-wide efforts to model nutrient impacts in the Bay. If a nutrient trading program is ever to be developed for the Bay, this cost information and the water quality modeling capability will form an essential foundation for such a program. Early results of the cost estimating efforts indicate that the cost for nutrient removal varies greatly between Bay Area WWTPs. As such, the potential for water quality trading to allow nutrient loading reductions at a reduced cost is likely high.

FEDERAL AND STATE AUTHORIZATION FOR WATER QUALITY TRADING

Water quality trading, and nutrient trading specifically, is well supported by federal regulations and guidance. Although California has not adopted any statewide regulations or policies concerning water quality trading, the discretion vested in the State Water Resources Control Board (SWRCB) and the Regional Water Quality Control Boards (Regional Water Boards) enables the development of water quality trading programs. This section provides an overview of the Federal and California State authorizations for water quality trading as well as an introduction to the main organizational features of trading programs.

Federal Authorization and Guidance for Water Quality Trading

In 2003, the U.S. EPA published a final water quality trading policy (EPA Trading Policy) outlining how water quality trading can be used as a flexible approach for Clean Water Act (CWA) compliance.[3] The EPA Trading Policy provides a framework for water quality trading consistent with the CWA's anti-backsliding policy, compliance and enforcement provisions, and public notice and comment procedures. The EPA Trading Policy also explicitly endorses trading for nutrients and other pollutants. To further support water quality trading, the EPA issued the *Water Quality Trading Toolkit for Permit Writers* in 2007.[4]

EPA guidance does not require a Total Maximum Daily Load (TMDL) as a prerequisite to water quality trading.[5] Although not a requirement, a majority of trading activities do take place under existing TMDLs. This is because trading requires a firm understanding of the water quality conditions in the waterbody. In the absence of a TMDL, water quality trading requires a TMDL-like watershed analysis capable of properly dividing load between sources and clarifying the watershed's characteristics, thereby creating the baseline necessary for trading activities.

Water quality trading requires that credit sellers reduce pollution beyond what would have occurred in the absence of a trading program, a concept known as additionality.[6] Financial additionality ensures that money used to generate credits is not money that would have benefited the environment otherwise.[7] Guaranteeing that financial

additionality is satisfied in the context of point-to-point source trading essentially looks to the underlying purpose of the sources of funding, ensuring that the finances were not intended for a non-compliance purpose. Only money raised or allocated for Clean Water Act compliance actions may be used for credit generation or the purchase of credits. Importantly, this restriction does not extend to public loans intended to be used for capital improvements of public water systems—this funding is intended to help achieve regulatory compliance and therefore does not result in any additionality issue. Generally, State Revolving Funds (SRF) can be used for credit-generating projects. [8]

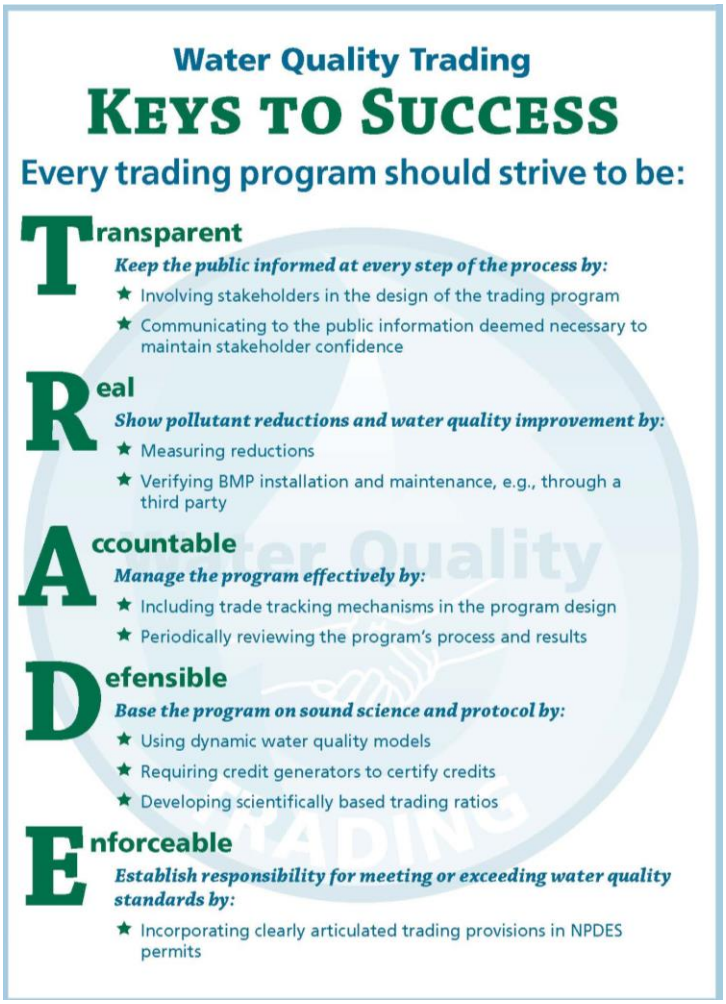


Figure 2. Keys to Water Quality Trading Success[9]

Source: U.S. EPA, Water Quality Trading Toolkit for Permit Writers, 15–17, EPA 833-R-07-004 (Aug. 2007, updated June 2009), available at www.epa.gov/npdes/pubs/wqtradingtoolkit.pdf

California State Authorization for Water Quality Trading

While California has not implemented any statewide regulations concerning water quality trading, there are no regulatory barriers to water quality trading in California or in the Bay Area specifically. As noted earlier, the Nutrient Watershed Permit explicitly mentions trading as a potential future compliance strategy.

While it does not mention water quality trading specifically, the SWRCB's 2005 *Water Quality Control Policy for Addressing Impaired Waters* states that the "Water Boards are committed to [using] all means to ensure that the waters of the state are protected" and goes on to discuss the "wide latitude" and "numerous options" available to the Regional Water Quality Control Boards to address impaired waters.[10] Furthermore, a 2001 memo from SWRCB's legal counsel stated that even in the absence of a TMDL, trading programs appeared consistent with water quality regulations so long as those programs complied with the applicable water quality standards.[11] A follow-up memo from the SWRCB's legal counsel further clarified that:

> *The use of offsets, pollutant trading, or other market-based mechanisms . . .is clearly appropriate when implemented in the context of a TMDL, in which case, substantial flexibility exists to achieve [water quality standards].*[12]

Although there are not presently (and may never be) any nutrient TMDLs for the San Francisco Bay, the Regional Water Boards have sufficient discretion to allow National Pollutant Discharge Elimination System (NPDES) permit compliance through trading, even in the absence of a TMDL.

OVERVIEW OF TRADING PROGRAM ORGANIZATION

There are several general categories of water quality trading programs based on the types of participants:

- *Point source-to-point source trading* occurs between regulated point sources, such as WWTPs or industrial dischargers. EPA considers point-to-point source trading "the most basic form of water quality trading" because it is "relatively straightforward, easily measurable, and directly enforceable".[13] For this reason, and because WWTPs contribute the majority of the nutrient loading to the Bay, the focus of the conceptual nutrient trading assessment has been on point-to-point source trading.
- *Point source-to-nonpoint source trading* occurs when a regulated point source offsets a portion of its discharges through environmental restoration or related action that addresses nonpoint source pollution. Nationally, point-to-nonpoint trading is the most common form of water quality trading.
- *Nonpoint-to-nonpoint source trading.* The last type of trading program involves trades between multiple nonpoint sources, such as municipal separate storm sewers.

For point-to-point trading, the focus of this study, the EPA identifies three primary models: (1) trading between two point sources; (2) multiple facility trading without a central exchange; and (3) trading through a point source credit exchange.[14] All three models could potentially be used by WWTPs in the San Francisco Bay Area. **Figure 3** below provides brief descriptions from the EPA Water Quality Trading Toolkit of these trading models.

Trading Between Two Point Sources

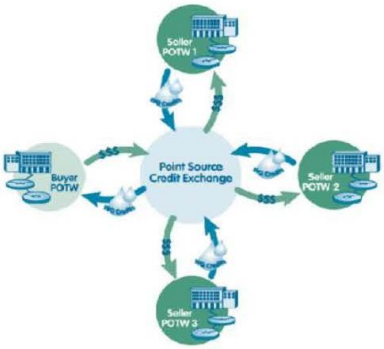
Single point source–single point source trades generally involve a trade agreement[1] between two point sources. In this type of trade, one point source is the credit generator and the other is the credit purchaser. For point source–point source trades, a single permit can be issued that incorporates or references the trade agreement and includes both point sources as co-permittees. Alternatively, each discharger can be issued an individual permit with trading provisions placed in each permit.

Multiple Facility Point Source Trading/No Exchange

Multiple facility point source trades involve a group of point sources operating under a single trade agreement. The agreement can establish ground rules for trading to allow point sources to trade among themselves as needed. The trade agreement can specifically identify the point sources that may participate in water quality trading, or it can identify a geographic boundary (typically a watershed) or a type of discharger, or both, and allow qualifying point sources to participate in trading as desired or appropriate. An overall limit or cap set by the permit regulates all trades. Point sources trading under a multiple facility trade agreement are sometimes organized under a group that facilitates and oversees trading among the members.

Point Source Credit Exchanges

Another type of multiple facility point source trade involves a group of point sources that may purchase credits from a central exchange as needed to comply with individual effluent limitations. The credit exchange is maintained by a separate entity, which may be a state agency, a conservation district, or other organization established to administer the credit exchange. Credits in the exchange are generated by point sources that over control their discharges. The trade agreement can specify how credits may be generated and purchased, how trade ratios are calculated, and individual and group responsibilities for meeting effluent limitations and overall pollutant loading caps. Credit exchanges do not hold credits for longer than the reconciliation period, which typically corresponds to the type of effluent limitation. For example, the reconciliation period for trades to meet monthly average effluent limitations for phosphorus would be one month. For each reconciliation period, new credits are generated for purchase. The credit exchange would likely have to be either operated by or approved and overseen by a state regulatory agency.



[1] A trade agreement is a document that specifies the overall trading policies that a buyer and a seller must follow to participate in trading. The NPDES permitting authority could approve the trade agreement and either reference the terms of the trade agreement in the NPDES permit or include the trade agreement as part of the permit for each point source participating in a trade.

Figure 3. Three Programmatic Options for a Point-to-Point Source Trading Program Identified by the EPA

Source: U.S. EPA, Water Quality Trading Toolkit for Permit Writers, 15–17, EPA 833-R-07-004 (Aug. 2007, updated June 2009), available at www.epa.gov/npdes/pubs/wqtradingtoolkit.pdf

EXISTING TRADING PROGRAMS IN THE UNITED STATES

Water quality trading has been implemented within jurisdictions throughout the nation, including point-to-point nutrient trading programs in large, complex watersheds. Within California, however, existing trading programs do not include point-to-point source trades. Two of the largest point-to-point nutrient trading programs in the U.S., those for the Chesapeake Bay and the Long Island Sound, are described below along with brief descriptions of existing California water quality trading programs.

Long Island Sound Nutrient Credit Exchange

In 1990, Connecticut, New York, and the EPA adopted a Comprehensive Conservation and Management Plan (CCMP) for the Long Island Sound which called for reducing nitrogen to address decreased levels of dissolved oxygen.[15] A 2001 TMDL prepared jointly by the New York State Department of Environmental Conservation and the Connecticut Department of Energy and Environmental Protection included wasteload allocations that reflected a 58.5 percent decrease in nitrogen loading from the 1990 baseline established in the CCMP.[16]

In January 2002, Connecticut's Department of Energy and Environmental Protection issued a General Permit for Nitrogen Discharges to implement the TMDL and establish a voluntary nutrient trading program with a central exchange.[17] This permit has been reissued with revised discharge limits several times and remains in effect today.[18] Through the nutrient trading program, which is administered by an advisory board and the Connecticut Department of Energy and Environmental Protection, the 79 WWTPs discharging directly or indirectly to the Long Island Sound may purchase credits needed to achieve their individual limits or sell credits that they may have in excess of their individual limits.[19]

Connecticut adopted broadly applicable trading ratios for regions of the state based on approximate attenuation and equivalency for those areas (**Figure 4**). Trading ratios are used to account for a number of concerns, such as uncertainty, attenuation of water quality benefits between locations, and to build a credit reserve. For trades between two permitted point sources, the EPA accepts trading ratios as low as 1-to-1 (sometimes expressed as a percentage) because these trades involve little uncertainty. However, in large trading areas with geographically dispersed participants, trades may require a higher ratio, even when trading between permitted point sources. This is because nutrient credits generated by a distant point source are not likely to have the same level of actual nutrient reduction at the location of a permittee's credit use.

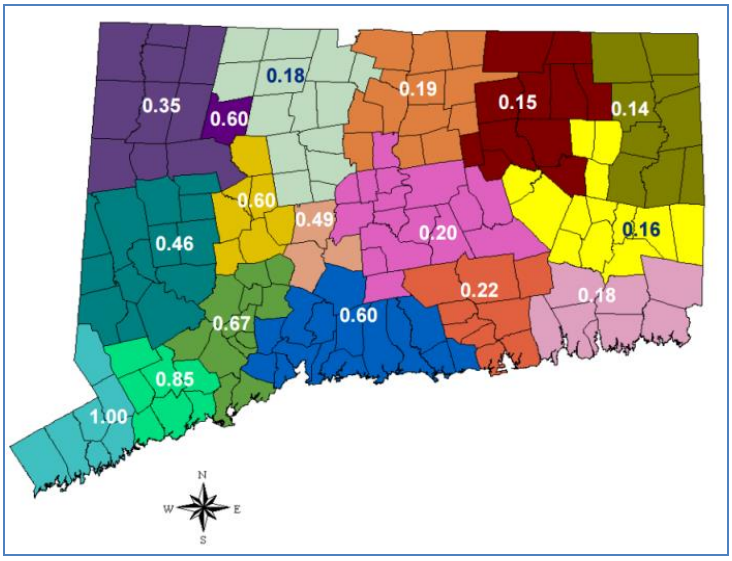


Figure 4. Connecticut's Trading Ratios

Source: Connecticut Department of Energy and Environmental Protection, presentation "Connecticut's Nitrogen Trading Program" (Sept 2014). Available at: http://www.ct.gov/deep/lib/deep/water/municipal_wastewater/9_17_14_pres_futureplans_ntp.pdf

Connecticut's permit and the trading program it facilitated have resulted in a 65 percent reduction in nitrogen from the 1990 levels.[20] Under this program, the state operates as a central exchange, thereby serving as an intermediary for all trading activities. The state sets the credit price, purchases all credits generated, and sells credits to facilities discharging beyond their individual allocations. Thus, all credit transactions are directly with the state agency. Through this process it is estimated that Connecticut municipalities have saved $300 to $400 million dollars in WWTP upgrades that would have been implemented in the absence of a trading program.[21]

Chesapeake Bay Nutrient Credit Exchange

In 2000, Virginia, Pennsylvania, Maryland, the District of Columbia, and the EPA signed an agreement to cooperatively work to improve Chesapeake Bay's water quality. Virginia and Pennsylvania developed trading programs in order to make progress towards these goals and allow dischargers flexibility in achieving compliance with permit limits. While the trading programs were established in advance of the Chesapeake Bay TMDL, a TMDL for nitrogen, phosphorus, and sediment was eventually adopted.[22] The trading programs developed by the states continue to operate within the framework of this TMDL.

Virginia utilized a similar methodology for TMDL compliance as was employed in Connecticut. Virginia issued a general permit for all WWTPs, assigned individual effluent allocations to each facility, and established a trading program with a voluntary central exchange.[23] If a WWTP is unable to comply with its individual limit, it may purchase credits either from individual facilities or through the Virginia Nutrient Credit

Exchange Association, a voluntary association operated by a third-party nonprofit industry group that functions as a central exchange.

Virginia also maintains a state-run water quality improvement fund, which facilities unable to buy credits on the market may pay into in order to offset the permit exceedance.[24] The use of the water quality improvement fund has not been necessary in recent years, as even large exceedances, such as the 172,000 pound nitrogen exceedance by Richmond's WWTP in 2015, have been offset using nutrient credits.[25]

In the Chesapeake Bay, the jurisdictions with point-to-point source trading programs use the Chesapeake Bay Watershed Model to estimate the individual trading ratios needed for specific trading partners.[26] This model generates a custom ratio for each trade to accurately account for attenuation without undermining the financial viability of trades. Furthermore, Virginia uses an additional 1-to-1.3 ratio for trades between certain basins.

Virginia's trading program has notably decreased nutrient loading from Virginian point sources into the Chesapeake Bay.[27] The success of this trading program led EPA Administrator Gina McCarthy to remark that EPA "encourage[s] states to look at Virginia as a model and a resource as they adopt similar programs."[28] Pennsylvania's program has not seen the objective success that has been generated by Virginia's program.[29] This is likely due to regulatory decisions that have impeded trading, such as the use of individual permits rather than general permits that bring all potential trading partners under a single regulatory document.

California Water Quality Trading Programs

The Laguna de Santa Rosa Nutrient Offset Program saw its first trade in 2012. The Santa Rosa Subregional Water Reclamation Facility discharges into the Laguna de Santa Rosa watershed—a CWA section 303(d) listed waterbody impaired by nutrients, metals, bacteria, sediment, and temperature. To address the impairment, the North Coast Regional Water Board imposed a "no net loading" nutrient limit in Santa Rosa's NPDES permit.[30] Rather than install costly technology, Santa Rosa pursued a trading program that allows for quantified and credited mitigation at select agricultural sites in the basin to reduce the animal waste and fertilizer runoff entering the waterway.

Santa Rosa's trading program operates under a general framework adopted by the North Coast Regional Water Board.[31] Currently, the framework is undergoing a process of revision to strengthen the program and facilitate more credit generating activities. To date, the program has relied on individual offset projects that have been individually approved by the North Coast Regional Water Board. The anticipated revisions seek to streamline the program, allowing for greater credit generation from a broader range of activities.

The Grasslands Bypass Trading Project is another California trading program. In 1996, San Joaquin Valley drainage districts needed to address elevated selenium levels in the waterways in order to obtain approval to use Bureau of Reclamation's San Luis Drain.[32] To get approval, an agreement was struck that imposed numeric selenium limits.[33] All of

the participants received WDRs that included selenium load allocations, which became more stringent annually until eventually equaling TMDL load allocations.[34] Each drainage district had flexibility to determine how to meet the limits and could pay other districts to make further reductions. Several districts did partake in trades, though in recent years other compliance options have made trading unnecessary.

The Los Angeles Municipal Separate Storm Sewer System (MS4) NPDES Permit applies to 84 distinct entities with jurisdiction over stormwater and allows them to collaboratively establish watershed management programs to meet water quality goals.[35] While not strictly a water quality trading program, it is similar in that off-site pollutant reductions can help establish NPDES permit compliance.

HYPOTHETICAL SCENARIO ANALYSIS

Quantifying the potential financial and environmental benefits of a nutrient trading program in the San Francisco Bay requires a robust understanding of the costs associated with treatment plant upgrades for nutrient management. As mentioned above, the current Nutrient Watershed Permit requires that the dischargers develop cost estimates for various treatment plant upgrades and that final results of the evaluations be presented to the Regional Board by July 1, 2018. At the present time, only preliminary cost estimates, pending further evaluation, are available for approximately half of the Bay wastewater treatment plants. Nevertheless, the preliminary data shows that nutrient removal is significantly less expensive at some plants than others with costs varying between $1/lb of nitrogen removed to upwards of $50/lb of nitrogen removed.

Using this preliminary cost estimate information, augmented with fictional information where necessary, several potential trading scenarios were analyzed. For this analysis, two two synthetic subembayments and twelve fictional dischargers. Although this analysis was constrained by available data, it still serves to provide broad insight into the potential benefits of water quality trading for nutrients in the San Francisco Bay.

These hypothetical scenarios were constructed to minimize the total expenditure necessary to meet several tiers of nitrogen load reductions for the fictional watershed as a whole, but not necessarily to optimize expenditures for individual facilities. While individual facility economic optimization would occur under an actual trading program, an economic analysis of that nature would require facility information that is currently unavailable, such as the ongoing expenses associated with different treatment technologies. Moreover, that type of precise analysis requires insight into individual facilities' willingness to take on particular risk(s), ability to pay for advance credits, and general economic position. While constrained by the lack of specifics, the analysis demonstrates broadly the mechanics of trading and what types of opportunities likely exist for trading based on the cost differentials for technological upgrades between facilities.

FEASIBILITY OF INCLUDING NONPOINT SOURCES

As noted in the Nutrient Watershed Permit, estimates show that municipal WWTPs account for 63 percent of the annual average total nitrogen load to San Francisco Bay. While these estimates are continuing to be refined, it is evident that, as shown **Table 1**, the contribution from POTWs and other point sources varies significantly across the subembayments. POTWs account for the majority of nitrogen loading in the southern and central portions of the Bay and while stormwater and Delta efflux contribute the majority of nitrogen loading in the northern subembayments.

Table 1. Annual Average Loads for Dissolved Inorganic Nitrogen, kg/day[36]

Embayment	Municipal	Refinery	Stormwater	Delta	Total	POTW %
Lower South Bay	6,805	n/a	539	n/a	7,344	93
South Bay	19,401	n/a	670	n/a	20,071	97
Central Bay	11,667	n/a	159	n/a	11,826	99
San Pablo Bay & Carquinez Strait	2,721	842	7,484	n/a	11,047	25
Suisun Bay	5,618	130	1,968	15,930	23,646	24
Baywide	46,212	972	10,820	15,930	73,934	63

Although POTWs contribute most of the nitrogen loading to the Bay, the contributions from nonpoint sources (stormwater and nonpoint contributions in the Delta efflux) are large enough to warrant considering inclusion of nonpoint sources in the trading program. While credit supply would be largest in the upper subembayments, the nonpoint source credits could be transferable between subembayments using trading ratios to account for attenuation and uncertainty. This would provide a greater supply of credits that, in some instances, may be more cost effective while producing meaningful environmental benefits.

Expanding the potential point-to-point program to include nonpoint trading would not require significant revisions to an existing point-to-point trading program. The nonpoint source trading framework should be developed independently of the trade agreement for point-to-point trading before being incorporated by reference into that trade agreement. This enables participants to formulate and operate a point source trading program first and to add nonpoint source trading later, possibly avoiding the need to reopen the Watershed Permit if the point source trade agreement has already been adequately incorporated into the permit. This provides flexibility for parties to collaboratively develop a robust system that benefits all stakeholders.

A nonpoint source trading framework would be created to govern nonpoint source credit generation and accounting. This framework would identify all pertinent considerations, such as the eligible activities, the project quality standards, accounting process, etc. As nonpoint source crediting has a much higher degree of inherent uncertainty than point source crediting, providing clarity regarding the methodologies underlying nonpoint source credits is of the utmost importance. The framework document should be developed through a collaborative process involving the trading participants, the Regional Board, the EPA, and other interested stakeholders.

A central exchange is recommendable for nonpoint credits, even if no such exchange is created for credits generated by point sources. This central exchange could be operated by the broker that facilitates point-to-point source trades, or by an independent entity such as a third-party or the regulatory authority. Using an exchange would allow credit buyers to avoid the confusion and uncertainty inherent in nonpoint source trading. The exchange would deal with credit generators, providing point sources with the ability to purchase verified and certified credits directly from the central exchange. The expertise and experience of the exchange will lower transactional expenses, keeping credit costs to a minimum. The central exchange would bear the responsibility for ensuring the ongoing maintenance and monitoring required to maintain the validity of nonpoint source credits. This option provides the greatest level of certainty and oversight for nonpoint trading.

The nonpoint central exchange could also oversee a nonpoint source restoration fund. Dischargers unable to acquire credits to offset their exceedance could pay into the fund to achieve permit compliance and the fund would finance future restoration activities. The use of such a nonpoint source restoration fund as a component of a point source trading program could likely be helpful due to the certainty and risk minimization it provides to regulated entities. This type of fund constitutes a permanent pool of financing that the central exchange can manage and distribute to pay for nonpoint source credit generating activities. This offsets permit exceedances that would otherwise result in noncompliance with the discharge permit and generates greater environmental benefit that would otherwise be realized. Virginia's Chesapeake Bay Nutrient Trading Program uses this type of fund, and it has proved a valuable tool for insuring against unexpected credit shortages.[37]

PRELIMINARY RECOMMENDATIONS

The next step in developing a nutrient trading program for the San Francisco Bay is to conduct scenario analyses with actual data rather than the hypothetical information that was necessarily used in the scenario analyses discussed above. Using the actual data in scenario analyses will reveal the extent of the benefits that could be realized through trading and will also guide the program structure. The necessary cost data is currently being developed through studies required in the Nutrient Watershed Permit.

Although analysis of specific and realistic trading scenarios is needed, there is no reason that water quality trading cannot be as successful in the San Francisco Bay as it has been in other large, complex watersheds such as the Long Island Sound and the Chesapeake Bay. The considerations below represent preliminary recommendations for the permitting structure, program type, and administration of nutrient trading in the San Francisco Bay. These recommendations would need to be revisited after a scenario analysis can be completed with data on estimated costs of nutrient removal for individual dischargers and with a better understanding of water quality issues, hydrodynamics, and potential nutrient impairment in the San Francisco Bay.

Permitting Structure

The existing Nutrient Watershed Permit jointly regulates the WWTPs in the San Francisco Bay and could be modified to incorporate trading provisions directly or by reference to another document in future reissuances. This approach aligns with the EPA's existing guidance documents and avoids the confusion that could arise if nutrient trading is implemented in individual permits.

While the next reissuance (2019) of the Nutrient Watershed Permit may not include nutrient effluent limits, future reissuances of the permit are likely to include requirements for measurable nutrient load reductions, either cumulatively for the entire Bay or individually for the delineated subembayments. In addition to these overarching limits, the Nutrient Watershed Permit could also include nutrient allocations for individual dischargers to allow for baseline determinations. The combined and individual limits could also include compliance schedules, if necessary and warranted.

Programmatic Type

A nutrient trading program for WWTPs in the San Francisco Bay could utilize a 'Multiple Facility Trading Program' structure with a trade agreement but without a central exchange **(Figure 4)**. Operating without a true central exchange offers parties more leeway to design individual trade transactions that better suit their individual needs. Thus, individual dischargers would have the flexibility to enter into credit contracts formulated to be responsive to existing and anticipated conditions for those specific facilities, with negotiated clauses detailing mutually beneficial provisions for issues such as risk minimization, the results of breaching the agreement, and transaction timing. The trade agreement would be between the dischargers to the San Francisco Bay and would establish a single framework for all trading activities that all trades must comply with. The trade agreement would resolve much of the potential uncertainty in a trading program by explicitly and unambiguously defining the various components and characteristics of the program for all participants in one place, along with repercussions for failure to perform.

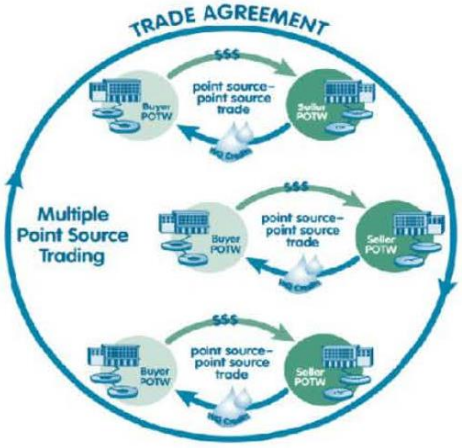


Figure 5. Multiple Facility Point Source Trading without an Central Exchange

Source: U.S. EPA, Water Quality Trading Toolkit for Permit Writers, EPA 833-R-07-04 (Aug. 2007, updated June 2009).

The trade agreement could be incorporated into the Nutrient Watershed Permit by reference, with some of the more important terms (i.e., trading area, reconciliation period, and baseline limits) included directly in the Watershed Permit. This approach allows for greater flexibility in refining the components of the trading program, as the parties and regulators could make amendments to the trade agreement in response to new information without having to reopen the general overlay permit. Importantly, such an agreement lowers transactional costs by defining the trading process and key components, which also makes participation easier.

Program Administration

A third-party broker could assist with trading forecasting, transaction documentation, reporting and credit accounting. Unlike a central exchange, the third-party broker will not act as an intermediary to buy and sell credits. Instead, the broker helps to anticipate credit supply and facilitate individual trades between two or more dischargers. Using a broker streamlines the trading process, lowering transaction costs and helping to minimize risk. This third-party broker should help to complete the documentation of individual trades required by regulators and should be responsible for maintaining a credit registry to track credit creation, serialization, transactions and custody.

Using a third-party broker significantly lowers the risk of noncompliance by providing a reliable mechanism for ensuring that credits are valid and properly documented before releasing them for compliance purposes. Moreover, a broker may be able to help direct trades in a way that further lowers risk and cost. For example, a broker can collaborate between multiple participants to forecast credit supply and demand, and facilitate future buy contracts—both of which can help minimize the capital exposure for potential credit sellers before they make costly upgrades. Of particular note, unlike a central exchange, a third-party broker may have as much or as little involvement in trading as the parties' to the trade agreement desire. Thus, a broker provides greater flexibility to individual parties as well as the certainty that comes with having an objective entity engaged in the process.

Additional Program Considerations

Although discrete program aspects will be completed in conjunction with stakeholders and the regulators, following components would likely be part of a successful trading program:

- The trading area should likely include the entire San Francisco Bay with all of the subembayments, using trading ratios derived through bay-wide studies to account for attenuation of benefits between the subembayments. Addressing impairment for the entire Bay represents the most holistic approach and, as such, has the greatest potential to improve conditions for the entire area. Similarly, a broader trading area allows for more participant permutations, which may also lead to further cost reduction opportunities.
- The trade agreement should include a methodology for establishing trading ratios. It is clear that a minimum 1-to-1 trading ratio would be required for nutrient trades between two point sources. Depending on the final trading area composition, higher ratios may be necessary to account for attenuation. One

option is to use a 1-to-1 ratio for trades within a subembayment and create higher ratios for trading between subembayments. Another option is to tier ratios to the distance between subembayments. It would be preferable to develop a modeling tool, like the trading programs in the Chesapeake use, in order to generate appropriate ratios for individual trades.

- Compliance should likely be determined on an annual basis, with credit duration matching this compliance period. Water quality trading credits usually have a duration that aligns with the compliance period (i.e., a monthly compliance period would have credits with a one month duration). As such, the period of compliance impacts the transactional costs associated with credit trading—too short a period leads to high administrative expenses due to frequent trading, too long a period creates credits that are too expensive and generates too much uncertainty. An annual period allows for accurate forecasting of credit supply and demand while avoiding the issues associated with compliance periods that are too short or too long. The annual compliance period has proven workable in both the Virginia and Connecticut trading programs.
- A reconciliation period should be adopted for achieving compliance with annual nutrient obligations. End-of-pipe discharge monitoring should continue to be required by individual dischargers along with receiving water monitoring. In addition to the monthly Discharge Monitoring Reports (DMRs), all participating parties would be responsible for an end-of-year compliance report that documents annual reductions and trades. This report should not be due until several months after the close of the previous reporting year, as credit buyers will need time to reconcile credit needs based on actual discharges, and then acquire a sufficient volume of credits to offset any exceedances. Likewise, credit sellers will need time to properly account for and document the credits generated and sold. This approach is important for the purposes of individual facility risk minimization, as money is only exchanged after effluent reductions are achieved and credits are verified. This method also has less transactional costs than real-time reconciliation.

CONCLUSIONS

Water quality trading for nutrients in the San Francisco Bay looks to be a viable and effective tool for achieving compliance with possible future effluent limits and best prioritizing facility upgrades. Water quality trading represents an alternative to traditional, across-the-board requirements on point sources, providing participants with a greater level of flexibility to efficiently achieve nutrient load reductions collaboratively. This collaboration allows for facilities to realize greater nutrient reductions at a lower cost by working together to implement the most effective and economical upgrades in order to jointly achieve permit compliance.

REFERENCES/ENDNOTES

[1] S.F. Bay Regional Water Quality Control Board, Order No. R2-2014-0014, Permit No. CA0038873, Waste Discharge Requirements for Nutrients from Municipal Wastewater Dischargers to San Francisco Bay, available at: http://www.waterboards.ca.gov/sanfranciscobay/board_decisions/adopted_orders/2014/R2-2014-0014.pdf One of these 34 outfalls is the outfall for the East Bay Dischargers Association (EBDA) which discharges effluent from seven distinct treatment facilities.

[2] *Id*. at page F-9

[3] U.S. EPA, Water Quality Trading Policy, 68 Fed. Reg. 1608(Jan. 13, 2003), *available at* https://www.gpo.gov/fdsys/pkg/FR-2003-01-13/pdf/03-620.pdf

[4] U.S. EPA, Water Quality Trading Toolkit for Permit Writers, EPA 833-R-07-004 (Aug. 2007, updated June 2009), *available at* www.epa.gov/npdes/pubs/wqtradingtoolkit.pdf

[5] "EPA supports implementation of water quality trading by states, interstate agencies and tribes where trading…[a]chieves early reductions and progress towards water quality standards pending development of TMDLs for impaired waters." U.S. EPA, Water Quality Trading Policy, 68 Fed. Reg. at 1609.

[6] U.S. EPA, Technical Memorandum: Components of Credit Calculation, at 9 (May 14, 2014), available at: http://www.epa.gov/reg3wapd/pdf/pdf_chesbay/TradingTMs/CreditCalculationTM_FINAL_5_14_14.pdf.

[7] WILLAMETTE PARTNERSHIP, ECOSYSTEM CREDIT ACCOUNTING SYSTEM: GENERAL CREDITING PROTOCOL VERSION 2.0 (Nov. 1, 2013), http://willamettepartnership.org/wp-content/uploads/2014/09/General-Crediting-Protocol-2.0.pdf

[8] For a detailed discussion on the interplay between water quality trading and the use of Clean Water State Revolving Funds, *see* U.S. EPA, WATER QUALITY TRADING TOOLKIT FOR PERMIT WRITERS, EPA 833-R-07-004, Appendix D: Use of Cost Share (Aug. 2007, updated June 2009). For a discussion of the savings calculus as applied to the Long Island Sound Nutrient Exchange, *see* NAT'L ENVTL. TRADING NETWORK, LONG ISLAND SOUND PROGRAM DESCRIPTION, SECTION J (last visited Nov. 2016), http://www.envtn.org/Long_Island_Sound.html

[9] U.S. EPA, Water Quality Trading Toolkit for Permit Writers, EPA 833-R-07-04 (Aug. 2007, updated June 2009), *available at* www.epa.gov/npdes/pubs/wqtradingtoolkit.pdf

[10] CAL. CODE REGS. tit. 23, § 2917; Cal. State Water Resources Control Bd., Res. No. 2005-0050: Water Quality Control Policy for Addressing Impaired Waters: Regulatory

Structure and Options (June 16, 2005), *available at* http://swrcb.ca.gov/water_issues/programs/tmdl/docs/iw_policy.pdf

[11] Memorandum from Craig Wilson, Chief Counsel, Cal. State Water Resources Control Bd., to Arthur G. Baggett, Jr., Chair, Cal. State Water Resources Control Bd., on Legal Authority for Offsets, Pollutant Trading, and Market Programs to Supplement Water Quality Regulation in California's Impaired Waters (Oct. 16, 2001), *available at* http://waterboards.ca.gov/water_issues/programs/tmdl/docs/iwguide_apxb.pdf

[12] Memorandum from Michael A.M. Lauffer, Chief Counsel, Cal. State Water Resources Control Bd., to Arthur G. Baggett, Jr., Chair, Cal. State Water Resources Control Bd., on Updated Legal Authority for Offsets, Pollutant Trading, and Market Programs to Supplement Water Quality Regulation in California's Impaired Waters With Established Total Maximum Daily Loads (Nov. 22, 2006).

[13]U.S. EPA, Water Quality Trading Toolkit for Permit Writers, 15, EPA 833-R-07-004 (Aug. 2007, updated June 2009).

[14] U.S. EPA, Water Quality Trading Toolkit for Permit Writers, 15–17, EPA 833-R-07-004 (Aug. 2007, updated June 2009).

[15] LONG ISLAND SOUND STUDY, THE COMPREHENSIVE CONSERVATION AND MANAGEMENT PLAN (Mar. 1994), http://longislandsoundstudy.net/wp-content/uploads/2011/10/management_plan.pdf.

[16] N.Y. Dep't of Envtl. Conservation & Conn. Dep't of Envtl. Prot., A Total Maximum Daily Load Analysis to Achieve Water Quality Standards for Dissolved Oxygen in the Long Island Sound (Dec. 2000).

[17] 2001 CONN. LEGIS. SERV. 01-180 (S.S.B. 1012) (West).

[18] Conn. Dep't of Energy & Envtl. Prot., General Permit for Nitrogen Dischargers (Jan 1, 2016).

[19] CONN. GEN STAT ANN. § 22a-523 (West 2015).

[20] CONN. DEP'T OF ENERGY & ENVTL. PROT., REPORT OF THE NITROGEN CREDIT ADVISORY BOARD FOR CALENDAR YEAR 2013 TO THE JOINT STANDING ENVIRONMENT COMMITTEE OF THE GENERAL ASSEMBLY (Sept. 30, 2014), *available at* http://www.ct.gov/deep/lib/deep/water/municipal_wastewater/nitrogen_report_2013.pdf.

[21] Connecticut Department of Energy & Environmental Protection, Nitrogen Control Program for Long Island Sound, *available at* http://www.ct.gov/deep/cwp/view.asp?a=2719&q=325572&deepNav_GID=1635%20

[22] U.S. EPA, Chesapeake Bay Total Maximum Daily Load for Nitrogen, Phosphorus and Sediment (Dec. 2010).

[23] VA. CODE ANN. §§ 62.1-44.19:12–19 (2015).

[24] 9 VA. ADMIN. CODE § 25-820-70(J)(3).

[25] Va. Dep't of Envtl. Quality, 2015 Nutrient Load Analysis (Mar. 2016), *available at* http://www.deq.virginia.gov/Portals/0/DEQ/Water/PollutionDischargeElimination/Watershed%20GP/2015%20Published%20Loads%203_31_16.pdf

[26] VA. DEP'T OF ENVTL. QUALITY, NUTRIENT CREDIT TRADING RATIO STUDY REPORT (Dec. 23, 2014), *available at* www.deq.virginia.gov/Portals/0/DEQ/Water/PollutionDischargeElimination/TradingRatioFinalReport12-23-2014.pdf. *See also* Jennifer Vogel, U. VA. ENVTL. LAW, *Trading Ratios Used for Generation of Credits in Water Quality Trading Programs* (July 2012), *available at* www.deq.virginia.gov/Portals/0/DEQ/Water/PollutionDischargeElimination/UVA_Trading_Ratios_Study.pdf.

[27] Reductions in wastewater pollutants have been and remain ahead of schedule for nitrogen, phosphorus, and sediment. See U.S. EPA, Fact Sheet: EPA Evaluation of Virginia's 2014-2015 Milestone Progress (June 2016).

[28] U.S. Dep't of Agric., Office of Commc'n, News Release: Federal Agencies Support Virginia's Innovative Market-based Approach to Improving Water Quality in the Chesapeake Bay, No. 0270.14 (Dec. 2014).

[29] U.S. EPA, Fact Sheet: EPA Evaluation of Pennsylvania's 2014-2015 Milestone Progress (June 2016).

[30] "No net loading" means the facility has a numeric discharges limit for nutrients equal to zero. The permit expressly allows this limit to be met by reducing discharges elsewhere in the watershed, though the North Coast RWQCB did require this to be accomplished pursuant to an approved offset plan. See N. Coast Reg'l Water Quality Control Bd., Order No. R1-2006-0045, Permit No. CA0022764, Waste Discharge Requirements & Master Reclamation Permit for the Santa Rosa Subregional Water Reclamation System, at 13, n. 5 (2006, rev. July 2008, Apr. 2009).

[31] N. Coast Reg'l Water Quality Control Bd., Res. No. R1-2008-0061: Approving Santa Rosa Nutrient Program (July 24, 2008).

[32] U.S. EPA, Grassland Bypass Project: Economic Incentives Program Helps to Improve Water Quality (Aug. 2012).

[33] U.S. Dep't of the Interior, Bureau of Reclamation, Agreement for Use of the San Luis Drain, No. 01-WC-20-2075 (Sept. 2001), *available at* www.usbr.gov/mp/sccao_new/west_sjv/grassland/documents/index.html

[34] Waste Discharge Requirements are similar to NPDES permits but issued by the California SWRCB under the California Porter-Cologne Water Quality Act, which regulates more sources than the CWA. HANNA L. BREETZ, ET AL., WATER QUALITY TRADING AND OFFSET INITIATIVES IN THE U.S.: A COMPREHENSIVE STUDY 10 (Aug. 5, 2005).

[35] L.A. Reg'l Water Quality Control Bd., Order No. R4-2012-0175, Permit No. CAS004001, Waste Discharge Requirements for MS4 Dischargers within Coastal Watersheds of Los Angeles County (2012, rev. July 2015).

[36] S.F. Bay Regional Water Quality Control Board, Order No. R2-2014-0014, Permit No. CA0038873, Waste Discharge Requirements for Nutrients from Municipal Wastewater Dischargers to San Francisco Bay. Data from San Francisco Estuary Institute, External Nutrient Loads to San Francisco Bay, Table 6, Draft, April 9, 2013. Final document (January 2014) available at: http://sfbaynutrients.sfei.org/sites/default/files/NutrientLoadsFINAL_FINAL_Jan232014.pdf . This report notes that: "the stormwater loads are highly uncertain, but nonetheless serve as order of magnitude estimates for comparison with other sources." (page 2).

[37] The Virginia Water Quality Improvement Act of 1997 established the Water Quality Improvement Fund (WQIF) to finance nutrient reduction strategies in the Chesapeake Bay and its tributaries. The WQIF is a permanent, non-reverting fund that point sources unable to acquire sufficient credits to offset exceedances may pay into in order to achieve permit compliance. The fund is used to finance point and nonpoint source nutrient reduction actions, thereby generating a net benefit to the local water quality. VA. CODE ANN. § 10.1-2117–2134 (2016). *See also* L.P. Bryant, Jr., Office of the Governor, Sec. of Nat. Res., Virginia Water Quality Improvement Fund Guidelines (Nov. 2006, updated May 2012), *available at* www.deq.virginia.gov/Portals/0/DEQ/Water/ChesapeakeBay/Nov2006WQIFGuidelines-updated_5-15-12.pdf.