Santa Ana Regional Water Quality Control Board (Regional Board) staff hereby request initiation of peer review pursuant to the requirements of Health and Safety Code section 57004 for scientific portions of a proposed Basin Plan Amendment (BPA) to incorporate Total Maximum Daily Loads (TMDLs) for selenium (Se) in three freshwater tributary subwatersheds in the Newport Bay watershed (San Diego Creek, Santa Ana-Delhi Channel, and Big Canyon Wash subwatersheds). These selenium TMDLs do not apply to the saltwater bodies in the Newport Bay watershed (Upper and Lower Newport Bay).

The Regional Board plans to consider the proposed amendment at a regularly scheduled meeting in early 2017. (The Regional Board’s 2017 meeting schedule is not yet established, but meetings in early February and mid-March are likely.) Regional Board staff anticipates submittal of the peer review package to CalEPA staff by December 9, 2016.

A succinct summary of the recommended TMDLs and the scientific elements for which review is requested is provided in Attachment 1. Attachment 2 provides a more detailed description of the scientific assumptions, findings and conclusions used in formulating the recommended TMDLs. Briefly, the critical components of the TMDLs needing independent review are: (1) the tissue-based numeric targets, which incorporate two fish tissue targets and one bird egg tissue target for selenium; (2) the impairment assessment portion of the problem statement; (3) the linkage analysis, which uses USGS’ biodynamic model1 to translate the proposed tissue targets into water column concentrations; (4) the allocations section, which then uses those water column translations to develop allocations for waste loads (point sources) and loads (non-point sources); and (5) the minimum monitoring requirements.

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1 The biodynamic model developed by the U.S. Geological Survey has undergone extensive independent peer review as required for their professional publications and by the environmental journals that have published papers on the model’s development, identification of underlying fundamental processes, and use in various ecosystems in salt and freshwater. This ecosystem-scale model has been used (or is being used) to develop potential water quality criteria for selenium for the protection of fish and wildlife and/or to predict environmental exposure and risk from selenium to sensitive food webs in California, Colorado, Idaho, Utah, and West Virginia. Attachment 4 includes a list of professional publications that required independent peer review of the model. The USGS does not provide the names of individuals that have provided peer review of their publications.
With these specific needs in mind, we ask that State Water Board staff solicit peer reviewers with expertise in one or more of the following areas, which cover the twelve (12) assumptions, findings and conclusions described in Attachment 2:

- **Ecotoxicologist/wildlife biologist** with experience in the study and investigation of the fate and effects of selenium in freshwater aquatic ecosystems. Potential reviewers need to have a thorough understanding of selenium exposure routes, speciation, food web transfer and sensitivity, species sensitivity, and biodynamic controls on selenium accumulation and trophic transfer. (Attachment 2: Numeric Targets, Conclusions 1-5; Monitoring, Conclusion 10, TMDL Evaluation Monitoring, Other Considerations, Special Studies; Site-Specific Objectives, Conclusions 11 and 12).

- **Environmental scientist, ecologist, ecotoxicologist, or other discipline** with expertise in ecosystem scale mechanistic modeling, in particular, biodynamic or biokenetic models used to translate selenium concentrations from one medium to another, especially tissue concentrations to water column concentrations, and ecological risk assessment. (Attachment 2: Linkage Analysis, Conclusions 6-8; TMDLs and Allocations, Conclusion 9.)

- **A biogeochemist, biochemist or similar background with knowledge** of selenium speciation and biogeochemical cycling in freshwater environments, in particular, selenium transfer between aquatic compartments (water, sediment, particulate material, and biota) and the effects of hydrological changes on selenium cycling. (Attachment 2: Linkage Analysis, Conclusions 6 and 7; Monitoring, Conclusion 10, TMDL Evaluation Monitoring, BMP Effectiveness Monitoring, Other Considerations, Special Studies.)

- **A hydrologist, hydrogeologist, geologist, or geotechnical/civil engineer** familiar with groundwater-surface water dynamics, groundwater and surface water chemistry, and water balance modeling, especially in highly urbanized and hydromodified environments. We recommend that reviewers have knowledge of: geological sources of selenium and selenium geochemistry, treatment and management of selenium and nitrate or similar pollutants in surface and ground waters (including reasonable and feasible Best Management Practices and selenium treatment technologies), and pollutant offset and trading programs. (Attachment 2: TMDLs and Allocations, Conclusion 9; Monitoring Conclusion 10, BMP Effectiveness Monitoring, Offset and Trading Program Monitoring, Source Assessment Monitoring, Special Studies.)

It is understood that a potential peer review candidate may (is likely to) have expertise in more than one of the above fields; the above descriptions are meant to be qualitative. In the area of selenium fate and transport, the fields of biology, ecology, hydrology, geology, chemistry, and engineering often overlap.

Regional Water Board staff request that the search for potential peer reviewers extend beyond the university system to include potential reviewers from federal or state agencies that have a high degree of expertise with selenium cycling in aquatic environments and selenium effects in fish and wildlife. Expertise in selenium exists within several US federal agencies (e.g., USGS, USFWS, U.S. Department of the Interior [USDOI], and USEPA) and at similar state agencies or organizations in other countries (e.g., Environment Canada). Such other agency reviewers may
have the advantage of familiarity with the regulatory process. We therefore request that at least one of the reviewers also have experience in the regulatory environment, including criteria development and implementation. In addition, we ask that one or more of the reviewers be familiar with, or have participated in, the 2009 Pellston Workshop on Selenium in the Aquatic Environment, and the resulting 2010 SETAC publication, *Ecological Assessment of Selenium in the Aquatic Environment*. We also request that that the peer reviewers who are selected provide comments on the TMDLs staff report and draft BPA within 30 days or less of the receipt of these documents.

This request includes the following enclosures:

- Attachment 1 – A summary of the proposed revised TMDLs for selenium in freshwater for the Newport Bay watershed;
- Attachment 2 – A list of the scientific assumptions, findings, and conclusions that have been identified by Regional Water Board staff as requiring review. Attachment 2 has been revised to clarify the relationship between several of the conclusions. Revisions are in red font and confined to pages 1 and 2 of the attachment;
- Attachment 3a – A list of all participants who have assisted in the development of these proposed selenium TMDLs;
- Attachment 3b – A list of all participating members of the Nitrogen and Selenium Management Program (NSMP);
- Attachment 4 – A list of references for the draft staff report.

The Basin Plan Amendment package that will be submitted to the selected peer reviewers will include an electronic copy of the proposed draft Basin Plan Amendment, the Newport Bay Watershed Selenium TMDLs draft staff report, and all references and appendices for the draft staff report. We understand that State Board staff has set up a secure File Transfer Protocol (ftp) site for posting documents for the peer reviewers and that we will need to provide staff with a portable electronic device (e.g., CD, DVD, USB drive) that contains copies of all of the necessary documents.

While reviewers are not prevented from commenting on other portions of the referenced documents, we would like to emphasize to potential reviewers the need to provide a concise evaluation of the assumptions, findings, and conclusions in the proposed TMDLs that have been identified by Regional Board staff in Attachment 2. It is particularly important that the scientific rationale underpinning the fish and bird egg tissue numeric targets proposed for the Newport Bay watershed (discussed in detail in Section 4.0 of the draft staff report) receive careful review by qualified individuals.

Should you have any questions, please contact me at Terri.Reeder@waterboards.ca.gov, (951) 906-1899 or (951) 782-4995.

cc:  Rik Rasmussen, Manager Water Quality Standards and Assessment Section, SWRCB, rik.rasmussen@waterboards.ca.gov
     Janet Hashimoto, USEPA TMDL Lead, Hashimoto.Janet@epa.gov
     Daniel Oros, USEPA TMDL Liaison, Oros.Daniel@epa.gov
In 2002, the U.S. EPA (EPA) established Total Maximum Daily Loads (TMDLs) for Toxic Pollutants for fresh and salt water bodies in the Newport Bay watershed, including TMDLs for selenium. USEPA’s impairment assessment was based on exceedances of the California Toxics Rule (CTR) chronic criterion for selenium in freshwater and exceedances of toxicological and reproductive effect guidelines in freshwater fish tissue.

Regional Board staff proposes the adoption of revised selenium TMDLs for freshwaters in the Newport Bay watershed. The revised impairment assessment conducted to support the recommended TMDLs considered human health risk based on selenium concentrations in fish fillets, ecological risk based on whole body fish tissue and bird egg tissue, and water column concentrations for comparison to the CTR. No impairment for human health, fish or wildlife health due to selenium was found in saltwater for either Upper or Lower Newport Bay. Selenium concentrations in freshwater fish fillets were also below levels of concern for human consumers of fish. However, concentrations of selenium in water, fish and bird egg tissue collected from several of the fresh surface waterbodies in the watershed were found to exceed ecological risk thresholds. Therefore, the proposed selenium TMDLs apply only to the following freshwater tributary subwatersheds in the Newport Bay watershed:

- San Diego Creek Subwatershed
- Santa Ana Delhi Channel Subwatershed
- Big Canyon Wash Subwatershed

The following numeric targets for selenium are being proposed:

1. A whole-body fish tissue target for the protection of fish of 8.1 micrograms selenium per gram dry weight (µg Se/g dw);
2. A whole-body fish tissue target of 5.0 µg Se/g dw as dietary concentration for the protection of birds (5.0 µg Se/g dw);
3. A bird egg tissue target for the protection of aquatic-dependent birds, including federally-listed species of 8.0 µg Se/g dw); and
4. A water column numeric target based on the currently applicable CTR criterion for selenium in freshwater of 5 µg Se/L.

The dietary fish tissue target of 5.0 µg Se/g dw (#2, above) will only apply where bird egg tissue concentrations are exceeding the proposed bird egg tissue numeric target of 8.0 µg Se/g dw even though the proposed primary fish tissue target of 8.1 µg Se/g dw is being met. This is a maximum target; the actual dietary target will be the whole body fish tissue concentration at which the bird egg tissue target is consistently being met (i.e., between 5 and 8.1 µg Se/g dw).

Regional Board staff anticipate presenting these proposed numeric tissue targets as Site-Specific Objectives (SSOs) for adoption in the next two years; therefore, the peer review is expected to serve a dual purpose and we ask that peer reviewers consider the scientific basis of the reports and data presented in the context of the adoption of these tissue targets as water quality objectives. The SSOs are intended to replace the currently applicable CTR chronic criterion of 5 µg/L for selenium in freshwater.

For each subwatershed, water column-based concentrations for selenium were derived from the proposed tissue targets using available site-specific data in the biodynamic model adapted for
the Newport Bay watershed by U.S. Geological Survey staff. These concentrations are being proposed as TMDL allocations. However, until the currently applicable CTR criteria for selenium are replaced by revised objectives (e.g., site-specific objectives), allocations based on the CTR chronic criterion for selenium in freshwater are also proposed:

<table>
<thead>
<tr>
<th>Subwatershed</th>
<th>Tissue-based Water Column WLA/LA (µg Se/L)</th>
<th>CTR-based Water Column WLA/LA (µg Se/L)</th>
</tr>
</thead>
<tbody>
<tr>
<td>San Diego Creek</td>
<td>10</td>
<td>5</td>
</tr>
<tr>
<td>Santa Ana Delhi</td>
<td>11</td>
<td>5</td>
</tr>
<tr>
<td>Big Canyon Wash</td>
<td>1</td>
<td>5</td>
</tr>
</tbody>
</table>

In addition, optional conditional mass-based allocations are proposed for those dischargers that qualify to participate in a pilot offset and trading program for selenium.

Recognizing uncertainty in the relationship between the water-column based allocations and achieving the tissue-based numeric targets, the proposed TMDLs specifically provide that where the tissue-based numeric targets are attained, the WLAs/LAs shall also be deemed to be attained.

The implementation plan recommended for these proposed selenium TMDLs requires that a Regional Monitoring Program (RMP) be proposed for each of the three identified subwatersheds and implemented upon Regional Board approval\(^1\). Each RMP is to address, at a minimum, seven identified elements and several different types of focused monitoring (e.g., TMDL evaluation monitoring, BMP effectiveness monitoring).

These proposed selenium TMDLs are being established and will be implemented as phased TMDLs, consistent with USEPA guidance and based upon the following three-part structure:

- **Phase I** – Completion as soon as possible, but no later than 6 years from the effective date of the proposed selenium TMDLs\(^2\).
- **TMDL Reconsideration** – Completion as soon as possible, but no later than 2 years after **Phase I**. Reconsideration of the proposed selenium TMDLs will be no later than 8 years from the effective date of the proposed selenium TMDLs.
- **Phase II** – Completion as soon as possible, but no later than 30 years from the effective date of the reconsidered selenium TMDLs.

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\(^1\) One RMP can be developed for all three freshwater subwatersheds or separate RMPs can be developed for each subwatershed, requiring the development and submittal of a minimum of one and up to three RMPs by the regulated parties.

\(^2\) Each individual action identified in the implementation plan will be scheduled as a specific number of years/months from the effective date of the proposed selenium TMDLs. The effective date is the date of U.S. EPA approval of the selenium TMDLs.
ATTACHMENT 2

Draft Basin Plan Amendment – Total Maximum Daily Loads for Selenium in Freshwater in the Newport Bay Watershed

Description of Scientific Assumptions, Findings and Conclusions to be Addressed by Peer Reviewers

The statutory mandate for an external scientific peer review (Health and Safety Code Section 57004) states that the reviewer’s responsibility is to determine whether the scientific portion of the proposed rule is based upon sound scientific knowledge, methods, and practices. We request that the reviewers make this determination for each of the following assumptions, findings, and conclusions that constitute the scientific portion of the proposed regulatory action. To help with the review, an explanatory statement has been provided for each assumption, finding, and conclusion. Assumptions, findings and conclusions are supported by literature references cited in the staff report (staff report references are included in parentheses).

These selenium TMDLs only apply to three freshwater tributary subwatersheds in the Newport Bay watershed (San Diego Creek, Santa Ana-Delhi Channel, and Big Canyon Wash subwatersheds). These selenium TMDLs do not apply to the saltwater bodies in the Newport Bay watershed (Upper and Lower Newport Bay) as there has been no finding of impairment due to selenium in saltwater, marine fish tissue (for human or wildlife consumers of fish), or in eggs collected from birds nesting in the Bay.

Note to Reviewers:

The terms “criteria” and “objectives” are a frequent source of confusion. Water quality “criteria” are values recommended by USEPA for adoption by the states. If promulgated by USEPA (e.g., the California Toxics Rule [CTR]), the criteria become enforceable water quality “objectives” in California parlance. Water quality objectives can be either numeric (e.g., CTR criteria) or narrative (e.g. pollutants shall not bioaccumulate in organisms at concentrations that affect human health).

The CTR\(^1\) allows States the discretion to develop site-specific criteria (objectives) when the CTR criteria appear to be either over- or under-protective of designated uses. In these cases, the State may propose site-specific objectives (SSOs) that apply statewide, on a regional or watershed basis, or only to specific, designated water bodies. Under California Law, SSOs must be publically reviewed and approved by the Regional Board, the State Water Resources Control Board (SWRCB), and the State’s Office of Administrative Law (OAL). SSOs must be submitted for consideration for adoption as part of a Regional Board Basin Plan Amendment (BPA). This BPA must then be submitted to the USEPA for review and approval under Clean Water Act Section 303. Regional Board staff will be recommending the adoption of the TMDL tissue-based numeric targets as SSOs for selenium for several of the freshwater tributaries in the Newport Bay watershed.

TMDL numeric targets define the measurements that will ensure recovery of the beneficial uses that are impaired so that water quality standards can be attained. Water quality standards

\(^1\) 40 CFR Part 131 (D)(4)

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include beneficial uses, water quality objectives (numeric and narrative), and an antidegradation policy. TMDL numeric targets are not themselves criteria or objectives and are therefore not enforceable. For the selenium TMDLs, the tissue-based numeric targets are Regional Board staff's interpretation of the values that must be achieved to meet the narrative water quality objective established in the Region's Basin Plan that toxic substances, including selenium, will not cause or contribute to adverse toxic effects on biota.

In this document, Nos. 1-4, below, address the three proposed tissue-based numeric targets. They provide succinct statements justifying the scientific validity and appropriateness of employing these targets to protect fish and birds that live or forage in freshwater drainages in the Newport Bay watershed from reproductive effects from excessive selenium. No. 11 provides Regional Board staffs' rationale for proposing to adopt these tissue-based numeric targets as SSOs. No. 5 explains why Regional Board staff must, at this time, use the currently legally applicable CTR chronic criterion for selenium in freshwater of 5 micrograms selenium (Se) per liter (µg Se/L) as a final numeric target even though Regional Board staff do not believe that water column criteria for selenium are appropriate or supported by the science. No. 12 explains Regional Board staffs' rationale for this and justification for not proposing to adopt any of the water column-based numeric targets calculated from the tissue targets as SSOs; instead the water column concentrations will be used as translators or surrogates for the tissue-based SSOs to aid in assessing progress towards meeting the SSOs. Therefore, these water column translators will not be directly enforceable as objectives/criteria under State law. Since diet is the primary exposure route for selenium in fish and birds, it is appropriate to adopt objectives that are based on tissue, which is a direct measure of effects, verses water column-based objectives, which are at best only surrogate indicators of likely concentrations in tissue and, thus, of biological effects. If USEPA approves the tissue-based SSOs, they will depromulgate the CTR criterion for selenium in freshwater for the Newport Bay watershed and the tissue-based SSOs will become the legally applicable objectives for selenium in this watershed.

TMDL NUMERIC TARGETS

1. Based on draft selenium criteria developed by USEPA, a fish tissue numeric target of 8.1 micrograms selenium per gram dry weight (µg Se/g dw) in whole body fish has been selected as a scientifically supported and appropriate concentration that will protect the species of fish present in the freshwater bodies in the watershed. (Staff Report: Sections 4, 4.1, 4.1.1, 4.4)

The whole-body fish tissue numeric target protective of fish as a separate endpoint for the freshwater portions of the Newport Bay watershed is based, in part, upon the USEPA's 2014 Draft Selenium Criterion2.

In May 2014, USEPA released a draft selenium criterion for public comment. The draft criterion reflected the latest scientific information, which indicates that toxicity to aquatic life is driven by dietary exposure. The 2014 draft criterion prioritized fish tissue concentrations over water column concentrations.

2 The drafting of these TMDLs was substantively completed prior to the release of EPA’s revised draft criterion in 2015 and the final criterion in 2016. As noted in the staff report, these TMDLs are phased and structured purposefully to account for the ongoing revisions to selenium objectives.

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The 2014 Draft Criterion was based upon chronic toxicity data obtained primarily by searching published literature using USEPA's public ECOTOX database\(^3\). In addition, USEPA considered studies submitted with comments during the review of the 2004 draft selenium criteria\(^4\), and studies provided in response to an October 2008 Federal Register Notice of Data Availability. All available, relevant, and acceptable chronic toxicity values were used to recalculate the Final Chronic Value (FCV) as outlined in detail in the USEPA guidance for development of water quality criteria (Stephen et al., 1985). The four elements of the 2014 Draft Selenium Criterion, which includes two fish tissue-based and two water column-based elements, are based on this recalculated FCV:

- A fish egg/ovary element of 15.2 µg Se/g dw
- A fish whole-body and/or muscle element of 8.1 µg Se/g dw and 11.8 µg Se/g dw, respectively
- A water-column chronic element for lentic or lotic waterbody types of 1.3 µg Se/L and 4.8 µg Se/L, respectively
- A water-column intermittent element for lentic or lotic waterbody types that is derived from the water-column chronic element to account for potential chronic effects from repeated, short-term exposures (USEPA, 2014a)

Again, the fish tissue elements are prioritized over the water column elements.

After consideration of the 2014 Draft Selenium Criterion and discussions with the stakeholders and USEPA Region IX staff, Regional Board staff selected USEPA's proposed 2014 draft chronic criterion for selenium in whole-body fish of 8.1 µg Se/g dw as the recommended numeric target for selenium in fish as a separate endpoint. A whole-body fish tissue criterion was selected because of the difficulty of collecting gravid female fish in the freshwater portions of the Newport Bay watershed (only five gestating female fish have been collected over the last four years).

2. Based on the recommendation of USFWS staff, a fish tissue numeric target of 5.0 µg Se/g dw in whole body fish as a dietary concentration for the protection of aquatic-dependent birds has been selected as a scientifically supported and appropriate concentration that will protect the birds foraging in the freshwater areas in the Newport Bay watershed. These birds include federally listed species. This dietary concentration would only apply if the fish tissue numeric target for the protection of fish (8.1 µg Se/g dw) is being met, but the numeric bird egg tissue target is not being met in some areas of the watershed (Staff Report: Sections 4. 4.1, 4.1.2, 4.4)

A whole-body fish tissue selenium concentration target of 5 µg Se/g dw is proposed for the Newport Bay watershed to protect aquatic-dependent shorebirds. This target is also protective of the fish themselves as it falls below the lower ranges of whole-body selenium concentrations that are associated with minimal effects in fish (ten percent effect concentration [EC\(_{10}\)]); see Appendix I. As early as 1998, the U.S. Department of the Interior's (USDOI) selenium guidelines identified a toxicity threshold range of 4-6 µg Se/g dw (whole body) for fish (USDOI, 1998); a value of 5 µg Se/g dw lies in the middle of that range (J. Skorupa, USFWS, electronic communication dated October 20, 2008).

\(^3\) (http://cfpub.epa.gov/ecotox/)
\(^4\) In 2004, USEPA released Draft Aquatic Life Criteria for Selenium for public review and comment. This criteria document was not finalized, but has been revised via USEPA 2014.

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For birds, ranges in selenium concentrations in dietary items of 3–7 µg Se/g dw (Presser et al. 2004) or 3–8 µg Se/g dw (USDOI, 1998) have been identified to cause potential marginal reproductive effects. As a dietary concentration for aquatic-dependent birds, 5 µg Se/g dw would range from an EC\textsubscript{10} (Ohlendorf, 2003; logistic model) to an EC\textsubscript{25} (Beckon et al., 2008; biphasic model) for mallard exposure to selenomethionine with an endpoint of egg hatchability (J. Skorupa, USFWS, electronic communication, October 20, 2008).

Studies indicate that piscivorous birds (e.g., black-crowned night-herons) may be less sensitive to the toxic effects of selenium than mallards (Smith et al., 1988 versus Heinz et al., 1987 and 1989; Goede, 1993; Goede and Wolterbeek, 1993), which have a primarily plant-based diet. However, birds that primarily consume vascular plants and algae have higher caloric requirements (Stewart et al., 2010) resulting in potentially higher exposure rates even though selenium concentrations in plants may be lower than concentrations in aquatic invertebrates or fish. Invertebrate-eating shorebirds (invertivorous birds) appear to be less sensitive to selenium effects than mallards, but more exposed than piscivorous birds.

Though there is some uncertainty regarding the sensitivity of shorebirds to selenium, USFWS staff have supported the 5 µg Se/g dw dietary fish tissue concentration as sufficiently protective of the birds foraging in the freshwater areas in the Newport Bay watershed, including federally listed species: a shorebird—Ridgway’s Rail (\textit{Rallus obsoletus levipes}; formerly known as the Light-footed Clapper Rail), and a piscivorous bird—the California Least Tern (\textit{Sterna antillarum brownie}) (J. Skorupa, USFWS, electronic communication, October 20, 2008).

3. Based on the recommendation of USFWS staff, a numeric target of 8.0 µg Se/g dw in bird egg tissue has been selected as a scientifically supported and appropriate concentration that will protect the species of aquatic-dependent birds that nest and forage in the watershed. (Staff Report: Sections 4, 4.2, 4.4)

For birds, a selenium concentration of 8 µg Se/g dw in egg tissue is proposed as a numeric target for the Newport Bay watershed. Selenium concentrations in eggs are more useful for evaluating potential reproductive impairment than other tissue types (Skorupa and Ohlendorf, 1991; Ohlendorf and Heinz, 2011), as many factors can influence the transfer of selenium from the food eaten by birds through their tissues (e.g., liver, blood) to the eggs, and because effects occur in the developing embryo. Selenium concentrations in livers or blood are useful for assessing exposure at the time of sampling, but they are not as useful as the concentrations in eggs for assessing potential reproductive impairment (Ohlendorf and Heinz, 2011; CH2M Hill, 2009a; CH2M Hill, 2009a also included in Appendix I).

Worldwide, mean background selenium concentrations (no effects level concentrations) in bird eggs are <3 µg Se/g dw (typically 1.5-2.5 µg Se/g dw, with individual eggs <5 µg Se/g dw). Selenium concentrations that are associated with effects have been estimated from field studies of shorebirds and waterfowl and from laboratory studies with mallards, chickens, and Japanese quail (Heinz et al., 1989; CH2M Hill, 2009a; Ohlendorf and Heinz, 2011). Reduced hatching success is considered the most sensitive, reliable endpoint for effects, with effect levels ranging from 6-7 µg Se/g dw to 14 µg Se/g dw in black-necked stilt eggs.

In USFWS staffs’ opinion (J. Skorupa, USFWS, electronic communication dated July 7, 2009), a range in selenium concentrations of 3-8 µg Se/g dw provides reasonable no effects concentrations (NECs) for egg selenium for sensitive bird species. The range of plausible EC\textsubscript{10} values overlaps the true NEC for many datasets. The upper end of this range of possible NECs (8 µg Se/g dw) has been judged by USFWS staff to represent sufficient conservatism based on
the specific bird species present in the Newport Bay watershed, including the federally listed California least tern and Ridgway’s rail (J. Skorupa, USFWS, electronic communication dated October 20, 2008).

4. **The fish tissue numeric target that applies depends upon the attainment of the bird egg target.** *(Staff Report: Section 4 and Table 4.3)*
   a. **Where the bird egg target is attained**, the fish tissue target of 8.1 µg Se/g dw applies. This target serves as a protective target for fish as a separate endpoint.
   b. **Where the bird egg tissue target is not attained**, the fish tissue target of 5 µg Se/g dw, or a site-specific fish tissue concentration at which the bird egg target is met, applies. This target serves as a protective dietary target for aquatic-dependent shorebirds and only applies if the bird egg tissue target is not being attained at a fish tissue concentration of 8.1 µg Se/g dw. *(Staff Report: Sections 4, 4.4)*

Selenium concentrations in fish tissue are a good integrator of selenium concentrations in aquatic invertebrates because selenium bioaccumulates in fish relative to the concentration in their diet; the trophic transfer factor for selenium from most [non-bivalve] aquatic invertebrates to fish is 1.1 *(Section 6)*. Laboratory-derived trophic transfer factors for a marine piscivorous fish *(English seabass – Dicentrarchus labrax)* support this and fall within the same range as those derived for fish feeding on invertebrates *(Stewart et al., 2010)*, indicating that the trophic transfer factors from invertebrates to fish and fish to fish, are similar. This same relationship has been found between freshwater fish and invertebrates.

Because there is the potential for selenium to bioaccumulate both from fish and from invertebrate food items to aquatic-dependent shorebirds, the recommended fish tissue dietary numeric target of 5 µg Se/g dw to protect aquatic-dependent shorebirds is lower than that proposed for the protection of fish (8.1 µg Se/g dw). This lower fish tissue target is intended to protect the aquatic-dependent shorebirds that forage in the same aquatic environment, as well as protecting fish. However, the ecosystem may function such that aquatic-dependent birds are protected even when selenium concentrations in fish tissue exceed the lower dietary numeric target. This scenario may be occurring in the Newport Bay watershed, where selenium concentrations in bird eggs appear to be close to the recommended numeric bird egg tissue target of 8 µg Se/g dw, even though fish tissue selenium concentrations exceed the proposed dietary fish tissue target by a greater margin *(Section 3.5)*. Therefore, a separate target, specific to the protection of fish without the dietary linkage to birds, is appropriate for the Newport Bay watershed. As noted however, this target only applies to areas within the watershed where the fish tissue target for the protection of fish is being attained, but the bird egg tissue target is not being met. The secondary dietary fish tissue target of 5 µg Se/g dw is considered to be the lower bound concentration that may be necessary to ensure that the bird egg tissue target is being met. It is acknowledged that the bird egg tissue target may therefore be met at some concentration between 5 and 8.1 µg Se/g dw *(Section 4, Table 4.3)*.

5. **A water column numeric target of 5.0 µg Se/L is being established for the freshwater tributaries in the watershed in accordance with the currently applicable California Toxics Rule chronic criterion for selenium in freshwater.** *(Staff Report: Sections 4, 4.3, 4.4)*

The CTR chronic water column concentration for selenium in freshwater is also established as a numeric target for freshwater in these proposed selenium TMDLs. Until tissue-based objectives are approved, the CTR chronic criterion for selenium in freshwater must serve as the final
numeric target for selenium for the freshwater areas in the Newport Bay watershed. However, the water column-based target will no longer be in effect once the CTR freshwater criterion has been replaced by revised objectives (e.g., the CTR freshwater selenium criterion has been revised by USEPA and/or selenium SSOs have been approved by USEPA for the freshwater tributaries in the Newport Bay watershed).

Regional Board staff believe that USEPA's draft (2014) and final (2014) recommendations for water column selenium criterion elements for lotic and lentic waterbodies are not appropriate given the wide range in selenium concentrations in water that may, or may not be, directly associated with selenium effects in aquatic life. This holds especially true for the Newport Bay watershed; therefore at this time these selenium TMDLs do not incorporate USEPA's recommended water column elements as a TMDL numeric target. Instead, the TMDLs use site-specific data and modeling to translate the numeric tissue targets into appropriate surrogate water column concentrations for the different waterbodies in watershed (Section 6).

LINKAGE ANALYSIS

6. The translation from fish tissue or bird egg tissue to water column concentrations using the biodynamic model developed by USGS staff and adapted to the Newport Bay watershed is supported by scientific data, including site-specific data (Staff Report: Section 6, 6.1, 6.2; Appendices N and O)

A biodynamic selenium model (herein referred to as the biodynamic model) was developed to conceptualize and quantify the current state of knowledge concerning the dietary transfer of Se through ecosystems (Luoma and Presser, 2009; Presser and Luoma, 2010). The biodynamic model links waterborne concentrations of selenium through food webs, taking into account the partitioning of selenium between water and particulate material and the species-specific transfer factors between trophic levels. The biodynamic model can be used to predict a water-column selenium concentration that would correspond to a specific tissue selenium concentration, such as a guideline or numeric target, or it can take a water-column selenium concentration and use it to predict a selenium concentration in the tissue of a target organism, such as fish or birds.

The biodynamic model was adapted for use in the Newport Bay watershed by developing conceptual food-web models (CH2M Hill 2009b) and compiling data from monitoring in the San Diego Creek watershed and Newport Bay during 1999-2007 (Presser and Luoma, 2009; Appendix N). The model was used to predict water-column selenium concentrations consistent with achieving numeric selenium targets for whole-body fish and bird eggs in Newport Bay (Presser and Luoma, 2009). The TMDL calculations includes all data collected between 1999 and 2007, as reported earlier (Presser and Luoma, 2009) as well as more targeted data collected from in the watershed from 2008 through 2014. These data include all available water, sediment, algae, suspended particulates, fish and bird egg tissue collected from the three subwatersheds to which these selenium TMDLs apply: San Diego Creek, Santa Ana-Delhi Channel, and Big Canyon Wash subwatersheds.

7. The modeling simulations, input parameters and assumptions are representative of site-specific conditions for the three freshwater subwatersheds modeled: Santa Ana-Delhi Channel, San Diego Creek, and Big Canyon Wash. (Staff Report: Sections 6, 6.2, 6.2.4; Appendix O)
The goal of the modeling for the Newport Bay watershed was to characterize the range of concentrations of dissolved selenium that must be maintained in the water column within each subwatershed (Santa Ana-Delhi Channel, San Diego Creek, and Big Canyon Wash) in order to achieve the fish and bird egg tissue concentrations consistent with the applicable numeric targets of the TMDLs. Appendix O of the staff report identifies the assumptions and decisions about coefficients that went into the model calculations that produced the resulting concentration ranges. The documentation also presents the data from which each calculation was made (the metadata, or data behind the final result).

The steps involved in the biodynamic selenium model documentation included:

a) Assembling a data set from each sub-watershed;
b) Calculating a range of watershed-specific partitioning coefficients (Kds) and trophic transfer factors (TTFs) from that data set and specifying the assumptions for each calculation;
c) Testing the validity of the coefficients (or calibrating those coefficients if necessary) by comparing observed tissue concentrations from the subwatersheds with concentrations predicted from the model;
d) Reconsidering the coefficients based upon the validity analysis and calibrating for “better” fits as needed;
e) Modeling water concentrations necessary to achieve the selected targets using the coefficients documented as above (a-d).

The modeling provides several choices for water column concentrations based upon the K_d values that best fit the existing whole body fish tissue and bird egg data in the validation exercise.

8. The range in potential water column concentrations generated by the different model runs for each of the waterbodies modeled and the methods used to calibrate the data are appropriate and supported by scientific data. (Staff Report: Sections 6, 6.2, 6.2.5; Appendix O)

The K_d values used for the different hydrologic compartments in the Newport Bay watershed result in a range of possible water column concentrations for each hydrologic unit (Section 6, Table 6.2). Based upon the validation exercise, the numeric targets for fish represent the values with the least uncertainty. The disparity between concentrations in bird eggs and concentrations expected from environmental conditions (as predicted by the biodynamic model) are likely to reflect the larger foraging ranges of birds as compared to fish and differences in feeding preferences among bird species, especially in the areas where the concentration of selenium in birds was much lower than predicted by the model (e.g., Big Canyon Wash).

With the exception of Big Canyon Wash\(^5\), the model results using the fish tissue targets and the invertebrate-based food web provides the greatest confidence in predicting the surrogate water column concentrations. The model results for the bird egg tissue target of 8.0 µg Se/g dw over-predict bird egg tissue concentrations when compared to existing data. Since the 5.0 µg Se/g

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\(^5\) For Big Canyon Wash, during the model calibration/validation step, the model results using a sediment/detrital link to mosquitofish (which consume detrital materials as well as invertebrates) instead of invertebrates to mosquitofish provided the closest match to the median selenium concentrations measured in mosquitofish collected from the creek. This may be because of the relative abundance of detrital material present in the pond areas as compared to invertebrates. Therefore, for the calculations, the K_d was directly linked to the fish tissue concentration and the invertebrate TTF was not used.
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dw fish tissue target is only triggered where bird eggs exceed the bird egg target but the primary fish tissue target of 8.1 µg Se/g dw is being met, the model results for the primary fish tissue target are the most relevant. In general, the 85th percentile $K_{ds}$ showed the best fit when validating the model for each assessment area using existing water column concentrations to predict fish tissue selenium concentrations. Exceptions to this were the UCI wetlands (best fit was the 75th percentile $K_{d}$) and Big Canyon Wash (mean $K_{d}$).

The model calculations and validation for the UCI wetlands suggest that reductions in selenium concentrations in the wetlands are currently not needed for resident fish since both the mean and 75th percentile selenium concentrations in fish living in the wetlands are below the primary fish tissue target of 8.1 µg Se/g dw. For the Santa Ana-Delhi Channel, while the model indicated a good correlation between predicted and observed fish tissue selenium concentrations, it over-predicted the water column concentration that would be needed to meet the fish tissue target of 8.1 µg Se/g dw. This is likely a result of the limited dataset available for this subwatershed.

**TMDL AND ALLOCATIONS**

9. **The TMDL and load and wasteload allocations are supported by the scientific information presented in the report. (Staff Report: Section 7)**

(Section 7.2) Protection of beneficial uses requires consideration of both the periods of highest selenium exposure (dry weather flows) and the periods of greatest potential harm to the beneficial uses (breeding season and periods of embryonic and/or juvenile development). Dry weather conditions with low flows occur year-round, and therefore, present potential periods of high selenium exposure all year. The period of potential greatest harm due to selenium exposure occurs seasonally (spring and early summer). As a result, consideration of seasonal variations could result in the development of different allocations for different periods of the year or the application of the allocations only during the breeding season. However, to ensure protection of beneficial uses both during the sensitive period and from the higher selenium concentrations that occur during dry weather, a year-round application of the TMDLs and allocations during dry weather conditions is the most protective approach.

Further, to evaluate the influence of seasonality and to provide the most protective assessment of beneficial uses, an averaging period for the wasteload allocations (WLAs) and load allocations (LAs) is appropriate. Averaging periods for the allocations are based on the potential impacts from selenium exposure and variability in observed receiving water data. Since the protection of beneficial uses is linked to chronic not acute selenium conditions, a semi-annual averaging period utilizing an arithmetic mean is appropriate for these TMDLs and allocations. The semi-annual averaging periods are defined as April 1 through September 30 and October 1 through March 31 each year.6

6 Note that this averaging period specifically applies to the concentration-based WLAs and LAs. As specifically noted in these proposed selenium TMDLs (Section 7.3), where the tissue-based numeric targets are attained, the WLAs/LAs shall be deemed to be attained. In evaluating the tissue-based numeric targets, an annual averaging period is more appropriate since bird eggs are only available during a very limited time of the year, and fish tissue and other biota should also be collected during the same timeframe that the birds are breeding since they constitute a likely source of selenium input. Because selenium concentrations in fish and bird egg tissue are expected to be much more variable than those in water, a geometric mean statistical approach should be employed for evaluating tissue data.
(Section 7.3) Tissue-Based Water Column WLAs and LAs. Ranges of water column concentrations necessary to achieve the tissue-based numeric targets were predicted for the freshwater areas of the watershed using the biodynamic model. These tissue-based water column concentrations, as opposed to the CTR-based water column concentration, provide a direct link to protection of beneficial uses (as they are derived from the tissue-based targets) and are, therefore, established as WLAs and LAs for these proposed selenium TMDLs. A range of loading capacities was derived from the biodynamic model for the three subwatershed areas. The range of results reflects the heterogeneity of the watershed, as well as the complexity in the pathways of selenium accumulation in the local foodwebs. All of the results are deemed equally valid for predictive purposes (i.e., there is not a single “most appropriate” number that results from running the biodynamic model that definitively corresponds with the protection of beneficial uses).

San Diego Creek Subwatershed: Based upon the evaluation of data collected to date in this subwatershed, it appears that fish tissue, not bird egg tissue, is the most sensitive endpoint. Validation modeling for the biodynamic model showed agreement between the predicted and observed selenium concentrations in fish for San Diego Creek, but in almost all cases, the validation modeling over-predicted the bird egg tissue selenium concentrations. Therefore, water column concentrations derived from the fish tissue target as a separate endpoint have been selected as the basis to establish the WLAs and LAs for this subwatershed.

Santa Ana-Delhi Channel: For Santa Ana-Delhi Channel, the predicted concentrations are greater than ambient concentrations. Therefore the allocations are set to existing conditions (ambient concentrations ±95% confidence interval). As the TMDL is implemented, there will be ongoing attempts to collect more tissue data. Such data will be used to re-evaluate the appropriateness of these initial WLAs and LAs for this subwatershed.

Big Canyon Wash Subwatershed: In the Big Canyon Wash subwatershed, bird egg tissue is significantly above the numeric targets. With one exception, every sample of pied bill grebe eggs exceeded the target more than threefold (Appendix O). Therefore, the predicted water column concentration for the protection of birds has been selected as the basis for WLAs and LAs for this subwatershed.

For each subwatershed, the upper end of the applicable predicted range of probable selenium concentrations has been selected for the establishment of allocations during Phase I of these proposed selenium TMDLs. As noted above, while the model results in a range of possible concentrations, all modeled concentrations are considered equally predictive of what is needed to protect beneficial uses since the range results from various pathways of potential accumulation in various foodwebs. This initial selection is based upon concentrations that are expected to result in protection of beneficial uses, but is not intended to be considered the only concentration that is appropriate (e.g., tissue-based targets may be attained at higher or lower concentrations). This approach also supports the adaptive management component of these proposed selenium TMDLs (Section 8) that requires iterative BMP implementation, focused on reductions in selenium concentrations until the tissue-based targets (and CTR water column-based targets, to the extent they remain in effect) are achieved. Further, as these proposed selenium TMDLs will be incorporated into regulatory mechanisms, including NPDES permits, decreasing rather than increasing the WLAs over time, if necessary and appropriate, will comply with the general prohibition on anti-backsliding.
CTR Water Column-Based WLAs and LAs. Until tissue-based objectives are approved, the CTR chronic criterion for selenium in freshwater must serve as the final numeric target for selenium for the freshwater areas in the Newport Bay watershed. As a result, water column-based allocations based on the CTR are also included in these proposed selenium TMDLs. However, the CTR water column-based allocations will no longer be in effect if and when the CTR freshwater criterion has been replaced by revised objectives (e.g., SSOs).

Conditional Mass-Based WLAs. Recognizing the lack of reasonable and feasible BMPs in the watershed, and that allowing certain discharges to be offset rather than prohibited may provide a greater net environmental benefit (Section 8.5.2), conditional mass-based WLAs are included as an alternative to the concentration-based WLAs. As a requirement of the offset and trading program, such discharges cannot result in downstream impacts (as defined in Section 8.5.2.3). Therefore, these conditional mass-based WLAs will result in attainment of the loading capacity and thereby attainment of the proposed selenium TMDLs.

Attainment of Tissue-Based Numeric Targets. While the tissue-based water column WLAs and LAs are expected to result in attainment of the tissue-based numeric targets, bioaccumulation in the various foodwebs in the watershed may be different than what was modeled with the biodynamic model (Section 6). Therefore, where tissue-based numeric targets are attained, the corresponding WLAs/LAs will also be deemed to be attained, regardless of the actual measured water column concentration. This approach emphasizes that the water column concentrations are only surrogate measures, while the tissue-based targets provide for the direct assessment and protection of beneficial uses.

MONITORING

10. A Regional Monitoring Program (RMP) must be developed for each subwatershed area (San Diego Creek, Santa Ana-Delhi Channel, and Big Canyon Wash). The RMP required monitoring elements include minimum monitoring requirements that are scientifically supported, are reasonable and appropriate, and are expected to provide the information needed to meet the intended purpose of each type of monitoring while still allowing flexibility for adaptive management. (Staff Report: Section 8.5.3)

For Regulated Parties implementing a BMP Strategic Plan, a Regional Monitoring Program (RMP) must be developed and submitted to the Executive Officer for approval7, consistent with the schedule identified in the Implementation Plan (Section 8.13), and implemented upon that approval. A RMP must be developed for each subwatershed area; RMPs can be submitted separately for each subwatershed or two or more can be combined. Integration of the various monitoring requirements for these TMDLs and coordination with other existing monitoring efforts (e.g., other TMDLs, the MS4 permit, other regional monitoring programs, etc.), is encouraged.

To be considered for approval by the Executive Officer, each RMP must include the following elements:

- TMDL Evaluation Monitoring (Section 8.5.3.1)
- BMP Effectiveness Monitoring (Section 8.5.3.2)

7 It is expected that prior to Executive Officer approval, input and recommendations from the U.S. Fish and Wildlife Service (USFWS) and the CDFW will be solicited concerning the proposed monitoring, particularly biological monitoring conducted as part of Assessment Area monitoring (see below).
The above monitoring elements reflect the various aspects of these proposed selenium TMDLs that are supported, informed and/or evaluated by monitoring in the watershed. In order to ensure integration of these elements and the various components of these proposed selenium TMDLs within each subwatershed, the monitoring requirements are contained within one unified document, the RMP.

**TMDL Evaluation Monitoring (Section 8.5.3.1)**

The purpose of the TMDL evaluation monitoring is to assess progress toward the attainment of the WLAs, LAs and the tissue-based numeric targets\(^9\), consistent with California Water Code Section 13242.

The TMDL evaluation monitoring is divided into two categories:

- **Assessment Point Monitoring** – Assessment Point Monitoring will be used to assess, through water column monitoring, whether the WLAs and LAs are being attained. An assessment point within each of the subwatershed/channel areas has been identified at the downstream end for each of the three subwatersheds. The monitoring parameters for the Assessment Point Monitoring must consist of the following:
  - Water column: selenium (total and dissolved)\(^{10}\)
  - Flow

  The frequency of sample collection must be sufficient to evaluate the WLAs and LAs (including the seasonal evaluation) and must be specified in the RMP.

- **Assessment Area Monitoring** – Assessment area monitoring will be used to assess, through bird egg and fish tissue samples, attainment of the tissue-based numeric targets. Tissue samples must be collected throughout the subwatershed area. For instances where sufficient tissue samples cannot be collected from an assessment area, a surrogate parameter (e.g., macroinvertebrates, reptiles, amphibians) may be used. The surrogate parameter must be proposed in the Regional Monitoring Program and, therefore, is subject to approval by the Executive Officer. The purpose of the surrogate parameter is to allow for an alternative assessment, as appropriate, of the tissue-based numeric targets to avoid a default presumption of attainment or lack of attainment due to an insufficient number of tissue samples. Given that numeric targets have not been established for these surrogate parameters, they would be used for informative purposes.

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\(^8\) Only required where the Regulated Parties opt to implement the Offset and Trading Program.

\(^9\) The monitoring program’s purpose is not to determine permit compliance. Permit compliance will be determined as described in Sections 7 and 8.11 of the staff report.

\(^{10}\) Selenium species in addition to total and dissolved selenium (collected at same time as assessment area monitoring is being conducted) should be considered under Other Considerations, but are not required for all monitoring events or locations.
(e.g., to observe trends over time) rather than compliance determinations. Two to three assessment areas have been designated for each subwatershed based on the presence of habitat suitable to support aquatic organisms and provide foraging and/or nesting habitat for aquatic-dependent birds.

At a minimum, the monitoring parameters for the Assessment Area Monitoring must consist of the following:

- **Bird Egg Tissue (individual eggs, contents only):** total selenium and percent solids; aquatic-dependent birds, especially shorebirds.

- **Fish Tissue (composite, whole-body tissue analyses):** total selenium and percent solids; targeted species include juvenile and adult fish of the Centrarchidae family (e.g., bluegill, largemouth bass) and smaller fish such as red shiners or mosquito fish where centrarchids are not available.

- **Surrogate Parameters:** Locations with limited habitat may not reliably provide fish or bird eggs for collection (e.g., Santa Ana-Delhi Channel). Therefore, the RMP must identify appropriate surrogate parameters (e.g., larger macroinvertebrates, such as crayfish, reptiles such as non-native turtles, or amphibians such as non-native frogs) for sampling.

The frequency of sample collection must be sufficient to evaluate the tissue-based numeric targets, provided sufficient samples can be collected during target sample collection times, and must be specified in the RMP. At a minimum, an attempt to collect samples must be conducted annually in each assessment area, unless and until the Executive Officer determines that sufficient tissue data has been obtained to adequately characterize conditions and a lower sample collection frequency is warranted. Bird egg collection should be conducted during the nesting season (generally March through August). Fish collection should be at the same time of year to capture the potential effects of fish as bird dietary items and for effects to spring fish reproduction (common timing for most of the target species).

**BMP Effectiveness Monitoring (Section 8.5.3.2)**

The purpose of the BMP effectiveness monitoring is to assess the effectiveness of the BMPs that have been implemented pursuant to the BMP Strategic Plan(s).

Changes in selenium concentrations in receiving waters, fish tissue, and bird eggs as a result of BMPs can be evaluated on either a project-specific or regional basis (e.g., the assessment area), depending upon the location and scale of the BMP. In addition, depending upon the type of BMP implemented, additional parameters or factors may be warranted (e.g., selenium speciation; bacteriological monitoring). Therefore, the monitoring that is appropriate to assess BMP effectiveness will be project-specific. However, to ensure integration of the goals and purposes of the BMP Strategic Plan and the RMP, a project-specific monitoring plan must be developed for each project. Each project-specific monitoring plan must be appended to the overall RMP and address the following:

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11 It is expected that prior to Executive Officer approval, input and recommendations from the U.S. Fish and Wildlife Service and the California Department of Fish and Wildlife will be solicited concerning the proposed monitoring, particularly biological monitoring conducted as part of Assessment Area monitoring.
• Baseline conditions prior to the project;
• Monitoring locations and rationale for the monitoring locations;
• Monitoring parameters, which at a minimum must include selenium in water (total and dissolved);
• Frequency with which each selenium reduction BMP will be monitored once the BMP is constructed and fully functioning. Monitoring must be sufficient to determine performance and selenium reduction effectiveness; and
• Duration of the BMP effectiveness monitoring.

**Offset and Trading Program Monitoring (Section 8.5.3.3)**

The purpose of the offset and trading program monitoring component is to provide the data that verify the generation of credits, and to conduct assessments on the effects of the offsets and/or trades on receiving water conditions to prevent localized impacts. This monitoring element only applies to Regulated Parties that opt to participate in the Offset and Trading Program.

For Regulated Parties who are generating credits via a BMP, at a minimum, monitoring must include the following:

- Influent water to the BMP (prior to treatment):
  - Water Column: selenium (total and dissolved)
  - Flow

- Effluent water (post-treatment) from the BMP (diversion projects are excluded from this requirement)
  - Water Column: selenium (total and dissolved)
  - Flow

For Regulated Parties who seek to use credits, at a minimum, monitoring must include the following:

- At the point of discharge:
  - Water Column: selenium (total and dissolved)
  - Flow

- Downstream of the point of discharge:
  - Water Column: selenium (total and dissolved). Water column monitoring conducted under the TMDL Evaluation Monitoring may be sufficient to satisfy this requirement.
  - Bird Egg Tissue: consistent with the requirements specified in TMDL Evaluation Monitoring; tissue monitoring conducted under Assessment Area monitoring may be sufficient to satisfy this requirement.
  - Fish Tissue: consistent with the requirements specified in TMDL Evaluation Monitoring; tissue monitoring conducted under Assessment Area monitoring may be sufficient to satisfy this requirement.

**Source Assessment Monitoring (Section 8.5.3.4)**

As BMPs needed to achieve these proposed selenium TMDLs are implemented, and as conditions in the subwatershed areas change over time, the collection of selenium source data in each of the subwatershed areas may be necessary to identify and assess significant

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remaining inputs that do not have BMPs. The need for and selection of additional sample collection locations will be based on the results of Assessment Point and Assessment Area monitoring. Each subwatershed RMP must provide for this monitoring element.

**Other Considerations (Section 8.5.3.5)**

In addition to the required monitoring elements of the RMP (TMDL evaluation monitoring, BMP effectiveness monitoring, offset and trading program monitoring, and source assessment monitoring), other elements, such as those listed below, may be considered for inclusion in the RMP. These elements are not required components of the RMP, but may be considered as the program develops or added based on consultation with Regional Board staff, and may change over time:

- **Selenium Speciation Analysis** – The chemical speciation of selenium is a critical consideration in assessing the potential impacts of selenium because the bioavailability and toxicity of selenium are greatly affected by its chemical forms. Monitoring aimed at collecting data on the chemical speciation of selenium in the water column should be considered where appropriate.

- **Additional Monitoring Sites** – Additional sites that provide meaningful data to support refinement of the TMDLs and/or BMP implementation may be considered. These sites would not be used for TMDL evaluation purposes but to support future decision-making.

- **Additional Monitoring Triggers** – As part of the overall adaptive management aspect of these proposed selenium TMDLs, the RMP may consider triggers where additional monitoring is warranted (e.g., tissue concentrations that are orders of magnitude higher than other samples).

**Special Studies (Section 8.5.3.6)**

Special studies are supplemental to the core, routine components of the RMP. These studies are intended to answer discrete questions and are not intended to be part of the routine monitoring conducted through the RMP. These studies can inform and fill data gaps that support refinement and/or modification to these proposed selenium TMDLs. Special studies can be recommended by the Regulated Parties or proposed by Regional Board staff. Any special study conducted during Phase I must be completed prior to the TMDL Reconsideration in order for that information to be included in that process.

**Quality Assurance and Quality Control Measures (Section 8.5.3.7)**

The Regional Monitoring Program must identify the quality assurance and quality control measures (QA/QC) that will be implemented including consideration of California’s Surface Water Ambient Monitoring Program (SWAMP).

**SITE-SPECIFIC OBJECTIVES FOR SELENIUM**

11. *The proposed tissue-based numeric targets for selenium in fish and bird egg tissue are expected to be proposed in the future as site-specific objectives for the Newport Bay watershed. These tissue-based selenium concentrations are protective of the fish and aquatic-dependent bird species present in the watershed including federally-listed species. Therefore the proposed numeric tissue targets*
of 8.1 µg Se/g dw in whole body fish for the protection of fish, 8.0 µg Se/g dw in bird eggs for the protection of aquatic-dependent birds, and 5 µg Se/g dw as a dietary target for the protection of birds are reasonable and appropriate as proposed site-specific objectives for the Newport Bay watershed. (Staff Report: Section 4, Appendix K.)

Site-specific Objective for the Protection of Fish
A fish tissue concentration for the protection of fish as its own endpoint in whole body fish of 8.1 µg Se/g dw is expected to be proposed (as a separate regulatory action in the future) as a site-specific objective for freshwater fish in the Newport Bay watershed. This tissue concentration is based on USEPA’s 2014 Draft Criterion for Selenium in freshwater (Appendix C). This number was selected by Regional Board staff as it falls in the middle between the estimated final chronic values (FCVs) recommended by GEI (9.1, 10.8, and 22.31 µg Se/g dw; Appendix J) and calculated by Regional Board staff (7.2 and 7.4 µg Se/g dw; Appendix K). While subsequent revisions after independent and internal peer review resulted in a slight increase in USEPA’s 2016 final criterion for selenium in whole body fish (from 8.1 to 8.5 µg Se/g dw), the increase is not statistically relevant for these TMDLs. Several test model runs using the biodynamic model were made using USEPA’s final recommended aquatic life criterion for selenium in whole body fish for comparison to the proposed TMDL numeric target. Calculated water column concentrations for selenium did not show a significant difference between the two criteria, especially for water bodies with the highest K_d, and only resulted in a change in water column concentrations generated by the biodynamic model of 0.1-1.2 µg Se/L.

Though this proposed criterion may be re-evaluated as work to develop recommended selenium site-specific objectives for the watershed proceeds, it is not expected to change significantly. As this concentration is considered to be protective of the fish present in the Newport Bay watershed, it is reasonable and appropriate to adopt the whole body fish tissue concentration of 8.1 µg Se/g dw as a site-specific objective.

Site-specific Objective for Fish as a Dietary Concentration for the Protection of Birds
A whole-body fish tissue selenium concentration of 5 µg Se/g dw is expected to be proposed in the future as a site-specific objective for the Newport Bay watershed as a dietary concentration for the protection of aquatic-dependent birds. Ranges in dietary selenium concentrations of 3–7 µg Se/g dw (Presser et al. 2004) or 3–8 µg Se/g dw (USDOI, 1998) have been identified to cause potential marginal reproductive effects in birds. As a dietary concentration for aquatic-dependent birds, 5 µg Se/g dw would range from an EC_{10} (Ohlendorf, 2003; logistic model) to an EC_{25} (Beckon et al., 2008; biphasic model) for mallard exposure to selenomethionine with an endpoint of egg hatchability (J. Skorupa, USFWS, electronic communication, October 20, 2008).

USFWS staff have supported the 5 µg Se/g dw dietary fish tissue concentration as sufficiently protective of the birds foraging in the freshwater areas in the Newport Bay watershed, including federally listed species: a shorebird—Ridgway’s Rail (Rallus obsoletus levipes; formerly known as the Light-footed Clapper Rail), and a piscivorous bird—the California Least Tern (Sterna

12As described in the numeric targets section of this document, the applicable fish tissue numeric target depends upon the attainment of the bird egg target. The 5 µg Se/g dw target serves as a protective dietary target for aquatic-dependent shorebirds and only applies if the bird egg tissue target is not being attained at a fish tissue concentration of 8.1 µg Se/g dw.
antillarum brownie) (J. Skorupa, USFWS, electronic communication, October 20, 2008). It is therefore reasonable and appropriate to also adopt this whole body fish tissue concentration of 5.0 µg Se/g dw as a dietary site-specific objective for selenium for the protection of birds. This fish tissue concentration would only apply to areas where the bird egg concentration of 8.0 µg Se/g dw is not being attained even though the fish tissue concentration of 8.1 µg Se/g dw is being attained. As a site-specific criterion, the same rule would apply.

Site-specific Objective for the Protection of Birds
For birds, a selenium concentration of 8 µg Se/g dw in egg tissue is expected to be proposed as a site-specific objective for the Newport Bay watershed in the future. Selenium concentrations in eggs are more useful for evaluating potential reproductive impairment than other tissue types (Skorupa and Ohlendorf, 1991; Ohlendorf and Heinz, 2011). Worldwide, mean background selenium concentrations (no effects level concentrations) in bird eggs are <3 µg Se/g dw (typically 1.5-2.5 µg Se/g dw, with individual eggs <5 µg Se/g dw). Selenium concentrations that are associated with effects have been estimated from field studies of shorebirds and waterfowl and from laboratory studies with mallards, chickens, and Japanese quail (Heinz et al., 1989; CH2M Hill, 2009a; Ohlendorf and Heinz, 2011). Reduced hatching success is considered the most sensitive, reliable endpoint for effects, with effect levels ranging from 6-7 µg Se/g dw to 14 µg Se/g dw in black-necked stilt eggs.

In USFWS staffs’ opinion (J. Skorupa, USFWS, electronic communication dated July 7, 2009), a range in selenium concentrations of 3-8 µg Se/g dw provides reasonable no effect concentrations (NECs) for egg selenium for sensitive bird species. The upper end of this range of possible NECs (8 µg Se/g dw) has been judged by USFWS staff to represent sufficient conservatism based on the specific bird species present in the Newport Bay watershed, including the federally listed California least tern and Ridgway’s rail13 (J. Skorupa, USFWS, electronic communication dated October 20, 2008). Therefore, it is reasonable and appropriate to adopt the bird egg tissue concentration of 8.0 µg Se/g dw as a site-specific objective for the protection of birds.

12. The water column concentrations generated by the biodynamic model will not be proposed as site-specific objectives. (Staff Report: Section 4, Appendix K.)

In their 2014 Draft selenium criterion (Appendix C), USEPA translated their primary egg/ovary fish tissue selenium criterion into two water column concentration elements, one for lentic and one for lotic waterbodies. However, in the data sets used by USEPA to develop their water column elements, there were a significant percentage of sites where the selenium water column criterion elements would be either under- or over-protective, especially for lotic systems. For the lotic systems included in the dataset, in 30% of the samples the selenium water concentrations exceeded the proposed lotic criterion element yet the fish tissue selenium concentrations were below the proposed fish egg/ovary criterion. In California, this has been observed in several areas where paired data for selenium water column concentrations and whole body fish tissue are available (e.g., Calleguas Creek, Muddy Slough in the Central Valley). For lentic systems, there was a slightly better correlation between tissue and water concentrations; however, more than 30% of the time, the binary relationship between water and tissue concentrations was either over or under their respective criteria. Therefore, Regional Board staff believes that because of the very site-specific nature of selenium speciation, bioaccumulation, cycling, and trophic transfer, it is more appropriate to generate water column concentrations using the

13 Formerly called the California Light-footed Clapper Rail.
biodynamic model on a site-specific basis, instead of relying on the water column elements
developed by USEPA (this also applies to USEPA’s 2016 final water column elements).

This holds especially true for the Newport Bay watershed. As an example, while median
ambient water column concentrations in the San Diego Creek and Big Canyon watersheds are
similar (13-14 µg Se/L and 14-15 µg Se/L, respectively), median ambient tissue concentrations
in fish and bird eggs differ significantly. Western mosquitofish are found in both subwatersheds
(only fathead minnows and mosquitofish have been found in Big Canyon Wash to date). Data
from 2002-2013 show a median concentration of 16 µg Se/g dw in mosquitofish collected from
lower San Diego Creek and a median concentration of 57 µg Se/g dw in mosquitofish collected
from lower Big Canyon Wash. A similar disparity in bird egg tissue concentrations is also
evident (5.3 µg Se/g dw in bird eggs collected from the San Diego Creek subwatershed and 33
µg Se/g dw in those collected from the Big Canyon Wash subwatershed). This is because of
the large differences between the partitioning coefficients (K_d) between the two subwatersheds:
272 for San Diego Creek and 3308 for Big Canyon Wash.

Regional Board staff will recommend adoption of only of tissue-based site-specific objectives for
selenium for the reasons given above and because the biodynamic model provides a
good approximation of potential water column concentrations that would result in attainment of
the proposed tissue concentrations in fish and bird egg tissue, it does not provide an exact
value but a range in potential values, primarily due to uncertainties in the calculated K_d and
trophic transfer factors (TTFs). As selenium is accumulated in aquatic and aquatic-dependent
organisms through their diet and not water, tissue concentrations provide a direct link to effects
in sensitive fish and wildlife. Therefore, it is reasonable and appropriate to not adopt site-
specific objectives for selenium in water for the Newport Bay watershed.

The Big Picture

Reviewers are not limited to addressing only the specific topics presented above, and are asked
to contemplate the following questions:

a) In reading the staff report and the proposed Basin Plan amendment, are there any additional
scientific issues not described above, which are part of the scientific basis of the proposed
TMDLs? If so, please comment with respect to the statutory language above.

b) Taken as a whole, is the scientific portion of the proposed rule based upon sound scientific
knowledge, methods, and practices?

The Board has a legal obligation to consider and respond to all feedback on the scientific
portions of the proposed rule. Because of this obligation, reviewers are encouraged to focus the
feedback on the scientific issues that are relevant to the central regulatory elements being
proposed. Some proposed actions might rely significantly on professional judgment where
available scientific data are not as extensive as needed to support the statutory requirement for
scientific rigor. In these situations, the proposed course of action is to be favored over no action.
## List of Contacts Involved with the Development of the Newport Bay Watershed Selenium TMDLs

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<table>
<thead>
<tr>
<th>Contact</th>
<th>Agency/Company</th>
<th>Area of Expertise/Classification</th>
<th>Role/Affiliation with Se TMDLs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abulala, Khalil</td>
<td>AMEC Environment and Infrastructure</td>
<td>Senior Associate Scientist - Water Resources, Selenium</td>
<td>former NSMP Consultant</td>
</tr>
<tr>
<td>Arenal, Christine</td>
<td>CH2M Hill</td>
<td>Project Scientist - Marine &amp; Wildlife Biology, Wildlife Toxicology</td>
<td>Data compilation for NSMP, Luoma-Presser model, and Se TMDLs/SSOs</td>
</tr>
<tr>
<td>Byron, Earle</td>
<td>CH2M Hill (retired)</td>
<td>Biologist - fish specialist</td>
<td>STRC/ TMDL Contract - Bioaccumulation studies/ current NSMP consultant</td>
</tr>
<tr>
<td>Edens, Ava</td>
<td>CH2M Hill</td>
<td>Biologist - fish specialist</td>
<td>STRC/ TMDL Contract - Bioaccumulation studies/ current NSMP consultant</td>
</tr>
<tr>
<td>Frank, Paul</td>
<td>CH2M Hill (former employee)</td>
<td>Project Technologist/Civil Engineer - Watershed Management, WQ</td>
<td>Development of Nitrogen/Se BMP model for evaluating implementation scenarios</td>
</tr>
<tr>
<td>Olsenford, Harry</td>
<td>CH2M Hill</td>
<td>Biologist - Avian specialist, Se effects</td>
<td>STRC/ TMDL Contract - Bioaccumulation studies/ current NSMP consultant</td>
</tr>
<tr>
<td>Santolo, Gary</td>
<td>CH2M Hill</td>
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**November 10, 2016**

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<th>Role/Affiliation with Se TMDLs</th>
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<td>Cutter, Gregory A.*</td>
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</table>

- * Dr. Benson, formerly of Lawrence Berkeley National Laboratory, was one of the first members of the STRC. However, Dr. Benson found that she did not have the time to commit to participating in the NSMP and dropped out prior to any real involvement with the selenium issues in the Newport Bay watershed.

- ** Dr. Cutter was briefly contact by Regional Water Board staff with questions regarding his analytical methods for determining speciation of selenium in water and comparison to other methods. Dr. Cutter had no other involvement with the selenium issues in the Newport Bay watershed.

### List of Abbreviations Used

- **BMP** Best Management Practices
- **CalEPA** California Environmental Protection Agency
- **CEQA** California Environmental Quality Act
- **CTR** California Toxics Rule
- **EPA** US Environmental Protection Agency
- **NSMP** Nitrogen and Selenium Management Program
- **OEHHA** Office of Environmental Health Hazard Assessment
- **RBF** Robert Ben Frost Associates
- **RWQCB** Santa Ana Regional Water Quality Control Board
- **SAWPA** Santa Ana Watershed Project Authority
- **Se** Selenium
- **SSO** Site Specific Objectives
- **STRC** Selenium Technical Review Committee
- **SWRCB** State Water Resources Control Board
- **TMDL** Total Maximum Daily Load
- **USGS** U.S. Geological Survey
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<th>Working Group Member</th>
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<th>Phone</th>
<th>Email</th>
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Attachment 4 – List of References


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