Alkylphenols & Ethoxylates Research Council

Comments on

California Department of Toxic Substances Control

Work Plan Implementation: Potential Aquatic Impacts and Continued Uses of Nonylphenol Ethoxylates and Triclosan (November 15, 2016)

Submitted

February 28, 2017

The Alkylphenols & Ethoxylates Research Council (APERC) appreciates this opportunity to provide comment on the California Department of Toxic Substances Control (DTSC or the Department) Work Plan Implementation Document "Potential Aquatic Impacts and Continued Uses of Nonylphenol Ethoxylates and Triclosan" and to inform the Department's evaluation of nonylphenol ethoxylates (NPEs) as Candidate Chemicals in Priority Products under the Safer Consumer Products regulations. [1]

APERC is a North American research-based trade association representing manufacturers of alkylphenols (APs) and their derivatives, including NPEs. For more than twenty years, APERC and its member companies have been actively engaged in the conduct and review of the toxicological, environmental fate, occurrence and ecotoxicity of alkylphenol based chemistries. [2]

Background

On November 15, 2016 CA DTSC published a Work Plan Implementation Document "Potential Aquatic Impacts and Continued Uses of Nonylphenol Ethoxylates and Triclosan", also called the Theme 3 Background Document, which describes the Department's preliminary findings regarding the potential aquatic impacts from uses NPEs. The Background document identifies the following specific questions about NPEs and their degradants, including nonylphenol (NP).

[1] California Department of Toxic Substances Control (CA DTSC). (2016, November 15). Work Plan Implementation: Potential Aquatic Impacts and Continued Uses of Nonylphenol Ethoxylates and Triclosan.

[2] Members of APERC include: The Dow Chemical Company, SI Group, Inc., and Dover Chemical Corporation.

- What are the most recent data available for the presence of NPE, NP and other transformation products in wastewater treatment plants and the aquatic environment?; and
- What hazard traits are most well understood for aquatic organisms for these chemicals?

APERC appreciates that DTSC is soliciting current information about the aquatic hazards and occurrence of NPEs and their degradants in the aquatic environment in California. It is important that the Priority Products Work Plan under the Safer Consumer Products regulations be anchored in a strong science-based understanding of the hazards and exposures of Candidate Chemicals to ensure that DTSC focuses its resources and the resources of affected businesses on Candidate Chemicals and Priority Products that warrant the greatest priority due to their exposures and risk in California. Designation of a Priority Product under the Safer Consumer Products Regulations sets into motion a process that is significant and burdensome to both affected businesses and the Department. Therefore the regulations include a provision that states "it is necessary to ensure that the limited resources of DTSC, responsible entities, and other interested parties are focused on Product-Candidate Chemical combinations that are of high priority …"

With this goal in mind, APERC offers these comments in response to the Background Document regarding potential hazard, exposure and aquatic impacts of NPEs as well as to the data and concerns related to these compounds and their degradation intermediates that were presented in reports referenced in the Background document as well as at the public meetings on the aquatic impacts of NPEs, which were held on January 11 and February 8, 2017.

Executive Summary of Comments

The conduct of Alternative Assessment on Priority Products under the SCP regulations poses a significant burden to business as well as the additional burden to both businesses and DTSC in the event of potential regulation. Therefore, selection of Priority Products should be focused on those that actually pose "significant or widespread adverse impacts" to the environment or human health in California, as required under ARTICLE 3 § Section 69503.2(a) of the CSP regulations. Available US EPA WQC and other EQS and PNECs are available and provide

environmental concentrations of NP (and NP1EO and NP2EO on a TEQ basis), which are protective of aquatic species to chronic exposures of these compounds. Concentrations of NP, NP1EO and NP2EO in the California environment simply do not exceed these values indicating that these degradation intermediates, and NPEs in general, *do not* present "significant or widespread adverse impacts" to the aquatic environment in California.

The Background Document relies heavily on reports generated by the San Francisco Bay Estuary Institute (SFEI) in the San Francisco Bay Estuary and the Science Advisory Panel (SAP) report to the California Water Resources Control Board under the Southern California Coastal Water Research Project. [3, 4, 5] However, neither of these reports suggest that NPEs, or APEs, pose "significant or widespread adverse impacts" to human health or the environment in California. The 2012 SFEI reports acknowledge that NPEs and APEs – even in aggregate - *do not exceed* US EPA WQC or other governmental thresholds for these compounds in the San Francisco Bay Estuary. While SFEI raises concern about two specific studies and pathways for APE, review of each of these is provided in the comments below and indicate no additional cause for concern. At most, SFEI identifies a need for "more information on the concentration of APEs and their degradation products in sediment and biota near Bay area treatment plant outfalls, where exposures are anticipated to be highest" [6] The SAP emphasized that the CECs in their report "represent an initial prioritization list based on available data and a number of qualifying assumptions" and "(w)hile their identification at this time represents a conservative screening of 'CECs at large', the information available for performing such screening continues to grow rapidly. The Panel thus urges the State to consider this an initial list that will evolve over time, to which more CECs may be added and others removed." [7] While there were apparent oversights by the SAP in the development of their Monitoring Trigger Level (MTL) for NP, which suggests that NP could be deprioritized for monitoring in California marine sediment and

[3] Klosterhaus, S., R.M. Allen, and J. Davis. (2012). Contaminants of Emerging Concern in the San Francisco Estuary: Alkylphenol Ethoxylates. A Report of the Regional Monitoring Program forWater Quality in the San Francisco Estuary. SFEI Contribution #657. Final Report. San Francisco Estuary Institute, Richmond, CA.
[4] San Francisco Estuary Institute (SFEI). (2013). The Pulse of the Bay: Contaminants of Emerging Concern. SFEI Contribution 701. San Francisco Bay Estuary Institute, Richmond, CA
[5] Anderson, P.D., Denslow, N.D., Drewes, J.E., Olivieri, A.W., Schlenk, D., Scott, G.I., Snyder, S.A. (2012, April). Final Report: Monitoring Strategies for Chemicals of Emerging Concern (CECs) in California's Aquatic Ecosystems, Recommendations of a Science Advisory Panel.
[6] Klosterhaus S. *et al* , (2012)
[7] Anderson. (2012, April)

wastewater effluents outfalls to the ocean, APERC recommends that DTSC take the SAP recommendation for monitoring for NP in sediment as just that – *a recommendation to monitor.* Prioritizing NPEs as an ingredient *in any Priority Product* under the SCP regulations would be inappropriate given the lack of evidence for "significant or widespread adverse impacts" in California from NPEs or their degradants.

Existing monitoring programs in California provide the best mechanism to monitor environmental trends for NPEs and their degradation intermediates in California's aquatic environment. This was the recommendation of the SAP and the SFEI. It is also APERC's view that this is the most appropriate approach to confirm a lack "significant or widespread adverse impacts" from NPEs in California and to inform the SCP Priority products work plan in the future.

The following comments address each of these points in more detail.

COMMENTS

1.0 THE AQUATIC HAZARDS OF NPES AND THEIR ENVIRONMENTAL DEGRADATION INTERMEDIATES ARE WELL UNDERSTOOD: THESE COMPOUNDS ARE NEITHER PERSISTENT NOR BIOACCUMULATIVE; U.S. EPA WATER QUALITY CRITERIA (WQC) EXIST, WHICH ARE PROTECTIVE OF THE AQUATIC ENVIRONMENT; AND CANADIAN TOXIC EQUIVALENCE FACTORS (TEF) FOR NPE DEGRADANTS CAN BE USED TO ASSESS AGGREGATE EXPOSURES OF THESE COMPOUNDS IN THE ENVIRONMENT.

1.1 NPEs and their degradation intermediates, including NP and low mole NPEs, are not persistent or bioaccumulative.

Commercial NPE are mixtures of structurally related compounds and are not pure compounds. For instance, NP9EO represents a mixture of oligomers with a normal distribution falling between 1 and 17 and centering on the 9 mole ethoxylate homolog. Staples et al., 2008 provide a detailed review of the identity, physical characterization and biodegradation pathways of NPE and a companion paper by Klecka et al., 2008 provides a comprehensive assessment of the

environment persistence and bioaccumulation potential of this compound and its degradation intermediates. [8, 9] In summary, under aerobic conditions, commercial NPE undergo rapid degradation to short chain ethoxylates (i.e., NP1EO and NP2EO) and their ether carboxylates, which in turn degrade ultimately to carbon dioxide and water. Under anaerobic conditions, NPE degrade more slowly, and production of NP is more likely. [10] The available data for NPE show that "the commercial products and their degradation intermediates do not meet any national or international criteria for identifying these compounds as PBT substances". [11]

1.1.1 NPEs and their degradation products are neither persistent nor bioaccumulative according to California definitions.

Definitions for "bioaccumulation" and "persistence" under §69501.1 of the Safer Consumer Products Regulations refer to the definitions for these hazard traits provided under the Green Chemistry Hazard Traits for California's Information Clearinghouse regulations. Comparison of available data for degradation and bioaccumulative traits of NPE and their degradation intermediates versus these definitions indicates that these compounds are neither persistent nor bioaccumulative according to California's definitions.

1.1.1.1 NPE and its degradants NP and low mole NPEs do not meet California's definition for persistence.

Environmental Persistence is defined as follows under Chapter 54 § 69405.3 of the Green Chemistry Hazard Traits for California's Information Clearinghouse regulations:

> "(a) The environmental persistence hazard trait is defined as the propensity for a chemical substance to remain in the environment for a long time period subsequent to its release by resisting chemical and biological degradation.

[8] Staples, C.A., Klecka, G.M., Naylor, C.G., Losey, B.S. (2008). C8- and C9-Alkylphenols and Ethoxylates: I. Identity, Physical Characterization, and Biodegradation Pathways Analysis. Human and Ecological Risk Assessment, 14: 1007-1024

[9] Klecka, G.M., Staples, C.A., Naylor, C.G., Woodburn, K.B., Losey, B.S. (2008). C8- and C9-Alkylphenols and Ethoxylates: II. Assessment of Environmental Persistence and Bioaccumulation Potential. Human and Ecological Risk Assessment, 14: 12025-1055.

[10] Staples *et al.* (2008).

[11] Klecka *et al.*, (2008).

(b) Evidence for environmental persistence includes but is not limited to: the identification of a substance to be persistent by an authoritative organization; resistance to degradation in wastewater treatment processes; half-lives in marine, fresh or estuary water of greater than 40 to 60 days, in sediment of greater than 2 months, in ambient air of greater than 2 days, or in soil of greater than 2 months; structural similarity to other persistent chemicals." (emphasis added)

Many studies have investigated the biodegradation of commercial NPE and more recent focus has been on the degradation of their degradation intermediates NP and low mole NPEO. [12, 13] Biodegradation studies for NP and low mole ethoxylates (NP1-3EO) are shown in the Table I below. These half-lives were calculated from high quality studies that employed mainly traditional die-away methods, for freshwater, seawater, sediments and soil.

TABLE I Biodegradation Studies		
Compound	Type of study	Half-lives (days)
NP	River and seawater die-away tests	5.9 to 40.8 [14, 15]
	Seawater & sediment die-away tests	26.3 [16]
	Soil die-away tests	4.5 to 51 [17, 18, 19, 20, 21]
NP1-3EO	River die-away tests	2 to 57.8 [22]
	Soil die-away tests	1.5 to 10.6 [23, 24]

[12] Klecka *et al* .(2008)
[13] Talmage, S.S. (1994). Environmental and Human Safety of Major Surfactants—Alcohol and Alkylphenol Ethoxylates. Lewis Publishers, Boca Raton, FL, USA
[14] Ekelund R, Granmo A, and Magnusson K. (1993). Biodegradation of 4-nonylphenol in seawater and sediment. Environ Pollut 79:59–61
[15] Yuan SY, Yu CH, and Chang BV. (2004). Biodegradation of nonylphenol in river sediment. Environ Pollut 127:425–30
[16] Ekelund *et al*. (1993)
[17] Trocme M, Tarraedellas J, and Vedy JC. (1988). Biotoxicity and persistence of nonylphenol during incubation in a compost-sandstone mixture. Biol Fertil Soils 5:299–303
[18] Jacobsen A.M., Mortensin G.K., and Hansen H.C.B. (2004). Organic compounds in the environment. Degradation and mobility of linear alkylbenzene sulfonates and nonylphenol in sludge-amended soil. J Environ Qual 33:232–40
[19] Topp E and Starratt A. (2000). Rapid mineralization of the endocrine-disrupting chemical 4-nonylphenol in soil. Environ Toxicol Chem 19:313–8
[20] Gejlsbjerg B, Klinge C, and Madsen T.(2001). Mineralization of organic contaminants in sludgesoil mixtures. Environ Toxicol Chem 20:698–705
[21]Dettenmaier E and Doucette WJ. (2007). Mineralization and plant uptake of ^{14}C labeled nonylphenol, nonylphenol tetraethoxylate, and nonylphenol nonylethoxylate inbiosolids/soil systems planted with crested wheatgrass. Environ Toxicol Chem 26:193–200
[22]Ahel M., Hrsak D., and Giger, W. (1994a). Aerobic transformation of short-chain alkylphenol polyethoxylates by mixed bacterial cultures. Arch Environ Contam Toxicol 26:540–8
[23] Gejlsbjerg et. al. (2001)

NPE and their degradation intermediates NP and NP1-3EO do not meet any of the persistence criteria listed under § 69405.3.

1.1.1.2 NP and low mole NPEs do not meet California's definition for bioaccumulation.

Bioaccumulation is defined under Chapter 54 § 69405.2 as:

> "(a) The bioaccumulation hazard trait is defined as the accumulation of a chemical substance in the tissue of organisms through any route, including respiration, ingestion, or dermal, including direct contact with contaminated water, sediment, and pore water in the sediment, or through transfer up the food chain.
> (b) Evidence for the bioaccumulation hazard trait includes but is not limited to: the identification of a substance to be bioaccumulative by an authoritative organization; studies which show bioaccumulation in human, domesticated animal, wildlife or plant tissues; inhibition of an efflux transporter; transfer of the chemical up a food web; a trophic magnification factor or biomagnification factor greater than 1 in aquatic or terrestrial systems; for organic chemicals, a bioaccumulation or bioconcentration factor greater than 1000; a log octanol-water partition coefficient greater than or equal to 4, or a log octanol-air partition coefficient greater than or equal to 5; results from bioaccumulation models indicating potential for bioaccumulation; structural similarity to other bioaccumulative chemicals." (emphasis added)

Higher mole NPEs do not meet bioaccumulative criteria as they are highly soluble, hydrophilic surfactants and do not accumulate in lipids. While there are no bioconcentration studies with higher NPEO, estimation of their bioaccumulation potential can be made using octanol-water partitioning (log Kow). Using a correlation equation for prediction of hydrocarbon-water partitioning, that was converted to a correlation with octanol-water, Ahel & Giger, 1993

[24] Kubiak, R.(2002). Alkylphenols in Agrar Ecosystems. In: Proceedings of 2nd Status Seminar Endocrine Disruptors, Berlin, Germany, April 2–4, 2001, pp. 93–95. ISBN 3-928875-03-5

estimated the log Kow for NP9EO to be 1.0 (i.e. Kow = 10). This value is well below the criteria of log 4.0 (i.e. Kow =10,000).[25]

For NP there are several studies that have measured the bioconcentration of NP using methods that follow or were based on traditional USEPA guidelines and which measured parent material to yield bioconcentration factors. Results from these studies are shown in Table II below.

TABLE II Bioconcentration Studies		
NP	Uptake and depuration studies, guidelines used include USEPA and Japan MITI	75 to 741 L/kg Mean: 249 L/kg [26, 27, 28, 29, 30]

These studies show that the bioconcentration factor for NP does not meet the threshold of 1000 to be considered bioaccumulative under Chapter 54 § 69405.2

With regard to trophic magnification and biomagnification potential, NP and NPEs are not considered to have the potential to biomagnify. Environment Canada's review of the data on NP and NPEs concluded that "there is no evidence in the current literature to suggest that NP or NPEs biomagnify". [31] Both Environment Canada and US EPA cited Ahel et al , 1993 in their reviews of data on NP and NPE on this point. [32, 33] Ahel et al, 1993 examined concentrations of NP, NP1E) and NP2EO in biota at several trophic levels in the Glatt River, Switzerland. They

[25] Ahel M and Giger W. (1993). Partitioning of alkylphenols and alkylphenol polyethoxylates between water and organic solvents. Chemosphere 26: 1471-1478

[26] McLeese DW, Zitko V, Sergeant DB, *et al*. (1981). Lethality and accumulation of alkylphenols in aquatic fauna. Chemosphere 10:723–30

[27] Ward TJ and Boeri RL. (1991). Bioconcentration Test with Nonylphenol and the Fathead Minnow *Pimephales promelas.* Report for the Chemical Manufacturers Association, Washington, DC, USA

[28] Brooke, L.T. (1993). Accumulation and Lethality forTwo Freshwater Fishes (Fathead Minnow and Bluegill) for Nonylphenol. EPA report 68 C1-0034. US Environmental Protection Agency, Duluth, MN, USA

[29] Giesy J.P., Pierens, S.L., Snyder, E.M., *et al.* (2000). Effects of 4-nonylphenol on fecundity and biomarkers of estrogenicity in fathead minnows (*Pimephales promelas*). Environ Toxicol Chem 19:1368–77

[30] Tsuda ,T., Takino, A., Muraki, K., *et al. (*2001). Evaluation of 4-nonylphenols and 4-*tert*-octylphenol contamination of fish in rivers by laboratory accumulation and excretion experiments. Wat Res 35:1786–92

[31] Environment Canada (EC) Environmental Quality Branch National Guidelines and Standards Office. (2001). Canadian Environmental Quality Guidelines for Nonylphenol and its Ethoxylates. Scientific Supporting Document (Water, Sediment, and Soil)

[32] EC. (2001).

[33] US Environmental Protection Agency (US EPA). (2005). Aquatic life ambient water quality criteria - nonylphenol. Report 822-R-05-005. US Environmental Protection Agency, Washington, DC, USA. http://www.epa.gov/waterscience/criteria/nonylphenol/final-doc.pdf

found for each of these substances, bioaccumulation factors (BAFs) in the algae *Cladophora glomerata* were significantly higher than the BAFs in three fish species (*Squalius cephalus*, *Barbus barbus* and *Oncorhynnchus mykiss*). Environment Canada noted "concentrations of nonylphenolic compounds detected in the tissues of a mallard duck (*Anas boscas*) were not significantly different from concentrations observed in fish tissues".[34] Both US EPA and Environment Canada concurred with the authors' conclusion that since the concentrations of NP and NPEs did not increase with increasing trophic level of organisms these compounds did not biomagnify. [35,36, 37]

In another study more specific to California, Diehl et al. (2012) examined the distribution of NP in various aquatic organisms, marine mammals, and terrestrial mammals in Morro Bay in California. [38]The authors collected samples of water and sediment from Morro Bay in California along with samples of several aquatic species, some of which came from locations in Oregon and Canada. The authors calculated biomagnification factors between several predator-prey couples and trophic magnification factors (TMF) for a Morro Bay food web. TMF that were calculated for the food web were about 1 and were not significantly different from 1. The authors concluded that the data did not indicate biomagnification. While this conclusion is probably correct, there were significant issues in the dataset that make this study unreliable for the calculation of TMFs in Morro Bay. First, the stable isotope ratios that are determined for each of the samples are used to determine trophic level or trophic position in the food web. The calculated trophic level data for Morro Bay indicated that the top predators included benthic organisms (TL 4.5) and the water sample containing plankton (Tl 4). This is completely backwards as compared to natural systems. Phytoplankton and zooplankton are always the base of pelagic food webs and benthic invertebrates are always the base of benthic food webs. In properly characterized food webs, plankton and benthos have TL typically in the range of 1 to 2, with top predator fish having TL of 4 to 5. Second, there is a mixed set of types of samples that are inappropriately compared. For

[34] EC. (2001).
[35] EC. (2001).
[36] US EPA. (2005).
[37] Ahel & Giger. (1993).
[38] Diehl, J., Johnson, S.E., Xia, K., West, A., Tomenak, L. (2012). The distribution of 4-nonylphenol in marine organisms of North American Pacific Coast estuaries. *Chemosphere*. doi:10.1016/j.chemosphere.2011.12.040

instance for several species, only livers were collected. For sea lions and porpoises, and perhaps sea birds and otters, this is understandable. However, to calculate TMF properly from concentrations for the various species in the food web, whole body lipid normalized concentrations are required. While the authors did provide both wet-weight and lipid-weight concentrations, they mixed whole body concentrations and liver-only concentrations into the food web. Lipophilic compounds such as NP are primarily accumulated in storage lipids. While some lipids are present in the liver and the liver serves to metabolize the NP, any accumulation in storage lipids present in any other body parts are lost. Thus the mix of types of samples (liver vs. whole body) give a distorted portrayal the distribution of NP in the food web.

In Diehl et al, 2012 the BMF for most predator-prey couplings were less than 1, with the exception of oysters and mussels consumed by otters (BMF=2.2, 10.9) and sculpins-gobies (BMF=2.7). However there are concerns with these calculations as well. For instance, the mussels were collected from both Morro Bay and a separate location in Canada that is nowhere near Morro Bay. Oysters were purchased from several sources in California, Oregon, and Canada. The locations of the collected sea otter carcasses were not identified. It is inappropriate to claim that the otters from unknown locations consumed either the mussels collected or oysters purchased in separate years from multiple distant locations.

With regards to the BMF of 2.7 for sculpins and gobies, concentrations of NP were only measured in livers and not whole bodies. As noted above, lipophilic compounds such as NP primarily accumulate in storage lipids. While some lipids are present in the liver and the liver serves to metabolize the NP, any accumulation in storage lipids present in any other body parts are lost. Thus the mix of types of samples (liver vs. whole body) give a distorted portrayal the distribution of NP in the food web.

In summary, Diehl et al. (2012) collected a variety of aquatic organisms, plus samples of marine mammals, seabirds, and sea otters from multiple locations on the west coast of North America and measured concentrations of 4-NP. While the study provides useful concentration data of 4-NP in such organisms, data from organisms collected in various locations outside Morro Bay cannot be used to examine trophic magnification or biomagnification. Similarly, data from

livers-only cannot meaningfully be used to characterize lipid-based concentrations of a lipophilic compound such as 4-NP. All three BMFs calculated by Diehl et al. (2012) that exceeded 1 were based on either liver-only concentrations or included the oysters and mussels, which were collected in multiple geographies and not Morro Bay and were therefore not valid.

1.1.2 NPEs and their degradation intermediates, including NP, are not persistent or bioaccumulative according to other governmental assessments.

Specific governmental assessments have been conducted by Environment Canada and Washington State Department of Ecology in 2006, which concluded that NP and/or NPEs do not meet their respective criteria for "persistent" and/or "bioaccumulative" compounds. [39, 40, 41] In addition, U.S. EPA does not categorize NP/NPE as having high persistence or bioaccumulation under its 2014 Work Plan.[42]

1.2 US EPA established ambient WQC for NP based on a robust aquatic toxicity dataset available for this compound.

Based on a robust aquatic toxicity database for NP that included adverse effects observed in *in vivo* toxicity studies that characterize population level effects in the environment (*i.e.* effects on survival, growth and development, and reproduction) US EPA calculated ambient WQC for NP, which are presented in Table III below. [43, 44] The US EPA WQC consider effects that represent

[39] Environment Canada (EC),. (2006, September). Ecological categorization of substances on the Domestic Substance List; Categorization decisions

[40] Washington State Department of Ecology (WA DoE). (2006a, January) Rule Adoption Notice:Persistent Bioaccumulative Toxins Chapter 173-333 WAC. http://www.ecy.wa.gov/biblio/0607007.html

[41] Washington State Department of Ecology. (2006b, January) Concise Explanatory Statement and Responsiveness Summary for the Adoption of Chapter 173-333 WAC Persistent Bioaccumulative Toxins. Publication: 06-07-006. http://www.ecy.wa.gov/biblio/0607006.html

[42] U.S. Environmental Protection Agency (US EPA). (2014, October). TSCA Work Plan for Chemical Assessments: 2014 Update http://www.epa.gov/opptintr/existingchemicals/pubs/TSCA_Work_Plan_Chemicals_2014_Update-final.pdf

[43] US Environmental Protection Agency (US EPA). (2005). Aquatic life ambient water quality criteria - nonylphenol. Report 822-R-05-005. US Environmental Protection Agency, Washington, DC, USA. http://www.epa.gov/waterscience/criteria/nonylphenol/final-doc.pdf

[44] US Environmental Protection Agency (US EPA). (2006, February 23). Notice of availability of final aquatic life ambient water quality criteria for nonylphenol. Federal Register, 71 (36), 9337-9339. http://www.epa.gov/EPA-WATER/2006/February/Day-23/w2558.htm.

the integration of all modes of toxicity and "represent the concentration in water at which aquatic life are protected from acute and chronic adverse effects." [45]

TABLE III: US EPA Water Quality Criteria for NP

Media, Type	WQC (µg/L, ppb)	WQC (ng/L, ppt)
Freshwater, acute Freshwater, chronic	28.0 µg/L 6.6 µg/L	28,000 ng/L 6,600 ng/L
Saltwater, acute Saltwater, chronic	7.0 µg/L 1.7 µg/L	7,000 ng/L 1,700 ng/L

A review of more recent aquatic toxicity studies (17 freshwater species and 13 marine species) on NP, NP1EO and NP2EO that were available after US EPA developed the WQC for NP was conducted by Coady et al, 2010, which confirmed that these newer data also support that the US EPA chronic WQC for NP in freshwater and saltwater are protective of aquatic species. [46]

1.3 Environment Canada developed TEFs for NPEs relative to NP, which can be used to calculate aggregate TEF-based aquatic concentrations in order to assess the aquatic risk of these compounds.

Based on a review of both lethal and sub-lethal toxicity data, Environment Canada (EC) concluded that NP1EO and NP2EO were half as toxic as NP; whereas NPE ≥9 and NPEC were 200 times less toxic than NP. [47,48] Based on these findings EC established TEFs for NPE relative to NP, which are presented in Table IV. [49, 50]

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[45] US EPA. (2005)

[46] Coady, K., Staples, C. Losey, B., and Klecka, G. (2010). A Hazard Assessment of Aggregate Exposure to Nonylphenol and Nonylphenol Mono- and Di-ethoxylates in the Aquatic Environment. *Human and Ecological Risk Assessment: An International Journal*. Volume 16, Issue 5, pgs 1066-1094

[47] Servos, M., Maguire, R.J., Bennie, D.T., Lee, H-B., Cureton, P.M., Davidson, N., Sutcliffe, R., & Rawn, D.F.K. (2000, March). Priority substances list. Supporting document for nonylphenol and its ethoxylates. Canadian Environmental Protection Act. Environment Canada, Toxics Pollution Prevention Directorate, Commercial Chemicals Evaluation Branch, Ottawa.

[48] Environment Canada and Health Canada (EC and HC). (2001). Priority substances list assessment report for nonylphenol and its ethoxylates. ISBN: 0-662-29248-0. http://www.hc-sc.gc.ca/ewh-semt/pubs/contaminants/psl2-lsp2/nonylphenol/index-eng.php.

[49] EC. (2001).

[50] Canadian Council of Ministers of the Environment (CCME). (2002). Canadian water quality guidelines for the protection of aquatic life: Nonylphenol and its ethoxylates. Environment Canada Publication Number 12999. ISBN 10896997-34-1.

TABLE IV: Canadian TEF-Based Environmental Quality Guidelines for NP and NPEs

Compound	TEF relative to NP
NP	1
NPEO1,2	0.5
NPEO3-17	0.005

The toxic equivalency approach for calculating the aggregate hazard of NP, NP1EO, and NP2EO was also reassessed by Coady et al, 2010. A review of relevant studies indicated that the TEF for NP1EO and NP2EO relative to NP approximated 0.37, which supported the use of the more conservative TEF value of 0.50 used by Environment Canada (2001) for these low mole NPE.[51]

1.4 Other Environmental Quality Guidelines and Toxicity-Based Predicted No Effect Concentrations (PNECs) have been calculated for NP, which can be used for risk evaluations of sediment-based exposures of benthic organisms to NP and low mole NPE.

In 2002, there were insufficient sediment dosed ecotoxicity data to meet the minimum requirements for developing toxicity-based Sediment Quality Guidelines (SQG) in Canada. Therefore an equilibrium partitioning approach was used to derive the provisional interim SQGs from the Canadian water quality guidelines, which are listed in Table V. [52]

TABLE V: Canadian Quality Guidelines for NP/NPE[53]

	Type	Value (TEQ Basis)
Water	Fresh Marine	1.0µg/L (1,000 ng/L) 0.7 µg/L (700 ng/L)
Sediment	Freshwater Marine	1.4 mg/kg-dw* (1,400 ng/g-dw) 1.0 mg/kg-dw* (1,000 ng/g-dw)
*Calculated based on equilibrium partitioning for sediments containing 1% total organic carbon		

[51] Coady, 2010
[52] EC. (2001)
[53] EC. (2001)

In 2010 sufficient sediment-based toxicity studies were available for Staples et al, 2010 to calculate toxicity-based Sediment PNEC in a manner similar to US EPA Guidance. [54] These sediment-based toxicity PNEC, which are listed in Table VI, represent more accurate and scientifically- based values for the assessment of exposures to sediment swelling organisms than those derived by EC based on aquatic toxicity and equilibrium partitioning.

TABLE VI: Toxicity-Based Sediment PNECs for NP [55]

Environmental Media	Type	PNEC
Sediment	Freshwater	6,150 ng/g-dw
	Marine	1,230 ng/g-dw

1.5 The estrogenically mediated adverse effects of NP, NP1EO and NP2EO in aquatic organisms do not appear to be more sensitive than other types of adverse effects and the US EPA WQC and Canadian EQGs are protective of this and other modes of action.

NP and some of the low mole NPE degradants have been found to have weak estrogenic activity; however, as with their toxicity in general, an inverse relationship is seen when examining the estrogenicity of the NPE metabolites versus their ethoxylate chain length. While only weakly estrogenic, NP has the highest estrogenic potency among those NPE degradation intermediates that have been found to be estrogenic. Depending on which assay is used, NP has been found to be between 10^3 and 10^6 fold less potent than the endogenous estrogen 17β-estradiol.[56,57,58,59] Short-chain NPE (NP1EO and NP2EO) are less estrogenic than NP. [60,61,62] Longer chain NPE

[54] Staples, C.A., Coady, K. and Losey, B. (2010, Nov). Assessing the Effects and Potential Risk of Branched para-Nonylphenol to Sediment Dwelling Organisms. Poster Presentation at Society of Environmental Toxicology and Chemistry, North American Annual Meeting, Portland, OR, USA

[55] Staples, C.A. et al. (2010).

[56] Routledge, E.J., & Sumpter, J.P. (1996). Estrogenic activity of surfactants and some of their degradation products assessed using a recombinant yeast screen. Environmental Toxicology and Chemistry, 15 (3), 241-248.

[57] Lee, P.C., & Lee, W. (1996). In vivo estrogenic action of nonylphenol in immature female rats. Bulletin of Environmental Contamination and Toxicology, 57, 341-348.

[58] Islinger, M., Pawlowski, S., Hollert, H., Völkl, A., & Braunbeck, T. (1999). Measurement of vitellogenin-mRNA expression in primary cultures of rainbow trout hepatocytes in a non-radioactive dot blot/RNAse protection-assay. *The Science of the Total Environment*, 233, 109-122.

[59] Jobling, S., & Sumpter J.P. (1993). Detergent components in sewage effluent are weakly oestrogenic to fish: An in vitro study using rainbow trout *(Oncorhynchus mykiss*) hepatocyte. Aquatic Toxicology, 27, 361-372.

[60] Dussault, E.B., Sherry, J.P., Lee, H.B., Burnison, B.K., Bennie, D.T., & Servos, M.R.. (2005). *In vivo* estrogenicity of nonylphenol and its ethoxylates in the Canadian environment. Human and Ecological Risk Assessment, 11 (2), 353–364.

(NPEn≥4) appear to have little to no estrogenic activity *in vivo*.[63,64] NPEC has been shown to have very weak estrogenicity *in vitro* [65,66] but no estrogenicity *in vivo.*[67]

In summary, existing higher-level apical studies, which are based on dose-response and adverse ecotoxicity effects, account for effects resulting from all modes of action (including estrogenic). This is acknowledged in the US EPA WQC document for NP.

> "Whole organism endpoints such as reproductive and growth effects are used to derive aquatic life ambient water quality criteria for nonylphenol. To the extent that such endpoints reflect the integration of molecular, biochemical and tissue-level effects at the whole organism level, the nonylphenol criteria address the estrogenicity of nonylphenol. For example, while vitellogenin is a commonly used biomarker indicative of exposure to estrogenic compounds, measurement of this molecular/biochemical endpoint alone does not necessarily indicate adverse effect on population relevant endpoints such as survival, growth and reproduction. However, several studies have demonstrated that vitellogenin induction can be accompanied by decreased fecundity (egg production) of breeding pairs of fathead minnows exposed chronically to estrogenic compounds (Ankley et al.). The chronic toxicity studies used in deriving the nonylphenol criteria (Table 6) included assessment of effects on growth and reproduction endpoints in aquatic organisms. Hence, to the extent that these endpoints are the result of effects on the endocrine system (although this was not definitively demonstrated in any of the tests by use of a concomitant measure of a estrogen-receptor specific endpoint), the estrogenic effects of nonylphenol have been considered in deriving the aquatic life ambient water quality criteria for nonylphenol" [68]

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[61] Balch, G., & Metcalfe, C. (2006). Developmental effects in Japanese medaka (Oryzias latipes) exposed to nonylphenol ethoxylates and their degradation products. Chemosphere, 62 (8), 1214-1223.
[62] Jobling et al. (1993).
[63] Balch & Metcalfe. (2006).
[64] Metcalfe, C.D., Metcalfe, T.L., Kiparissis, Y., Koenig, B.G., Khan, C., Hughes, R.J., Croley, T.R., March, R.E., & Potter, T. (2001). Estrogenic potency of chemicals detected in sewage treatment plant effluents as determined by in vivo assays with japanese medaka (oryzias latipes). Environmental Toxicology and Chemistry, 20, 297–308.
[65] Jobling et al. (1993).
[66] Routledge & Sumpter. (1996).
[67] Balch & Metcalfe. (2006).
[68] US EPA. (2005)

Furthermore, in the case of NP, Environment Canada concluded **"**It appears that the concentrations of NP required to elicit oestrogenic effects are comparable to concentrations at which other chronic toxic effects are observed" and "(t)hese data indicate that guidelines for nonylphenolic substances set at concentrations that protect against conventional toxicity endpoints are likely to protect against most endocrine disrupting effects as well." [69]

By using various approaches to investigate the mode of action of NP, it is apparent that multiple modes of action exist for NP, and these activities occur within the same concentration range that results in weak, estrogenic effects. Specifically, NP was evaluated in more than 890 ToxCast Phase II high throughput *in vitro* assays, and below the lower limit of cytotoxicity, multiple biological activities were apparent for NP, including estrogen receptor activity, retinoic X receptor activity, vitamin D activity, CYP enzyme activity, and mitochondrial toxicity.[70] In addition to the known weak estrogenic activity of NP, other *in vitro* studies with NP reported disruption to cellular membranes, alteration of cell signaling and increases in oxidative stress and apoptosis. [71,72] It is also apparent from comparing the acute-to-chronic ratios (ACR) of NP and the potent estrogen, ethinylestradiol, that these two compounds differ in their toxicity profiles. The Lower ACR for NP (*i.e.* 22-116) compared to the high ACR for ethinylestradiol (*i.e.* 5.73 x 10^6) indicates that the NP response is reflective of baseline toxicity whereas the ethinylestradiol ACR indicates a very specific acting chemistry with reproductive effects noted far below the concentrations that cause overt toxicity. [73] Most *in vivo* aquatic vertebrate studies with NP and other alkylphenols such as octylphenol (OP) tend to focus efforts on endocrine biomarker endpoints. However, when other biomarkers are included in the study design, (*e.g.* those related to oxidative stress and/or apoptosis) it is apparent that these biomarkers are induced within the same concentration range as estrogenic biomarkers (*e.g.* yolk precursor protein, vitellogenin

[69] Environment Canada, National Guidelines and Standards Office (2001, April). Canadian Environmental Quality Guidelines for Nonylphenol and Its Ethoxylates. Scientific Supporting Document (Water, Sediment and Soil)
[70] US EPA iCSS ToxCast Dashboard (2017, February). https://actor.epa.gov/dashboard/#chemical/84852-15-3
[71] Choi MS, et al. (2014). Nonylphenol-induced apoptotic cell death in mouse TM4 Sertoli cells via the generation of reactive oxygen spceis and activation of the ERK signaling pathway. J Appl Toxicol **34**(6): 628-636.
[72] Liu X. et al. (2015). Mitogen-activated protein kinase and Akt pathways are involved in 4-n-nonylphenol induced apoptosis in mouse Sertoli TM$ cells. Environ Toxicol Pharmacol **39**(2): 815-824.
[73] Coady K, Klapacz J, Staples C, Losey B. (2016). Advantages and Challenges for Determining Mode of Action of Industrial Chemicals: A Case Study with Alkphenol and Alkylphenol Ethoxylates. SETAC North America Poster Presentation

(VTG). [74] Invertebrates and fish appear to be similarly affected by NP and OP exposure, while plants appear less sensitive. Since invertebrates do not have an estrogen system that is analogous to vertebrates, this is a line of evidence indicating that the estrogenic activity of NP and OP may not be responsible for driving toxicity in these diverse taxa, rather it is likely a common mode of action that is shared by both vertebrates and invertebrates [75]. In summary, multiple lines of evidence indicate that NP has multiple modes action within the same concentration range.

For compounds like NP that show multiple modes of action within a similar concentration range measuring adverse apical endpoints provide a better measure of the aquatic hazards. Therefore, hazard and risk assessments that evaluate NP, NP1EO and NP2EO based on the US EPA WQC and TEFs derived for these compounds by Environment Canada will also address any estrogenically mediated adverse effects.

2.0 NPE AND THEIR DEGRADANTS, INCLUDING NP, ARE TREATABLE IN WASTEWATER TREATMENT PLANTS AND THEIR DEGRADATION METABOLITES, WHILE NOT PERSISTENT OR BIOACCUMULATIVE, CAN OCCUR AT LOW LEVELS IN EFFLUENT AND THE AQUATIC ENVIRONMENT; THE DEGRADANTS NP1EO, NP2EO AND NP ARE THE MOST COMMONLY DETECTED AND MOST RELEVANT FOR THE FOCUS OF ENVIRONMENTAL HAZARD OR RISK ASSESSMENT.

Biodegradation has been shown to be the dominant mechanism responsible for removal of NP and NPE during wastewater treatment and in the environment.[76,77,78,79] While NPE is highly

[74] Coady K,et al . (2016). Advantages and Challenges for Determining Mode of Action of Industrial Chemicals: A Case Study with Alkphenol and Alkylphenol Ethoxylates. SETAC North America Poster Presentation
[75] Coady K, Klapacz J, Staples C, Losey B. (2016).
[76] Staples, C.A., Williams, J.B., Blessing, R.L., & Varineau, P.T. (1999). Measuring the biodegradability of nonylphenol ether carboxylates, octylphenol ether carboxylates, and nonylphenol. Chemosphere, 38, 2029-2039.
[77] Staples, C.A., Naylor, C.G., Williams, J.B., & Gledhill, W.E. (2001). Ultimate biodegradation of alkylphenol ethoxylate surfactants and their biodegradation intermediates. Environmental Toxicology and Chemistry, 20, 2450-2455.
[78] Staples, C.A., Klecka, G.M., Naylor, C.G., & Losey, B.S. (2008). C8- and C9-alkylphenols and ethoxylates: I. identity, physical characterization, and biodegradation pathways analysis. Human and Ecological Risk Assessment, 14, 1007- 1024.

treatable in wastewater treatment plants, with removal rates commonly greater than 90%, low levels of its degradation metabolites have been reported in effluent and surface waters.[80] Under anaerobic conditions, the major metabolites of NPE include: NP1EO, NP2EO and to a lesser extent NP. Under aerobic conditions, nonylphenol monoethoxycarboxylate (NPEC1) and nonylphenol diethoxycarboxylate (NPEC2) also occur.[81,82] These intermediates continue to degrade in the environment, including mineralization of the phenolic ring, to carbon dioxide.[83,84,85,86,87]

NP, NP1EO and NP2EO are known to co-occur at low concentrations in the aquatic environments; therefore, Klecka et al. (2007) conducted an assessment of surface water and/or sediment monitoring studies available in the published or publicly available literature to develop a statistical understanding of exposures to APE, including NPE and its metabolites in US surface waters. A literature search was conducted to identify environmental monitoring studies published during the 15 year period between 1990 and 2005, which contained information on surface water and/or sediment concentrations of APE and its metabolites in US waters. Nineteen reliable monitoring studies, most of which were conducted by the US Geological Survey (USGS), were reviewed and the highest concentrations of all NPE metabolites were generally observed for rivers in heavily urbanized or industrialized locations with average concentrations of 1.7 µg/L, 1.2 µg/L, 2.3 µg/L, and 8.1 µg/L for NP, NP1EO, NPEO>1, and nonylphenol ethoxycarboxylate (NPEC) respectively reported. Klecka et al. (2007) reported NPE>1 as a group because the US Geological Survey (USGS), which provided much of the data analyzed in this paper, frequently reported in this manner. However, a review of the database that catalogued

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[79] Melcer, H., Klecka, G., Monteith, H., & Staples, C. (2007). Wastewater treatment of alkylphenols and their ethoxylates: A state of the science review. Water Environment Federation, Alexandria, VA.
[80] Melcer et al. (2007).
[81] Klecka, G., Zabik, J., Woodburn, K., Naylor, C., Staples, C. & Huntsman, B. (2007). Exposure analysis of C8- and C9-alkylphenols, alkylphenol ethoxylates, and their metabolites in surface water systems within the United States. Human and Ecological Risk Assessment, 13, 792-822.
[82] Staples. (2008).
[83] Ahel, M., Giger, W., & Koch, M. (1994). Behaviour of alkylphenol polyethoxylate surfactants in the aquatic environment. I: Occurrence and transformation in sewage treatment. Water Research, 28 (5), 1131-1142.
[84] Staples, C.A., *et al*., (1999)
[85] Staples, C.A., *et al.*, (2001).
[86] Staples, C.A., *et al* (2008).
[87] Naylor, C.G., Staples, C.A., Klecka, G.M., Williams, J.B., Varineau, P.T., & Cady, C. (2006). Biodegradation of [^{14}C] ring-labeled nonylphenol ethoxylates. Archives of Environmental Contamination and Toxicology, 51, 11-20.

all of the raw data analyzed by Klecka et al. (2007) confirmed that the majority (87%) of the data points categorized as NPE>1 do in fact represent concentrations of NP2EO.[88]

2.2. NP, NP1EO and NP2EO are the most environmentally relevant metabolites to the hazard or risk assessment of NPE degradants

In a review of nation-wide monitoring studies conducted in the years 1990 to 2005 in the U.S. by Klecka et al. (2007) , the average concentration, as reported of NPEC (8.1 µg/L) is greater than the average concentrations of NP (1.7 µg/L), NP1EO (1.2 µg/L) and NP2EO (2.3 µg/L). [89] However NPEC toxicity is significantly lower than these latter three compounds; therefore, their contribution to the aggregate toxicity of NPE metabolites is correspondingly less. In other words, the contribution of NPEC and the higher oligomer NPE to the overall toxicity of the mixture of NPE and its metabolites found in the environment is minimal. This is consistent with findings by Calabrese and Baldwin (1993) on the relative contribution of individual organic chemicals to the aggregate toxicity of a mixture, which concluded that the components with the highest toxic units (i.e., the combination of toxicity and concentration in water) dictate the toxicity of the mixture.[90]

Table VII illustrates the negligible contribution of higher mole NPE and NPEC to the toxicity of environmentally relevant mixtures of NPE metabolites. Average concentrations of NPE metabolites reported in the 15 year survey of monitoring studies by Klecka et al. (2007) are converted to NP-equivalent concentrations based on the toxic equivalency factors (TEFs) developed by Environment Canada (2001).[91] The relative contribution of each of the metabolite fractions is presented as a percentage of the total NP-equivalent concentration. The results illustrate that while measured concentrations of NPEC may appear to be the most relevant NPE metabolite in terms of concentrations detected in the environment, adjustments to accommodate

[88] Klecka, G.M. (2009, August). Personal communication to Alkylphenols & Ethoxylates Research Council regarding occurrence of NPE2 in environmental occurrence database for NP/NPE.
[89] Note that based on personal communication with the author, NPE2 is the primary oligomer represented in the NPE>1 concentrations reported by Klecka et al. (2007); therefore, the 2.3 µg/L concentration is presented as NPE2 for this exercise.
[90] Calabrese, E.J. & Baldwin, L.A. (1993). Performing ecological risk assessments. Lewis Publishers, Chelsea, MI.
[91] EC & HC. (2001).

for relative toxicity indicate that NP, NP1EO and NP2EO actually contribute 98.9% to the toxicity of the mixture found in the aquatic environment.

TABLE VII: Relative Contribution to Aggregate Toxicity of Environmentally Relevant Concentrations of NPEs and their Metabolites

Metabolite	Avg. Env. Concentration* (µg/L)	Unadjusted Contribution (%)	TEF***	NP-equivalent Concentration (µg/L)	NP-equivalent Contribution (%)
NP	1.7	12.8	1.0	1.7	48.7
NP1EO	1.2	9.0	0.5	0.6	17.2
NP2EO**	2.3	17.3	0.5	1.15	33.0
NPEC	8.1	60.9	0.005	0.04	1.1
Total	13.3	100.0	-	3.49	100.0

* Average concentrations from Klecka et al. (2007)

** Concentrations of NPE>1 reported in Klecka et al. (2007) are presented in this table as NP2EO based on confirmation from the author that it was NP2EO that was measured in at least 87% of the samples reported as NPE>1

*** Toxicity Equivalence Factors (TEFs) relative to NP developed by Environment Canada (2001)

In summary, it is reasonable to focus hazard and risk assessment on the most toxicologically relevant of the NPE metabolites - in this case NP, NP1EO and NP2EO - because substances with lower toxicity (e.g., higher mole NPE or NPEC), even when present in a mixture at higher concentrations, do not measurably contribute to the overall toxicity of the mixture. Due to their greater relative toxicity, NP, NP1EO and NP2EO contribute much more significantly to the aggregate ecotoxicity effects of NPE degradants than either the higher chain NPE or NPECs; therefore, these former compounds are the most appropriate for inclusion in any assessment of aggregate hazard or risk.

3.0 AVAILABLE DATA ON THE OCCURRENCE AND EXPOSURE OF NP/NPE IN CALIFORNIA'S AQUATIC ENVIRONMENT DO NOT INDICATE POTENTIAL FOR "SIGNIFICANT OR WIDESPREAD ADVERSE IMPACTS" AS REQUIRED FOR DESIGNATING A PRIORITY PRODUCT UNDER THE SAFER CONSUMER PRODUCTS REGULATIONS.

Designation of a Priority Product under the Safer Consumer Products Regulations sets into motion a process that is significant and burdensome to both affected businesses and the Department. Therefore the regulations include a provision that states "it is necessary to ensure that the limited resources of DTSC, responsible entities, and other interested parties are focused on Product-Candidate Chemical combinations that are of high priority …"

ARTICLE 3 § Section 69503.2(a) of the Safer Consumer Product Regulations specifies that any product-chemical combination listed as a Priority Product must not only demonstrate the **potential for exposure** but ALSO that there must be the **potential for one or more exposures to contribute to or cause "significant or widespread adverse impacts"**.

3.1 Concentrations of NP/NPE in ambient surface water and sediment in California are generally well below US Water Quality Criteria (WQC), Canadian Environmental Quality Standards (EQS) for Sediment or toxicity-based sediment PNECs, which are derived based on robust data sets to be protective of aquatic organisms.

As discussed in Section 1.0 of these comments, US EPA WQC and other Environmental Quality Standards (EQS) exist for NP that can be applied not only to NP but also to low mole NPEs on a Toxicity Equivalence basis and in aggregate. These WQC and other available Sediment Quality Guidelines for NP have been developed considering the weight-of-evidence for the aquatic hazard data. [92, 93] Therefore, they provide a well-founded scientific basis to determine whether concentrations of NP and low mole NPE in California's aquatic environment pose a "significant or widespread adverse impact" as required under § Section 69503.2(a).

The Background Document references reports on chemicals of emerging concern and on alkylphenol ethoxylates (APEs) prepared by the San Francisco Estuary Institute (SFEI)

[92] US EPA. (2005)
[93] Environment Canada (EC) (2001).

regarding the Regional Monitoring Program (RMP) in the San Francisco Bay Estuary, which evaluates concentrations found relative to governmental WQC and EQS. [94, 95, 96] SFEI concludes:

> " Concentrations of NP and its ethoxylates in San Francisco Bay are generally well below concentrations expected to elicit toxic effects in aquatic organisms. The maximum NP surface water concentration detected in the 2010 RMP pilot study (0.07 µg/L) was more than 20 times lower than the USEPA water quality criteria for NP (1.7 µg/L), more than 25 times lower than the maximum allowable concentration permitted by the EU (2.0 µg/L), and four times lower than the annual average concentration permitted in EU surface waters (0.3 µg/L). Using the TEQ approach developed by Environment Canada, the maximum concentrations of NP and its ethoxylates in Bay waters and sediments (0.07 µg/L and 0.12 µg/g dry weight, respectively) were an order of magnitude below the water and sediment quality guidelines developed by that agency to be protective of aquatic life." [97]

In addition, review of the monitoring data for NP, NP1EO and NP2EO in the California aquatic environment, which are presented and/or referenced in the DTSC Background document and/or otherwise available in the published literature indicate that reported values of these compounds in California surface water and sediment are well below US EPA WQC and other EQS and PNECs for NP.

Perhaps the largest review and summary of environmental concentrations of NP/NPE conducted nationally in the US was published by Klecka et al, 2007 and is summarized in Section 1.0 of these comments. That study included greater than 6000 samples from across the US of which 67% where less than the analytical Limit of Quantification (LOQ) and 97% where less than the US EPA chronic WQC for NP with an national average concentration of 0.8 µg/L TEF-based aggregate concentration for NP, NP1EO and NP2EO. A subset of the data from Klecka et al, 2007 taken from California locations included 45 samples of which 75% were less than the LOQ and 100% were less than the US EPA WQC for NP on a TEF-based aggregate basis. The average and maximum concentrations

[94] CA DTSC (2016, Nov. 15)
[95] Klosterhaus, S., R.M. Allen, and J. Davis. (2012). Contaminants of Emerging Concern in the San Francisco Estuary: Alkylphenol Ethoxylates. A Report of the Regional Monitoring Program forWater Quality in the San Francisco Estuary. SFEI Contribution #657. Final Report. San Francisco Estuary Institute, Richmond, CA.
[96] Klosterhaus, S. *et al.,* (2012).
[97] Klosterhaus, S. *et al* (2012).

(TEQ aggregate basis) reported in surface water in California for the sample years 1990 – 2005 was 0.2 µg/L and 2.0 µg/L respectively.[98]

A more recent paper published about national monitoring for NP conducted by US EPA and USGS between 2010 and 2016 reported that this compound was not detected in any of the 21 samples taken at an analytical reporting limit (RL) of 1.0 µg/L, which is sufficiently lower than the chronic freshwater and marine WQC for NP published by US EPA to ensure these waters did not exceed the WQC. [99] As discussed below in these comments this reduction in surface water concentrations of NP nationally since 2005 is likely related to a significant reduction in the use and volume of NPEs sold in the U.S. due to various US EPA and market initiatives.

More directly related to California, monitoring discussed and referenced in the DTSCA Background Document on Aquatic Impacts of NPE as well as in the additional monitoring presented during the January 11, 2017 roundtable discussion, which are summarized in Table VIII (attached) , indicate that concentrations of NP, NP1EO and NP2EO in California's aquatic environment rarely exceed US EPA WQC, Canadian EQGs and toxicity-based sediment PNECs for these compounds.

3.2 Despite recognizing that concentrations of NP/NPE in the San Francisco Estuary are well below US EPA and other governmental WQC and EQS, the San Francisco Estuary Institute (SFEI) classifies NP/NPE as a "moderate priority" based on erroneous conclusions that were developed based on papers by Billinghurst et al., 1998 and Schlenk et al, 2012; closer review of these studies indicates that neither justifies a need for concern about NP/NPE in the San Francisco Estuary or a "moderate priority" ranking for these compounds.

As noted above, SFEI acknowledges that concentrations of NP, NP1EO and NP2EO in the San Francisco Bay Estuary are well below US EPA WQC as well as other governmental PNECs and

[98] Klecka, G.M.*et al*. (2007).
[99] Kostich, M.S., Flick, R.W., Batt, A.L., Mash, H.E., Boone, J.S., Furlong, E.T., Kolpin, D.W., Glassmeyer, S.T. (2017). Aquatic Concentrations of Chemical Analytes Compared to Ecotoxicity Estimates. Science of the Total Environment 579: 1649-1657

EQS values for NP, even on an aggregate basis. [100] However SFEI classified NP and NPEs as Tier 3 (Moderate Concern Risk) based on conclusions they derived erroneously based on studies by Billinghurst et al., 1998 and Schlenk et al, 2012. [101, 102]

SFEI defines Tier 3 (Moderate Concern Risk Level) as compounds having a "high probability of low impact on water quality" and as including "contaminants that are frequently found at concentrations that are equal to or slightly higher than an effect threshold". [103] (emphasis added) While the criteria of having a "high probability of low impact" raises the question of why something with "potentially low impact" would rise to a "moderate concern level", the criteria that concentrations that are "frequently found at concentrations equal or slightly higher than an effect threshold" seems justifiable for a moderate ranking provided that the selected threshold is a governmentally developed WQC or EQS or a scientifically derived PNEC. Selection of individual studies as the basis for a threshold is not sufficient, particularly – as is the case with NP/NPE – the studies selected are not consistent with the weight-of-evidence for the compounds in question or have been otherwise found to be scientifically inadequate for use in a regulatory or quasi-regulatory determination.

Discussion below about the studies by Billinghurst et al., 1998 and Schlenk et al, 2012 support removing these studies as a basis for concern about NP/NPEs in the San Francisco Bay Estuary and reclassifying NP/NPE under the SFEI RMP Tiered Framework for CECs as Tier 2 (Low Concern Risk Level), which is defined as including contaminants where Bay occurrence data are available and indicate that the contaminant is present below thresholds.[104]

3.2.1 SFEI concern related to Billinghurst et al., 1998

[100] Klosterhaus S. *et al* (2012)
[101] Billinghurst, Z., Clare, A.S., Fileman, T., Mcevoy, J. Readman, J., Depledge, M.H., (1998). Inhibition of Barnacle Settlement by the Environmental Oestrogen 4-nonylphenol and the Natural Oestrogen 17βOestradiol. Marine Pollution Bulletin. Vol 36, No 10 pp 833-839
[102] Schlenk, D., Lavado, R. Loyo-Rosales, J.E., Jones, W., Maryoung, L., Riar, N. , Werner, I., Sedlak, D. (2012). Reconstitution Studies of Pesticides and Surfactants Exploring the Cause of Estrogenic Activity Observed in Surface Waters of the San Francisco Bay Delta. *Environmental Science & Technology*. 46, 9106-9111
[103] San Francisco Estuary Institute (SFEI). (2013). The Pulse of the Bay: Contaminants of Emerging Concern. SFEI Contribution 701. San Francisco Bay Estuary Institute, Richmond, CA
[104] SFEI. (2013)

While SFEI acknowledges concentrations in San Francisco Bay are well below US EPA chronic marine WQC for NP (1.7 µg/L) they suggest a paper by Billinghurst et al., 1998 raises potential concern for impacts on barnacle settlement due to exposure to NP. [105,106] SFEI raises the following concern, which is also repeated in the DTSC Background document on aquatic impacts of NPEs.

> " Maximum concentrations of NP in Bay surface waters were, however, comparable to the concentration observed to impact barnacle settlement in a laboratory study (0.06 µg/L) (Billinghurst et al., 1998)."[107]

The Billinghurst et al., 1998 study aimed to examine the effect of exposure to NP and 17-β estradiol on settlement of cypris larvae of the barnacle *Balanus amphitrite*. In addition to the fact that this is not a conventional endpoint used in environmental hazard and risk assessment, other issues with this study obviate its use as either a hazard threshold or in the derivation of a PNEC. The results for 4-n-NP in the 0.1 µg/L nominal (0.06 µg/L measured) exposure group with 48-h exposures were inconsistent between experiments within the same study. Experiment II showed reduced settlement after 48-h, while experiment IV showed no reduced settlement after 48-h. This inconsistency within replicates of the same study preclude the use of 0.06 µg/L as a LOEC for this study. In addition, issues with analytical confirmation of initial test solutions, which were prepared separately at different times than the testing, showed contamination of the control with NP. While these issues with the quality of this study prevent its use in identifying a LOEC it does provide interesting qualitative results related to the mechanism of action of NP and E2 on this endpoint. Results from experiment III showed that larval settlement was inhibited by E2 at all concentrations, but the trend (biphasic response) was the opposite to that seen with NP (standard response curve). The authors state that this difference along with the recovery of the larval settlement following 48-h exposure to 4-n-NP indicates that "…the mechanism of action is other than estrogenic".[108]

[105] Klosterhaus, 2012
[106] Billinghurst Z. *et a*l (1998).
[107] Klosterhaus, S. *et al* (2012)
[108] Billinghurst, Z. *et al* (1998)

Study quality and other issues with the Billinghurst et al., 1998 paper were considered by Environment Canada in the development of marine water quality guidelines for NP and prevented the use of the 0.06 µg/L value from this study in derivation of that country's marine water quality guideline for NP and NPE. EC concluded:

> "The LOEC for reduced settlement in barnacles, *Balanus amphitrite*, was the most sensitive endpoint reported (48 hour, LOEC at 0.06 µg/L; Billinghurst et al, 1998). However, this study was of secondary quality, involved a short exposure time and used an unconventional endpoint. Also, this LOEC value was two orders of magnitude lower than another other endpoints reported in the literature. This suggests that either larval settlement is much more sensitive than other endpoints or that this particular LOEC is an outlier that is not reproducible. Unfortunately, there have been no other studies conducted on barnacle larval settlement with exposure to nonylphenol with which to compare these results. The LOECs reported for larval settlement of *Balanus amphitrite* exposure to cadmium and phenol (Wu et al 1997) are higher than the LOECs for many other endpoints that have been reported for these substances in marine aquatic life (see CCME 1999). This suggests that larval settlement is not a particularly sensitive endpoint. Due to the suspicion caused by these various sources of uncertainty, confidence in the study by Billinghurst et al. (1998) was not high enough to base the guideline value on this LOEC."[109]

US EPA took a similar view of the paper by Billinghurst et al., 1998 in developing the WQC for NP, including this paper among the additional data on the lethal and sublethal effects of NP that do not meet the data quality requirements described under US EPA Guidelines for use in deriving aquatic life ambient WQC. [110]

Additional work has been conducted ranging from genomic screening to chronic studies that looked at development and reproductive capacity with an interest in understanding the potential for an estrogenic mechanism of action in barnacle species. [111,112,113] Billinghurst et al., 2000

[109] EC. (2001).
[110] US EPA. (2005)
[111] Billinghurst, Z., Clare, A.S. , Matsumura, K., Depledge, M.H. (2000) Induction of cypris major protein in barnacle larvae by exposure to 4-n-Nonylphenol and 17βoestradiol. *Aquatic Toxicology*. 47(2000) 203-212

examined the effect of exposure to 4-n-NP or 17-β estradiol on levels of a larval storage protein, cypris major protein (CMP) in *Balanus amphitrite*, which is related to barnacle vitellin and was being evaluated as a potential biomarker of low level estrogenic exposures in crustaceans. The authors suggested that the ecological significance of the qualitatively assessed increases or decreases in CMP production at the different nauplii stages has yet to be determined. [114] Billinghurst et al., (2001) examined the effects of 4-n-NP and 17-β estradiol (E2) on larval development on another species of barnacle, *Elminius modestus*. Long term exposure show that exposed animals are able to reproduce successfully and produce viable offspring indicating to the authors that "the impacts of comparable levels of NP and E2 in the environment may not have significant impacts on coastal populations of *E. modestus*." [115]

Overall, the available data on barnacle species indicates that an estrogenic mechanism of action is not prominent in these crustaceans and that NP is not likely to have significant impacts on coastal populations of barnacles.

3.2.2 SFEI concern related to Schlenk et al, 2012

SFEI also based their categorization of NP/NPE as "moderate priority" based on the following concern about a study by Schlenk et al., 2012, which was also noted by DTSC in the Background Document.

> " Schlenk et al (2012) found estrogenic activity in laboratory fish exposed to mixtures of pyrethroid pesticides, alkylphenols, and APEs. Pesticides alone did not cause estrogenic activity. Their results suggested that endocrine disruption , caused by these mixtures , could be partially responsible for the observed declines of pelagic fish populations in the San Francisco Bay Delta." [116]

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[112] Atienzar, F.A, Billinghurst, Z., Depledge (2002). 4-n-Nonylphenol and 17β- estradiol may induce common DNA effects in developing barnacle larvae. *Environmental Pollution* 120 (2002) 735-738

[113] Billinghurst, Z., Clare, A.S., Depledge, M.H (2001) Effects of 4-n-Nonylphenol and 17 –oestradiol on early development of the barnacle *Elminius modestus. Journal of Experimental Marine Biology and Ecology. 257 (2001) 255-268*

[114] Billinghurst, Z. *et al* (2000)

[115] Billinghurst, Z. *et al* (2001)

[116] SFEI (2013)

In the Schlenk et al 2012 study, alkylphenols (APs) and alkylphenol ethoxylates (APEs), including NP and NPE were measured in the San Francisco Bay Delta, and the maximum concentrations that were detected across sampling locations were used to make a reconstituted mixture that was assessed both *in vitro* and *in vivo* using fish liver cell lines and medaka fish, respectively. The reconstituted AP and APE mixtures did not result in significantly higher estrogenic activity either *in vitro* or *in vivo*. Only when maximal AP and APE concentrations were increased five-fold were some sensitive indications of estrogenic activity apparent. Thus, at environmentally relevant maximum concentrations, AP and APE mixtures in the San Francisco Bay Delta did not result in significant estrogenic activity either *in vitro* or *in vivo*.

When mixtures of APs and APEs were combined with two pesticides (*i.e.* bifenthrin and diuron, both detected at only one sampling location in the San Francisco Bay Delta), higher estrogenic activity was noted *in vivo* (but not *in vitro)* than was expected based on the responses of these substance alone. The significance of these findings is unclear as no estrogenic responses were observed when fish were exposed to either bifenthrin or diuron alone. Without additional data, to include repeatability, it is impossible to draw conclusions regarding the biological plausibility of the discordance between these *in vivo* and *in vitro* results. These uncertainties notwithstanding, the data show that neither APs nor APEs cause significant estrogenic activity. It is important to keep in mind this study investigated biomarkers of estrogenic effects (*i.e.* vitellogenin concentrations), not effects likely to cause population-level adverse effects. This is especially important when evaluating data involving bifenthrin as it has recently been subjected to comprehensive screening for endocrine activity in amphibians, fish, and mammals as part of USEPA's Endocrine Disruptor Screening Program (EDSP). Based on this extensive study, the EPA concluded that:

> "Based on weight of evidence considerations, mammalian EDSP Tier 2 testing is not recommended for bifenthrin since there was no convincing evidence of potential interaction with the estrogen, androgen or thyroid pathways**."** [117]

[117] US EPA Endocrine Disruptor Screening Program (EPA EDSP) (2015, June). Weight of Evidence Analysis of Potential Interaction with the Estrogen, Androgen or Thyroid Pathway: Bifenthrin.

Moreover, considering that bifenthrin and diruron were both detected at only one sampling site (#711) and at only 1 ng/L (just above the limit of detection) and 41 ng/L, respectively, the assertion by the authors that:

> "mixtures of pesticides with significantly different modes of action and AP/APEOs at environmentally relevant concentrations may be associated with estrogenic activity measured in water extracts and feral fish that have been shown to be in population decline in the San Francisco Bay Delta."

and the inference that there may be a causal link between the laboratory-measured activity and fish populations *is not* supported by the data. Therefore, this study should not be used as a basis for either concern or a "moderate" categorization in the SFEI Prioritization Scheme for CECs.

In addition, if there is concern about NPEs co-occurring in the environment due to their use in pesticidal or herbicidal products, these uses are already regulated at the national level under the Federal Insecticide, Fungicide and Rodenticide Act (FIFRA) and in California by the Department of Pesticide Regulation under California pesticide laws and regulations. Therefore, these uses are outside of the scope of the SCP Priority Products regulations.

3.3 DTSC concern regarding measured low concentrations of NP in various biota (i.e., mussels, oyster, wildlife, birds)

DTSC notes that monitoring data are available for NP, NPE and other APEs in wildlife, fish and invertebrates in the San Francisco Bay and Estuary and Morro Bay and other areas of California. SFEI provides a summary of studies, mostly focused on NP, which was sporadically detected in the NOAA Mussel Watch California Chemicals of Emerging Concern (CEC) Pilot Study and San Francisco RMP mussel samples. Concentrations were sometimes described as "high", which is a description relative to concentrations other measured CECs rather than to any toxicologically-based internal exposure concentrations. [118] While the detection of NP in aquatic species and wildlife is interesting, it is not surprising to find contaminants in fish and organisms

[118] SFEI. (2013).

that live in and around surface waters and sediments that have measureable levels of those contaminants. However, without the benefit of Physiologically Based Pharmacokinetic (PBPK) data for each species involved, the concentrations are not useful to assess whether the detected levels can cause an adverse effect to the organism. The risks of NP and NPE to fish, pelagic inverts (water column) and benthic inverts can be best assessed by comparing water and sediment concentrations in the environment to US EPA WQC and other EQS or PNEC values as discussed above in these comments. For example, the Diehl et al 2012 study discussed above detected NP in a variety of species; however the concentration of NP in Morro Bay did not exceed 0.9 l µg /L at any collection time, and it was most often present at the detection limit of 0.1 µg /L, averaging 0.42 1 µg /L. The NP concentration in nine samples of sediment from five sites in Morro Bay ranged from undetected to 157 ng/g, averaging 53 ng/g 4-NP (dw). All of these values were below the US EPA chronic marine WQC and PNEC (sediment) derived from sediment dosed ecotoxicity studies, indicating a low likelihood of adverse effects and risk of NP to the aquatic species living in Morro Bay.

3.4 Concern regarding human exposure from consumption of shellfish and human biomonitoring

While the Background Document is requesting information on the aquatic hazards and detection of NP and NPEs, the detection of NP in mussels and oysters, as in the Diehl et al. 2012 paper [1], raises the question of risk to humans from consumption of these shellfish. Therefore, APERC calculated Margins of Exposure (MOE) to adult human males and females based on consumption rates for freshwater and estuarine fish (edible portion) estimated for the U.S. population and selected subpopulations by the US National Health and Nutrition Examination Survey with results presented in Table IX.[119] While fish and oyster are not expected to be consumed at the same rate as fish, the fish consumption rates provide a conservative basis for calculation of Margins of Exposure for oysters and mussels containing levels of NP as reported in Diehl et al. 2012. A No Observed Adverse Effects Level (NOAEL) of 13,000 µg/kg body weight / day,

[119] US National Health and Nutrition Examination Survey (NHANES). 2003-2014. Estimated Fish Consumption Rates for the U.S. Population and Selected Subpopulations.

which was used as the basis for the MOE calculation, was based on reproductive and systemic effects as reported in multigenerational rat studies[120, 121, 122, 123, 124] [2-5].

TABLE IX Margins of Exposure Calculated for Human Consumption of Oysters and Mussels Containing NP at Concentrations Reported in Diehl et al, 2012

	Consumption estimates freshwater + estuarine fish edible portion*	Oyster 99th Percentile Consumption		Mussel 99th Percentile Consumption	
Population	99th Percentile (g/day raw weight)	Internal Dose (ug/kg)**	MOE	Internal Dose (ug/kg)**	MOE
Adults (≥21 yrs)	61.1	0.479635	27,104	0.09699625	134,026
Female	48.2	0.37837	34,358	0.0765175	169,896
Male	71.9	0.564415	23,033	0.11414125	113,894

** EPA (2014): Estimated Fish Consumption Rates for the U.S. Population and Selected Subpopulations (NHANES 2003-2010).*

***Calculated using concentrations in oyster and mussels reported in Diehl et al. 2012*

MOEs for the 99th percentile consumption of oysters and mussels, containing NP as reported in Diehl et al. 2012 indicated very low to no likelihood of adverse effects from consumption of these shellfish.

[120] Specifically, acceleration of vaginal opening in females (Chapin et al. 1999) and toxicologically significant changes in the kidney from males (Chapin et al. 1999; Nagao et al. 2001; NCTR 2009; Tyl et al. 2006)

[121] Tyl, R.W., et al., (2006).Three-generation evaluation of dietary para-nonylphenol in CD (Sprague-Dawley) rats. *Toxicol Sci*, **92**(1): p. 295-310.

[122]Chapin, R.E., et al., (1999). The effects of 4-nonylphenol in rats: a multigeneration reproduction study. *Toxicol Sci*, 1999. **52**(1): p. 80-91.

[123] Nagao, T., et al., *Reproductive effects of nonylphenol in rats after gavage administration: a two-generation study.* Reprod Toxicol, 2001. **15**(3): p. 293-315.

[124] NCTR (National Center for Toxicology Research), *para-Nonylphenol: Evaluation of Reproductive Effects over Multiple Generations (E0213501). Available at URL:* http://www.fda.gov/AboutFDA/CentersOffices/OC/OfficeofScientificandMedicalPrograms/NCTR/. 2009.

While the focus of the Background Document, the public workshops and these comments is on the aquatic environment , DTSC notes that NP has been measured in humans. [125] Osimitz *et al*, 2015 conducted a risk assessment for human exposure to NP based on environmental monitoring data as well as on human biomonitoring data. [126] Human biomonitoring studies can provide a basis to estimate aggregate exposure to a chemical. Using the daily absorbed dose estimates for NP, MOEs were calculated based on the same NOAEL 13,000 µg/kg body weight / day NP that was used in the calculations in Table VIII above, for sensitive toxicological endpoints of interest, *i.e.*, systemic and reproductive toxicity from continuous-feeding more than 3.5 generations in rats. The MOEs were all greater than 1,000 clearly indicating reasonable certainty of no harm for source-specific and aggregate (based on biomonitoring) exposures to NP.[127]

3.5 DTSC and SFEI raised the Science Advisory Panel to the California Water Resources Board recommendation of NP for monitoring in ocean wastewater effluent and sediment; the monitoring thresholds developed by the SAP do not reflect risk and was based on an overly conservative PNEC.

DTSC and SFEI raised a recommendation to monitor NP by a Science Advisory Panel (SAP) commissioned at the request of the California Water Resources Control Board under the Southern California Coastal Water Research Project developed a report on Monitoring Strategies for Chemicals of Emerging Concern (CECs) in California's Aquatic Ecosystems. [128, 129, 130] The group was charged to identify potential sources and evaluate the fate and effects of CECs, and ultimately to provide guidance for developing monitoring programs that assess those chemicals with the highest potential to cause effects in the State's receiving waters. In that effort, the SAP took the following steps for various CECs.

[125] CA DTSC. (2016, November 15)
[126] Osimitz, T.G., Droege, W. and Driver, J.H. (2015): Human Risk Assessment for Nonylphenol, Human and Ecological Risk Assessment: An International Journal, DOI: 10.1080/10807039.2014.999520
[127] Osimitz. T et al., (2015).
[128] Anderson, P.D., Denslow, N.D., Drewes, J.E., Olivieri, A.W., Schlenk, D., Scott, G.I., Snyder, S.A. (2012, April). Final Report: Monitoring Strategies for Chemicals of Emerging Concern (CECs) in California's Aquatic Ecosystems, Recommendations of a Science Advisory Panel.
[129] CA DTSC (2016, November)
[130] SFEI (2013)

" 1. Developed monitoring trigger levels (MTLs) for CECs that pose the greatest potential risk to aquatic systems based on published effects concentrations.
2. Compiled measured or predicted environmental concentrations (MECs or PECs) for CECs for which MTLs could be estimated.
3. Identified those CECs that have the greatest potential to pose a risk by comparing MECs (or PECs) to MTLs. CECs with a monitoring trigger quotient (MTQ = MEC(or PEC)/MTL) greater than "1" were identified for monitoring. **(Note than an MTQ of greater than 1.0 does not indicate a risk is present, only that sufficient potential for a risk exists that the chemical should be considered for inclusion in a monitoring program.)**
4. Apply the risk-based screening framework (steps 1-3) to each of three representative scenarios that capture the key types of exposure (sources and fate) to CECs in the State's inland, coastal and marine receiving water systems." [131] emphasis added

The SAP Final Report explains the process as follows:

" For each scenario, MECs were compiled from the literature and from the most recent studies in California. The maximum MEC was selected for use in the risk-based screening framework. In cases where MECs were not available, PECs were employed. To derive MTLs the toxicological literature was reviewed to identify lowest observed effect concentrations (LOECs) and no observed effect concentrations (NOECs) from studies of reproduction, growth of survival of fish and invertebrates. MTLs were derived by adjusting LOECs and NOECs by safety factors ranging from 1-1,000 to account for several sources of uncertainty including extrapolation of toxicity data across species and differences in receiving water environments. Monitoring trigger quotients (MTQs), equal to the MEC or PEC divided by the MTL, were estimated for aqueous, sediment and tissue matrices for each scenario when data were available." [132]

The SAP recommended NP for initial monitoring in WWTP effluent discharging to ocean waters and in marine sediment since the MTL for this scenario was calculated to be greater than 1. This

[131] Anderson, P.D. et al., (2012, April)
[132] Anderson, P.D. et al., (2012, April)

was based on a MEC of 420 ng/g NP, which was the maximum concentration for NP that the SAP found reported in California ocean sediments. The NP MTL was set at 14 ng/g, which was based on the Canadian Interim Freshwater Sediment Quality Criteria of 1400 ng/g with safety factor of 10 applied for a freshwater to saltwater conversion and another safety factor of 10 applied for an endocrine mode of action. Based on the MEC of 420 ng/g and the MTL of 14 ng/g, the resulting MTQ for NP is marine sediment was calculated by the SAP as 30. However, the SAP did not take into account that there was in fact a Canadian Interim Sediment Quality Criteria for Marine Sediment of 1,000 ng/g that could have been used directly, without the safety factor of 10 for freshwater to saltwater. Also, the SAP did not take into account that the Canadian SQGs were already protective for the endocrine mode of action associated with NP, and therefore, a second safety factor of 10 was also not needed. A more appropriate approach for NP would be to directly use the Canadian interim marine SQG for NP of 1,000 ng/g as the MTL along with the MEC of 420 ng/g for the maximum concentration of NP in California marine sediment, which would result in an MTQ of 0.42, which is less than 1 and would not have triggered a need for further monitoring of NP in marine sediment.

The SAP emphasized that the CECs in the report " represent an initial prioritization list based on available data and a number of qualifying assumptions. While their identification at this time represents a conservative screening of 'CECs at large', the information available for performing such screening continues to grow rapidly. The Panel thus urges the State to consider this an initial list that will evolve over time, to which more CECs may be added and others removed."[133] Based on this recommendation and more appropriate development of the MTL for NP, APERC recommends that NP be deprioritized for monitoring in California sediment. APERC also recommends that DTSC take the SAP recommendation to monitoring for NP as just that – a recommendation to monitor. Prioritizing NPEs as an ingredient in any Priority Product under the Safer Consumer Products regulation based on this SAP monitoring recommendation would be inappropriate, particularly given the oversights in the MTL developed for NP by the SAP.

[133] Anderson, P.D. *et al* . (2012, April)

3.6 DTSC concern for biosolids-amended soil as a pathway to the aquatic environment for NP/NPE

DTSC states in the Background Document that land application of sewage sludge, or biosolids, as fertilizer may be an additional route of exposure to the aquatic environment. Use of biosolids as fertilizer is not a consumer use of NPE and it is regulated under CalRecyle regulations and well as local authorities. [134] Monitoring of surface water and sediment will detect NP, NP1EO and NP2EO from all pathways to the environment allowing comparison to existing WQC and EQS (sediment) for NP as discussed above in order to determine the risk for adverse effects in aquatic and benthic species.

While not mentioned by DTSC, land application of biosolids is also a route of exposure to soil dwelling species. Staples et al (2016) developed an assessment, which was published as a paper by the Water Environment Federation that estimated potential risk from NP to soil-dwelling in biosolids-amended soil.[135] For NP there are chronic toxicity values for soil-dwelling arthropods, annelids, plants, and microbes, which were used to plot a range of protective chronic toxicity values for soil dwelling organisms. From the distribution of ecotoxicity values, median and lower-bound 5th centile no effect concentrations (NOECs) of 99 and 26 mg/kg-dw were calculated. Concentrations of NP in biosolids from mainly US treatment plants were used to calculate concentrations in soil, incorporating a dissipation term that accounts for all biological and abiotic processes that reduce concentrations and bioavailability of constituents such as NP. Laboratory and field dissipation studies taken from the literature yielded a mean (±SD) dissipation half-life of 24±20 days. Distributions of soil concentrations calculated while varying dissipation rate and time after incorporation were all lower than all of chronic toxicity values for terrestrial organisms. [136] This indicates a low likelihood of adverse effects or risk to terrestrial organism based on practices for land application of biosolids containing NP at concentrations typically seen in biosolids in the US. In addition, migration of NP and low mole NPEO via rainwater runoff following

[134] CalRecycle http://www.calrecycle.ca.gov/organics/biosolids/BioBkgd.htm#Resources
[135]Staples CA, Coady KC, Losey B.S.(2016). Estimating exposure of nonylphenol to soil-dwelling macroinvertebrates and plants inhabiting the base of the terrestrial food web in biosolids-amended agricultural fields. Water Environment Federation. Proc. Residuals and Biosolids – Biosolids as a Resource. 2016. Milwaukee, WI.
[136] Staples, (2016)

application of the biosolids to agricultural soils would not be significant given the relatively high soil-water partition coefficients (10,000 to 50,000) for these compounds. [137]

4.0 NP/NPE ARE REGULATED IN CONSUMER PRODUCTS AND IN THE MANUFACTURE OF CONSUMER PRODUCTS BY EXISTING US EPA AND CALIFORNIA REGULATIONS, WHICH SHOULD EXEMPT THESE USES FROM CONSIDERATION UNDER THE SAFER CONSUMER PRODUCTS REGULATION.

Section 25257.1(c) of the California Health and Safety Code provides that DTSC '**shall not duplicate or adopt conflicting regulations for product categories already subject to pending regulation consistent with the purposes of this article.**" Therefore, APERC strongly urges DTSC to recognize existing federal and California regulations that address uses of NPEs in consumer as well as in industrial or institutional applications.

As noted above, US EPA finalized fresh and marine ambient WQC for NP under the Clean Water Act, which can be incorporated at the state level into development of NPDES permits to control its industrial discharges. Regulation of consumer pesticide products is governed nationally by U.S. EPA under FIFRA and in California by the Department of Pesticide Regulation under California pesticide laws and regulations . Also on the national level, NP is listed on the Toxics Release Inventory (TRI) under the U.S. Emergency Planning and Community Right-to-Know Act (EPCRA) and NPE has been proposed for addition. [138, 139] Therefore, discharges and emissions of these compounds from industrial sources will subject to reporting and trends in California can be monitored.

Also at the state level in California, regulations administered by the California Air Resources Board (CARB), prohibit the use of NPE in consumer cleaning products as summarized in Table X.

[137] Staples. (2008).
[138] U.S. EPA. (2014, September 30). Final Rule: Addition of Nonylphenol Category; Community Right-to-Know Chemical Release Reporting. *Federal Register*.
[139] US EPA (2016, November 16). Proposed Rule: Addition of Nonylphenol Ethoxylates Category; Community Right-to-Know Toxic Chemical Release Reporting. *Federal Register*. Vol. 81, No. 221 pp. 80624-80627

Table X Consumer Products Categories in Which APEs are Prohibited by CARB

Product Category	Effective Date	Sell Through Date
General Purpose Cleaner (nonaerosol)	12/31/2012	12/31/2015
General Purpose Degreaser (nonaerosol)	12/31/2012	12/31/2015
Glass Cleaner (nonaerosol)	12/31/2012	12/31/2015
Heavy-duty Hand Cleaner or Soap (nonaerosol)	12/31/2012	12/31/2015
Oven or Grill Cleaner	12/31/2012	12/31/2015
* Reference CARB Regulation for Reducing Emissions from Consumer Products, § 94509. Standards for Consumer Products (m)(3) -Table 94509(m)(3)		

The sell through date for existing products was December 21, 2015; therefore there should no longer be consumer cleaning products of these types containing NPEs on the market in California.

5.0 VOLUMES OF NPES SOLD IN NORTH AMERICA HAVE DECLINED BY ALMOST 50% IN THE PAST DECADE LIKELY DUE TO EXISTING EPA DFE VOLUNTARY INITIATIVES AND MARKET BASED INITIATIVES THAT PROMOTE DESELECTION OF NPE IN LAUNDRY, CLEANING AND CONSUMER PRODUCTS.

Market reports indicate that the total consumption of APEs in North American declined almost 50% in the decade between 2005 and 2015[140 , 141] This dramatic decline in the U.S. is likely to due in part to deselection prompted by voluntary programs under U.S. EPA's Design for Environment Safer Chemical Choice Program, which include the Safer Detergent Stewardship Initiative (SDSI). SDSI, which began in 2007, specifically promotes the deselection of NPE surfactants in laundry detergents and includes an Alternative Assessment for NPEs in this application. [142, 143] Perhaps more influential in the reductions between 2005 and 2015 was the

[140] Colin A. Houston & Associates, Inc. (2007, June). Surfactant Developments Newsletter. Brewster, NY USA
[141] Colin A. Houston & Associates, Inc. (2016, March). Surfactant Developments Newsletter. Aiken, SC, USA
[142] US EPA (2007) Design for Environment Safer Detergent Stewardship Initiative
https://www.epa.gov/saferchoice/design-environment-safer-detergents-stewardship-initiative

corporate mandate in 2006 from Wal-Mart that restricted the use of NPEs in consumer cleaning and laundry products that it sells. Wal-Mart updated its list of High Priority Chemicals, which still includes NPEs, again in 2016. More recently, Target announced that it will work to remove NPEs from beauty, baby care and household cleaning products it sells by 2020. [144]

6.0 CONCENTRATIONS OF NPE DEGRADANTS IN THE AQUATIC ENVIRONMENT IN CALIFORNIA DO NOT WARRANT CONCERN FOR "SIGNIFICANT OR WIDESPREAD ADVERSE IMPACTS" AS REQUIRED UNDER THE SCP REGULATIONS AND THE USE OF NPES IN CONSUMER AND COMMERCIAL HOUSEHOLD CLEANERS AND LAUNDRY DETERGENTS HAS ALREADY DECREASED SIGNIFICANTLY OVER THE PAST DECADE; THEREFORE EXISTING CALIFORNIA MONITORING PROGRAMS PROVIDE THE BEST MECHANISM TO MONITOR ENVIRONMENTAL TRENDS FOR NPES AND THEIR DEGRADATION INTERMEDIATES IN CALIFORNIA AND TO INFORM THE SCP PRIORITY PRODUCTS WORK PLAN IN THE FUTURE.

As discussed above, concentrations of NPE degradants in California's aquatic environment do not warrant concern for "significant or widespread adverse impacts" as required under the SCP regulations. Concentrations of NP, NP1EO and NP2EO in the aquatic environment do not exceed US EPA chronic WQC and other EQS values for NP, even when considered in aggregate. Therefore consideration of NPEs as a Candidate Chemical in *any* Priority Product is not warranted. NPEs have already been significantly deselected in the U.S. and North America due to voluntary and market-based deselection initiatives with volume reductions approaching 50% in the past decade. In addition, the use and manufacture of NPEs in many consumer products are already subject to regulation at the federal level as well as in California, which should exempt these products from consideration under the SCP Regulations.

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[143] US EPA (2012) Design for Environment Program Alternative Assessment for NPEs. https://www.epa.gov/sites/production/files/2014-06/documents/npe_final.pdf

[144] Target(2016, January). Chemicals@Target: Chemicals Policy & Goals. Available at https://corporate.target.com/_media/TargetCorp/csr/pdf/Target-Chemicals-Policy-and-Goals.pdf

The conduct of Alternative Assessment on Priority Products under the SCP regulations will pose a significant burden to business as well as the additional burden to both businesses and DTSC in the event of potential regulation. Therefore, selection of Priority Products should be focused on those that actually pose "significant or widespread adverse impacts" to the environment or human health in California, as required under ARTICLE 3 § Section 69503.2(a) of the CSP regulations. Available US EPA WQC and other EQS and PNECs are available and provide environmental concentrations of NP (and NP1EO and NP2EO on a TEQ basis), which are protective of aquatic species to chronic exposures of these compounds. Concentrations of NP, NP1EO and NP2EO in the California environment simply do not exceed these values indicating that these degradation intermediates, and NPEs in general, *do not* present "significant or widespread adverse impacts" to the aquatic environment in California.

The Background Document relies heavily on reports generated by the SFEI regarding the RMP in the San Francisco Bay Estuary and the SAP to the California Water Resources Control Board under the Southern California Coastal Water Research Project. [145, 146, 147] However, neither of these reports suggest that NPEs, or APEs, pose "significant or widespread adverse impacts" to human health or the environment in California. The 2012 SFEI reports acknowledges that NPEs and APEs – even in aggregate - do not exceed US EPA WQC or other governmental thresholds for these compounds in the San Francisco Bay Estuary. While SFEI raises concern about two specific studies and pathways for APE, review of each indicates no additional cause for concern. At most, SFEI identifies a need for "more information on the concentration of APEs and their degradation products in sediment and biota near Bay area treatment plant outfalls, where exposures are anticipated to be highest" [148] The SAP emphasized that the CECs in their report "represent an initial prioritization list based on available data and a number of qualifying assumptions" and "(w)hile their identification at this time represents a conservative screening of 'CECs at large', the information available for performing such screening continues to grow rapidly. The Panel thus urges the State to consider this an initial list that will evolve over time, to

[145] Klosterhaus S. et al (2012)
[146] SFEI. (2013).
[147] Anderson, P.D. et al (2012, April)
[148] Klosterhaus S. *et al* , (2012)

which more CECs may be added and others removed." [149] While there were apparent oversights by the SAP in the development of the MTL for NP, which suggests that NP could be deprioritized for monitoring in California marine sediment and wastewater effluents outfalls to the ocean, APERC recommends that DTSC take the SAP recommendation for monitoring for NP in sediment as just that – *a recommendation to monitor*. Prioritizing NPEs as an ingredient *in any Priority Product* under the SCP regulations based on either the SFEI reports or the SAP monitoring recommendation would be inappropriate given the lack of evidence for "significant or widespread adverse impacts" in California from NPEs or their degradants.

Existing monitoring programs in California provide the best mechanism to monitor environmental trends for NPEs and their degradation intermediates in California's aquatic environment. This was the recommendation of the SAP and the SFEI. It is also APERC's view that this is the most appropriate approach to confirm a lack "significant or widespread adverse impacts" from NPEs in California and to inform the SCP Priority products work plan in the future.

[149] Anderson. (2012, April)

ATTACHMENT TO

Alkylphenols & Ethoxylates Research Council

Comments on

California Department of Toxic Substances Control

Work Plan Implementation: Potential Aquatic Impacts and Continued Uses of Nonylphenol Ethoxylates and Triclosan (November 15, 2016)

February 28, 2017

TABLE VIII: Occurrence Data or NPE Biodegradation Intermediates in California Surface Water, Urban Run Off, and Sediment

	Years Sampled (S) or Published (P)	**Result Presented on TEQ Basis Relative to NP**	**References**
Surface water			
San Francisco Bay	2002-2003 (S)	**NP**: 0.005 µg/L- 0.073 µg/L	Klosterhaus, 2012
Surface water, San Franciso Bay	2009-2010 (S)	**NP**: ND – 73 ng/L	Klosterhaus, 2013
San Franciso Bay	2010 (S)	**NP** 0.035 – 0.073 µg/L; **NP1EO**: ND **NP2EO**: ND	Klosterhaus, 2012
San Francisco Bay	2010	**NP:**0.35 -0.73 µg/L**; NP1EO:** ND**; NP2EO:** ND	Klosterhaus, 2012
Santa Ana River, Effluent Dominated	2006 (P)	**APs:** 0.05 -0.4µg/L **APECs**: 0.005 – 0.074 µg/L	Klosterhaus, 2012;
Southern California Coastal Water Research Project		**NP** (bottom water near ocean wastewater outfalls): low ng/L	Klosterhaus, 2012, SCCWRP, unpublished Data
Morro Bay		**NP**: Majority of samples detected at or near the Detection Limit of 0.1 ng/L	Klosterhaus, 2012, unpublished data
		NP: 1.3 to 3.4 µg/L	

Morro Bay Tributary, receiving wastewater effluent		**NP:** ND	Klosterhaus, 2012, unpublished data
Santa Clara River	2013	**NP:** ND	Maruya, 2016
Urban Runoff			
Urban Runoff		**NP:** 920 ng/L	Anderson et al, 2012
Sediment			
San Francisco Bay	2010	**Median:** **NP:** 50 ± 30 ng/g; NP1EO: 20 ± 10 ng/g; NPE2 9±7 ng/g **Range:** **NP:** 20-90 ng/g dw **NP1EO:** 4-40 ng/g; **NP2EO :** <1 to 20 ng/g	Klosterhaus, 2012
NA	2012 (P)	**NP (Ocean Sediment)**: 420 ng/g dw NP (**Estuary Sediment):** 86 ng/g dw	Anderson, 2012;
Southern California Bight, Orange County Sanitation District	2003	**NP (near ocean wastewater outfall):** 330 ng/g **NP (Other sites**): 122-198 **ng/g; NPEs (assume NP1EO and NP2EO):** 1-46 ng/g **NP (Max): NP:** 3200 ng/g**,** **NPE (assume NP1EO, NP2EO):** 1950 ng/g	Klosterhaus, 2012, Shlenk, 2005
Southern California Coastal Water Research Project	2006-2007	**NP**: ~ 80 to 800 ng/g dw	Klosterhaus, 2012, SCCWRP unpublished
Morro Bay		**NP**: ND- 158 ng/g dw with most between 40 to 60 ng/g dw	Klosterhaus, 2012, unpublished

San Francisco Bay	2010	**NP** (Sediment pore water estimated using Max sediment concentration): 0.04µg/L	Klosterhaus, 2012; Sekela, 1999
San Francisco Bay	2010 [(a)]	**NP (Median):** 50 ± 30 ng/g dw NP1EO : 10 ± 10 ng/g; NP2EO: 4.5 ± 7 ng/g **NP (Range):** 20-90 ng/g dw **NP1EO:** 2 - 20 ng/g dw; **NP2EO**:<0.5 - 10 ng/g **NP (Max):** 90 ng/g dw	Klosterhaus, 2012; San Francisco Bay RMP Pilot on CECs:
Highly urbanized Southern CA Coast	Archived Samples 1995-2009	**NP (1995):** ~ 3,000ng/g dw **NP(2009):** ~300 ng/g dw	Maruya, 2015

ND: Not Detected

(a) "Higher concentrations in the 2010 samples compared to the 2002/2003 may be the result of an increase in concentration over time or analytical method differences.

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