Evaluation of CRWQCB Human Health Risk Assessment for the San Diego Shipyard Sediment Site

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Contents

1 Introduction

This report provides an evaluation of the “Tier 2” Site-specific human health risk assessment (HHRA) performed by CRWQCB (2010) to address Beneficial Use Impairment (BUI) of Commercial and Sport Fishing and Shellfish Harvesting Beneficial Uses at the San Diego Shipyard Sediment Site (Site). In Finding 25 of CRWQCB (2010), CRWQCB states four Beneficial Uses that must be fully protected in order to provide for the protection of human health: Contact Water Recreation, Non-contact Water Recreation, Shellfish Harvesting, and Commercial and Sport Fishing. Based on the HHRA in Finding 28 of CRWQCB (2010), which was conducted in a manner similar to that prescribed by USEPA’s Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual (Part A) (USEPA, 1989), CRWQCB (2010) concluded that unacceptable levels of human health risk would be expected for anglers consuming Site fish and shellfish and that the Site exhibited BUI for Shellfish Harvesting and Commercial and Sport Fishing Beneficial Uses. Among the Site’s five primary chemicals of concern (COCs) identified by CRWQCB, the CRWQCB (2010) HHRA indicated unacceptable levels of human health risk were present due to polychlorinated biphenyls (PCBs), copper, and mercury.

Based on the findings of the CRWQCB (2010) HHRA, concentrations of PCBs, copper, and mercury in surface sediment were used by CRWQCB to derive Spatially Weighted Average Concentrations (SWACs) at the Site. SWACs were used to relate concentrations in Site surface sediment to potential Human Health BUI (CRWQCB, 2010). Along with the Triad and Non-Triad Data approaches to address Aquatic Life BUI, CRWQCB used SWACs to delineate areas of the Site for potential remedial action (CRWQCB, 2010). CRWQCB (2010) also used the HHRA to verify the ability of the currently propose remedial footprint to address human health BUI. Because it is was an impetus for remedial action and was used, in part, to derive benchmarks by which Site remedial success will be evaluated, the CRWQCB (2010) HHRA plays a pivotal role in the Site decision-making process. This report provides a review and evaluation of the technical foundations for this HHRA.

My expertise is in the area of environmental toxicology and chemistry, with a particular focus on ecotoxicology, environmental chemistry, and bioaccumulation of chemicals by invertebrates, fish, and wildlife. I have been employed with ENVIRON International Corporation (ENVIRON), an environmental consultancy, since July 2004. The main focus of my experience with ENVIRON has been on ecological and human health risk assessment of contaminated sites. I am listed as a primary or co-author on over 20 peer-reviewed publications in environmental toxicology, environmental chemistry, and risk assessment. My career vita is included as Appendix A of this report.

2 Review of CRWQCB HHRA

The focus of this review concerns the following key technical aspects of the CRWQCB HHRA:

1. The assumption of a complete exposure pathway for human anglers (Section 2.1);

2. The assumption of a value of 1 for fractional intake of fish and shellfish (Section 2.2); and

3. The lack of consideration for human health risks posed by consumption of fish and shellfish from reference areas in San Diego Bay (Section 2.3).

2.1 Assumption of a Complete Exposure Pathway

A key assumption in the CRWQCB (2010) HHRA is that current Site conditions, as characterized by Exponent (2003) in their 2001-2002 Site investigation, currently result or will result in the exposure of human anglers to chemicals in fish and shellfish that have accumulated chemicals directly or indirectly from Site sediment. In the lexicon of risk assessment, this key assumption is referred to as a *complete exposure pathway*. When an exposure pathway is assumed to be complete at a contaminated site, it is assumed that environmental conditions and processes facilitate the transport of chemicals from site environmental media (e.g., sediment) such that a receptor of concern (e.g., a human angler) is exposed (e.g., via consumption of Site fish and shellfish).

CRWQCB (2010) supports the assumption of a complete exposure pathway for anglers consuming Site fish and shellfish in the following text, quoted from pages 27-4 to 27-5:

> "*Exponent reported that public fishing and shellfish harvesting are currently unlikely events at the Shipyard Sediment Site due to the current security measures. Under the current site usage, there are security measures in place at both the upland property and the in-water leaseholds of NASSCO and BAE Systems due to the work performed on U.S. Navy ships (Exponent, 2003). Force protection measures, required for U.S. Navy vessels, prohibit non-mission-essential vessels from approaching U.S. Navy ships. A security boom prevents unauthorized vessels from approaching closer than 300 feet in the NASSCO and BAE Systems leaseholds. Furthermore, armed personnel are present at all times to ensure that no trespassing occurs at the site.*
>
> *Despite these factors the San Diego Water Board, as discussed with OEHHA, required a screening level risk assessment using the two theoretical receptors identified above based on the following recommended considerations (Brodberg, personal communication, 2004):*
>
> - *Although fishing is currently prohibited, it is possible that NASSCO and BAE Systems employees or U.S. Navy personnel may fish off of the piers, bulkhead, riprap, ships, etc.;*

- *Although NASSCO and BAE Systems have long-term leases (NASSCO through 2040, BAE through 2034), it is possible that they may not occupy the site in the future and future site usage may allow for fishing. This scenario recently occurred at a former shipyard (Campbell Shipyard) located in San Diego Bay just north of the Shipyard Sediment Site;*

- *It is possible that sediment chemical pollutants within the NASSCO and BAE Systems leaseholds may migrate to areas outside the leasehold where fishing by boat and fishing at a nearby public pier (Crosby Street Park Pier located approximately ½ mile north of BAE Systems just past the Coronado Bridge) is accessible; and*

- *The San Diego Water Board's statutory responsibility is to protect the present and reasonably anticipated beneficial uses designated for San Diego Bay. The beneficial uses pertaining to human health are Commercial and Sport Fishing (COMM) and Shellfish Harvesting (SHELL). These beneficial uses are to be protected at all times regardless of the current site-access measures that prevent the uses from occurring."*

As stated in the CRWQCB's own report (excerpted above), current Site security measures prohibit fishing or collection of shellfish. The exposure pathway, therefore, could not be considered complete, because anglers do not have access to the Site, and therefore do not consume fish and shellfish exposed to Site chemicals. Per USEPA (1989) HHRA guidance for Site-specific risk assessments like the Tier 2 HHRA conducted by CRWQCB (2010), the absence of an exposure pathway equates with the absence of exposure, and thus, the absence of risk.

Despite the absence of a complete exposure pathway, CRWQCB justified their assumption of the presence of a complete exposure pathway based on four considerations (bulleted text above): 1) fishing is possible by shipyard employees; (2) future access to the Site is possible after the shipyards no longer occupy the Site; (3) chemicals in sediment might migrate to other locations where angler access is possible; and (4) current restrictions on access do not justify excluding the possibility for exposure according to the San Diego Water Board's statutory responsibility. The first and third considerations regard current exposure pathways (discussed in Section 2.1.1 below), while the second consideration regards future exposure pathways (discussed in Section 2.1.2 below). The fourth consideration concerning the San Diego Water Board's statutory responsibility presents a legal argument that is beyond my expert opinion.

2.1.1 Current Exposure Pathway

CRWQCB states that current conditions support their assumption that a complete exposure pathway is present at the Site because shipyard workers consume Site fish and shellfish (first bullet, above) and Site chemicals migrate to areas outside of the Site's security perimeter (third bullet, above). These two assumptions are invalid for the following reasons:

- There is no evidence to support CRWQCB's assumption that shipyard or Navy personnel obtain fish or shellfish at the Site. Mr. Tom Alo, the CRWQCB's Person Most Knowledgeable (PMK) stated in his February 16, 2011 deposition that CRWQCB has no evidence regarding angling at the Site (Alo, 2011). Mr. Alo further stated that the assumption that angling was taking place was unrealistic (Alo, 2011). Although it is unrealistic to assume shipyard and Navy personnel harvest fish and shellfish from the Site, it is especially unreasonable to assume and there is no supporting evidence that personnel consume Site fish and shellfish at the rates used to model exposure in the CRWQCB (2010) HHRA. For example, it is highly unlikely that Site personnel consume Site fish on a daily basis for 30 years, as shown in Table 28-7 of CRWQCB (2010).
- There is no evidence to support CRWQCB's assumption that Site chemicals migrate from the Site to other areas that are accessible to anglers. Further, there is no evidence to support the CRWQCB's assumption that the amount of Site chemicals transported outside the Site's boundaries would be equivalent to the amount in the Site. Furthermore, there is no evidence to support the CRWQCB's assumption that the chemicals in fish and shellfish that are caught outside the Site originated from the Site.

  To further evaluate the CRWQCB (2010) assumptions, this review of two of the most plausible scenarios was conducted: 1) migration via abiotic environmental media such as the movement of chemicals in suspended sediment; and 2) migration via the movement of Site fish or shellfish to off-site areas.

  1. In regards to the migration of Site chemicals via the suspension of contaminated sediment, it is possible that contaminated Site sediments that are resuspended by shipyard propeller wash activity may be transported from the Site by San Diego Bay current and tidal movements to off-site areas where they may deposit. It is also possible that Site chemicals in these re-deposited sediments could enter off-site aquatic foodwebs such that accumulation may occur in fish or shellfish that might be consumed by anglers. The CRWQCB has not provided sufficient evidence to determine whether this chain of events has occurred or is possible.

     From a review of the sediment data and proposed cleanup approach, it is clear that this chain of events is unlikely and lacks any Site-specific evidence. The highest concentrations of PCBs, mercury, and copper in Site surface sediment are limited to nearshore areas, as shown in Figures 4-6, 4-8, and 4-15 of Exponent (2003). Concentrations at the far-shore edge of the Site investigation area are much lower than the highest concentrations found at the Site, suggesting a decreasing concentration gradient from the Site's most contaminated areas to the margins of the Site investigation area (Exponent, 2003).

     Considering this concentration gradient, it is not surprising that polygons at the far-shore margin of the Site (e.g., SW19, SW32, SW33, etc.) were not included by CRWQCB (2010) in the proposed remedial footprint (Figure 33-1 in CRWQCB, 2010) and thus were not identified as posing human health risks using the CRWQCB's risk-based remedy footprint derivation process. Considering that concentrations of chemicals in surface sediment decrease to levels are that not sufficient to elicit HHRA-based remedial management within the boundaries of the Site, it is not logical to assume that chemicals have been transported off-Site in quantities that would elicit human health risk concerns.

2. In regards to the biotic migration pathway, it is possible that fish and lobster exposed to Site chemicals may migrate to other areas of San Diego Bay where they may be caught and consumed by anglers. As noted by CRWQCB (2010), the nearest public fishing pier, Crosby Street Pier, is the nearest location that hosts fishing activity unlikely to be prohibited by Site security. Crosby Street Pier is located approximately 0.5 kilometers (km) northwest of the northwestern boundary of the Site.

   Available scientific literature on the migration patterns of the lobster species (California spiny lobster, *Panulirus interruptus*) and fish species (spotted sand bass, *Paralabrax maculatofasciatus*) that were sampled to provide concentrations of chemicals in angler fish and shellfish diets for the HHRA indicates that the populations of lobster and bass sampled within the Site are unlikely to migrate to Crosby Street Pier. Lobster is the only shellfish species targeted by anglers whose adult life stages (i.e., mature individuals likely to exhibiting elevated concentrations of chemicals) could be considered to migrate from the Site (adult mussels, abalone, shrimp, scallop, and other species are comparatively stationary). Stull (1991) found that the home range of California spiny lobster (9 individuals tracked via radio telemetry over a period of 15 to 99 days) was limited to an area between 2,800 and 263,500 m^2. The linear range of the individual lobster with the largest home range was observed to be as high as 1.3 km, although the average maximum distance moved was only 0.4 km for lobsters in the tracking experiment. Stull (1991) also conducted a mark and recapture study of 118 lobsters over an average 481-day period. Of the 12 lobsters that were recaptured, 11 individuals were recaptured within 0.3 km of their original location. One of the recaptured lobsters moved approximately 1.1 km during a 449-day period. Of the remaining 106 lobsters that were not recaptured, individuals may have moved beyond the study area, died prior to capture, or eluded capture. Both experiments by Stull (1991) indicate site fidelity for most California spiny lobster is such that their migration distances are less than the distance between Crosby Street Pier and the nearest boundary of the Site (0.5 km).

   The home range of adult kelp bass (*Paralabrax clathratus*), a species closely related to the spotted sand bass, was found to be limited to an average of 3,300 m^2, with a maximum of 11,000 m^2, as tracked during a 2 to 4 week monitoring period (Lowe et al., 2003). These home ranges represent linear ranges of 0.06 to 0.12 km (diameter of circles with areas of 3,300 to 11,000 m^2). Thus, the range of maximum migration estimates for these species (0.12-0.35 km) is less than the distance to Crosby Street Pier (0.5 km). The assumption that bass migrate to the Site to Crosby Street Pier is not supported by the scientific literature.

   It is uncertain whether the information for *Paralabrax clathratus* would apply to all species of commercially- or recreationally-important fish species that could be present at the Site. Information on the spatial ecology for all fish species is not available, and Site-specific chemical data on other species (as well as their presence) would be required to fully evaluate the likelihood that these fish both pose a risk to anglers and exhibit migration behavior that would result in their movement to the nearest areas of public angling activity. Under the CRWQCB (2010) and Exponent (2003) assumption that the spotted sand bass represents the typical fish species that would be targeted by anglers, the only Site-specific information available (i.e., spotted sand bass) suggests that sportfish would not migrate from the Site to Crosby Street Pier.

Furthermore, even if long-distance migration of some fish or lobster to Crosby Street Pier was assumed, it is unreasonable to assume that 100% of animals consumed by anglers at Crosby Street Pier would originate from the Site. Additionally, it is uncertain whether the concentration of Site chemicals in any long-distance fish and lobster migrants would be a high as individuals that restrict their movements within the boundaries of the Site, because it is possible that these long-distance fish and lobster migrants may eliminate Site-derived chemicals from tissue in the time period between the departure from contaminated areas of the Site and capture at Crosby Street Pier. This scenario is currently impossible to evaluate scientifically, as there are no available data to suggest that concentrations of PCBs, mercury, and copper in fish and shellfish at Crosby Street Pier are similar to those of animals collected at the Site or if the concentrations exceed risk-based thresholds.

In conclusion, the assumption that Site fish and lobster migrate from the Site and caught by anglers is untenable. Available scientific literature suggests that migration ranges are insufficient (fish) or unlikely (shellfish) to suggest that Site biota migrate to the nearest location of publicly-accessible angling opportunity. Furthermore, CRWQCB has not verified the assumption in the HHRA by collecting fish and lobsters at Crosby State Pier and testing the tissues for chemicals.

2.1.2 Future Exposure Pathway

In the second bullet within the CRWQCB-quoted text (above), CRWQCB (2010) states that current shipyard industrial uses may cease upon termination of the current shipyard subleases in 2034 or 2040, and that access to anglers would be allowed at that time. It is untenable to assume that the HHRA performed by CRWQCB (2010) would provide a reasonably-accurate estimation of risk 23 years or more in the future.

There is no evidence to suggest that conditions as characterized in 2001-2002 by the Exponent (2003) will represent conditions in 2034-2040. A recent (2011) investigation of concentrations of mercury, PCBs, and copper in surface sediments within a portion of the Site indicates that concentrations in surface sediment have decreased since the 2001-2002 investigation (AMEC, 2011). The CRWQCB has already recognized that concentrations of chemicals in Site surface sediment may decrease as chemical sources are reduced and natural recovery processes continue (CRWQCB, 2010). For example, CRWQCB (2010) notes that sedimentation may be occurring at rates of 1 to 2 cm/year at the Site. Sedimentation natural recovery processes generally result in the reduction of concentrations in surface sediment (Magar et al., 2009), although it is acknowledged that this process may be hampered by ship propeller wash (Exponent, 2003; CRWQCB, 2010). Regardless of the degree to which natural recovery will be active in reducing the concentrations of chemicals in surface sediment at all areas of the Site, it is clear that the variety of physical phenomena (sedimentation, propeller wash, shipyard maintenance dredging, etc.) will continue to result in dynamic chemical conditions in surface sediment that are difficult to predict in the future.

Additionally, stormwater management practices at both BAE Systems and NASSCO shipyards currently aim to prevent the release of stormwater to San Diego Bay (CRWQCB, 2010). This practice was implemented on a Site-wide basis after the Exponent (2003) investigation. Source control of shipyard stormwater releases limits the addition of chemicals to the Site is likely to result in a decrease in concentrations of chemicals in surface sediment over time.

Because the conclusion of CRWQCB (2010) is that chemicals in surface sediments are the source of chemicals to Site fish and shellfish, and that concentrations in surface sediment and biota are directly related, it is reasonable to conclude that concentrations of chemicals in fish and shellfish collected in 2002 will not equate with concentrations in 2034-2040 given the dynamic nature of Site surface sediment chemical conditions. Given that natural recovery and shipyard chemical source control measures have resulted in decreases in the concentration of chemicals in surface sediment, it is reasonable to predict that concentrations in fish and shellfish will also decrease. Thus, concentrations of chemicals in fish and shellfish collected in 2002 cannot be used in the HHRA model to predict risks in 2034-2040.

2.2 Fractional Intake

Fractional Intake (FI) refers to the proportion of the angler diet of fish or shellfish that is derived from a particular site. For the Site HHRA, the CRWQCB assumed a value of 1 (Table 28-7 in CRWQCB, 2010). A selection of a value of 1 assumes 100% of the hypothetical angler fish or shellfish diet is derived from organisms obtained from the Site. This assumption greatly overestimates Site chemical exposure to anglers. As noted by CRWQCB (2010, pg 28-17): "*Since it is likely that anglers catch at least a portion of their seafood from other locations in San Diego Bay and/or the fish caught from the Shipyard Sediment Site comes from elsewhere, the actual site fractional intake is likely to be less than 100 percent*." Tom Alo, CRWQCB PMK, also reiterated this statement in his February 16, 2011 deposition, concluding that the proportion of the angler's fish and shellfish diet derived from the Site is likely to be less than 100% (Alo, 2011).

CRWQCB (2010) states that the Site HHRA follows the USEPA (1989) approach and estimates a reasonable maximum exposure (RME) such that the HHRA exposure model is parameterized to estimate the highest exposure that is reasonably expected to occur at the Site. The assumption that 100% of the hypothetical angler fish or shellfish diet is derived from organisms obtained from the Site is not reasonable because there is a lack of a complete exposure pathway as described in Section 2.1.1 above. As noted in Section 2.1.1, it is even more unreasonable to assume that 100% of the fish or shellfish caught at Crosby Street Pier would be comprised entirely of animals that migrated from the Site.

Although there is no official guidance regarding FI values from the California Office of Environmental Health Hazard Assessment (OEHHA), the California regulatory agency that addresses chemical risks associated with fish and shellfish consumption on a statewide level, guidance from USEPA (1993) suggests that an FI value less than 1 can be assumed:

> "*In some cases, it may be appropriate to determine the fractional intake of exposure that occurs at a site. The fractional intake, which is the proportion of all exposure of a given type (e.g., the fraction of all fish consumed) that comes from the site, is generally estimated based on best professional judgment of factors such as the site size and accessibility and any restrictions on site use (e.g., warning signs, fishing bans, or barriers to the site.*"

In conclusion, CRWQCB provides no evidence supporting its conclusion that site COCs in fish and shellfish caught at the Site or off-site originate entirely from Site sediments. An FI value of 1, used by the CRWQCB in the HHRA (CRWQCB, 2010) for estimating the exposure of anglers to chemicals in Site fish and shellfish is not supported by applicable agency guidance or scientific evidence.

2.3 Risks Associated With Reference Conditions

On page 28-1 of CRWQCB (2010), CRWQCB states: "*the Shipyard Sediment Site poses a greater cancer and non-cancer risk to recreational and subsistence anglers than the risks posed at reference conditions in San Diego Bay.*" According to the HHRA performed by CRWQCB (2010, Appendix for Finding 28), risk to anglers from fish and shellfish consumption are unacceptable for reference conditions identified for San Diego Bay by CRWQCB (2010). At reference sites selected by CRWQCB (2010), the CRWQCB HHRA found Hazard indices (HIs) are greater than one (indicating potential risk) for mercury (HI = 3.68) and PCBs (HI = 64) and for sand bass consumption by subsistence anglers. HI values for copper (HI = 4.1), mercury (HI = 2.0), and PCBs (HI = 4.7) for lobster consumption by subsistence anglers also indicate potential risk. Cancer risk is greater than the range of acceptable cancer risk (1.1×10^{-6} to 1.1×10^{-4}) for PCBs (risk = 1.1×10^{-3}) for sand bass consumption by subsistence anglers.

Neither the risk management nor remedial goal determinations of CRWQCB (2010) clearly communicate the unacceptable levels of background or reference condition risks for human anglers consuming San Diego Bay fish and shellfish. As stated in USEPA (2002): "Risk Characterization should include a discussion of elevated background concentrations of COPCs and the contribution to site risks".

Additionally, CRWQCB (2010) does not evaluate how the targeted risk levels (HI of 1 and cancer risks of 1.1×10^{-6} to 1.1×10^{-4}) for remedial footprint derivation will be met considering the high levels of unacceptable reference condition risks in San Diego Bay. Additionally, concentrations of chemicals in sediment at reference areas are low, yet concentrations in fish and shellfish indicate potential risks. The CRWQCB has not provided evidence to explain the contribution of sediment-related and non-sediment related chemical sources to San Diego fish and shellfish. In failing to address the above issues, CRWQCB (2010) does not establish a causal link between chemicals in Site sediment and hypothetical human health risk potential, and does not establish the efficacy of the proposed sediment management activities in reducing the hypothetical human health risk potential to below levels of concern.

3 Conclusion

The HHRA performed for the Site by CRWQCB (2010) represents a purely hypothetical exercise not supported by Site-specific information or scientific evidence, and is critically flawed for the following reasons:

- **There is currently no exposure, and thus no risk, to Site chemicals via the consumption of Site fish or shellfish**. There is no evidence of angling activity at the Site, and such activity is prohibited by current Site security measures. Available evidence indicates that chemicals are not migrating from the Site in sufficient amounts to warrant concerns of human health risk. Available studies on the migration ecology of fish and shellfish indicate that fish and shellfish are unlikely to migrate to the nearest area accessible to San Diego Bay anglers.
- **The current HHRA cannot be used to predict risk for a hypothetical future scenario in which Site access to anglers is granted**. Considering the dynamic nature of anthropogenic and natural physical processes at the Site and recent source control measures implemented by BAE and NASSCO shipyards, it is reasonable to conclude that concentrations of chemicals in sediment may be decreasing and may continue to decrease during the 23 or more years remaining in the current BAE and NASSCO subleases. Assuming a quantitative relationship between chemicals in Site sediment and chemicals in Site biota, the concentrations of chemicals in fish and shellfish, as measured in 2001-2002 and used in the current CRWQCB HHRA, cannot be expected to equate with values in 2034 and/or 2040.
- **The CRWQCB HHRA assumption regarding Fractional Intake is untenable**. Given the lack of current angling at the Site and unlikely migration of fish and shellfish to nearest area of angling activity, the assumption that 100% of an angler's fish and shellfish diet originates from the Site is untenable and results in an overestimation of potential human health risk.
- **Unacceptable levels of risks due to reference or background conditions are not incorporated in the CRWQCB HHRA**. In failing to address the issues regarding the contribution of background chemicals to Site fish and shellfish, CRWQCB (2010) does not establish a causal link between chemicals in Site sediment and hypothetical human health risk potential, and does not establish the efficacy of the proposed sediment management activities in reducing the hypothetical human health risk potential to below levels of concern.

In conclusion, the CRWQCB (2010) determination of Human Health BUI is speculative and lacks scientific foundation. There is no evidence to support a conclusion that Site-derived chemicals impair Commercial and Sport Fishing and Shellfish Harvesting Beneficial Uses in San Diego Bay. Because there is no evidence of a Human Health BUI, consideration of Human Health Beneficial Uses should be withdrawn from Site decision-making algorithms (e.g., SWAC-based assessments of Findings 32-33 in CRWQCB (2010)) used to identify areas for potential remedial action. Aquatic dependent wildlife BUI considerations should also be withdrawn by CRWQCB, because there is a lack evidence for wildlife risk at the Site (Exponent, 2003). The

Site remedial footprint should only focus on addressing Aquatic Life BUI because scientific evidence most-strongly supports the presence of Aquatic Life BUI among the BUIs investigated at the Site by CRWQCB (2010). Portions of the Site identified in Figure 3 of Conder (2011; where Toxic Unit > 1) represent areas that could be used to delineate a remedy footprint to address Aquatic Life BUI.

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Appendix A

Career Vitae for Jason Conder

Jason M. Conder, PhD

EDUCATION

2004	PhD, Environmental Science, University of North Texas (UNT)
2000	MS, Zoology, Oklahoma State University (OSU)
1997	BS, Wildlife and Fisheries Ecology, OSU

EXPERIENCE

Dr. Jason M. Conder is a Manager in the Ecological/Sediment Practice at ENVIRON. He has over 10 years research and consulting experience in environmental toxicology, ecological risk assessment, bioaccumulation and bioavailability of environmental contaminants, environmental chemistry, environmental monitoring technology, wildlife ecology and management, plant and animal taxonomy, and statistics. Project-related experience includes the assessment of ecotoxicity, bioaccumulation, and bioavailability of organic compounds and metals to aquatic and terrestrial invertebrates, plants, mammals, reptiles, and fish exposed to contaminated soils, sediments, and water. A key focus of his expertise is contaminant bioavailability. Jason has extensive experience with the measurement and interpretation of environmental contaminants in soil, sediment, water, and biological tissues, including innovative methods to predict contaminant bioavailability and toxicity.

Jason has published over 20 peer-reviewed articles in the primary scientific literature in environmental toxicology and chemistry, including several book chapters on contaminant bioavailability and sediment quality assessment. He serves as a peer reviewer for scientific journals, including: Environmental Toxicology and Chemistry, Integrated Environmental Assessment and Management, Chemosphere, Archives of Environmental Contamination and Toxicology, and Journal of Soils and Sediments.

Since joining ENVIRON in 2004, Jason has led ecological risk assessments, ecological/biological investigations, ecotoxicological studies, environmental fate and transport studies, and human health risk assessments. Representative experience includes:

- Fish Bioaccumulation Assessment, Metropolitan Council, Upper Mississippi River, MN. Evaluated bioaccumulation of PFOS in benthic and pelagic fish from water column and sediment PFOS sources. Investigated chemical fate and source issues relevant to exposure of fish to PFOS.
- Ecological Risk Assessment, Private Client, Augusta Bay, Sicily. Prepared an Ecological Risk Assessment and Sediment Quality Triad Evaluation for an industrial pier impacted with a variety of organics and metals, including mercury, methylmercury, and PAHs. Managed a team of 3 ecotoxicologists in providing a full assessment using various lines of evidence, including habitat information and chemical measurements in sediment, sediment porewater, fish, mussels, and benthic invertebrates. Key components of the assessment included food chain and bioavailability modeling and risk assessment to evaluate risks to invertebrates, fish, and piscivorous birds. Geospatial modeling was also conducted to identify areas of Augusta Bay that are associated with potentially-elevated chemical exposures.
- Contaminated Sediment Risk and Chemical Fate and Transport Evaluation, San Diego Gas & Electric (Subsidiary of Sempra Energy), San Diego Bay, CA. Evaluation of human health and ecological risks, sediment cleanup values, remedial strategies, sediment hydrodynamics, chemical fate and transport, remedial cost allocation, and chemical sources and uses in San Diego Bay. Served as project manager and technical advisor in proceedings with the California Regional Water Quality Control Board (CRWQCB) and other parties named in the CRWQCB's Cleanup and Abatement Order.

- Monitored Natural Recovery (MNR) Guidance, United States Department of Defense (DoD). Technical advisor on a resource document used to guide DoD remedial project managers on the evaluation and application of MNR for contaminated sediment.
- Evaluation of Water Quality Impacts from Terrestrial Burn Dump, Private Client, San Francisco Bay, CA. With hydrogeologists, evaluated the ecological and human risks associated with the hypothetical transport of metals and organic chemicals to San Francisco Bay via ground water flow from a former burn dump site located 0.25 miles upland of the Bay. With considerations of appropriate aquatic life screening values and sediment geochemistry conditions, the evaluation demonstrated insignificant risk associated with the site.
- Quantico Bay Thin-Layer Cap Demonstration Project, United States Department of Defense (DoD). Led evaluation of a Thin-Layer Cap remediation project for 14-acres of sediments impacted with chlorinated pesticides (DDT, DDD, and DDE). The 5-year study is evaluating a variety of endpoints involving chemical fate and transport, chemical bioavailability measurements via *in situ* organism deployment and SPME measurements, cap physical stability, and degree of ecological risk reduction. Responsibilities included project management, coordination of field work, and interpretation and presentation of results.
- Ecotoxicological Data Review, The Dow Chemical Company, Saginaw River and Bay Watershed, MI. Review and synthesis of 30+ years of environmental data to support the avian and aquatic ecological risk assessment of dioxins and furans present in the Tittabawassee River, Saginaw River, and Saginaw Bay.
- Contaminated Sediment Management Decision-making Framework, The Dow Chemical Company. Led the development of a decision-making framework for evaluating the cause-effect relationships between chemically-impacted sediments and 16 different Beneficial Use Impairments identified by the State of Michigan. Using a tiered approach, frameworks begin with simple and resource-efficient screening steps using sediment quality guidelines and ecological benchmarks, then proceeds to considerations of more site-specific factors and determinations of probable linkages between sediments and specific Beneficial Use Impairments. Higher tiers in the frameworks utilize more advanced, but scientifically rigorous and agency-accepted approaches utilizing tools such as chemical fate and transport modeling, risk assessment, and Sediment Quality Triad, complete with decision rules for the interpretation of results with respect to resource impairment. The frameworks place screening and investigative tools in the proper context and facilitate a more efficient characterization of natural resources suspected to be affected by chemically-impacted sediment.
- Ecological Risk Assessment, Honeywell, NY/NJ Estuary System, Jersey City, NJ. Avian and aquatic ecological risk assessment of 66-acre area offshore of a former chromium ore processing facility. In addition to evaluation of chemicals in sediment, pore water, and surface water and wildlife species and habitat at the Site, responsibilities included TrophicTrace modeling to predict chemical bioaccumulation in avian and human food chains and application of the Sediment Quality Triad (SQT), a line-of-evidence approach that integrates chemistry data, laboratory toxicity results, and benthic community surveys to understand ecological risk. Using the SQT with equilibrium partitioning modeling to quantify risks, revealed that benthic community impacts and sediment toxicity were associated with widespread background PAH contamination in the local estuary, not site-related chromium releases. Key work also included evaluation of the effectiveness and risks associated with application of 11 sediment remedial alternatives, highlighting the ability of cost-effective remedies to reduce risk to ecological and human receptors.

- Sediment Monitoring Guidance and Web Portal, US Navy Space and Naval Warfare Systems Center, San Diego, CA. Prepared a guidance document and online web portal/database (http://www.ISRAP.org) of monitoring needs and tools associated with sediment remediation (dredging, capping, and monitored natural recovery). The guidance and online web portal assists Navy remedial project managers in developing efficient and effective monitoring plans and includes a decision-making framework to aid in selecting effective monitoring tools to assess all phases of remediation, including short-term monitoring (construction and remedial design performance) and long-term monitoring (ecological and human health risk).
- Landscape-level Ecological Risk Assessment, ICF Consulting/US Department of Energy, Bakersfield, CA. Developed a unique landscape-level approach for performing a California Department of Toxic Substances Control (DTSC) Part B Scoping Ecological Risk Assessment at a 75-square mile petroleum reserve located in southern California. The novel approach used landscape ecology and population indices to discern potential effects of active and historical petroleum exploration and production activities on the habitat and populations of endangered species and other sensitive receptors. The first step in this assessment included the site-wide investigation of the spatial co-occurrence of soil contamination and ecological receptors, as predicted by landscape-level models integrating historical ecological monitoring data, topography, and soil type.
- Ecological Risk Assessment, Private Client, CA. Conducted a DTSC Part B Scoping Ecological Risk Assessment for a former 996-acre munitions, explosives, and solid rocket fuel manufacturing facility located in southern California. Project responsibilities included the compilation of generic ecological risk-based soil screening benchmarks, preparation of a technical brief on the ecotoxicity of perchlorate, and development of a site-specific ecological risk-based soil screening level for perchlorate.
- Ecological Risk Assessment, Private Client, CA. Prepared a DTSC Part B Scoping and Phase I Predictive Ecological Risk Assessment for a 429-acre site in southern California at which explosives, solid rocket motor fuel, cryogenics, petroleum hydrocarbons, hypergolic fuels, and solvents were used. Project responsibilities have included the compilation of generic ecological risk-based soil screening benchmarks, field inspection of the Site, interpretation of biological survey information for development of the conceptual site model, food chain modeling to predict chemical bioaccumulation, and ecological risk calculations, including estimation of inhalation risks to burrowing mammals and development of toxicity reference values. Through interpretation of historical site use and the spatial pattern of chemical impacts and projected future land uses, narrowed the focus of the assessment to an undeveloped riparian area comprising approximately 5-10% of the site, enabling a more efficient and realistic approach to characterizing long-term ecological risk.
- Human Health Risk Assessment for Perchlorate Associated with Homegrown Produce, Private Client, CA. Designed and managed a laboratory plant-uptake study to determine bioconcentration factors for perchlorate accumulation by garden crops from perchlorate-impacted soils at a site in southern California. Results from the three-species study were used to generate site-specific, risk-based perchlorate concentrations associated with the consumption of homegrown garden produce by future residents. Responsibilities included experimental design and management, collection of site soils, and analysis and interpretation of data. Risk-based concentrations estimated with site-specific data developed in this study were approximately 100-fold higher than concentrations estimated using data from previous studies, which were shown to be unrealistic and overly conservative.
- Food-chain Modeling of Perfluorinated Compounds, E.I. du Pont de Nemours and Company (DuPont), Canadian Arctic. With a multi-disciplinary team of environmental chemists, engineers,

and risk assessors, assessed of the global fate and transport of perfluorinated carboxylic acids (PFCAs) to the Canadian Arctic. As lead technical advisor in ecotoxicology, responsibilities included development of a 5-tier food chain bioaccumulation model. The model integrated biological receptor life history and behavior, toxicokinetics of PFCAs, and environmental fate and transport processes in the Arctic Ocean to predict concentrations of PFCAs in polar bear liver tissue. Key challenges of the project included developing a model that did not rely on octanol-water partition coefficients (KOW values). Model development included Monte Carlo analysis to account for uncertainty and variability associated with model parameters and predictions.

- Critical Review of the Bioaccumulative Potential of Perfluorinated Compounds, E.I. du Pont de Nemours and Company (DuPont). Performed a survey of environmental monitoring and laboratory data on the bioaccumulation, bioconcentration, and biomagnification of perfluorinated carboxylic acids (PFCAs) and perfluorinated sulfonates (PFASs). Results were synthesized in a scientific manuscript submitted to a peer-reviewed scientific journal (Environmental Science & Technology) that summarized the bioaccumulative potential of these compounds according to guidance from current US and European chemical regulatory frameworks.

PROFESSIONAL AFFILIATIONS & ACTIVITIES

Member, Society of Environmental Toxicology and Chemistry (1997-Present)

Member, American Chemical Society (2005-Present)

PUBLICATIONS & PRESENTATIONS

Publications

Conder, J.M., Gobas, F.A.P.C., Borgå, K., Muir, D.C.G., Powell, D.E. In press. Characterizing bioaccumulative potential of chemicals using trophic magnification factors and related measures. Integr. Environ. Assess. Manag. 0:000-000.

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Sorensen, M.T., Conder, J.M., Fuchsman, P.C., Martello, L.B., Wenning, R.J. 2007. Using a Sediment Quality Triad approach to evaluate benthic toxicity in the lower Hackensack River, New Jersey. *Arch. Environ. Contam. Toxicol.* 53:36-49.

Bowen, A.B., Conder, J.M., La Point, T.W. 2006. Solid phase microextraction of aminodinitrotoluenes in tissue. *Chemosphere* 63:58-63.

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Lanno, R., Wells, J., Conder, J., Bradham, K., Basta, N. 2004. The bioavailability of chemicals in soil for earthworms. *Ecotox. Environ. Saf.* 57:39-47.

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Conder, J.M., Lanno, R.P. 2003. Lethal critical body residues as measures of Cd, Pb, and Zn bioavailability and toxicity in the earthworm *Eisenia fetida*. *J. Soils and Sediments* 3:13-20.

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Conder, J.M., Wenning, R., Achour, F., Wells, J., Colombo, F. 2011. Spatially-explicit Bioaccumulation Model of Mercury in Benthic Fish (Platform). Battelle Sixth International Conference on Remediation of Contaminated Sediments, New Orleans, LA, February, 2011.

Conder, J.M., Sower, G.S. 2010. Importance of Sediment-Associated PFOS to Aquatic Food Web Biomagnification (Poster). Society of Environmental Toxicology and Chemistry (SETAC) North America Annual Meeting, Portland, OR, November 2010.

Conder, J.M., Gobas, F.A.P.C., Borgå, K., Muir, D.C.G., Powell, D.E. 2010. Use of Trophic Magnification Factors to Characterize Bioaccumulative Potential (Platform). Society of Environmental Toxicology and Chemistry (SETAC) North America Annual Meeting, Portland, OR, November 2010.

Borgå, K., Kidd, K., Beglund, O., Conder, J.M., Gobas, F.A.P.C., Kucklick, J., Malm, O., Powell., D.E., Muir, D.C.G. 2010. Trophic Magnification Factors: Impact of Ecology, Ecosystem and Study Design (Platform). Society of Environmental Toxicology and Chemistry (SETAC) North America Annual Meeting, Portland, OR, November 2010.

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McMeechan, M.M., Conder, J.M. 2010. Baseline Benthic Community Characterization in Advance of Thin-layer Placement at Quantico Embayment, Virginia, USA (Poster). Society of Environmental Toxicology and Chemistry (SETAC) North America Annual Meeting, Portland, OR, November 2010.

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Conder, J.M., Klepper, G., Martello, L.B., Fuchsman, P., Daniel, J., McCullough, M., Wenning, R.J. Use impairment decision-making approach for assessment of sediments. Society of Environmental Toxicology and Chemistry (SETAC) North America Annual Meeting, Milwaukee, WI, November 2007.

Conder, J.M., Hoke, R.A., Russell, M.H., Buck, R.C., de Wolf, W. The Bioaccumulation Potential of PFCAs and Comparison with Persistent Lipophilic Compounds. Society of Environmental Toxicology and Chemistry (SETAC) North America Annual Meeting, Milwaukee, WI, November 2007.

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Conder, J.M., Haroun, L., Scofield, R. Uptake of perchlorate by garden crops in perchlorate-impacted soil: Implications for risk assessment. 16th Annual Association for Environmental Health and Sciences (AEHS) Meeting and West Coast Conference, San Diego, CA, March 2006.

Conder, J.M., Haroun, L., Lockwood, R.E., Roberts, S., Scofield, R., Hall, S., Horsley, T. 2006. Uptake of perchlorate by garden crops from a perchlorate-impacted soil and risk via produce consumption. Perchlorate: Progress Toward Understanding and Cleanup, Groundwater Resources Association of California, Santa Clara, CA, January, 2006.

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Conder, J.M., Lotufo, G.L. 2005. Ecological fate and effects of explosives and related compounds. SETAC North America Annual Meeting, Baltimore, MD, November 2005.

Russell, M.H., Korzeniowski, S.H., Gannon, J.T., Buck, R.C., Rickard, R.W., Washburn, S.T., Keinath, M., Yarwood, G., Wenning, R.J., Conder, J.M. 2005. Development of a global exposure model for DuPont fluorotelomer-based products. FLUOROS: International Symposium on Fluorinated Alkyl Organics in the Environment, Toronto, Canada, August, 2005.

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Bowen, A.T., Conder, J.M., La Point, T.W. 2004. Solid phase microextraction of ADNTs in tissue. SETAC World Congress, November 2004.

Conder, J.M., Bowen, A.T. 2003. Bioconcentration and metabolism of TNT in an aquatic oligochaete. SETAC North America Annual Meeting, November 2003.

Conder, J.M., La Point, T.W. 2003. SPMEs: Matrix-independent measures of toxicity and bioavailability for TNT and nitroaromatics. SETAC North America Annual Meeting, November 2003.

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Conder, J.M., Lanno, R.P. 1999. Critical body residues for heavy metals in the earthworm *Eisenia fetida*. SETAC North America Annual Meeting, November 1999.

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Jason M. Conder, PhD

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