



[A comprehensive guide to peer-reviewed published articles on the safety and efficacy of Lanthanum Modified Bentonite \(Phoslock®\)](#)

There are over 150 peer-reviewed publications on Phoslock® that specifically address its effectiveness, how long it lasts, and its impact on non-target organisms. Several standard ecotoxicity studies have been conducted on fish, water column invertebrates, and benthic invertebrates, all of which support the positive environmental impact and indicate no expected toxicity concerns at typical and recommended usage rates. The State of Washington Department of Ecology has independently reviewed Phoslock® and supports its use in the state with essentially no restrictions. Phoslock® has been used globally for many years to reduce phosphorus in waterbodies and can be combined with other lake management strategies to achieve desired outcomes. Hundreds of lakes worldwide have been treated with Phoslock®, and both large and small waterbodies in the United States use it on an annual basis.

Phoslock® applications generally have not required state or federal permitting across the United States. Statewide in California, there has not been a requirement to permit, but the San Diego Regional Water Board has developed a permit (CRWQCBSDR 2021). No SEIS, NEPA assessments have been required historically to implement these projects.

[Phoslock® Environmental Information](#)

Lanthanum, a naturally occurring earth element, was found to have an average background level of 20.3 mg La/kg in soil samples collected throughout California, as per a soil study conducted by the University of California (Bradford et al. 1996). It is essential to comprehensively evaluate and manage potential environmental impacts associated with the use of a product. When Phoslock® is applied to water, lanthanum, in association with the clay, swiftly binds with phosphate (PO_4) to form a highly stable mineral known as rhabdophane (LaPO_4). This resulting rhabdophane complex exhibits very low solubility ($K_{sp} < 10^{-27}$) and remains unaffected by changes in pH and redox reactions in waterbody sediments, making it non-bio-available. Lanthanum can only be extracted from rhabdophane in the laboratory using strong acid extraction methods. Laboratory studies with Phoslock® reveal that a minimal amount of lanthanum (~0.1%) is released within 24 hours when granular Phoslock® (250 mg/L) is dissolved in nano-pure water (unpublished). Studies on various animals and plant species have shown that lanthanum toxicity is generally very low. There are generally 2-5 orders of magnitude difference between application rate and toxicity. Field applications in the United States and internationally have not resulted in any observed fish mortality or adverse impacts. Data from different fish species indicate minimal risk to fish when Phoslock® is used at standard dose rates in aquatic environments. For example, a study on rainbow trout showed a 96-hour LC_{50} value of greater than 3,125 mg/L, and a 48-hour LC_{50} value of greater than 13,000 mg/L. Tests on zooplankton and daphnids also yielded high LC_{50} values, indicating low toxicity. Studies on benthic invertebrates showed no significant impacts or toxicity at or above anticipated use rates for Phoslock®. LOECs were calculated for each of these tests, and

produced a range of LOEC values from 400 mg/L to 50,000 mg/L. In addition, no field toxicity has been observed in invertebrate species. Overall, the margin of safety associated with Phoslock® toxicity is very high.

The presence of lanthanum in water after a Phoslock® application poses very low potential exposure for humans due to its minimal bio-availability. Phoslock® and the associated lanthanum settle quickly to the lake sediments. Even in the event of exposure, lanthanum is efficiently processed by the liver and excreted without any observed negative impacts. Lanthanum is also used in a prescription drug called Fosrenol® to decrease blood phosphate levels in humans, with a Food and Drug Administration approved human dose rate of 750 to 3,000 mg/day. It would require a person to drink hundreds of gallons of water during application to receive a dose of lanthanum comparable to the daily intake of Fosrenol®. Additionally, drinking Phoslock® treated water directly after an application would pose negligible risk to human health. Furthermore, the risk of consuming Phoslock®/lanthanum in fish harvested from treated water after application is negligible, as evidenced by a field study. It was found that fish accumulate low levels of lanthanum only in liver and hepatopancreas tissues, not in the consumable flesh/muscles, and concentrations of lanthanum return to baseline levels within a few months (Landman et al. 2007).

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[Historically Published papers on Phoslock®](#)

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