



Executive Summary

April 2, 2018 DEQ Memorandum to BSB Chief Executive Dave Palmer regarding "More Consideration and Evaluation of Alternatives" for Dioxin Remediation at Montana Pole

In October, Butte-Silver Bow Chief Executive Dave Palmer sent DEQ a comment letter requesting, among other things, that DEQ "validate, explain and communicate to the public (why) dioxin cannot be 're-treated' and remediated to meet acceptable standards..."

DEQ is committed to addressing the concerns of the City and County of Butte-Silver Bow and its residents regarding dioxins and the treatment plan at Montana Pole. In response, DEQ prepared a four-part, in-depth report, which was provided to Chief Executive Palmer and the Butte-Silver Bow Council of Commissioners earlier this month.

The limitations and challenges found in screening and selecting dioxin technologies used at wood-treating sites such as Montana Pole are presented in four sections:

1. Initial Alternative Screening Document for a Wood-Treating Waste Site in Montana

A helpful start to understanding the current state of dioxin remediation is to examine a recently developed Initial Alternative Screening Document (IASD) for a similar wood-treating waste site in Montana. The S&W Sawmill Site in Darby is being remediated under the State Superfund program for soil and groundwater contaminated by wood-treating waste – a mix of pentachlorophenol (PCP), petroleum constituents and dioxins like that found at Montana Pole.

The IASD is part of the Superfund remedial investigation/feasibility study (RI/FS) process. Its purpose is to develop a comprehensive list of potential treatment and disposal technologies for a given site, and then to screen them based on effectiveness, implementability and relative cost. The result is a reduced list of alternatives that will be retained for a more detailed screening prior to the final comprehensive analysis that is performed in the Feasibility Study. The IASD for S&W was completed in September 2017.

The IASD for the S&W Sawmill screened 42 potential treatment technologies for soil remediation.

In order to meet cleanup levels, the majority of these soil treatment technologies would need to be used in combination with other technologies on the list.

Only two technologies were identified as effective enough to be stand-alone treatments: incineration and off-site disposal.

(Note: At Montana Pole, the Record of Decision (ROD) identified above-ground biological treatment as the remedy for all accessible contaminated soils. On-site incineration was also considered, but ruled out due to cost (\$72-101 million per 1993 estimate) and community opposition. The volume of contaminated soil (in excess of 200,000 cubic yards) doesn't make off-site incineration/disposal at a licensed facility (nearest facility is in southern Utah) feasible.

2. Feasibility Study for a Wood-Treating Waste Site in Montana

The second section of DEQ's report to BSB is the 2015 Feasibility Study for the White Pine Sash Site in Missoula, a historic wood-treatment site also contaminated by wood-treating waste that includes PCP and dioxins.

In this example, we see the final step in the Remedial Investigation/Feasibility Study (RI/FS) process. The FS is a detailed evaluation of remediation technologies identified in the screening process that started with an IASD.

The White Pine Sash FS represents the current technology selection process for remediation of wood-treating wastes. The FS examined:

1. No action (Serves as a baseline and is included in all feasibility studies)
2. Excavation and offsite disposal
3. Excavation and onsite ex-situ treatment (enhanced bioremediation, chemical oxidation, incineration)
4. Excavation and onsite spreading
5. In-situ treatment (enhanced bioremediation, chemical oxidation, soil flushing, soil vapor extraction)
6. Containment

The FS findings included, among other things:

- While enhanced bioremediation and chemical oxidation are effective for PCP and petroleum hydrocarbons, they are either limited or have uncertain effectiveness for dioxins. (At the Montana Pole Site, bioremediation removed 95 percent of PCP and associated hydrocarbons from the soil.)
- On-site incineration comes with its own set of complications, including uncertainty with meeting cleanup levels and meeting Clean Air Act regulations. It is unlikely a permit for treatment, storage and disposal could be attained because of the White Pine Sash Site's proximity to a residential area, the FS found.
- The effectiveness of chemical oxidation for dioxins is limited and soil flushing carries the risk of moving contaminants into uncontaminated areas.

The White Pine Sash FS also stated that soil-vapor extraction is not capable of remediating/reducing PCP or dioxins, but it may reduce the mobility of PCP and dioxins by removing the petroleum (carrier fluid) contamination.

Finally, the FS identified containment, or “capping” for more detailed analysis, finding that:

“Soil barriers, such as a horizontal cap, can be used to minimize exposure, prevent vertical infiltration of water and leachate, contain waste while treatment is being applied, control vapor and odor emissions, or to create a land surface that is suitable for the intended reuse of the property. Capping is the most common form of barrier remediation because it is generally less expensive than other technologies and may effectively manage the human health risk.”

As DEQ has previously stated, and as supported by the White Pine Sash FS, capping (also referred to as “containment,”) remains the preferred **final phase** alternative at most wood-treating waste sites because of the challenges and limitations with meeting dioxin contamination cleanup levels.

(Note: Capping is the final phase in the “treatment train” – meaning capping is appropriate only when dioxins or other contaminants remain above cleanup levels after other remediation technologies have been completed. Capping alone does not satisfy Superfund’s preference for reducing toxicity, mobility or volume through treatment.

3. Biological Remediation (Fungal-Based) for Wood-Treating Waste Sites

Bioremediation and specifically fungal-based remediation have been the center of much discussion around the remediation at Montana Pole. While fungal-based remediation using white rot fungi (WRF) has shown promising results in the laboratory, limited field studies have shown it to be less effective. There are three key reasons why WRF is still considered an emerging technology:

1. Extremely low dioxins cleanup levels, often below 1 part per billion or 1 microgram per kilogram (ug/kg) are hard to achieve
2. The successful dioxins treatment results produced in the laboratory are hard to reproduce because of the variable soil conditions found in the field.
3. The cultivation and delivery of WRF is expensive.

To elaborate on point No. 1, the recreational cleanup level for dioxins at Montana Pole is 200 parts per trillion (ppt) or 200 nanograms per kilogram (ng/kg). To put the scale of parts per trillion in perspective, one part per trillion is the equivalent of one second in nearly 32,000 years. Using this analogy, the Montana Pole recreational dioxin cleanup level is equivalent to 1 minute and 40 seconds in 32,000 years.

The relationship between cleanup level and the amount of contamination found in contaminated soils becomes crucial when considering the effectiveness of a cleanup technology. As an example, 30 dioxins

samples were taken for the treated soils in the 2007 off-load at Montana Pole. Dioxins concentrations in these samples ranges from 900 ng/kg to 9,100 ng/kg. Dioxin concentrations in this range would require a cleanup technology to remove 99 percent of the contamination to meet the Montana Pole recreational cleanup level of 200 ng/kg. Contaminant removal efficiencies greater than 90 percent are daunting, even for the most effective cleanup technologies.

4. National Corporate Inquiry for New Technologies at Wood-Treating Waste Sites

As part of DEQ's efforts to identify any possible new dioxin remediation technologies, the agency asked Tetra Tech, a company that performs remedial cleanups world-wide, to query its technology research group about dioxin cleanup methods other than containment/capping and incineration. Two responses in the memo from Tetra are noted:

1. Depending on dioxin concentrations and hazardous waste determinations, incineration or landfilling are typically used.
2. Incineration or landfilling are often used, but a project at the Vietnam Airport in Danang is using thermal desorption, in which soils are heated to extremely high temperatures to evaporate organic contaminants in the soil. Dioxins contaminated soils must be heated to over 600° Fahrenheit for thermal desorption to occur.

A few notes regarding thermal desorption: A quick search found that it costs about \$70 million to treat 200,000 cubic yards. Thermal desorption has the potential to be very effective at 96 percent removal and higher, which is still not a high enough rate to address all dioxin concentrations at Montana Pole. The technology has had isolated issues with air emissions containing dioxins at unacceptable levels.

Conclusion

Careful examination of a recent Initial Alternatives Screening Document (IASD) for a former wood-treating facility, S&W Sawmill in Darby, and a Feasibility Study for a former wood-treating facility, White Pine Sash in Missoula, demonstrates that dioxin remediation technologies continue to be limited.

An update on the status of bioremediation, specifically the use of white rot fungi (WRF), identifies the challenges faced in developing WRF as a remedial technology for dioxins.

Finally, Tetra Tech (a national company that performs environmental cleanups worldwide) was tasked to perform a query into remedial alternatives other than consolidation and capping after treatment of wood-treating waste and incineration. The query produced limited results aside from consolidation and capping or incineration.

DEQ is confident that it has thoroughly and carefully considered all available treatment alternatives for the Montana Pole Site, including bioremediation. In doing so, DEQ accomplishes the intent of the memo:

1. Validate, explain and communicate that dioxin cannot be "re-treated" and remediated any further to meet Montana Pole cleanup levels.

2. Validate, explain and communicate that containment (capping) will provide a protective solid barrier between buried, off-loaded/treated soils containing dioxin and the surface and its everyday users.



DEQ Statement

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In October, Butte-Silver Bow Chief Executive Dave Palmer sent DEQ a comment letter requesting, among other things, that DEQ "validate, explain and communicate to the public (why) dioxin cannot be 're-treated' and remediated to meet acceptable standards..."

DEQ understands the concerns of the City & County of Butte-Silver Bow and its residents about dioxins at Montana Pole. We took time to respond to Butte Silver-Bow's request, preparing a four-part, in-depth report, which was provided to Chief Executive Palmer and the Butte-Silver Bow Council of Commissioners earlier this month.

- The report examined a recent Initial Alternatives Screening Document (IASD) for a former wood-treating facility in Montana – the S&W Sawmill in Darby (2017). The report also examined a Feasibility Study for a former wood-treating facility – White Pine Sash in Missoula (2015). Both documents included extensive examination of cleanup alternatives for dioxins at former wood-treating facilities, and both documents showed that remediation technologies for dioxins continue to be limited.
- A detailed examination of the status of bioremediation, specifically the use of white rot fungi, identifies the challenges faced in developing white rot fungi as a remedial technology for dioxins, specifically:
 - Extremely low dioxins cleanup levels, often below 1 part per billion, are hard to achieve even through incineration, let alone white rot fungi bioremediation.
 - The successful dioxins treatment results produced in the laboratory are hard to reproduce because of the variable soil conditions found in the field.
 - The cultivation and delivery of white rot fungi is expensive, and its less-than-reliable performance under field conditions would most likely lead to required capping of the treated soils.
- Finally, DEQ asked Tetra Tech, a national company that performs environmental cleanups worldwide, to query its technology research group about remedial alternatives

other than consolidation and capping after treatment of wood treating wastes or incineration for dioxins. The query produced limited results aside from consolidation and capping or incineration. (Incineration also was considered in the ROD at Montana Pole, but ruled out due to cost - \$72 to 101 million per 1993 estimate - and community opposition.)

DEQ is confident that it has thoroughly and carefully considered all available treatment alternatives for the Montana Pole Site, including bioremediation.

DEQ is confident that capping will provide a protective solid barrier between buried soils containing dioxin and the surface and its everyday users.

A few notes on capping:

- The cap will break the exposure pathway, preventing human contact with contaminated soils.
- Long-term Institutional Controls for the cap, such as use restrictions and annual inspections, will be implemented to prevent damage to the cap. It is the cap itself that will prevent human exposure.
- It should be noted that capping is part of a “treatment train,” meaning it is being used only as a final step in what has been a complete cleanup process. The “treatment train” for contaminated soil at Montana Pole prescribed in the 1993 Record of Decision (ROD) called for excavation, above-ground biological treatment (Land Treatment Unit), backfill of excavated and treated soils into excavated areas, and surface grading and revegetation (containment). The Montana Pole ROD remedy for its wood-treating contaminated soils is very similar to recent soil remediation at wood-treating sites in Montana. It should also be noted that the bioremediation portion of the treatment train at Montana Pole successfully removed 95 percent (more than 266,000 pounds) of PCP from the soil. PCP was the toxin of greatest concern because of its toxicity and mobility (tendency to spread). Bioremediation reduced Levels of PCP and associated PAH at Montana Pole to below the cleanup level required in the 1993 Record of Decision for the Site. Because dioxins bind to soil in the absence of a carrier co-contaminant, such as PCP, the bioremediation made the dioxins less mobile, and thus better suited to capping.
- DEQ is committed to maintaining the cap long-term. Under the Superfund process, the cap must be evaluated every five years to ensure that it continues to protect human health and the environment. In addition, an operation and maintenance plan (O&M plan) for the cap would identify a regular inspection schedule. If the cap were damaged, it would be fixed per requirements that will be outlined in an O&M plan specific to the cap. Remember that risks are from long-term exposure.