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GE-Housatonic River Site Public Comments
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Comments re EPA's 2020 Proposed Revised Cleanup Plan.

EPA, on March 5, 2020, during its Public Information Session about the provisions of its Proposed Revised Cleanup Plan for the GE/Housatonic River site offered this slide:

EPA shared its renewed commitment "to identify opportunities to apply existing and potential future PCB treatment opportunities."

My name is Mickey Friedman and I am a founding Board member of the Housatonic River Initiative (HRI). After I left the Board, I have remained a member and was one of the principal authors of HRI's appeal to EPA's Environmental Appeals Board (EAB). I have steadfastly and continually made the case for the utilization of treatment for the PCB contaminated soil and sediment of the Housatonic in written comments to the EPA and GE since 1994. Unfortunately, because HRI failed to specifically mention thermal desorption in its comments on the 2014 Revised Corrective Measures study, EPA asked the EAB not to consider the fact that we raised the issues of EPA's failure to seriously consider the very successful use by USAID and the government of Vietnam of thermal desorption to remediate dioxin contaminated sediments and soils at the Danang airbase.

Because "in the 2020 Settlement Agreement, EPA has committed to significant steps to help solicit new research in PCB remediation technologies"[1] and because:
"Notwithstanding, the 2016 Permit contained a number of "Adaptive Management" principles, including the continued evaluation of innovative treatment technologies. EPA reiterated and augmented that commitment as part of the February 2020 Settlement Agreement to facilitate opportunities for research and testing of innovative treatment and other technologies and approaches for reducing PCB toxicity and/or concentrations in excavated soil and/or sediment before, during, or after disposal in a landfill. These opportunities may include: (1) reviewing recent and new research; (2) identifying opportunities to apply existing and potential future research resources to PCB treatment technologies, through EPA and/or other Federal research programs; and (3) encouraging solicitations for research opportunities for research institutions and/or small businesses to target relevant technologies. The research may focus on soil and sediment removed (or to be removed) from the Housatonic River or similar sites to ensure potential applicability to the permit/selected remedy. GE and EPA will continue to explore current and future technology developments and, where appropriate, will collaborate on on-site technology demonstration efforts and pilot studies, and, consistent with the adaptive management requirements in the Final Permit together, will consider the applicability of promising research at the Housatonic Rest of River site" [2], I am using this opportunity to make a case for implementing the principles of adaptive management and urging EPA, before it implements the provisions calling for an Upland Disposal Facility to take another, more comprehensive look at the potential effectiveness of thermal desorption for this site.

EPA makes the case in its 2020 Proposed Revised Cleanup Plan that EPA and GE have already done a "detailed evaluation" of thermal desorption but I believe that overstates the case and ignores the most recent evolution of the technology.

Let's take a closer look at the extent of the testing GE and EPA have done over the years on the potential efficacy of thermal desorption. One of the primary testing regimes EPA has relied upon is the Assessment of Contaminated Sediments (ARCS) Final Summary of August 1994. The ARCS program was limited to "testing only readily available technologies … In addition, recognizing that decision-makers addressing the cleanup of contaminated sediments in areas around the Great Lakes may not have significant resources, the ARCS Program also targeted the most cost-effective remediation technologies for evaluation."[3]

These conditions clearly do not apply to the GE/Housatonic River site where the responsible party is one of the world's most successful corporations and where negotiating the parameters of the Rest of River cleanup has already taken close to two decades.

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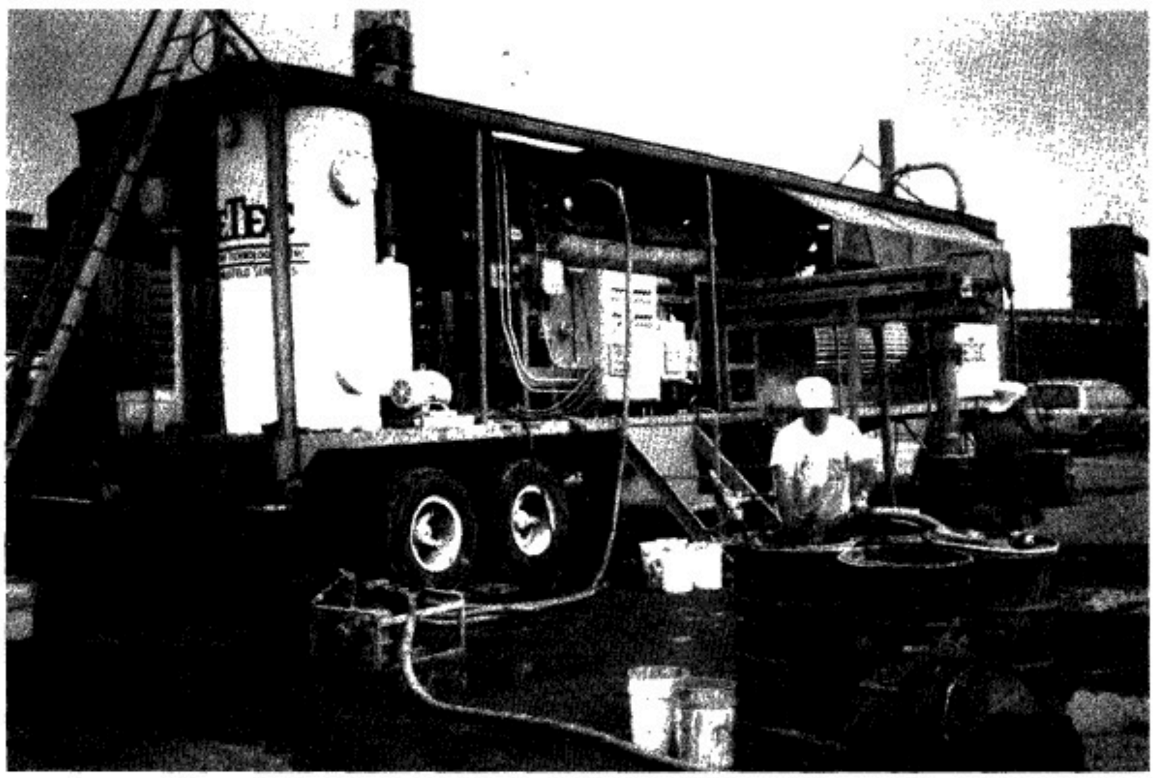
[1] https://semspub.epa.gov/work/01/647211.pdf
Statement of Basis for EPA's Proposed 2020 Revisions to the Remedial Action for the Housatonic River "Rest of River" Page 34.
[2] https://semspub.epa.gov/work/01/647211.pdf
Statement of Basis for EPA's Proposed 2020 Revisions to the Remedial Action for the Housatonic River "Rest of River" Page 32
[3] https://nepis.epa.gov/Exe/ZyPDF.cgi/50000O8U.PDF?Dockey=50000O8U.PDF
Assessment of Contaminated Sediments (ARCS) Final Summary August 1994 Page 29

According to the summary, nine technologies were subject to bench-scale tests using a few grams or kilograms of contaminated sediment. Pilot scale demonstrations involved testing on several thousand cubic yards of sediment from the Great Lakes Areas of Concern (AOCs): "Low temperature thermal desorption, which uses indirect heat to separate organic contaminants from contaminated sediments through volatilization was demonstrated on 12 cubic yards of sediment from the Buffalo River AOC. This technology consists primarily of a twin-screw heating element, which the sediments pass over and around to be heated. Hot, molten salt flows through the interior of the twin screws and heats the sediments to temperatures up to 500°F … Following the treatment demonstration, sediment samples were analyzed for PCBs, PAHs, and heavy metals to determine how effectively this process removes organic contaminants. The process removed more than 80 percent of the PAHs [4]

Figure 8A: Thermal desorption unit and screw processor



Thermal desorption unit at Buffalo River pilot demonstration site

ARC Pilot Scale Demonstration of Thermal Desorption for Treatment of Buffalo River Sediments, EPA 905-R93-005, December 1993 – Figure 8A
https://nepis.epa.gov/Exe/ZyPDF.cgi/2000FYFV.PDF?Dockey=2000FYFV.pdf

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[4] Assessment of Contaminated Sediments (ARCS) Final Summary August 1994, Page 31

"The same low temperature thermal desorption technology that was used in the Buffalo River demonstration was also used in on approximately 15 cubic yards of sediment in the Ashtabula River demonstration. This technology was repeated at the Ashtabula River AOC to test its capabilities for treating contaminants such as PCBs and other chlorinated hydrocarbons that were not present at the Buffalo River AOC … The process removed 86 percent of the PCBs, up to 99 percent of the semivolatile compounds, and more than 92 percent of the chlorinated volatile compounds … The cost of applying this technology is estimated to be similar to the costs developed during the Buffalo River demonstration – between $350 and $535 per cubic yard of sediment – not including the costs of dredging and storage of the material prior to treatment."[5]

By the time GE produced its 2007 Rest of River Corrective Measures Study Proposal[6], the company, in its initial screening of remedies, acknowledged the promise of Ex Situ Thermal Treatment and thermal desorption, in particular.

"Thermal destruction, another *ex situ* thermal treatment process, has been demonstrated on full-scale applications at sites with PCB-containing media (EPA, 1998a). Full-scale applications at Superfund sites generally exceeded 99.99% destruction for PCBs and produced off-gases and combustion residuals (ash), which required treatment (EPA, 2004a). Combustion residuals generated from on-site incineration would likely not be suitable as fill without the addition of amendments (i.e., organics), and as such would likely be disposed of in a landfill after pretreatment. Flue gases from incineration units need to be cooled quickly to minimize the possibility of organics like dioxins forming in the stack emissions. High moisture content and low thermal content (low BTU value) of sediments would require additional fuel for drying and sustaining the incineration process. Given its use at other sites and its potential applicability for stabilizing/treating sediments and/or soils removed from the Rest of River, *ex situ* thermal treatment was retained for the secondary screening."[7]

In its secondary screening, GE describes thermal desorption and notes those aspects of the process that might limit its usefulness as a remedy: "Heating is typically accomplished by indirectly fired rotary kilns, a series of externally heated distillation chambers, heated screw conveyors, or fluidized beds (EPA, 1991). The boiling points for PCBs generally range from 644 to 707 degrees Fahrenheit (°F); therefore, the thermal desorption treatment reaches temperatures greater than this range in order to effectively volatilize PCBs. Removed liquid PCBs would require treatment/disposal. Soils/sediments treated with temperatures greater than 600°F usually do not contain any free organic material, which makes them suitable for backfill. However, these treated solids may not be able to support microbial life, which may limit potential application."[8]

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[5] Assessment of Contaminated Sediments (ARCS) Final Summary August 1994, Page 34
[6] Rest of River Corrective Measures Study Proposal*,* General Electric Company, February 2007 http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.221.867&rep=rep1&type=pdf
[7] Rest of River Corrective Measures Study Proposal, 2007, Page 4-58
[8] Rest of River Corrective Measures Study Proposal, 2007, Page 4-58

So, while acknowledging its effectiveness, GE highlights the limitations of thermal desorption: "Thermal desorption would reduce the potential toxicity, mobility, and volume of PCBs in the removed solids via treatment and proper management and/or disposal of treatment residuals. Appropriate environmental and process controls (e.g., process treatment units) would be used during treatment. Depending on the final residual PCB concentrations, use of this process may allow more cost-effective disposal options. In addition, if the treatment process could achieve sufficiently low residual PCB concentrations and could accommodate sufficient quantities of sediment/soil to do so in a timely and cost-effective manner, reuse of the treated materials as backfill could also be considered. However, the treated solids usually do not contain any free organic material and thus may not support microbial life without amendment. This would limit potential applications of this process option and/or increase the cost for reuse of the treated solids."[9]

As for issues of implementability, GE notes: "Thermal desorption is generally considered to be an implementable process option for sediment and soil. While specialized equipment, materials, and operating personnel would be required, commercial vendors are available. Very wet sediments would require stabilization and/or dewatering before treatment. An additional step would be needed to destroy the removed chemicals, since thermal desorption extracts but typically does not destroy the target chemicals unless the system contains an afterburner (similar to an incineration unit) at the end of the process. This process option would require sufficient space to conduct the treatment and processing activities, which would require locating a suitable area and reaching an access agreement with the property owner. This could pose a challenge. Construction and operation of thermal treatment units at other sites have often been met with community resistance – e.g., at the New Bedford Harbor (MA) site (Davila et al., 1993, and EPA, 2005d)."[10]

Nevertheless, "Based on this evaluation, thermal desorption has been retained for further evaluation as a potential alternative for sediment and soil handling due to its reported use and effectiveness for other projects, its potential implementability, and its potential to reduce PCB concentrations and associated disposal costs."[11]

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[9] Rest of River Corrective Measures Study Proposal, 2007, Page 4-59
[10] Rest of River Corrective Measures Study Proposal, 2007, Page 4-59
[11] Rest of River Corrective Measures Study Proposal, 2007, Page 4-60

Finally, in section 5.2.3 Alternatives for Managing Removed Sediments/Soil, GE writes "For the sediment/riverbank remedial alternatives that involve removal of sediments or bank soils, there are a variety of available options for managing the removed materials. The sediment/soil management technologies and process options that were retained from the two-step screening process … will be combined in the CMS into comprehensive sediment/soil management alternatives for detailed evaluation. **Given some of the uncertainties associated with application of thermal desorption for Housatonic River sediments/soils, performance of treatability tests using sediments/soils from representative reaches of the Housatonic River may be warranted to evaluate the degree of effectiveness of the technology for this site and the reuse potential of the treated solids. GE is currently evaluating the need for a treatability study for this technology."**[12] (Emphasis added.)

In fact, GE performed only one full scale treatability study of an alternate remedial technology, the chemical extraction process of Soil Washing. GE explained its study in the 2010 Rest of River Revised Corrective Measures Study Report: "At EPA's request, a bench-scale study of chemical extraction was performed to more fully evaluate this alternative in the CMS. The BioGenesis[SM] Soil Washing process was selected as the representative chemical extraction treatment technology, and a bench-scale study of this process was conducted in accordance with a work plan approved by EPA on July 31, 2007. The study was conducted during October and November 2007 using sediments and floodplain soils from the Rest of River area. A detailed description of the bench-scale study and its findings is provided in the Bench-Scale Treatability Study Report included as Appendix O to this CMS Report."**[13]**

"BioGenesis performed jar tests and optimization tests on" a variety of coarse-grained and fine-grained and fine-grained soils with PCB concentrations ranging from 63 to 180 mg/kg. "In general, each material was tested three times using the optimized proportions of reagents and conditions determined from their respective jar tests … After the first treatment cycle, treated solids from the Solid/Liquid Separation step were recombined and processed two additional times and analyzed, and the mass balance calculations were repeated to evaluate the extent of any reductions in PCB concentrations associated with multiple processing cycles. Samples were collected before and after various steps of the process. Samples of wastewater were also collected following treatment activities. Samples were analyzed for PCB Aroclors and certain samples were also analyzed for PCB congeners and dioxins and furans. Samples were also collected and analyzed for grain size, TOC, TSS, and total dissolved solids (TDS) to provide additional information on the process."[14]

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[12] Rest of River Corrective Measures Study Proposal, 2007, Pages 5-30-31; 5-33
[13] Rest of River Revised Corrective Measures Study Report, 2010, Volume Two, Page 9-76 https://semspub.epa.gov/src/document/01/580275
[14] Rest of River Revised Corrective Measures Study Report, 2010, Volume Two, Pages 9-80, 81.

It was clear that the BioGenesis^{SM} Soil Washing process didn't sufficiently reduce the toxicity of the soil and sediment: "In the fine-grained sediment (TS-SED-B), initial concentrations ranged from 110 to 180mg/kg. The treated sediment was sampled in two grain size fractions. PCB concentrations in those treated sediments after the first treatment cycle were in the range of 16 to 21 mg/kg and 9 to 60 mg/kg … Somewhat lower concentrations were obtained after additional treatment cycles, with overall weighted average PCB concentrations after the third treatment cycle of 11 to 18 mg/kg …

"In the coarse-grained sediment (TS-SED-A), initial concentrations ranged from 63 to 80 mg/kg. The treated sediment was sampled in five grain size fractions. PCB concentrations in the treated sediments after the first treatment cycle were lower in the larger grain-size material (< 1 mg/kg to 2.8 mg/kg in the two largest grain-size fractions [> 425 microns]), intermediate in the intermediate grain-size fraction (~ 40 to 50 mg/kg), and highest in the two smallest grain-size fractions (55 to 143 mg/kg); and the overall weighted averages in the combined material ranged from 13 to 30 mg/kg. Lower concentrations were obtained after additional treatment cycles, with the overall weighted average PCB concentrations after the third treatment cycle ranging from 5 to 22 mg/kg."[15]

And so GE concluded: "the BioGenesis^{SM} process did not reduce the PCB concentrations in the site-specific materials to an extent that would allow on-site reuse of the material. In general, the process was able to reduce the weighted average PCB concentrations in the combined treated solids materials to concentrations that ranged from 7 to 48 mg/kg after one treatment cycle. However, the individual results from the various outputs, and particularly the smaller grain-size fractions for the coarse-grained sediment, did not achieve these relatively low concentrations at bench scale."[16]

The 2010 Rest of River Revised Corrective Measures Study Report went on to discuss thermal desorption in greater detail: a facility could be located on five acres of GE property, the former DeVos farm: "System components would either be constructed/installed in the fixed base thermal desorption unit or brought to the site in trailers that make up the transportable thermal desorption unit … For this evaluation, it has been assumed that, before going through the thermal desorption process, all hydraulically removed sediments would need to go through the following pretreatment steps: (1) screening of the dredged materials and separation of those materials according to size; (2) mechanical dewatering of the finer fraction using a plate and frame filter press; (3) mixing of the dewatered materials with dry material (e.g., sand, excavated floodplain soils, or thermally treated materials); and (4) pre-heating of the amended materials by the thermal desorption process exhaust to further reduce the moisture content below 18 to 20%. A similar approach would be used for mechanically dredged sediments except that these sediments would undergo gravity dewatering instead of mechanical dewatering. (The actual amount and type of the dry materials to be added to the dewatered and screened sediments would be determined during the design phase.) …

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[15] Rest of River Revised Corrective Measures Study Report, 2010, Volume Two, Pages 9-82.
[16] Rest of River Revised Corrective Measures Study Report, 2010, Volume Two, Page 9-83.

"The resulting drier homogeneous material would be fed to the indirectly fired thermal desorber, which has been assumed for purposes of this Revised CMS Report, to have an estimated capacity range of 10 to 40 tons per hour. As the sediments and soils are heated to temperatures up to 1,400°F in the thermal desorber, the PCBs would volatilize from the sediments or soils."[17] (Emphasis added.)

While GE assumes that treating the contaminated sediments and soils will lower its organic content making it unacceptable to be used as backfill in the river, it could be used "as landfill cover material or incorporation into asphalt (EPA, 2004a). The ability to implement either of these two options would be dependent on whether there is a need for such material at the time the remedial action is carried out."[18]

GE outlined several combinations of soil and sediment removal and subsequent treatment. Rest of River Revised Corrective Measures Study Report, 2010 estimates that **the time frame for utilizing thermal desorption "range from approximately 8 years based on SED 3 and FP 2 (the smallest-volume combination) to approximately 40 years based on SED 8 and FP 7."** (Emphasis added)

GE now catalogues reasons that might disqualify thermal desorption: "Historically, thermal desorption to treat materials containing PCBs at other sites has primarily been used on soils, with limited application on sediments, likely due in part to the increased time and costs to sufficiently dewater the sediments as a pretreatment step."[19]

GE cites projects at Sangamo Weston/Twelve-Mile Creek/Lake Hartwell site in Pickens, South Carolina where 40,000 cy of PCB-impacted soil was cleaned to level of 2 mg/kg (EPA, 2003); the Industrial Latex Site in Wallington, New Jersey where 53,685 cy of PCB-impacted soil was cleaned to an average PCB concentration of 1 mg/kg; the Re-Solve, Inc. site in North Dartmouth, Massachusetts, where 36,200 cy of PCB impacted soil were treated to a cleanup level of < 25 mg/kg using low-temperature thermal desorption; and Springvale, Victoria, Australia where 21,000 tons of PCB-impacted soil was treated to PCB concentrations of <0.1 mg/kg.[20]

Having outlined several combinations of varying amounts of soil and sediment to be removed and several varieties of subsequent treatment modalities, GE remarks on the "Overall Effectiveness and Reliability"_of thermal desorption:

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[17] Rest of River Revised Corrective Measures Study Report, 2010, Volume Two, Pages 9-108,109.
[18] Rest of River Revised Corrective Measures Study Report, 2010, Volume Two, Page 9-111.
[19] Rest of River Revised Corrective Measures Study Report, 2010, Volume Two, Page 9-115.
[20] Rest of River Revised Corrective Measures Study Report, 2010, Volume Two, Pages 9-115,16.

“Depending upon the sediment and soil alternatives selected, the duration of treatment could range from approximately 5 years (if SED 10 were selected) to approximately 52 years (if SED 8 were selected). **The longer the period of operation of the thermal desorption facility, the greater likelihood would exist for periodic equipment failures and downtime. Moreover, mechanical problems can result from treatment of high-organic, high-moisture-content, fine-grained materials, which can clump and clog equipment or otherwise be physically difficult to treat. These types of materials are present in parts of the River. Since no thermal treatment unit was identified as having been operated full scale at a PCB site over a period of more than 1.5 years, it is difficult to predict the reliability of the equipment in the longer term.**”[21] (Emphasis added)

GE notes thermal desorption “would reduce the toxicity of PCB-containing soil and sediment by permanently removing PCBs from these materials. In addition, the PCBs in the liquid stream sent to a permitted off-site disposal facility would be destroyed.”[22]

Re the critical aims of reducing mobility and volume: “TD 5 would reduce the mobility of PCBs present in the removed sediment and soil by permanently removing PCBs from these materials. The treatment process would transfer the PCBs into the off-gas and then into the liquid stream that would be sent to a permitted off-site facility for destruction … Treatment of removed sediment and soil in the indirect fired thermal desorption system would reduce the volume of PCB-containing material. Experience at other sites indicates that PCB concentrations on the order of 1 to 2 mg/kg in treated solids can be achieved using thermal desorption. Thermal desorption would also remove the naturally occurring organic matter present in the river sediment and floodplain soils, resulting in a slightly lower volume for the treated sediment/soil.” [23]

GE then calculates how thermal desorption would increase Greenhouse Gas Emissions: “estimates have been developed of the carbon footprint composed of GHG emissions anticipated to occur through construction and operation of a thermal desorption facility to treat removed sediments and soils … These estimates have been made for two scenarios: (1) assuming on-site reuse of 50% of the treated floodplain soils as backfill in the floodplain and off-site disposal of all other treated materials; and (2) assuming off-site disposal of all treated materials. For both scenarios, the estimates were based on the range of potential removal volumes requiring treatment – from the combination of sediment and floodplain alternatives with the lowest *in situ* volume (SED 3 and FP 2 – 191,000 cy) to the combination with the highest *in situ* volume (SED 8 and FP 7 – 2.9 million cy) …

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[21] Rest of River Revised Corrective Measures Study Report, 2010, Volume Two, Page 9-116.
[22] Rest of River Revised Corrective Measures Study Report, 2010, Volume Two, Pages 9-119, 20
[23] Rest of River Revised Corrective Measures Study Report, 2010, Volume Two, Page 9-120

"Based on this range of volumes, the total carbon footprint associated with TD 5 has been estimated to range from 66,000 tonnes (under both scenarios) to 1,000,000 tonnes (assuming 50% reuse of treated soils) or 1,100,000 tonnes (assuming no reuse of treated soils) of GHG emissions. Of this total, the GHG emissions associated with direct emission sources (primarily construction activities and transportation activities) range from approximately 55,000 tonnes (under both scenarios) to 860,000 tonnes (assuming reuse of treated soils) or 890,000 tonnes (assuming no reuse of treated soils). The GHG emissions associated with indirect emission sources (primarily power requirements for operating the thermal desorption treatment system) range from approximately 250 tonnes to 3,800 tonnes (under both scenarios). The GHG emissions calculated for off-site emissions (primarily refinement of diesel fuel, production (drilling) and distribution of natural gas for use in the thermal desorption treatment system, and manufacture of concrete used in construction of buildings to house thermal desorption system) range from approximately 11,000 tonnes (under both scenarios) to 160,000 tonnes (under both scenarios). The range of total GHG emissions estimated for this alternative is equivalent to the annual output of 12,600 to 210,300 passenger vehicles (assuming no reuse of treated soils)." [24]

When it comes to the issue of "Impacts on the Environment – Ecological Effects" **GE reminds us: "the longer the time required to implement this alternative, the greater potential would exist for failure of process and control equipment and a consequent release of PCBs, and metals and/or dioxin/furans (if formed during the process) into the atmosphere. Similarly, there would be a greater likelihood of spillage of the highly concentrated PCB containing liquids during accidents as these materials are being transported off-site for treatment/disposal."** [25] (Emphasis added.)

As for Reliability: "Thermal desorption has been shown to be reliable at other sites for projects involving relatively small volumes and short durations, as discussed in Section 9.5.5.2. **However, there is only limited precedent for implementation of thermal desorption for treatment of sediment. As previously noted, mechanical problems can arise as a result of the high-organic, high-moisture-content, fine-grained sediments, which tend to clump and can clog equipment or otherwise be physically difficult to treat. Moreover, the longer the operations period, the greater potential would exist for failure of process and control equipment, which could lead to the release of PCBs, metals, and/or dioxin/furans (if formed during the process) into the atmosphere, as well as incomplete treatment of the sediments/soils. There would also be a greater potential for spillage of the highly concentrated PCB-containing liquids during accidents as they are being transported off-site for treatment/disposal.**"[26] (Emphasis added.)

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[24] Rest of River Revised Corrective Measures Study Report, 2010, Volume Two, Pages 9-121,2
[25] Rest of River Revised Corrective Measures Study Report, 2010, Volume Two, Page 9-121
[26] Rest of River Revised Corrective Measures Study Report, 2010, Volume Two, Page 9-125

Then there's the issue of Cost: "The overall range of estimated total costs to implement TD 5 is $103 M to $1.53 billion (not including the cost of the sediment or floodplain removal alternatives). These costs include all labor, equipment, and materials necessary for the thermal treatment process as well as the associated post-treatment off-site disposal. Costs have been estimated for both scenarios: (1) assuming on-site reuse of 50% of the treated floodplain soils as backfill in the floodplain, and off-site disposal of remaining treated soils and all treated sediments; and (2) assuming off-site disposal of all treated materials … In all cases, the estimated costs assume that the treated solid materials to be transported off-site would be disposed of at a non-TSCA solid waste landfill, and that the liquid condensate would be transported to an appropriate TSCA incineration facility …

"The range of estimated capital costs associated with construction/set-up of the thermal desorption facility is $20 M to $232 M (depending on the size of the facility). Annual operations costs related to the thermal treatment facility over the course of the entire project range from $5 M to $16 M per year, depending on the volume of materials to be treated, resulting in total operations costs of $42 M to $642 M. The estimated total post-treatment disposal costs range from $36 M to $595 M, depending on the volume of material being disposed of and the method of disposition … For purposes of this Revised CMS Report, restoration and the associated monitoring and maintenance costs are assumed to consist of monitoring and maintenance of the restored area for a period of five years at $25,000 per year, resulting in a total cost of $125,000. The following summarizes the total costs estimated for TD 5."[27]

Table 9-7 – Cost Summary for Treatment/Disposition Alternatives

	TD 1	TD 2	TD 3	TD 4	TD 5 (with reuse)	TD 5 (w/o reuse)
Total Capital Costs	0	$6.5 – 20 M	$9.5 – 67 M	$17 – 20 M	$20 – 232 M	$20 – 232 M
Total Operations Cost	0	$6.8 – 25 M	$11 – 110 M	$32 – 365 M	$47 – 698 M	$47 – 698 M
Total Off-Site Disposal Costs	$55 – 832 M	$75 – 445 M	0	$40 – 614 M	$36 – 518 M	$39 – 595 M
Total Monitoring and Maintenance Costs	0	$12 – 20 M	$15 – 24 M	$0.125 M	$0.125 M	$0.125 M
Total Cost for Alternative	**$55 – 832 M**	**$100 – 510 M**	**$36 – 201 M**	**$89 – 999 M**	**$103 – 1,450 M**	**$106 – 1,530 M**
Total Present Worth	$40 – 220 M	$46 – 131 M	$17 – 49 M	$70 – 286 M	$81 – 569 M	$83 – 590 M

[27] Rest of River Revised Corrective Measures Study Report, 2010, Volume Two, Pages 9-126,7

Notes:
1. All costs are in 2010 dollars. $ M = Million dollars.
2. With the exception of TD 2, the ranges of costs presented are the minimum and maximum anticipated costs based on the potential range of volumes that would be potentially removed under the sediment and floodplain soil alternatives (191,000 cy to 2.9 M cy). For TD 2, the lowerbound costs are based on the combined volume of SED 6 and FP 2 and the upper-bound costs are based on the combined volume of SED 8 and FP 7, with material not placed in the CDF(s) assumed to be transported off-site for non-TSCA disposal. Thus, the upper-bound costs, but not the lower-bound costs, for TD 2 are comparable to the costs for the other alternatives.
3. Total Capital Costs are for engineering, labor, equipment, and materials associated with implementation.
4. Total Operations Costs consist of the total of the average annual costs for operation, placement, and/or treatment of sediments and/or soils, estimated for the range of durations for implementing the alternatives.
5. Total Monitoring and Maintenance Costs are for performance of post-closure monitoring and maintenance programs of 100 years for TD 2 and TD 3 and 5 years for TD 4 and TD 5.
6. Total Present Worth cost is based on using a discount factor of 7%, considering the range of total potential durations for the alternative, and post-closure monitoring and maintenance periods of 100 years for TD 2 and TD 3 and 5 years for TD 4 and TD 5.
7. For TD 5 with reuse, it is assumed that approximately 50% of the floodplain soils treated by thermal desorption would be reused on-site and that all remaining materials would be transported off-site for disposal.[28] (Emphasis added.)

GE summarizes: "For the reasons given above, it is concluded that TD 5 would provide overall protection of human health. With respect to environmental protection, it is concluded that if the treated soils are not used as backfill, TD 5 would provide overall protection of the environment, although the substantial carbon footprint of this alternative in terms of GHG emissions, particularly with the larger volumes, is of concern. **If 50% of the treated soils are used as backfill in the floodplain, TD 5 would not meet the standard of overall protection of the environment due to the adverse impacts resulting from the inability of those soils to match the characteristics of the existing soils in wetland areas, as well as due to the large carbon footprint from GHG emissions."**[29] (Emphasis added.)

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[28] Rest of River Revised Corrective Measures Study Report, 2010, Volume Two Page 9-153
[29] Rest of River Revised Corrective Measures Study Report, 2010, Volume Two, Pages 9-129,30

GE reminds us of the uncertainties of Thermal Desorption once more: "TD 5 (thermal desorption) would provide human health protection by reducing the PCB concentrations in the sediments and soils, followed by on-site reuse and/or off-site disposal of those treated materials and off-site disposal/destruction of the liquids containing the condensed PCBs. On-site reuse of a portion of the treated soils would be protective of health because the treated solids would be sufficiently characterized to ensure that they would not cause adverse human health effects. From an environmental perspective, TD 5 would provide protection of ecological receptors from potential exposure to PCBs for the same reasons discussed for human receptors. However, if a portion of the treated soils is reused as backfill in the floodplain, that reuse would result in long-term adverse environmental impacts in the forested floodplain and other wetland areas due to the differences in soil characteristics between those materials (even if amended with organic containing topsoil) and the existing natural soils in those wetland areas. In addition, regardless of whether treated soil is reused in the floodplain, TD 5 would produce by far the greatest amount of GHG emissions (for the range of volumes) of any of the alternatives, which is of concern from an environmental standpoint. Finally, since thermal desorption has not to date been used for the sediment and soil volumes and implementation durations that could be involved at the Rest of River, the reliability of the thermal desorption process for such a large-scale operation is unknown ..."[30]

I have quoted so extensively from 2007 and 2010 because these considerations, these analyses, form the bedrock of GE's and EPA's disqualification of Thermal Desorption.

In May 2014 EPA, with the collaboration of the U.S. Army Corps of Engineers, published its Comparative Analysis of Remedial Alternatives for the General Electric (GE) – Pittsfield/Housatonic Project, Rest of River.[31] It is clear the authors relied upon the prior analysis of GE, including the conclusions of its earlier BioGenesis[SM] study: "The results of a bench-scale test of a representative chemical extraction process indicate that PCB concentrations in the treated sediment and soil would not be sufficiently low to allow reuse on-site; therefore, the treated sediment and soil resulting from TD 4 would have to be transported to a landfill for disposal …

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[30] Rest of River Revised Corrective Measures Study Report, 2010, Volume Two, Pages 9-154.55
[31] SDMS Doc ID 557091, https://semspub.epa.gov/work/01/557091.pdf

"**For TD 5, it is assumed that the thermal desorption process would reduce the concentrations of PCBs in the treated solid materials to levels (around 1 to 2 mg/kg) that could allow reuse in the floodplain[11] and that it would not increase the leachability of metals from those materials so as to preclude such use. However, due to uncertainties regarding the ultimate effectiveness of the treatment process (as well as issues relating to the reuse of the treated soil), TD 5 has also been evaluated based on the additional alternate assumption that all the treated material would be transported to an off-site landfill for disposal."**[32] (Emphasis added.)

Again, a familiar critique: "TD 5 (thermal desorption) would provide human health protection by reducing the PCB concentrations in the sediment and soil, followed by on-site reuse and/or off-site disposal of those treated materials and off-site disposal/destruction of the liquids containing the condensed PCBs. On-site reuse of a portion of the treated soil would be protective of human health because the treated solids would be sufficiently characterized to ensure that residual PCB concentrations would not cause adverse human health effects. **However, if a portion of the treated soil is reused as backfill in the floodplain, that reuse would potentially result in long-term adverse environmental impacts in the forested floodplain and other wetland areas due to the differences in soil characteristics between those materials and the existing natural soil in those wetland areas unless the treated soil is properly amended. In addition, regardless of whether treated soil is reused in the floodplain, TD 5 would produce the greatest amount of GHG emissions of any of the alternatives."**[33] (Emphasis added.)

So, too, the discussion of the Adequacy and Reliability of Alternatives: "Thermal desorption (TD 5) has been used at several sites to treat PCB-contaminated soil; however, **there is only limited precedent for use of this technology on sediment due in part to the time and cost of removing moisture from the sediment prior to treatment. At the sites identified where thermal desorption has been used, the volumes of materials that were treated were substantially smaller and the duration of the treatment operations was substantially shorter than the volumes and duration that could be required at the Rest of River.** Furthermore, when on-site reuse of treated materials has occurred, the materials have typically been placed in a small area and covered with clean backfill. **For these reasons, the adequacy and reliability of this process for a long-term treatment operation with a large volume of materials such as sediment/soil from the Rest of River is uncertain."** [34] (Emphasis added.)

When it comes to the evaluating Green House Gas Emissions generated by various remediation alternatives, rather than perform their own analysis, EPA and the Army Corps relied entirely on GE's calculations. Compare the charts:

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[32] Comparative Analysis of Remedial Alternatives, 2014, Page 60
[33] Comparative Analysis of Remedial Alternatives, 2014, Page 62
[34] Comparative Analysis of Remedial Alternatives, 2014, Page 65

Table 9-3 – Calculated GHG Emissions Anticipated to Result from Treatment/Disposition Alternatives

Alternative	Total GHG Emissions (tonnes)	No. Vehicles w/ Equivalent Emissions
TD 1	19,000 – 290,000	3,600 – 55,400
TD 2	See note 1	See note 1
TD 3 (see note 2)	5,500 – 61,000	1,100 –11,700
TD 4	27,000 – 370,000	5,200 – 70,700
TD 5 (w/ reuse)	66,000 – 1,000,000	12,600 – 191,200
TD 5 (w/o reuse)	66,000 – 1,100,000	12,600 – 210,300

Notes:

1. Emissions estimated for TD 2 range from 2,700 to 8,800 tonnes and do not include the emissions that would be necessary for off-site transport and disposal of materials that are not placed in the CDF(s). As such, these estimates are not comparable to the emissions listed for the other alternatives.
2. As discussed in Section 9.3.7, the lower bound of this range for TD 3 is based on disposal of the minimum potential removal volume at the Woods Pond Site (which would have the lowest GHG emissions of the identified sites) and the upper bound is based on disposal of the maximum potential removal volume at the Rising Pond Site, which is the only one of the identified local disposal sites that could accommodate that maximum volume.

Table 23 Calculated GHG Emissions Anticipated to Result from Treatment/Disposition Alternatives

Alternative	Total GHG Emissions (tonnes)	No. Vehicles with Equivalent Emissions
TD 1	19,000 – 290,000	3,600 – 55,400
TD 2	See Note 1	See Note 1
TD 3 (see Note 2)	5,500 – 61,000	1,100 – 11,700
TD 4	27,000 – 370,000	5,200 – 70,700
TD 5 (with reuse)	66,000 – 1,000,000	12,600 – 191,200
TD 5 (without reuse)	66,000 – 1,100,000	12,600 – 210,300

Notes:

1. Emissions estimated for TD 2 range from 2,700 to 8,800 tonnes and do not include the emissions that would be necessary for off-site transport and disposal of materials that are not placed in the CDF(s). As such, these estimates are not comparable to the emissions listed for the other alternatives.
2. The lower bound of this range for TD 3 is based on disposal of the minimum potential removal volume at the Woods Pond site (which would have the lowest GHG emissions of the identified sites) and the upper bound is based on disposal of the maximum potential removal volume at the Rising Pond site, which is the only one of the identified local disposal sites that could accommodate that maximum volume. Note also that the Woods Pond site is located within the State-designated Area of Critical Environmental Concern.

EPA, Comparative Analysis of Remedial Alternatives, 2014, Page 69

EPA declares: "**Thermal desorption, although generally accepted as a reliable technology for removing contaminants from soil, has similarly not been demonstrated on Housatonic River materials and, in addition, would involve prior dewatering of contaminated sediment. Although sediment dewatering is a generally proven and accepted technology, its effectiveness in conjunction with thermal desorption has not been demonstrated on sediment from Rest of River. Accordingly, thermal desorption cannot be considered a reliable technology for the proposed application at this time."**[35] (Emphasis added.)

Additionally, "TD 4 and TD 5 would be implementable provided that vendors are available to operate the treatment process. The former DeVos property could be used as a potential area to locate a treatment facility. **However, there are several uncertainties regarding full-scale application of both chemical and thermal processes to sediment (e.g., moisture content), particularly with some of the volumes associated with the sediment alternatives."** [36] (Emphasis added.)

EPA concludes: "The availability of additional and/or innovative treatment/disposition technologies during the life of the project is possible, but at this time, none has been demonstrated. In general, any technologies that become available during the implementation of the remediation would be evaluated in a manner similar to that discussed above for Alternatives TD 4 and TD 5 … and may be tested during the implementation of the preferred remedy. [37] (Emphasis added).

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[35] Comparative Analysis of Remedial Alternatives, 2014, Page 74
[36] Comparative Analysis of Remedial Alternatives, 2014, Page 76
[37] Comparative Analysis of Remedial Alternatives, 2014, Page 76

In the 2014 Statement of Basis for the Proposed Remedial Action for the Housatonic River "Rest of River", EPA states: "Adaptive management is a process that allows a project management team to adapt and optimize project activities as they are implemented to account for new information, changing conditions, and additional opportunities such as innovative technologies … EPA envisions that the corrective measures identified in the Proposed Remedial Action will be implemented in a phased manner using such an adaptive management approach. This approach will be administered during design and construction activities (including restoration), to adapt and optimize project activities to account for 'lessons learned,' new information and data, changing conditions, pilot studies, and additional opportunities that may present themselves over the duration of the project."[38]

This seems the appropriate time to remind EPA of the promise made by Region One Administrator Mindy Lubber as part of the negotiations between EPA and the Housatonic River Initiative that led to HRI withdrawing its legal challenge to the 2000 Consent Decree. In a press conference I videotaped for my film, *Good Things To Life: GE, PCBs, and Our Town*, Mindy Lubber declared: "The end result of these discussions was an agreement which only helps to enhance the public's confidence in the clean ups under the consent decree. The agreement includes among other things, the EPA's commitment to identify and potentially test new and innovative treatment technologies."

What is, of course, very frustrating is the simple reality that had GE performed a rigorous pilot study that combined de-watering of Housatonic River sediments with thermal desorption treatment, we would have moved beyond the speculation raised in 2010 and again in 2014 and EPA and the public would, in fact, know whether and how reliable thermal desorption is.

In June 2014, EPA issued its Draft Modification to the Reissued RCRA Permit for Public Comment with revised Performance Standards: "'Performance Standards' mean cleanup standards, design standards, and other measures and requirements identified in this Modification of the Reissued RCRA Permit or subsequently identified in the Rest of River Statement of Work ('Rest of River SOW' or 'SOW') that must be met."[39]

EPA required GE to perform a series of pilot tests: "EPA will select an initial number of additional Vernal Pools for pilot testing of an amendment such as activated carbon in lieu of excavation. (c) EPA will select an initial number of additional Vernal Pools for pilot testing by a third remediation method to be proposed by the Permittee for EPA approval and/or additional pools to be monitored concurrently with remediated Vernal Pools as a 'reference' group for comparison purposes."[40]

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[38] Statement of Basis for EPA's Proposed Remedial Action for the Housatonic River "Rest of River" 2014, Page 10.
https://semspub.epa.gov/src/document/01/558621

[39] EPA Draft Modification to the Reissued RCRA Permit for Public Comment, https://semspub.epa.gov/work/01/558619.pdf, Page 5

[40] EPA Draft Modification to the Reissued RCRA Permit for Public Comment, https://semspub.epa.gov/work/01/558619.pdf, Page 27

It's clear that in 2007 on through 2014, GE and EPA and the US Army Corps of Engineers all raised important questions about the effectiveness of thermal desorption to treat PCB-contaminated Housatonic River sediment. The 2014 revision of Performance Standards and the SOW for Rest of River offered the perfect opportunity to request GE to perform a pilot study that combined de-watering a representative sample of PCB-contaminated Housatonic River sediments with thermal desorption treatment. We'd then be able to better resolve questions of moisture content, how reliable a technology TD would prove to treat sediment, and whether the treated material would need to be transported to an off-site landfill for disposal or productively used for other purposes.

It is precisely the lack of this kind of recent, up-to-date evaluations that forces EPA to harken back to more than decades-old analyses. For example, here is EPA's response to 2016 public comments calling for the use of new and innovative treatment technologies:
"III.F.3 New and Innovative Technologies
Several commenters encouraged the use of new and innovative technologies as part of the Rest of River remediation. Some recommended pilot programs to test new technologies that could then be incorporated into the cleanup … Where appropriate, innovative and/or less invasive technologies have been incorporated into the Final Permit Modification. Specifically, the Final Permit Modification requires the use of an amendment such as activated carbon and/or other comparable amendment in lieu of excavation/dredging in Reach 5B sediment in certain Backwaters, and as an initial remediation measure in Vernal Pools.

"ii. Evaluation of New and Innovative Treatment Technologies
Prior to proposing the Draft Permit Modification, EPA required GE to investigate technologies to treat the PCB contaminated soil and sediment … **GE also evaluated thermal desorption (TD-5) in its Revised CMS. Revised CMS at Section 9.5. Due in part to its high cost, and the likelihood that all of the treated material could not be reused in Rest of River, thermal desorption was not selected for use. See the Comparative Analysis at 59-77 and the Statement of Basis pages 35 to 39 for the full rationale for not selecting thermal desorption."**[41] **(Emphasis added.)**

The 2016 Final Permit Modification to the Reissued RCRA Permit and Selection of CERCLA Remedial Action for Rest of River[42] lays out a series of actions for applying activated carbon to vernal pools and offers some guidance to how applying the principles of Adaptive Management and creating a testing regime for Thermal Desorption and TD5 might work:

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[41] Response to Comments on Draft Permit Modification and Statement of Basis for EPA's Proposed Remedial Action for the Housatonic River "Rest of River" GE-Pittsfield/Housatonic River Site SDMS: 593922 https://semspub.epa.gov/work/01/593922.pdf, Page 271
[42] Final Permit Modification to the Reissued RCRA Permit and Selection of CERCLA Remedial Action and Operation & Maintenance for Rest of River, October 2016 https://semspub.epa.gov/work/01/593921.pdf

(2) Corrective Measures
To achieve and maintain these Performance Standards, Permittee shall place an amendment such as activated carbon and/or other comparable amendments, and/or conduct excavation and backfill, and perform all other related activities. Permittee shall perform the foregoing pursuant to the Performance Standards and the requirements in Section II.B.3.b.(2)(a) through (g) below, and in accordance with plans submitted and approved pursuant to Section II.H. of this Permit.

(a) The Permittee shall submit a plan to EPA and, upon approval, conduct one or more site visits to identify potential Vernal Pools. EPA will make the determination as to what constitutes a Vernal Pool. Areas determined not to be Vernal Pools shall be considered Backwaters or Floodplain soil under II.B.2.d, or II.B.3.a, respectively, depending on whether or not the area is typically inundated.

(b) The Permittee shall conduct additional sampling and characterization of Vernal Pools, to generate baseline data on the concentrations of total PCBs and the presence and abundance of animal species, including, but not limited to, threatened, endangered or state-listed species. The Permittee shall also conduct additional field reconnaissance as needed to evaluate the potential ecological effects of remediation of the Vernal Pools. The Permittee shall conduct the above actions in accordance with a work plan approved by EPA. [43]

A mechanism for triggering a rigorous pilot project for Thermal Desorption can be found here:

"F. Adaptive Management

An adaptive management approach shall be implemented by the Permittee in the conduct of any of the Corrective Measures, whether specifically referenced in the requirements for those Corrective Measures or not, to adapt and optimize project activities to account for "lessons learned," new information, changing conditions, evaluations of the use of innovative technologies, results from pilot studies, if any, and additional opportunities that may present themselves over the duration of the project, including during periodic reviews. The Permittee shall modify the implementation of the Corrective Measures, with EPA approval, after a reasonable opportunity for review and comment by the States, through this process to minimize any adverse impacts of the response action, expedite the response, improve the Corrective Measures, and/or to ensure compliance with, or continued progress towards, achieving Performance Standards." [44]

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[43] Final Permit Modification to the Reissued RCRA Permit and Selection of CERCLA Remedial Action and Operation & Maintenance for Rest of River, October 2016, Page 48
[44] Final Permit Modification to the Reissued RCRA Permit and Selection of CERCLA Remedial Action and Operation & Maintenance for Rest of River, October 2016, Page 64

Here are some of the 2020 modifications that were made to the 2016 Reissued RCRA Permit for Rest of River. The major change is EPA's commitment to an Upland Disposal Facility that will contain contaminated river sediment and bank soil: "River bed sediment shall be removed, generally using engineering methods employed from within the river channel with dredging or wet excavation techniques to be approved by EPA. Regardless of sediment removal technique, the sediment shall, if feasible, be conveyed hydraulically to the Upland Disposal Facility location for processing."[45]

Here is a description of the planned landfill:

5. Upland Disposal Facility
a. Performance Standards
(1) The Permittee shall construct an Upland Disposal Facility to contain certain sediment, floodplain soils and other
waste material (as defined in the Consent Decree) generated as part of the Rest of River Remedial Action that meet the Acceptance Criteria in Attachment E to this Permit at the location shown in Figure 6.

(2) The Upland Disposal Facility shall meet the following design Performance Standards:

(a) The Upland Disposal Facility shall have a maximum design capacity of 1.3 million cubic yards.

(b) The landfill consolidation area shall have a maximum footprint of 20 acres and a maximum elevation of 1,099 feet above mean sea level. If the seasonally high groundwater elevation is determined to be higher than 950 feet above mean sea level, the maximum elevation of the landfill consolidation area may be increased by the number of feet that is the difference between the seasonally high groundwater elevation and 950 feet abovemean sea level in order for the Upland Disposal Facility to have a maximum capacity of 1.3 million cubic yards.

(c) The Upland Disposal Facility shall consist of a double bottom liner, separated by a drainage layer, and shall incorporate primary and secondary leachate collection systems.

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[45] General Electric Company, Pittsfield, Massachusetts, Draft 2020 Modification to the 2016 Reissued RCRA Permit and Selection of CERCLA Remedial Action & Maintenance for Rest of River for Public Comment – July 2020, Page 26.
https://semspub.epa.gov/work/01/647214.pdf

(d) The bottom liner of the landfill will be installed a minimum of 15 feet above a conservative estimate of the seasonally high groundwater elevation. The seasonally high groundwater elevation will be projected using site-specific groundwater elevation data collected in the location of the Upland Disposal Facility, modified by an appropriate technical method that takes into account historic groundwater level fluctuations at similarly-sited off-site long-term monitoring wells in Massachusetts. The estimation of a seasonally high groundwater elevation will be performed pursuant to a methodology reviewed and approved by EPA. The estimate of seasonally high groundwater elevation shall then be used to support the design of the landfill relative to achieving the required minimum separation distance from the bottom of the liner system to the seasonally high groundwater elevation.

(e) The landfill will be capped with a low-permeability cap to include liner(s) drainage layer(s) and vegetation.

(f) Liners (bottom liners and cap liners) shall have a permeability equal or less than 1 x 10-7 cm/sec, a minimum thickness of 30 mils and be chemically compatible with PCBs.

(g) Landfill design will include a stormwater management system to control surface runoff, to minimize the potential for surface erosion or stormwater contribution to leachate generation.

(h) A groundwater monitoring network shall be designed and installed around the Upland Disposal Facility to monitor for PCBs and other constituents identified in the groundwater monitoring plan as approved or modified by EPA. Groundwater monitoring shall include a sufficient number of monitoring wells to allow detection of groundwater impacts.[46]

This extremely large confined disposal facility, requiring vigilant maintenance for an extraordinarily long time, may very well prove unnecessary should a rigorous test of a Thermal Desorption treatment protocol prove successful.

A review of the major studies produced over the last decade reveal that beside adding activated carbon, only one treatment alternative, BioGenesis^{SM} underwent a thorough pilot study. In its brief before EAB, HRI made a case for implementing Thermal Desorption:

> Given the very limited range of treatment options presented in the CMS, HRI would prefer Thermal Desorption, TD5: "The estimated cost for this alternative ranges from $103 million to $1.53 billion, depending on which Combination Alternative it is paired with and how much material is reused; with EPA's preferred Combination Alternative, this alternative is estimated to cost between $515 and $540 million." (GE-Housatonic River, Statement of Basis, Page 25).

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[46] Draft 2020 Modification to the 2016 Reissued RCRA Permit. Pages 57, 58

HRI believes that given the lack of other alternatives, the most rigorous consideration of, and commitment to some of the General Standards for Corrective Measures would support the conclusion that TD5 is the most appropriate treatment/disposal option offered us for the Rest of River remedy.

Similarly, an objective consideration of the criteria governing: “The Reduction of Toxicity, Mobility, or Volume of Wastes” would support the choice of TD5:
a. If applicable, treatment process used and materials treated;
b. If applicable, amount of hazardous materials destroyed or treated;
c. If applicable, degree of expected reductions in toxicity, mobility, or volume;
d. If applicable, degree to which treatment is irreversible; and
e. If applicable, type and quantity of residuals remaining after treatment.” (GE Housatonic River, Statement of Basis, Page 27).

Other EPA regions have successfully employed thermal desorption. An extensive though not comprehensive list of sites that have implemented or planned to implement thermal desorption in the years up to 1997 can be found on pages 7-8 in EPA's Office of Emergency and Remedial Response's January 1997 publication: "Engineering Forum Issue Paper: Thermal Desorption Implementation Issues." https://clu-in.org/download/remed/tdissue.pdf

John Blanchard, PE and Robert Stamnes, PE note: "Thermal desorption has been selected as the remedy for VOCs or SVOCs in soils at the sites or operable units listed below. Some sites are currently operating, and some are in the design phase.” They offer a list of more than 50 sites. “Innovative Treatment Technologies: Annual Status Report (Eighth Edition),” September 1996 (EPA 542-R-96-010)
(http://nepis.epa.gov/Exe/ZyPDF.cgi/10002Y79.PDF?Dockey=10002Y79.PDF):
As EPA notes, "**Thermal desorption has been safely used at many Superfund sites** …Thermal desorption is typically used to clean up soil that is contaminated with VOCs and SVOCs at depths shallow enough to reach through excavation. Thermal desorption may be faster and provide better cleanup than other methods, particularly at sites that have high concentrations of contaminants. A faster cleanup may be important if a contaminated site poses a threat to the community or needs to be cleaned up quickly so (Similarly, an objective consideration of the criteria governing: "The Reduction of Toxicity, Mobility, or Volume of Wastes” would support the choice of TD5:
“a. If applicable, treatment process used and materials treated;
b. If applicable, amount of hazardous materials destroyed or treated;
c. If applicable, degree of expected reductions in toxicity, mobility, or volume;
d. If applicable, degree to which treatment is irreversible; and
e. If applicable, type and quantity of residuals remaining after treatment." (GE Housatonic River, Statement of Basis, Page 27).

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As EPA notes, "**Thermal desorption has been safely used at many Superfund sites** …Thermal desorption is typically used to clean up soil that is contaminated with VOCs and SVOCs at depths shallow enough to reach through excavation. Thermal desorption may be faster and provide better cleanup than other methods, particularly at sites that have high concentrations of contaminants. A faster cleanup may be important if a contaminated site poses a threat to the community or needs to be cleaned up quickly so that it can be reused. **Thermal desorption is being used or has been selected for use at over 70 Superfund sites across the country.)**" A Citizens Guide to Thermal Desorption, EPA Office of Solid Waste and Environmental Protection, EPA 542-F-12-020, September 2012, Page 2, Emphasis added).
(https://clu-in.org/download/Citizens/a_citizens_guide_to_thermal_desorption.pdf)

TD5 meets the Implementability standard:
"a. Ability to construct and operate the technology, taking into account any relevant site characteristics;
b. Reliability of the technology;
c. Regulatory and zoning restrictions;
d. Ease of undertaking additional corrective measures if necessary;
e. Ability to monitor effectiveness of remedy;
f. Coordination with other agencies;
g. Availability of suitable on-site or off-site treatment, storage and disposal facilities and specialists; and,
h. Availability of prospective technologies." (GE-Housatonic River, Statement of Basis, Pages 27-28).

Here in Region 1, EPA has already demonstrated that thermal desorption can be effectively implemented at the GE PCB Rose Disposal site (National Priorities List site), in Lanesborough, Massachusetts.

Most recently, the United States (USAID) and the Government of Vietnam have undertaken the large-scale joint remediation of the dioxin-contaminated Danang Airport. According to USAID, “It is expected that over 95 percent of the dioxin will be destroyed through the thermal desorption heating process. Any dioxin that vaporizes will be vacuumed out and captured in a secondary treatment system for liquids and vapors extracted from the pile. The secondary treatment system will ensure that no dioxin or other contaminants are released into the environment.” You can view an animation of the In-Pile Thermal Desorption process currently being implemented at Danang here:
https://www.usaid.gov/vietnam/environmental-remediation-process

And you can read more about how and why they chose to utilize Thermal Desorption here:
https://www.usaid.gov/vietnam/environmental-remediation-dioxin-contaminationdanang-airport-project-frequently-asked-questions

In its Comparative Analysis of Treatment/Disposition Alternatives, EPA acknowledges that "**TD 1, 3 and 5 would provide high levels of protection to human health and the environment because all excavated contaminated material would either be removed from the site (TD 1), contained in an upland disposal facility (TD 3), or treated to levels safe for off-site disposal or potential reuse (TD5).**" (GE-Housatonic River, Statement of Basis, Page 35, Emphasis added).

HRI would argue that the added long-term benefit of destroying PCB-contamination rather than changing its location outweighs the other alternatives. As for Control of Sources of Releases, EPA notes: "Under TD 4 and **TD 5, the potential for the PCB-contaminated sediment and soil to be released within the river or onto the floodplain during treatment operations would be minimal as long as these facilities are properly operated and maintained.**" (GE-Housatonic River, Statement of Basis, Page 36. Emphasis added).

But as EPA notes in its "Technology Alternatives for the Remediation of PCB Contaminated Soils and Sediments": **Landfill disposal of PCB contaminated soil and sediment does not provide waste reduction or destruction, only containment.** Persistent substances like PCB wastes will remain in landfills for long periods of time with little degradation. " (Page 11, Emphasis added) (http://nepis.epa.gov/Adobe/PDF/P100GJNO.pdf).

HRI would argue that while placement of contaminated materials either at on-site or offsite landfills would simply transfer the risk of release from one location in Berkshire County to another, or from Berkshire County to another community in the United States, TD5 or bioremediation would overwhelmingly reduce these risks by significantly and permanently reducing the volume of contaminated material.

EPA writes in its discussion of Short-Term Effectiveness: "TD 2 through TD 5 could cause permanent loss of habitat and loss or displacement of wildlife in the area depending upon where the disposal or treatment facility is located. TD 1 would have fewer impacts on the environment than the other alternatives." (GE-Housatonic River, Statement of Basis, Pages 37-38).

HRI suggests that if TD5 is adopted, EPA could surely create an appropriate restoration plan to undo these short-term effects once treatment has been completed. GE has already purchased or has lease agreements for parcels along the Rest of River for its proposed landfills in Lenox, Lee, and Housatonic, Massachusetts. Surely the temporary use of these spaces - followed by restoration - would be better for the habitat that a permanent PCB landfill.

As for Implementability, EPA notes: "TD 4 and 5 would require access to large areas for the construction and operation of a treatment facility. Locating such a facility would require coordination with state and local agencies. Other access and zoning issues may also be present. Since state and local officials have expressed a strong preference for offsite disposal, these alternatives may encounter significant opposition, thus rendering these alternatives difficult to implement." (GE-Housatonic River, Statement of Basis, Page 38).

HRI has been educating local public officials and the public at large about the issues involved with treatment and alternative remedial technologies vs. landfilling for several decades. We believe that EPA overstates the potential of opposition to TD5 especially when the alternative is landfilling without treatment.

While state, even federal officials have failed to educate the public about CERCLA's preference for both established treatment technologies like Thermal Desorption and alternative technologies like Bioremediation, HRI believes that because of our advocacy there is significant public support for a more permanent solution to our PCB problem.

As for location, a Thermal Desorption unit could be placed on the property GE has already leased or purchased for its intended Upland Disposal Facilities. Please see Attachment A Petition of Concerned Citizens supporting the treatment of PCBs rather than landfilling them. [47]

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[47] BEFORE THE ENVIRONMENTAL APPEALS BOARD UNITED STATES ENVIRONMENTAL PROTECTION AGENCY WASHINGTON, D.C.
HRI Appeal from Permit Decision. Docket No MAD002084093
https://yosemite.epa.gov/oa/eab_web_docket.nsf/Filings By Appeal Number/53E000D2D74B93D085258065006322F1/$File/HRI FINAL EAB 11-3 E-File.pdf

Region One countered these concerns and asked that the EAB dismiss our objections for several reasons:

> In selecting the remedy set forth in the Permit, EPA relied upon its scientific, technical and policy expertise, following a decade and a half of analysis, modeling, risk assessments, independent external peer review, and internal EPA reviews. To arrive at the appropriate level and method of cleanup for Rest of River, including different components of the remedy, EPA first evaluated a large and complex Administrative Record ("Record" or "AR") comprised primarily of scientific and technical material. EPA then exercised its scientific and policy discretion to select among the range of possible outcomes. This lengthy scientific analysis was informed by an extraordinary degree of public participation.
>
> First, although HRI's Petition turns on interpretations of record materials that are largely technical, HRI in significant measure simply expresses differences of opinion on inherently technical matters within EPA's expertise. While HRI may agree with alternative technical theories on various issues, simply articulating these preferences does not demonstrate error. Rather, determinations made on the record by EPA's experts, even in the face of other plausible options, deserve deference from the Board.
>
> HRI never justifies why EPA's exercise of discretion in selecting a cleanup based on the CD-Permit criteria was flawed. While HRI may have opted for a different approach, this difference of opinion does not constitute reviewable error or abuse of discretion.
>
> Second, HRI has not responded to EPA's Response to Comments regarding several arguments, and has not explained why EPA's response was clearly erroneous or otherwise warrants review. 40 C.F.R. §124.19(a)(4). Without substantively confronting EPA's considered responses to comments, a petitioner cannot hope to garner review, particularly where, as here, the matters in dispute are inherently technical in nature and accordingly warrant deference by the Board to determinations made on the record by EPA's experts.
>
> Third, HRI in some cases simply did not raise some of its arguments in its comments on the Draft Permit Modification ("Draft Permit"). AR558619, counter to 40 C.F.R. 124.13, 124.19(a)(4)(ii). [48]

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[48] REGION 1'S RESPONSE TO PETITION OF HOUSATONIC RIVER INITIATIVE, INC. FOR REVIEW OF FINAL MODIFICATION OF RCRA CORRECTIVE ACTION PERMIT ISSUED BY REGION 1, Pages 2, 3.
https://yosemite.epa.gov/oa/eab_web_docket.nsf/Filings By Appeal Number/B264B6D634F49B3B852580C8004AD44B/$File/HRI Response Brief_RCRA 16-02.pdf

That HRI did not specifically raise the issue of Thermal Desorption in its formal comments to the Draft Permit Modification is accurate. But that oversight does not discount the several decades-long commitment to educating the public and advocating to GE, EPA, and the Commonwealth of Massachusetts about the need to utilize an alternative technology that would substantially destroy the PCB contamination.

But what is now clear is that we are talking about far more than a "difference of opinion" but whether or not EPA performed its due diligence when it comes to selecting a cleanup remedy. And while it may well be true that "determinations made on the record by EPA's experts, even in the face of other plausible options, deserve deference from the Board," it may also be true that these same EPA experts haven't fairly examined the new advances demonstrated by the successful cleanup of the Danang dioxin site utilizing thermal desorption.

In an August 10, 2020 email, in response to my request for documents and a question about Danang, Dave Deegan, of the Office of Public Affairs wrote:

2. Did EPA conduct any rigorous evaluation of the USAID/Government of Vietnam dioxin cleanup utilizing thermal desorption at Danang prior to remedy selection?

    In its detailed analysis of thermal desorption and other alternatives, EPA did not specifically evaluate the USAID/Government of Vietnam dioxin cleanup utilizing thermal desorption at Danang prior to the 2016 remedy selection. (Emphasis added).

    Prior to issuing its Draft Revised 2020 Permit, EPA did review information relative to the Danang project including the following two documents, which are in the Administrative Record:
    https://dec.usaid.gov/dec/content/Detail_Presto.aspx?vID=47&ctID=ODVhZjk4NWQtM2YyMi00YjRmLTkxNjktZTcxMjM2NDBmY2Uy&rID=NTE0MTM4

    https://www.usaid.gov/vietnam/environmental-remediation-dioxin-contamination-danang-airport-project-frequently-asked-questions

In its response to HRI's comments to the EAB, EPA also wrote:

> EPA conducted a multi-layered analysis of the remediation and disposal alternatives against the CD-Permit criteria. For remediation of PCB contamination in sediment and floodplain, EPA reviewed nine separate remediation alternatives (denoted as "SED/FP" alternatives). Att. 10, Table 1, Combination Alternatives Matrix, CA at 10. Similarly, in evaluating alternatives for treatment/disposition of the excavated PCB-contaminated material, EPA evaluated five alternatives (denoted as "T/D" alternatives). Att. 10, CA at 59-78. Based on that comprehensive review, EPA proposed a remedy referenced in EPA's Comparative Analysis as "SED 9/FP 4 MOD" and "TD 1/TD1 RR" that was in its judgment best suited to meet the CD-Permit's General Standards in consideration of the CD-Permit's Selection Decision Factors, including a balancing of those factors against one another. Att. 10, CA at 59, 77.

> The distinction between the threshold General Standards and the balancing Selection Decision Factors is an important consideration. The CD-Permit describes the process as determining which corrective measure or combination of corrective measures "is best suited to meet the *general standards* … in consideration of the *decision factors*..., including a balancing of *those factors* against one another." Att. 6, CD-Permit II.G.3 (emphasis added). Accordingly, EPA's evaluation of the three threshold criteria – Protectiveness, Control of Sources of Releases, and Compliance with ARARs – requires that those standards be met.[49]

Let's review the success and potential relevance of the Danang remediation to the critically important act of "balancing Selection Decision Factors." It's important to note that USAID and Vietnam hired CDM Smith to conduct a thorough environmental assessment "that analyzed conditions at Danang Airport and evaluated a number of possible dioxin remediation technologies."[50]

Terratherm describes a process that could easily be replicated by GE and EPA: "One of the technologies considered for treating TCDD-contaminated soils and sediments at the Airport was In-Pile Thermal Desorption (IPTD). **Although results from studies at other sites indicated that IPTD was capable of achieving target cleanup goals at the Airport, a laboratory treatability study was performed to confirm treatment with site-specific soil and sediment, and to estimate the required time for TCDD destruction in the treatment pile at the minimum design temperature of 335oC. The treatability study was performed by KEMRON Environmental Services (Atlanta, Georgia, USA). Soil and sediment samples were collected in August 2010 from areas expected to have some of the highest TCDD concentrations at the Airport.** (Emphasis added).

"Upon receipt, the soil and sediment were maintained at 4oC, and were homogenized prior to analysis of baseline contaminant concentrations and treatment. Triplicate aliquots of the soil and the sediment were analyzed for total dioxins/furans using a modified version of EPA Method 8290. The two test materials, sediment and soil, were subjected to thermal desorption treatment performed at a temperature of 335oC, plus or minus 5oC, for a treatment duration of 7 days for sediment, and 21 days for soil at the target temperature.

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[49] REGION 1'S RESPONSE TO PETITION OF HOUSATONIC RIVER INITIATIVE, INC. FOR REVIEW OF FINAL MODIFICATION OF RCRA CORRECTIVE ACTION PERMIT ISSUED BY REGION 1, Pages 7, 8.

[50] Environmental Remediation Process
https://www.usaid.gov/vietnam/environmental-remediation-process

"Treatment simulations were performed using stainless steel box reactors measuring approximately 30 cm in length, 15 cm in width, and 7.5 cm in depth. The untreated materials were placed loose inside the box reactor and then covered with a stainless steel lid and carbon gasket material. The lid was fitted with Swagelok ports to allow the introduction of breathing quality air into the reactor chamber, and the insertion of a thermocouple probe for monitoring and recording the soil temperatures during treatment. An additional port allowed the removal of off-gas from the reactor during testing. Finally, a condensate collection system was utilized to remove and condense vaporized water and any organics in the off-gas during treatment. The reactors were heated to temperature using a Fisher Isotemp Muffle Furnace. Once inside the furnace, the appropriate air inlet and off-gas lines as well as the temperature thermocouples were connected."[51]

By 2010, USAID and Vietnam determined that Thermal Desorption treatment was "the most effective and scientifically proven method for destroying dioxin and to have the lowest potential impact on human health and the environment given the specific conditions of the site. The technology is an innovative dioxin destruction technology that uses conductive heating and vacuum extraction to remediate soil and sediment contaminated with dioxins. The excavated soil and sediment is placed into a completely enclosed above-ground pile structure. Heating rods operating at temperatures of approximately 750 to 800 degrees Celsius (°C) (1400 to 1500 degrees Fahrenheit [°F]) raise the temperature of the entire pile to at least 335°C (635°F). At that temperature, the molecular bonds holding the dioxin compound together break, causing the dioxin compound to decompose into other, harmless substances, primarily CO2, H2O and Cl2."[52]

By 2013:

- All major contractors were signed onto the project
- Comprehensive health and safety training consistent with international standards was conducted and continues to be conducted for on-site workers
- Containment/treatment structure was built
- Majority of contaminated soil and sediment designated for Phase 1 treatment was excavated
- The structure was completely filled with approximately 45,000 cubic meters of contaminated soil and sediment Installation of the remediation technology and liquid/vapor treatment plant began[53]

Several illustrations of the construction of the structure and how the process works reveals how very different this version of Thermal Desorption is from the Thermal Desorption Unit used in the remediation of the Buffalo River in 1993:

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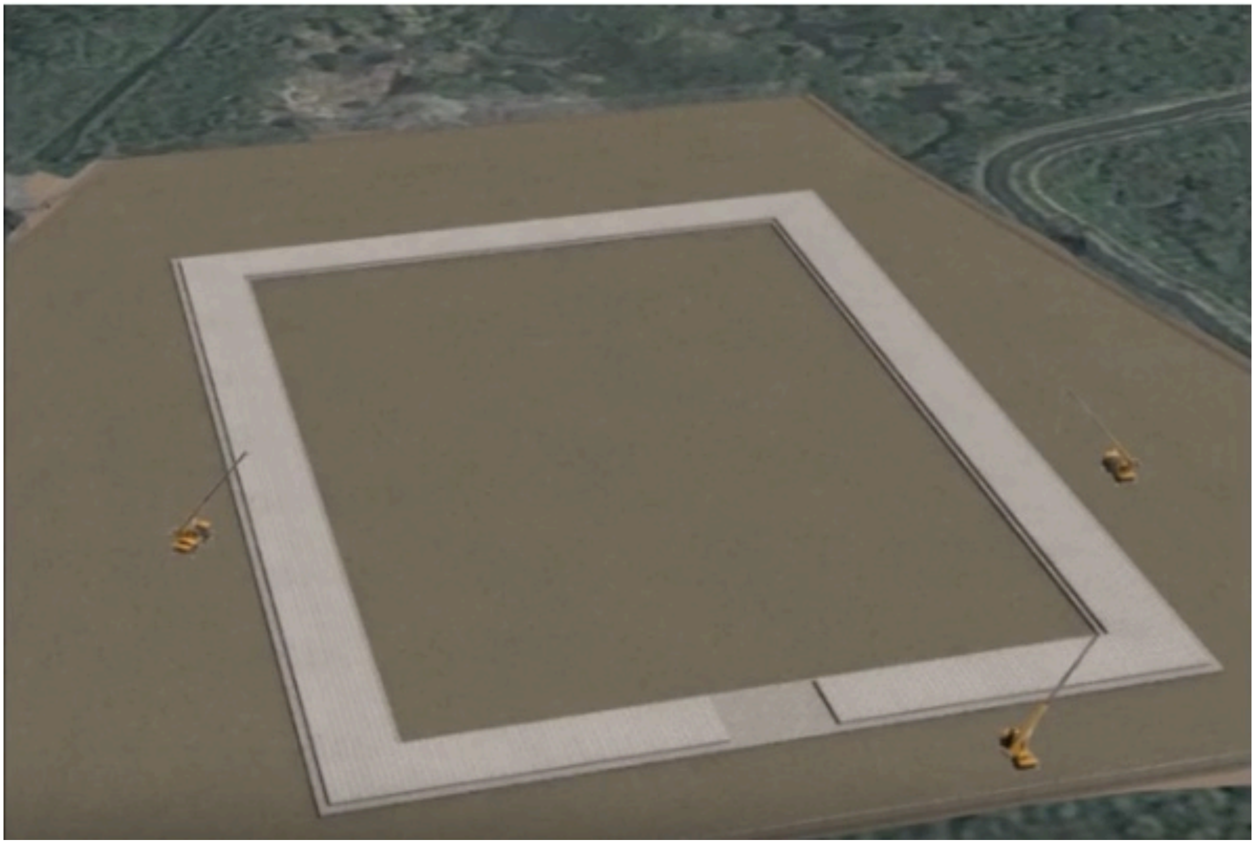
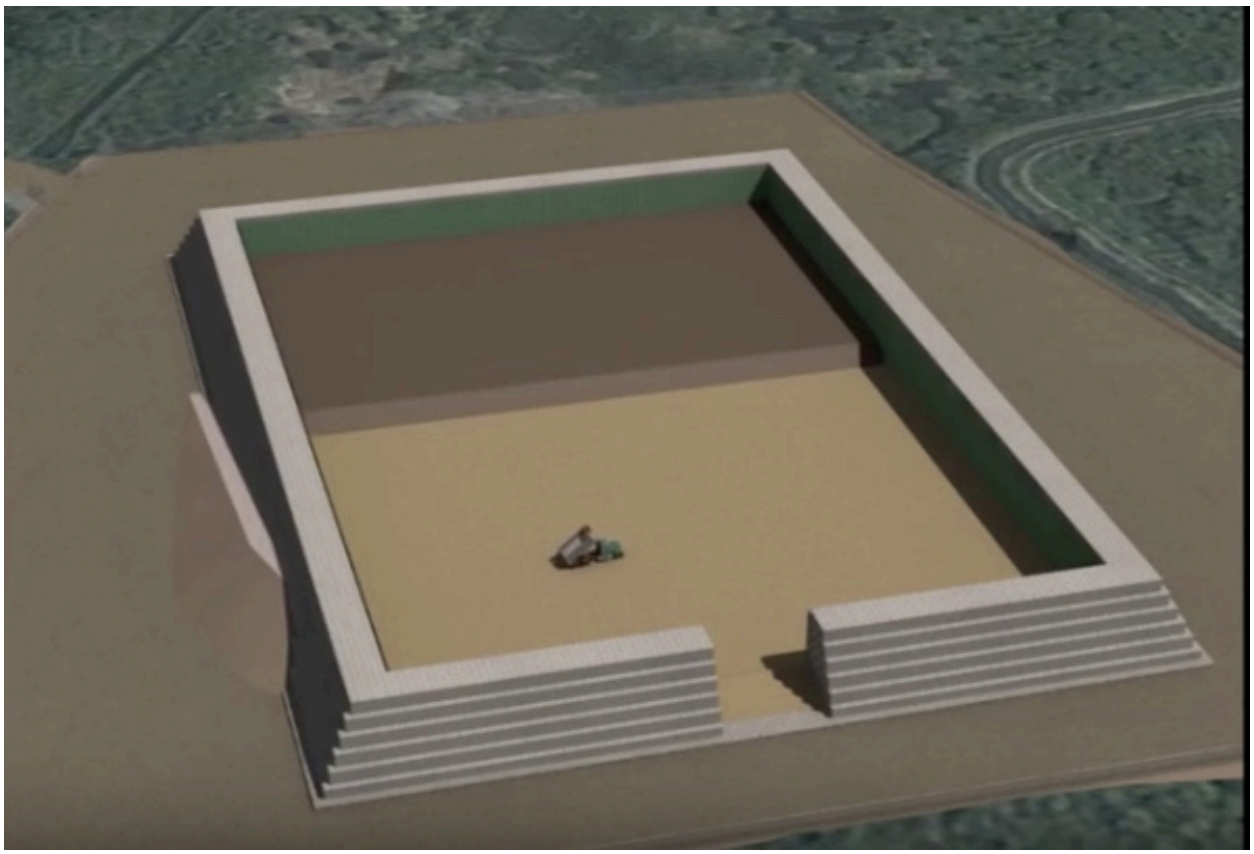
[51] TechnologySelectionandConceptualDesignforCleanupofDioxinContaminationattheDanangAirportHotSpotVietNam1.pdf

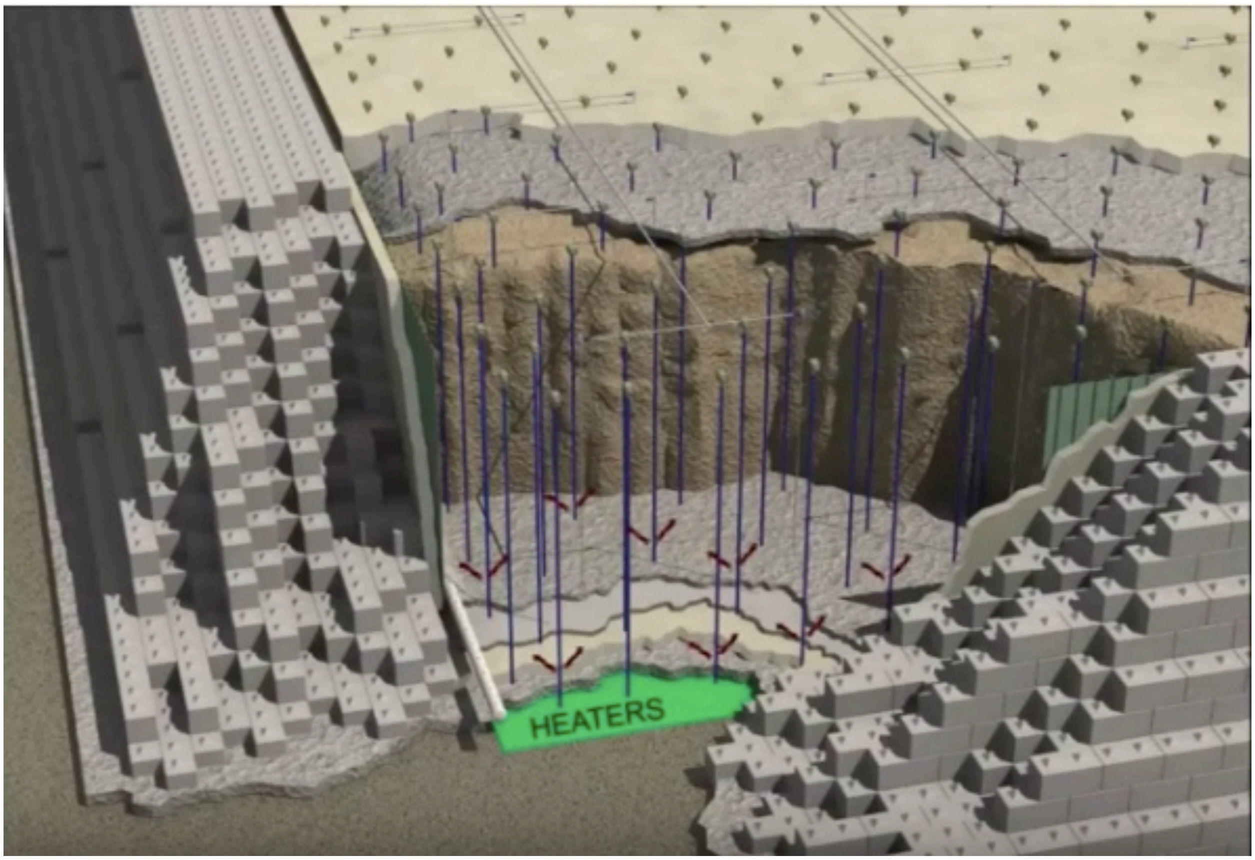
[52] Environmental Remediation Process https://www.usaid.gov/vietnam/environmental-remediation-process

[53] https://www.usaid.gov/vietnam/environmental-remediation-project-timeline

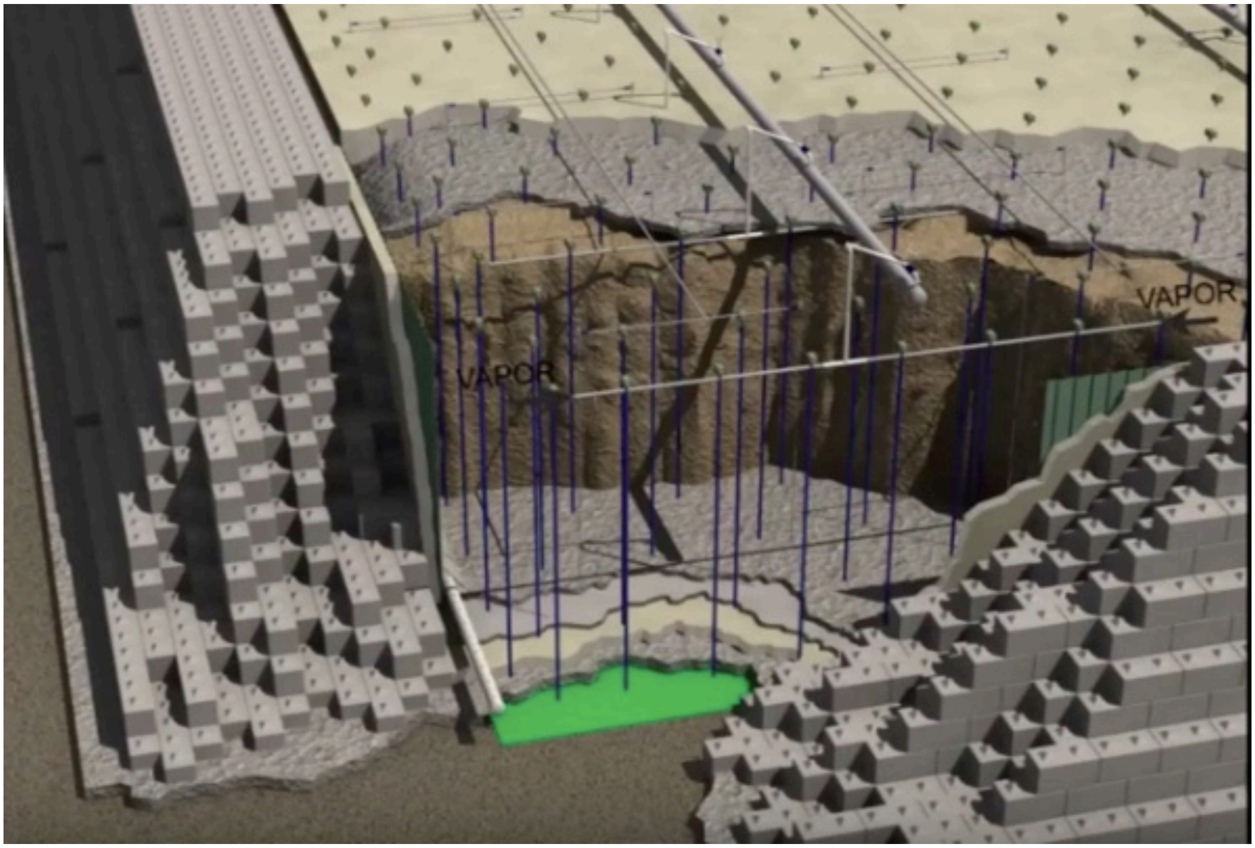

Construction



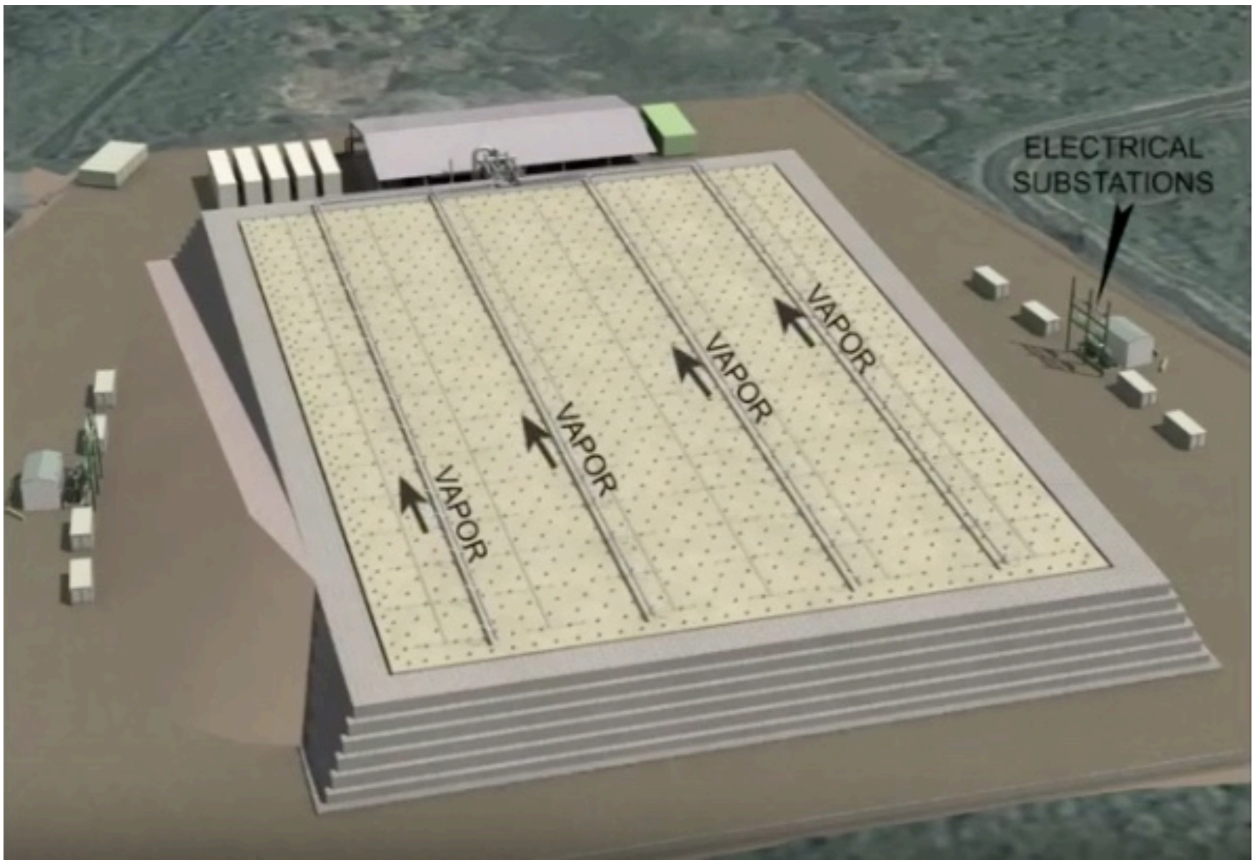
Bringing contaminated soil and sediment



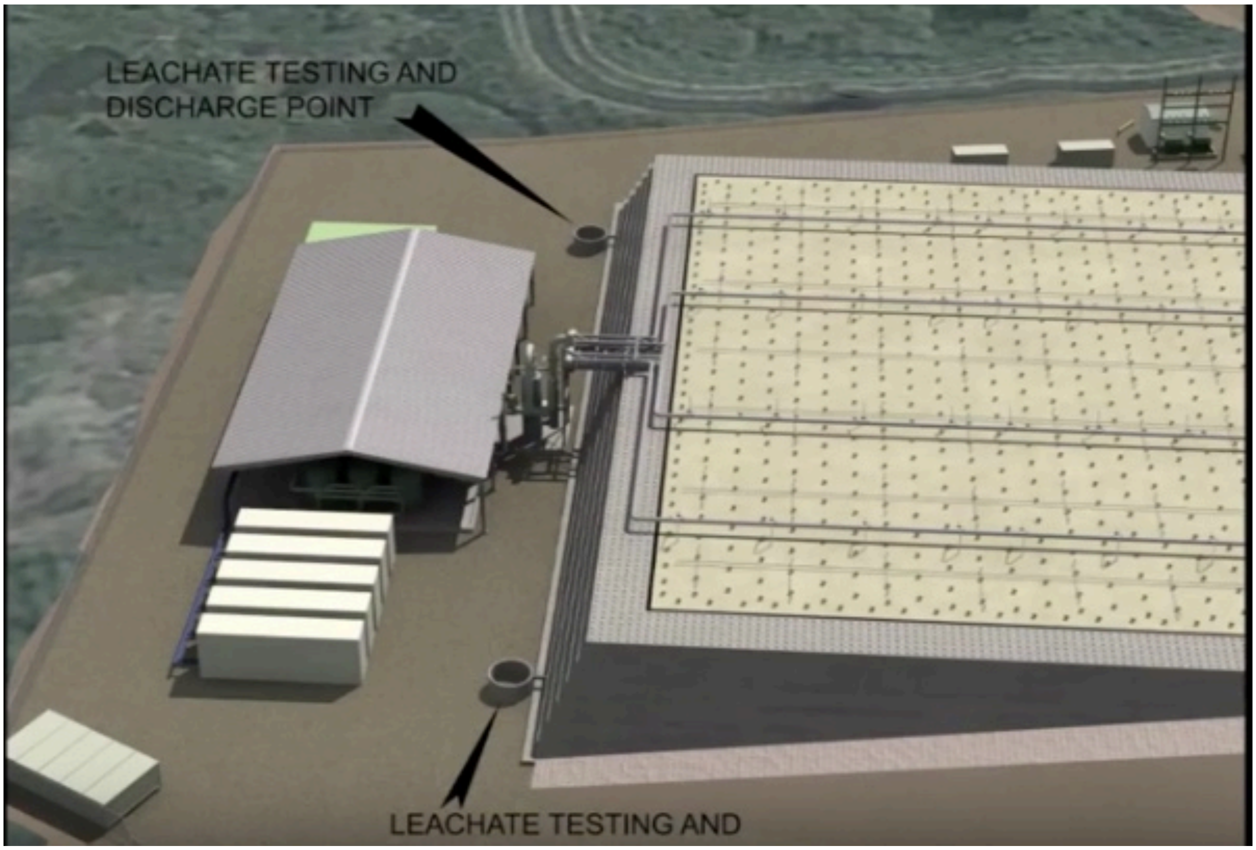
Heaters



Vapor



Vapor Extraction



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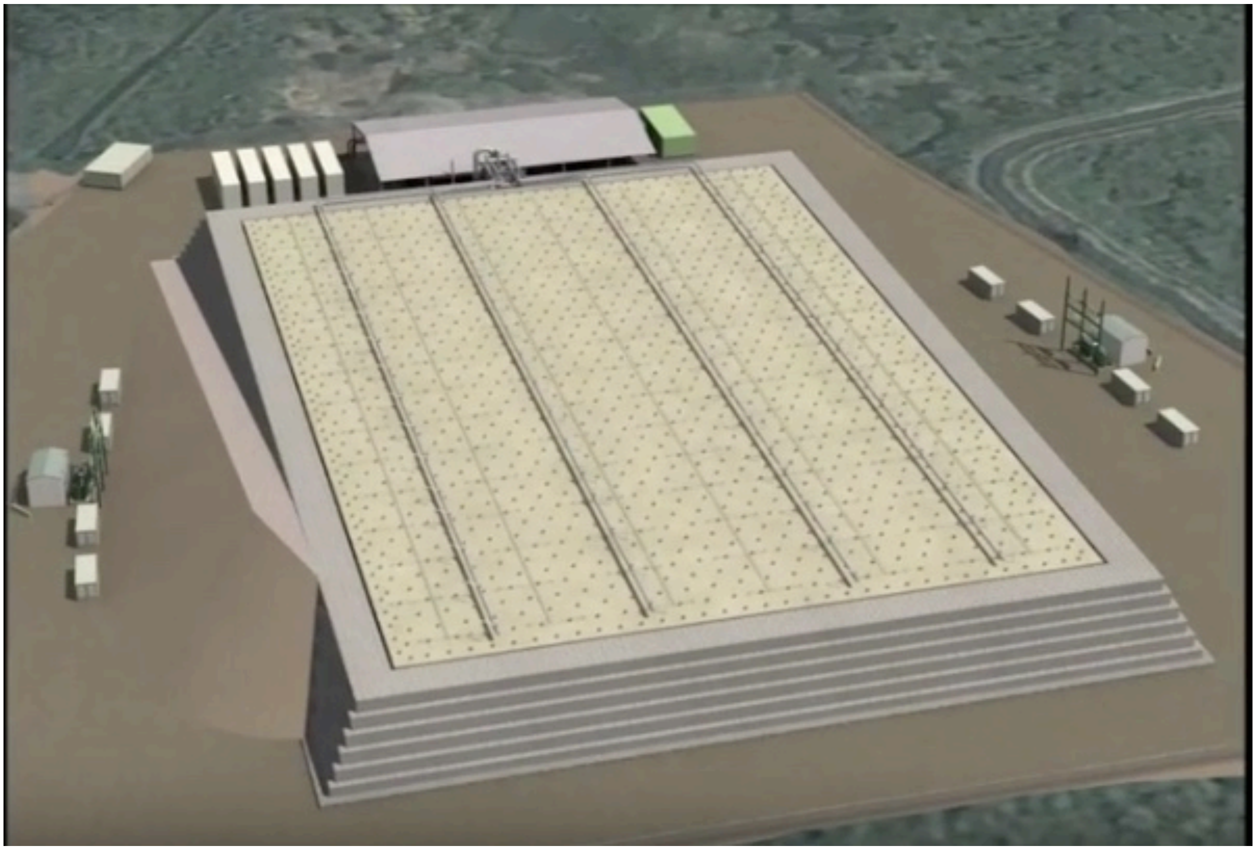

Treatment Building

The thermal treatment structure at Danang Airport is 70 meters wide and approximately 100 meters long.
CDM Smith

USAID produced as animated video illustrating the construction of the Danang facility:
In-Pile Thermal Desorption (IPTD) Animation

As for protecting the health and safety of the public:
"Contaminated Soil and Sediment
International best practices will be followed to ensure that contaminated soil and sediment do not leave the project site. Examples include:

- Installing silt fences and barriers to capture soil/sediment in storm water runoff;
- Minimizing construction activities during the rainy season;
- Protecting the project site during heavy rains; and
- Decontaminating all vehicles, equipment, and personnel before moving from contaminated to clean areas.

"**Contaminated Dust**
International best practices and engineering controls will be applied to ensure that contaminated dust does not leave the project site. Examples include:

- Monitoring wind speed and ensuring that activities are not conducted during high winds;
- Spraying down areas with water to suppress dust; and
- Covering soils in trucks during transportation.

"Dust monitoring and air sampling will be conducted at the limits of the excavation area to ensure that contaminated dust is not leaving the project site.

Contaminated Wastewater

All water generated during remediation activities will be collected, sampled, and, if necessary, treated before leaving the project site."[54]

According to USAID's final evaluation:

"The Project was successful in achieving its higher-level purpose of treating dioxin and improving relationships between the Governments of the United States and Vietnam. The project excavated 162,567 m^3, treated 94,593 m^3, and contained 67,974 m^3 of contaminated soil in landfills …

"Results indicate that the project was cost effective—treating large amounts of dioxin and contaminated materials at a low per unit cost and in a short time. Specifically, the treatment cost 669 USD per ton of soil, which compares to costs ranging from 337 - 5,2054 USD for similar onsite measures. Within Phase II of IPTD, the heating time was reduced from 10 months to 6 months which is a shorter time than in other dioxin treatment projects."[55]

1.5 FINDINGS, LESSONS, AND CONCLUSIONS

Evaluation Question 1: To what degree did the project achieve its purpose of characterizing, removing and containing dioxin contaminated soil and sediment from hotspots at Danang airport?

Findings	The project was a resounding success in treating dioxin contaminated soil and sediments, with resulting post-treatment dioxin levels well below the required limits. However, gaps in planning and testing hindered project performance relating to soil characterization, which in turn led to delays and higher project costs.
Conclusions	From the point of view of the higher-level goal of treating dioxin contaminated areas, the project was a success.
Recommendations	Employ a combination of soil sampling techniques to improve characterization, and strengthen planning. Explicitly state all assumptions.

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[54] https://www.usaid.gov/vietnam/environmental-remediation-process

[55] PERFORMANCE EVALUATION OF USAID'S ENVIRONMENTAL REMEDIATION AT DANANG AIRPORT, October 25, 2018, Page 2. https://pdf.usaid.gov/pdf_docs/PA00TDS3.pdf

[56] PERFORMANCE EVALUATION OF USAID'S ENVIRONMENTAL REMEDIATION AT DANANG AIRPORT, October 25, 2018, Page 3.

Evaluation Question 2: How cost effective was using thermal destruction of dioxin (IPTD) at the Danang Airport compared to similar and/or alternative solutions used in comparable remediation projects elsewhere in the world?

Findings	The Project cost 669 USD per ton to treat the material compared to similar methods which ranged from 337 – 5,205 USD per ton. The Danang project treated roughly 7.8 times more material than did the lowest cost project.
Conclusions	The project was cost effective, being the third least expensive project examined out of 10 technologies The agreed selection criteria for reference projects included: Definitive (not temporary) solution; Full scale method, able to remediate > 90,000 m^3 of highly contaminated soil; Verified method, able to reach the target values; On-site remediation; and compliance with Vietnamese regulations.
Recommendations	Cost per unit treated is not the only factor that should be considered when making the decision on technology choice. Other factors must be considered such as duration of treatment, site conditions and local standards and norms. It is necessary to improve reporting consistency, including a breakdown of the costs as well as summaries of incurred costs until the date of reporting. The system of monitoring and of calculating mass balance must be included in the design of the project.

[57]

Conclusion

There is continuing public discontent with EPA's decision to place massive amounts of contaminated soil and sediment (below 50ppm) in the planned Consolidated Disposal Facility on the former Lane Construction site.

Since 1993, there have been significant improvements in the ability of Thermal Desorption to effectively treat contaminated soils and sediments.

Some of the factors that both GE and EPA thought disqualified Thermal Desorption from serious consideration for use at the Housatonic River Rest of River cleanup may no longer prove true.

GE and EPA have already determined how to move dredged contaminated soils and sediments up to the area of the planned Consolidated Disposal Facility.

It is very possible on that very same land to create a facility to de-water river sediments and then move them to be treated in a Thermal Desorption facility resembling that utilized by USAID in Danang.

I urge the EPA to trigger Adaptive Management provisions and begin a thorough pilot test to see whether we can successful remediate PCB-contaminated Housatonic River sediments utilizing Thermal Desorption.

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[57] PERFORMANCE EVALUATION OF USAID'S ENVIRONMENTAL REMEDIATION AT DANANG AIRPORT, October 25, 2018, Page 3.

Sincerely,

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