SUPERFUND CLEANUP PESTICIDE WAREHOUSE III

IDALISSE SALDAÑA PIÑERO #9640

ARELYS MURIEL CRUZ #47706

ITZIA I. SANTIAGO COLON #59788

MENTOR: EDUARDO R. GONZÁLEZ P.E., MBA, MSChE, CEA

ABSTRACT

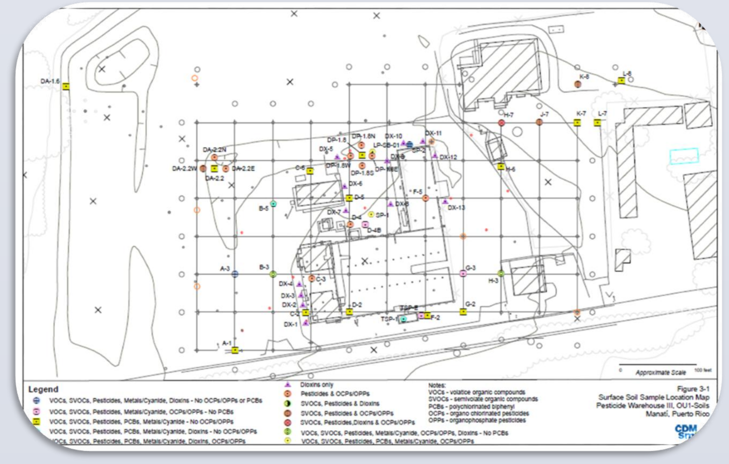
The Pesticide Warehouse III (PWIII) is an inactive facility in a rural / residential area located in Manati, PR. During its operational history, various chemicals were spilled from tanker trucks over bare ground and ground water. This facility is now under the EPA jurisdiction. Through a variety of remediation techniques we propose to lower the contamination levels in a manner that is cost efficient and safe for the environment and the surrounding community. This Proposed Plan describes the remedial alternatives evaluated for the Superfund Pesticide Warehouse III (PWIII), in the municipality of Manatí, Puerto Rico. The purpose of the project is to assess remediation techniques for both, soil and groundwater. To determine applicable remedial technology and choose which or what are the most viable alternatives to implement in our Superfund site, which has been contaminated with pesticides.

SUPERFUND LAW

The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), commonly known as Superfund, was enacted by Congress on December 11, 1980. This law created a tax on the chemical and petroleum industries and provided broad Federal authority to respond directly to releases or threatened releases of hazardous substances that may endanger public health or the environment. This project has been evaluated to correspondingly fulfill the steps of the Superfund program.

SITE DESCRIPTION AND HISTORY

The Pesticide Warehouse III (PWIII) is an inactive facility in a rural / residential area located on Rt. PR-670 Km 3.7 Bo. Coto Norte, Manati, PR. It is bounded to the south by a mechanic shop and Road PR-670, to the east by Reine Christian Bilingual School. Chains of mogotes and other karst features are located north and west of the site.



Sampling Points

PWIII was reportedly used for pineapple processing and canning from the 1930s to the early 1950s. The Puerto Rico Land Authority owned and operated it from 1954 to 1996. The operations conducted during this period included the preparation of pesticides/insecticides, herbicides, and fertilizers. From 1996 to 2002, pesticide production continued at the site by Argo Campo Inc. until they vacated the property.

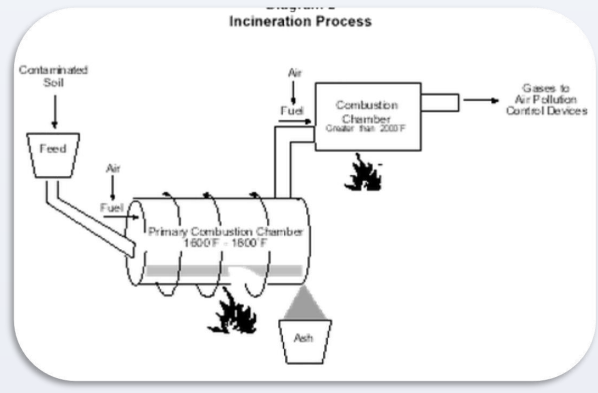
During its operational history, various chemicals were stored within the onsite warehouse. The concentrated chemical products were mixed with water drawn from an onsite well. Mixing occurred in tanker trucks at an onsite loading dock over bare ground. Some of these chemicals included pesticides, heavy metals, organic and inorganic compounds. Due to a lack of institutional or engineering controls, spills from the mixing process were not contained and were allowed to flow freely across the site. Chemical spills also entered a drainage ditch located along the periphery of the site which discharged to a leach pit (sinkhole) situated on the northeast portion of PWIII.

Site Aerial View

REMEDIATION TECHNOLOGY EVALUATED

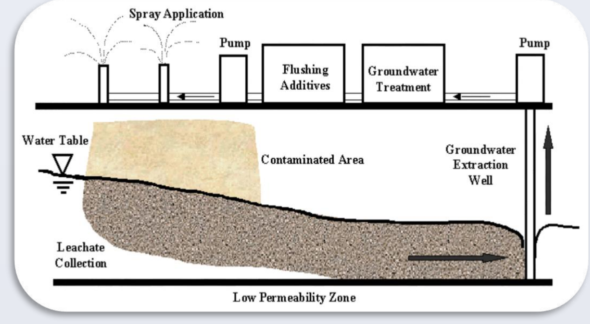
INCINERATION

Throughout the world, sites have been discovered which contain hazardous wastes. To completely destroy the contaminants in the soil, incineration remains the primary option for soils containing organics with high boiling points.



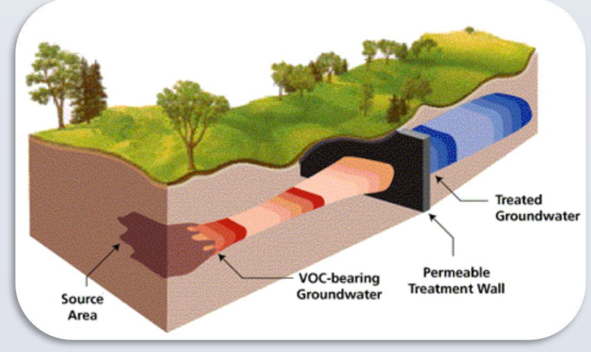
SOIL FLUSHING

In situ flushing involves flooding a zone of contamination with an appropriate solution to remove the contaminant from the soil. Water or a liquid solution is injected or infiltrated into the area of contamination. After passing through the contamination zone, the contaminant-bearing fluid is usually collected and brought to the surface for disposal, recirculation, or on-site treatment and reinjection. Traditional flushing techniques rely on the ability to deliver, control the flow, and recover the flushing fluid via a pump-and-treat system.



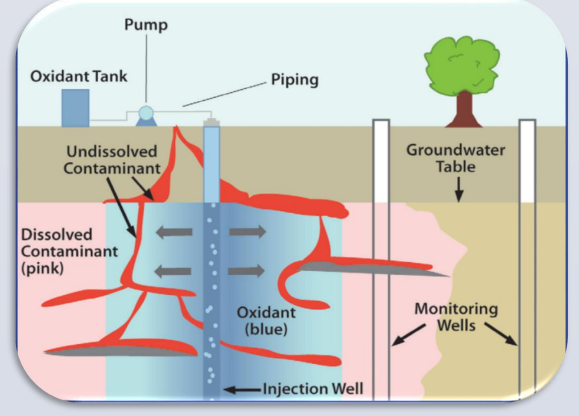
PERMEABLE ACTIVE BARRIERS

A permeable reactive barrier is a subsurface emplacement of reactive materials through which a dissolved contaminant plume must move as it flows, typically under natural gradient.



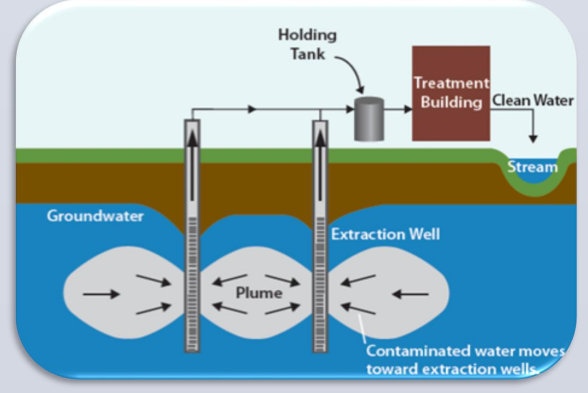
CHEMICAL OXIDATION

In situ chemical oxidation involves the introduction of a chemical oxidant into the subsurface for the purpose of transforming groundwater or soil contaminants into less harmful chemical species.



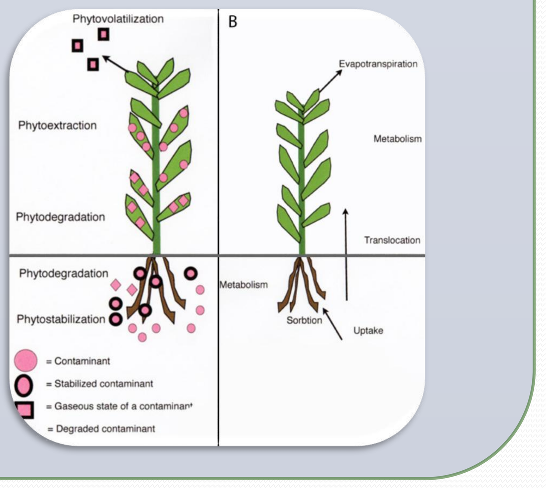
PUMP-AND-TREATMENT

Pump-and-treat methods involve pumping contaminated groundwater to the surface for treatment, with the use of a submersible or vacuum pump, and allowing the extracted groundwater to be purified by slowly proceeding through a series of vessels that contain materials designed to absorb the contaminants from the groundwater.



PHYTOTECHNOLOGY

Phytotechnology is broadly defined as the use of vegetation to address contaminants in soil, sediment, surface water, and groundwater.

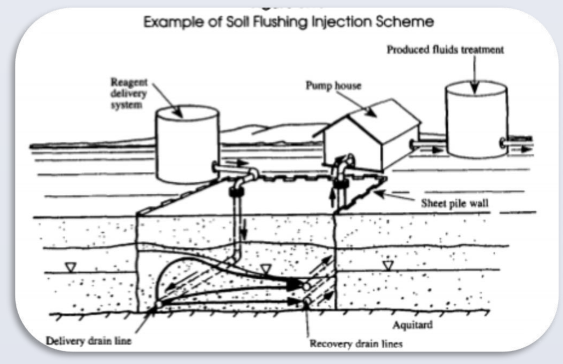


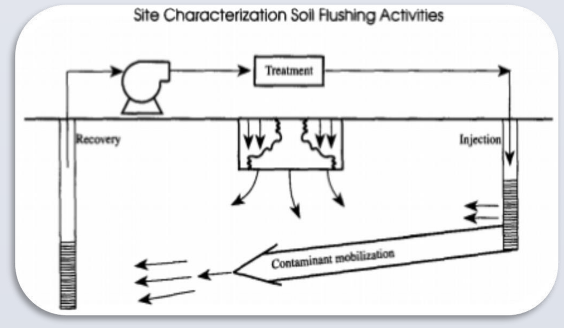
FINAL REMEDIATION CONCLUSION

In this study, we were able to observe a number of pollutants in the area, both in the soil and groundwater. The contaminants found are composed of pesticides, heavy metals, organic and inorganic compounds. According to the Superfund program, and abiding by section 121 (b) of the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) which requires permanent solutions to be used.

Of all the applicable technologies soil flushing was selected as this applies to the contaminants found at the site, does not affect the wellbeing of the community, takes less time to clean, is *in situ*, cost-efficient, and the soil can be reused. To reduce pollutants in the groundwater, the pump-and-treat method was selected with carbon filter since most of these pollutants are organic compounds which can be removed with this technology. This method is the most cost-efficient in the long run, takes less time than Permeable Reactive Barriers and it does not have a possibility to form secondary pollutants which could happen with the chemical oxidation method. These two Remediation technologies are used together to obtain better results. Finally, in order to select these technologies we considered the costs, remediation time, environmental and public health risks.

CONTAMINATED SOIL





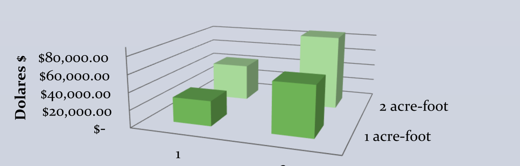
RISK ANALYSIS

- ✓ This technique of remediation is done in-situ so that avoids the risks inherent in the transport of contaminated from the site to the cleaning plant floor.
- ✓ During the digging of wells and cleaning, a team of air pollution control handles dust and other potential air pollution problems to avoid risks to the health of nearby communities.
- ✓ Excavations for wells in the contaminated soil could be affected and limited by nature of the deposits that make up the stratification, as well as the order or sequence with which deposits are formed.

Soil Flushing Comparative Cost Data				
	Volume (tons)			
	25000	50000	100000	200000
Capital Costs				
Plant Capacity	15 ton/hr	25 ton/hr	25 ton/hr	50 ton/hr
Plant Capacity Process Time	6 months	9 months	12 months	12 months
Plant Cost ($)	3000000	4500000	4500000	7500000
	Prices expressed in $/ ton			
Operating Costs				
Depreciation	40	30	15	12
MOB nnd DEMOB	8	4	3	1
'Normal* Site Prep	12	6	4	2
Material handling	15	15	15	15
Labor	30	25	20	15
Chemicals	15	15	15	15
Maintenance	8	6	4	2
Safety Equipment	3	3	3	3
Utilities	8	8	8	8
Process Testing	15	12	8	5
Disposal of Residuals 10% assumption	32	32	32	32
Managemetu/Exiginecring Overhead and Profit	70	60	48	40
NET PRICE (t/short tort)	256	216	175	150

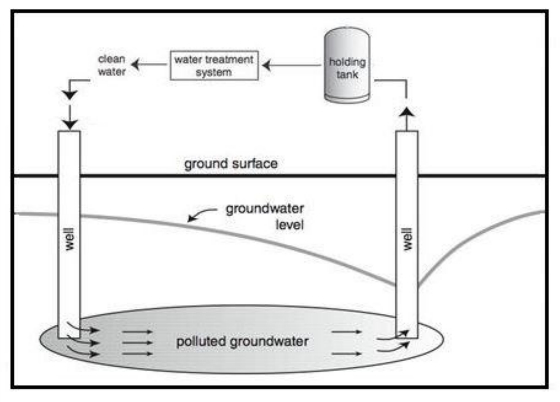
1ton=3.7 cubic yards		
1cubic yard= 0.27 tons		
1 acre-foot =	435.78	tons
2 acre-foot =	871.56	tons

SOIL TECHNOLOGY: Soil Flushing		
PARAMETERS	Scenario A	Scenario B
	Large Site (1 acre-foot)	Large Site (1 acre-foot)
	Easy	Difficult
Media/Waste Type	Soil	Soil
Contaminant	High Level Radioactive Material	High Level Radioactive Material
Approach	In situ	In situ
Contaminated Area (SF)	10,000	10,000
Depth to Groundwater (ft)	15	15
Soil Permeability (cm/s)	0.1	0.001
Safety Level	D	D
Number of Flushes	10	10
Flushing Solution	Surfactants and water	Surfactants and water
Subtotal Costs	$91,278	$134,266
CUBIC YARDS PROCESSED	1614	1614
COST PER CUBIC YARD	$18	$27
1acre-foot	$29,052.00	$58,104.00
2acre-foot	$43,578.00	$87,156.00
total for 1 acre-foot	120,330.00	192,370.00
total for 2 acre-foot	134,856	221,422



	1	2
1 acre-foot	$29,052.00	$58,104.00
2 acre-foot	$43,578.00	$87,156.00

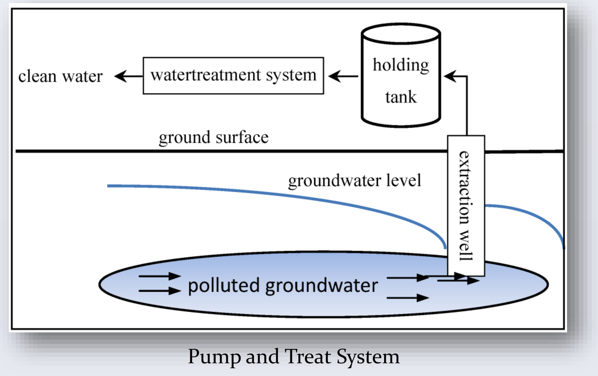
CONTAMINATED GROUNDWATER



Pump and Treat System with Activated Carbon Filter

RISK ANALYSIS

- ✓ Relatively safe procedure when designed and operated properly.
- ✓ This remediation does not cause any problem to the nearest public health as it does not come into contact with any contaminants.
- ✓ The only ecological risk of this remediation is doing the construction of the extraction system, since should be excavated and inject mineshafts which may affect uncontaminated soil.

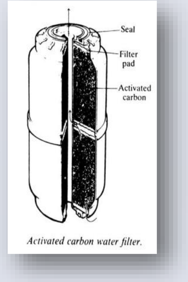


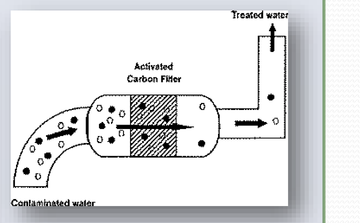
Pump and Treat System

COSTS

Based on the earlier analysis we found that the soil flushing and pumping and treatment with activated carbon remediation would be ideal for the PWIII. According to our research the installation costs of injection wells and pumping and treatment would have cost approximately $100 per foot of depth and the equipment would be approximately $200. The amount of deposits will be determined with a more in-depth research in the future. Surfactant quantities depend on the flow to be treat and the prices ranges from $0.75 to $1.08 per pound. The activated carbon filters costs range from $1,470.00 to $17,000.00 with a capacity of 14 gpm at 205 gpm. The quantity and capacity of the filters required will depend on flow treated.

Activated Carbon Filters





Activated Carbon Filter Mechanism

REFERENCES

http://archive.orr.noaa.gov/book_shelf/459_PesticideWarehouse.pdf
http://www.epa.gov/superfund/sites/docrec/pdoc1668.pdf
http://www.onsitepr.com/web/wp-content/uploads/2014/07/Statement-of-Qualification-2014.pdf
http://www.atsdr.cdc.gov/HAC/pha/PesticideWarehouseIII/PesticideWarehousePHA090905.pdf
http://www.epa.gov/superfund/sites/npl/nar1668.htm
http://www.crrt.nrt.org/production/NRT/RRTHome.nsf/resources/caribbean/$file/5_EPA_CEPD_May_2005.pdf
http://ciapr.org/ciapr.org/templates/CIAPR/Dimension/dimA25v3.pdf
http://www.manati.pr/datos_demograficos.html
http://www.manati.pr/pdf/mapa_manati.pdf
http://www.salonhogar.com/est_soc/pr/pueblos/manati/
http://www.lahistoriaconmapas.com/historia/historia2/geografia-e-historia-de-manati-puerto-rico/
http://www.slideshare.net/leonardoignacio/tecnologas-de-remediacin
http://www.frtr.gov/matrix2/section4/4-9.html
file:///C:/Users/Idalisse/Desktop/Soil%20FLushing/TechnicalBulletin13.pdf
http://www.frtr.gov/matrix2/section1/list-of-fig.html
http://infohouse.p2ric.org/ref/07/06188/
http://www.filterwater.com/p-157-gac-carbon-commercial-water-filter-system.aspx

ACKNOWLEDGEMENTS

For this project, we would like to thank our parents and family members for giving us their unconditional support, moral as well as economic in order to pursue our path and achieve our goal for a better future.

We also want to thank the Polytechnic University of Puerto Rico for molding us into excellent future environmental engineers.

In the same manner we would like to thank our professors who gave us the tools to complete this research. Also to Aluisio Pimenta PhD, PE, Cristian Villalta PhD who are always available to answer our questions. Last but not least we would like to give special thanks in particular to our mentor Eduardo R. Gonzalez P.E., MBA, MSChE, CEA and Mr. Luis Santos for helping us with this research.

PREs Environmental Solutions