IN-SITU BIO-REMEDIATION

Intro

Plants (phytoremediation)

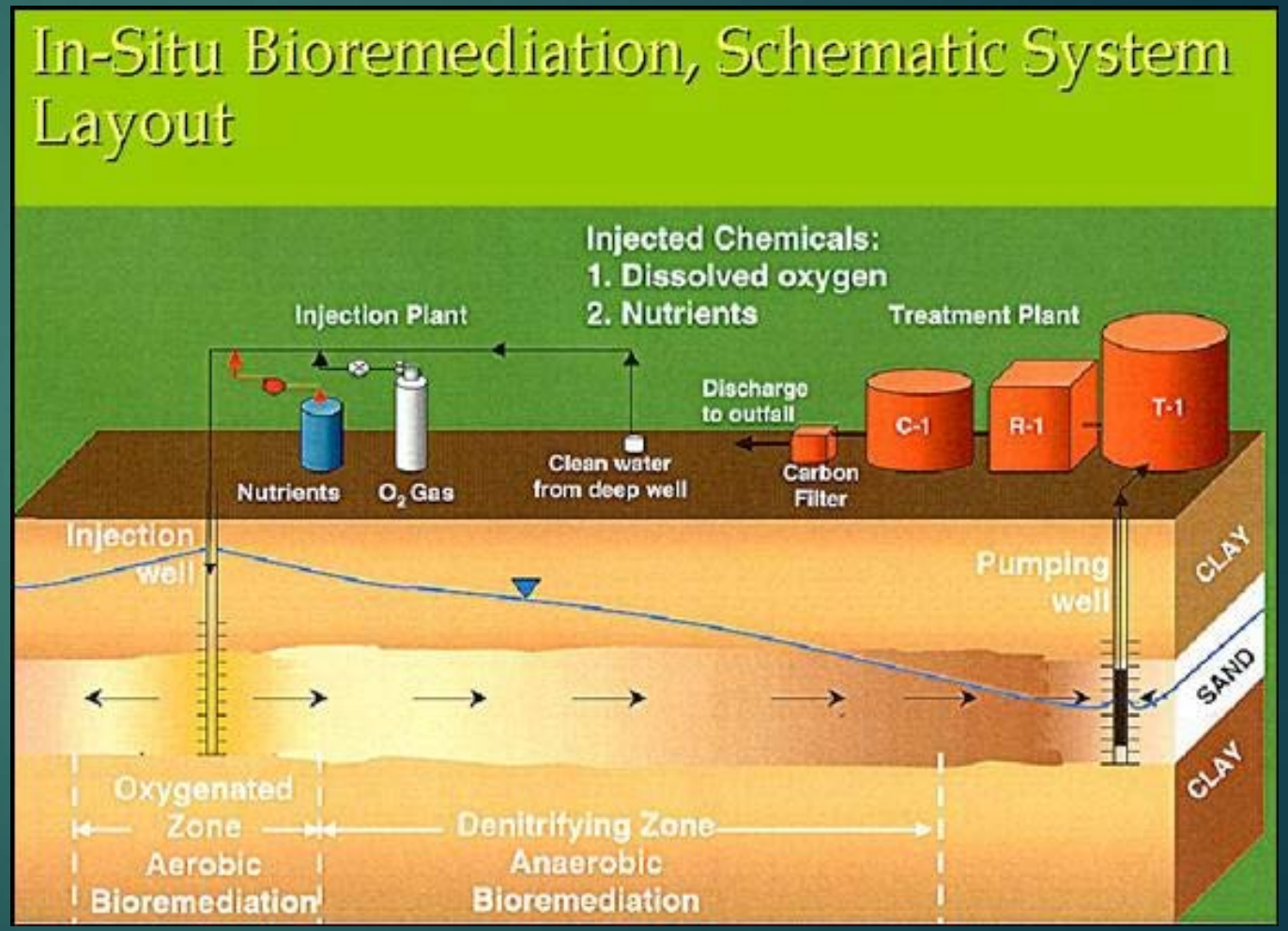
Microorganisms

E.g. Bacteria

E.g. Fungi

Nutrients

E.g. O,N,P



http://bioprocess.pnnl.gov/resour/rt3d.in.situ.bioremediation.htm

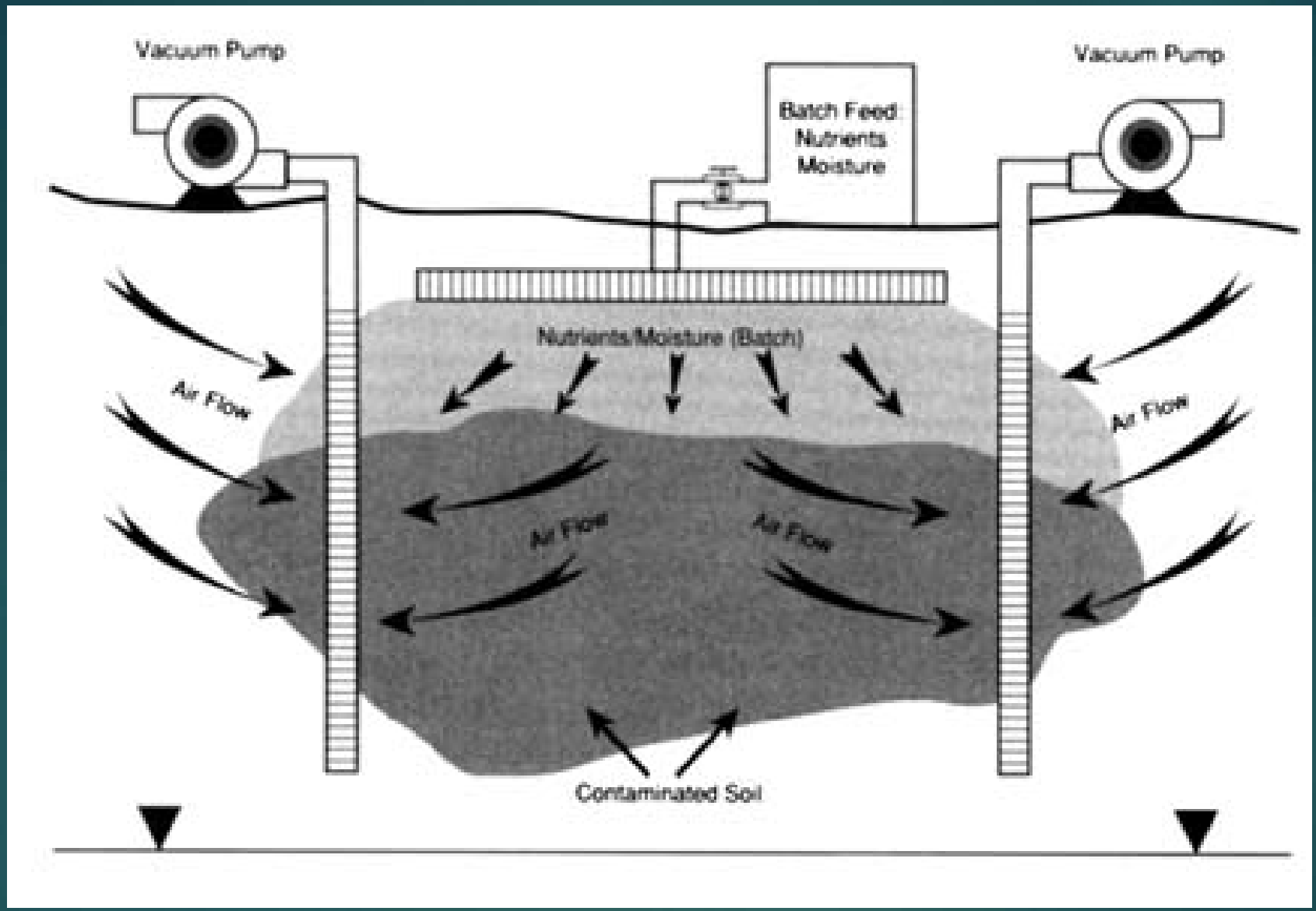
http://www.chickadeeusa.com/site%20remediation_files/image022.jpg

Plan for HSU

- HSU uses in-situ chemical oxidation
- In-situ bioremediation is a type of that
- Has been working so far
- Clay level underneath soil, helps maintain the process

Appropriate for HSU?

- Due to hydrocarbons in soil, yes!
- Microorganisms break down enzymes from oil
- Reduced risk of human exposure (in-situ)
- HSU took out much of contaminated soil
- What's left would be ideal for bio-remediation



http://www.nap.edu/openbook/0309048966/xhtml/images/img00006.jpg

Limitations

- Extremely specific and dependent to the environment
  - Site specific conditions must be met
  - HSU has a mixture of silt, sand, and clay
  - Does the pollutant serve as a sufficient energy source?
  - Is the substance compatible for biodegradation? Are there any competitors in the reaction?
  - Long periods of time needed for assessment

Cleanup Status History

DATE	STATUS
5/15/2015	Open - Site Assessment
8/28/2009	Open - Verification Monitoring
5/19/2004	Open - Site Assessment
1/14/2004	Open - Remediation
11/25/2003	Open - Site Assessment
8/5/2003	Open - Remediation
6/11/2003	Open - Site Assessment
4/25/1994	Open - Site Assessment
8/18/1993	Open - Site Assessment
8/5/1993	Open - Site Assessment
5/7/1992	Open - Site Assessment
5/7/1992	Open - Case Begin Date

Estimated Cost Analysis

Bioremediation Techniques:

--$50-$130 per cubic meter of soil

Incineration:

--$300-$1000 per cubic meter of soil

Landfill Disposal:

--$200-$300 per cubic meter of soil

Naseri M, Barabady J, Barabadi A. Bioremediation Treatment of Hydrocarbon-Contaminated Arctic Soils: Influencing Parameters. Environmental Science and Pollution Research, 21(19), pp 11250-11265. doi: http://dx.doi.org/10.1007/s11356-014-3122-2

Additional Cost Estimates

Bioventing:

--$13-$65 per cubic meter of soil

Solidification/Stabilization:

--$8-$1200 per cubic meter of soil

Soil Flushing:

--$75-$300 per cubic meter of soil

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