NewFields
Perspective. Vision. Solutions.

ECO-ENGINEERING

Ecological engineering is nature centric problem solving. Focused nudging of physical, biochemical, and geomicrobial processes can break the seemingly endless cycle of spiraling cost and illusive end points. Some call it Eco-Engineering. We call it responsible stewardship/beyond sustainability.

Working with nature and utilizing our total mastery of data, we develop sustainable, cost-effective solutions to complex environmental issues. This approach improves your business' bottom line while leaving a legacy of a resilient environment. Nature is self-sustaining and can rejuvenate itself, so why over-engineer when you can eco-engineer? Learn more about these innovative solutions:

- Passive Potentiometric Control
- Microbial Induced Calcium Precipitation
- Biochar
- Microbial Contaminant Degradation
- Zerovalent Iron and Nano-Zerovalent Iron
- Phytoremediation
- Wetland Bioreactors

How We Can Help

Our value is in preserving your company's reputation and balance sheet by resolving environment-related business challenges with emphasis on nature-based, eco-engineering solutions.

Ecological engineering is a powerful tool to accelerate actual or *de facto* closure and achieve renewal of land and water resources. Remediation, renovation, and restoration of resources through physical, biochemical, and biological ecosystem functions coupled with systems-based land reuse provide opportunities to go beyond sustainability.

We apply mastery of science, engineering, data, and communication so that decision makers can navigate complex environmental issues accurately and efficiently with the right information, in the right form, at the right time.

Passive Potentiometric Control

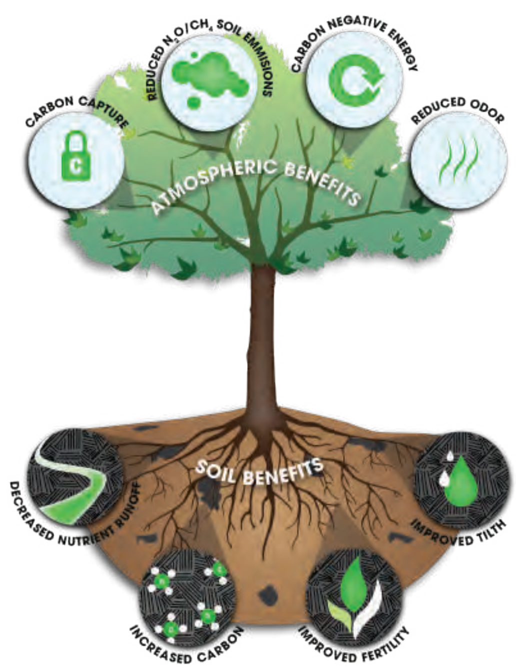
Passive potentiometric control is managing contaminant transport through low impact, low-cost, natural system management of hydraulic gradients. The approach reduces flux through a contaminated area by combining features such as decreasing flows with phytopumping, increasing downgradient groundwater elevations through gravity-fed elevated wetlands, and reducing upgradient groundwater elevation through "shadow" walls. The goal is to bring the rate of natural or enhanced attenuation in balance with flux rates with minimal human intervention over the long term.

Microbial-Induced Calcium Precipitation

Microbial-Induced Calcium Precipitation (MICP) is a process in which ureolytic bacteria hydrolyze a urea or nitrogen source. This process increases the alkalinity of the pore fluid and induces calcium carbonate precipitation. The precipitation of calcium carbonate binds the soil particles together and increases the density of the soil by decreasing its void ratio thus increasing shear strength and stiffness. MICP can be used to stabilize mine tailings, ash, and other residuals as well as to immobilize trace elements within the material. It is also used for carbon sequestration by trapping CO_2 as solid carbonates.

Biochar

Biochar is a relatively stable carbonaceous media made from the pyrolysis of biomass. It has been widely used for organic and inorganic contaminant removal in many different scenarios both in surface water and groundwater. Biochar's success has been linked to its unique chemical and physical characteristics and the capability of customizing the source material and manufacture to target a wide range of contaminants. A case study is detailed in this document.



Microbial Contaminant Degradation

The synthesis and degradation of anthropogenic organohalides, organochlorides, and other chlorinated compounds occurs naturally within a global cycle. Chlorinated compounds are susceptible to degradation with a multitude of naturally occurring bacteria and fungi present in subsurface soils, groundwater, wetland and forest soils, and sediments. Both anaerobic and aerobic bacteria frequently coexist with basidiomycete fungi which provides additional flexibility in designing contaminant removal strategies. The technical capability of understanding and quantifying the metagenomic bacterial ecosystems has advanced dramatically in just the last few years in terms of both cost and refinement. These advancements provide the opportunity to enhance and manage those communities to address specific environmental issues.

Zerovalent Iron and Nano-Zerovalent Iron

Zerovalent iron (ZVI) and nano-zerovalent iron have been widely used as a media for both adsorbing contaminants from water and destroying or mineralizing organic compounds, especially chlorinated compounds. ZVI has been used in groundwater remediation both in a barrier configuration as well as an injectable slurry. ZVI can be purchased from many different vendors worldwide in a range of particle sizes, morphologies, and with or without surface modified compounds. The ZVI can also be manufactured by heating iron oxides and adding hydrogen at high temperature or by grinding coarse material to more finely divided material. Recent advances, such as those favored by NewFields, include "green" manufacturing from inexpensive ferrous sulfate and easily obtained reducing agents extracted from various plant residues (e.g., tea, blueberry).

Phytoremediation

Phytoremediation refers to the use of plants, particularly trees, to remove, transfer, stabilize, and/or destroy contaminants in the soil and/or groundwater. Phytoremediation has seen a resurgence in the past few years as a less resource-intensive alternative to traditional active remediation approaches. Phytoremediation has been shown to be highly effective on a wide range of contaminants including VOCs, hydrocarbons, agricultural chemicals, soluble metals, and PFAS compounds while providing a sustainable and cost-effective solution to site remediation. NewFields' use of the TreeWell® system allows us to target very specific intervals in groundwater, up to a depth of 90 feet, while preventing clean water from becoming contaminated.

Wetland Bioreactors

NewFields has employed a number of bioreactors to passively treat water, particularly at mining sites. Bioreactors function as follows:

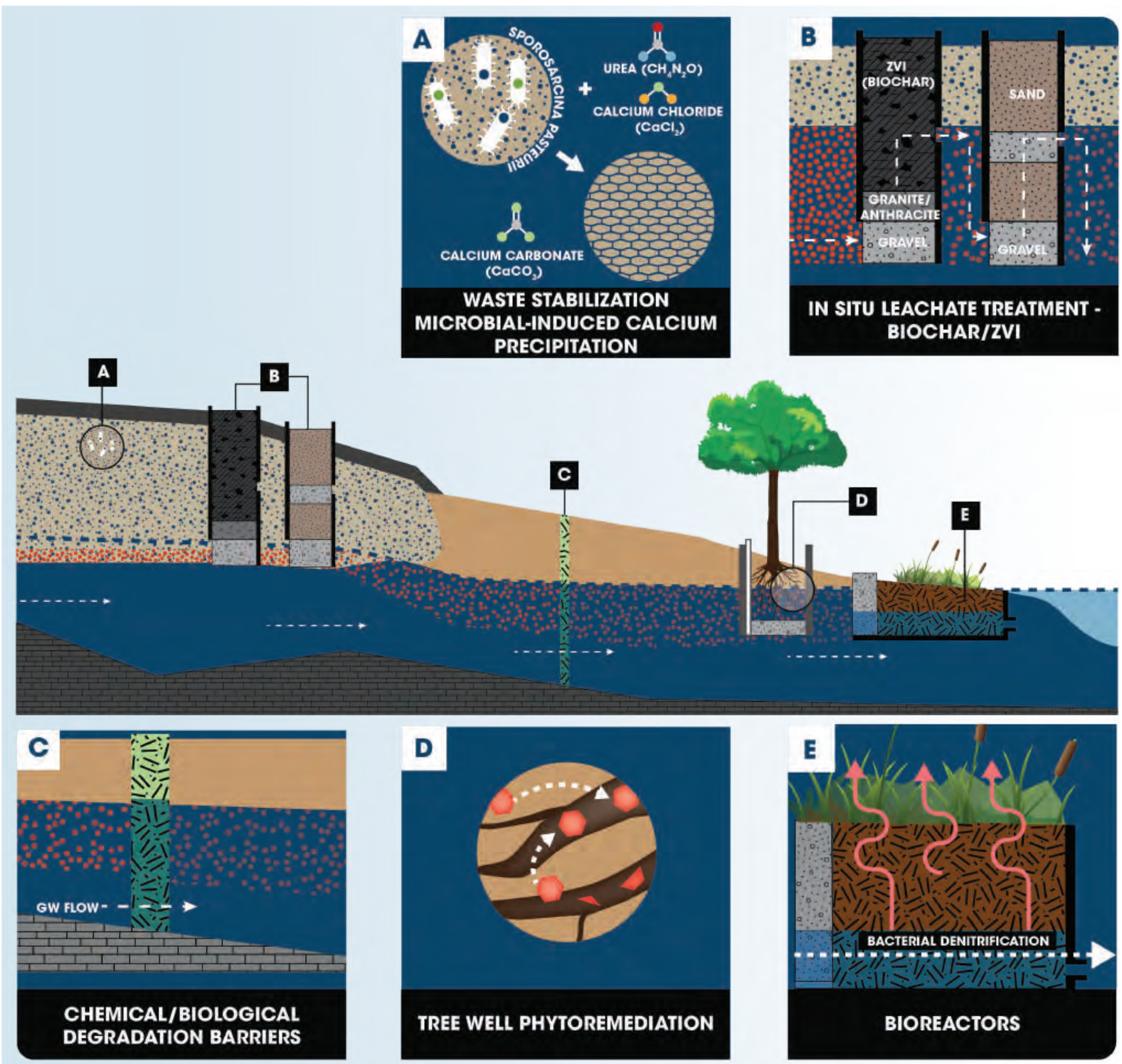
1. Under anaerobic conditions, bacterial reduction of sulfate to sulfide using a liquid carbon source SO_4
   SO_4^{2-} (sulfate) + $2CH_2OH$ (ethanol) = H_2S (sulfide) + $2HCO_3^-$ (bicarbonate)
2. The bicarbonate raises pH
3. The increase in pH decreases metals in the water
4. The sulfide also removes metals as metal sulfides, e.g. ZnS. The divalent metals in the mine/industrial water will react with sulfide and precipitate as sulfide solids.

Wetland Bioreactors (continued)

There are many reasons for the effectiveness of the wetland bioreactor systems in the mining industry:

- Gravity fed
- No sludge production
- Potential to separate and recover metals
- Low O&M, and
- Few moving parts.

NewFields has utilized bioreactors for many applications outside the mining industry as well. Bioreactors have been employed for treatment of industrial effluents containing various chemicals, including chlorinated compounds. The bioreactors can be configured as aerobic or anaerobic systems depending on the target chemicals and can be designed to function both above and below ground.



Case Study

THE CHALLENGE

Biochar Use for Stabilization of High Sulfide Tailings Concentrates

Storage of iron sulfide (pyritic) concentrates produced from gold/copper recovery mills is problematic due to the rapid oxidation of the high pyrite material leading to very acidic (pH 2) leachate in the storage area. This leachate can eventually acidify and increase the metal concentrations in underlying groundwater and nearby surface water bodies. NewFields has developed a rapid mix process that occurs during the production of the concentrates and prior to deposition where biochar alone, and with other chemicals, is added to prevent oxidation of the pyrites in the tailings. The bench testing of the process is complete and plans for a pilot test are in preparation.

THE APPROACH

NewFields will work directly with the client and complete an internal impact analysis associated with the proposed project. This will allow modifications to the project description to address potential impacts and implement mitigations measures as part of the proposed action prior to submittal of the permit application.

NewFields uses Eco-Engineering to improve our clients' bottom line and accelerate site closures while protecting the environment for generations to come.

The NewFields Difference

NewFields focuses on meeting the clients' needs while providing a quality product.

We promote the use of baseline environmental data to complete a plan that will minimize impacts resulting from the siting, design, operation, and closure of the project. This approach reduces the risk that a regulatory agency will develop alternatives or mitigation measures during the public/NEPA process that will affect the economics and feasibility of the project.

Let us help you with your next project and experience the NewFields difference!

Since 1995 we have been providing businesses with practical and tactical expertise. We collect, research, refine and provide the actionable intelligence needed to resolve your complex business needs.

About NewFields

NewFields is an environmental, engineering, and construction management consulting firm. We provide access to a global network of recognized experts and professionals who work together to resolve our clients' complex business needs.

Our talented staff is a diverse group of accomplished individuals, most of whom are senior level engineers, scientists, and specialists, who offer our client base both practical and strategic solutions.

We look forward to helping you achieve success and sustainability in a rapidly changing, interconnected world.

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