



**Earth Sustaining Sciences Group  
ESS Soil Bioremediation Process**

**Sustainable Shared Success Solutions**

**It is really so simple**



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## Introduction

### ESS Soil Bioremediation

- ESS Soil Bioremediation engages cost-effective, high impact bioorganics for reducing salinity, adjusting pH, restoring nutrients and sustaining organic structure in soils.
- The system utilises the globally proven ESS SABR BioReactor process developed to deliver processing solutions, environmental stabilisation, clean-up, and rehabilitation in mining an industry.
- Utilising locally sourced, natural bacteria cultivated to desalinate, adjust pH and improve organics, this system when applied in conjunction with cost effective natural soil binders to reduce moisture loss and erosion is a full-cycle sustainable process.
- The system operates by engaging the natural tendency of colonised naturally occurring bacteria to adjust their disturbed environment towards an optimum. Through selective and intensive cultivation of optimal bacteria in specialised reactor structures the system exerts a vigorous biochemical process to optimised soil conditions for sustainable agriculture.

### ESS Soil Bioremediation System



#### Cost Effective:

1. Utilises existing structures,
2. Low-cost new structures,
3. Laboratory and on-site development,
4. Multiple function system,
5. Staged advancement.

#### Minimum Change for Maximum Benefit:

1. Utilisation of existing,
2. Same tasks utilising consultant supervised & supported landholder managed improved process,
3. Staged application (small scale to broad scale),
4. Simplistic solutions to complex issues,
5. Sustainable advancement.

#### Natural Applied Bioorganics:

1. Local natural bacteria colonisation,
2. Symbiotic natural bioorganics,
3. Minimum maintenance systems,
4. Reduced external needs and influence,
5. Sustainable system.

#### Low Risk:

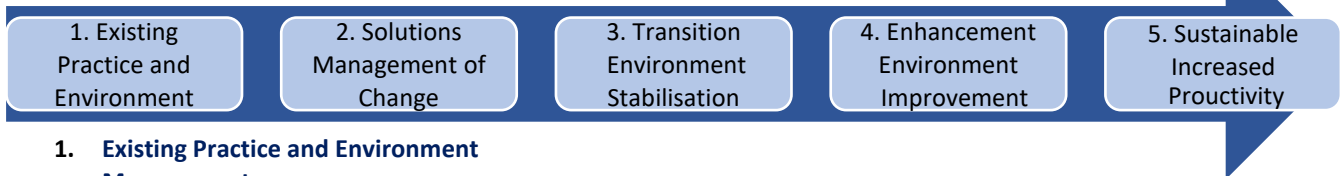
1. Simplified approach,
2. Local environment natural development and site-specific application,
3. Non-chemical,
4. Landholder controlled,
5. Sustainable environmental profile.

#### Localised Sustaining Practices:

1. Site developed, applied and managed,
2. Sustainable cost profiles,
3. Progressive land and crop enhancement,
4. Progressive reversal of land degradation,
5. Increased viability of environment.



### ESS Soil Bioremediation System



**1. Existing Practice and Environment**

**Management:**

- The progressive curbing of soils degradation through salts, metals and chemicals contamination,
- The remediation of water degradation through salts, metals and chemicals contamination,
- Soils remediation to optimal growing environments.

**2. Solutions through Management of Change:**

- Understanding of the real issues,
- Understanding of solutions and their applications,
- Design and implementation of management of change programme.

**3. Transition to Environment Stabilisation:**

- Stripping of soil contaminants,
- Stabilisation of soils,
- Bioorganic water remediation.

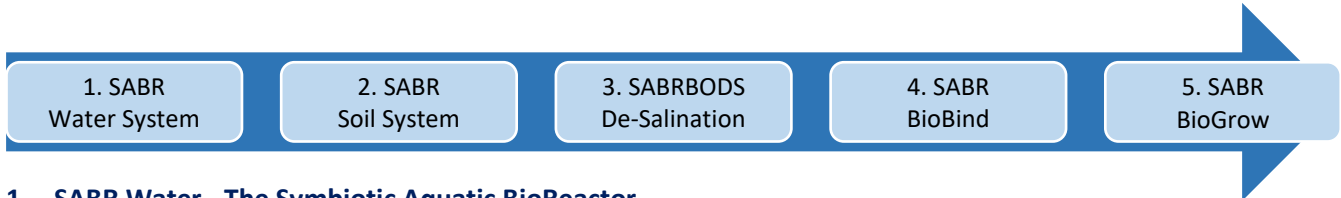
**4. Enhancement Delivering Environment Improvement:**

- Organic restructuring of soils,
- Organic nitrification of soils,
- Enrichment and conservation of irrigation water.

**5. Sustainable Increased Productivity:**

- Availability of improved soils,
- Availability of improved water,
- Reduced cost, improved output.

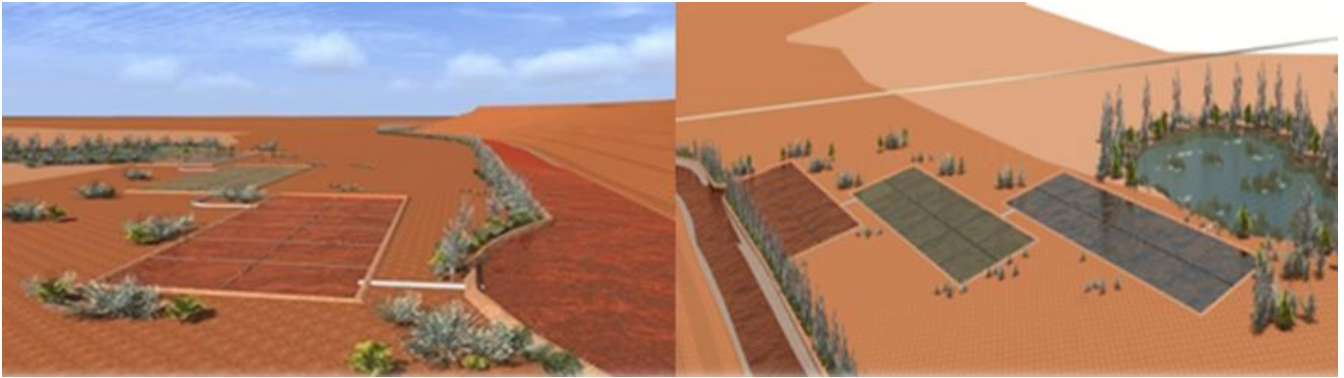
**The ESS Bioremediation System encompasses elements of:**



**1. SABR Water - The Symbiotic Aquatic BioReactor**

The SABR process was developed following 20 years of research and thus far proven to treat all levels of acid mine drainage (AMD), extreme alkaline process drainage, salinity and other metals and organic reagent contaminated waters and soils across several countries in many climates.

- SABR allows bioorganic remediation of sub-compliant water volumes utilising tailored bioreactors to correct pH issues at all levels (0-14 pH) and remove contaminants including, metals and salts; decreasing contamination of water, soil and the environment, thus reducing risk and increasing agricultural productivity. SABR is scalable to any required size and throughput using open systems. In situations where space is at a premium or contaminants may be especially hazardous, SABR can be implemented in closed systems.
- Complex chemistries often result in a system where conditions appropriate to strip one class of contaminants are conducive to stabilisation of others in solution. SABR allows serial reactor implementation using different sets of bio-cells, such that consecutive manifolds can control all contaminants.
- SABR can rapidly, naturally and cost effectively treat AMD/ARD and process waters to a standard that allows their safe use or disposal on site, or discharge off site with negligible risk and within compliance requirements. SABR is quick to implement and quick to bring online. Initial tailoring of the approach is through lab based wet chemistry, followed by small scale cost effective on-site pilot reactors to determine a site-specific bio-tuning and demonstrate that the full-scale system will deliver appropriate results.



SABR Three Stage Large Scale Multiple Bio-Cell Open System - 5.4 M/L system (225,000 LPH)

### 2. SABR Soil - Optimised Bioreactor for Soil Environments

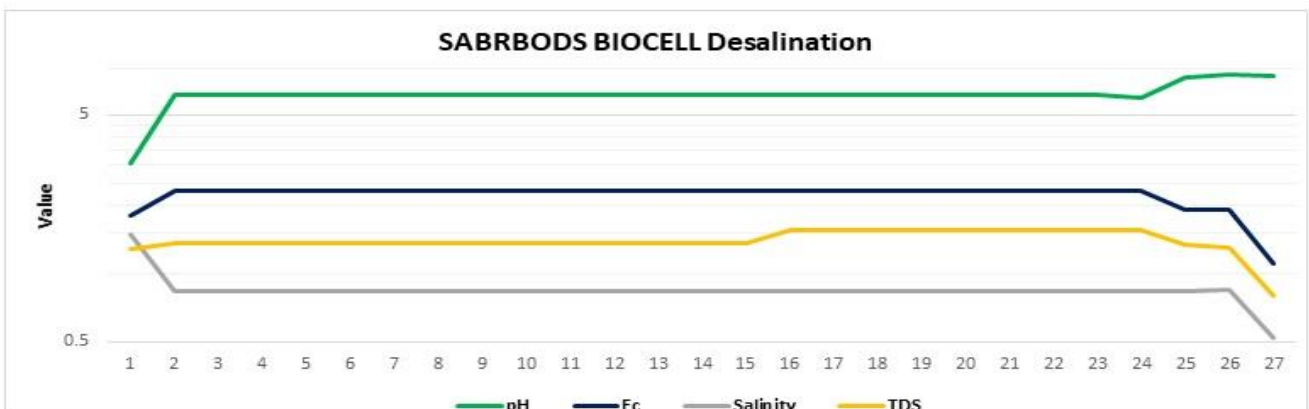
With tailored modification, the SABRSoil System accomplishes effective remediation of disturbed and contaminated soils utilising primary structured manifold microorganisms like the SABR aquatic reactor. The structured in-water and in-soil manifolds progressively remediate contaminants whilst allowing the system’s secondary bioorganic constituents to deliver balanced improvement in nutrient composition. As the system progresses, contaminant sequestration coupled with nutrient enrichment enables growth of a selected phyto-transformation crop as the final stage before appropriate planting or soil use.



SABRSoil System mine site results in 2000 hours

### 3. SABRBODS - BioOrganic Desalination System

ESS is at the forefront of low cost bioorganic desalination system research and development. (SABRBODS) To date, ESS’ new SABRBODS system has reduced seawater salinity by 71% and mine water salinity by 66% in both laboratory and field applications. ESS is currently progressing this exiting and widely applicable solution to bio-organic seawater desalination and industry and agriculture soil and water salinity solutions with practical applications across a range of agriculture, industry and societal sectors.



SABRBODS - BioDesalination of Mine Pit Water 2017



#### 4. SABRBioBind - Soil Binding and Management

ESS BioBind family of products are custom binding agents with blends tailored for specific applications. All are formulated from non-toxic organic and biodegradable components that present no environmental or OH&S issues. ESS BioBind solutions are an all-natural combination of minimal risk biotechnological, mineral and natural chemistry solutions. The solutions have been laboratory and field proven as highly cost-effective practical applications in a significant number of mines and disturbed land locations in South Africa and Australia with run-off and inward permeation control, wetting, conditioning in multiple soil types. ESS BioBind solutions exhibit exceptional reduction of erosion, transmittable dust and particulates for up to 70-days without repeat application compared with multiple costly water applications each day. ESS has demonstrated the ability for BioBind to stabilise surfaces for extended periods while being applied at minimal frequency over the course of the year. BioBindActive permits growth through bound soils, restricting from-soil evaporation while allowing to-soil water permeation.



#### 5. SABRBioGrow – Bioorganic Growth Support System

BioGrow is a phytonutrient accelerating natural growth system for crops and rehabilitation plantings, including dry or water-soak plantings. The system can also be blended with a permeable, soils and particulates' binder and stabiliser (BioBindActive) and can be applied at concentration and saturation rates tailored to the receiving medium and plant requirements. The solution binds the soil assisting in erosion and evaporation reduction, allowing to-soil permeation through the bound surface, maintaining the light seal reducing from-soil evaporation when dry. BioGrow can also be blended with BioSeal to manage soils and surfaces that present greater difficulty as required. The process sustainably improves the growth of crops and rehabilitation plantings, in dry to water soak plantings.

The BioBindActive solution binds and lightly seals the soil assisting in erosion and evaporation reduction, allowing permeation through the bound surface, maintaining the light seal when dry.



BioGrow only

BioGrow and BioBind Active

All-natural crop soil system



SABR Remediation system mine-site implemented design



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**Shared Success Sustainable Solutions**