GoldSET©
Evaluating your Sustainability Options
GoldSET Projects

- GoldSET has been used in Canada, Europe, Australia and the United States for evaluating site remediation alternatives in different sectors

- Recent GoldSET applications:
  - Point Nepean Community Trust: SD evaluation to support the redevelopment of the site for incorporation into the Mornington Peninsula National Park (Australia) – 2006 to present
  - Railway company: Contaminated sites planning (North America) – Ongoing
  - Federal Government: Customizing GoldSET to manage federal contaminated sites (Canada) – 2009
  - Municipality: SD assessment of a recycling project, as part of their Zero Waste Challenge (Canada) – 2009 to 2011
Sustainability: Two Levels of Application

1. To integrate sustainability principles in organizational management:
   - Benchmarking
   - Sustainability corporate plan
   - Carbon neutral strategies
   - Community involvement
   - Eco-efficiency

2. To integrate sustainability at the project level:
   - Decision support tools
   - Life-cycle analysis
   - GHG inventory
   - Eco-efficiency
   - Evaluation of social impacts
Sustainable Organizations: What are the Drivers?

Development of sustainable projects and businesses requires the management and cohesion of conflicting priorities:

- **Profit**: Corporate and shareholder value, stakeholders, industry, bankers
- **People**: Employees, Consumers, Communities, Countries (governments)
- **Planet**: Meeting global and local agreed upon environmental standards

Rising Stakeholder Expectations

Growing Complexity of Sustainability Issues

How to manage the pressure?

Multiplication of Principles, Indicators, Guidelines, etc.
There are multiple forums and groups working on the application of sustainable principles in remediation:

- SURF (Sustainable Remediation Forum) – US
- CLARINET (« Contaminated Land Rehabilitation Network for Environmental Technologies ») - Europe
- NICOLE (« Network for Contaminated land in Europe ») - Europe
- EURODEMO (« European Platform for Demonstration of Efficient Soil and Groundwater Remediation ») - Europe
- CalEPA Green Remediation Symposium / Sacramento, CA – February, 2009
Sustainability and Remediation


**Core elements**

1) Energy requirement of the treatment system
2) Air Emissions
3) Water requirements and impacts on water resources
4) Land and eco-system impact
5) Material consumption and waste generation
6) Long-term stewardship of actions

Section 6 of the document addresses the future opportunities of Green Remediation

- Building stronger communities
- Expanding the options for site reuse
- Increasing economic gains
- Increasing environmental benefits of cleanup
The traditional method of evaluating remedial options was based on:
- Objective
- Advantage & drawback
- Technical feasibility
- Cost

This traditional approach is now evolving. It now includes notions such as:
- Sustainability principles
- Wider environmental impact
- Direct and collateral impacts and benefits
- Socio-economic analysis

GoldSET was designed to take into account this new trend
GoldSET was designed to bring Sustainable Development at the operational level so that organizations can “Walk the Talk”

- Addresses the evaluation of the “Triple Bottom Line”: Economic, Social and Environmental.
- Transparent decision process for stakeholders, investors and regulators alike
- Provides a quantitative and qualitative evaluation
  - Measures direct and collateral impacts and benefits
  - Efficient and effective decisions
  - Easy to communicate and understand
- Tailored to the organization undertaking the activities
- Balanced, impartial and comprehensive, yet simple to us
- Reduces overall economic impacts through optimization
### Site Description
- Conceptualization of site conditions
- Evaluation is site specific
- Objective definition

### Indicators
**Includes:**
- Int’l Standards & Best Practices
- Corp. Objectives
- Legal Requirements

**Environmental**
- Natural Resources, Ecological Integrity, Energy, Waste, etc.

**Social**
- Health & Safety, QOL, Culture, Regulations

**Economic**
- NPV, ROI, Technological Regiments, etc.

### Scoring
**Quantification of indicators:**
- Specific to client requirements

**Evaluation of Options based on “Triple Bottom Line”**

**Structured system for ranking options:**
- Tailored scoring and weighing schemes
- Results are given by ternary diagram

**Eco-efficiency**
- Cost Benefit Analysis
- Stakeholder Concerns

### Interpretation & Reporting
**OPTION A**
**OPTION B**
**OPTION C**
**OPTION D**

Recommendations to support decision making:
- Tangible
- Transparent
- Optimized

Automated reporting (web version)
GoldSET: Quantitative Indicators

- Qualitative and Quantitative indicators may be quantified through customized GoldSET modules or other tools.
- All quantitative indicators (\$, t CO2 e, KWh, water usage …) can be calculated to compare relative scores of alternatives.
- Can be customized to fit the company’s tolerance to uncertainty.
The best approach from a sustainability standpoint is based on:

- The biggest, most balanced triangle.
- Highest performance in each dimension
- Balanced performance between all dimensions
- Local specificities must be considered in selecting the option
To provide a more detailed evaluation of remedial options a fourth dimension can be added to address technological aspects;

Indicators for the evaluation of the technical dimension would be geared towards the evaluation of detailed engineering and operational aspects of the alternatives.
Case Study: Site in Western Canada

Site conceptual model:

- Approx. half a million litres of weathered diesel estimated to be in subsurface from leaks and spills from former ASTs and locomotive fuelling area
- LNAPL thicknesses vary from 0 to 3 m in places.
- Depth to product approx. 16-18 m below grade
- Dissolved phase impacts present above guideline.
- Hydraulic gradient estimated to be 0.02 to 0.04 m/m
- Silty SAND, fine to medium grained
- Remedial action required as plumes appear to be migrating toward site boundary
## Case Study: Site in Western Canada

### Step 2 - Site Description: Conceptualization of the site conditions

### Project Objective and Constraints

### General Description

#### Zoning & Surroundings
Describe the zoning and the surroundings of the contaminated areas:

<table>
<thead>
<tr>
<th>The surrounding land use is generally commercial with some light industrial and agricultural. The nearest residential property is approximately 300 m from the Site boundary.</th>
</tr>
</thead>
</table>

#### Above Ground Infrastructure
Detail the above ground infrastructure on and around the contaminated areas:

<table>
<thead>
<tr>
<th>There is no above ground infrastructure on the contaminated area. There is one power line adjacent to the gravel road located north of the contaminated area running parallel to the road.</th>
</tr>
</thead>
</table>

#### Underground Infrastructure
Detail the underground infrastructure on and around the contaminated areas:

<table>
<thead>
<tr>
<th>There are no underground infrastructures on and around the contaminated areas; however, the ground surface is rough and undulating which has been a tripping hazard in the past.</th>
</tr>
</thead>
</table>
### Step 2 - Site Description: Conceptualization of the site conditions

#### Project Objective and Constraints

#### General Description

#### Site Geology & Hydrogeology

#### Site Contamination

**Contaminants**

Describe the contaminants on site:

<table>
<thead>
<tr>
<th>Contaminants</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Petroleum hydrocarbons, BTEX and F1-F4. The LNAPL at the site is weathered diesel.</td>
<td></td>
</tr>
<tr>
<td>Soil and groundwater have been sampled for PAHs, VOCs and lead; these compounds have NOT impacted the on-site media.</td>
<td></td>
</tr>
</tbody>
</table>

**Media Affected**

Describe the media affected on site:

<table>
<thead>
<tr>
<th>Media Affected</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soil and groundwater. Surface water is NOT affected.</td>
<td></td>
</tr>
</tbody>
</table>
Case Study: Site in Western Canada

Option Description

General description of the approach versus objective(s)
Provide a general description of the approach and explain how the approach will meet the project objective(s):

A system of four networks of recovery wells tie into the main VER unit to recover LNAPL.

Is the proposed approach expected to meet the objectives?
Yes

Description of technology

Technology
Provide a summary of the technology and explain how the technology will meet physical site constraints if any:

With product at depths of >12 m below grade, VER with air lines are known to produce enough lift to recover large volumes of LNAPL.

Additional Testing Required
Detail additional testing required if any:

A pilot test should be conducted at the site prior to system design.

Machinery and System Components
Describe the machinery and physical components required (succinct description of main components only):

VER unit in series with a biological percolation unit, followed by a water treatment unit (activated carbon and clay), followed by an

Is the proposed approach technically feasible given site constraints?
Yes
### Case Study: Site in Western Canada

#### Step 4 - Indicator Selection

**Manage Indicators**

<table>
<thead>
<tr>
<th>Environmental Aspect</th>
<th>Selection</th>
<th>Indicator</th>
<th>Description</th>
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<tbody>
<tr>
<td>Soil Quality</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sediment Quality</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Soil Vapour Intrusion</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Groundwater Quality</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Free Product</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Surface Water Quality</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Water Usage</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Drinking Water Supply</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Off-Site Migration</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Short-Term Impacts on Biodiversity and Species Status</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Long-Term Impacts on Biodiversity and Species Status</td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

**Free Product**

Assesses the recoverable and mobile free product (LNAPL or DNAPL) that will be managed by the option. Not applicable if there is no free product on site.

**Scoring Scheme:**
- 0 = No removal
- 50 = Partial removal
- 100 = Complete removal of mobile and recoverable free product

**Water Usage**

Water Quality Management on Sensitive Areas & Prevention of Off-Site Migration

**Ecological Integrity**

Impact Reduction on Sensitive Areas & Prevention of Off-Site Migration

**Reference**

1  
2  
3  
4  
5  
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13 
14 
15
## Case Study: Site in Western Canada

### Energy & GHG Estimation Module
Winterized VER Unit and annual O&M

<table>
<thead>
<tr>
<th>SUB TOTAL (Without Renewable Energy)</th>
<th>Energy Consumed</th>
<th>GHG Emissions</th>
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<tbody>
<tr>
<td></td>
<td>83 (GJ PFE)</td>
<td>6 (t CO2 e)</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>GRAND TOTAL (With Renewable Energy)</th>
<th>Energy Consumed</th>
<th>GHG Emissions</th>
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<tbody>
<tr>
<td></td>
<td>83 (GJ PFE)</td>
<td>6 (t CO2 e)</td>
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### Construction

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<thead>
<tr>
<th>Activity</th>
<th>Type</th>
<th>Size</th>
<th>Qty</th>
<th>Energy Type</th>
<th>Duration (days)</th>
<th>Frequency / Distance</th>
<th>Energy / Fuel Consumption</th>
<th>Energy / CO2 Consumption</th>
<th>GHG Emissions</th>
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</thead>
<tbody>
<tr>
<td>Drilling</td>
<td>Drill rig</td>
<td>Medium - 2.75 to 12.5 Lhr or 7</td>
<td>1</td>
<td>Diesel</td>
<td>20</td>
<td>10 holiday</td>
<td>8</td>
<td>61.20</td>
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<td>Gasoline</td>
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<td></td>
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<tr>
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<td>Gasoline</td>
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<td>Light-Duty Diesel Trucks 3 and 1</td>
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<td>Diesel</td>
<td>20</td>
<td>200 l/hr</td>
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<tr>
<td>Drilling</td>
<td>Other Equipment</td>
<td>Select a category ...</td>
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<td>Other Equipment</td>
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<td>Gasoline</td>
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<tr>
<td>Drilling</td>
<td>Other Equipment</td>
<td>Select a category ...</td>
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<td>Gasoline</td>
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</table>

**Done**

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Golder Associates
## Case Study: Site in Western Canada

### Step 6 - Evaluation of Options

<table>
<thead>
<tr>
<th>Environmental Aspect</th>
<th>Code</th>
<th>Indicator</th>
<th>Recovery Trench at property boundary &amp; pump product</th>
<th>Pump and Treat prevent offsite migration</th>
<th>Winterized VER Unit and annual O&amp;M</th>
<th>Do Nothing</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>ENV-1</td>
<td>Soil Quality</td>
<td>0</td>
<td>50</td>
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<td>ENV-2</td>
<td>Groundwater Quality</td>
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<td>ENV-3</td>
<td>Free Product</td>
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<td>90</td>
<td>100</td>
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<tr>
<td></td>
<td>ENV-4</td>
<td>Surface Water Quality</td>
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<tr>
<td></td>
<td>ENV-5</td>
<td>Water Usage</td>
<td></td>
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<td></td>
<td>ENV-6</td>
<td>Off-Site Migration</td>
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</table>
## Case Study: Site in Western Canada

<table>
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<th>Winterized VER Unit and annual O&amp;M</th>
<th>Do Nothing</th>
<th>Weight</th>
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</thead>
<tbody>
<tr>
<td>SOC-1</td>
<td>Public Safety</td>
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<td>50</td>
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<td>SOC-2</td>
<td>Worker’s Safety</td>
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<td>SOC-3</td>
<td>Duration of Work</td>
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<td>100</td>
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<tr>
<td>SOC-4</td>
<td>Quality of Life (During the Project)</td>
<td>100</td>
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<tr>
<td>SOC-5</td>
<td>Reuse of the Property by the Corporation</td>
<td>50</td>
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<tr>
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<td>Use for the Public</td>
<td>50</td>
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<td>SOC-8</td>
<td>Local Job Creation and Diversity</td>
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<td>100</td>
<td>100</td>
<td>0</td>
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<td>SOC-9</td>
<td>Response to Social Sensitivity</td>
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<td>50</td>
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<td>Standards, Laws and Regulations</td>
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</tr>
</tbody>
</table>

**Economic Aspect**
Case Study: Site in Western Canada

- **Recovery Trench at property boundary**
  - Environment: 40%
  - Society: 29%
  - Economics: 35%

- **Pump and Treat prevent offsite migration**
  - Environment: 40%
  - Society: 50%
  - Economics: 53%

- **Winterized VER Unit and annual O&M**
  - Environment: 72%
  - Society: 71%
  - Economics: 58%

- **Do Nothing**
  - Environment: 12%
  - Society: 12%
  - Economics: 54%

Project Cost:
- Recovery Trench: $2,100,000.00
- Pump and Treat: $1,100,000.00
- Winterized VER: $1,800,000.00
- Do Nothing: $0.00

Project Duration:
- Recovery Trench: 30 years
- Pump and Treat: 30 years
- Winterized VER: 10 years
- Do Nothing: 30 years
Case Study: Site in Western Canada

What did we learn?

- Is the basis for a good understanding of the site conceptual model
- Anticipate Health and Safety or logistical issues for design and construction
- Tweak the energy consumption by installing other equipment, to renewable energy source
- VER option scores well on Environmental indicators
- VER option scores well on many Social indicators
- Helped client to participate and ‘believe’ in the remedial option chosen – transparent and visual
- Efficient reporting
Conclusion

GoldSET:

- Is a hands-on visual tool
  - Transparent decision making
  - Simplifies an abstract concept
  - Helps manage business risk

- Provides tangible benefits
  - Saves money by identifying improvements
  - Re-engineering & optimization
  - Positive corporate image
  - Good communication tool of impacts & benefits
Conclusion

- Effective Performance
- Responsible Development
- Sustainable Communities

Questions?