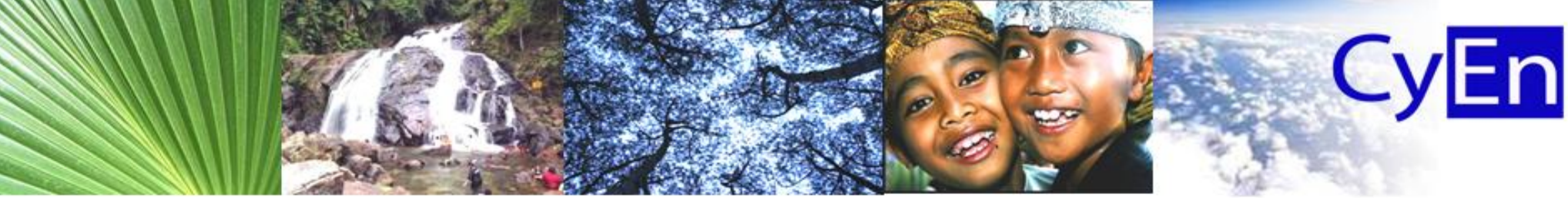

20th EAROPH WORLD CONGRESS & MAYOR CAUCUS

Sustainable Human Settlement For A Better Quality OF Live

SUSTAINABLE APPROACH TO SAFE CLOSURE, REHABILITATION & CAPACITY EXTENSION OF LANDFILLS IN MALAYSIA

by

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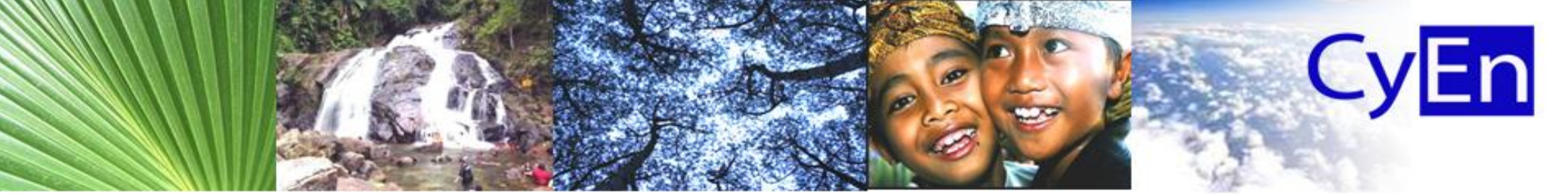


Landfills in Malaysia

- Landfills are widely used as the predominant form of final disposal of solid waste
- The majority of these landfills are dumpsites and non-sanitary with limited or no environmental pollution control measures provided
- Mostly located on ex-mining lands, swampy grounds or convenient disposal sites on state land with low economic land value
- Environmental pollutions emanate from these landfills/dumpsites to the surrounding areas
- Causes health and safety risks to local communities

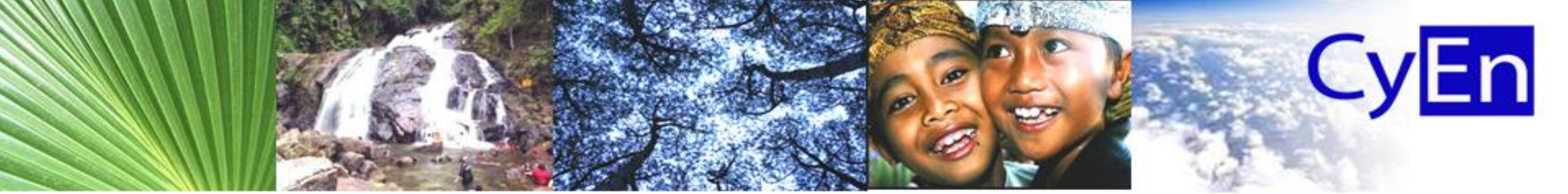
Exact nos. of landfills in Malaysia remains not fully known:

1990: 230 landfills

2004: 170 landfills

2006: 231 landfills; 15 sanitary landfills

46% of existing landfills will be closed within the next 5 years

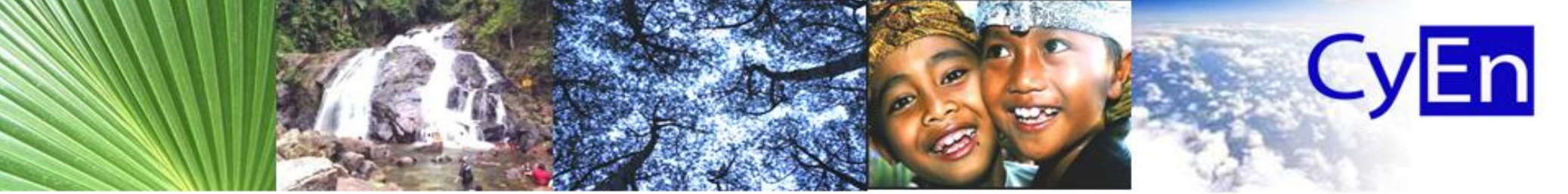


Environmental Impact

LEACHATE

- Leachate is formed when:
  - **Water or any liquid passes through household waste**
  - **Rainfall, surface water and/or groundwater passes through wastes in any waste disposal sites**
- Responsible for contaminating ground water supplies and surface water ecosystems in communities all over the world
- **Highly contaminated** & **hazardous** with high BOD, COD, ammonia, lead, cadmium, chromium, mercury, toluene, organophosphates, etc.
- Extent of damage by leachate is unknown due to complexity of leachate flows within landfills and the complex systems of aquifers



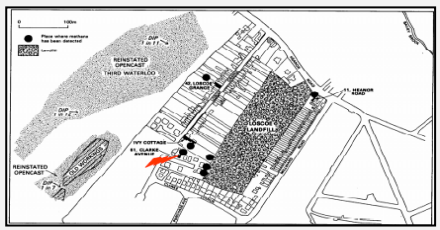
Environmental Impact

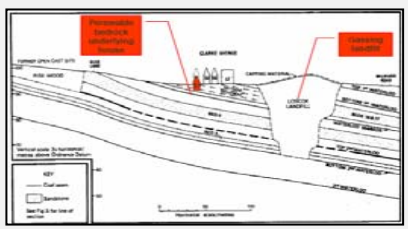
LANDFILL GAS

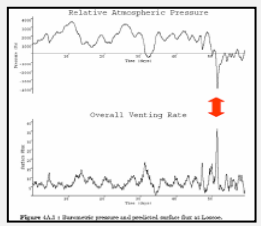
- Consists mainly of **methane (CH_4)** & **carbon dioxide (CO_2)**
- Methane gas (CH_4) is **colourless, odourless and poisonous with asphyxiate properties but can be destroyed through flaring**
- Methane gas concentrations in **excess of 5% are explosive**. Landfill gas may collect in uneven pockets within the landfill, gradually seeping through the ground or waste mass, or building up pressure until an explosion or uncontrolled fire occurs
- Landfill gas migration causes the 'greenhouse gas' (GHG) which affects climate change because **methane (CH4) traps over 21 times more heat per molecule than carbon dioxide (CO2)** in accordance with Climate Change Convention

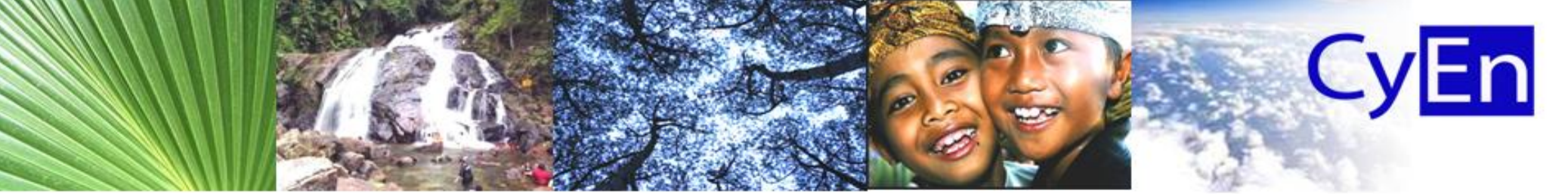
Case Study: **Loscoe Incident, Derbyshire, United Kingdom**

Explosion occurred 24 March 1986 in a bungalow following the largest barometric pressure drop ever recorded overnight of 4.8mbar/hr. Landfill gas had seeped from the landfill into the basement resulting in an explosion that caused injury to the occupants and damage to the building







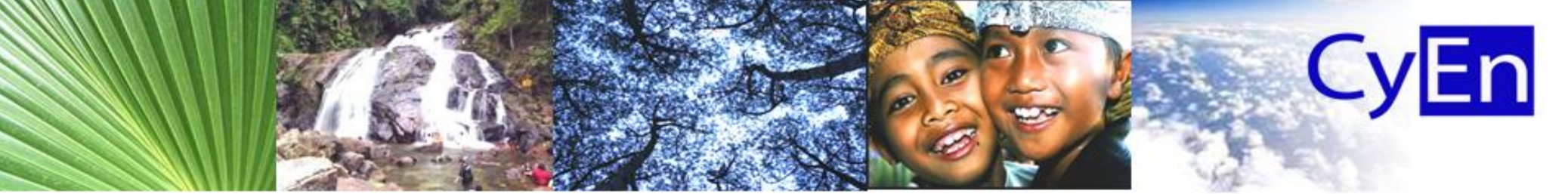


Environmental Impact

SURFACE WATER CONTAMINATION

- More than 90% of existing waste disposal sites are open dumps without proper liners and treatment process installed
- Majority of existing waste disposal sites do not have countermeasures for groundwater protection (e.g. bottom liners) and installation of monitoring wells
- Raw leachate is highly contaminated and its uncontrolled flow to nearby ground and water courses can cause environmental pollution and pose high health and safety risks to surrounding communities
- More than 10% of waste disposal sites are located upstream of water intake points to drinking water treatment facilities – ***causing potential risk to the drinking water system and possible contamination of the public water supply***



Safety Risks

SLOPE STABILITY

- Forming of steep and non-engineered side slopes
- Critical slope stability issues
- Failure of waste stability causes catastrophic consequences that result in loss of lives, damage to adjacent properties and disruptions to surrounding communities

Case Studies:

1. **Kampung Sundang Darat, Sandakan, Malaysia**

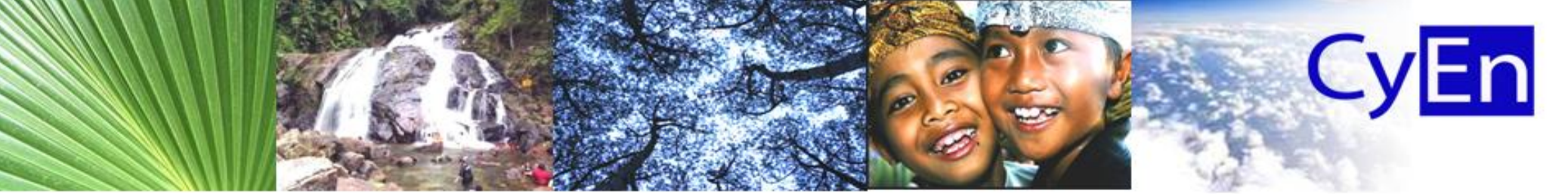
   A landslide of timber wastes on 6 February 2006 killed 3 persons and severely damaged 15 houses

2. **Leuwigajah Dumpsite, Bandung, Indonesia**

   On 21 February 2005, an avalanche of 2.7 million m^3 wastes occurred after 3 days of heavy rain which killed 55 persons, 101 persons were missing and more than 70 homes were destroyed

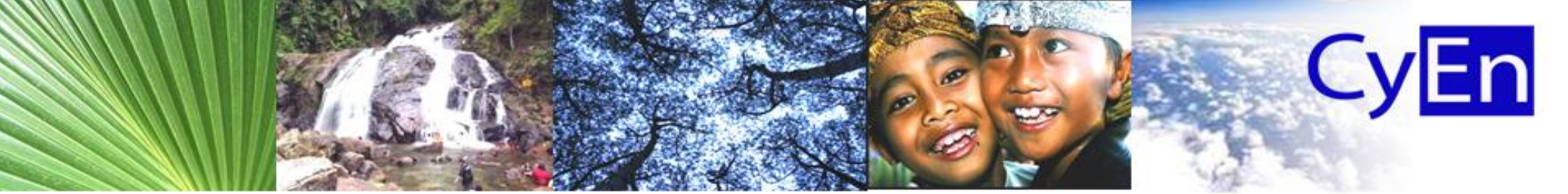
3. **Payatas Dumpsite, Quezon City, Philippines**

   On 10 July 2000, 1.2 million m^3 of mud and wastes moved down like an avalanche burying and destroying homes in its path. In the aftermath, 230 persons were killed and more than 800 persons were missing



Closure & Rehabilitation

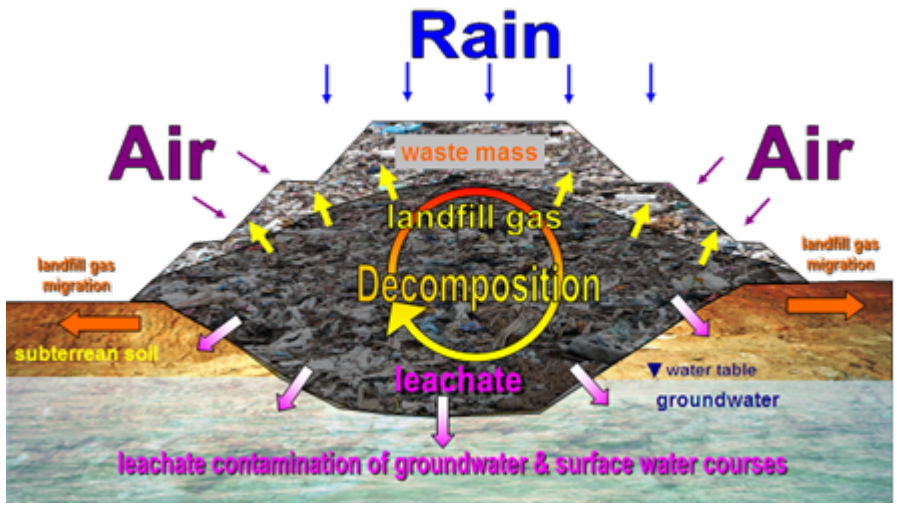
Case Study: TAMAN BERINGIN LANDFILL, Kuala Lumpur



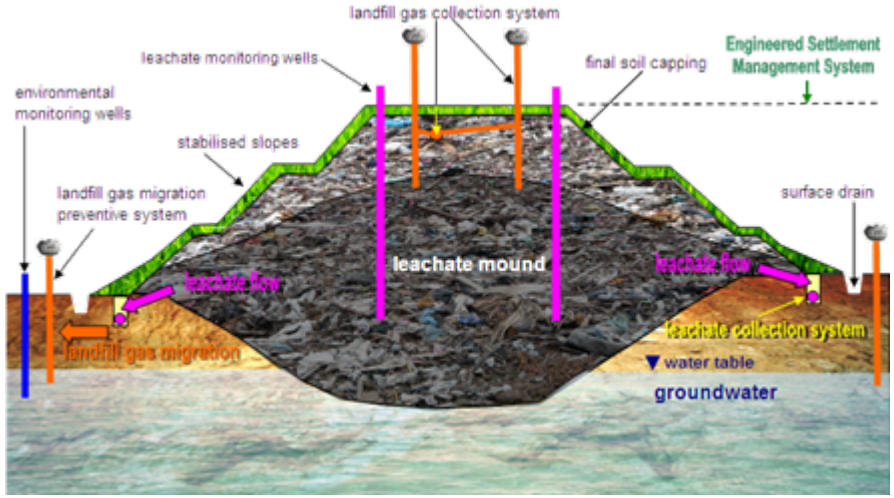
Our Technology - SER©

Sustainable Engineered Rehabilitation (SER)® System

CyEn developed the **'Sustainable Engineered Rehabilitation (SER)® System'** for the safe closure and rehabilitation of any dumpsites or non-sanitary landfills

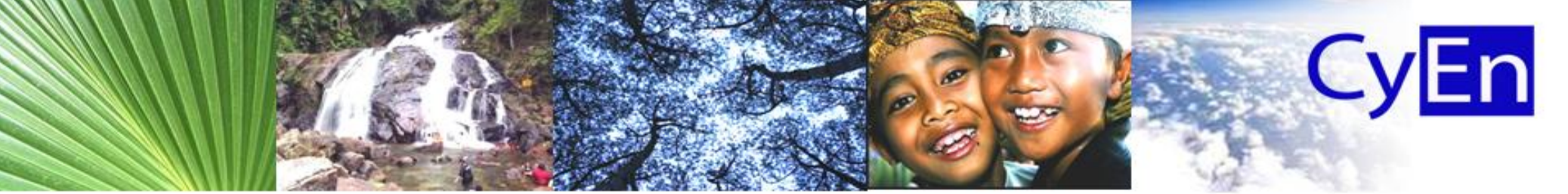


Dumpsite or Non-Sanitary Landfill



Properly-closed Dumpsite or Non-Sanitary Landfill using CyEn's SER® System

[implemented for the safe closure and rehabilitation of the Taman Beringin Landfill (Dumpsite)]



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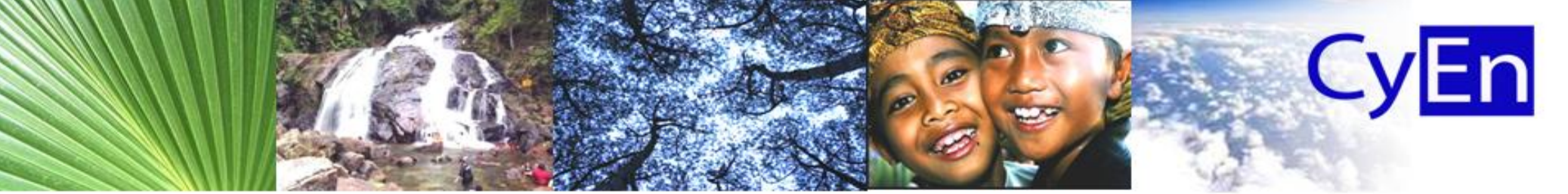
Sustainable Engineered Rehabilitation (SER)® System

Environmental Site Assessment

- Environmental investigation
- Hydrogeotechnical investigation
- Landfill gas assessment & monitoring
- Groundwater and surface water assessment & monitoring

Leachate Treatability Trials

- Leachate sampling & testings
- Leachate characterisation
- Leachate assessment & monitoring



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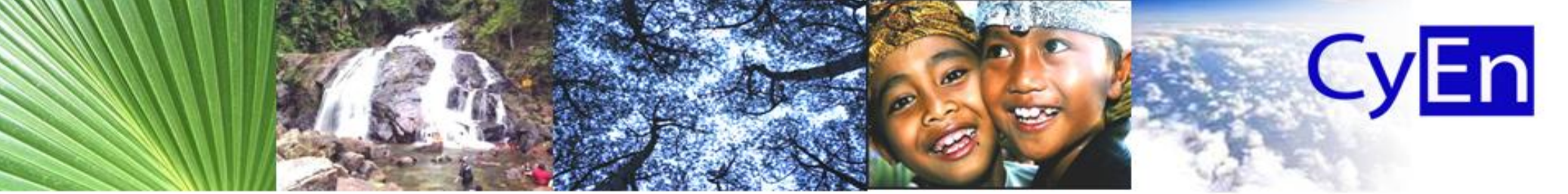
Sustainable Engineered Rehabilitation (SER)© System

The leachate collection management system consists of:

- Installation of the final soil capping. Leachate generation in landfill had reduced from 1,000 m3/d to 200 m3/d after completion of the final capping works
- Installation of leachate monitoring wells
- Construction of separate drainage system to segregate stormwater from leachate

Leachate Collection System

Stormwater Drainage System



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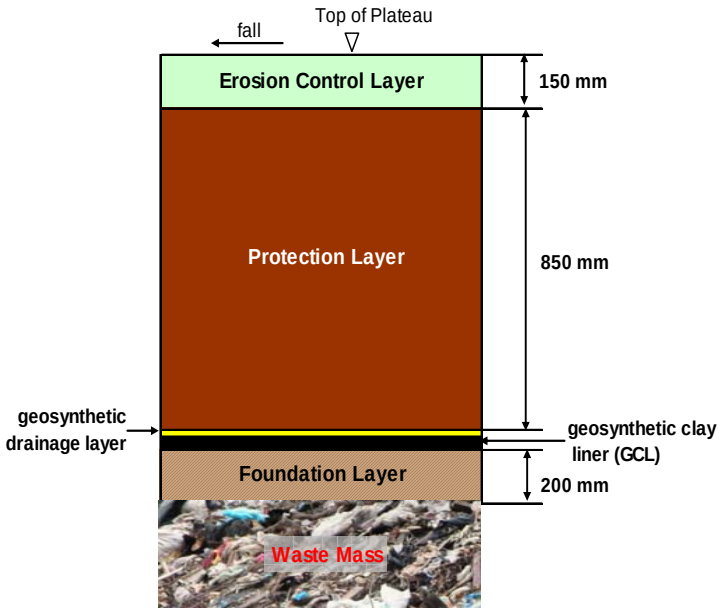
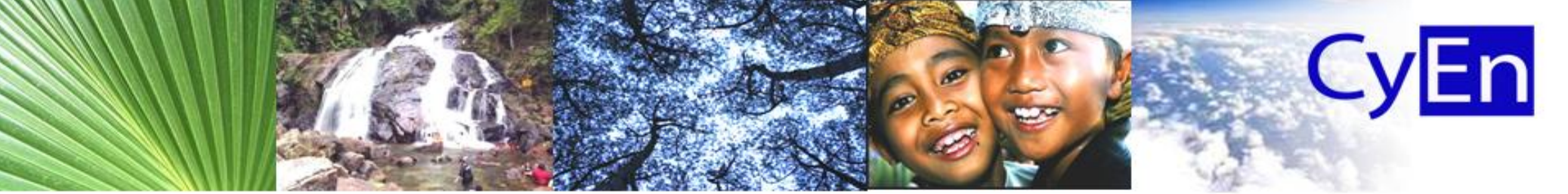
Sustainable Engineered Rehabilitation (SER)® System

Final soil capping system effectively prevents the infiltration of rain water into the waste mass through application of :

- Geosynthetic clay liner (hydraulic conductivity 1x 10^{-11} cm/sec, better than clay)
- Geosynthetic drainage layer
- Protection layer (minimum 850mm thick)
- Soil erosion layer (minimum 150mm thick)



Final Soil Capping System



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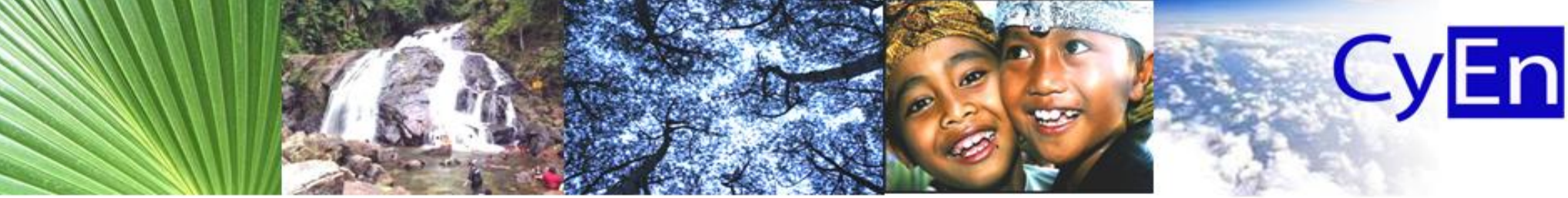
Sustainable Engineered Rehabilitation (SER)® System

Final Soil Capping System at Base of Landfill

Final Soil Capping System on Side Slopes of Plateau



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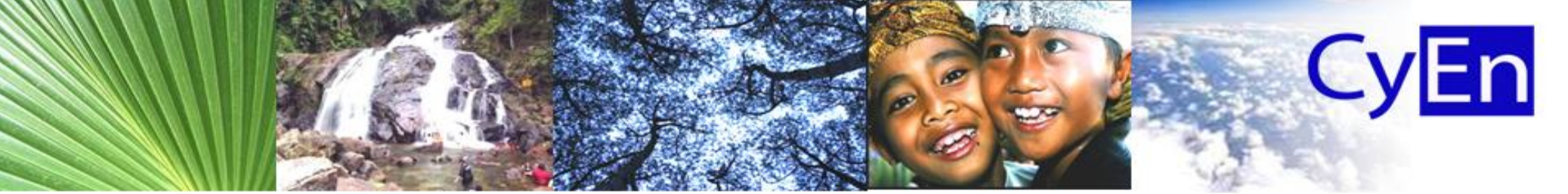
Sustainable Engineered Rehabilitation (SER)® System

Final Soil Capping System at Plateau of Landfill



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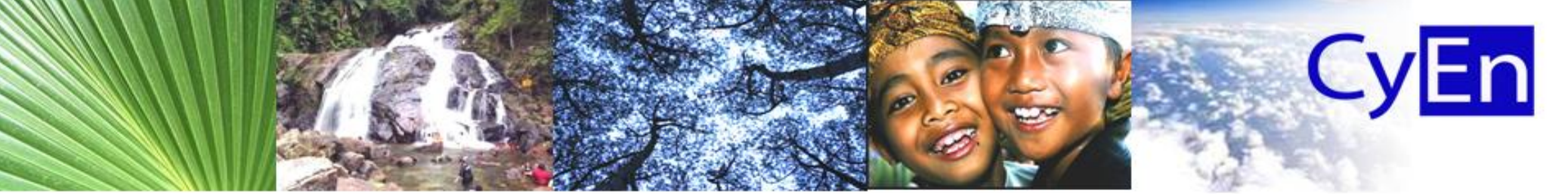
Sustainable Engineered Rehabilitation (SER)® System

Application of **BEST PRACTICABLE ENVIRONMENTAL OPTION (BPEO)** in determining the treatment of leachate through:

- Leachate treatability trials and characterisation
- Selection of a leachate treatment process is highly site specific and is dependent on:
  - Effluent discharge standards and alternatives
  - Land availability at site
  - Treatment process residuals
  - Cost-effectiveness of treatment
  - Permit requirements



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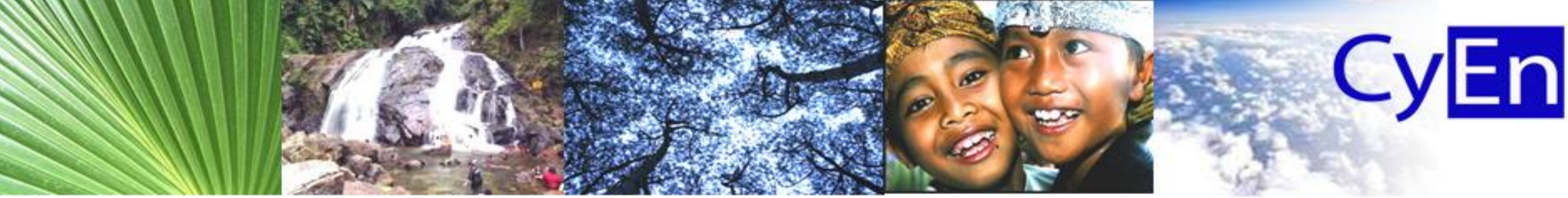
Sustainable Engineered Rehabilitation (SER)® System

The landfill gas management system consists of:

- Installation of landfill gas venting pipes as landfill gas barrier against migration of landfill gas to populated areas nearby
- Installation of landfill gas monitoring wells





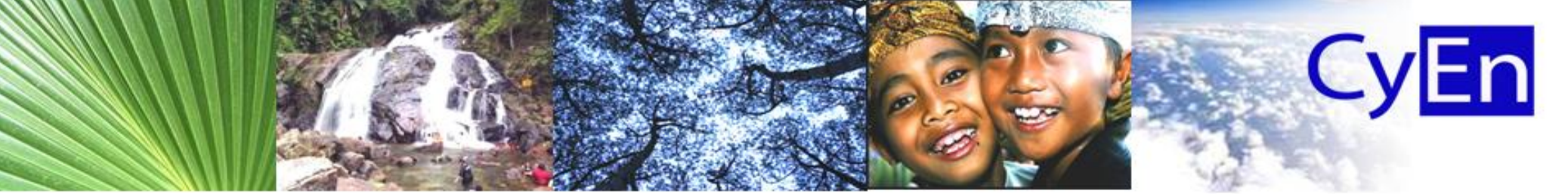
Post-Closure Services

Aftercare

Aftercare involves any measures that are necessary to be taken in relation to the facility for the purposes of preventing environmental pollution following the cessation of dumping or landfill activities at the facility and the capping and rehabilitation of the site. The length of the aftercare period will vary from site to site.

Aftercare involves the operations, maintenance, collection, testing and monitoring of environmental hazards and physical site attributes of the safely closed dumpsite or landfill, e.g.:

- ❑ Leachate
- ❑ Landfill gas
- ❑ Groundwater
- ❑ Surface water
- ❑ Ground settlement
- ❑ Slope
- ❑ Facility maintenance
- ❑ Leachate Treatment Plant – Operations & Maintenance



Post-Closure Utilisation

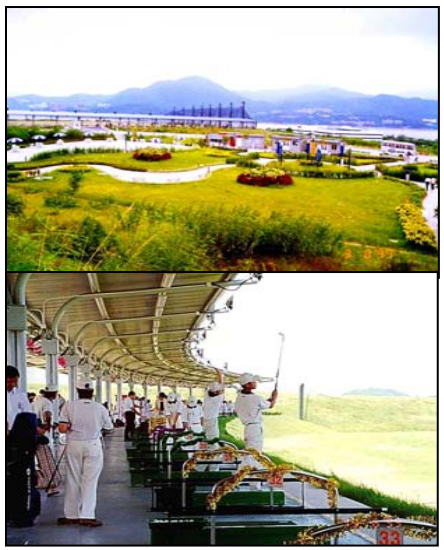
Afteruse

Afteruse is the beneficial use of a closed dumpsite/landfill following the safe closure and rehabilitation works

Benefits:

- ❑ Land to be gazetted as buffer/green zone for beneficial uses to the local communities
- ❑ Eliminates environmental pollution threats and health & safety risks
- ❑ Enhances surrounding land value and land use
- ❑ Improves the socio-economic benefits to the local communities

Liverpool Garden Festival Site, United Kingdom



Golf Driving Range, Shuen Wan, Hong Kong

Sai Tso Wan Recreation Ground, Hong Kong

Dyer Park, Florida USA

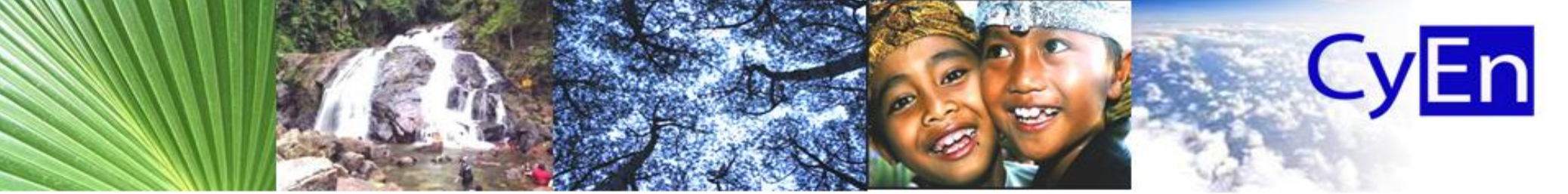
Landfill Transitory Stage

Old Landfills

- Not sanitary landfills but typically dumpsites
- Conveniently located near to waste generation area with local conditions such as former mining site, pond, swamp, ravine, etc.
- Poor or limited landfill management practice in use
- Limited operational lifespan / attaining limit of operational lifespan
- Proximity to water resources, water catchment area and/or potable water supply intake points
- Environmental pollution & hazards
- Health & safety risks
- Government's policies

New Landfills

- Meeting solid waste management needs into the future; hence, longer operational lifespan
- Probably, a sanitary landfill as a replacement for older landfills
- Located in less-sensitive site away from major waste generation areas, water catchment and/or potable water supply intake points
- Better landfill management practice adopted
- Consistent with government policy's on the integrated solid waste management for state



Landfill Transitory Stage

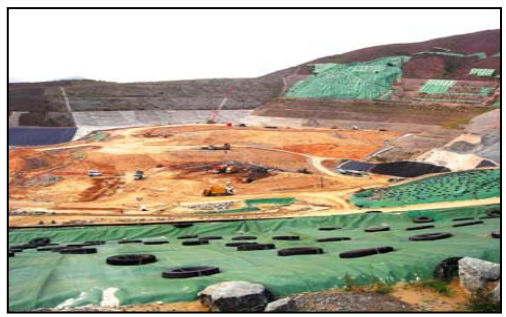
New Landfill Development

Typical new landfill development process include:

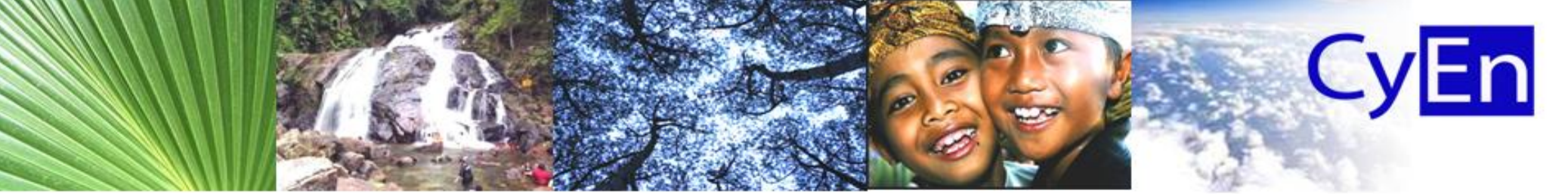
- Selection of suitable site – physical, environmental, landuse, etc.
- Preparation, submission and approval of Detailed Environmental Impact Assessment (DEIA) of proposed site
- Seeking and obtaining relevant approvals from the federal and/or state government
- Seeking and obtaining necessary fundings from the federal and/or state government
- Preparation, submission and approval of necessary planning development and land acquisition
- Project technical development
- Seeking and obtaining the necessary approvals from the relevant government agencies
- Tender procurement and award
- Construction, completion and testing and commissioning of new landfill and ancillaries
- Commencement of new landfill operations (after award to Landfill Operator)

Old Landfills

2 years or more to initiate & complete new landfill development



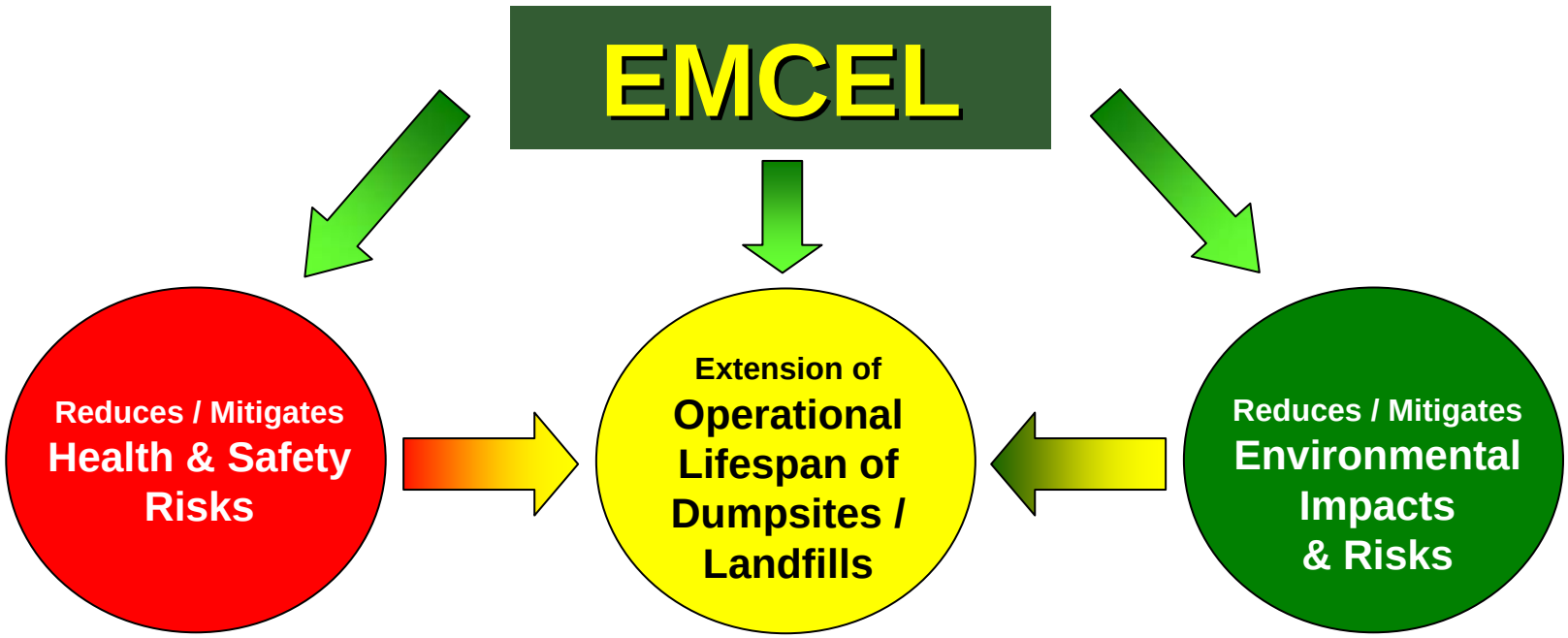
New Landfills

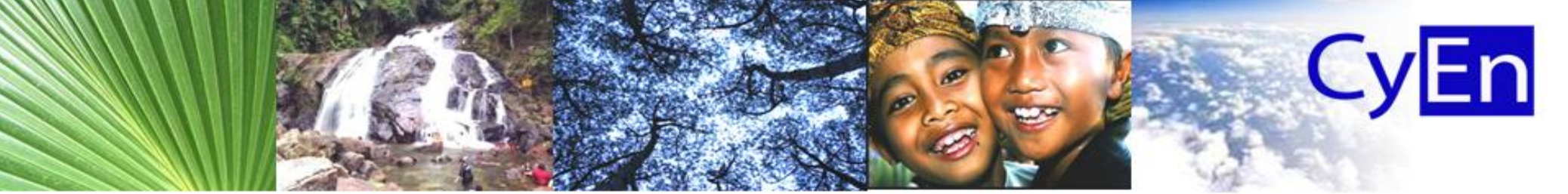


EMCEL Advantage

EMCEL – **the Environmental Management & Capacity Extension of Landfills** – provides for the environmental sustainability of existing landfills in mitigating any environmental and health and safety risks in compliance with the prescribed environmental legislation and any local regulations

In realising the complex due process and timeliness in setting up a new landfill, **EMCEL** serves to provide local authorities, as principal owners of existing dumpsites/landfills, an opportunity to extend the operational lifespan of these existing dumpsites/landfills for another few years yet in an acceptable environmental sustainable manner while new landfills are being proposed or developed





EMCEL Services

CONSULTANCY SERVICES:

Provides technical and commercial assessment of landfill sites (existing or proposed) on environmental site assessment, safe closure & rehabilitation, extension of operational lifespan and new landfill development

ENVIRONMENTAL MANAGEMENT SERVICES:

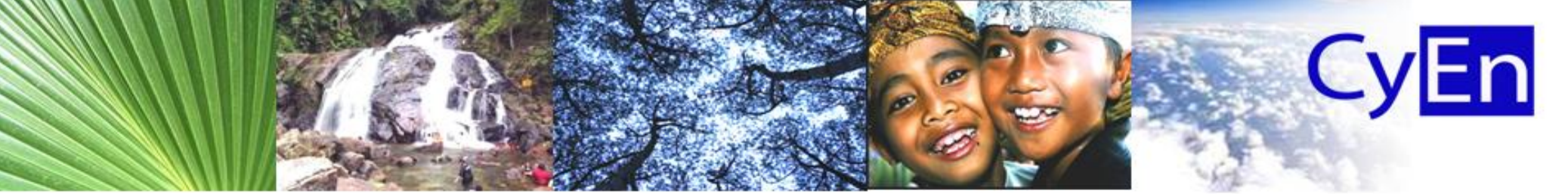
Provides **BEST PRACTICABLE ENVIRONMENTAL OPTION (BPEO)** and/or **BEST AVAILABLE TECHNIQUES NOT ENTAILING EXCESSIVE COSTS (BATNEEC)** solutions to environmental issues to ensure due compliance with the prescribed current environmental standards/best practices

SAFE CLOSURE & REHABILITATION SERVICES:

Provides design and construction expertise to safely close and rehabilitate existing dumpsites/landfills to any closure levels as specified by the client

CAPACITY EXTENSION OF LANDFILLS:

Adopting good engineering and landfill management practices, including taking into consideration the environmental, geotechnical and safety guidelines, the capacity extension of landfills can be achieved through reprofiling the existing dumpsites/landfills to increase available area for waste disposal, compactability of solid waste, waste mining & repositioning, applying new technology, increasing recycling and materials recovery, and Increasing waste decomposition



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Thank you

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