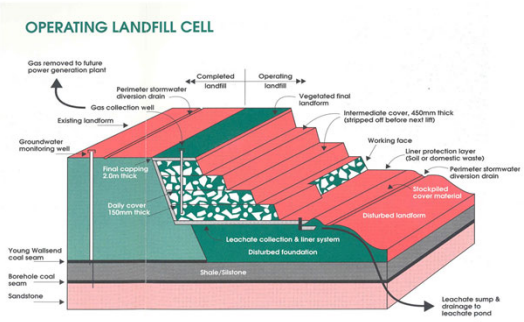
Improved Landfill Management

Cells, Liners, Filling and Cover

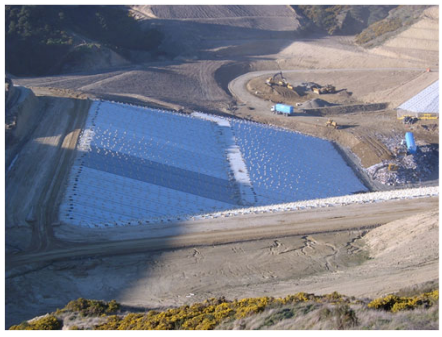
Cell construction - schematic



Lined cell setting – Kate Valley, NZ

Liner construction – Kate Valley, NZ

Liner construction



Liner construction

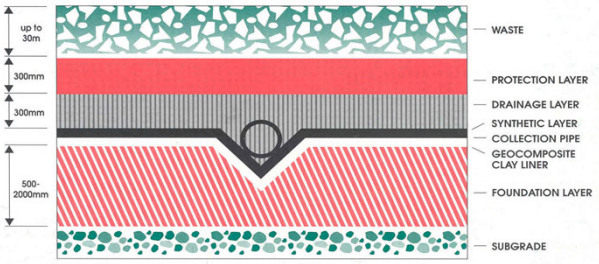
Laying the liner

Liner construction

- Trench to anchor liner

Liner construction

- Typical liner configuration



Liner construction

- Protective sand layer spread on top of liner

Liner construction

- Tyres placed to protect membrane from weighted ropes used to hold liner in place

Geosynthetic clay liners (GCL)

Bentonite clay for clay liner

Clay lined cell with overlying drainage layer

Waste placement

- Waste placed in lifts either from above or beneath
- Minimise lift height to optimise compaction but do not smear, optimum lift height 0.3m
- Progressively compact as lift height increases
- Maximum lift thickness 2.0m to ensure compaction
- Keep working face area as small as possible for effective compaction and to minimise cover usage
- Compact and roll waste surface as smooth as possible before placing daily cover

Waste placement at foot of face

Pushing up to face

- Waste deposited below face
- Bulldozer pushes up to face

Operating face – lined cell

Landfill operations – working face

Waste placed from above

- Dozer pushing waste over protection layer at base of new cell

Landfill compactor operating

Sheep's foot compactor

Clarinda landfill, Clayton South, VIC – tight working face for good compaction

Hallam Road, VIC – large working face

Victorian landfills – Rye, large face

WA rural landfills

Environmental Protection (Rural Landfill) Regulations 2002

Tipping area:

- Not greater than 30 metres in length
- Not greater than 2 metres above ground level in height

Borrow pit for cover

Stockpiled daily cover

Earth daily cover – Ravenhall Quarry landfill, VIC

Working face at end of day prior to application of daily cover

Daily cover stockpiled beside face

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Applying earthen daily cover

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Good positioning of daily cover stock

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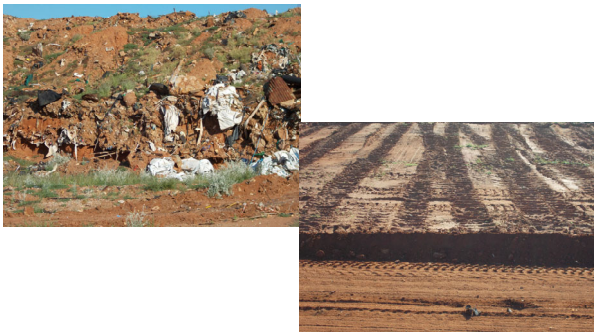
Improving inadequate cover?



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Daily cover

- Apply cover at least daily on putrescible waste
- Reduces potential for wind blown litter
- Contains odours
- Discourages birds
- Reduces fire risk
- Reduces escape of gas
- Minimises leachate generation potential
- Minimum earthen daily cover requirements 0.3m
- Acid sulfate soils not to be used unless stabilised
- Pull back and recover daily cover where possible

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Alternative daily covers

- A number of alternative daily cover options are available:
  - Degradable plastic film covers
  - Tarp covers
  - Spray on covers
  - Landfill lids
- Take up less air space than earthen covers
- Some fully recoverable and reusable
- Generally need to keep operating face small to contain costs

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Applying degradable plastic film cover

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Alternative daily cover retained by earth

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Enviro Cover

- Non-toxic, brown (daily), buff (intermediate) colours
- Degradable (up to 7 days) or Intermediate cover (~4 weeks)
- Good tear and puncture resistance, stretches over uneven surfaces
- 32-52 microns x 3.0-5.5 metres wide x 6,500-12,500 m^2 rolls

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Tarpomatic

- Rollable, recoverable 25.6m long X 9.1m wide tarpaulin panels.
- Each covers an area of 234 m^2. Spool holds 3 tarps

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Landfill Lids

- Quick to deploy and recover, steel, ~13m x 7m, 62 m^2/lid, weighs 1,900kg
- Include odour, fly and fire suppressant options

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Envirofix Posi-Shell

- Mineral mortar coating, durable, non-flammable

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WA Rural Landfills

Environmental Protection (Rural Landfill) Regulations 2002

- Minimum frequency of cover of tipping area:

Tonnes of waste received per year	Frequency waste is to be covered
Less than 500 tonnes	Monthly
Between 500 and 2,000 tonnes	Fortnightly
Between 2,000 and 5,000 tonnes	Weekly

- Sufficient cover must be available on-site

Intermediate cover - mulch stablised cell batter

Final cover

- Rehabilitation plan
- Seepage through cap <75% of anticipated seepage through basal liner (i.e. better sealed than liner)
- Prevents groundwater pollution and air quality
- Robust and durable
- Cracking concern with thin clay seals of shrink/swell clays
- Progressive rehabilitation of landfill
- Specified geomembranes and geosynthetic clay liners
- Minimum phytocap 1.5m with lysimeter trials and monitoring
- May include gas drainage layer
- Topsoil and revegetation

Phytocaps

- Thick layer of permeable cover retains rainfall which is largely managed by evapotranspiration from the vegetative cover
- Trialled at Henderson Waste Recovery Park as part of A-ACAP (2006-2011)
- Average precipitation 790mm/yr
- Cover of 1.6 metres of loamy sand to sand applied
- Native shrubs and grasses as vegetation
- ~15% of incident rainfall drained through phytocap (largest percentage of all five Australian trials)
- Four months (May-Aug) with rainfall significantly higher than evapotranspiration and relatively low temperatures
- Can be cheaper than conventional covers, but less well suited to colder, wetter coastal locations, the drier interior

Tullamarine closed landfill site

- Installation of final capping

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Tullamarine cover post closure

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Final HDPE cell cover and leachate pond

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Sign marking extent of cover

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Final cover and landform at Eastern Creek

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Store and release cover monitoring

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Survey or aerial survey to monitor cells

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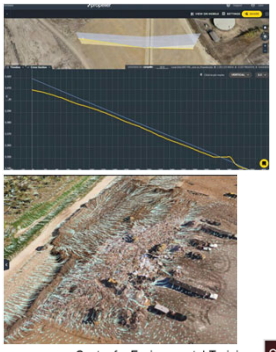
Drone survey/software integration

- Volumetric surveys help optimize long-term performance
- Slope tools help maximise airspace usage
- Manage cover thickness for operational, compliance and economic efficiency
- Minimise stormwater runoff and erosion risks
- Improve site management



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