

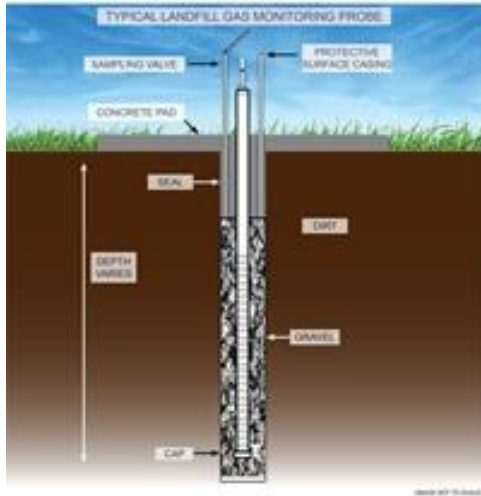
Landfill Closure Program Leachate Management

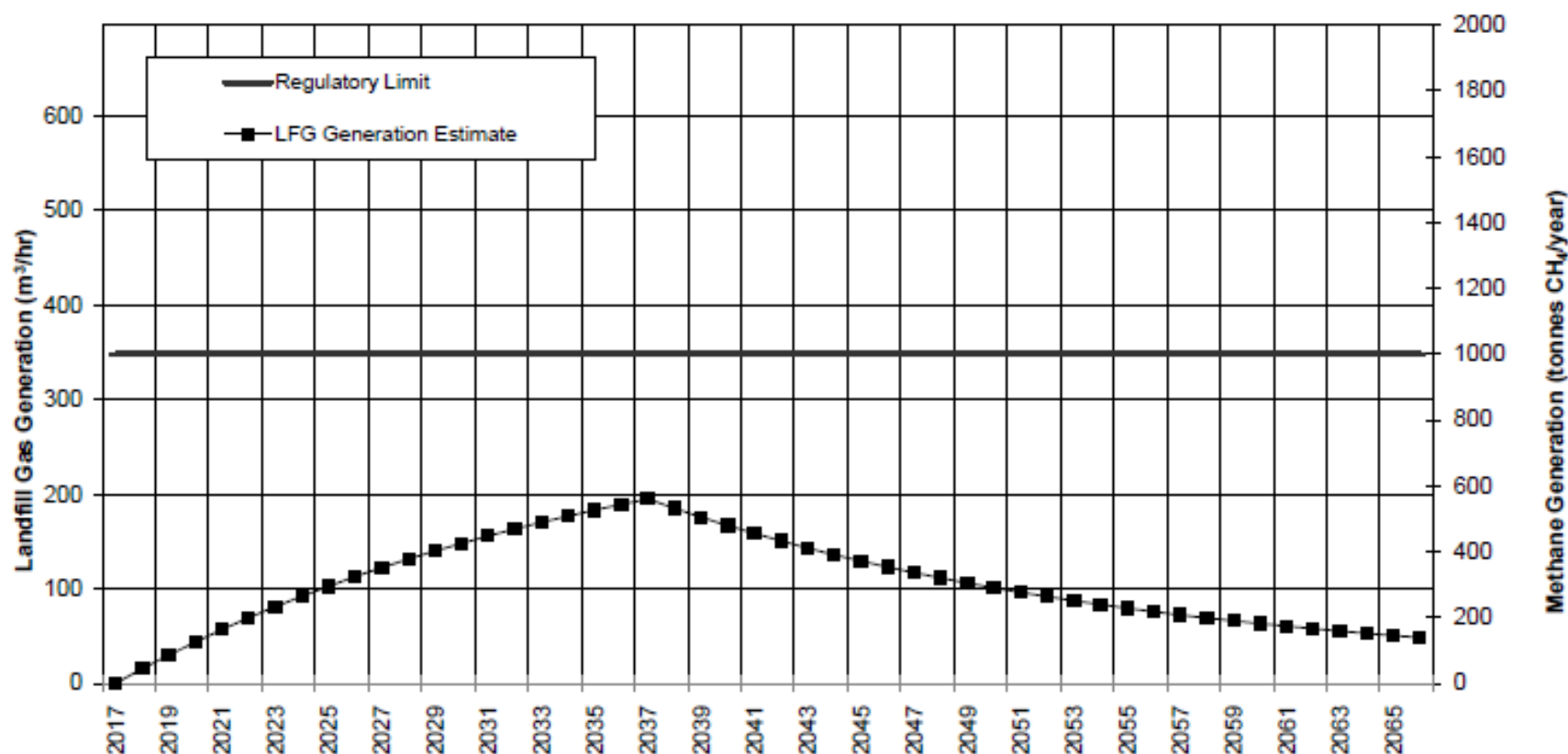
- Leachate Management ranges from natural attenuation to active treatment.
- Active treatment range from on-site treatment, wetlands, to pumping via force main to off-site treatment facility.



Landfill Closure Program

Landfill Gas Management





k values (year^{-1}) 0.02, 0.06, 0.11

L_0 (weighted) ($\text{m}^3 \text{CH}_4/\text{tonne}$) 20, 120, 160

Precipitation (mm/year) 1,489

Volumetric LFG Composition
(percent methane) 50%

Waste Composition

Relatively Inert (%) 75.0%

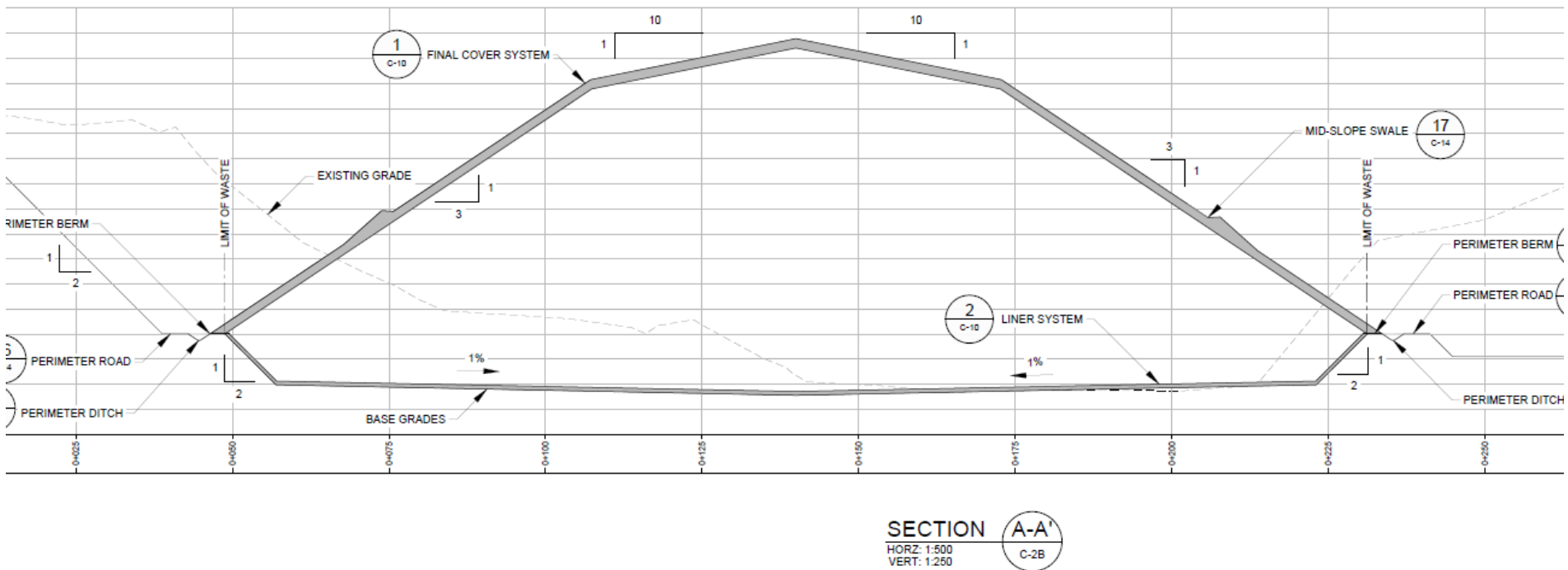
Moderately Decomposable (%) 25.0%

Decomposable (%) 0.0%



figure 10.2
LANDFILL GAS GENERATION ESTIMATE
2017 DESIGN, OPERATIONS, AND CLOSURE PLAN
UPLAND LANDFILL
Upland Excavations Ltd.

Landfill Closure Program



Landfill Closure Program

Environmental monitoring

- Monitoring performance of environmental controls, and closure systems
- Groundwater
- Surface water
- Soil gas



Landfill Closure Program

Element of post closure care

Final Cover System

- Erosion control
- Mowing and Overseeding
- Invasive Species

Storm water management

- Ditch maintenance
- Pond dredging
- Damage from large storm events

Leachate Management

- Leachate treatment and disposal

Landfill Gas Management

- LFG collection system operations, maintenance.
- Equipment replacement.

Environmental Monitoring

- Groundwater
- Surface water
- Soil gas

Landfill Closure Program

Closure costs

Final cover and stormwater management system / closure costs are highly variable and dependant upon numerous factors including:

- Site sensitivity (environmental receptors);
- Site geology and topography;
- Meteorological conditions;
- Material availability; and
- Spatial constraints.

Landfill Closure Program

Closure costs

So how much ???

- \$15-35 per square meter for compacted clay cover systems when materials readily available, low sensitivity.
- \$40-50 per square meter for compacted clay covers systems when material scarce or high sensitivity.
- \$50-80 per square meter for geosynthetic composite covers for high sensitivity areas where “entombment” is required.

Landfill Closure Program

Closure example

- Rural attenuation landfill.
- Low sensitivity.
- Existing GW monitoring wells (3).
- No storm water infrastructure.
- Attenuation (unlined) site.
- Closure area of 1.2 hectares.
- Topsoil stockpiled on site.
- Readily available clay barrier soil.
- Some regrading required to achieve 3H:1V (33 percent) slopes.

Landfill Closure Program Closure example

Item	Description	Unit	Approx. Quantity	Unit Price	Total Price
Administration and Execution Requirements	Bonds, Insurance, Mobilization, Demobilization, Temporary Controls and Closeout (15%)				\$53,025
Closure / Reclamation	Grading	C.M.	1,500	\$15	\$22,500
	Final Cover / Reclamation - supply, place, compact, grade, and seed	S.M.	12,000	\$25	\$300,000
Stormwater	Ditching	L.M.	400	\$40	\$16,000
	Pond with emergency spillway	L.S.			\$15,000
Subtotal					\$375,525
Engineering and Approvals (10%)					\$37,553
Total (Excluding GST)					\$413,078

Landfill Closure Program

Post closure liability

Description	Annual Costs
Environmental Monitoring (3 wells, bi-annual)	\$14,000
Final Cover Maintenance	\$5,000
Stormwater Management Maintenance	\$5,000
General Maintenance Reserve	\$5,000
Total	\$29,000
Total for 25 Year Time Period	\$725,000

SWIM-H2020 SM

For further information

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SWIM and Horizon 2020 Support Mechanism

Working for a Sustainable Mediterranean, Caring for our Future

Thank you for your attention.

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