

**APPLICATION FOR A PERMIT TO CONSTRUCT AND OPERATE A
CLASS I LANDFILL FACILITY
JUNGO DISPOSAL SITE
Humboldt County, Nevada**

**CLOSURE AND POSTCLOSURE MONITORING AND
MAINTENANCE PLAN**

Revision 2

Prepared For

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TABLE OF CONTENTS

<u>Section</u>	<u>Page</u>
1.0 INTRODUCTION.....	1
2.0 CLOSURE PLAN	1
2.1 Final Cover System	1
2.2 Postclosure Land Use	2
2.3 Environmental Monitoring and Controls.....	2
2.4 Closure Activities	2
2.4.1 Phased Closure	2
2.4.2 Site Security, Dismantling and Structure Removal	3
2.4.3 Final Cover Construction	3
2.5 Closure Cost Estimate	3
3.0 POSTCLOSURE PLAN.....	5
3.1 Monitoring and Sampling Activities	5
3.2 Operating Activities.....	5
3.3 Postclosure Inspection and Maintenance Activities	6
3.4 Cost Estimate.....	7

TABLES

Table 1	Closure Cost Estimate
Table 2	Postclosure Cost Estimate

1.0 INTRODUCTION

This Closure and Postclosure Monitoring and Maintenance Plan describe the closure and post closure requirements for the Jungo Disposal Site. In addition, closure and postclosure cost estimates are prepared to support the financial assurance funding estimates. Section 2 presents the Closure Plan. Section 3 presents the Postclosure Monitoring Maintenance Plan.

2.0 CLOSURE PLAN

At closure the Jungo Disposal Site Landfill will measure approximately 560-acres in area and contain approximately 57.1 million tons (104 mcy) of refuse. The maximum side-slope inclination is 4H:1V (horizontal to vertical); the maximum elevation is 4,375 feet mean sea level (msl), or approximately 200 feet above the surrounding ground surface. The top deck of the landfill will be graded at 5 percent to accommodate postclosure settlements and maintain positive drainage.

In accordance with NAC 444.6892, JLI will provide notice to the solid waste authority of the intent to close the landfill within 15 days of initiating closure. Landfill closure activities will begin within 30 days of the receipt of the final refuse shipment. Landfill closure will be completed within 180 days of the date closure activities are initiated, unless the solid waste management authority grants a schedule extension (NAC 444.6892.3).

2.1 Final Cover System

A final cover system will be constructed over the waste at the Jungo Disposal Site as part of the closure activities. The primary functions of the final cover system are to:

- Isolate the waste from the environment;
- Control odors, vectors and litter;
- Control surface water infiltration into the landfill;
- Control erosion and run-on (if any), and convey run-off to the surface water management system; and
- Control landfill gas.

The prescriptive cover system (NAC 444.6891) requires a minimum 6-inch thick erosion layer underlain by minimum 18-inch thick infiltration layer. In addition, the permeability of the cover shall be equal to or less than 1×10^{-5} cm/s or less than the permeability of any component of the bottom liner, whichever is less.

The final cover system for the Jungo Disposal Site consists of the following components:

- A minimum 2-foot thick vegetative soil layer;
- A geocomposite drainage layer;
- A 60-mil HDPE geomembrane layer (textured on both sides); and
- A one-foot thick foundation layer.

The Jungo Cover System uses a vegetated, 2-foot thick erosion layer in place of the minimum 6-inch thick erosion layer. In addition, a geocomposite drainage layer, 60-mil HDPE geomembrane and a one-foot thick foundation layer are substituted for the minimum 18-inch thick infiltration layer. These

modifications are necessary to result in a cover system that is no more permeable than the bottom liner in accordance with NAC 444.6891(a) (i.e. install low-permeability geomembrane component) and to establish an erosion resistant layer over the geomembrane layer that is capable of supporting the growth of native plants per NAC 444.6891(b).

The site will have a landfill gas collection system fully installed prior to closure. Therefore, closure construction requirements for the landfill gas collection system are limited to activities integrating the landfill gas extraction wells and piping into the closure cover design. Integration of gas controls with a closure cover system is routinely completed and standard conceptual design details are included in *Volume II*.

At closure, drainage will be conveyed along the top deck and intermediate slope benches to down-drains located along the sides of the landfill. The down-drain pipes will be fitted with diffuser tees at the discharge ends to dissipate high velocity hydraulic energy before discharging to the perimeter channels. Run-off will then be conveyed off-site where it will eventually collect in shallow depressions until it evaporates or infiltrates into the underlying soils similar to the existing surface water conditions in the site vicinity. *Appendix J of the Report of Design (Volume I)* presents conceptual drainage calculations to verify that the above conceptual drainage facilities are designed to accommodate a 25-year, 24-hour precipitation event as required by NAC 444.6885.

2.2 Postclosure Land Use

The postclosure end use of the site will be undeveloped open space, which is consistent with surrounding terrain and land uses. The site is planned to be maintained as secured non-irrigated open space and the closed landfill will be designed to reduce health and safety impacts with proper site security fencing and access control.

After closure, JLI will record a notation on the deed that the land has been used as a landfill and that the land is restricted to prevent disturbance of the final cover, liner system, or other containment controls unless necessary to comply with the requirements of NAC 444.570 to 444.7499. JLI will notify NDEP of the completion of the deed notation.

2.3 Environmental Monitoring and Controls

Environmental monitoring and controls will consist of leachate monitoring, groundwater monitoring and landfill gas monitoring. The leachate sumps, groundwater monitoring network, and landfill gas monitoring network will be installed as the site is developed, and therefore, they will be fully installed prior to the closure of the last landfill cell. No additional environmental monitoring and control systems will be installed at closure. However, these systems will be operated and maintained as discussed in Section 3.

2.4 Closure Activities

2.4.1 Phased Closure

Closure will be completed in phases as the site is developed. Generally, closure activities will occur in areas where the final grades have been achieved for a period of at least 5 years. This will allow the largest waste settlements to occur prior to closure, and therefore, reduce postclosure settlement impacts. Based on this phased closure approach, the maximum extent of closure at any point in time is estimated to be 205-acres or less.

For each closure phase, NDEP will be contacted and will review and approve the partial closure as it is completed.

2.4.2 Site Security, Dismantling and Structure Removal

JLII will provide site security upon closure. Site security will include:

- Proper signs posted at all points of access;
- Access will be controlled by locked gates at all access points around the perimeter; and
- Fencing will be maintained around the entire site.

The operating facilities (office and maintenance shop) and operating equipment will be removed from the site at the time the final phase of closure is completed.

2.4.3 Final Cover Construction

A final cover will be constructed as part of the closure activities. The final cover, as described in Section 2.1, is a prescriptive composite cover system. Prior to completing closure construction, construction plans, technical specifications, and a construction quality assurance plan will be prepared and submitted to the Nevada Department of Environmental Protection (NDEP) for review.

Construction Quality Assurance (CQA) will be completed during the closure activities to ensure that the construction complies with the closure design plans and specifications. Following closure construction, a closure certification report will be prepared and submitted to provide documentation that the closure activities were completed in accordance with the design plans and applicable federal and state regulations. A Nevada registered civil engineer will supervise CQA activities and certify the closure report.

Typical CQA activities will include, but are not limited to the following:

- Verifying the materials, thickness and compaction of the foundation layer;
- Observation and inspection of the geosynthetic materials for conformance with the engineering plans and specifications;
- Conformance testing of soil and geosynthetic materials;
- Documentation of construction procedures, and identification and resolution of construction problems; and
- Preparation of a CQA report providing documentation that the closure activities and construction complied with the project plans and specifications.

2.5 **Closure Cost Estimate**

Table 1 summarizes the closure cost estimate representing the maximum closure costs at any point during site development. Key cost assumptions include:

- Environmental controls are installed prior to closure; and
- The maximum extent of closure at any point in time is 205-acres or less, including the first phase of closure

Closure funding will be based on the proportion of the volume of waste disposed to the final refuse volume. In addition, the closure funding will be established prior to the construction of each phase of the base liner system.

3.0 POSTCLOSURE PLAN

JLII will implement postclosure monitoring and maintenance of Jungo Disposal Site, which will be performed for a period of 30 years following closure. Postclosure activities will consist of the following:

- Groundwater, leachate, surface water, and landfill gas monitoring;
- Operation of leachate collection and disposal controls and the landfill gas collection and disposal system; and
- Inspection and repair of the final cover system and other environmental controls.

These postclosure activities are described in further detail in Sections 3.1 through 3.3. Section 3.4 summarizes the postclosure monitoring and maintenance cost estimate.

Prior to implementing final closure, the Jungo Disposal Site emergency response plan will be updated and include JLII emergency contact information, local emergency contact information, and NDEP emergency contacts. Written notification of unusual incidents or occurrences observed during inspections will be provided to NDEP regarding such events as; vandalism, fires, explosions, earthquakes, surface drainage problems; and other incidents involving or potentially threatening waste releases.

3.1 Monitoring and Sampling Activities

Monitoring and sampling activities include leachate, groundwater, and landfill gas. Sampling and analysis of groundwater and gas will be performed on a semi-annual basis. Leachate monitoring at the sumps will be performed at least semi-annually. If necessary, more frequent monitoring of leachate will be completed to ensure leachate is managed to prevent accumulation of leachate to a depth of more than one foot on the liner system.

If after 5 years of closure, there are no reported groundwater releases or accumulation of leachate, the monitoring frequency will be reduced to annual. If after 10 years of closure, there continues to be no groundwater release or leachate accumulation, the monitoring frequency will be further reduced to every other year.

Based on the landfill design, the groundwater monitoring plan (Appendix D), and landfill gas monitoring plan (Appendix D), the monitoring system will include the following:

- 10 Leachate Sumps;
- 14 Permanent Groundwater Monitoring Wells and 4 Interim Groundwater Wells;
and
- 21 Landfill Gas Monitoring Probes.

Postclosure groundwater monitoring and landfill gas monitoring will follow the procedures described in Appendix D, except that the frequency will be reduced from a quarterly basis to a semi-annual basis.

3.2 Operating Activities

A landfill gas extraction and disposal system will be operated until landfill gas generation rates no longer support the gas extraction and disposal system. For cost estimating purposes, it is assumed that landfill gas will be collected and disposed of using a series of landfill gas flares. Landfills generate

methane gas, which in many cases can be used to generate electricity. JLII will investigate the feasibility of such Waste-To-Energy (WTE) uses during operations. However, until WTE is determined to be feasible for the Jungo Disposal Site, a flare disposal system is conservatively assumed in the postclosure monitoring and maintenance cost estimate.

Leachate will be monitored at the sumps, and if liquids pond to depths of about 6-inches or more, they will be extracted. If necessary, an approximately 0.5-acre, double-lined (HDPE geomembrane) evaporation pond will be constructed on north side of the landfill to accommodate leachate. The pond also will be used to dispose and evaporate landfill gas condensate.

An evaporation pond may not be required. Due to the arid environment, a very limited amount of leachate (or no leachate) is expected to be generated during operations, when leachate generation rates are the greatest. A study by the U.S. Environmental Protection Agency (USEPA, 2002) indicates that leachate generation in landfills typically reduces to 10 percent of the leachate generation rate during operations after about 4 years following closure. Within 10 years following closure, leachate generation rates are near zero. Therefore, leachate generation should be negligible for the Jungo Disposal Site following closure.

The site will implement closure in phases and JLII will be able to monitor the impact of closure on leachate generation rates during the site development. This will allow JLII to refine the leachate disposal needs prior to the closure of the last cell.

3.3 Postclosure Inspection and Maintenance Activities

Postclosure inspection and maintenance activities will include the final cover, the site drainage system, environmental controls, and security system as described below.

In the first 5 years, when most settlement is predicted to occur, the final cover will be inspected semi-annually and annual topographic surveys completed to confirm that the final cover continues to function as an infiltration barrier and meets required grades. If the final cover meets grades after 5 years, the inspection frequency will be reduced to every other year with a topographic survey completed every four years.

Visual inspections will be performed by qualified personnel to verify the integrity of the final cover. The cover will be inspected for signs of settlement and subsidence, erosion, cracking or other items that could adversely affect the integrity and effectiveness of the final cover. Items requiring corrective action will be repaired as soon as feasible.

Some minor differential settlement is expected at every landfill. Minor settlement can create relatively small depressions on a landfill surface where water will pond. At the Jungo Disposal Site, repair of such depressions will be completed in one of the following ways:

- Small depressions (less than 10 feet by 10 feet in plan area and which do not drain) will be filled with soil to promote positive surface drainage.
- Larger depressions (greater than 10 feet by 10 feet in plan area) will be excavated to remove the cover system components above the foundation layer. Additional foundation soils will be added as necessary to establish suitable drainage grades. The overlying cover components will be replaced using the existing cover materials or new materials as may be necessary. The replaced materials will be constructed in compliance with the original closure engineering plans, specifications, and CQA plan.

Appendix I (Report of Design, Volume I) presents the results of settlement analyses that were completed to evaluate the effects of postclosure settlement on the final cover grades. The results of these analyses indicated that the proposed grades are sufficient to accommodate the anticipated post-closure settlement and still provide adequate drainage. In addition, because the phased closure approach will be generally implemented in areas of the landfill where final grades have been established for at least five (5) years, postclosure settlement impacts on the final cover should be limited.

Additional inspection activities include:

- The vegetative cover will be inspected for signs of erosion, degradation, and areas that lack vegetative growth. Items requiring corrective action will be repaired as soon as feasible. The postclosure maintenance costs provided in Section 3.4 assume that reseeding will be completed for an average of 25 acres per year.
- The surface drainage controls will be inspected annually for evidence of damage, excessive erosion, settlement, and obstruction by debris. The effectiveness of the surface water drainage ditches will be maintained by keeping the ditches, down-drains, and culverts clear of debris, excess soils and excess vegetation. Repairs to the structures will be made if the inspections reveal excessive damage to the ditches, down-drains and culverts. In addition, regrading will be performed as necessary to maintain positive drainage.
- As part of the periodic sampling program, the groundwater wells, leachate riser pipes, and landfill gas probes will be inspected for damage. Well heads, locks, caps, sampling ports and/or tubes that appear damaged or excessively worn will be identified and replaced.
- All locks, gates, signs, and fences will be inspected on an annual basis. Any damage to the security system due to vandalism, trespassing, or natural wear and tear will be immediately repaired and/or replaced. Signs will be repainted or replaced on an as-needed basis to maintain their visibility.

3.4 Cost Estimate

Table 2 presents a 30-year postclosure maintenance cost estimate for Jungo Disposal Site. JLII will establish a postclosure maintenance fund prior to developing landfill disposal modules. The postclosure maintenance costs and fund are reviewed and updated annually.

The current cost estimate for postclosure maintenance of the Jungo Disposal Site is based upon information presented in this report and includes an area of approximately 350-acres, which is the largest area of the landfill under the 30-year postclosure area at one time. The following key assumptions were made in compiling these estimates:

- Environmental monitoring costs are based on the projected number of sampling points and testing described in the monitoring plan (Section 3) with semi-annual monitoring by a third party.
- On average, about 20-acres of the cover will require reseeding each year;
- Inspections are completed annually;
- Landfill gas operation and maintenance will occur throughout the entire 30-year postclosure period.

As indicated in *Table 2*, the projected annual postclosure maintenance cost is approximately \$417,000/year.

**TABLE 1
CLOSURE COST ESTIMATE**

INITIAL 25-ACRE CELL

Item	Unit	Unit Cost	Quantity	Total
1. Final Soil Cover ¹				
a. Foundation Layer	cy	\$ 3.00	41,000	\$ 123,000
b. Vegetative Layer	cy	\$ 3.00	82,000	\$ 246,000
2. Geosynthetic Layers ¹				
a. Geomembrane (60 mil HDPE)	sf	\$ 0.70	1,100,000	\$ 770,000
b. Geocomposite drainage layer	sf	\$ 0.70	1,100,000	\$ 770,000
3. Design/CQA				
a. Design, plans, specifications	ls	\$ 50,000	1	\$ 50,000
b. CQA	acre	\$ 5,000	25.3	\$ 126,263
4. Revegetation	acre	\$ 1,000	25.3	\$ 25,253
5. Gas Control		\$ -	-	\$ -
6. Drainage Structures				
a. CMP and drop inlets	lf	\$ 25	800	\$ 20,000
b. V-ditches	lf	\$ 2	800	\$ 1,600
7. Closure Survey, Settlement Monuments	ls	\$ 2,500	1	\$ 2,500
Total				\$ 2,134,615

Notes

1. Cover Profile - 1 Ft Foundation L; Geomembrane, Geocomposite, 2 Ft Vegetative Layer.
2. Active gas control not required for initial cell.

MAXIMUM PROJECTED CLOSURE AREA - 205 ACRES

Item	Unit	Unit Cost	Quantity	Total
1. Final Soil Cover ¹				
a. Foundation Layer	cy	\$ 3.00	330,733	\$ 992,200
b. Vegetative Layer	cy	\$ 3.00	661,467	\$ 1,984,400
2. Geosynthetic Layers ¹				
a. Geomembrane (60 mil HDPE)	sf	\$ 0.50	8,929,800	\$ 4,464,900
b. Geocomposite drainage layer	sf	\$ 0.58	8,929,800	\$ 5,179,284
3. Design/CQA				
a. Design, plans, specifications	ls	\$ 100,000	1	\$ 100,000
b. CQA	acre	\$ 5,000	205.0	\$ 1,025,000
4. Revegetation	acre	\$ 1,000	205.0	\$ 205,000
5. Gas Control				
LFG Control System	/ac	\$ 15,000	205.0	\$ 3,075,000
Flare and upgrades	ea	\$1,000,000	1.0	\$ 1,000,000
6. Drainage Structures				
a. CMP and drop inlets	lf	\$ 25	7,000	\$ 175,000
b. V-ditches	lf	\$ 2	20,000	\$ 40,000
7. Closure Survey, Settlement Monuments	ls	\$ 10,000	1	\$ 10,000
Total				\$ 18,250,784

Notes

1. Cover Profile - 1 Ft Foundation L; Clay, Geomembrane, Geocomposite, 2 Ft Vegetative Layer.
2. Includes additional flare installed for closure. Other flares assumed to be installed during operations.

**TABLE 2
POST-CLOSURE MONITORING AND MAINTENANCE COST ESTIMATE**

Item	Unit	Unit Cost	Annual Quantity	Total
1. Vegetation Maintenance	acre	\$ 250	55.0	\$ 13,750
2. Leachate - Sampling and Testing, O&M	annually	\$ 5,000	1	\$ 5,000
3. Landfill Gas Monitoring/Maintenance	annually	\$ 215,000	1	\$ 215,000
5. Groundwater Monitoring/Maintenance	annually	\$ 50,000	1	\$ 50,000
6. Surface Water Monitoring/Maintenance	annually	\$ 5,000	1	\$ 5,000
7. Drainage/Cover Maintenance	annually	\$ 125,000	1	\$ 125,000
8. Security Maintenance	annually	\$ 1,000	1	\$ 1,000
9. Inspections	annually	\$ 2,000	1	\$ 2,000
				\$ -
Total Annual Cost				\$ 416,750
Annual Cost/acre				\$ 738
Total Annual Cost x 30 yrs				\$12,502,500

Notes

1. Postclosure costs are projected at full build-out.