FEASIBILITY STUDY

Municipal Solid Waste Disposal Site Report (2025)

Overview

This feasibility study evaluates and defines the technical, environmental, and operational pathway to upgrade, extend, rehabilitate, and ultimately close the municipal solid waste disposal site (MSWDS) in Philipsburg, Sint Maarten. Drawing on new field investigations (Aug–Sep 2024), past studies, and an alternatives analysis, it identifies critical environmental, health, and safety (EHS) risks at the current landfill, determines a technically feasible concept design to mitigate those risks, estimates remaining capacity and disposal lifespan, and sets out an indicative construction schedule and cost estimate to guide procurement under a design–build contract.

The report is structured as a full basis-of-design and concept engineering package. It consolidates: (i) field study results on geotechnical stability, leachate quality/flows, and waste composition; (ii) assessment and selection of a preferred closure/upgrade alternative; (iii) concept designs for re-profiling, capping, leachate and stormwater management, gas control, and a ring dike; (iv) quality assurance/quality control (QA/QC) requirements; (v) an indicative construction methodology and schedule; (vi) capacity and lifespan analysis under different waste management scenarios; and (vii) a Class 4 capital cost estimate with risk contingencies and allowances.

Objectives and Audiences

This report summarizes the findings from data collection, field studies, and alternatives analyses that led to the selection of a preferred MSWDS upgrade. It presents the Concept Engineering Design for the chosen alternative, including core criteria such as stability, environmental, health, and safety (EHS) standards, specifications, and construction methods, providing a foundation for detailed design. The report also includes a construction schedule and cost estimate to support procurement, funding, and work sequencing, while guiding the future works contractor in executing the project under a design–build contract. In addition, it informs policy and operational decisions on safely continuing limited disposal during the transition period and closing the landfill in accordance with EHS requirements.

The report addresses multiple audiences. Primary institutions—NRPB, the Government of Sint Maarten (VROMI), and the World Bank—will use it to inform strategic, regulatory, and funding decisions. Implementation partners, including prospective design–build contractors and supervising engineers, will rely on it for technical planning, design development, and construction execution. Broader stakeholders, such as environmental regulators, local utilities, emergency services, and communities affected by the Great Salt Pond, will gain insight into project impacts, safeguards, and operational considerations.

Findings

Geotechnical instability and slope safety

- Field investigations and stability analyses indicate most slopes are not stable under current conditions. Deep shear planes through a clay–silt layer beneath the waste mass create macro-instability risks even in normal operating conditions.
- A minimum factor of safety (SF) of >1.1 is adopted for design under Eurocode 7. Achieving this requires re-profiling of existing slopes to a gentler 1:3 (vertical:horizontal) configuration, along with appropriate support layers and surface capping to reduce infiltration and pore pressures.

Leachate contamination and pathways

- Groundwater/leachate monitoring showed high pollutant loads exceeding wastewater treatment targets. Representative values recorded include COD above 5,000 mg/L in multiple wells, chlorides up to ~110,000 mg/L, total nitrogen up to ~1,006 mg/L, and E. coli >200 CFU/100mL in all samples.
- The plume and hydraulic gradients indicate uncontrolled leachate discharge toward and into the Great Salt Pond (GSP), contributing to ecological and public health risks.
- A reduction in leachate generation through surface capping, and improved control/collection at the perimeter, are essential to interrupt contaminant migration.

Landfill gas and fires

- Landfill gas emissions are noted as a concern, compounded by a history of fires. Gas production estimates are theoretical and uncertain due to past combustion events. Nonetheless, capping and passive/active gas management provisions are included in the design to control emissions and reduce fire risk.

Remaining capacity and disposal lifespan

- The concept design increases usable capacity by optimizing re-profiling and leveraging on-site materials (e.g., recycled aggregates from C&D waste, removal of tire stockpiles). Estimated remaining capacity increases from an initial ~360,000 m^3 to approximately 648,000–658,000 m^3.
- Disposal lifespan projections, derived from annual and cumulative disposal forecasts, indicate that without waste diversification the capacity is exhausted by 2031; with a waste diversification strategy (e.g., source separation, composting/diversion), the horizon extends to approximately 2033. In either case, closure is finite and imminent within a decade.

Cost and schedule

- The concept-level investment cost is estimated at USD 44.7 million. This includes direct contractor costs ($26.6m), contingencies and allowances (~$38.9m total foreseen/unforeseen contractor costs), and miscellaneous additional costs (e.g., supervision, ~$5.9m).
- Schedule analysis highlights a major challenge: the long lag between constructing closure capping for the solid waste disposal site (SWDS) and completing other scope, due to continued disposal operations during the transition period. This multi-year interface complicates a single design–build contract and demands careful staging and risk allocation.

Operational constraints and interfaces

- Construction must interface with ongoing disposal up to 2031–2033. This requires meticulous logistics planning (traffic, lifts, working faces, safety buffers) and sequencing to maintain safe service continuity while progressively closing portions of the site.
- Prerequisites include regulatory permits, relocation of overlapping operations (e.g., Steel Crushers), and mitigation for any hydrological impacts (e.g., compensating for lost buffer capacity in the GSP due to perimeter works).

Selected Alternative and Concept Design

The selected alternative for the MSWDS upgrade applies a uniform engineering concept across multiple site layouts, evaluated for technical feasibility, socio-economic impacts, operability during transition, and environmental performance. The chosen approach retains the existing site footprint while re-profiling slopes to stable angles, constructing a perimeter ring dike, and implementing a multi-layer surface cap to minimize infiltration, control emissions, and manage runoff.

Core elements of the concept design include slope re-profiling to approximately 1:3 with support and drainage layers to meet stability criteria and limit pore pressure development; surface capping to reduce rainfall infiltration, manage gas venting, and prevent erosion; and a perimeter ring dike and drainage system to control floodwater and leachate interfaces, preventing uncontrolled discharge to the Great Salt Pond. Leachate management is enhanced through improved collection, separation, and controlled discharge, while gas is addressed with passive or active management to mitigate odors, explosive risks, and greenhouse emissions. Materials optimization maximizes the use of on-site recycled aggregates for structural layers, dike fills, and geocell infills, reducing costs and embedded carbon while preserving landfill capacity. Interface works ensure safe and continuous disposal operations during the transition to full closure.

Implementation Considerations

Procurement and contracting

- The anticipated form is a single design–build works contract. Given the extended period between early closure works (e.g., capping) and final completion under continuing disposal, the report flags the risk that a monolithic contract may encounter idle periods and inefficiencies. Options to mitigate include staged milestones, interim acceptances, and contractual provisions for demobilization/remobilization.

Permitting and preconditions

- Essential preconditions include: (i) securing environmental and construction permits; (ii) relocating or reconfiguring conflicting on-site industrial operations; and (iii) ensuring hydrological compensation for any lost GSP buffering (especially important under extreme rainfall events).

Logistics and safety

- The contractor must develop a comprehensive logistical plan addressing: separation of public/operational traffic from construction traffic; safe access to working faces; temporary drainage; and emergency response for slope, gas, or fire incidents. Strict QA/QC and EHS plans are mandatory throughout staging.

Risk management

- Geotechnical uncertainty in subsurface stratigraphy and waste composition requires allowance for discovery and adaptive management.
- Landfill gas generation is uncertain due to past fires; monitoring and flexible gas control provisions are recommended.
- The bed level of the GSP and precise quantities/locations of suitable C&D material for recycling are not fully mapped, requiring field verification and potential contingent sourcing.

Lessons Learned

1. Stabilization and EHS controls must be integrated and sequenced

- Slope stability, leachate control, and gas management are interdependent; treating them as separate workstreams risks suboptimal outcomes. A systems approach—re-profiling synchronized with capping and perimeter controls—delivers the largest EHS risk reduction.

2. In-situ resource recovery is a powerful lever

- Recycling on-site C&D waste into engineered aggregates for support layers and dike construction reduces import costs, accelerates delivery, and frees airspace. This dual benefit (cost/capacity) is particularly valuable in insular settings where material supply is costly and constrained.

3. Closure plans must accommodate operational realities

- Continuing disposal during transition is often unavoidable. Designing closure to coexist safely with ongoing operations—and explicitly addressing the time gap between early and late works—helps to manage contractor performance and budget risk.

4. Early leachate reduction is a high-impact priority

- Even partial capping and perimeter control yields immediate environmental benefits, reducing pollutant loading toward the GSP and lowering treatment/management burdens.

5. Diversion strategy is necessary—capacity gains are finite

- Even with optimized re-profiling, remaining capacity supports only a limited extension. Instituting diversion (source separation, organics management, C&D sorting) is critical to avoid a hard stop and to meet environmental objectives.

6. Contracting strategy needs to reflect the long, two-phase timeline

- A single design–build contract can be made to work, but only with clear milestones, risk allocation for idle periods, and options for phased completion. Alternative strategies (e.g., separate enabling works vs. closure packages) may merit consideration given the multi-year interface with operations.

Recommendations

- **Proceed with the concept design:** Adopt the selected alternative and associated basis of design as the foundation for procurement. Re-profile to 1:3, cap with a multi-layer system, construct the ring dike, and install integrated leachate and gas control.
- **Maximize on-site materials:** Implement robust crushing/screening to recover aggregates from C&D deposits for support layers and dike infill; plan for tire stockpile removal to unlock additional capacity and reduce fire risk.
- **Sequence for early EHS wins:** Prioritize perimeter controls, initial capping in the most critical leachate-generating zones, and high-risk slope re-profiling to reduce immediate environmental and safety risks.
- **Plan for operations–construction interfaces:** Require a detailed logistics plan, with dedicated access, traffic control, dust/odor suppression, and emergency response measures. Establish interim acceptance milestones tied to safe operational handovers.
- **Optimize contracting strategy:** Build in milestone payments, idle/standby provisions, and flexible mobilization windows that align with disposal tapering; consider whether select early works should be procured separately to de-risk the main contract.
- **Implement a waste diversification roadmap:** In parallel with closure works, accelerate diversion measures (e.g., organics, recyclables) to extend capacity from 2031 to 2033 and reduce future environmental liabilities.
- **Strengthen monitoring and adaptive management:** Establish ongoing monitoring for slope movements, gas, and leachate quality; use results to refine capping, drainage, and gas control measures as needed during and after construction.
- **Secure permits and hydrological mitigation:** Obtain all necessary permits early and commit to compensatory measures for any reduction in GSP buffering capacity from perimeter works.

Conclusion

The study concludes that the current configuration of the Philipsburg MSWDS poses unacceptable EHS risks due to slope instability, uncontrolled leachate discharge to the Great Salt Pond, and unmanaged gas emissions. The selected alternative—re-profiling to stable slopes, constructing a perimeter ring dike, and installing a multi-layer cap—mitigates these risks and provides a viable pathway to closure while allowing limited, safe disposal during a short, finite transition period.

Even with optimization, usable capacity remains limited, extending the disposal horizon only to 2031 (without diversion) or 2033 (with diversion). The concept design therefore serves as a bridge to a post-landfilling future, emphasizing the need for an urgent waste diversification strategy. The projected investment (~USD 44.7 million) and the complex, multi-year schedule underscore the importance of a carefully structured design–build contract, strong contractor logistics and QA/QC, and early implementation of high-impact EHS controls.

With clear milestones, robust reuse of on-site materials, targeted early capping and perimeter works, and parallel advances in waste diversion, the project can substantially reduce environmental and safety risks, safeguard the GSP, and enable a controlled, compliant closure of the landfill.

Methodology

- Evidence base and sources:
    - Review of prior studies (referenced in the report's literature table).

    - New field study (Aug–Sep 2024), including topographic surveys, geotechnical investigations, waste characterization, and hydrogeological/leachate sampling.
- Field investigations:
    - Geotechnical: Cone penetration tests with pore pressure (CPTu), stability analyses consistent with Eurocode 7; design safety factor >1.1.
    - Waste: Trial excavations and compositional assessment, including locations and quantities of C&D materials potentially suitable for recycling.
    - Hydrogeology and leachate: Installation/sampling of monitoring wells; laboratory analysis of chemical and microbial indicators (e.g., COD, chlorides, nitrogen species, E. coli).
- Alternatives analysis:
    - Application of a uniform engineering concept to multiple site layouts; evaluation against technical feasibility, environmental performance, operability during transition, and socio-economic considerations; selection of the alternative retaining site boundaries with re-profiling, ring dike, and capping.
- Concept design development:
    - Basis of design for slopes, capping, gas, and leachate control; integration of recycled on-site aggregates; sequencing for concurrent operations and construction; QA/QC requirements and EHS controls.
- Capacity and lifespan modeling:
    - Forecast of annual and cumulative disposal volumes; scenario analysis with and without waste diversion to determine the end-of-life horizon (2031 vs. 2033).
- Cost estimation:
    - AACE Class 4 deterministic estimate; accuracy band of approximately −15% to +50%; benchmarked against internal databases and comparable regional projects; inclusive of direct costs, contingencies/allowances, and owner-side costs (e.g., supervision).
- Limitations and uncertainties:
    - Post-survey deposit volumes are estimated.
    - Great Salt Pond bed levels are not fully known for ring dike foundation planning.
    - Quantities and locations of recyclable C&D materials are derived from historical data rather than full high-resolution mapping.
    - Landfill gas generation is modeled with uncertainty due to prior fires; monitoring and adaptive design are required.