CLIMATE & CLEAN AIR COALITION
TO REDUCE SHORT-LIVED CLIMATE POLLUTANTS

EXECUTIVE SUMMARY

Assessment for Closure of Waste Disposal Site TPA Terjun City of Medan, Indonesia

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The Assessment for the Closure of the Waste Disposal Site for the final disposal site (TPA is the acronym in Indonesian) Terjun (Terjun) located in the City of Medan (Medan), Indonesia was performed as part of direct technical assistance being provided by the Waste Initiative of the Climate and Clean Air Coalition (CCAC). The main objective of this assessment is to provide Medan with a technical and economical document to seek financing for the implementation of this project. The assessment was composed of three main activities: Data collection and site visit, development of a preliminary conceptual closure plan, and assessment of landfill gas (LFG). In addition, This summary provides financing and contracting options as well as recommendations for project implementation.

Data Collection and Site Visit

This activity is documented in the Final Site Assessment Report. The main objective of this activity was to present an analysis of the documentation provided by Medan, an assessment of the technical aspects related to current site conditions, landfill operations, stormwater, leachate and landfill gas management observed during the site visit performed the week of March 10, 2020; and recommendations to move forward on the next steps to complete the Assessment for the Closure of the Waste Disposal Site for Terjun.

Terjun has been in operation since 1993 with a current average disposal rate of approximately 1,155 tonnes per day Medan expects to reach full capacity by end of 2021. Terjun has 6.6 million tonnes of waste disposed as of the end of 2019. The current waste footprint is approximately 8 hectares (Area A and B). Medan is currently planning to develop a new disposal area (Area C) as an engineered landfill with a waste footprint of 2 hectares.

Terjun can be classified as an unmanaged deep final disposal site per IPCC criteria. The site does not have a bottom liner system and the water table is very high up to 50 cm below ground level, so groundwater is most certainly being polluted by leachate. Leachate, landfill gas, and stormwater controls do not exist on the site. Due to the lack of soil at the site, closure of the site will require the transport of soil from about 60 km to the closest source. Due to this factor a final cover system with a geomembrane was considered for the preliminary conceptual closure plan.

Development of a Preliminary Conceptual Closure Plan

This activity is documented on the Preliminary Conceptual Closure Plan. This Plan contains a conceptual design and capital cost estimations for the closure of Terjun. This plan was prepared using industry standards, best management practices and the information collected during the site assessment. In addition, the conceptual design assumes that Area C is going

to be constructed and the leachate treatment area will be rehabilitated. This plan includes the following: The final grading plan, stormwater management features, leachate management and control, LFG management and control, and preliminary plans drawings.

The project capital costs were estimated based on the preliminary conceptual closure plan. The unit prices used were developed from similar projects developed in the United States and abroad. In addition, some costs such as soil, were material costs provided by Medan. The following table presents a summary of the capital costs.

Summary of Closure Plan Capital Costs

Area of Work	Total
Earthwork	$ 760,463
Geosynthetics	$1,166,700
Stormwater Management	$ 374,525
Leachate Management	$ 511,000
Gas Collection and Control System (GCCS)	$ 788,440
Miscellaneous	$ 399,282
Capital Cost Subtotal	**$4,000,411**
5% Contingency	**$ 200,021**
Total Capital Cost	**$4,200,431**

The GCCS cost for Area C is not considered on closure plan capital costs. The average investment cost for an LFG to energy (LFGE) project is about USD 2.5 million per megawatt (MW), plus the cost related to the interconnection point to the public network. Therefore, a 0.9 MW LFGE project will cost about USD 2.25 million plus the cost of interconnection to the grid. This study did not investigate the latter; further study will be needed to estimate the interconnection cost.

Preparation of Landfill Gas Assessment Report

This activity is documented on the LFG Assessment Report. The LFG assessment report contains LFG generation and recovery projections. These projections forecast the amount of LFG that can be collected for the implementation of an LFG utilization project at Terjun. LFG generation projections were developed based on information gathered including waste types, waste quantities, dates of filling, projected filling plans, climate, waste filling practices and the future disposal plans as well as observations made during the site visit to Terjun in the week of March 10, 2020 regarding current site conditions, waste disposal practices, and site operations.

LFG Model Results

Year	LFG Generation (m^3/hr)	LFG Recovery (m^3/hr)	Maximum Power Plant Capacity (MW)	Methane Emissions Reduction Estimates (tonnes/CO_2eq/yr)
2021	1,663	998	1.7	65,723
2022	1,647	988	1.6	65,064
2023	1,652	991	1.6	65,282
2024	1,673	1,004	1.7	66,126
2025	1,706	1,024	1.7	67,429
2026	1,748	1,049	1.7	69,079
2027	1,345	807	1.3	53,157
2028	1,064	638	1.1	42,028
2029	864	518	0.9	34,143
2030	720	432	0.7	28,461
2031	614	369	0.6	24,281
2032	535	321	0.5	21,134
2033	473	284	0.5	18,703
2034	424	255	0.4	16,772
2035	385	231	0.4	15,197
2036	351	211	0.3	13,879
2037	323	194	0.3	12,752
2038	298	179	0.3	11,768
2039	276	165	0.3	10,896
2040	256	154	0.3	10,113

Note: Projected LFG recovery rates are in m3/hr, adjusted to 50% methane.

Landfill Gas to Energy Project. Based on the LFG generation and recovery projections, a landfill gas to energy (LFGE) project of 0.9 MW is sustainable from 2021 thru 2029.

Financing and Contracting Options

Financing Sources

A list of potential financing partners that can provide financial support for the development of the Project is presented on this section. The opportunities include grants for procurements, technical assistance and services to loans, loan guarantees, etc.

Asian Development Bank (ADB). The ADB Leading Asia's Private Sector Infrastructure Fund provide co-financing to non-sovereign infrastructure projects at different stages of development, including early stage, growth stage, and greenfield and brownfield projects including solid waste management projects (https://www.adb.org/what-we-do/funds/leap).

Global Environmental Facility (GEF). GEF provides support to government agencies, civil society organizations, private sector companies, and research institutions—among the broad diversity of potential partners to implement projects and programs in recipient countries. Climate change is one of GEF's focus topics; GEF provides support for the shift to a low-carbon economy (https://www.thegef.org/topics/climate-change).

Inter-American Development Bank (IDB). The IDB vision is a region with clean cities, capable of providing integrated services for solid waste management to the entire population, tailored to local realities, sustainable from the environmental and economic point of view, and socially inclusive. Toward this goal, the Water and Sanitation Initiative has created a specialized group for solid waste management and has established a long-term program to support IDB activities in the sector (https://www.iadb.org/en/residussolides).

United States Trade and Development Agency (USTDA). USTDA awards grant funds to overseas project sponsors for a variety of activities, including technical assistance, training programs and early investment analysis/feasibility studies. USTDA responds to priorities that overseas project sponsors establish for themselves. If necessary, USTDA can help project sponsors define their priorities.

World Bank Group. The World Bank finances and advises on solid waste management projects using a diverse suite of products and services, including traditional loans, results-based financing, development policy financing, and technical advisory. World Bank financed waste management projects address the entire lifecycle of waste from generation to collection and transportation, and finally treatment and disposal.

- The Climate Finance Program provides financing for transitioning to a low-carbon, climate-resilient global economy (http://www.worldbank.org/en/topic/climatefinance#1).

- The International Finance Corporation provides financing opportunities for the private sector and can be used by the potential contractor to finance the engineered landfill and LFG system. (https://www.ifc.org/wps/wcm/connect/CORP_EXT_Content/IFC_External_Corporate_Site/Solutions/)

Contracting with the Private Sector Through a Concession. This is a type of contract where a private company is selected through a competitive process to provide services for a fee. The private company would finance the development of the landfill closure as well as the new landfill cell. The private company retains ownership for the length of the contract; while the Municipality would be responsible for paying a previously negotiated tipping (gate) fee for every ton of waste disposed of at the landfill. This fee is typically set to be sufficient for the company to recoup depreciation on their investment, generate sufficient return on investment, and cover O&M costs.

Recommendations

Recommendations that will be key on the implementation of the project are presented below:

- The ADB has prepared a guide called Integrated Solid Waste Management for Local Governments: A Practical Guide. This document can help you guiding you to solve some of the issues The City of Medan is or might be face (https://www.adb.org/documents/solid-waste-mgt-local-gov).
- Use this assessment as a tool to seek for potential financing and contract arrangements. Full engineering design will be necessary prior to project implementation.
- Stormwater management at the site will be a challenge since the waste footprint covers most of the site property. It would be beneficial if Medan would acquire additional property around the site to properly design stormwater runoff control from the site.
- The surrounding area used for informal fishing ponds could potentially be a health risk due to the migration of leachate from Terjun into the adjacent fishing ponds. It is important to assess these potential health risks and make people aware if these risks exist.
- Fix or replace weighbridge at Terjun to have more reliable data regarding incoming waste.
- Try to eliminate the high occurrences of smoldering fires by placing cover soil. Smoldering fires make difficult the estimation of LFG generation and recovery, since it is impossible to estimate the extent of these fires and determine the amount of organic waste consumed by these fires. In addition, landfill fires generate $PM_{2.5}$ which impacts negatively the air quality of the city. Likewise, landfill fires can become uncontrollable rapidly which can lead to losses of human lives and property.
- Maintain access roads to all areas of the site so that vehicles and heavy equipment can access such areas more safely and in a timely matter.
- Maintain and regrade side slopes at 3:1 (horizontal:vertical) while placing waste to minimize the chances of waste slides.
- Applying daily cover to the waste whether with soil or tarps will help mitigate the incidence of vectors (flies, birds, rodents, etc.) on the waste, also mitigating any potential spread of infections.
- The City needs to find a solution for remove scavengers or waste pickers from the active disposal area. This is a social and economic issue that will need to be handle properly. In similar cases, scavengers have been assimilated to work on recycling plants, and other waste related activities under the solid waste management system, such as labor workers in the landfill.

Priority Actions

Medan has requested to provide prioritization of the closure plan activities to better managed the available annual budget. It is important to note that this prioritization of closure plan activities do not guarantee that major issues such as a waste slide can occur. It only provides guidance on how Medan can potentially mitigate some of the current and existing issues.

1. Recontouring of the waste mass to maximum side slopes of 3:1 (H:V). This is important to mitigate the potential of a waste slide since current slopes do not present any particular pattern and sideslopes that up to 1:1 (H:V) were observed during the Site Visit.

2. Placement of soil cover layer. The proposed final cover system requires a 30 cm soil layer on top of the waste (this is typically an intermediate cover layer used on most sites). Placement of this layer will help mitigate leachate generation, presence of vectors, and odor control. The type of soil used will preferably be of low permeability (high clay content) and should be placed in layers of 10 cm, properly compacted. The placement of this soil cover layer must be done after the recontouring of the waste has been completed.

3. Placement of the geosynthetics and soil layer on top of geosynthetics will have to be done in conjunction to the GCCS. If the GGCS is not placed the accumulated gas under the liner will make the liner inflate like a balloon and you will have other operational problems.

I would like to emphasize that doing step 1 and 2 only do not guarantee that issues in the site will not happened, it only mitigates the issues mentioned above.