WASTE MANAGEMENT PLAN
SNNP IAIP AND RTC

Report Produced by:
WSP in with Engineer Tequam Water Resources Development and Environment Consultancy (ETWRDEC)

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INTRODUCTION

The Waste Management Plan (WMP) addresses management of all solid and liquid refuse, including hazardous and non-hazardous waste, produced as a result of Project activities within the SNNP IAIP and RTC sites.

The WMP covers the construction and operational phases. This report constitutes the initial draft which will require amendment and updating as enterprises begin development and operation within the IAIP and RTC.

PURPOSE

The WMP aims to provide guidelines on waste reduction, segregation, collection and disposal practices in accordance with international best practices, to avoid deterioration of the natural environment and negative impacts on the health and safety of communities in the Project area.

The Project is committed to apply the waste hierarchy and will seek to be a zero waste discharge facility. This plan is the primary tool to guide employees towards waste management.

WASTE MANAGEMENT OPTIONS - WASTE HIERARCHY

The waste hierarchy presents waste management stages commencing with the most preferable option to the least preferable option. Waste prevention is the most preferred option, followed by re-use, recycling, recovery including energy recovery and as the last option is safe disposal, see Figure 1.

Figure 1: Stages of the Waste Hierarchy

These stages are described in more detail below:

PREVENTION

Enterprises should be required to strictly manage purchasing of raw materials in order to ensure there is minimal wastage. The focus is to prevent raw materials, ingredients and products from becoming waste in the first place. Any surplus raw materials or produce not meeting exporting standards or products that have been sent back after being exported owing to defects should be reduced by redistributing these products at organised market events occurring within the IAIP or RTC twice annually, donate to charity lawfully within the country or sending for animal feed. This is in line with the requirements set out within the Industrial Park Proclamation No. 886/2015.

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1 Refer to Article 19(11)
Enterprises should be committed to avoiding the generation of waste and not using hazardous materials. Where the use of hazardous materials is unavoidable, efforts should be made to identify replacement materials that are non-hazardous through continued research and development.

RE-USE

Enterprises should be required to prepare a Maintenance Management Plan which seeks to ensure that all equipment is regularly checked and maintained and refurbished or repaired. In addition, Enterprises should seek to sell and buy used items, donating them for free or exchanging them.

RECYCLING

Enterprises should seek to turn waste into a new substance or product, such as composting of organic wastes to a standard that meets relevant quality controls. This compost could be sold or given to farmers outside the boundary of the sites to facilitate improvements in soil conditions and hence their production levels.

RECOVERY

Recovery of waste is usually most successful when done in bulk. Therefore, a centralised recovery facility is preferable. Forms of recovery include anaerobic digestion, incineration with energy recovery, gasification and pyrolysis which produce energy (fuels, heat and power) and materials from waste. It is recommended that the solid waste management system be modified and improved to make it compatible with the requirements of the proposed bio-methanation technology.

DISPOSAL

Disposal is deemed the last resort and must occur in an environmentally responsible manner. Disposal results in waste going to landfill or to incineration without energy recovery and is the least preferred environmental option. However when wastes must go for disposal this must occur at a suitably designed sanitary waste disposal site.

4 WASTE CATEGORIES GENERATED BY THE IAIP AND RTC SITE

Solid waste generation in the SNNP IAIP and RTC will generally include domestic waste, commercial waste, construction and demolition debris, sanitation residue and waste from streets. These wastes will be in solid or semi-solid form and will potentially include very low quantities of industrial hazardous wastes and bio-medical waste (from the polyclinic). All industrial hazardous waste and biomedical waste must be disposed of properly by the respective industries and cannot be included in the site wide waste management system.

The main waste categories anticipated are:

- Biodegradable waste (food and kitchen waste, green waste (vegetables, flowers, leaves, fruits) etc.);
- Recyclable material (paper, glass, bottles, cans, metals, certain plastics, etc.); and
- Inert waste (construction and demolition waste, dirt, rocks, street sweeping, drain silt, debris, etc.)

The sources of waste and waste generators and the anticipated content of the solid waste generated are presented in Table 1 below.

<table>
<thead>
<tr>
<th>Source</th>
<th>Typical waste generators</th>
<th>Solid waste content</th>
</tr>
</thead>
<tbody>
<tr>
<td>Industrial</td>
<td>Process by industries and employees</td>
<td>Food wastes, paper, cardboard, plastics, ashes, special wastes (e.g. bulky items, consumer electronics, batteries, oil, tyres) and limited industrial hazardous wastes.</td>
</tr>
</tbody>
</table>
### Source

<table>
<thead>
<tr>
<th>Typical waste generators</th>
<th>Solid waste content</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Residential</strong></td>
<td>Dwelling units</td>
</tr>
<tr>
<td></td>
<td>Food wastes, paper, cardboard, plastics, textiles, leather, yard wastes, wood, glass, metals, ashes, special wastes (e.g. consumer electronics, batteries, oil, tyres) and limited household hazardous wastes. Sewage waste.</td>
</tr>
<tr>
<td><strong>Commercial</strong></td>
<td>Stores, hotels, restaurants, markets, office buildings</td>
</tr>
<tr>
<td></td>
<td>Paper, cardboard, plastics, wood, food wastes, glass, metals, special wastes, hazardous wastes</td>
</tr>
<tr>
<td><strong>Institutional</strong></td>
<td>Schools, hospitals, government centres</td>
</tr>
<tr>
<td></td>
<td>Paper, cardboard, plastics, wood, food wastes, glass, metals, special wastes, hazardous wastes</td>
</tr>
<tr>
<td><strong>Construction and demolition</strong></td>
<td>New construction sites, road repair, renovation sites, demolition of buildings</td>
</tr>
<tr>
<td></td>
<td>Wood, steel, concrete, rubble, dirt etc.</td>
</tr>
<tr>
<td><strong>Municipal services</strong></td>
<td>Street cleaning, landscaping parks and other recreational areas, water and waste water treatment plants</td>
</tr>
<tr>
<td></td>
<td>Street sweepings, drain silt, landscape and tree trimmings, general wastes from parks and other recreational areas, sludge.</td>
</tr>
</tbody>
</table>

The estimated solid waste generation volumes have been provided by MACE within the Solid Waste Management Plant – 5 TPD – IAIP at Yirga Alem Report (October 2017) and are presented in Table 2.

**Table 2: Solid waste generation estimation**

<table>
<thead>
<tr>
<th>SI No.</th>
<th>Description</th>
<th>Total Area</th>
<th>Percentage</th>
<th>Population</th>
<th>Per Capita SWM generation kg/ha or gm/capita</th>
<th>SWM generation in TPD</th>
<th>Biodegradable in TPD</th>
<th>Non-biodegradable / Recycle waste in TPD</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Hectares</td>
<td>Acres</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Industries</td>
<td>122.42</td>
<td>302.51</td>
<td>57%</td>
<td>15676.00</td>
<td>200</td>
<td>3.135</td>
<td>2.508</td>
</tr>
<tr>
<td>2</td>
<td>Amenities</td>
<td>23.97</td>
<td>59.22</td>
<td>11%</td>
<td>2281.80</td>
<td>100</td>
<td>0.228</td>
<td>0.183</td>
</tr>
<tr>
<td>3</td>
<td>Residential</td>
<td>1.88</td>
<td>4.65</td>
<td>1%</td>
<td>1011.00</td>
<td>450</td>
<td>0.455</td>
<td>0.364</td>
</tr>
<tr>
<td>4</td>
<td>Road</td>
<td>23.98</td>
<td>59.26</td>
<td>11%</td>
<td>0</td>
<td>10</td>
<td>0.240</td>
<td>0.192</td>
</tr>
<tr>
<td>5</td>
<td>Utilities</td>
<td>10.39</td>
<td>25.69</td>
<td>5%</td>
<td>40.00</td>
<td>100</td>
<td>0.004</td>
<td>0.003</td>
</tr>
<tr>
<td>6</td>
<td>Park, greenery &amp; existing stream area</td>
<td>32.21</td>
<td>79.58</td>
<td>15%</td>
<td>0</td>
<td>30</td>
<td>0.967</td>
<td>0.773</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>214.85</strong></td>
<td><strong>530.90</strong></td>
<td><strong>100%</strong></td>
<td><strong>18968.80</strong></td>
<td><strong>-</strong></td>
<td><strong>5.029</strong></td>
<td><strong>4.023</strong></td>
</tr>
</tbody>
</table>

### 5 WASTE TREATMENT OPTIONS

The primary options for the treatment of solid waste include, in order of environmental benefit:
Anaerobic Digestion;
Composting (windrow, aerated static pile, in-vessel and vermicomposting);
Incineration with or without energy recovery;
Pyrolysis and gasification;
Plasma pyrolysis and palletisation; and
Reuse Derived Fuel (RDF) for mixture waste.

Since the nature of waste envisaged in this park is wet, bioconversion methodologies are considered the preferred technology.

### EXISTING AND PROPOSED WASTE MANAGEMENT INFRASTRUCTURE

Solid waste management in the towns is very much similar to many towns in Ethiopia. Solid waste management activities associated with generation, storage, collection, transportation, processing and safe disposal are not properly established. Solid waste is collected in bulk and disposed of at an open dumpsite on the outskirt of the town without any form of pre-treatment or formal management.

The current municipal waste management practices in Yirga Alem town are not adequately organised. There are eight SMEs in Yirga Alem with a combined membership of eighty individuals that are involved in primary door to door solid waste collection. This collection is undertaken utilising approximately ten donkey-pull carts. The municipality has two tractors for waste collection from the temporary waste transfer stations (containers) to the waste disposal dumpsite. An informal waste dumpsite is located approximately 1 km away from the centre of Yirga Alem town at Bulbulcho, on the way to Aposto. The dumpsite is not fenced nor has any lining. There is no formal waste treatment facility or management practice at the dumping site, however there are some individuals (scavengers) who have been involved in informal waste recovery and recycling activities.

Solid waste management in Dilla town is very much limited to bulk collection and disposal. About 40-50% of the solid waste produced by the city is collected and disposed of at the informal dumping site located at Chito about 8km away from the centre of the town. There are six SMEs primary door to door waste collection service providers which collects household and institutional wastes by using donkey-pull carts. According to the Dilla structural plan proposal report (ECSA, 2012) indicates that the disposal site is not located in an appropriate areas with respect to the prevailing wind conditions. The structural plan recommends that the disposal site be relocated to an appropriate location. There is no formal waste treatment facility or management practice at the dumpsite, however there are some informal individuals (scavengers) who pick valuable items such as metals, glasses and plastics for reuse or recycling purposes. Liquid waste management (both greywater and faecal sludge) of Dilla town is very poor. Despite the presence of drainage lines for greywater along main roadsides, they are not well managed.

### YIRGA ALEM IAIP

A Sewage Treatment Plant (STP) and common Effluent Treatment Plant (CETP) are proposed to be located in the most southwest corner of the IAIP in close proximity Solid Waste Management (SWM) area. The SWM area will be located on the western boundary, one plot north of the STP/CETP.

The SWM area will be used for receipt of primary collection waste. Here the waste will be segregated and prepared for onward transport to the recycling area and any leachate to the sewage treatment plant.

Landfills are limited in Ethiopia and Yirga Alem town has no suitably designed and controlled landfill site. According to the town’s structural plan, the municipality has aimed to initiate the construction of a new solid waste disposal site in the coming fiscal year 2017/18. According to the plan a proposed new disposal site will be located approximately 6km from the Yirga Alem town centre, along the Aposto-Dilla road in the neighbouring Woreda (Dale Woreda). It is noted that the proposed site is very close to the IAIP site. It is understood that an environmental and social safeguard study will be conducted of the new disposal site prior to its construction. According to the structural plan, the proposed dumpsite is being promoted by the municipality with involvement of the local environmental protection office. Details of the proposed landfill site were not available to be assessed, it is therefore not evident as to whether the site will be suitable for disposal of waste form the proposed IAIP.
Since there is no well managed sanitary landfill site in close proximity to the Park any residual waste, such as hazardous industrial waste and biomedical waste, which will require safe disposal, must be transported the necessary distance to ensure disposal occurs in an environmentally responsible manner. A sanitary landfill site must be used for the disposal of hazardous waste.

**DILLA RTC**

The Dilla municipality has no integrated solid waste management plan or strategy. It has a plan to construct a new standardised landfill at Waleme site, located in the north western part of the city. An Environmental Impact Assessment of this proposed landfill site was conducted in 2010. However the landfill construction has not been yet commenced. In addition, the municipality has an annual plan to conduct awareness raising of the community of solid waste management in the 2017/2018 fiscal year. Details of the proposed landfill site were not available to be assessed, it is therefore not evident as to whether the site will be suitable for disposal of waste form the proposed IAIP.

Therefore, since there is no well managed sanitary landfill site in close proximity to the RTC any residual waste, such as hazardous waste which will require safe disposal, must be transported the necessary distance to ensure disposal occurs in an environmentally responsible manner. A sanitary landfill site must be used for the disposal of hazardous waste.

7 **SOLID WASTE MANAGEMENT AT THE SNNP IAIP AND RTC**

All enterprises within the IAIP and RTC will be required to segregate waste at source to ensure the value of the wastes are optimised through recovery, reuse and recycling. By providing an enabling environment the success rate of correct waste practices being implemented are increased.

Segregation should be by generators and into three main waste streams:

- Wet (biodegradable);
- Dry (plastic, paper, metal and wood); and
- Domestic hazardous wastes (diapers, napkins, empty containers of cleaning agents, mosquito repellents etc.).

Collection of the segregated waste is to be undertaken by an authorised waste collector. As a minimum wet and dry wastes should be segregated (2-bin system) by the waste generators, see Figure 2 below. Source segregation of waste optimises waste processing and treatment technologies. The bio-degradable waste should be processed, treated and disposed of through composting or bio-methanation within the premises as far as possible. The development is required to be a zero waste facility and therefore all residual waste from the bio-methanation or composting will need to be managed on the IAIP site. Plots or sheds within the IAIP are to be designated for recovery and recycling facilities.

Figure 2: Example of waste separate of inorganic and organic wastes at source

![Food wastes of all kinds, cooked and uncooked, including eggs, fish, and bones, flower and fruit wastes including juice peels and house-plant wastes, soiled tissues, food wrappers, paper towels](image)

![Paper; cardboard and cartons; Containers & packaging of all kinds excluding those containing hazardous materials; Compound packaging (tetra pack, blisters etc.) and plastics; Rags, rubber, wood, discarded clothing and furniture; Metals, Glass (all kinds), House sweepings and inert (not garden, yard or street sweepings)](image)
A bio-methanation facility is being proposed at the IAIP for the treatment of the wet waste component generated at the IAIP. This involves the anaerobic decomposition of wet organic wastes to produce a methane-rich biogas fuel and a small amount of residual sludge that can be used for making enriching compost. It is currently proposed that the biogas will supply fuel to a 25KVA capacity biogas engine which will be used for generating power from the biogas produced. The generated power can be used for internal electrification and street lighting. It is also possible to consider using the biogas fuel to fuel transport trucks and waste trucks associated with the IAIP and RTC sites.

Anaerobic digestion is best suited to the treatment of wet organic feed stocks such as high moisture agricultural biomass, food waste, and animal wastes including manure and domestic sewage.

Construction and demolition waste should be stored separately. Opportunities to repurpose this waste as secondary aggregate to the construction industry should be investigated to ensure this waste is either utilised on the IAIP site or is sold as a product to the construction industry. No construction or demolition waste should be disposed of to landfill.

No hazardous wastes shall be permitted to be disposed of outside the boundary of the IAIP or RTC unless being transported to a sanitary landfill. The IPDC must place the responsibility of safe disposal of hazardous waste on the generator. It will be the generators responsibility to ensure that the waste collector which will be transporting the waste for disposal has obtained a permit from the Urban Administration to do so in terms of Article 4(1) of the ‘Solid Waste Management Proclamation 513/2007’. In addition, the Generator will need to provide evidence in writing from the receiving disposal site of its capacity to recycle or dispose of the waste in an environmentally sound manner (Article 6(3)). Proof of safe disposal should be provided to the IPDC, such as a waste disposal ticket issued and date stamped by the sanitary landfill. This waste stream is anticipated to be small, limited to cleaning materials and small quantities of bio-medical waste since most of the processing to be undertaken on site is for the food industry and therefore hazardous process materials should be limited.

Within the Park there will be primary collection of waste from the industries, households, markets and other commercial establishments. This waste will be taken directly to the treatment site. Primary collection will occur by either ‘door to door’ collection using segregated bins or containers which will be placed on the streets for collection. This waste will be taken to a solid waste intermediate storage facility. The use of an intermediate site allows for the optimisation of transport devices and manpower which in addition allows for timely collection of waste from source and onward treatment. Secondary transportation occurs from the storage area to the final destination of the waste, wet waste will go to the bio-methanation plant and dry wastes will go to the recycling depot.

The dry waste such as paper and plastic and cardboard and glass are to be recycled. The IPDC must provide a site with a covered storage area for recyclable waste. The size of the area provided should be suitable for the bulk storage of up to 7 days of waste generation.

Waste collection from generators within the IAIP and RTC will need to occur on a daily basis in order to prevent garbage containers overflowing and waste littering the streets. To maintain a hygienic environment regular waste clearance is required.

8 PERFORMANCE MONITORING

INSPECTIONS

Site inspections must be performed by the Health, Safety and Environment (HSE) Officer for the SNNP IPDC. The IAIP site and RTC site should be inspected on a regular basis with a formally-documented inspection each month. Inspections will ensure that all commitments in this WMP are being enforced and that specific waste management elements are verified.

DATA COLLECTION

Implementation of the waste hierarchy principles requires that destinations and quantities of residual matter are monitored. A register of waste material should be maintained to ensure the measurement of eliminated waste and of residual matter sent for reuse, recycling and reclamation.
WASTE AUDIT
After a year of operation, a waste audit should be performed, on all waste data collected, to identify waste streams and fate and develop ways to reduce waste production.

PERFORMANCE INDICATORS
Measurement is an important tool in improving performance, and performance indicators will help the SNNP IPDC define and measure progress towards their goals. The results reflect current conditions and allow orientation and coordination of further actions towards sustainability.

ENVIRONMENTAL AUDIT RESULTS
Environmental auditing is a key process in the implementation of the Environmental and Social Management Plan (ESMP), of which the WMP forms a part. The findings of each audit should be registered in a database, where corrective and/or preventive actions are prescribed, responsibilities assigned to people, deadlines established and necessary resources mobilised.

In compliance with the procedure, audit reports should categorise findings as being either “major”, “minor” or “observation”. The number of findings shall be decreasing every year until the ultimate goal of zero major findings is achieved. This indicator is not specific to the WMP, but to all facets of the ESMP.

PERCENTAGE WASTE GENERATED
During the operational phase, the quantities and types of waste produced should be tracked for each department, and activities examined to identify waste reduction opportunities. Specific reduction target ratios should be determined and the rate of waste production is required to reduce annually relative to production volumes. Waste includes packaging and any residual product sent for disposal, both hazardous and non-hazardous.

RESPONSIBILITIES
The roles and responsibilities inherent to the WMP are presented in Table 3 below.

Table 3: Roles and Responsibilities

<table>
<thead>
<tr>
<th>Entity</th>
<th>Responsibilities</th>
</tr>
</thead>
<tbody>
<tr>
<td>SNNP IPDC</td>
<td>- Enforce the Waste Management Plan.</td>
</tr>
<tr>
<td></td>
<td>- Contractually obligate the Enterprises to meet the requirements of the Waste Management Plan.</td>
</tr>
<tr>
<td></td>
<td>- Manage the Solid Waste Management Area or appoint an appropriate contractor.</td>
</tr>
<tr>
<td></td>
<td>- Manage the Solid Waste Treatment plant or appoint an appropriate contractor.</td>
</tr>
<tr>
<td></td>
<td>- Manage the Recycling and Recovery area or appoint an appropriate contractor.</td>
</tr>
<tr>
<td>Enterprises</td>
<td>- Provide a minimum of two garbage receptacles to each waste generator to allow for wet and dry waste segregation. An additional bin for hazardous waste is highly recommended.</td>
</tr>
<tr>
<td></td>
<td>- Develop an Enterprise specific Waste Management Plan for the activities of said Enterprise.</td>
</tr>
<tr>
<td></td>
<td>- Enterprise specific Waste Management Plan must be aligned with the full site WMP and must be approved by the IPDC HSE prior to commencement of operations.</td>
</tr>
<tr>
<td></td>
<td>- Educate all members of staff on the waste hierarchy.</td>
</tr>
<tr>
<td></td>
<td>- Educate all members of staff on the Enterprise WMP and the Waste Management Plan for the IAIP/RTC.</td>
</tr>
<tr>
<td></td>
<td>- Education is to be provided to each staff member prior to commencement of work, and regular refresher sessions are to be undertaken in the form of toolbox talks or training sessions throughout the operation of the facility.</td>
</tr>
<tr>
<td>Contractors</td>
<td>- Provide a minimum of two garbage receptacles to allow for wet and dry waste segregation. An additional bin for hazardous waste is highly recommended.</td>
</tr>
</tbody>
</table>
11 RECORD KEEPING

Data on waste production and disposal should be gathered continually via logbooks and registers. Records should be maintained on site and made available to the IPDC, authorities and any other party contracted to audit or assess the waste management practices on site. The data should include the final destination of each waste stream and where disposal has occurred proof of safe disposal will be required, such as a date stamped waste disposal ticket issued by a sanitary landfill. A cost should be paid for safe disposal of wastes. Evidence of waste disposal should also be maintained.

12 REVIEW PROCESS

The WMP is to be reviewed and updated on an annual basis.

Date of next review: December 2018