Feasibility study for alternative waste treatment technology

Feasibility study report

City of Johannesburg

13 October 2017
Revision: 3
Reference: 111022_011
### Document control record

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<tr>
<th>Report title</th>
<th>Feasibility study report</th>
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<tbody>
<tr>
<td>Project number</td>
<td>111022</td>
</tr>
<tr>
<td>Document ID / reference</td>
<td>111022_011</td>
</tr>
<tr>
<td>Client</td>
<td>City of Johannesburg</td>
</tr>
<tr>
<td>Client contact</td>
<td>Makhosazana Baker / Li-pei Huang</td>
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</tbody>
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<tr>
<th>Rev</th>
<th>Date</th>
<th>Revision details / status</th>
<th>Prepared by / author</th>
<th>Verifier</th>
<th>Approver</th>
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<tr>
<td>A</td>
<td>3 March 2015</td>
<td>2015.02.25.STRUCTURE OF City PPP FEASIBILITY STUDY.docx</td>
<td>Karen van der Merwe</td>
<td></td>
<td></td>
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<td>1</td>
<td>7 August 2015</td>
<td>Circulated to Makhosazana Baker and Li-pei Huang</td>
<td>Louié Schoeman</td>
<td>Nick Mannie</td>
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<tr>
<td>2</td>
<td>10 August 2015</td>
<td>Content reviewed</td>
<td>Nick Mannie</td>
<td></td>
<td></td>
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<tr>
<td>3</td>
<td>14 August 2015</td>
<td>Final submitted to CoJ (Makhosazana Baker) and GIFA (Li-pei Huang)</td>
<td>Louié Schoeman</td>
<td>Nick Mannie</td>
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## Glossary

### 1.1.1.1 Abbreviations, acronyms and definitions

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| AD | Anaerobic Digestion is the breakdown of biodegradable organic material by microorganisms in the absence of oxygen. In a controlled treatment process two useful products are obtained:  
  - Biogas (which can yield heat and power)  
  - Residual digestate (a nutrient-rich fertiliser) |
| ABT | Anaerobic Biological Treatment |
| Aerobic | In the presence of oxygen |
| Anaerobic | In the absence of oxygen |
| AP | Acidification Potential relates to the release of acidic gases, such as sulphur dioxide, which have the potential to react with water in the atmosphere to form ‘acid rain’ and causing ecosystem impairment. |
| APCr | Air Pollution Control residues: Small quantity of hazardous waste produced by the automated process to remove potentially polluting gases and particulates from the flue gases produced by the combustion of waste in a WtE plant |
| ARD | Abiotic Resource Depletion is related to extraction of scarce minerals and fossil fuels. The abiotic depletion factor is determined for each extraction of minerals and fossil fuels based on the remaining reserves and rate of extraction. |
| Autoclave | Autoclave is the application of high temperature steam and high pressure to treat waste. Also used in the medical industry to sterilise surgical instruments and clinical wastes |
| ATT | Advanced thermal treatment is an all-encompassing term for those waste treatment technologies which utilise thermal processes to treat waste. Technologies that are usually included within the ATT grouping are primarily those that employ pyrolysis and/or gasification to process mixed general waste and also exclude full combustion thermal processes (i.e. incineration) |
| AWTT | Alternative waste treatment technology: Any modern waste treatment process that diverts waste from landfill |
| AWTT PPP | The Project |
| BBBEE | Broad based black economic empowerment |
| Biogas | Gas generated from the anaerobic degradation of organic material which contains methane and carbon dioxide. Biogas can be used to generate energy |
| Biostabilisation | Biostabilisation is the aerobic (composting) or anaerobic (Anaerobic Digestion) treatment of the organic fraction of municipal solid waste to produce a biologically stable material which will not produce methane when landfilled. Organic waste will decompose naturally under a controlled environment |
| **Bio-drying** | A bio-drying process uses the natural composting process in the organic fraction of MSW to generate heat which accelerates the drying of all wet fractions of municipal solid waste. Biodrying does not result in a biostabilised waste, rather a dryer waste with a higher calorific value and less mass. |
| **Biofilter** | Natural biological process to remove odour from gaseous emissions |
| **Biowaste** | The organic fraction of MSW which can include garden and food waste |
| **CAPEX** | Capital expenditure |
| **C&I** | Commercial and industrial waste generated from commercial businesses such as wholesales, catering establishments, shops and offices and industrial activities such as factories and industrial plants |
| **CBD** | Central business district |
| **CLO** | Compost like output |
| **CoJ** | City of Johannesburg |
| **Co-mingled** | Mixed recyclable materials such as paper, glass, plastics and metals |
| **CIG** | Conventional Incineration Gasification |
| **CV** | Calorific value of a material or waste is the energy content and is typically measured in Mega Joules per tonne |
| **DCOG** | Department of Co-operative Government, or the national department responsible for the local government |
| **DEA** | Department of Environmental Affairs, or the national department responsible for the waste sector and/or the environmental issues |
| **Db** | Dry weight basis |
| **Disposal** | Final option on the waste hierarchy: Residual material which cannot be further reused, recycled or recovered is disposed of by incineration or landfilling |
| **Dry recyclates** | Materials such as paper, card, plastic, metal and glass can be source segregated or co-mingled at the kerbside before being taken for treatment |
| **DOE** | Department of Energy, or the national department responsible for electricity |
| **EIA** | Environmental impact assessment |
| **EISD** | Environment and Infrastructure Services Department |
| **EOI** | Expression of interest |
| **EP** | Eutrophication Potential is a reflection of released nitrate and phosphate levels. Nit rates and phosphates are essential for life but increased concentrations in water can encourage excessive growth of algae, reducing the oxygen within the water and damaging ecosystems. |
| **E-waste** | Waste consisting of electrical and electronic equipment |
| **FAETP** | Freshwater Aquatic EcoToxicity Potential is a measure of the adverse effects to aquatic organisms that result from being exposed to toxic substances. It is well known that fish can ‘bioaccumulate’ concentrations of mercury and other toxins. |
Mobile heavy metals are extremely toxic to aquatic life, so activities that reduce releases of heavy metals will be favourable in this assessment.

**FEL**
Front end loader (excavator): Wheeled mobile plant used to load bulk waste into vehicles or a treatment process

**GDP**
Gross domestic product

**GDS 2040**
Growth and Development Strategy 2040

**GiFA**
Gauteng Infrastructure Financing Agency

**GIS**
Geospatial Information System

**Greenfield**
New project; activity has never been undertaken by the CoJ before

**GWP**
Global Warming Potential is an assessment of the amount of carbon dioxide and other gases emitted into the atmosphere and liable to cause global warming. Apart from CO\(_2\), the other major greenhouse gas for waste management tends to be methane, which is 23-times more potent than CO\(_2\). WRATE also weights emissions of other greenhouse gases according to the climate change potency to produce a carbon footprint expressed in CO\(_2\) equivalents.

**HDPE**
High density polyethylene

**HTP**
Human Toxicity Potential is a measure of the impacts on human health. Characterisation factors describe the fate, exposure and effects of toxic substances over an infinite time horizon.

**IED**
European Industrial Emissions Directive

**IBA**
Incinerator bottom ash: The inert product dropping off the end of the grate following the combustion of waste in a WtE plant

**IIWTMP**
Integrated Industry Waste Tyre Management Plan

**IPPO**
Independent Power Producers Office

**IWMS**
Integrated Waste Management Strategy defining a municipality’s overarching plans for the future management of waste defining key performance indicators for the whole management system (e.g. minimisation, collection, treatment and disposal) and typically include indicative levels of landfill diversion, recycling and energy recover. Strategies often include implementation plans which define how and by when initiatives need to be commenced and the likely timeline to service commencement

**IVC**
In-vessel Composting uses naturally occurring microbes within a closed and controlled environment, which feed on the organic material and oxygen, to break down organic material and turn it into compost

**JFPM**
Johannesburg Fresh Produce Market

**LCA**
Life cycle assessment

**LCI**
Life cycle inventory

**LCV**
Lower calorific value

**LFG**
Landfill gas recovery

**M**
Moisture content
<table>
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<tr>
<th>MBT</th>
<th>Mechanical Biological Treatment plants are processing facilities that treat residual MSW to separate recyclable material and the organic fraction</th>
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<tr>
<td>MFMA</td>
<td>Municipal Finance Management Act, Act No. 56 of 2003</td>
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<tr>
<td>MHT</td>
<td>Mechanical Heat Treatment plants use steam to treat and sterilise residual MSW using autoclave technology</td>
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<tr>
<td>MOE</td>
<td>Municipal owned entity, referred to as a municipal entity in the MFMA and Municipal Systems Act</td>
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<tr>
<td>MRF</td>
<td>Materials Recovery Facility, which separates co-mingled recyclables by a number of processes</td>
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<tr>
<td>dMRF</td>
<td>Dirty Materials Recovery Facility, which separates mixed waste by a number of processes to recover materials of value (recyclates) and/or pre-treat waste to help achieve a homogenous WtE feedstock</td>
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<tr>
<td>MSW</td>
<td>Municipal solid waste, being residual household waste plus commercial and industrial waste similar to that generated by households</td>
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<tr>
<td>NEMS</td>
<td>National Environmental Management Strategy</td>
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<tr>
<td>NERSA</td>
<td>National Electricity Regulator of South Africa or its successor in title</td>
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<tr>
<td>NIR</td>
<td>Near Infra-Red: Automatic detectors used to sort commingled plastics by type and/or material colour</td>
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<tr>
<td>NWMS</td>
<td>National Waste Management Strategy</td>
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<tr>
<td>NPC</td>
<td>Net present cost</td>
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<td>NPV</td>
<td>Net present value</td>
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<tr>
<td>O&amp;M</td>
<td>Operational and maintenance</td>
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<tr>
<td>OM</td>
<td>Organic matter</td>
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<tr>
<td>OPEX</td>
<td>Operational expenditure</td>
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<tr>
<td>PET</td>
<td>Polyethylene Terephthalate</td>
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<tr>
<td>PP</td>
<td>Poly Propylene</td>
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<tr>
<td>PPE</td>
<td>Personal protective equipment</td>
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<tr>
<td>PPP</td>
<td>Public-private partnership, as defined in the MFMA and PPP Regulations</td>
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<td>PPP Guidelines</td>
<td>Municipal Service Delivery and PPP Guidelines Module 4: Feasibility Study; and Feasibility Study Toolkit: Solid Waste Management; of 2007, jointly issued by the Minister of Finance and Minister for Local Government under the MFMA and the Municipal Systems Act</td>
</tr>
<tr>
<td>PRASA</td>
<td>Paper Recycling Association of South Africa</td>
</tr>
<tr>
<td>Private party</td>
<td>The successful tenderer which will be constituted as a special purpose vehicle to contract with the CoJ to execute the PPP agreement</td>
</tr>
<tr>
<td><strong>Project</strong></td>
<td>The recommended technical solution as defined in section 18.1 to meet the CoJ's objectives as defined in section 1.2</td>
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<tr>
<td><strong>PSC</strong></td>
<td>Public sector comparator (or Project Steering Committee as is relevant in the context in which the abbreviation is used)</td>
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<tr>
<td><strong>Prevention</strong></td>
<td>Part of the waste hierarchy: Prevention of waste production at all stages reduces the amount of waste entering the waste stream</td>
</tr>
<tr>
<td><strong>RCR</strong></td>
<td>Round collection refuse: Domestic and C&amp;I waste collected by the municipality</td>
</tr>
<tr>
<td><strong>RDP</strong></td>
<td>Reconstruction and Development Programme</td>
</tr>
<tr>
<td><strong>REDIS&amp;A</strong></td>
<td>Recycling and Economic Development Initiative of South Africa</td>
</tr>
<tr>
<td><strong>PRFs</strong></td>
<td>Plastic Recycling Facilities: Used to sort commingled plastics (refer to MRFs and NIR)</td>
</tr>
<tr>
<td><strong>Recovery</strong></td>
<td>Part of the waste hierarchy: The remaining material that cannot be recycled or reused energy is recovered from the material in the form of heat, gas and electricity by different treatment methods</td>
</tr>
<tr>
<td><strong>Recyclate</strong></td>
<td>Raw material sent to, and processed in, a waste recycling plant or Materials Recovery Facility</td>
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<tr>
<td><strong>Recycle</strong></td>
<td>Part of the waste hierarchy: Materials which can be collected and reprocessed into new materials or products such as paper, plastics, glass and organic food and garden waste</td>
</tr>
<tr>
<td><strong>REL</strong></td>
<td>Rear end loader</td>
</tr>
<tr>
<td><strong>Reuse</strong></td>
<td>Part of the waste hierarchy: Materials or products are repaired or refurbished to be able to be reused as a new product</td>
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<td><strong>RDF</strong></td>
<td>Refuse Derived Fuel is the residual fraction after mechanical sorting processes such as MRF and MBT / MHT</td>
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<tr>
<td><strong>REIPPPP</strong></td>
<td>Renewable Energy Independent Power Producers Procurement programme</td>
</tr>
<tr>
<td><strong>RFP</strong></td>
<td>Request for proposal, as part of the procurement process</td>
</tr>
<tr>
<td><strong>RFQ</strong></td>
<td>Request for qualification, as part of the procurement process</td>
</tr>
<tr>
<td><strong>RTO</strong></td>
<td>Regenerative Thermal Oxidation: Used to remove odour from gaseous emissions from wastes facilities</td>
</tr>
<tr>
<td><strong>SCM</strong></td>
<td>Supply chain management</td>
</tr>
<tr>
<td><strong>SDF</strong></td>
<td>Spatial development framework</td>
</tr>
<tr>
<td><strong>SRF</strong></td>
<td>Solid Recovered Fuel is subject to meeting a performance specification (homogeneity, CV, particle size, etc.) produced by an MBT / MHT</td>
</tr>
<tr>
<td><strong>Syngas</strong></td>
<td>Gas generated during the conversion of waste products to simpler molecules in low oxygen (gasification) or in the absence of oxygen (pyrolysis). Syngas can be used to generate energy or further processed to manufactured products.</td>
</tr>
<tr>
<td><strong>SOC</strong></td>
<td>State Owned Company as referred to in the Companies Act, including a municipal entity constituted as a private company as referred to in the Municipal Systems Act and MFMA</td>
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<tr>
<td>SPV</td>
<td>Special purpose vehicle</td>
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<tr>
<td>TA</td>
<td>Transaction Advisor</td>
</tr>
<tr>
<td>ToR</td>
<td>Terms of Reference for the appointment of a transaction advisor to develop a feasibility study on an alternative waste treatment technology project on behalf of the City of Johannesburg Metropolitan Municipality, issued on 17 April 2014 (GT/GFA/50/2014)</td>
</tr>
<tr>
<td>The city</td>
<td>The geographic area that falls within the demarcated boundaries of Johannesburg, and the area for which the City of Johannesburg is responsible in its role as local government</td>
</tr>
<tr>
<td>TVR</td>
<td>Treasury views and recommendations</td>
</tr>
<tr>
<td>UDP</td>
<td>User-defined processes</td>
</tr>
<tr>
<td>VOC</td>
<td>Volatile Organic Carbons</td>
</tr>
<tr>
<td>Wb</td>
<td>Wet weight basis</td>
</tr>
<tr>
<td>WCS</td>
<td>Waste characterisation study</td>
</tr>
<tr>
<td>Windrow</td>
<td>The production of compost by piling biodegradable waste in long rows where the material can break down in the presence of oxygen. This is generally less controlled than in-vessel composting and tends to be used for garden wastes</td>
</tr>
<tr>
<td>WRATE</td>
<td>Waste and Resources Assessment Tool for the Environment</td>
</tr>
<tr>
<td>WtE</td>
<td>Waste-to-Energy plant which generates energy from the combustion of MSW and RDF</td>
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Section 1: Executive summary

1.1 Background
The City of Johannesburg (CoJ) has a Constitutional duty to ensure service delivery. This includes municipal solid waste (MSW) management services; a function of which is treatment and disposal of MSW.

The CoJ is aware that airspace at its existing landfills is being consumed at a rapid rate and that it requires alternative disposal solutions for the city. It has thus been exploring options, in particular alternative waste treatment technology (AWTT). This is in line with the national waste management strategy and approach to waste management.

The Council resolved in principle in 2012 to proceed to procure an AWTT solution. It was, however, recognised by both National Treasury and the Council of CoJ that there were fundamental gaps in the presentation of the feasibility argument, including the understanding of the calorific value (CV) of the waste, the funding model and the site selection. National Treasury also raised the issue of the role of Pikitup in the structuring of the transaction and the need to run the environmental impact assessment (EIA) process in parallel with the procurement process.

Thus an independent Transaction Advisor (TA), with multi-disciplinary experience in waste management, public-private partnerships (PPPs), and international expertise in advising on alternative waste treatment technology, was procured, and over a period of 10 months from September 2014, the most up to date technology options and the feasibility of an AWTT solution was again explored and tested. The key objective of the feasibility process was to recommend what the best technical, financial and legal solution (transaction) would be for the CoJ to implement an AWTT project as a PPP.

The key outcome sought was to support Council decision making so that any resolution could be implemented and have an impact on diverting waste going to landfill as quickly as possible.

1.2 The needs
The CoJ expressed its objective to have an AWTT solution implemented as a PPP to address:

- Reduction of waste to landfill
- Generation of renewable energy
- Creation of jobs

The CoJ’s stated objectives, the PPP regulatory framework and the technical assistance from the Project Steering Committee, including the Gauteng Infrastructure Funding Agency (GIFA) and National and Provincial Treasury, drove the approach to the determine the feasibility.

1.3 Approach
The TA, working closely with the Project Steering Committee, attended to the following tasks:

- CoJ’s waste characterisation was confirmed:
  - The CoJ is the first municipality to have a comprehensive, scientific analysis of its waste characterisation
  - Both a winter and summer sampling was undertaken as part of the waste characterisation study (WCS)
- A waste flow model (WFM) was built and calibrated to numerically represent the flow of the CoJ’s municipal wastes through their current and planned waste management systems:
  - The findings of the WCS, including availability of volume and CV, was fed into a WFM, which was used in the technical options appraisal to:
- Forecast waste growth
- Understand the flow of waste through the CoJ’s current and future planned waste management systems
- Determine the performance of the evaluated AWTT (the options appraised)
  - The WFM was adjusted to allow for Pikitup’s reduction / diversion initiatives
  - It was used to assess the suitability of technology options
- The need for an AWTT solution was independently confirmed:
  - Landfill airspace is urgently required by the CoJ
  - Waste-to-Energy (WtE) is aligned to regulatory and policy environment
- Available AWTT options were identified, explained and presented. It was also deemed necessary to update the AWTT considered by the six year old feasibility study1 to reflect recent technological developments and operational experience, plus any changes in the CoJ’s waste management practices. The AWTT review was carried out in two stages:
  - An AWTT overview report (refer to appendix D) presented a range (the ‘long list’) of AWTTs potentially suitable for the diversion of MSW and commercial waste from landfill. The report pre-screened the long list of AWTT to a ‘short list’ of AWTT potentially suitable for the CoJ.
  - The short list of AWTT passed forward to the technical options appraisal (refer to appendix C), which used multi-criteria analysis to rank the suitability of each AWTT to reduce household round collected refuse (herein termed Project Waste) from landfill, generate energy and create jobs. The preferred technical option passed forward to the feasibility study for financial evaluation and determination of the appropriate construction and operational delivery arrangements.
- A key issue influencing the appropriateness of technology options was the off-take market. All three short-listed options produce an energy by-product. The off-take market was thus assessed and appraised, including recyclates, RDF for potential use in the cement industry, and electricity.
- The optimal AWTT solution to meet CoJ’s stated objectives was determined and defined
- The feasibility of the defined ‘Project’ was assessed
- Following identification of the preferred technical option, a conceptual design of the required AWTT infrastructure was developed to determine the building footprint, services required, vehicular access arrangements, etc. With this data a site assessment was undertaken to identify sites suitable and best situated to accommodate the AWTT, and ensure that the proposed solution could be implemented as a PPP.
- The value assessment was undertaken to determine the PPP feasibility study outcomes of the solution to meet the CoJ’s stated objectives. Although it has risks from a regulatory perspective and will require significant investment of time, effort, support and funding from the CoJ to implement, it is feasible - the scope, cost and transaction structure are known and can be presented to the market as a PPP. The Project will have budget implications which the CoJ will need to take cognisance of and address.
- A legal assessment was undertaken to consolidate the legal issues arising in relation to the solution, and to assess whether all foreseeable legal requirements can be met for the development of the proposed transaction
- A procurement plan was developed as the indicative way forward, should Council decide to proceed in principle with the procurement of a transaction as a PPP. It indicates the activities, the outcome sought from the activity, the indicative time frame and accountability.

1.4 The alternative waste treatment technology Project

Following the methodical and consequential steps as outlined above, the Project, and its relevance to the CoJ, was defined. The outcome of the feasibility was based on the CoJ’s needs and objectives, its

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waste characterisation and waste flow, MSW strategies, the existing technologies for alternative waste treatment, and the outcomes of market discussions regarding recyclates and energy off-take. The following technology solution were identified to be the best for the CoJ:

- Two dirty Materials Recycling Facilities (dMRF), situated at the Robinson Deep and Marie Louise Landfill sites, each with a treatment capacity in the order of 250,000 tonnes per annum (tpa) of Project Waste. The recovery of recyclates from the residual waste feedstock will be primarily by manual picking from not less than four conveyor picking lines. In order to achieve the required throughput rates, two 8-hour shifts were recommended with the third shift used for the cleaning and maintenance of the dMRF.

- The Project Waste not recovered during recycling by the dMRF will be the feedstock to one of the WtE plant at the Robinson Deep Landfill site. The WtE plant will have a treatment capacity of approximately 335,000 tpa, adopting proven moving grate conventional combustion technology, steam turbines and generators, and modern air pollution control technologies. To maximise process availability the WtE is likely to have two combustion lines and one or two steam turbines. The WtE plant will operate 24 hours a day for 7 days a week for approximately 90% of the year.

- In addition to generating a significant number of jobs, the dMRFs will act as a pre-treatment for the WtE plant and help manage the characteristics of the WtE feedstock (e.g. CV, ash, moisture and chlorine content). The highly automated WtE plant will employ few staff but will recover energy from the waste to power itself and the dMRF at Robinson Deep, with the majority of energy being exported to the power grid. Ash and process residues generated by the WtE will be landfilled at Robinson Deep. It is estimated that approximately 25 MW of power will be produced.

- This combination of technologies will:
  - Divert approximately 80% by mass of the Project Waste from the landfill site
  - Result in energy generation of 25 MW, which equates to providing power for approximately 60,000 households
  - Create between 400-500 full-time new employment opportunities
  - Create approximately 500 indirect new employment opportunities

- Two existing landfill sites, Marie Louise and Robinson Deep, were chosen to accommodate the required infrastructure for a number of reasons, including the:
  - Availability of Project Waste in the central belt and growth projections
  - Urgent need for diversion from the two landfills
  - Existing infrastructure that will benefit the project and availability of land at the landfills

Accordingly, the limited impact on the capital budget for land procurement, limited impact on Pikitup’s waste collection route planning, and the impact of EIA and regulatory requirements are positively impacted because of the sites being in use already.

1.5 Feasibility outcomes

The value assessment study simulated the public sector comparator (PSC), i.e. the estimated cost of the CoJ’s AWTT Project, including capital costs of developing two dMRFs and one WtE plant and operating them over a contract period of 25 years. The study further assessed the revenue that would be generated from the sale of recyclates that will be recovered from the dMRF and revenue that will be generated from the sale of electricity to the City. The Project cost is estimated at R 2,2 billion in today’s terms, over a period of 25 years.

Due to high project cost, the feasibility had then recommended that a PPP procurement process be followed to ensure transfer of significant technical, operational and financial risk associated with the Project to a private entity. The study further demonstrated that the private entity is best placed to manage the risks associated with Project and could do so 30% more effectively than the public sector.

The net cost of the Project is estimated to R 225 to R 250 per tonne of waste disposed (R 125 million per annum over the 25 year contract period). Included in this cost per tonne is the transfer of all operational, technical and financial risk to a private party. It is inclusive of capital to build the
recommended technology solution, and considers the potential revenue generated from recyclates and electricity. This is the fee that the CoJ will pay to ensure the proper disposal of its waste and achieve diversion from landfill, generation of energy and creation of jobs.

The PPP affordability argument needs to be carefully considered by the CoJ. There is currently no budgeted or actual costs for AWTT as the activity is not undertaken by the CoJ. The payment of a gate fee to dispose of MSW is common practice both locally and internationally. Although the CoJ currently budgets for gate fees and pays Pikitup and/or private landfills, the budget is not reflective of true costs of disposal. For comparison purposes and to inform affordability, the current disposal costs at landfills were assessed, as well as the cost of developing another landfill site.

Pikitup advises that CoJ budgets R 153 per tonne\(^2\) for a gate fee at the CoJ’s landfills and pays R 125 per tonne to dispose at a privately operated landfill. Regarding the Pikitup gate fee, the figures provided by Pikitup are not cost reflective as they do not include capital redemption / replacement costs associated with disposal, and operational costs are not truly ring-fenced. Regarding the private sector gate fee, this was recently escalated by 31%. Note that the CoJ has no control over this fee.

An immediate alternative to AWTT is to develop a new landfill, an undertaking which is estimated to cost the CoJ at least R 2.065 billion. This, however, is exclusive of a risk adjustment and other factors, such as the time it takes to establish a landfill, the availability of land fit for purpose, the regulatory requirements, community consultation processes etc. In addition to the capital cost and the risk regarding timing of implementation, there will still be the operational cost associated with operating and maintaining the landfill on a monthly basis, which is estimated at R 240 to R 270 per tonne.

1.6 Findings

Council’s 2012 comments regarding the CoJ’s waste composition, identification of a site and funding models have been addressed. Given the time lapse since the previous study, and with guidance and direction from the Project Steering Committee, the TA has reconsidered all options against the stated objectives, landfill needs, and latest policy and legislative environment.

The outcomes of this PPP feasibility study of the optimal AWTT for MSW to meet the CoJ’s stated objectives, strategies and policies, are that it is feasible. The scope and costs and transaction structure are known, and significant technical, operational and financial risk can be transferred.

The proposed technology solution will meet the City’s objective to:

- Reduce waste to landfill
- Generate energy
- Create jobs

From a project funding perspective, it will impact the costing of municipal waste services delivery, but the costing as benchmarked internationally and locally is sound. CoJ has been presented\(^3\) with scenarios regarding the impact of grant funding on the gate fee. The issue of affordability has been explained with reference to the need for landfill space and the alternatives available to the CoJ.

The CoJ had to decide whether the gate fee cost is worth investing in, given the policy, strategy and immediate challenge regarding landfill airspace.

The future financial implications to the City will be determined once the private entity market has been tested during the PPP procurement phase, and the Council will be informed accordingly before approving the contract in terms of s33 of the Municipal Finance Management Act, Act No. 56 of 2003 (MFMA).

The Project has to go through regulatory approvals within the City’s and National Treasury structures and it will significant investment of time, effort and support from the CoJ to be implement.

\(^2\) Based on 2015/2016 disposal rates
\(^3\) Project Steering Committee, 24 July 2015

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The proposed technology will be able to meet the City’s objective of:

- 1. Minimise waste
- 2. Generate alternate energy
- 3. Create jobs

1.7 Way forward

1.7.1 Senior management approval
Given the outcomes of the feasibility regarding affordability, and the legislative requirement for the City Manager to notify stakeholders, the feasibility study has been presented to the CoJ’s senior management. National Treasury also requires the CoJ’s Chief Financial Officer to acknowledge the affordability and budget implications of the proposed transaction.

1.7.2 Notification and request
The City Manager authorised a public notification process and had requested the views and recommendation of the Public, Provincial and National Treasuries and Department of Co-operative Government (DCOG), in terms of s120 (6) of the MFMA. The comments are important for the Council to make a decision on whether they will proceed with the PPP procurement process.

1.7.3 Report to Council
The City Manager will report to the Council regarding the transaction, the comments, views and recommendations received, and seek an in principle decision from the Council to proceed to procure a PPP.

1.7.4 Council decision
The procurement plan can be implemented if Council does resolve in principle to proceed and procure a private entity.

1.8 Recommendations

- It is recommended that the CoJ accounting officer:
  - Take note of the outcomes of this AWTT PPP feasibility study
  - Proceed with the MFMA s120(6) public notification process
  - Proceed with MFMA s120(6) soliciting the views and recommendations of National Treasury, Provincial Treasury, COGTA and, if required, the Department of Environmental Affairs (DEA) and Department of Energy (DOE)
  - Report to Council:
    - Noting the alignment of the proposed Project to the CoJ’s strategy and policies
    - Noting the comments, views and recommendations received, and that there will be further opportunity to solicit views and consult in the procurement and implementation process
    - The National Treasury issues of site selection, CV of the waste composition and financial modelling has been addressed
    - Recommending that Council resolve in principle to proceed with the PPP based on the outcomes of this feasibility study and affordability report
    - Recommending that Council advise the Boards of Pikitup and City Power to acknowledge Council’s resolution, and manage the impact on their respective processes of planning and implementation of the Project in their business plans, and that contracts must be concluded to facilitate the Project
  - If Council resolves to proceed in principle with the AWTT PPP, then the implementation of the procurement plan will proceed, including:
- Consultation with the stakeholders (National Electricity Regulator of South Africa (NERSA), DOE)
- Commencement with the EIA process
- Commencement with a 10 year Integrated waste management and implementation plan
- Finalisation of the sources of the transaction funding model to address the Project costing modelled in the value assessment
- Initiation and implementation of the procurement process

1.9  Procurement strategy

It is proposed that a 2-phase procurement strategy be pursued, with the first phase being a process of pre-qualifying interested parties based on the consortium’s skills and expertise on previous similar projects.

Following which only pre-qualified bidders are issued with the more detailed request for proposal (RFP). These bidders will be required to expend time and effort in responding to the CoJ’s tender specifications, and propose their approach and price to achieve the output specifications. It will be a competitive procurement process executed in line with the CoJ’s supply chain management (SCM) policy and prescripts.

The PPP agreement will be negotiated with the preferred bidder. Before the contract is concluded it will be necessary for Council to be advised of the future financial commitments as a result of the contract. This is a MFMA s33 requirement, and also requires the public notification process, and the views and recommendation of Treasuries and the department responsible for local government.

It is anticipated that if Council resolution to proceed to PPP procurement can be achieved by November 2015, that the PPP agreement can be finalised within a period of two years, and that the AWTT solution can be fully functioning by end 2021. These timeframes are aggressive and are dependent on timeous approvals of external regulators, the CoJ’s SCM processes and the Council decision making processes.
Section 2: Introduction

1.10 Project brief
The CoJ has a Constitutional duty to ensure service delivery. This includes municipal solid waste management services; a function of which is treatment and disposal of MSW.

The CoJ is aware that the available airspace at its four landfills is being consumed at a rapid rate, largely due to population and socio-economic changes. The CoJ is also mindful of its need to align to the paradigm shift of waste management approaches and implement sustainable waste diversion strategies to augment waste disposal to landfill.

Thus the CoJ, with the financial support of the GIFA, procured the TA to develop a feasibility study on an AWTT.

The CoJ indicated that the scope of the project is to provide waste treatment technology facilities that will accept 500,000 tonnes of MSW per annum through a ‘design-build-finance-maintain-operate-transfer’ public-private partnership (PPP) model. The key drivers of a waste treatment technology is the:

- Drastic reduction of waste to landfill
- Generation of renewable energy
- Creation of jobs

1.11 Feasibility study report objective
The initial feasibility study was conducted by KV3 in 2010, and the report was forwarded to National Treasury for comments. National recommended that further studies need to be conducted. A TA was appointed to address the gaps identified by Treasury in the KV3 report, and presents the feasibility study outcome to treat 500,000 tpa of Project Waste with AWTT through a PPP procurement model.

This report forms the lead document, underpinned by detailed specialist studies (appendices), and is further supported by Project Steering Committee meeting minutes and presentations (available on the project portal).

In addition to the ToR’s stated objectives, this report is also aligned with the Municipal PPP Guidelines, to address the following:

- To scope a project to meet the needs and objectives of the CoJ
- To provide information about costs and indicate whether costs can be met within municipal budgets without disrupting other activities
- Identify, quantify, and allocate risks and suggest mitigation strategies
- Identify constraints that may cause the project to be halted
- Provide enabling framework for the CoJ to take steps to achieve implementation of the decision, such that the vision is achieved and needs are met

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6 As identified in the ‘Alternative Waste Treatment Technology Project: Feasibility Report, KV3 Engineers, 2008/2009’. This feasibility study serves to build on the gaps identified in the KV3 report

5 City of Johannesburg presentation at project inception meeting, 5 September 2014

6 From Gauteng Infrastructure Funding Agency’s Terms of Reference for the appointment of a Transaction Advisor to develop a feasibility study on an alternative waste treatment technology project on behalf of the Johannesburg Metropolitan Municipality: section 2, dated 17 April 2014

7 https://auredev.com/gfa/

8 National Treasury and Department of Provincial and Local Government: Municipal Service Delivery and PPP Guidelines: Module 4: Feasibility Study
2 Transaction background

The City and GIFA has funded the Phase 2 of the feasibility study where a TA was appointed to address gaps raised by National Treasury which were:

- Waste characterisation etc.

A bid was advertised on the ……………………..2010. Aurecon was appointed on September and Aurecon was

3 Feasibility approach

The PPP transaction takes place within a complex Constitutional framework of the CoJ’s obligation to ensure service delivery to the community, and to take steps to progressively improve service delivery. This PPP transaction cannot address all aspects of the CoJ’s municipal waste services delivery, and accordingly, for feasibility purposes, this transaction is ring-fenced within the broader integrated waste management mandate of CoJ.

The TA followed a logical approach, namely engaging and consulting with the various representatives from the CoJ and Pikitup to gather information regarding their waste management strategies and planning, and the current state of solid waste management in the CoJ. The input received was augmented by a broad-based / evaluation, analysis, international benchmarking and detailed modelling. The assessment of feasibility and its conclusions are based on the information available, the TA’s professional opinion, and a number of assumptions.

In testing the feasibility of the recommended solution, the approach depicted in Figure 1 was adopted by the TA and confirmed by the CoJ, and the Project Steering Committee.

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9 Data and planning / programmes / strategies were evaluated.
Over a 10-month period the TA, working closely with the Project Steering Committee, attended to the following tasks:

- CoJ's waste characterisation study was confirmed:
  - The CoJ is the first municipality to have a comprehensive, scientific analysis of its waste characterisation
  - Both a winter and summer sampling was undertaken as part of the waste characterisation study (WCS)
A WFM was built and calibrated to numerically represent the flow of the CoJ's municipal wastes through their current and planned waste management systems:

- The findings of the WCS, including availability of volume and CV, was fed into a WFM, which was used in the technical options appraisal to:
  - Forecast waste growth
  - Understand the flow of waste through the CoJ's current and future planned waste management systems
  - Determine the performance of the evaluated AWTT (the options appraised)
  - The WFM was adjusted to allow for Pikitup's reduction / diversion initiatives
  - It was used to assess the suitability of technology options

The need for an AWTT solution was independently confirmed:

- Landfill airspace is urgently required by the CoJ
- WtE is aligned to regulatory and policy environment

Available AWTT options were identified, explained and presented. It was also deemed necessary to update the AWTT considered by the six year old feasibility study\(^\text{10}\) to reflect recent technological developments and operational experience, plus any changes in the CoJ's waste management practices. The AWTT review was carried out in two stages:

- An AWTT overview report (refer to appendix D) presented a range (the ‘long list’) of AWTTs potentially suitable for the diversion of MSW and commercial waste from landfill. The report pre-screened the long list of AWTT to a ‘short list’ of AWTT potentially suitable for the CoJ
- The short list of AWTT passed forward to the technical options appraisal (refer to appendix C), which used multi-criteria analysis to rank the suitability of each AWTT to reduce household Project Waste from landfill, generate energy and create jobs. The preferred technical option passed forward to the feasibility study for financial evaluation and determination of the appropriate construction and operational delivery arrangements

A key issue influencing the appropriateness of technology options was the off-take market. All three short-listed options produce an energy by-product. The off-take market was thus assessed and appraised, including recyclates, RDF for potential use in the cement industry, and electricity

The optimal AWTT solution to meet CoJ’s stated objectives was determined and defined

The feasibility of the defined ‘Project’ was assessed

Following identification of the preferred technical option, a conceptual design of the required AWTT infrastructure was developed to determine the building footprint, services required, vehicular access arrangements, etc. With this data a site assessment was undertaken to identify sites suitable and best situated to accommodate the AWTT, and ensure that the proposed solution could be implemented as a PPP

The value assessment was undertaken to determine the PPP feasibility study outcomes of the solution to meet the CoJ's stated objectives. Although it has risks from a regulatory perspective and will require significant investment of time, effort, support and funding from the CoJ to implement, it is feasible - the scope, cost and transaction structure are known and can be presented to the market as a PPP. The Project will have budget implications which the CoJ will need to take cognisance of and address

A legal assessment was undertaken to consolidate the legal issues arising in relation to the solution, and to assess whether all foreseeable legal requirements can be met for the development of the proposed transaction

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A procurement plan was developed as the indicative way forward, should Council decide to proceed in principle with the procurement of a transaction as a PPP. It indicates the activities, the outcome sought from the activity, the indicative time frame and accountability.

Once the AWTT feasibility study is finalised, the City Manager is required to authorise a public notification process and request the views and recommendation of Provincial and National Treasuries and DCOG in terms of s120(6) of the MFMA. National Treasury also requires the CoJ’s Chief Financial Officer to acknowledge the affordability and budget implications of the transaction as proposed. The City Manager will report to Council regarding the transaction, the comments, views and recommendations received, and seek an in principle decision from the Council to proceed to procure a PPP. The procurement plan can be implemented if Council does resolve in principle to proceed to procure a PPP.

4 Stakeholders

4.1 Project Steering Committee
A Project Steering Committee was constituted and convened on the 5th of September, 2014. An inception meeting was convened where the stakeholders and the TA team were introduced. The ToR was presented and the wider waste challenges and initiatives were discussed. Pikitup (CoJ’s waste service Municipal Owned Entities (MOE)) provided insight on the CoJ’s waste strategies, initiatives and plans with the aid of presentations.

Pikitup discussed the expected benefits of the Project, particularly around the current challenges with landfill airspace at the CoJ’s four landfills. The stakeholders and the TA further discussed the benefit of meeting the Pikitup Waste Minimisation Strategy (2013) and the National Waste Strategy (2011) with regard to waste diversion.

The Project Steering Committee members comprised of:

- CoJ
- Pikitup
- Provincial Treasury
- National Treasury
- GIFA
- The TA

City Power participated by invitation.

The Project Steering Committee met regularly to be informed on progress to date by the TA and address challenges the TA was faced with. Deliverables were presented and input received. Reference to the ToR was made continuously to ensure the objectives were being addressed. Minutes, presentations, correspondence and data was distributed to all stakeholders for review and comment.

The key aim of the Project Steering Committee was to ensure the AWTT addressed the ToR objectives and that the feasibility study was delivered.

4.2 Stakeholder engagement
A broad-based inception meeting was facilitated in September 2014.

The TA facilitated the project portal (a web-based tool) that was made available with all project documentation readily accessible and the secretariat function ensured timeous communication, circulation of documentation and record keeping.
Engagement in working sessions were facilitated where required. This included presenting to Pikitup Management Committee, engaging with City Power, the waste recycling market, and discussions with representatives from the Renewable Energy Independent Power Producers Procurement programme (REIPPPP) to provide guidance, etc.

Engagement with organised labour was not required as there is no trigger to comply with s78 of the Municipal Systems Act, and there are no municipal employees directly impacted by the proposed transaction as it is not a function currently undertaken by the CoJ.

### 4.3 Transaction Advisor

The Transactional Advisor, led by Aurecon and including the CSIR, Amber Public Sector Consulting, Solvem Consulting, Ricardo-AEA and WastePlan, was competitively procured as TA to assist the CoJ in assessing options for AWTT and testing the feasibility of the preferred option.

The TA is a multi-disciplinary team which was arranged to address the specific requirements of the Principal in regard to site determination, financial modelling and waste characterisation determination. International expertise was incorporated in the technical options assessment and solution recommendation.

The TA demonstrated a track record of working in the waste sector, from both public and private sectors, and demonstrated technical advice and knowledge on waste issues, assessment of waste technology options and procurement of waste treatment solutions.

The approach of the TA was to work towards facilitating a decision making process for the CoJ by understanding the needs, assessing the options and presenting information in a consultative way to ensure that the Project could be taken through from inception to conceptualisation to implementation.

The key objective of the TA was to ensure that the needs drive the assessment of technology options and that the ultimate recommendation is implementable by the CoJ, should the CoJ elect to proceed in principle with the procurement of a PPP for the development and operation of AWTT.
Section 3: Needs analysis

5 Approach

This section sets out the TA’s analysis of the CoJ’s needs as is relevant to the CoJ’s AWTT objectives. The objective of the needs analysis is therefore to understand what the needs of the CoJ are in relation to diversion of waste from landfill through AWTT as this informs the assessment of options and drives the structuring of the transaction.

Addressed in this section are:

- The CoJ’s strategic objectives regarding diversion of waste from landfill, energy generation and private sector participation in infrastructure projects
- The key project drivers and needs of the CoJ, including landfill airspace, population growth and impact on future waste generation, waste characterisation and understanding the mass flow of waste through the CoJ’s current and planned waste management systems

6 Project scope

The scope involves the assessment of AWTT to address the CoJ’s objectives of reducing Project Waste going to landfill, generating renewable energy and creating jobs.

It does not extend to addressing the CoJ’s Integrated Waste Management Strategy (IWMS) and implementation plans, the development of which is recommended as this would help mitigate key Project risks, such as future AWTT feedstock availability and composition.

The Project study area is depicted in Figure 2.
7 The City of Johannesburg’s strategic objectives

The CoJ has expressed a need\textsuperscript{11} to introduce AWTT that can:

\begin{itemize}
  \item Drastically reduce waste to landfill
  \item Generate renewable energy
  \item Create jobs
\end{itemize}

The Project is aligned to the current policy environment\textsuperscript{12}, from a local and national perspective, particularly in regard to strategies and policies dealing with:

\begin{itemize}
  \item Waste diversion from landfill
  \item Renewable energy generation
  \item Private sector participation in infrastructure projects
\end{itemize}

7.1 The City of Johannesburg

The CoJ’s strategy drivers include:

\begin{itemize}
  \item The Waste Act and the National Waste Management Strategy, in particular the implementation of the waste hierarchy (avoidance, reduction, recovery, reuse, recycle, treat, dispose)
  \item The CoJ’s Growth and Development Strategy (GDS) 2040, which acknowledges sustainable, reliable infrastructure, supportive of low carbon emission, in addition to the decoupling of economic growth from resource use
  \item The CoJ’s Waste Policy and Plan, which sets the strategic direction on waste management and targets for the reduction of waste to landfill, and commits to the GDS target to reduce treatment by 40\% by 2040
  \item The CoJ’s operator Pikitup’s Waste Minimisation Plan, which sets out the implementation plans in terms of national and the CoJ’s priorities
  \item The CoJ’s 2040 Vision is that of a resilient, live-able, sustainable urban environment, underpinned by infrastructure supportive of a low carbon economy
  \item The CoJ plans to lead in the establishment of sustainable and eco-efficient infrastructure solutions to create a landscape that is live-able, environmentally resilient, sustainable, and supportive of low-carbon economy
  \item Managing the impacts of climate change by reducing the greenhouse gas emissions is also what the CoJ is striving for as part of moving towards a sustainable City by 2040 (therefore a waste treatment / disposal technology that is low in carbon emissions is the future of the CoJ)
  \item The CoJ’s 2040 strategy includes the development of integrated waste disposal and treatment systems, and solutions that simultaneously address waste issues and the CoJ’s need for reliable, affordable energy from an alternative source to coal (the CoJ has initiated some work in this area through the development of its landfill sites for methane gas to be harvested and used in generating renewable power)
  \item 2015/2016 IDP review identifies Green and Blue Economies Flagship programmes
\end{itemize}

\textsuperscript{11} From Gauteng Infrastructure Funding Agency’s Terms of Reference for the appointment of a Transaction Advisor to develop a feasibility study on an alternative waste treatment technology project on behalf of the Johannesburg Metropolitan Municipality: section 2, dated 17 April 2014

\textsuperscript{12} See annexure I for the legal assessment report
The CoJ expresses its paradigm shift in regard to waste management as illustrated in Figure 3.

**Figure 3 | City of Johannesburg’s waste management strategy paradigm shift**

The CoJ has previously (2008/2009) undertaken an AWTT feasibility study:

- In 2012 Council approved in principle to proceed with the procurement of a PPP, subject to addressing the outstanding issues of project funding, site selection and waste characterisation

- National Treasury also supported the procurement phase, and expressed its views that the CoJ should proceed with the EIA process in parallel to the procurement process

Pikitup has confirmed the need for waste diversion. In Pikitup’s view, although waste volumes can be significantly reduced by diverting certain volumes of the generated waste to recovery operations, landfills cannot be completely avoided, as technology might not be implemented at all landfill sites. In their planning, they propose to implement interventions targeting various waste streams, plus a minimum of six WtE plants for treatment of residual waste. In Pikitup’s view, this will increase landfill airspace up to 2030 and will also be resulting in a 93% diversion.

### 7.2 National frameworks

- National policy supports both waste minimisation through the National Waste Management Strategy and waste management and environmental management legislation

- National policy supports the principle of renewable energy:
  - Voluntary presidential undertakings to reduce carbon emissions (Kyoto Protocol) in 2009
    - South Africa approved its Integrated Resource Plan (IRP) for the energy sector which outlines the government's strategy for electricity generation by 2030

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13 See National Treasury TVR IIA dated 17/02/2012
The REIPPP is the major driver of installing green power generation capacity in South Africa. It focuses on delivering sustainable power to the grid and also creating jobs and fostering local development. National Treasury and the DOE established the Independent Power Producer Office (IPPO) to manage the REIPPP and it is currently on Phase 4 of the procurement process.

The REIPPP is a national initiative which is indicative of market interest in renewable energy projects. The CoJ’s projects would not be dealt with under the REIPPP if it is to be implemented by the CoJ as a local government PPP.

8 Municipality capacity and commitment

8.1 The City of Johannesburg’s project objective

The CoJ’s key objective for the Project is to reduce waste to landfill through the development of AWTT. It is accordingly a project that falls within the scope of the municipal waste management, under the Infrastructure and Planning Directorate. Although the Project generates energy (to be converted to electricity), this is a by-product of the key objective of reducing waste to landfill.

It is proposed to implement the Project as a PPP. Only the CoJ may initiate and enter into a PPP arrangement and only the Municipal Manager, as Accounting Officer, may sign a PPP.

8.2 The City of Johannesburg’s mandate

The CoJ is a category A municipality, a metropolitan municipality with the powers and functions conferred upon it.

As with category B and C municipalities it does not have concurrent jurisdiction and is the sole power and function.

In terms of s156(1) of the Constitution, the CoJ “has executive authority in respect of, and has the right to administer (a) the local government matters listed in Part B of Schedule 4 and Part B of Schedule 5; and (b) any other matters assigned to it by national or provincial legislation”.

Part B of Schedule 5 lists the local government matters which municipalities have executive authority in respect of, and the right to administer, and includes ‘refuse removal, refuse dumps and solid waste disposal’. S156(5) of the Constitution gives the CoJ the right to exercise any power concerning a matter reasonably necessary for, or incidental to, the effective performance of its functions.

Alternative waste treatment technology falls within the scope of this power of local government.

8.3 PPP Regulations

The CoJ has the power and function to initiate and conclude the Project as a PPP. The process must, however, be regulatory compliant and is subject to compliance with s120 of the MFMA, the PPP Regulations and the Municipal PPP Guidelines.

In terms of Regulation 10 of the MFMA PPP Regulations, no municipal entity may initiate, procure or enter into a PPP agreement on its own or on behalf of its parent municipality, but may be a party to a PPP agreement initiated, procured and entered into by its parent municipality.

In order to initiate, procure and conclude a PPP for AWTT, the CoJ must comply with the MFMA regarding feasibility, procurement, consultation, decision making and contract management. In particular:

- s120 of the MFMA and the PPP Regulations and Guidelines regarding feasibility, procurement and decision making
- s33 of the MFMA regarding future financial commitments
- s116 of the MFMA regarding contracting
- s14(4) of the MFMA in so far as a capital asset is being transferred or disposed of
s78 of the Municipal Systems Act is not applicable to the Project because AWTT is not a ‘municipal service’, but rather a ‘municipal support activity’ as discussed in the Municipal PPP Guidelines, and in particular the Feasibility Study Toolkit: Solid Waste Management.

Note also that the MFMA Asset Transfer Regulations, dealing with the granting of the right to use, manage and control municipal assets, is not applicable because the CoJ is following s120 of the MFMA regarding PPPs.

8.4 Service delivery model

The scope of the proposed PPP is not a municipal service, but rather a function or municipal support activity. Accordingly the need to comply with s78 of the Municipal Systems Act is not triggered. The CoJ’s municipal service delivery model (Pikitup structured as a MOE) is not the subject of this feasibility study\textsuperscript{15}.

MOEs were established by the CoJ and are State Owned Companies (SOCs) under the Companies Act. The CoJ MOEs are structured as wholly owned entities of the CoJ, which report directly to the CoJ. They act in terms of business plans and budgets approved by the Council, and report to and are accountable to the CoJ for the execution of their mandates.

The role of the CoJ’s MOEs in the proposed PPP transaction was raised by stakeholders. As the service delivery arms of the CoJ, the MOEs are critical to the Project:

- Pikitup, as the CoJ’s waste management operator, will need to deliver Project Waste to the Project (waste supply agreement)
- City Power, as the CoJ’s electricity reticulator, will need to reticulate the electricity generated by the Project, on behalf of the CoJ

If the proposed AWTT proceeds, the private party will want assurances regarding the following:

- The delivery of Project Waste at the right quantity and quality and payment of a gate fee
- Remuneration for the generation of electricity

The private party will require guarantees in the PPP agreement with the CoJ regarding the performance undertaking of the CoJ, which will be executed by the CoJ’s nominated operators. Note that the market is used to ‘sovereign guarantees’ of national government in the REIPPPP where, although the power purchase agreement is with Eskom, the DOE guarantees the payment by Eskom.

The CoJ will make contractual commitments to the private party, which will include delivery of Project Waste and off-take of electricity. The CoJ will need to address its contractual risk with back-to-back undertakings and commitments in the MOEs’ business plans and, if necessary, enter into specific agreements with the MOEs. The option of the MOEs signing the PPP agreement, although permitted by the PPP Regulations, is not ideal given that the CoJ may at some stage, over the duration of the 25-year contract, want to change the way in which it is structured to deliver municipal services. This risk will be considered in the bidding process. Accordingly, the CoJ should give the undertakings itself in the PPP agreement and then put its arrangements in place to ensure those undertakings can be met over the duration of the contract.

Pikitup must be instructed regarding the implications of any Council decision and the implications for longer term planning, especially regarding use of the identified sites, obligation to deliver Project Waste, and the outcome of the discussion regarding gate fees, if any.

\textsuperscript{15} The PPP Guidelines
9 City of Johannesburg’s needs

Given that the CoJ has expressed its needs and the key drivers thereof, the approach of the TA was to independently confirm these.

9.1 Landfill diversion

The CoJ’s key driver of the Project is to reduce waste going to landfill. The project is thus a ‘municipal solid waste project’.

Landfilling is the traditional disposal option that has characterised the CoJ’s waste management to date, whereby about 93% of waste is disposed of at landfills. Currently, there are four permitted, operational landfills situated in the south and south western side of the city that is owned by the CoJ and operated by Pikitup, namely:

- Robinson Deep
- Marie Louise
- Goudkoppies
- Ennerdale

The amount of waste which is being generated in the city is escalating because of significant growth, both in population as well as in the average income of the residents. The four operational landfill sites’ airspace is fast depleting, with the estimated cumulative remaining airspace expected to last for 10 years, assuming no further interventions are implemented. When all the local landfill sites are closed, waste will have to be exported to long distance destinations at much higher cost.

9.2 Need drivers

9.2.1 Landfill airspace

The TA’s assessment of the CoJ’s current status of landfill airspace availability is summarised in Table 1.

Table 1 | Airspace modelling and remaining lifespan of landfill sites

<table>
<thead>
<tr>
<th>Site Name</th>
<th>Designed Capacity (m³)</th>
<th>Pikitup Data</th>
<th>Aurecon Data</th>
<th>Airspace Utilised (incl. cover material) (m³)</th>
<th>Pikitup Data</th>
<th>Aurecon Data</th>
<th>Growth Rate (%)</th>
<th>Landfill Site Lifespan Remaining (years)</th>
<th>End Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ennerdale</td>
<td>2,233,209</td>
<td>946,288</td>
<td>1,110,936</td>
<td>1,193,490</td>
<td>1,112,271</td>
<td>2.74%</td>
<td>13</td>
<td>Jul2027</td>
<td>11 Sep2025</td>
</tr>
<tr>
<td>Goudkoppies</td>
<td>6,651,222</td>
<td>5,084,732</td>
<td>5,052,104</td>
<td>4,432,393</td>
<td>4,581,290</td>
<td>2.23%</td>
<td>13</td>
<td>Jan2030</td>
<td>13 Sep2027</td>
</tr>
<tr>
<td>Marie Louise</td>
<td>6,776,717</td>
<td>5,084,289</td>
<td>5,052,104</td>
<td>2,119,971</td>
<td>1,744,013</td>
<td>1.65%</td>
<td>8</td>
<td>Jan2021</td>
<td>8 Sep2020</td>
</tr>
<tr>
<td>Robinson Deep</td>
<td>22,968,866</td>
<td>17,684,789</td>
<td>17,096,188</td>
<td>4,432,393</td>
<td>4,072,080</td>
<td>2.60%</td>
<td>7</td>
<td>May2021</td>
<td>5 Sep2019</td>
</tr>
</tbody>
</table>

Date of Data: Sep 2014

The landfill airspace modelling was undertaken in consultation with Pikitup and highlights that there is an estimated five years remaining life at Robinson Deep and six years at Marie Louise.

9.2.2 Findings

The TA’s findings, from having analysed the expected growth rate in number of households (refer to Figure 4 and Figure 5), is that there is a steady growth in the waste catchment areas, with the growth in the number of households in the Robinson Deep catchment area increasing quite rapidly between 2025 and 2030.

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16 As stated in the ToR, page 4. However, the airspace model (refer to section 9.2.1), based on data provided by Pikitup, indicates that there are five years left at Robinson Deep and six years at Marie Louise.

17 The TA is not responsible for the airspace data, which was provided by Pikitup.
Figure 4 | Landfill sites: Number of households (Census 2011)
Figure 5 | Landfill sites: Growth in households
The central belt demonstrates both the existing need for AWTT and the future waste generation capacity to sustain AWTT, while taking cognisance of planned source separated recycling, garden waste and food waste treatment activities.

9.2.3 Conclusions
The TA therefore conclude that in addition to the general strategies and policies in regard to waste management and the waste management hierarchy, the practical reality of how the CoJ will manage 1.6 million tonnes of waste per annum must be addressed urgently.

10 Existing budget
The CoJ has a budget for municipal waste services. However, the proposed AWTT solution to address reducing waste going to landfill, is not currently undertaken nor budgeted for by the CoJ. The true cost associated with disposal (operations and capital) has not been ring-fenced and is not known by the CoJ, nor is the cost drivers of the gate fees charged for disposal.

Currently the CoJ pays Pikitup in the order of R 153 per tonne to manage landfill sites. A concern with regards to the information supplied is that this cost does not provide for capital investment, i.e. the creation of an additional landfill or the repayment of the capital for the current landfill. If this trend continues, the CoJ will ultimately just run out of airspace which will inform an ultimate crisis. In essence, this approach is not sustainable and additional investment beyond the R 153 per tonne is required.

In comparison the CoJ pays FG Interwaste Landfill Site, a privately operated landfill, an amount of R 125 (2015/2016) per tonne to dispose waste at. It is important to keep in mind that the following is outside of CoJ’s control, should it continue to make use of FG:
- FG charged an annual increase of 31% in their disposal fee (R 95 per tonne in 2014/2015 to R 125 per tonne in 2015/2016)
- There is a cost of transporting the waste over vast distances to these sites
- The availability timeframes and cost over the longer term is unknown and outside of the control of the CoJ

Although the current budget for disposal of 500,000 tpa of MSW could not be ring-fenced, the CoJ is facing a crisis with its current landfill airspace, as there is no landfill space for the northern regions and the airspace in the southern regions is less than what it would take to establish a new landfill.

Given its Constitutional duty to ensure service delivery and the implications for health and socio-economic development, planning and budgeting for implementation of MSW disposal is thus something the CoJ cannot divest itself of and requires careful and urgent attention to.

11 Output specification
The CoJ has confirmed that the Project must achieve the following:
- AWTT as a solution to reduce Project Waste going to landfill (500,0000 tpa)
- Generation of renewable energy
- Creation of jobs
- PPP as a procurement choice

These activities inform the scoping of the technology options and the recommendations regarding the way forward.

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18 Information supplied by Pikitup
Section 4: Technical options assessment

12 Approach

The technical gaps in the 2008/2009 feasibility study identified by Council and National Treasury were:

a) Review and update technical aspects
b) Conduct the WCS of the waste generated in the CoJ to determine the CV
c) Conduct a detailed site assessment

A winter and summer season WCS and laboratory testing were commissioned to determine characteristics of the CoJ’s waste and understand any seasonal variation.

The findings of the WCS was fed into a WFM, which was used in the technical options appraisal (refer to section 16) to forecast waste growth, understand the flow of waste through the CoJ’s current and future planned waste management systems (status quo) and the performance of the evaluated AWTT (the options appraised).

It was also deemed necessary to update the AWTT considered by the six year old 2008 feasibility study to reflect recent technological developments and operational experience, plus any changes in the CoJ’s waste management practices. The AWTT review was carried out in two stages:

a) An AWTT overview report (refer to appendix D) presented a range (the 'long list') of AWTTs potentially suitable for the diversion of MSW and commercial waste from landfill. The report pre-screened the long list of AWTT to a ‘short list’ of AWTT potentially suitable for the CoJ.

b) The short list of AWTT passed forward to the technical options appraisal (refer to appendix C), which used multi-criteria analysis to rank the suitability of each AWTT to reduce MSW from landfill, generate energy and create jobs. The preferred technical option passed forward to the feasibility study for financial evaluation and determination of the appropriate construction and operational delivery arrangements.

Following identification of the preferred technical option, a conceptual design of the required AWTT infrastructure was developed to determine the building footprint, services required, vehicular access arrangements, etc. With this data a site assessment was undertaken to identify sites suitable to accommodate the AWTT.

13 Waste characterisation study and calorific value

13.1 Approach

The aim of the WCS was to capture seasonal and socio-economic variability in the composition and generation rates of MSW within the CoJ. The ToR for the study stipulates winter and summer sampling, but in order to fast track the project, the first round of sampling was done in September 2014, followed by a second round of sampling in November 2014. A comparison between these two samples provided evidence to support a decision to conduct a true winter sample to feed into this feasibility study (refer to appendix A for the WCS and CV report).

The waste composition was broken down into two groups, namely: Household waste and special waste. ‘Special waste’ was further broken down into smaller categories as indicated in Figure 6.
### 13.1.1 Household waste

A total of 54 purposive selected, random samples were collected and analysed during September 2014 and 74 samples during November 2014. This resulted in the inclusion of a total of 128 (i.e. 94%) out of the possible 136 collection routes included as part of the sampling process in the WCS. During the winter sampling, a purposive sampling approach was again followed, targeting a sample of similar routes as those included in the November sample.

A total of 18 Round Collection Refuse (RCR) routes without waste separation at source, and an additional nine routes with waste separation at source, were included in the June 2015 sample.

A total of 21.5 tonnes of households waste was sorted through by the waste team and categorised as part of the study.

Refer to Table 2 for a summarised breakdown of the sampling method undertaken to analyse household waste streams.

**Table 2 | Breakdown of household sampling method**

<table>
<thead>
<tr>
<th></th>
<th>September 2014</th>
<th>November 2014</th>
<th>June 2015</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of samples analysed</td>
<td>54</td>
<td>74</td>
<td>27</td>
<td>128</td>
</tr>
<tr>
<td>Tonnages household waste sampled</td>
<td>7.8</td>
<td>10.6</td>
<td>3.1</td>
<td>21.5</td>
</tr>
<tr>
<td>Percentage of routes covered(^{19})</td>
<td>40%</td>
<td>54%</td>
<td>20%</td>
<td>114%</td>
</tr>
</tbody>
</table>

\(^{19}\) A sample of similar routes covered in November 2014 was included in the June sample. There was therefore some duplication in routes covered in November 2014 and June 2015.
Waste generation was calculated per capita for each socio-economic group in the CoJ, based on Census 2011 data taken from the demographic growth projection report prepared by Kayamandi in 2013\textsuperscript{20}, and the actual data collected during the September 2014 and November 2014 sampling. It should be noted that this calculation is a preliminary estimate based on limited data. The median calculated annual waste generation in the CoJ is between 0.9 and 1.6 million tpa.

13.1.2 Special waste
Three categories of special waste were examined during the November sampling period, inclusive of commercial waste from two commercial clients, illegal dumping and builder’s rubble. Dailies from restaurants and food preparation clients and street sweepings from the CoJ CBD was analysed in September. The results indicate that commercial waste contains mainly recyclable waste, street sweepings from the CBD, 59\% food waste and dailies only 10\% food waste. The waste from the fresh produce market contains 94\% food waste. Illegal dumping, depending on the areas from where it is collected consisted mainly of garden waste or builder’s rubble.

13.1.3 Household waste (Round Collection Refuse)
Household waste composition is directly affected by a variety of factors, including socio-economic status, food habits, geographic location and culture, amongst others.

The waste composition for September, November and June is presented in Figure 7. When considering the different waste categories for the RCR waste stream between November 2014 and June 2015, there were statistically significant differences between nine of the fifteen waste categories considered. These were:

- Food waste
- Garden waste
- Hazardous waste
- Healthcare waste
- Metals
- Miscellaneous non-combustible (rubble)
- Paper and cardboard
- Plastic
- Tyres

\textsuperscript{20} Kayamandi July 2013 Report, Demographic Growth Projections’ report
**Figure 7 | Comparison of September 2014, November 2014 and June 2015 RCR waste**

**Figure 8 | Comparison of RCR waste composition between September 2014, November 2014 and June 2015 (all areas, all income categories)**
13.1.4 Waste generation by income group

The best way to compare the waste generation rates between seasons is to compare median waste generation at household level per income area (refer to Table 22). Both middle and high income households generated more waste on a weekly basis in November than in June, but low income households generated less waste in November than in June.

Table 3 | Comparing household waste generation (kg/household and kg/bin) by median values

<table>
<thead>
<tr>
<th>Income category</th>
<th>September 2014</th>
<th>November 2014</th>
<th>June 2015</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No of samples</td>
<td>Kg/hh</td>
<td>kg/bin</td>
</tr>
<tr>
<td>High</td>
<td>15</td>
<td>22.8</td>
<td>22.8</td>
</tr>
<tr>
<td>Middle</td>
<td>8</td>
<td>17.4</td>
<td>17.4</td>
</tr>
<tr>
<td>Low</td>
<td>19</td>
<td>22.6</td>
<td>21.4</td>
</tr>
<tr>
<td>Total</td>
<td>42</td>
<td>49</td>
<td></td>
</tr>
</tbody>
</table>
13.1.5 Recycling

Differences in the presence of recyclables between the September and November samples could be explained by the fact that the November sample included routes where source separation initiatives are rolled-out, whereas the September sample purposefully avoided routes with source separation at household level.

Waste separation at source initiatives are being rolled out in City. For the September 2014 data, samples of the recyclable waste sorted at source by the high income households were sorted into the different waste streams. The results provided an indication of the accuracy of the sorting done at household level as well as the composition of the recyclable waste from this area. The recyclable composition by weight from this area comprised of:

- Glass 22.9%
- Paper and cardboard 7.15%
- Textiles and footwear 1.32%
- Plastics 1.01%
- Other 1.11%

Low and medium income households were included in the November 2014 sample. Contrary to expectation, the November 2014 sample from low income households contained portions of fines, food waste, hazardous and health care waste. This is indicative of the need for more training and awareness creation on the recyclables to be separated at source.

The composition of residual waste from areas with a kerbside collection service for source separated recyclables was also determined. One sample from each of the socio-economic areas (low, middle and high income) was taken and analysed. The results indicate that sorting of plastics, paper and metals seem to be very effective with only small amounts remaining in the residual waste of all income groups. Low income households are not effective in sorting out glass with 21.85% of the residual waste being glass. This trend was not repeated in the November 2014 sample however, there was still some glass found in the November 2014 sample from low income areas. The high proportion of miscellaneous non-combustible waste in residues is indicative of there being very little awareness of recycling opportunities for building rubble etc. This should be considered by the CoJ.

13.2 Findings: Calorific value

A total of 19 waste samples (level 2 waste categories) were sent to the laboratory for analysis of moisture content, ash and gross calorific value. The results are on par with CVs reported in literature and therefore confirm the potential of the waste as a possible source of energy. The CV of the AWTT feedstock was calculated by the WFM.

13.3 Waste characterisation study conclusion

The similarity in the overall waste composition in the CoJ between 2001 and 2014 is indicative that no significant changes impacting on the waste generation and composition occurred in the CoJ over this period. It is therefore unlikely that the overall composition of the waste in the CoJ will change significantly in the foreseeable future.

Seasonal variation in waste generation (kg/hh) and composition has been established and the results indicate geographical differences in per capita waste generation between income groups in the CoJ. However, there were only three waste categories in which statistically significant differences between high and low income households were found, namely healthcare waste, plastics, and paper and cardboard.

Waste separation at source is currently being rolled-out to households in the CoJ. The composition of the source separated waste analysed indicates that more awareness creation and education on source separation of waste is required, as food waste and garden waste were found amongst source separated recyclables from low income households.
13.4 Findings
Findings from the WCS, indicating considerable amounts of recyclables remaining in the residual waste after waste separation at source, support the inclusion of a dMRF as part of the AWTT options (refer to section 16). It also confirmed that enough RCR waste is generated in the CoJ to feed into AWTT with a capacity to treat 500,000 tpa, as required by the CoJ.

13.5 Risks
The WCS did not identify any specific risks to the AWTT. The seasonal variability in the waste composition related mostly to garden waste and recyclables, which should ideally not form part of the feedstock for the AWTT plant. Overall, the residual waste (sum of non-recyclable but combustible portions of the waste stream), have a seasonal variation of about 12% (contributing 27% to the waste stream in November and 39% in June). The operations of the plant should cater for this variability.

14 Waste flow model
14.1 Background
This section describes the WFM exercise that has been carried out to appraise the CoJ’s current waste management systems (the status quo) and a range (the ‘short list’) of AWTT potentially suitable for the reduction of waste from landfill.

A WFM is used to make informed decisions about future waste strategies and/or required infrastructure. It plays a pivotal role in feasibility studies around waste treatment infrastructure and provides a comprehensive snapshot of current waste arisings, through collection and onto recycling / recovery and disposal. It then builds up projections of future waste arisings, including the effects of changes in composition.

The WFM report (refer to appendix B) provides an overview of the waste flow modelling that has been carried out.

The findings of the WCS were fed into the WFM, which was then used in the technical options appraisal (refer to section 15 and appendix C) to forecast waste growth, understand the flow of waste through the CoJ’s current and future planned waste management systems (the status quo), and determine the performance of the evaluated AWTT (the options appraised).

14.2 Objectives of the waste flow model
The WFM builds on available waste data and agreed assumptions to examine how waste flows through different sorts of waste sites to its final treatment, recovery and disposal. The analysis provides insights into the projected:

- Project Waste diversion from landfill (i.e. landfill diversion expected from the 500,000 tonnes treated each year)
- Overall landfill diversion (i.e. taking account of the waste that falls outside the 500,000 tonnes treated each year in the Project)
- Recycling rate
- Energy content / calorific value of the Project Waste and AWTT feedstock

Projections are based upon the best available data; there can be no guarantees around the future waste generation, or the assumed data that helps to build waste projections.
14.3 Assumptions
Assumptions used in the modelling were presented to the PSC in November 2014 and approved in
December 2014.

The assumptions are listed below (refer to appendix L for the full list of assumptions).

14.3.1.1 Waste arisings
Data provided by Pikitup, with the waste arisings in future years growing in line with the projected
population. The total waste arisings increase by 181% in the modelled years (from 2015 to 2044). The
baseline waste arisings was 1,261,483 tonnes in 2014.

14.3.1.2 Calorific values
The WFM uses a material’s calorific values to predict the energy content of the residual waste. CVs
are required for each individual material entering the final recovery stage of the modelled options, i.e.
WtE or cement kiln. The WFM used the CV values present in the Waste and Resources Assessment
Tool for the Environment (WRATE) to provide a consistent dataset. WRATE is widely used in the
United Kingdom for modelling the life cycle assessment of waste, and calculates the total energy
content of waste entering a facility.

14.3.1.3 Characterisation of waste (refer to section 13)
The characterisation or composition of the waste is an important dataset to determine the future
landfill diversion, energy generation and recycling that could be achieved in the CoJ.

14.3.1.4 Population
The current and future population is a key aspect of the WFM, as it influences the potential waste
arisings for the CoJ over the next 30 years. The population projections used in the WFM are based on
the ‘Kayamandi July 2013 Report, Demographic Growth Projections’ report. This includes future
changes in the proportion of households of high, middle and low income areas, as well as informal
housing, which is important as the waste characterisation differs in different income groups.

Population, as with waste arisings, is difficult to accurately predict, particularly beyond the short term.
It is recommended that with any revision to the population projections, a reassessment of its impact on
waste arisings be carried out.

14.3.1.5 Future collection and diversion strategy
A number of assumed future collection and diversion strategies have been included within the WFM,
based on data and information provided by Pikitup:

- **Source separate recycling**: Pikitup is currently in the process of rolling out source separate
  recycling, from its 2014 figure of 486,239 households to 958,000 households by 2016. This figure
  has been used within the WFM, with an increase from the current participation rate of 19.42% to
  50% by 2020, based on minimum recycling participation in other major cities and in line with
  Pikitup’s Waste Management Strategy.

- **Garden waste**: Pikitup Jeffares & Green Report, 2014, states that 50% of household garden waste
  will be composted by 2020. The WFM has assumed that this will be achieved.

- **Food waste**: Pikitup Waste Management Strategy recognises that there is a large amount of food
  waste arisings within the CoJ. As a result, Pikitup aims to divert the 130,000 tonnes of food waste
  per year from landfill, which has been assumed in the WFM. The WFM does not account for the
  infrastructure required for diversion.

14.3.1.6 Economic growth
As well as household waste, the WFM includes forward projections of other waste including the ‘bulk’
and ‘dailies’ waste. An assumption has been made that the waste arisings from these streams will
grow in line with the Gross Domestic Product (GDP) forecast. The GDP forecast that has been
modelled is 2.26% per year, as indicated by Pikitup in October 2014.
14.3.1.1.7 Landfill diversion targets

The WFM considers the performance of each option against the landfill diversion targets. The targets used are:

- 2016: 20% landfill diversion (City Integrated Waste Management Plan 2011)
- 2020: 47% landfill diversion (Pikitup Waste Minimisation Plan)
- 2040: 93% landfill diversion (Pikitup Waste Minimisation Plan)

14.3.1.1.8 Facility performance

Within the WFM, assumptions are made on the performance of different facilities in terms of capturing target materials. In this case, ‘capture’ refers to the percentage of each material that is extracted by the facility (or its operations) for its intended use. See section 14.2 for details of the technologies and the assumed performances of each.

14.4 Waste flow model process

The WFM builds on all the assumptions listed in 0 and flows through the process as shown in Figure 11.

In summary, it uses all the baseline data (such as tonnages, waste characterisation, population, existing diversion strategies) to build a projection of what the CoJ’s waste arisings will look like over the next 30 years, before taking 500,000 tonnes per year (household waste) to go to the AWTT. This is then taken through each option, such as Waste-to-Energy, where the WFM then determines the outputs, e.g. sent for recycling, combustion, sent to landfill etc.

Figure 11 | Waste flow model process
14.5 Waste flow model conclusion

The WFM provides a number of outputs, including landfill diversion, recycling / composting rate, total waste managed, and potential energy recovery for the following technical options, see sections 16.2 to 16.4 for more detail.

The following options were modelled for the CoJ, with 500,000 tonnes of household waste (Project waste) being subject to the technologies listed:

- Status quo: No change to the current practice, i.e. landfill, other than the future collection and diversion strategies that Pikitup has in place
- Option 1.1: Project Waste is sent to a large single WtE plant (500,000 tonnes)
- Option 1.2: Project Waste is sent to two smaller WtE plants (250,000 tonnes each)
- Option 2: Project Waste is first sent to dMRFs, with the residual fraction then sent to a WtE plant
- Option 3.1: Project Waste is sent to a bio-drying MBT plant, with the residual fraction then sent to a WtE plant
- Option 3.2: Project Waste is sent to a bio-drying MBT plant, with the residual fraction then sent to a cement kiln
- Option 3.3: As option 3.1, but built as a separate dMRF and IVC plant, with the residual fraction then sent to a WtE plant. The advantage being that the dMRF will enable waste to be diverted sooner than in option 3.1
- Option 3.4: As option 3.2, but built as a separate dMRF and IVC plant, with the residual fraction then sent to a cement kiln. The advantage being that the dMRF will enable waste to be diverted sooner than in option 3.2

The performance of each option is summarised in Table 4.
<table>
<thead>
<tr>
<th>Comparator</th>
<th>Status quo</th>
<th>Option 1.1</th>
<th>Option 1.2</th>
<th>Option 2</th>
<th>Option 3.1</th>
<th>Option 3.2</th>
<th>Option 3.3</th>
<th>Option 3.4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Size of WtE / kiln</td>
<td>N/A</td>
<td>500,000</td>
<td>500,000</td>
<td>334,275</td>
<td>194,011</td>
<td>194,011</td>
<td>194,011</td>
<td>194,011</td>
</tr>
<tr>
<td>Size of dMRF</td>
<td>N/A</td>
<td>500,000</td>
<td>500,000</td>
<td>500,000</td>
<td>0</td>
<td>0</td>
<td>500,000</td>
<td>500,000</td>
</tr>
<tr>
<td>Size of IVC</td>
<td>N/A</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>334,275</td>
<td>334,275</td>
</tr>
<tr>
<td>Size of MBT</td>
<td>N/A</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>500,000</td>
<td>500,000</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>CV</td>
<td>N/A</td>
<td>9.72</td>
<td>9.72</td>
<td>10.29</td>
<td>17.05</td>
<td>17.05</td>
<td>17.05</td>
<td>17.05</td>
</tr>
<tr>
<td>Ash content (of WtE / kiln)</td>
<td>N/A</td>
<td>20.23%</td>
<td>20.23%</td>
<td>26.67%</td>
<td>9.38%</td>
<td>9.38%</td>
<td>9.38%</td>
<td>9.38%</td>
</tr>
<tr>
<td>Metal content (of WtE / kiln)</td>
<td>N/A</td>
<td>3.04%</td>
<td>3.04%</td>
<td>0.91%</td>
<td>0.10%</td>
<td>0.10%</td>
<td>0.10%</td>
<td>0.10%</td>
</tr>
<tr>
<td>Project waste diverted - 2018</td>
<td>N/A</td>
<td>0</td>
<td>0</td>
<td>155,619</td>
<td>0</td>
<td>0</td>
<td>155,619</td>
<td>155,619</td>
</tr>
<tr>
<td>Project waste diverted - 2021</td>
<td>N/A</td>
<td>373,846</td>
<td>373,846</td>
<td>394,136</td>
<td>396,447</td>
<td>414,655</td>
<td>396,447</td>
<td>414,655</td>
</tr>
<tr>
<td>Project waste diversion rate (2021)</td>
<td>N/A</td>
<td>74.77%</td>
<td>74.77%</td>
<td>78.83%</td>
<td>79.29%</td>
<td>82.93%</td>
<td>79.29%</td>
<td>82.93%</td>
</tr>
<tr>
<td>Landfill</td>
<td>41,784,000</td>
<td>33,395,000</td>
<td>33,395,000</td>
<td>32,343,000</td>
<td>32,776,000</td>
<td>32,343,000</td>
<td>32,230,000</td>
<td>31,797,000</td>
</tr>
<tr>
<td>Recovery21</td>
<td>0</td>
<td>8,972,000</td>
<td>8,972,000</td>
<td>5,440,000</td>
<td>3,948,000</td>
<td>4,381,000</td>
<td>3,948,000</td>
<td>4,381,000</td>
</tr>
<tr>
<td>Recycling18</td>
<td>1,474,000</td>
<td>1,474,000</td>
<td>1,474,000</td>
<td>5,345,000</td>
<td>4,909,000</td>
<td>4,909,000</td>
<td>5,413,000</td>
<td>5,413,000</td>
</tr>
<tr>
<td>Composting</td>
<td>9,621,000</td>
<td>9,621,000</td>
<td>9,621,000</td>
<td>10,421,000</td>
<td>10,293,000</td>
<td>10,293,000</td>
<td>10,421,000</td>
<td>10,421,000</td>
</tr>
<tr>
<td>Other22</td>
<td>1,315,000</td>
<td>732,000</td>
<td>732,000</td>
<td>645,000</td>
<td>2,268,000</td>
<td>2,268,000</td>
<td>2,181,000</td>
<td>2,181,000</td>
</tr>
</tbody>
</table>

21 For the options including a dMRF the modelled date for the facility entering operation was 2017. It should be noted that the options appraisal report has subsequently concluded that the dMRF and WtE plant will enter operation in 2021. Therefore, the early diversion of waste from landfill modelled in the WFM is unlikely.

22 Includes informal picking by the reclaimers at the landfills and moisture loss in the MBT (bio-drying IVC) process. Within each of the modelled options (excluding the status quo), moisture is evaporated. Within options 1.1, 1.2 and 2, the moisture loss occurs in the WtE plant (and is reported in the table above in the ‘Recovery’ category), whereas in options 3.1, 3.2, 3.3 and 3.4 there is some moisture loss at the MBT / IVC (reported in the ‘Other’ category), with further moisture loss in the WtE or cement kiln process.
<table>
<thead>
<tr>
<th>Comparator</th>
<th>Status quo</th>
<th>Option 1.1</th>
<th>Option 1.2</th>
<th>Option 2</th>
<th>Option 3.1</th>
<th>Option 3.2</th>
<th>Option 3.3</th>
<th>Option 3.4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Landfill diversion 2016</td>
<td>15.10%</td>
<td>15.10%</td>
<td>15.10%</td>
<td>15.10%</td>
<td>15.10%</td>
<td>15.10%</td>
<td>15.10%</td>
<td>15.10%</td>
</tr>
<tr>
<td>Landfill diversion 2020</td>
<td>23.96%</td>
<td>23.96%</td>
<td>23.96%</td>
<td>33.57%</td>
<td>23.96%</td>
<td>23.96%</td>
<td>33.57%</td>
<td>33.57%</td>
</tr>
<tr>
<td>Landfill diversion 2040</td>
<td>24.04%</td>
<td>40.12%</td>
<td>40.12%</td>
<td>41.12%</td>
<td>41.30%</td>
<td>42.13%</td>
<td>41.30%</td>
<td>42.13%</td>
</tr>
</tbody>
</table>
14.6 Waste flow model findings and risks

There is a range of landfill diversions, recycling and composting expected through the modelled options, including a range of landfill diversion and recycling performances. Option 3 variants provide a higher potential to create energy, as the waste sent to a WtE or third-party cement kiln is subject to a drying process, reducing the moisture content and effectively increasing the calorific value of the waste.

The results of Table 6 show that the biggest diversion of Project Waste from landfill is in option 3.4 (a separate dMRF and IVC, prior to the remaining waste being sent to a cement kiln), whilst all of option 3 variations provide much higher energy content that in option 1.1, 1.2 and 2. Each of the options modelled in the WFM fail to meet the CoJ’s landfill diversion targets described in section 15.3.

They do, however, divert between a total of 8.3 million (option 1.1 and 1.2) and nearly 10 million tonnes (option 3.4) from landfill between 2015 and 2044, a reduction of between 20% and 24% respectively compared to the status quo option.

Even with the solutions described in section 16.4, the CoJ is highly unlikely to meet its landfill diversion of 93% by 2040, whilst only hitting the 2020 target of 40% by 2021 at the earliest.

It should be noted that for all options including a dMRF the assumed date for the facility entering operation was modelled as 2017, resulting in the recovery of recyclates and the diversion of waste from landfill from 2017 onwards. The options appraisal report has subsequently concluded that the dMRF and WtE plant should both be developed by the private sector through the PPP contract to mitigate interface risks. It is therefore likely that the dMRF will enter operation in 2021, at the same time as the WtE plant, and the early recycling of waste as modelled in the WFM unlikely.

The outputs of the WFM exercise feed into the options appraisal process and are key to the overall scoring provided against each option. There are a number of risks which have been identified in relation to the WFM. The assumptions were all presented to and approved in November 2014 by the Project Steering Committee. However a number listed below were recorded as having a low or very low confidence level.

These key risks include:

- The WFM assumes that Pikitup will meet its future collection strategies of composting 50% of garden waste by 2020, diverting 235,000 tonnes of builder’s rubble from landfill by 2015, diverting 130,000 tonnes of food waste from landfill by 2040. If these targets are not met, this would impact the waste on the characterisation and in turn the calorific value of the waste stream.
- Waste diversion from landfill may lead to waste reclaimers moving from landfill to street collecting and result in loss of recyclable materials sent to the dMRF
- Waste composition: CSIR has undertaken a further waste composition analysis to more clearly reflect winter conditions. This may impact upon waste composition data and have effects upon waste composition / tonnages, technology selection and CV

15 Alternative waste treatment technologies overview

15.1 Approach

It was deemed necessary to update the AWTT considered by the six year old 2008 feasibility study to reflect recent technological developments and operational experience, and to address changes in the CoJ’s waste management practices. The AWTT review was carried out in two stages:

- An AWTT overview report (refer to appendix D) presented a range (the ‘long list’) of AWTTs commercially available and potentially suitable for the diversion of MSW and commercial wastes from landfill
- The report pre-screened the long list of AWTT to a ‘short list’ of AWTT which satisfied the project objectives (landfill diversion, energy recovery and job creation) and were appropriate for South Africa
- The findings were presented to the Project Steering Committee and a short list of AWTT was recommended to be subject to detailed evaluation at the options appraisal stage
- The short list of AWTT then passed forward to the technical options appraisal (refer to section 16 and appendix C) which used multi criteria analysis to rank the suitability of each AWTT to divert residual MSW from landfill, to recover energy and generate jobs
15.2 Pre-screening criteria
The AWTTs overview report aimed to introduce all AWTTs currently available throughout the world and, through a high level assessment of the following criteria, identify those technologies suitable to pass through to a more detailed options appraisal. The criteria included:

- Feedstock availability
- Landfill diversion
- Process product off-take markets
- Demand for power and/or biogas
- Technology risk
- Commercial scale reference plants in South Africa and internationally

15.3 Findings
Following the high level assessment of each AWTT against six criteria (refer to appendix C for more detail) the residual waste AWTT in Error! Reference source not found. were recommended to pass forward to the options appraisal for detailed analysis.

Table 5 | Short listed options

<table>
<thead>
<tr>
<th>AWTT</th>
<th>Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dirty MRF</td>
<td>Landfill diversion, job creation</td>
</tr>
<tr>
<td>Mechanical Biological Treatment</td>
<td>Landfill diversion, job creation</td>
</tr>
<tr>
<td>Conventional Incineration</td>
<td>Landfill diversion and energy recovery</td>
</tr>
</tbody>
</table>

16 Technical options appraisal

16.1 Approach
The short list of AWTT (refer to section 15 and appendix D) passed forward to the technical options appraisal (see appendix C) which used multi criteria analysis to rank the suitability of each AWTT to divert residual MSW from landfill, recover energy and generate jobs. The following was undertaken:

- The TA built options comprising of a combination of the short-listed AWTT from the overview report
- The evaluation criteria was agreed at the Project Steering Committee
- A detailed analysis of each option against agreed evaluation criteria was undertaken and reported on
- Each criteria was scored using agreed weighting
- The option scores were ranked to identify the technically preferred option
- The findings were presented to the Project Steering Committee and the preferred option was recommended to be subject to detailed commercial evaluation at the feasibility stage

See appendix C for the full technical options appraisal.

16.2 Description of alternative waste treatment technologies appraised

16.2.1 Dirty Materials Recovery Facilities
Dirty Materials Recovery Facilities are enclosed warehouse-type buildings designed for the purpose of receiving loads of mixed waste and recovering recyclates in order that they can be sold on to reprocessors. As this process will rely on manual picking, it will generate jobs and offer significant flexibility to future changes in the waste composition or off-take market demands. Following the recovery of recyclates the remaining waste, or refuse derived fuel, will be sent to a WtE plant for the recovery of energy.
It was estimated that the development of two 250,000 tpa dMRFs, operating 7 days per week and two 8-hour shifts, would employ a total of approximately 380 manual pickers and another 20 support staff.

Figure 12 summarises the estimated process mass balance for a dMRF.

![Assumed mass balance of a dirty Materials Recovery Facility](image1)

**16.2.2 Manual Biological Treatment**

Manual Biological Treatment is an umbrella term of a range of technologies designed to treat residual waste to recover recyclates (using pickers), and biologically (using In-vessel Composting (IVC)) treat the organic component of the waste. The appraisal concentrated on the biodrying configuration designed to produce a drier higher calorific waste to be used as Solid Recovered Fuel (SRF).

It was estimated that the development of two 250,000 tpa MBTs, operating 7 days per week and two 8-hour shifts, would employ a total of approximately 200 manual pickers and another 100 staff.

Figure 13 summarises the estimated process mass balance for an MBT plant.

![Assumed mass balance of Manual Biological Treatment](image2)

As an MBT is essentially a combined dMRF and IVC, the options appraisal also tested the benefits of separately developing a dMRF facility and IVC facility which, when combined, would act as an MBT.
16.2.3 In-vessel Composting
Residual waste can be biologically treated by IVC to dry the waste. The process typically takes two weeks and is intended to dry the waste to produce a higher calorific SRF, rather than biostabilise it to produce compost.

There are various IVC systems commercially available; for the purposes of this report two 175,000 tpa tunnel systems were assumed, each located in an enclosed warehouse type-building.

Operating an IVC facility at such a scale would require the use of mobile plant and automated materials handling systems. Accordingly, it was estimated that the development of two 175,000 tpa IVCs, operating 7 days per week and two 8-hour shifts, would employ a total of approximately 100 staff.

Figure 14 summarises the estimated process mass balance for an IVC plant.

Figure 14 | Assumed mass balance of an In-vessel Composting
16.2.4 Waste-to-Energy plant
A WtE plant is based on the direct combustion of the RDF or SRF feedstock leaving the dMRF or MBT respectively. Combustion is on a moving grate furnace above 850°C and for at least two seconds (as defined by the European Industrial Emissions Directive (IED)), so that it undergoes complete oxidation, producing heat, flue gases and incinerator bottom ash (IBA). These heated gases are then used to heat water to produce steam which then goes through a steam turbine to generate electricity. Conventional combustion converts waste into carbon dioxide and water, as well as non-combustible inerts (e.g. metals, glass) that remain as IBA.

It was estimated that:
- The development of a single 500,000 tpa WtE, operating 7 days per week and two 8-hour shifts, would employ a total of approximately 80 staff
- The development of a 335,000 tpa WtE, operating 7 days per week and two 8-hour shifts, would employ a total of approximately 60 staff
- The development of two 250,000 tpa WtE, operating 7 days per week and two 8-hour shifts, would employ a total of approximately 90 staff
- The development of a 195,000 tpa WtE, operating 7 days per week and two 8-hour shifts, would employ a total of approximately 50 staff

Figure 15 summarises the estimated process mass balance for a WtE plant.

![Assumed mass balance of a Waste-to-Energy plant](image)

16.3 Cement kiln
A third party cement manufacturer could adapt their cement kiln to co-fire SRF and coal. This would benefit the cement manufacturer by offsetting reliance on coal and thus improve the carbon footprint and cost of operations. SRF would help mitigate the volatile and currently increasing price of fuel due to the long term availability of quality South African coal traded on the international markets.

No job creation has been assumed for this AWTT.

Figure 16 summarises the estimated process mass balance of firing SRF in a cement kiln.
16.4 Appraisal options
The short-listed AWTT from the overview report were combined into appraisal options to understand the potential benefits of each option to the CoJ. The appraisals options evaluated are set out in Table 6.

Table 6 | Short listed options of potential alternative waste treatment technologies

<table>
<thead>
<tr>
<th>Appraisal option</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Status quo</td>
</tr>
<tr>
<td>1.1</td>
<td>No recycling - large WtE</td>
</tr>
<tr>
<td>1.2</td>
<td>No recycling - small WtE</td>
</tr>
<tr>
<td>2</td>
<td>Recycling (staged roll out) - dMRF / medium WtE</td>
</tr>
<tr>
<td>3.1</td>
<td>Maximum diversion - MBT / small WtE</td>
</tr>
<tr>
<td>3.2</td>
<td>Maximum diversion, low CAPEX - MBT / third party cement kiln</td>
</tr>
<tr>
<td>3.3</td>
<td>Maximum diversion (staged roll out) - dMRF / IVC / small WtE</td>
</tr>
<tr>
<td>3.4</td>
<td>Maximum diversion (staged roll out), lower CAPEX - dMRF / IVC / third party cement kiln</td>
</tr>
</tbody>
</table>

16.5 Evaluation criteria and weighting
Table 7 lists the criteria, sub-criteria and weightings agreed with the PSC.

Table 7 | Evaluation criteria and weighting

<table>
<thead>
<tr>
<th>Headline criteria / sub-criteria</th>
<th>Weighting</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technology and deliverability</td>
<td>Overall</td>
</tr>
<tr>
<td></td>
<td>20%</td>
</tr>
<tr>
<td>Bankability of technology</td>
<td>2%</td>
</tr>
<tr>
<td>Availability of technology providers</td>
<td>2%</td>
</tr>
<tr>
<td>Flexibility of technology to changes in feedstock growth / composition</td>
<td>2%</td>
</tr>
<tr>
<td>Availability of process consumables</td>
<td>1%</td>
</tr>
<tr>
<td>Headline criteria / sub-criteria</td>
<td>Weighting</td>
</tr>
<tr>
<td>-------------------------------------------------------------------------------------------------</td>
<td>-------------</td>
</tr>
<tr>
<td></td>
<td>Overall</td>
</tr>
<tr>
<td>Capital investment (relative)</td>
<td>3%</td>
</tr>
<tr>
<td>Operational cost (relative)</td>
<td>2%</td>
</tr>
<tr>
<td>Staged development possible to deliver early landfill diversion</td>
<td>6%</td>
</tr>
<tr>
<td>Estimated timeline to full operations</td>
<td>2%</td>
</tr>
<tr>
<td><strong>Mass flow and energy performance (refer to section 14)</strong></td>
<td><strong>30%</strong></td>
</tr>
<tr>
<td>2016 landfill diversion target (20%)</td>
<td>3%</td>
</tr>
<tr>
<td>2020 landfill diversion target (40%)</td>
<td>9%</td>
</tr>
<tr>
<td>2040 landfill diversion target (93%)</td>
<td>3%</td>
</tr>
<tr>
<td>Recycling</td>
<td>3%</td>
</tr>
<tr>
<td>Energy recovery from AWTT</td>
<td>12%</td>
</tr>
<tr>
<td><strong>Social impact</strong></td>
<td><strong>20%</strong></td>
</tr>
<tr>
<td>Direct employment (by option)</td>
<td>10%</td>
</tr>
<tr>
<td>Secondary employment (by option)</td>
<td>6%</td>
</tr>
<tr>
<td>Other economic benefits (by option)</td>
<td>4%</td>
</tr>
<tr>
<td><strong>Product off-take (refer to section 16.6)</strong></td>
<td><strong>8%</strong></td>
</tr>
<tr>
<td>Availability of product off-take markets (glass)</td>
<td>0.80%</td>
</tr>
<tr>
<td>Availability of product off-take markets (ferrous metals)</td>
<td>0.80%</td>
</tr>
<tr>
<td>Availability of product off-take markets (non-ferrous metals)</td>
<td>0.80%</td>
</tr>
<tr>
<td>Availability of product off-take markets (mixed plastics)</td>
<td>0.80%</td>
</tr>
<tr>
<td>Availability of product off-take markets (paper and card)</td>
<td>0.80%</td>
</tr>
<tr>
<td>Availability of product off-take markets (garden waste)</td>
<td>0.40%</td>
</tr>
<tr>
<td>Availability of product off-take markets (e-waste)</td>
<td>0.40%</td>
</tr>
<tr>
<td>Availability of product off-take markets (SRF)</td>
<td>1.20%</td>
</tr>
<tr>
<td>Availability of product off-take markets (power)</td>
<td>1.60%</td>
</tr>
<tr>
<td>Availability of product off-take markets (heat)</td>
<td>0.40%</td>
</tr>
<tr>
<td><strong>Residue disposal</strong></td>
<td><strong>2%</strong></td>
</tr>
<tr>
<td>Availability of APC residue disposal facilities</td>
<td>0.67%</td>
</tr>
<tr>
<td>Availability of IBA disposal facilities</td>
<td>0.67%</td>
</tr>
<tr>
<td>Availability of rejected waste disposal facilities</td>
<td>0.67%</td>
</tr>
<tr>
<td><strong>Technical risk</strong></td>
<td><strong>10%</strong></td>
</tr>
<tr>
<td>Waste security</td>
<td>1%</td>
</tr>
</tbody>
</table>
### 16.6 Off-take market assessment

A key issue influencing the appropriateness of technology options was the off-take market for recyclates and energy.

All three short-listed options produce an energy by-product. The off-take market was thus assessed and appraised including refuse derived fuel for potential use in the cement industry and electricity.

It was also important to assess the recyclates as this influenced the assumptions in the value assessment.

A detailed off-take market assessment report is attached as appendix E.

The recyclates market was assessed. There is a recyclates market. The assumptions do take into account Pikitup’s waste minimisation strategies. The following findings were raised:

- The market for recyclables does vary and is largely a supply and demand cycle
- The recyclable market is also driven by the price for the materials and where there is an oversupply then recyclers are faced with hanging on to large stock levels
- It should also be noted that there are numerous other interventions in place to look at using recyclables for other uses other than traditional uses and there are still being tested and possibly will change the market outlook in the future

The energy options was also assessed.

The option of the cement industry buying the energy was tested. The current MSW CV is less than that of coal, but the cost of coal far outweighs the MSW cost. However, it was found that the cement industry is very prescriptive in its demands, limited in terms of suitable locations, and has very precise CV requirements in order to produce the right energy for its kilns.

City Power was also engaged regarding the option to off-take the electricity generated by the WtE plant. Pikitup expressed an interest based on the need to access electricity in the current power supply situation and the associated costs. City Power has confirmed that the CoJ requires the energy and has the infrastructure within the vicinity of the recommended site of the WtE plant to receive the energy. The concern raised was the cost of the off-take arrangement.

It was initially anticipated that the cement kiln would be the preferred option. Following the market assessment, this proved not be the case.

Accordingly, the energy option of electricity generation for the CoJ’s own use was pursued.

### 16.7 Results and recommendations

Table 8 summarises the results of the options appraisal.
Although the difference in score between the top 3 options was marginal, the off-take market assessment (refer to section 16.6) addresses the off-take risks associated with options 2 and 3.3 which are fully captive (i.e. the CoJ would develop the WtE plant) and option 3.4 where a third party cement kiln would utilise the SRF produced by the CoJ's dMRF and IVC. In conclusion the South African cement industry is not yet ready to commit to the long term off-take of SRF, in lieu of coal, and option 3.4 discounted due to off-take risk.

It was recommended that option 2 pass forward to the PPP feasibility study for detailed financial and legal analysis. This option comprises the following AWTT infrastructure:

- Two 250,000 tpa dMRFs
- A 335,000 tpa WtE plant

In developing the options appraisal and WFM the assumed timeline for delivery of the preferred option was as follows:

- November 2015: Commence two years of PPP procurement, preparation and approval of EIA and electricity generation arrangements
- September 2017: The CoJ secures EIA for both sites and electricity generation arrangements
- September 2017: PPP financial close
- 2021: WtE plant is handed over to operational and maintenance (O&M) contractor and enters full operation

Note that the assumptions inform the WFM and options assessment as at February 2015, but have been updated in more detail in the indicative procurement plan in section 23, in particular the timing of the commencement of the procurement phase given the procedural regulatory requirements.

## 17 Site options assessment

### 17.1 Approach

A site assessment was undertaken in accordance with Council’s 2010 resolution, that the Project site be identified (refer to the site assessment report in appendix F). The objective of the site options assessment was to identify sites where the AWTT Project could best be situated to ensure that the proposed technical solution could be implemented.

The approach and methodology is based on the ‘Drastic’ methodology in order to derive at a suitable option for site selection. This method provides an easy, intuitive way to overlay spatial data to deliver results in a structured manner.
17.2 Site needs
The AWTT solution requires:

- Council owned land (to avoid capital cost and protracted procurement processes)
- Land fit for purpose (to manage EIA, zoning and licensing issues)
- Site with enough space which is flat and accessible (to avoid capital and operational expenditure)
- Volume of waste required is available
- Accessibility for existing waste without additional cost associated with transport (i.e., proximity to existing waste diversion activity)
- Accessibility for off-take (i.e. proximity to users of the by-products)

17.3 Assessment
The TA’s assessment of the information at hand:

- The northern areas (all areas and regions from Sandton northwards, including Fourways and Diepsloot) require an interim diversion solution and longer term AWTT intervention to contend with the anticipated growth
- The southern areas’ landfills require AWTT to handle the current waste generation and future growth projected in these areas

There are a number of potential site options for AWTT:

- Four existing landfill sites were identified, predominantly in the southern areas with close proximity to the central belt of CoJ jurisdiction
- Ten new sites, predominantly in the north, were identified and assessed. They are all new sites requiring engagement with private land owners with associated time, cost and zoning risks

17.4 Findings
Of the existing landfill sites, the options of Marie Louise and Robinson Deep for the AWTT PPP seem most appropriate, for the following reasons:

- It is Council owned land, and accordingly does not require cost to be incurred to secure access:
  - Acquiring land is costly and poses a risk with an array of specialist studies that will need to be undertaken and the possibility of communities around one of the site options could delay the development of such AWTT project
  - Due diligence done on the land assessed and land identified in the EMM area next to FG Landfill was also investigated. Sites close to AECI / Chloorkop will need consultation with the appropriate landowners on future intended use
  - There is neighbouring CoJ land (operated by Johannesburg Metropolitan Police Department) which could be used for expansion if necessary
- The land is currently zoned and licensed for waste storage and disposal activities and is accordingly fit for purpose. The possibility of further industrial development could occur in the future and the current proximity of Robinson Deep Landfill is probable. Should the need arise for ‘heat’, then this option could be explored further but with the current topography this could lend itself to this fairly well
- The available land is flat and adequate in size given the spatial requirements of the infrastructure and operations of the Project, in particular waste disposal trucks can access the site to store waste
- There is a pre-built MRF at Robinson Deep Landfill which further likely compliments the planned AWTT Project
- There is no need to change the current municipal waste collection routes, i.e. the logistics for receiving the municipal waste is supported
- City Power has indicated its interest in the electricity off-take, and has indicated it has the required city infrastructure to receive the electricity and demand in the area for the constant supply
- City Power’s proximity to the Robinson Deep Landfill is ideal and makes logic for choice of site for the transfer of energy and establishment of the required electrical infrastructure. Should the area be developed further then the possibility of exploring neighbouring mining land not in use any further also serves as a possibility
17.4.1 Materials Recovery Facility at Marie Louise Landfill

Although there is not a single area or space at Marie Louise that meets the criteria of 3.5 ha, it is suggested that the MRF needs to be established on the properties indicated in red. The detail of the area is depicted in Error! Reference source not found..
17.4.2 Waste-to-Energy plant and Materials Recovery Facility at Robinson Deep

From the statistics of the landfill sites, Robinson Deep has the least remaining life span of the other operational landfill sites, but the site does have ample space for the implementation of a MRF, as indicated in Error! Reference source not found.

![Figure 18 | Waste-to-Energy plant and Materials Recovery Facility at Robinson Deep](image)

The red area in Error! Reference source not found. indicates where the technology can be established; however, the area indicated in yellow already belongs to the CoJ and the activities can easily be expanded to this area.

17.5 Site enablement

- The land is owned by the CoJ, but the sites are permitted in the name of Pikitup. Pikitup is thus responsible for the operations of the landfill footprint. There is a need for an agreement between CoJ and Pikitup to address the implications of the proposed AWTT PPP.

- Detailed geotechnical and geohydrological assessments can only be done once the site is confirmed in principle by Council resolution. As suggested by National Treasury, this should take place in parallel with the procurement process.

- Both sites have physical available space. Nothing has been approved from a budget perspective on these sites which will impede the provision of the dMRF and WtE. The Council must be sure to inform the Boards of the MOEs of the outcome of the Council decision and instruct them regarding implications.

- An EIA is proposed to further establish the implications for authorisation, permitting and license requirements to implement the transaction.

- The private party can have access to the site as required to develop and operate the Project over the contract term (25 years). It will be included as part of the transaction with applicable clauses to the land use and management there off.
17.6 Conclusion
A dMRF should be established at Marie Louise, and a dMRF and WtE plant at Robinson Deep.

The two sites are appropriate for the technology solution proposed.

The CoJ should commence with the EIA as soon as is possible. It was the view of National Treasury that the EIA process should run in parallel with the procurement process, and the TA supports the recommendation as still being relevant. It will assist with managing risk which will impact the competitive procurement process, and will also assists with the tight time frames to address the landfill airspace challenge.

Pikitup should be instructed about the intention of the CoJ and Pikitup’s planning must take cognisance of and be aligned with the Project requirements for the project period of 25 years.

18 Technical assessment recommendation

18.1 Technical solution
It is recommended that the following preferred option passes forward to feasibility assessment:

- Two dMRFs, situated at the Robinson Deep and Marie Louise Landfill sites, each with a treatment capacity in the order of 250,000 tonnes per annum (tpa) of Project Waste. The recovery of recyclates from the residual waste feedstock will principally be by manual picking from not less than four conveyor picking lines. In order to achieve the required throughput rates, two 8-hour shifts will be operated with the 3rd used for cleaning and maintenance.

- The Project Waste not recovered for recycling by the dMRF will be the feedstock for one WtE plant at the Robinson Deep Landfill site. The WtE plant will have a treatment capacity of approximately 335,000 tpa, adopting proven moving grate conventional combustion technology, steam turbines and generators, and modern air pollution control technologies. To maximise process availability the WtE is likely to have two combustion lines and one or two steam turbines. The WtE plant will operate 24 hours a day for 7 days a week for approximately 90% of the year.

- In addition to generating a significant number of jobs, the dMRFs will act as a pre-treatment for the WtE plant and help manage the characteristics of the WtE feedstock (e.g. CV, ash, moisture and chlorine content). The highly automated WtE plant will employ few staff but will recover energy from the waste to power itself and the dMRF at Robinson Deep, with the majority of energy being exported to the power grid. Ash and process residues generated by the WtE will be landfilled at Robinson Deep. It is estimated that proximately 25 MW of power will be produced. This combination of technologies will divert approximately 80% by mass of waste treated from landfill.

18.2 Performance against project objectives
The proposed technical solution will have the following outcomes:

- 80% (400,000 tpa) diversion from landfill of Project Waste treated from 2021 (three years after PPP financial close)

- 25 MW (electrical) power exported to the grid, equating to power for up to 60,000 households

- Between 400 and 500 direct new jobs could be created in and around the Robinson Deep and Marie Louise Landfill sites, and more than 500 indirect new jobs could be created principally within the CoJ and the Gauteng region
Section 5: Feasibility

19 Approach

In order to assess the feasibility of the recommended technology (refer to section 18.1), a due diligence was undertaken to ensure that there are no legal impediments to the implication of the solution and transaction (refer to appendix I for the legal assessment report). This was followed by the value assessment (refer to appendix H for the financial value assessment report).

The key enquiry is whether the recommended transaction is feasible for the CoJ to initiate, procure and implement, with particular focus on value for money, affordability and risk transfer.

20 Due diligence

20.1 Legal assessment

Contracting by local government is regulated and complicated. Very often the focus of municipalities is on procedural compliance, i.e. ‘to do a PPP’. Although procedural compliance is important to ensure that actions are not challenged, what is more important is that the needs of the municipality and community drive the solution. The solution will then determine what procedures have to be put in place in order to ultimately achieve the solution.

In identifying the foreseeable legal requirements relevant to the development of the Project, the key enquiry is whether there is anything that would prevent the Project from being procured or implemented by the CoJ.

The TA’s summary of the legal assessment outcome is listed in Table 9 (refer to appendix I for the detailed analysis).

Table 9 | Summary of the legal due diligence

<table>
<thead>
<tr>
<th>Question</th>
<th>Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>Does the CoJ have the power and function to initiate and conclude the Project?</td>
<td>Yes, AWTT is recognised as a municipal support activity in the Municipal PPP Guidelines: Feasibility Study Toolkit: Solid Waste Management</td>
</tr>
<tr>
<td>Is the Project aligned to the current policy of government?</td>
<td>Yes, all three objectives of the CoJ, namely waste minimisation, renewable energy generation and job creation are supported locally, nationally and internationally</td>
</tr>
<tr>
<td>Does the CoJ have the power to initiate and conclude the Project as a PPP?</td>
<td>Yes, subject to compliance with the procedural requirements of the MFMA</td>
</tr>
<tr>
<td>Are there alternatives to a PPP as a procurement choice?</td>
<td>Yes, including:</td>
</tr>
<tr>
<td></td>
<td>▪ Developing the infrastructure by the CoJ and procuring a management contract (not a PPP by definition as technical and financial risk vests with the CoJ)</td>
</tr>
<tr>
<td></td>
<td>▪ Lobbying to have the project registered on the national government’s REIPPPP</td>
</tr>
<tr>
<td></td>
<td>▪ Developing landfills</td>
</tr>
<tr>
<td></td>
<td>When considered against the CoJ’s project objectives, the PPP as procurement option demonstrates value for money</td>
</tr>
<tr>
<td>What is the role of the CoJ’s operators (Pikitup and City Power)?</td>
<td>It’s acknowledged that the municipal entities have a significant role to play. The PPP agreement will be between the CoJ and the private party. The CoJ will</td>
</tr>
</tbody>
</table>
In identifying and then assessing the potential legal issues arising, the TA has considered the following in the legal assessment report:

- The definition of the Project and PPPs
- Whether the scope of the Project falls within the mandate of the CoJ, i.e. can the CoJ contract for the Project and the roles and responsibilities of the MOEs?
- The contracting arrangements and parameters, i.e. what parameters must the CoJ follow in order to conclude the contract
- The institutional roles and responsibilities
- The regulatory parameters for implementation of the Project, distinguishing the reduction of waste from landfill process, and the WtE process

The decision making requirement and indicative time frames are dealt with in the procurement plan (refer to appendix J).

### 20.2 BEE and socio-economic issues

In its inception presentation, the CoJ identified the following potential socio-economic benefits of the Project:

- Reduction of waste going to landfill (500,000 tonnes)
- Renewable energy
- Low carbon economy
- Revenue from sale of by-products (energy recyclables)
- Potential to earn carbon credits
- Private party expertise and raising capital
- Job creation
- Strong localisation and skills transfer
- Innovative solution

PPPs present themselves with useful opportunities to structure a transaction to achieve broad based black economic empowerment (BBBEE).

The CoJ’s SCM Framework aligns itself to the Preferential Procurement Framework Act, and in this instance would weigh the preferential points at a ratio of 90/10.

The Municipal PPP Guidelines recommend going further and elaborate on seven areas where PPPs can contribute, especially in greenfield special purpose vehicle (SPV) structure, as set out in Table 10.
### Table 10 | PPP BBBEE guidelines

<table>
<thead>
<tr>
<th>Element</th>
<th>Weighting</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ownership</td>
<td>20</td>
</tr>
<tr>
<td>Management control</td>
<td>10</td>
</tr>
<tr>
<td>Employment equity</td>
<td>15</td>
</tr>
<tr>
<td>Skills development</td>
<td>15</td>
</tr>
<tr>
<td>Preferential procurement</td>
<td>20</td>
</tr>
<tr>
<td>Enterprise development</td>
<td>15</td>
</tr>
<tr>
<td>Local economic development</td>
<td>5</td>
</tr>
</tbody>
</table>

This is ambitious. Lessons can be learned from the REIPPPP where assessment by the World Bank\(^{23}\) indicated the BBBEE requirements were controversial, confusing and accordingly expensive.

#### 20.3 Due diligence findings and conclusion

It is the TA’s view that the legislative environment is enabling for local government PPPs for AWTT. The assessment has not revealed any legislative prescription directly prohibiting the CoJ from initiating, procuring and implementing the optimal AWTT solution.

This transaction does present itself as an opportunity for BBBEE, especially in the SPV structuring and the dMRF operations contract. The construction of the WtE plant will likely be imported and this will impact the ability of the consortiums to structure themselves with assuming, and therefor pricing, for risk.

#### 20.4 Caution

The following cautions are however raised:

- A project of this nature hasn’t been done in South Africa before
- The potential reaction of NERSA, the Minister of Energy, and the impact on the IRP and REIPPPP are not predictable at this stage

The TA also notes that there is reliance on external parties for Project authorisations:

- National and Provincial Treasuries, DCOG, DOE and DEA for MFMA views and recommendation
- DEA: Site EIA and waste storage and treatment
- NERSA and DOE: Electricity generation license and tariff determination

There is also reliance on external parties for Project performance (including Pikitup and City Power).

Contractually, the lenders are used to sovereign guarantees in REIPPPs.

Although the Project can be implemented as a PPP to meet the CoJ’s stated Project objectives:

- It is a stand-alone project and does not address the CoJ’s holistic waste management needs
- It will not drastically impact the landfills for at least another six years

Notwithstanding the WtE PPP, planning and implementation of landfill airspace will remain a key challenge for the CoJ.

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21 Feasibility conclusion

- Council's 2012 comments regarding CV of waste, identification of a site and funding models have been addressed. Given the time lapse since the previous study, and with guidance and direction from the Project Steering Committee, the TA has reconsidered all options against the stated objectives, landfill needs and latest policy and legislative environment.

- The outcomes of this PPP study of the optimal AWTT for MSW to meet the CoJ’s stated objectives, strategies and policies, are that it is feasible. The scope, costs and transaction structure are known, and significant technical, operational and financial risk can be transferred.

- The proposed technology solution will:
  - Drastically reduce waste to landfill
  - Generate renewable energy
  - Create jobs

- From a project funding perspective, it will impact the costing of municipal waste services delivery, but the costing as benchmarked internationally and locally is sound. The issue of affordability has been explained with reference to the need for landfill space and the alternatives available to the CoJ. The future financial implications will be determined in the procurement phase and Council will be informed accordingly before approving the contract in terms of s33 of the MFMA.

- The AWTT PPP has risks from a regulatory perspective and will require significant investment of time, effort, support and funding from the CoJ to implement

- Although the Project can be implemented as a PPP to meet the CoJ’s stated project objectives:
  - It is a stand-alone project and does not address the CoJ’s holistic waste management needs
  - It will not drastically impact the landfill for at least another six years

- Notwithstanding the AWTT PPP, planning and implementation of landfill airspace remains a key challenge for the CoJ

- ‘Going Green’ comes at a cost: The CoJ has to decide whether that cost is worth investing in or if there are alternative more cost effective and efficient options

- The CoJ must accordingly, in addition to deciding about the Project, pursue the optimisation of integrated waste management strategy and business optimisation for the CoJ to make commercially informed decisions

22 Alternative waste treatment technologies feasibility recommendation

- It is recommended that the CoJ accounting officer:
  - Take note of the outcomes of this AWTT PPP feasibility study
  - Proceed with the MFMA s120(6) public notification process
  - Proceed with MFMA s120(6), soliciting the views and recommendations of National Treasury, Provincial Treasury, COGTA and, if required, DEA and DOE
  - Report to Council:
    - Noting the alignment of the proposed Project to the CoJ’s strategy and policies
    - Noting the comments, views and recommendations received, and that there will be further opportunity to solicit views and consult in the procurement and implementation process
    - That Council’s issues of site selection, CV of the waste composition and financial modelling has been addressed
    - Recommending that Council resolve in principle to proceed with the PPP based on the outcomes of this feasibility study
Recommending that Council advise the Boards of Pikitup and City Power to acknowledge Council’s resolution, and to manage the impact on their respective processes of planning and implementation of the Project in their business plans, and that contracts will be concluded to facilitate the Project.

If Council resolve to proceed in principle with the AWTT PPP, proceed with the implementation of the procurement plan, including:

- Consultation with stakeholders (NERSA, DOE)
- Commencement with the EIA process
- Finalisation of the sources of the transaction funding model to address the Project costing modelled in the value assessment
- Initiation and implementation of the procurement process

In addition to proceeding with the AWTT PPP, the CoJ develop an integrated waste management strategy and implementation plan whereby:

- Waste minimisation initiatives and desired outcome are set
- The target levels of diversion of source separated biowaste and dry recyclates through upfront initiatives and supporting waste collection arrangements are set
- The target levels of residual waste diversion, recycling an energy recovery are set
- The type and treatment capacity of additional residual waste AWTT be defined
- The likely demand for landfill going forward be determined and the preferred source of airspace found (city or regional municipal landfill or private sector landfill)
- A timeline for implementation of each of the above be formalised

23 Way forward: Procurement plan

A procurement plan is the indicative way forward should Council decide in terms of MFMA s120(6) to proceed in principle with the procurement of the Project as a PPP.

It indicates activities, the outcome sought to be achieved by the activity, the indicative time frame and accountability.

23.1 Procurement phases

There are four key phases to consider in implementing the Project. The finalisation of the plan for each phase is influenced by the outcome of the previous phase at the time of finalisation of that phase.

The four phases include:

- Council decision making:
  - This requires views and recommendations from stakeholders, and a decision by Council as to whether to proceed in principle to procure a PPP
  - The feasibility study’s project plan anticipates this decision by end November 2015, subject to the views of the City Manager and the Council decision making processes

- Procurement phase:
  - This phase will take a minimum of 18 months, best case scenario, but more likely not less than two years given the MFMA procedural requirements regarding procurement (Supply Chain Management Regulations), s120, the PPP Regulations and s33 regarding contracts with future financial commitments. It estimates bidders will be pre-qualified in four months, and the RFP process will take five months. These are aggressive time frames and require significant co-operation from all parties. It also assumes that the market interest shown in the DOE’s REIPP will facilitate the CoJ’s process.
  - The CoJ’s Supply Chain Management Unit will need to be closely engaged in regard to bid specification, evaluation and adjudication of the proposals received. There will need to be approval of RFP, RFQ and specification documentation.
  - National Treasury and Provincial Treasury are required to give its views and recommendations on the procurement documentation and the outcomes of the procurement process. The views of the national
department of local government must also be solicited. Although it is not prescribed, because of the scope of the Project it is suggested that the views of the Department of Environmental Affairs (waste) and Department of Energy (electricity) also be solicited.

- There will need to be engagement by the CoJ with external regulators, including National Treasury, DEA and NERSA, regarding the transaction and their role in the implementation phase. In principle agreement regarding the regulatory risks to be shifted to the private party will be required prior to the RFP being issued.
- Financial closure of the contract and requirements of funders of the Project will also need to be carefully managed

- Contract implementation phase:
  - This phase requires engagement with the external regulators, in particular in regard to the environmental approvals and electricity approvals, as more fully elaborated on in the legal assessment

- PPP contract management phase:
  - Notwithstanding that the private party will take the technical, financial and operational risk in implementing the Project, the CoJ will need to ensure that it counter-performs as is required by the contract. This will require dedicated contract management capacity, ideally by the project officer who leads the procurement of the PPP.
  - The performance of the CoJ’s MOEs (Pikitup and City Power) will need to be carefully managed by the CoJ

23.2 Procurement approach

The value assessment section has demonstrated that there is value for money in pursuing the Project as a PPP. The full cost of the Project is, however, not currently budgeted for by the CoJ and provision will need to be made once the funding model has been settled by the CoJ.

The Project can be structured in such a way that there is significant technical, operational and financial risk transfer to the private party (successful bidder).

Bidders should thus be invited to design, build, finance and operate the Project for the contract period of 25 years. Given the complexity of the technical solution required, the TA recommends a two phase bidding process.

Although the CoJ wants to implement as quickly as possible, especially given the confirmation of the CoJ’s needs regarding landfill diversion and generation of electricity, because PPPs and government procurement is regulated, this process will take time.

Once the Council has resolved in principle to procure a PPP, the TA recommends that interested parties be invited to submit bids to be short-listed as pre-qualified bidders. Only pre-qualified bidders would be issued with the more detailed transaction documents and be required to undertake a due diligence. This is because the process is expensive and time consuming or all concerned.

The RFQ process is undertaken in the procurement phase. It happens after the community have given their views, TVR I (Treasury views on the feasibility) and after the Council has approved in principle to proceed to procure a PPP.

It is the first phase of a two phase bidding process. The interested parties are invited to submit their consortium details to demonstrate technical skills expertise and experience in similar projects, the financial ability to do the deal and their approach to BBBEE. In other words, bidders are pre-qualified on the strength of their consortium, existing demonstrated skills and experience to receive the more detailed RFP.

In the second phase, the RFP documentation sets out the detailed project definition and bidding requirements. It requires a process of due diligence by the bidder. It involves evaluation of bid response regarding the Project, price and nomination of a preferred bidder and second preferred bidder by the CoJ. It will require bidder’s briefings and site visits. Because the bidders need to prepare a technical response and price, there is more time required by the bidders to prepare their RFP responses. The RFP also has the draft contract attached to it for all bidders to consider the proposed risk allocation and respond to it in a competitive bidding environment.

The RFQ and RFP are procurement process. They are thus regulated by the SCM Regulations. It requires the CoJ’s SCM committees to participate, including bid specification, bid evaluation and bid adjudication. It also needs Treasury views and recommendations on the procurement documentation (TVR IIA), the outcome of the procurement process (TVR IIB regarding the preferred bidder) and the contract negotiations (TVR III).
23.3 Procurement plan

The indicative Project timetable for the key milestones and all approvals for implementation of a PPP agreement, which will be required to take the Project to contract closure, is indicated in the procurement plan (refer to appendix J). Procurement, contract negotiation and approval processes are estimated to take no less than two years. The WtE plant will be fully operational four years after financial closure of the PPP agreement. Thus, best case scenario, if all goes well and according to plan, including input and decision making of external regulators, the WtE PPP will be fully operational towards the end of 2021.

Given the need for solutions to be implemented to address the landfill airspace challenges facing the CoJ, and also that the procurement of the long term PPP agreement must be able to stand the test of time, the TA would urge the decision makers to proceed as recommended.