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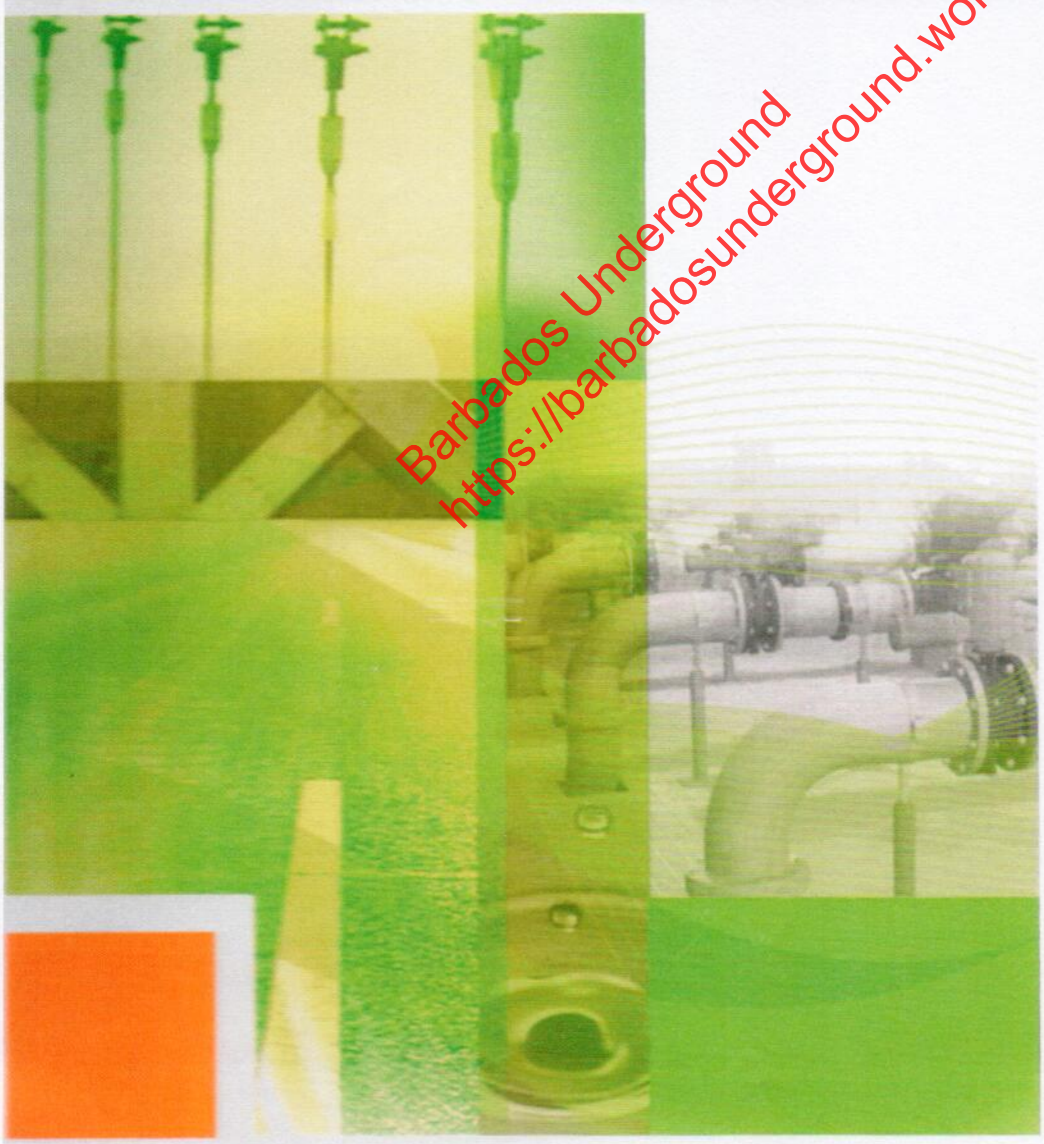
Mangrove Pond Green Energy Complex & Beautification Programm

Environmental Impact Assessment Outline Review

TCDPO Ref: 1123/07/2013C



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Mangrove Pond Green Energy Complex & Beautification Programme

Environmental Impact Assessment Outline Review

TCDPO Ref: 1123/07/2013C

Prepared by:

R.J. Burnside International Limited
15 Greenidge Drive, Payne's Bay St. James

Prepared for:

Sanitation Service Authority

March 2014

File No: 300030292 & 300030295

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March 31, 2014

Via: Hand Delivered

Chief Town Planner
c/o Ms. Marjorie Stuart-Griffith
Town and Country Development Planning Office
Block C, Garrison, St. Michael, BB14308, Barbados

Dear Ms. Stuart-Griffith:

Re: TCDPO Application 1123/07/2013C
Erection of a building for industrial purposes (mechanical workshop, waste to energy plant, wind turbines and solar farm facility) at the Mangrove Pond Landfill and Solid Waste Management Complex at Vaucluse, St. Thomas
Burnside File No's: 300030292 & 300030295

The Government of Barbados through the Sanitation Service Authority (SSA) are proposing to develop the Mangrove Pond Green Energy Complex and Beautification Program. In support of this proposed development, R.J. Burnside International Limited (Burnside) has prepared an Environmental Impact Assessment (EIA), Outline Review.

Burnside is pleased to submit six (6) copies of this EIA for your distribution and review as appropriate. Should you or your colleagues have any comments or questions, please contact the undersigned.

Yours truly,

R.J. Burnside International Limited

Derek O'Rourke, CET.	James R. Hollingsworth, P.Eng.
Project Manager	Technical Leader, Solid Waste

encl. 6 copies of EIA

c: Ms. Margot Harvey, Chairman SSA Board (hand delivered, 2 EIA copies)

140326 Stewart-Griffith, TCDPO EIA Submission.docx
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Green Energy Complex EIA
TCDPO Ref: 1123/07/2013C
March 2014

Record of Revisions

Revision	Date	Description
0	Dec. 20, 2013	Preliminary draft for TCDPO review
1	Feb. 28, 2014	Draft for Minister of Environment and Drainage
2	March 28, 2014	Submission for TCDPO review

are considered to evaluate potential options that may be proposed, although other designs could also be used by the contractor that builds the system.

Savonius Design

The Savonius design is a drag-type device consisting of two or three scoops that rotate along a vertical axis. The curvature of the scoops create a differential drag as they experience less drag when moving against the wind than when moving with the wind. This causes the turbine to spin and makes the Savonius design turbine self-starting. No pointing mechanism is required to allow for shifting wind direction. Savonius turbines are typically very reliable, but are less efficient at converting the wind's energy into useful mechanical (or electrical) energy than other similarly sized designs.

Darrieus Design

The Darrieus design consists of a number of curved aerofoil blades mounted on a vertical rotating shaft. The curvature of the blades allows the blade to be stressed only in tension at higher rotating speeds. A Darrieus turbine cannot be self-starting. It must be brought to a sufficiently high speed by external means in order to begin operating (i.e., producing electricity). However, it does not need to be pointed into the wind. Typical Darrieus design turbines provide a middle efficiency, between a Savonius design and HAWT designs.

Darrieus Savonius Design

As the name would suggest, the Darrieus Savonius design consists of a hybrid design that incorporates the "scoops" of the Savonius design and the curved blades of the Darrieus design that rotate along a vertical axis. The Savonius portion of the design allows the turbine to be self-starting while the Darrieus part increases the turbine's efficiency.

3.3.3 Waste to Energy Plant

Waste to energy is a method of waste disposal which has the added benefits of waste volume reduction and energy recovery. The process is designed to utilize waste that will completely combust while creating heat or produce a combustible fuel source such as methane.

Thermal technologies utilizing high temperature processing of Municipal Solid Waste (MSW) are most commonly used. Although facility set-ups may differ in the specific technology used, the sequence of events in the process generally involves:

1. Physical processing equipment to remove non-combustible and recyclable materials contained in the incoming waste stream, and sometimes some drying of the incoming waste stream (i.e., moisture content reduction).
2. A thermal treatment/destruction unit.
3. Heat and/or energy recovery system.
4. Air pollution control system.
5. Ash (residuals) management system.

Thermal treatment technologies typically produce steam in a boiler that is used to power a turbine. The turbine turns an electrical generator to produce electricity. Additional efficiencies can be achieved through secondary uses of the steam after it exits the turbine. This waste heat can be used for industrial processes, including chillers or air conditioners. The use of waste heat for air conditioning through thermal inversion technology can be included for both the proposed SSA Administration Building (Section 2.1.6) and the offices at the proposed equipment maintenance facility (Section 1.4.4), thereby greatly lowering electrical costs while increasing the efficiency of the .

The technologies described below have been implemented in some capacity around the world. Never the less, some proponents using these proven technologies have failed due to technical, financial or other reasons at various stages. Ultimately the RFP documents prepared for procurement of a Waste to Energy proponent for Barbados will strive to retain a technology and a capable contractor that are proven under similar conditions and provides the Government with confidence that Barbados will receive a beneficial and cost effective solution.

The actual operating differences among the specific technologies relate to operating temperatures, process oxygen concentration, point of application of pollution control and the physical location where the energy is recovered. Thermal technologies considered "proven technologies", i.e., with several full scale operating examples, include the following:

3.3.3.1 Rotary Kiln Incineration

This technology has been used since the 1950s and has the capacity to handle a variety of solid and liquid hazardous waste including Industrial, Commercial and Institutional (IC&I) waste and sludge. The rotary kiln incinerator is manufactured with an inclined rotating combustion chamber that keeps moving, thus allowing for complete burning. The waste is introduced at the high end and the ash falls through to the lower end. Energy recovery is usually in the form of steam. This technology is typically applied at a smaller scale than anticipated for Barbados.

4.0 Existing Environment

4.1 Waste Generation and Disposal Requirements

In the early 1990's, the disposal of solid waste in Barbados was in the range of 300 metric tonnes per day (tpd). By 2007, that rate had reached 1,000 tpd, with peak rates in excess of 1,200 tpd. With the operation of the SWMCV, waste disposal tonnages have reportedly remained consistent with the 2007 levels, with a portion now diverted to beneficial uses.

Waste generation is closely linked to population, though for Barbados, tourism contributes a disproportionate quantity of waste. A rule-of-thumb is that each tourist generates roughly three times the waste of a local person in the same period of time.

The CIA World Fact Book[2] estimates Barbados total population at 288,000 and growing at approximately 0.366 percent annually. For 2011, overall economic growth, a rough proxy for tourism growth, was estimated to be 0.2 percent by the International Monetary Fund[3]. For simplicity, we can assume that tourist-days will grow at one-third of the local population's growth. This assumption maintains the current proportion of waste quantity contributed by locals and tourists. We note that the anticipated lifespan of Cell 4 is relatively short – approximately nine years (see Section 2.1.1) – so a slight imbalance in this estimate has negligible effect. Over the nine year life of Cell 4, based on population growth, waste generation is expected to increase by a total of 3.3 percent (that is, from the current 1,000 tpd to 1,033 tpd).

Waste composition is often associated with social change, such as increased affluence leading to changes in consumer purchasing habits. During the anticipated lifespan of Cell 4, such social change is not anticipated to result in a measurable change in waste composition.

North America and Europe have slowly seen changes to consumer packaging with producers looking for lighter packaging materials or increased recyclability of packaging. As importers of such goods, Barbados may benefit from lighter packaging – mainly plastics – entering their waste stream. This may be offset by heavier recyclable materials that are not economically recyclable for Barbados. Again, during the relatively short period of Cell 4's projected operation, such changes are anticipated to be insignificant.

[2] https://www.cia.gov/library/publications/the-world-factbook/geos/bb.html, accessed December 16, 2011.
[3] http://www.imf.org/external/np/sec/pn/2011/pn11153.htm, accessed December 16, 2011.

Potentially significant changes to disposal quantities landfilled, and the composition of materials landfilled, could be realized with the introduction of additional waste separation or a waste-to-energy facility as envisioned for the Green Energy Complex. Increased waste separation and diversion efforts could recover valuable materials from the waste stream. SWMCV is already doing such work, though the potential remains to increase efforts and hence waste diversion. A waste-to-energy facility could accept the remaining *waste stream, producing electricity and recovering metals.*

4.2 Leachate Quality

As part of the Terms of Reference prepared for the Leachate Treatment Plant (the LTP TOR, TCDPO Application No. 1179/07/2013C), efforts have been made to consider current and future leachate quality so that appropriate treatment technologies can be used to achieve effluent discharge requirements. Waste characteristics and quantities play a significant role in determining leachate quantity and quality, though so too does the age of the waste. The LTP TOR incorporated existing leachate quality and quantity data as a baseline point. This is significant due to the quantity and age of waste currently in-place in the former fill areas of the Mangrove Pond Landfill. The existing waste in place, on a volume or tonnage basis, is significantly more than the remaining capacity provided by Cell 4. It therefore will dominate the average leachate quality received by the treatment plant.

As noted in Section 2.1.1, additional waste diversion through SWMCV or a new entity may change future waste composition. However, the waste currently in place and the future residual wastes after such diversion will likely result in a similar leachate quality as currently experienced. The LTP-TOR includes control requirements for a broad range of leachate quality and quantity to address such a situation.

The ash and/or other residuals generated from the proposed WtE facility will be analysed to determine if they are considered hazardous or non-hazardous waste. If the quality of the ash or residuals is non-hazardous, they will be disposed of in Cell 4 which may have an impact on leachate quality. This however will ultimately depend upon the disposal method selected for the ash/residual stream and should be considered during the TCDPO approval process for the waste-to-energy facility design (Section 1.2). Again however, the LTP TOR has broadly defined the anticipated leachate quality and quantity, and the actual leachate treatment plant may handle the leachate without requiring modification.

4.3 Land Conditions

Barbados is 33 km long and 22 km across at its widest point. The study area, shown on Figure 2, is in the physiographic region to the west of the island; the Upland Plateau,

4.5.2.3 Wind

During high wind events, a properly designed and installed solar panel is not likely to be dislodged, it's possible however, that the solar panel may be struck by flying debris. The implementation of barriers such as fences or walls downwind of the panel installation may help minimise the chance of being struck by a random projectile.

High wind events may have a minor effect on thermal solar farms. The wind may cool the collection and utilisation equipment.

4.5.3 Waste-to-Energy Plant

As stated above, the Island can expect to see higher temperatures over the next sixty to seventy years. This, along with a potential decrees in precipitation amounts, may have a positive impact on the operation of the waste to energy plant. Fuel for use in a waste to energy plant may be moisture laden, as refuse can be left exposed to the elements for extended periods of time. An increase in the temperature on the island, accompanied with a reduction in rainfall may lower (on average) the moisture content of the waste as it is collected (i.e., at curb side). Further, upon reaching the plant, shorter drying times may be experienced. This leads to a more efficient energy production system as less effort (energy) is required to remove moisture from the fuel.

The building structure of the waste to energy plant should also consider the climate change effects on the plant's construction and materials, as described in Section 4.5.4.

4.5.4 Equipment Maintenance Facility

Climate change effects on the equipment maintenance facility will be related to the built environment and the operational cost. As building materials are exposed to elements of weather they tend to deteriorate. This includes exposure from heat, sunlight, wind, rain and humidity. The contractor must take this into account and only provide quality materials for the construction of this facility. Replacing and maintain materials and plant in the facility is an expected overhead cost. Through proper material selection, zero cost or only slight cost increases (i.e., capital costs for materials, equipment and labour) can more than be offset through lowered maintenance/operating costs during the life of the facility.

4.6 Biological Conditions

The area outside of the proposed Green Energy Complex site is dominated by agricultural lands and residential communities. The majority of the site is comprised of closed and active landfill cells and a waste management facility. A quarry also exists

The upper floors of the proposed SSA Administrative Building and the Waste to Energy plant are the most likely to experience reflection effects from the solar farm. The successful contractor may propose to add window films on the affected area(s) of these buildings. This or other mitigation measures would need to be negotiated with the facility/building owners

Presuming a moving mounting system that tracks the sun, protection for aircraft and vehicular traffic may require that the panels be diverted during certain periods of the day, and possibly based on season/time of year. In this way, the system would not track the sun when certain combinations of the suns position and sensitive receptors (i.e., pilots or drivers) are present. Typically, the diversion would only be required for around 15 minutes to mitigate the issue. During this time, the efficiency (output) of the diverted solar panels (not all panels would need to be diverted) may be reduced as the rays would not be perpendicular to the panel. It is therefore important to minimize the time for diversion in order to maximize power output.

4.8.3 Waste-to- Energy

The waste-to-energy facility is a plant designed to convert chemical energy contained within the wastes to electric energy, typically through the intermediate formation of steam and processing within a turbine unit.

There are two main potential visual impacts for this facility, the first is a result of the construction of the plant itself, which is a short term impact and not considered further. The other visual impact relates to the plant's stack and plume.

Typically a waste to energy plant includes a large stack in order to aid in the dispersion of any emissions. This stack may include lights to warn away aircraft. The plume discharged from the stack, consisting of a variety of emissions and including any waste steam, may add to the visual impact.

The size of the plant, the size of the stack and the nature of the plume will be a function of the type and size of the unit selected for construction. As such a visual impact assessment should for a portion of the EIA for the awarded technology. The impact assessment should include discussion relating to the building, including local mitigation strategies, the stack, including the areas from which it and the plume will be visible. The plume should be characterized based on composition, stack velocity and temperature, based on the typical annual range of local conditions. The visual aspects of the plume should form a portion of the discussion surrounding the selection of appropriate mitigation measures, in addition to those which are related to chemical limits.

- Number and locations of all bridge/culvert crossings where the load weight exceeds 80% of the maximum per axle design weight;
- Any locations where assisted turning is required (i.e. crane assisted swinging); and
- Analysis of the potential for off-peak transport (evening/overnight).

Preliminary planning can be achieved using available mapping information. Some field work may be required where additional details of clearances are required. The overall impacts of transportation will likely be manageable as the movement of materials to the site is a one-time event and will occur over relatively short durations. The analysis of routing, and adequate consultation and planning, including movement of materials during night time hours will reduce the potential levels of impact.

The component transportation assessment should include details of the contractor's liability insurance and plans to repair any damage that may occur.

4.12.3 Transportation of Waste

As described in Section 4.12.1, the existing waste transportation to the Green Energy Complex is expected to continue in its current form. However, there is a possibility that a larger than currently required waste to energy facility will be proposed by the contractor. Such a facility may source waste materials, perhaps agricultural waste, from elsewhere in Barbados or from overseas, such as used tires. If this is proposed by the contractor, then an Environmental Impact Assessment must be undertaken. This would include an analysis of the trucking routes (and possibly the sea port upgrades) that would be required to accommodate such an increased quantity of waste.

4.13 Service and Utility Structure

A Utility Services Assessment was completed by Burnside in March 2014. This report is included in Appendix L.

According to the report, there are a variety of service and utility infrastructure located on Site and within the 2 km study area. The SWMCV has electrical, telephone and potable water infrastructure on site. A natural gas pipeline is accessible from the south-west corner of the site, although alternative access may be available.

Potable water is delivered via the Barbados Water Authority at a pressure of 71.3 psi. Natural gas is provided via the National Petroleum Corporations natural gas distribution network while electrical power is supplied by the Barbados Light and Power Company at 50 hertz with voltage service as high as 24,900 volts in select areas.

retention of a water supply and storage system through either the use of an on-site well, or connection to the Barbados Water Authority supply network. In addition, a wastewater management system may also be needed to connect to the wastewater/ leachate collection and pumping system at the landfill LTP.

Table 1.3: Waste To Energy Plant, Core Project Works

Phase		Core Project Works
Construction Phase	Site Preparation	• survey for layout and delineation of work areas and natural features to be protected; • installation of erosion and sediment control measures; • setup of portable offices and temporary construction facilities (i.e., construction site trailers, equipment fuelling area, etc.); and, • site lighting and security provisions, as required.
	Local Road Improve's	• install/extend culverts in public road right-of-ways; • construct temporary lane modifications to facilitate turning requirements of turbine delivery trucks; • after delivery of plant components/equipment, restore intersections to pre-construction condition.
	Grading and Drainage Improvements	• site preparation including the removal of all vegetation in required areas within the area of construction, installation of siltation control measures, removal and/or stockpiling of 'loose' material (including topsoil) remaining from excavation operations. • construction of drainage ditches, surface water sediment control ponds and suck wells – both temporary for construction and permanent installations. • excavation of existing soil and rock, and compaction as required around base of excavations prior to construction/installation of building footings and foundations;

Table 5.2: Solar Farm - Project/Environment Interaction Matrix

Key:
X = Presence of project-environment interaction
P = Potential project-environment interaction
Blank = Absence of project-environment interaction

Component	Ground & Surface Water	Soils and Sedimentation	Air Quality and Climate Change	Noise / Vibration	Terrain / Topography	Vegetation	Wetlands	Wildlife and Wildlife Habitat	Migratory Birds	Designated Species	Heritage Features	Archaeological Resources	Land Rights	Land Use	Human Health and Safety	Socio-economic Conditions	Transportation
Site grading (preparation for final cover repair)	P	P	X	X	X	X									P	X	
Repair of final cover system and site restoration	P	P			X	X									P	X	X
Site monitoring and inspection (potential leachate issues, surface water control, erosion control and mitigation of nuisances)															P	X	
Removal of complete transmission system		P		X	P										P	X	X

Table 5.3: Waste to Energy Plant - Project/Environment Interaction Matrix

Key:
X = Presence of project-environment interaction
P = Potential project-environment interaction
Blank = Absence of project-environment interaction

Component	Ground & Surface Water	Soils and Sedimentation	Air Quality and Climate Change	Noise / Vibration	Terrain / Topography	Vegetation	Wetlands	Wildlife and Wildlife Habitat	Migratory Birds	Designated Species	Heritage Features	Archaeological Resources	Land Rights	Land Use	Human Health and Safety	Socio-economic Conditions	Transportation
Construction Activities																	
Site preparation (clearing vegetation, existing material including concrete and asphalt, installation of silt controls, removal and stockpiling of loose materials)	P	P	X	X		X		P	P			P		X	P	X	X
Temporary lane modifications to public road right-of-ways to facilitate delivery trucks including culvert extension and installation; restore to pre-construction after use has been completed	P	P	X	X	P			P	P			P			P	X	X
Construction and maintenance of access roads including culvert installations/modifications (permanent and temporary)	P	P	X	X	P			P	P			P			P	X	X
Installation of fencing and gates and security provisions (as required)		P		P				P	P			P			P	X	X
Setup of portable offices and temporary construction facilities (site trailers)				X								P			P	X	
Rock and soil excavation and stockpiling of reusable material, disposal of unusable excavation materials	P	P	X	X	X							P			P	X	X
Construction of drainage improvements and storm water management (temporary and permanent)	X	X	P	X	X							P			P	X	X
Compaction around base and side slope around excavations (below grade)	P	P	X	X	P										P	X	X
Construction of plant buildings works (adjoined power transmission and turbine buildings), exhaust vents, and ash collection/storage system and foundations	P	P	X	X				P	P			P			P	X	X
Construction of water and wastewater plumbing	P	P	X	X								P			P	X	X
Installation of WtE plant equipment (scrubbers, fly ash collectors, etc.)			P	X											P	X	X
Connection with yard conveyor system (SBRC to WtE plant)		P	X	X								P			P	X	X

Table 5.3: Waste to Energy Plant - Project/Environment Interaction Matrix

Key:
X = Presence of project-environment interaction
P = Potential project-environment interaction
Blank = Absence of project-environment interaction

Component	Ground & Surface Water	Soils and Sedimentation	Air Quality and Climate Change	Noise / Vibration	Terrain / Topography	Vegetation	Wetlands	Wildlife and Wildlife Habitat	Migratory Birds	Designated Species	Heritage Features	Archaeological Resources	Land Rights	Land Use	Human Health and Safety	Socio-economic Conditions	Transportation
Installation of pad-mounted transformers and associated electrical equipment, and raw material storage bins, including relevant environmental containment systems	P	P	X	X								P			P	X	X
Well drilling, testing, and connection to on-site buildings via underground distribution system (if required)	X	P	X	X	P							P			P	X	X
Construction of a pond with liner for fire protection demand (if required)	X	P	X	X	X							P			P	X	
Install oil/grit/water separators as required				X											P	X	X
Installation of gravity pipes or force mains with pumps and connect with on-site buildings to the wastewater/leachate management system at the landfill LTP	P	P	X	X								P			P	X	
Construction and installation of substation and related electrical, safety, and communications equipment	P	P	X	X				P	P			P			P	X	
Installation of above ground electrical collection system (private land and public right-of-way, as required) and transmission lines				X				P	P			P			P	X	
Site grading and restoration	P	P	X	X	P			P	P			P			P	X	X
Fuelling of construction equipment	P	P	X	X											P	X	X
Operational Activities																	
Access road and grounds keeping maintenance		P		X		X									P	X	X
Treatment of supply water	P														P	X	
Material transport via a mechanical conveyor system including refuse cranes and feeders				X											P	X	
Drying of waste			X	P											P	X	
Combustion of waste and creation of steam through use of a furnace			X	P		P		P	P						P	X	
Maintenance and replacement of scrubbers, fabric filter bags, particulate collectors			X												P	X	
Operation of fan and exhaust venting			X	P				P	P						P	X	
Monitoring of air emissions															P	X	
Collection of ash (bottom and fly) prior to transportation to an approved disposal facility			X												P	X	
Operation of emergency backup generator during plant maintenance (estimated 1-3 day maintenance)			X	P				P	P						P	X	
General equipment operations and maintenance of WTE plant															P	X	
Chemical storage and refuelling	P	P	X												P	X	
Decommissioning / Closure Activities																	
Temporary lane modifications to public road right-of-ways to facilitate delivery trucks including culvert extension and installation; restore to pre-construction after use has been completed	P	P	X	X	P			P	P						P	X	X
Removal of all construction material, equipment, temporary facilities, access roads, and waste at an approved location	P	P	X	X											P	X	X

Table 5.3: Waste to Energy Plant - Project/Environment Interaction Matrix

Key:
X = Presence of project-environment interaction
P = Potential project-environment interaction
Blank = Absence of project-environment interaction

Component	Ground & Surface Water	Soils and Sedimentation	Air Quality and Climate Change	Noise / Vibration	Terrain / Topography	Vegetation	Wetlands	Wildlife and Wildlife Habitat	Migratory Birds	Designated Species	Heritage Features	Archaeological Resources	Land Rights	Land Use	Human Health and Safety	Socio-economic Conditions	Transportation
Use of stockpiled or imported fill to aid in grading/filling voids left from removal of access roads/equipment and structures	P	P	X	X	X											P	P
Final grading, topsoil, vegetation planting and enhancement plan implementation		P	P	X	X									P	P	X	
Site monitoring and inspection for surface water and erosion control, and mitigation of nuisances															P	X	

Table 5.4: Equipment Maintenance Facility - Project/Environment Interaction Matrix

Key:
X = Presence of project-environment interaction
P = Potential project-environment interaction
Blank = Absence of project-environment interaction

Component	Ground & Surface Water	Soils and Sedimentation	Air Quality and Climate Change	Noise / Vibration	Terrain / Topography	Vegetation	Wetlands	Wildlife and Wildlife Habitat	Migratory Birds	Designated Species	Heritage Features	Archaeological Resources	Land Rights	Land Use	Human Health and Safety	Socio-economic Conditions	Transportation
Construction Activities																	
Site preparation (clearing vegetation, existing material including concrete and asphalt, installation of silt controls, removal and stockpiling of loose materials)	P	P	X	X		X		P	P			P		X	P	X	X
Temporary lane modifications to public road right-of-ways to facilitate delivery trucks including culvert extension and installation; restore to pre-construction after use has been completed	P	P	X	X	P			P	P			P			P	X	X
Construction and maintenance of access roads including culvert installations/modifications (permanent and temporary)	P	P	X	X	P			P	P			P			P	X	X
Construction of drainage improvements and storm water management (permanent and temporary)	X	X	P	X	X							P			P	X	X
Excavation and disposal/stockpiling of excavated materials	P	P	X	X	X							P			P	X	X
Compaction around base and side slope around excavations (below grade)	P	P	X	X								P			P	X	X
Construction of concrete footings and foundations	P	P	X	X	P							P			P	X	X
Construction of administration building (concrete block) and maintenance building (structural steel)	P	P	X	X								P			P	X	X
Installation of fencing and gates and security provisions (as required)		P		P				P	P						P	X	X
Construction of parking areas	P	P	X	X								P			P	X	X
Extension of water line from existing line to buildings	P	P	X	X								P			P	X	X
Construction of sanitary sewer from each building to LTP	P	P	X	X								P			P	X	X
Installation of electrical power				X								P			P	X	
Site grading and restoration	P	P	X	X	P							P			P	X	X