# PRESENTATION TO CARIBBEAN WATER & WASTEWATER CONFERENCE BARBADOS 2016

# WATER AND WASTEWATER MANAGEMENT IN THE CARIBBEAN: COOPERATION FOR ACTION

# MANGROVE POND LANDFILL GREEN ENERGY & LANDFILL BEAUTIFICATION PROGRAMME MANGROVE POND LANDFILL ST. THOMAS, BARBADOS

#### Presenter:

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## **Biography:**

Bill Yokom has been in the Consulting Engineering industry in Canada since 1978. His focus has ranged from Construction Contract Administration to Project Management of projects in a wide range of civil, environmental, and structural focuses. In 1999, Bill was appointed to the position of General Manager of R.J. Burnside & Associates Ltd., the parent company of R.J. Burnside International Limited, a position he maintained through 2007.

Since 2002 Bill has been involved in the construction of landfill Cell 3 at Mangrove Pond, the follow up work at Greenland, and now several major projects at Mangrove Pond including landfill Cell 4, a Leachate Treatment Plant, an Administration Building, and now the Mangrove Pond Landfill Green Energy & Landfill Beautification Programme.

# **Background**

In 2009, the new (and current) Government of Barbados abandoned the controversial Greenland Landfill Site, located in the parish of St. Andrew, and instead made a commitment to modernise the planning, design and operations of the existing waste disposal facility at the Mangrove Pond landfill in the parish of St. Thomas. At the time, the decision was somewhat controversial, given the quantum of funds that had been spent there over two efforts; however the logic behind the decision was sound.

The SSA had filled and thence abandoned Mangrove Pond Landfill Cell 1 in 1992. As of 2009, Cell 2 and the attached Cell 3 had been receiving waste at the rate of approximately 1000 tons per day and the pile just kept growing. The previous administration had entered into an arrangement with a local company called Sustainable Barbados Recycling Centre Limited, who undertook some diversion of the waste stream; however significant portions of waste continued to be disposed of at the landfill.

In 2009, Government recognised the unsustainability of the present planning and operational practices, and instead devoted its efforts to the commencement of a more sustainable plan. That year, Burnside was employed to assist Government with the following projects:

**Cell 4 Landfill** – A new landfill was to be designed and constructed to ease the pressure off of the existing landfill Cells 2 & 3. The new landfill was to be constructed in a 130 ft deep quarry which was immediately adjacent to Cells 2 & 3. The new landfill was to be designed with state of the art lining systems to protect the environment – especially the valuable groundwater table. This landfill was designed and constructed between 2011 and 2012, and put into service in 2012.

**A Leachate Treatment Plant** – Leachate is the liquid by-product of a landfill operation. By its nature, it is a highly toxic witches brew of chemical, heavy metals, and organics which have the potential of being a very serious pollutant to the groundwater, which is the major source of drinking water to Barbadians and their visitors. Government is presently in its final steps of procuring a contractor to deal with this problem material.

**A Waste to Energy Plant** – This was the initial effort in procuring a developer to partner with Government in the development of a Waste to Energy Plant. This component of the greater project has since been transferred to the Green Energy Programme and will be discussed below.

An Administration Building for the Sanitation Service Authority – In order to properly manage a complex solid waste centre, the centralisation of the Sanitation Service Authority in one location will be an advantage. Government is presently in its final steps of procuring a contractor to construct such a facility.

# The Mangrove Pond Landfill Green Energy & Landfill Beautification Programme

In 2011, the western world was showing signs of crawling out of one of the worst recessions since the 1930's. The price of oil, which had peaked in 2007 at about US \$140 per barrel, had dropped to an average of US \$84.

As a small island state without a major oil deposit, Barbados is highly reliant on the importation of oil for the generation of electricity as well as for fueling its vehicles etc.

The purchase of fossil fuels had created serious challenges to Government in its need to balance their annual budget. That cost was creeping up to and eventually beyond important social programmes such as health and education.

Although the price of oil has since crashed, there is a likelihood of a high price in the future, reestablishing the economic viability of this project. Further, since this project significantly reduces Barbados' dependence on fossil fuels, it contributes toward greater environmental stewardship. In fact, the projects discussed herein as a major component of the commitment made by Barbados to the Paris Climate Change Accord from December 2015.

In the meantime, 1000 tons of waste was being disposed of daily at Mangrove Pond, and that volume had been steadily increasing over the past 20 years or more. Furthermore, the landfill cells were emitting greenhouse gases, contributing to global warming; another issue that puts Barbados and other small island states at risk.

There were many other factors such as land availability and cost of landfilling which pointed to a need to reverse the previous direction in handling solid waste. Hence arose the introduction of the Mangrove Pond Landfill Green Energy & Landfill Beautification Programme.

## The Three Pillars of Sustainable Development

The Green Energy Programme has been developed on the basis of the Three Pillars of Sustainable Development. By ensuring that the country receives economic, environmental, and social benefits; by ensuring that the Developer receives a fair return for his investment; and by ensuring that the existing utility is not negatively impacted so that it may continue to be able to work with a profitable margin, then there should be little reason to reject the concept of this project.

The three pillars will be referenced at many times during this presentation.

# Landfill Gas to Energy

The waste composition of the Mangrove Pond Landfill includes highly organic component. Greenhouse gases are created as a result of the decomposition of these organic wastes. Currently those gases permeate into the atmosphere throughout the entire site. The landfill gases can be captured and converted to electricity or perhaps to a biofuel.

In order to achieve this, vertical wells are installed within the existing landfill cells and connected to a horizontal piping grid. Suction pumps draw the gases to a central collection point where they will be converted as noted, but likely to electricity.

In addition to the above, following the installation of the piping infrastructure, a clay cover will be applied to the entire site. In addition to minimising the infiltration of rainwater which may become leachate, this cover will help contain the gases so that they may be captured and do not escape into the atmosphere.

Preliminary estimates are that 3.6 MW of base load power can be generated in this manner. This will generate an estimated annual revenue of BDS \$13.3M or US \$6.65M, and we are proposing that Government, as the entity which owns the land and provides the resource (garbage), can assume a share of the profit generated out of the revenue. This "profit sharing" may take the form of a land lease, royalty, or actual profit sharing but the net result should be a positive cash flow.

In addition to the profit sharing that Government will gain, there will be a reduced need to import oil for that portion of the electrical generation. Approximately 15,500 fewer barrels of oil will be needed for this component of the project.

If and as the economy in Europe returns to normal, then the sale of carbon credits are another potential revenue stream. Although the financial model does not rely on this revenue to validate the project, the potential must be continually monitored.

We have estimated that this component will generate 38 man years of employment during the construction phase, and 12 new, fulltime jobs for operations.

# **Electrical Power from a Solar Farm**

Barbados has slightly in excess of 3,000 hours of sunlight annually. If solar panels are placed on approximately 50% of the area of Cells 1, 2 and 3, then an estimated 5.5 MW of power can be produced. Although classified as transient power, this can be offered to the national utility company during daytime hours when daily demands are at their highest.

In order to achieve this, it is intended to use solar panels with specially designed foundations to address differential settlement caused by the degradation of the waste over time. These would be installed above the landfill gas collection system and the cover. A tarp style of solar collectors may be considered however at this stage in their development, they are considered to be too inefficient for practical application at this time in Barbados.

Preliminary estimates are that 5.5 MW of transient power can be generated in this manner for 10 hours per day. This will generate an estimated annual revenue of BDS \$7.6M or US \$3.8M, and again we are proposing that Government, as the entity which owns the land, can assume a share of the profit generated out of the revenue. This "profit sharing" may take the form of a land lease, royalty, or actual profit sharing but the net result should be a positive cash flow.

In addition to the profit sharing that Government will gain, there will be a reduced need to import oil for that portion of the electrical generation. Approximately 1,900 fewer barrels of oil per year will be diverted for this component of the project.

We have estimated that this component will generate 120 man years of employment during the construction phase, and 8 new, fulltime jobs during operations.

## **Electrical Power from Wind Turbines**

While solar panels are very light from a structural perspective, wind turbines cannot be installed on top of unstable grounds offered by a landfill. However, the Mangrove Pond Landfill area offers adequate areas to allow for the siting of approximately six 1.0 MW wind turbines, which will allow the site to contribute a net of 5.25 MW of transient power into the national grid.

This aspect of the project will require a wind study which will take at least one full year. As such, it is anticipated that the wind turbines will be put into service in early 2016.

This component of the project will generate an estimated annual revenue of BDS \$19.5M or US \$9.8M, and again we are proposing that Government, as the entity which owns the land, can assume a share of the profit generated out of the revenue. This "profit sharing" may take the form of a land lease, royalty, or actual profit sharing but the net result should be a positive cash flow.

In addition to the profit sharing that Government will gain, there will be a reduced need to import oil for that portion of the electrical generation. Approximately, 14,000 fewer barrels of oil will be needed annually for this component of the project.

We have estimated that this component will generate 16 man years of employment during the construction phase and 6 new, fulltime jobs thereafter.

# The Waste to Energy Plant

The Waste to Energy Plant is the jewel of the Mangrove Pond Landfill Green Energy & Landfill Beautification Programme. The current conceptual planning shows the WTE plant being based on incineration, although it is possible that it may end up being undertaken through anaerobic digestion.

The Waste to Energy Plant will operate on a 24 / 7 basis. Preliminary estimates indicate that the WTE plant can offer 14 MW of base load electricity to the grid. The estimated annual revenue generated through this project is BDS \$47M or US \$23.5M. The total estimated capital cost of the plant is presently US \$145 million, and it is anticipated that it will be put into service by the end of 2017. Again we are proposing that Government, as the entity which owns the land and the entity that collects the waste and delivers it to the facility, can assume a share of the profit generated out of the revenue.

The WTE will offer direct financial benefits primarily through sale of electricity. In addition to the profit sharing that Government will gain, there will be a reduced need to import oil for that portion of the electrical generation. Approximately 54,000 fewer barrels of oil will be needed for this component of the project.

As noted above, other benefits will include the extended life of the landfill. The new landfill will be full in ten years at the current rate of filling. For every year that the landfill is not required to receive the waste in its untreated form, the life of the cell can increase by 8 to 10 years. Since the cost of the construction of a new landfill is estimated to be approximately BDS \$3.0M annually, the savings could be very significant.

Waste heat which may otherwise be vented into the atmosphere will be captured and through thermal inversion technology, that could be utilised to air condition the new, nearby SSA Administration Building, offering a savings estimated to be \$2.0 M annually.

Lastly, if the incineration option is selected, the WTE will be able to assist Government in disposing of some problem wastes such as tyres, unrecyclable plastics, and some hazardous wastes.

We have estimated that this component will generate 48 new, fulltime jobs as well as many hundreds of man years of employment during the construction phase.

## A New Mechanical Workshop for SSA Fleet & Equipment

This project is to be affiliated with the Waste to Energy Plant, so that Government revenues gained from the Green Energy facilities can offset the cost of a new, centralised Mechanical Workshop for the SSA fleet.

Presently, the SSA maintains its fleet in a workshop in Wildey, in the parish of St. Michael. The present facility was constructed in 1982, and badly needs to be replaced or updated. Service equipment is often broken down or inappropriate for today's modern vehicles. As such, fleet servicing is often a challenge, and not completed in its entirety which in turn compromises the life and functionality of the equipment.

The new workshop is expected to be 16 bays each of which would be constructed to an appropriate size to handle both today's fleet and fleet forecast within the foreseeable future. Modern management of assets will be included such as in appropriately

scheduled maintenance of each piece of equipment and stores with inventory control for tools and parts. Wash bays will also be included and wash waters will be collected and sent to the leachate plant for wastewater treatment.

Once in service, the existing facility will be demolished and lands will undergo an environmental clean-up. Upon completion of that effort, the lands may be used for housing or other purpose deemed appropriate by Government.

## Human Resource Development

A significant benefit of this project is the creation of an estimated 80 full time private sector jobs. These project components will have needs for both unskilled and skilled labour.

## Power Purchase Agreement

Nothing within this project as envisioned can be undertaken without a Power Purchase Agreement. The PPA once executed will ensure that power produced will be purchased by the national private sector utility company.

The PPA will ultimately be one of the two main contracts which will exist between the project developer, Government, and the national utility. It will include not only the sale of the electricity generated, but also quality of power and the daily schedule for delivery.

# **Current Status of Project**

The current planning is at a conceptual basis, and applications for permission to develop this project on the site have been undertaken on that basis. Requests for Expressions of Interest have been called and short-listing of prospective developers is being undertaken. This is expected to be confirmed very soon.

Environmental Impact Assessments are well underway. Presently social, environmental, and scientific data are being collected, and shortly thereafter, public consultations will commence. It is expected that the commencement of construction will begin in mid-2014 with the Landfill Gas to Energy Project.

# **Questions**