

**ADDENDUM TO EIA FOR THE PROPOSED NATURE
TOURISM THEME PARK
WHITE RIVER, ST. MARY**

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Table of Contents

1.0 Introduction5

2.0 Water Quality Tests.....5

3.0 Engineering Designs for the Water Features6

4.0 Ponds to west of the JPS Woodstave Pipe.....7

 4.1 Description of the area.....7

 4.2 Conclusion.....12

5.0 Maintenance of JPS Woodstave Pipeline.....12

6.0 Alternative Methods to Supply Water.....17

 6.1 Leaking JPS Woodstave Pipe17

 6.2 Water from the river17

 6.3 Rain fall runoff from the surrounding hills19

 6.4 NWC Option for water supply for the lake20

 6.5 Conclusion.....20

7.0 Details of the Floating Restaurant20

8.0 Water Treatment.....21

9.0 Aquatic Survey23

10.0 Vector Control.....23

11.0 Drainage Plan.....23

 11.1 History of Natural Ponds at Rivva Riddim24

 11.2 Lake/pond.....26

 11.3 Flood Management30

12.0 Irrigated Soil Permeability30

13.0 Project Phasing30

 13.1 Zip Lines.....34

14.0 Education Focus.....36

Tables

Table 1: Water flowing from leaking pipe to ponds at the Rivva Riddim Property26

Figures

Figure 1: Water Quality Monitoring Points	5
Figure 2: Average Monthly High and Low Temperatures and Average Monthly Rainfall – Ocho Rios	7
Figure 3: Picture taken from southern hills showing possible rain water runoff capture area.....	8
Figure 4: Examples of Swales cut at the base of Hillsides	8
Figure 5: Schematic showing Hillside Drain and Reservoir	9
Figure 6: AutoCAD Topographic drawing of the project area showing natural water flow in drainage plan.....	10
Figure 7: Typical Installation of Pond Liner.....	11
Figure 8: Schematic of the Rainwater Harvesting System	11
Figure 9: Picture of the Woodstave Pipeline at White River.....	12
Figure 10: Components of a Woodstave Pipe.....	13
Figure 11: JPS Head Pond's proximity to the Rivva Riddim Property	14
Figure 12: Woodstave Pipeline running through the Rivva Riddim Property	15
Figure 13: Valve on JPS Woodstave pipe for the Rivva Riddim Property	15
Figure 14: Location of valve on JPS woodstave pipe (overgrown with bush) on Rivva Riddim Property	16
Figure 15: Leaking Woodstave Pipeline	16
Figure 16: Water level in the White River adjacent to the Rivva Riddim Property when the HPP is in operation	18
Figure 17: White River adjacent to River Riddim Property when the HPP is not in operation	18
Figure 18: Typical Floating Restaurant	21
Figure 19: Thetford Portable Toilet Units	21
Figure 20: Water Ionization Equipment.....	22
Figure 21: Mosquito Fish.....	23
Figure 22: 2010 picture of tick infested cows with the property in ruins	24
Figure 23: Lush Green Vegetation at the Rivva Riddim Property	25
Figure 24: Water fall resulting from the leaking woodstave pipe	25
Figure 25: Drainage Channel.....	27
Figure 26: Area cleared with backhoe	28
Figure 27: Cleared area filled with water from leaking JPS woodstave pipe	28
Figure 28: Soil Sampling Points	30
Figure 29: Typical Kayak	32
Figure 30: Typical Floating Restaurant	32
Figure 31: Typical Hillside Water Slide.....	33
Figure 32: Pool for Multiple Recreational Purposes.....	33
Figure 33: Hillside Slides.....	34
Figure 34: Typical Zip Line	35
Figure 35: Zip Line Cable Configuration	36

Figure 36: Typical Solar Boating by University Students in the Netherlands with 2KW of panels seen on boat.....37

Figure 37: High school Students in California in a 2 panel boat with one student.....38

Figure 38: Inner city children learning how to build wind 200W wind generator from a steel drum at Caribbean Maritime Institute38

Appendices

Appendix 1: Water Quality Results – White River in the vicinity of the Proposed Park.....40

Appendix 2: Maps and Diagrams of Proposed Property.....42

Appendix 3: Hill Betty Irrigated Soils Report.....51

ADDENDUM TO EIA FOR THE PROPOSED NATURE TOURISM THEME PARK WHITE RIVER, ST. MARY

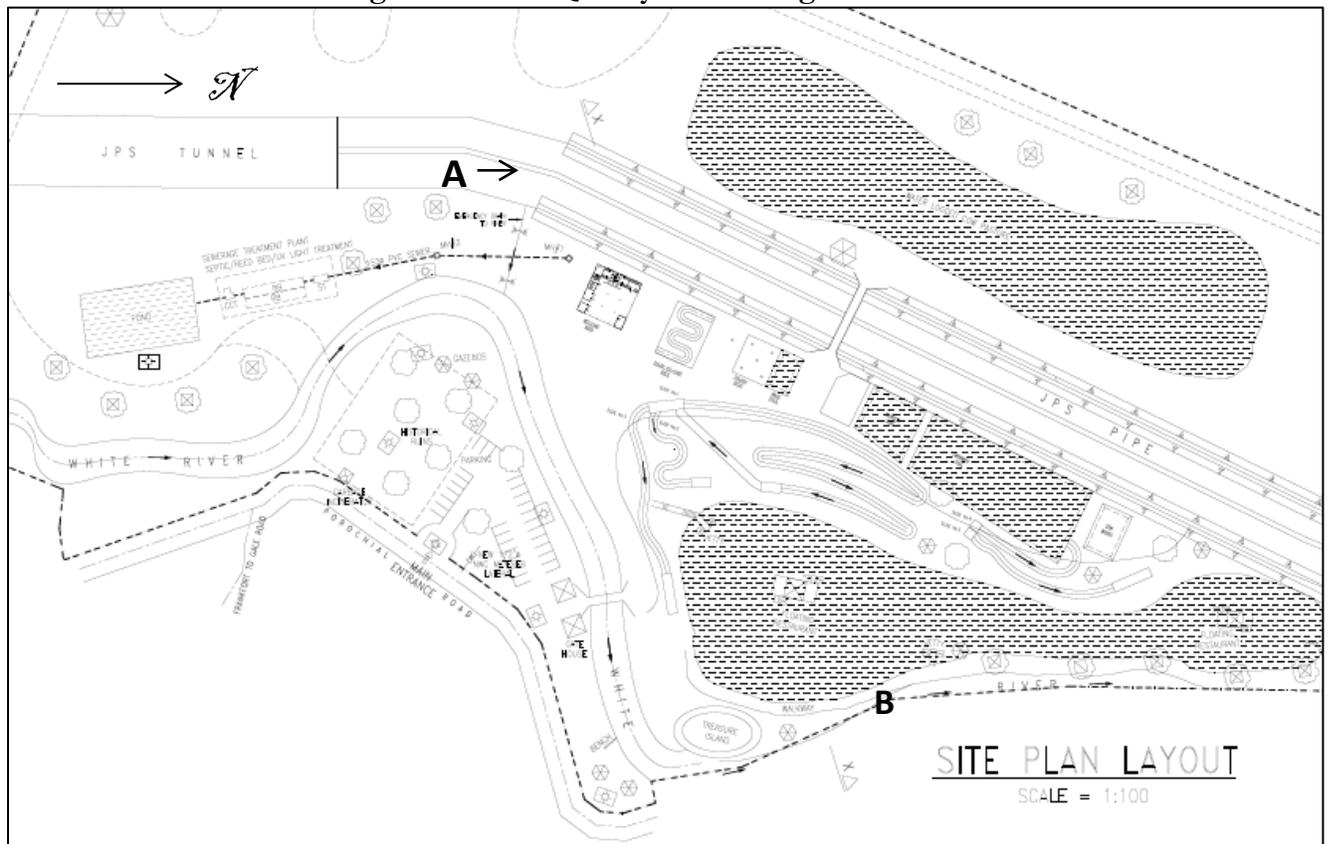
1.0 Introduction

This Addendum addresses questions from the National Environment and Planning Agency (NEPA) in correspondence dated September 25, 2012.

2.0 Water Quality Tests

The results of water quality tests done at points A and B in the vicinity of the proposed park are presented in **Appendix 1**. Sample point A is water collected from the JPS woodstave pipe while sample point B is directly from the White River. The samples points are shown on Figure 1.

Figure 1: Water Quality Monitoring Points



Source: Rivva Riddim

3.0 Engineering Designs for the Water Features

The water features at the Park include:

- a. Recreational pool
- b. Freshwater lake

The engineering designs for these features are included at Appendix 2 and provided as large scale maps separately.

Water features for the park are the backbone of the attractions. They comprise a fresh water recreational pool of approximately half hectare (0.5 ha) of water surface area to allow water activities such as water seesaw, floating chair and water volley ball at the same time. It is designed as a pond with sloping edges and will be decorated to give that impression. The engineering of the pond is based on the excavation of 0.5 metres of soil and using the spoil to create the berms. A 20 gage pond liner will be installed on the compacted earth. Berms are compacted in 150 mm layers. It is designed to allow for swimming only therefore the water level is to be maintained at 1.5 metres. (See diagram at Appendix 2). Other features include:

- Water purification will be achieved using two water doctor ionization units (See Section 8.0 on water purification).
- A 2 m³ sand filter will be used to remove body solids and atmospheric dust.
- Two 2Hp low pressure solar powered pumps will circulate water.
- A 200mm overflow pipe placed at the northern end will remove overflow water due to rainfall the water will flow to the lower lake.
- Make up water will be supplied by the JPS woodstave pipe under the Riparian rights arrangements with them.

The lakes will comprise two 1.5 hectare ponds, 1.5 metres average depth. Both lakes/ponds will be lined with 20 gage pvc pond liners. Both ponds are situated on the slightly depressed areas of the property where water has traditionally settled. The upper pond will need a berm on the north eastern end. A rainwater catchment system using swales on the hillside to catch runoff will provide water for the upper pond. A 1.5 metre overflow will be used to manage adverse weather.

Water slides will be erected on the natural slope of the hillside, running on the ground between trees and ending up in a small pool at the bottom of the slide. The slides will be constructed 3,000 psi concrete and reinforced with 126 steel matting. A circular raised edge will run along the length of the slide to prevent external objects from entering the slide. The concrete will be treated with a resin and finished with a coating of water slide spray paint. The slide pond is made in a similar way. (See diagrams at Appendix 2) Water will be pumped by a 1KW solar pump from the slide pool to the top of the slide. A similar water purification system for the pools will be used for the water slides.

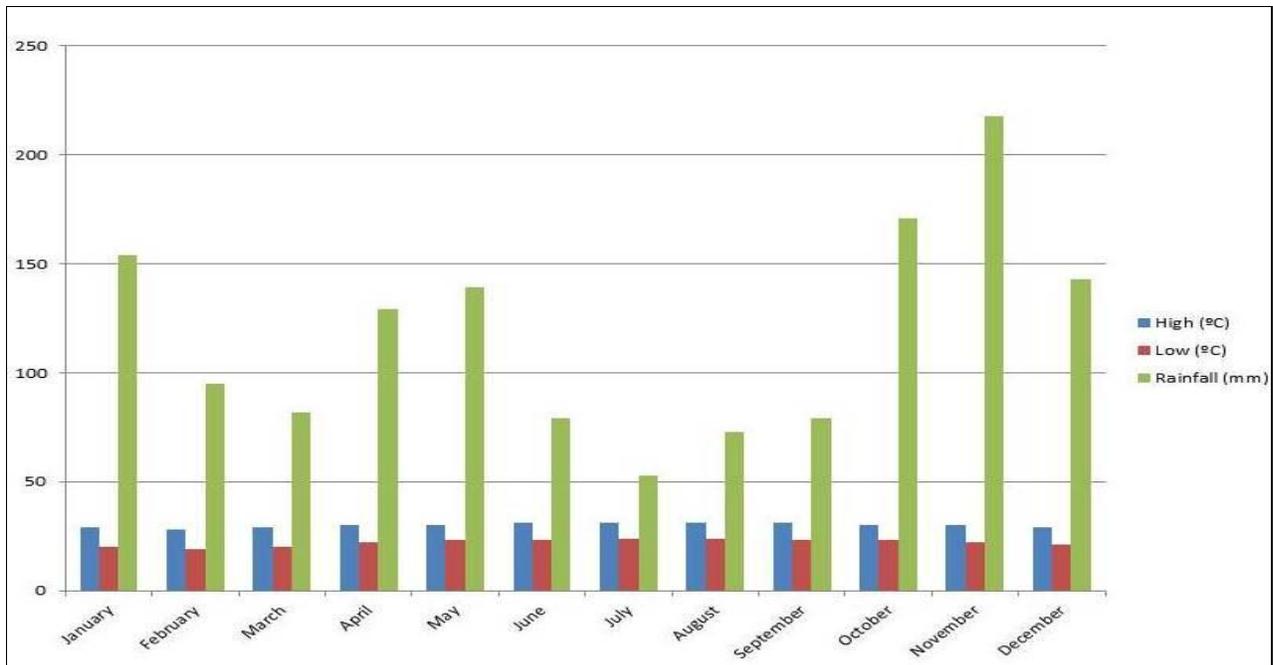
Water splash and spray deck will be a 15 m x 30 m concrete slab with pipes projecting from it. The pipes are connected to nozzles that are used to spray water. Participants spray water on each other. Water is pumped by a 1,000 W solar driven pump. Water runs back to a shallow pool in which the children play. A similar water purification system for the pools will be used for the water splash and spray deck.

4.0 Ponds to west of the JPS Woodstave Pipe

4.1 Description of the area

There are two main areas (previously cow feed lots) where water settles naturally on the property with one to the east and the other to the west of the JPS pipe (Refer to the Site Plan at Appendix 2). Both areas are approximately 1.5 hectares. Both areas are saturated by runoff from the JPS pipe but the eastern area is much lower than the pipe therefore much more water flows to it. The western area is also fed by rainfall runoff mainly from the gently sloping southern hills which were used as feed lots for cows and where informal settlers have been farming on the plateau on top of the hill. The western and northern hills supply less water. Since cattle farming ceased, scrub has taken over much of the grassed areas and cattle ticks and mosquitoes are prevalent. The slopes are very stable and resistant to erosion. The western and northern hills are steeper and stonier but are also stable. The approximately five hectare (5 ha) natural catchment is calculated to pick up about 120 million litres of rain water most years. This represents about 70% during the rainy season. (Refer to Figure 2).

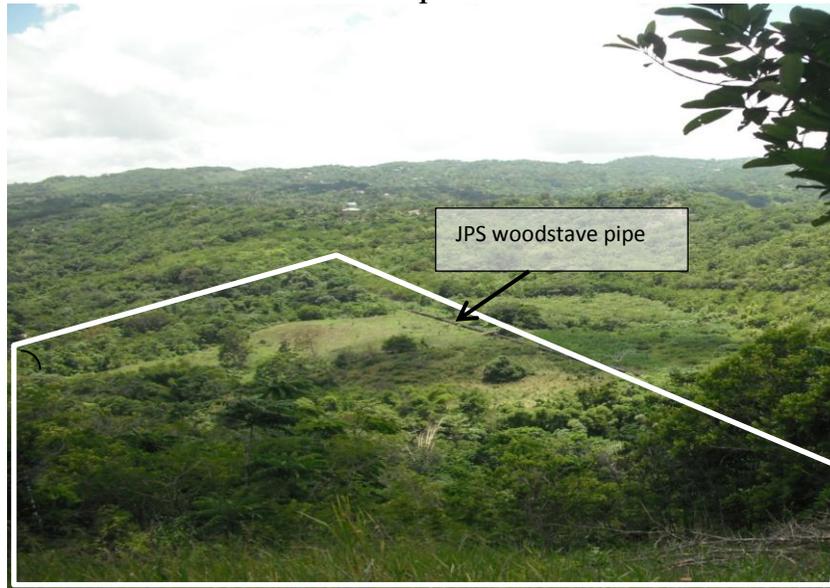
Figure 2: Average Monthly High and Low Temperatures and Average Monthly Rainfall – Ocho Rios



Source: <http://www.jaweather.com/ocho-rios.html>

The total area of the slope that could drain water to the depression west of the JPS woodstave pipe is five hectares (5 ha). A study of the foothills of the property located the runoff streams coming from the hills.

Figure 3: Picture taken from southern hills showing possible rain water runoff capture area



Source: Rivva Riddim

In Figure 3 the JPS pipe runs diagonally across the property. Additionally the flat area adjacent to pipe is approximately four hectares (4 ha) on the flat

Rain water runs off the hills via natural contour canals and the naturally sloping areas on the hillside. A swale is to be cut across the foot of the hill to catch all water descending from the slope.

Figure 4: Examples of Swales cut at the base of Hillsides

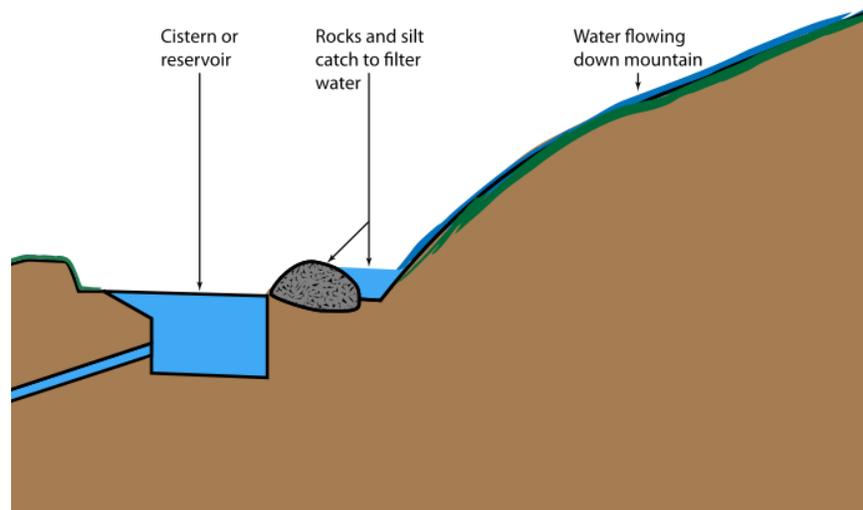


Sources: http://farm3.static.flickr.com/2283/3703683767_447c3c2fb1.jpg?v=0 and <http://www.parmeleegeology.com/slope%20drain.JPG>

These channels run near horizontally at a shallow angle (Figure 4 and Figure 5) and water caught is conveyed to a stone filter where debris and stones are strained and manually

removed. Muddy water is stored in temporary reservoirs where it is held for 24 hours after rainfall ceases to allow sediments to settle. Clear water above the sediments is passed through a sand filter before the water gets to the western lake (Figure 5). This is proposed for the base of the hills south, west and north of the proposed lake.

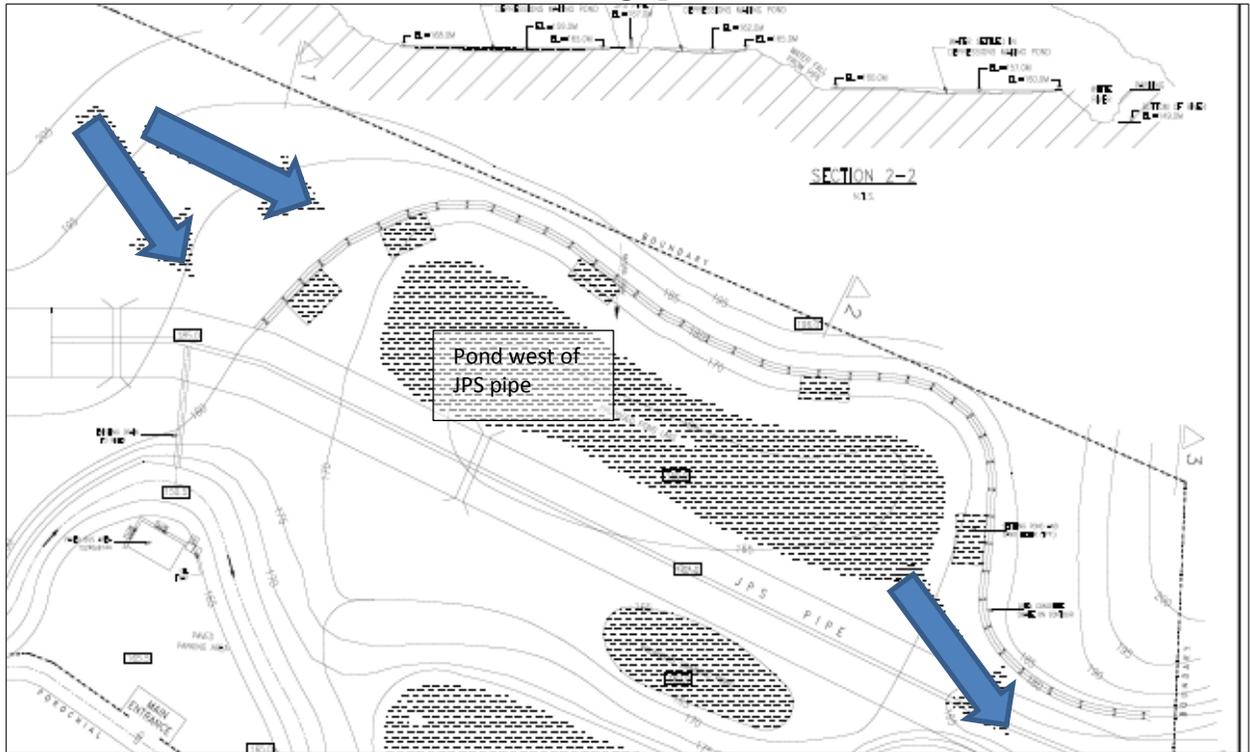
Figure 5: Schematic showing Hillside Drain and Reservoir



Source: http://mc5360.rotaryglobal.net/p/blog/78/Rainwater_harvesting/

The flat areas slope gently northwards with many small dips which trap water. The flat areas will be prepared by removing grass and small trees and building a berm to the northeast where it is appropriate. The south eastern and western areas slope positively and need no berm. The lake/pond, approximately 1.5 hectares, will be lined with pvc liner. Based on spot levels it will be 3.3 metres deep at the lowest point and have an average depth of 1.5 metres. No major earth movement will be needed to achieve this.

Figure 6: AutoCAD Topographic drawing of the project area showing natural water flow in drainage plan



Source: Rivva Riddim

Figure 6 shows drainage to the pond west of the JPS woodstave pipe. A larger map showing the Drainage plan is provided separately.

A pond liner will be employed to fully seal the base to keep all the water captured for temporary storage ponds and the main pond. Figure 7 shows the typical installation of a pond liner.

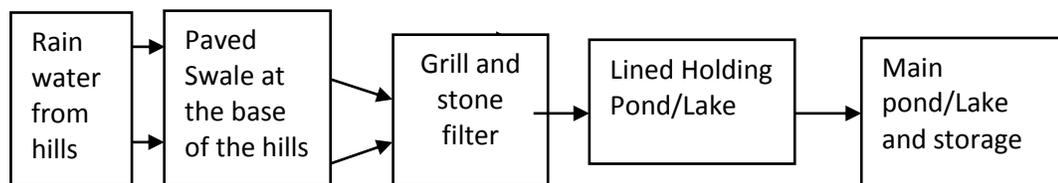
Figure 7: Typical Installation of Pond Liner



Source: <http://www.geocheminc.com/hdpealloy.htm>

The engineering necessary to operate this simple three stage rainwater purification system will be put in place to obtain the maximum water possible without erosion. Mosquito fish (Figure 21) will be added to the residual water in the preliminary and secondary ponds/lakes for vector control. Several preliminary ponds may be necessary to pick up water from the various naturally forming run off streams and swales. While rainfall calculations show that one hundred and twenty million litres (120 ML) of water could come from rain in the hills per annum, only the streams successfully tapped will determine the final efficiency.

Figure 8: Schematic of the Rainwater Harvesting System



Source: Rivva Riddim

If only twenty per cent (20%) of rainfall is captured, about twenty four million litres (24 ML) would be available for this purpose. This is the capacity of the lake/pond. If eighty thousand litres (80,000 L) of water is needed per day, the storage system would be sufficient to support the lower lake/pond. If 100 days of support is required eight million litres (8 ML) of water would be necessary. Since the western pond can obtain water from the catchment system during the low rainfall periods, it could sustain itself and the lower pond during this period.

A 50mm water pipe will link both ponds and feed the lower pond (east of the JPS woodstave pipe) by gravity.

4.2 Conclusion

The western depression of the property is overgrown because it has ceased to be pasture land. Cattle ticks are still prevalent there as they can live for years without blood. Scrubs and small trees block the sun and have promoted serious mosquito breeding as water from the pipe and run off water from the hills create ponding which facilitates and promotes breeding. The pond on the eastern property is vulnerable to the water supply from the woodstave pipe.

A pond of similar size built on the western side of the property fed mainly by rainwater runoff from the hills and stocked with fish from the river would:

- a. Become the best method permanent of vector control.
- b. Become the additional 1.5 hectares to fulfil the recreation plans.
- c. Kill the ticks remaining as the grass and shrubs on which they live would be covered.
- d. Help keep the lower pond full during dry times.

5.0 Maintenance of JPS Woodstave Pipeline

Woodstave pipes have been used for thousands of years and are still used today. They are in use in New York and Washington in the USA and several areas throughout Europe. They are gradually being replaced mainly because of their severe propensity to leak and unsightly appearance.

Figure 9: Picture of the Woodstave Pipeline at White River

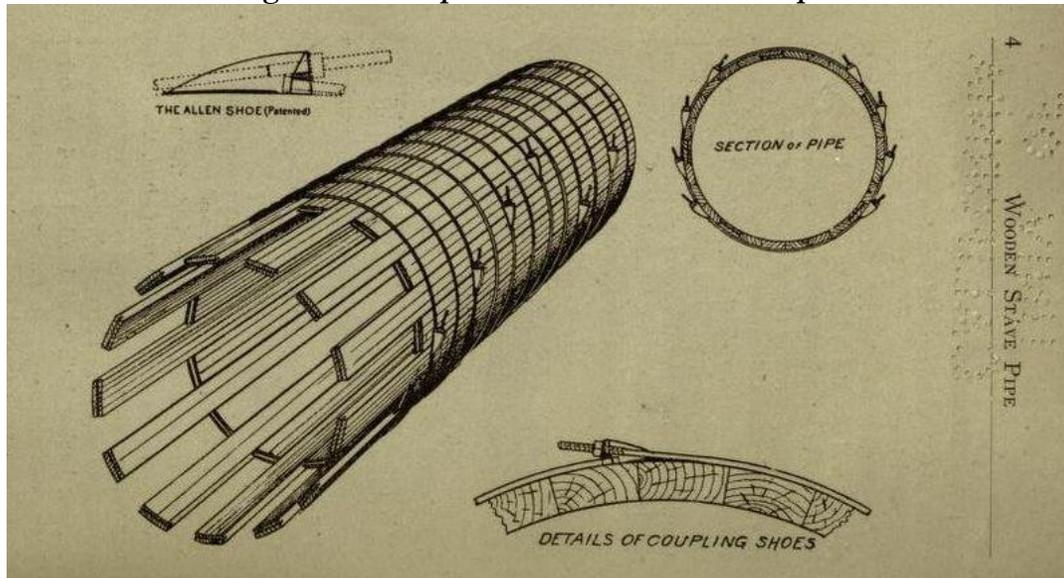


Source: Rivva Riddim

These woodstave pipes are made from planks of wood precisely shaped to fit together to make the required diameter of the pipe. They are assembled like a barrel and strapped together with circular steel clamps. They are assembled in the field from stacks of wood in a circle within steel clamps. The steel clamps are tightened to hold the planks of wood together (Refer to Figure 10).

While they are extremely strong, they generally leak as there are no sealants used in their construction. They are frequently maintained but still leak about 1-3% of their throughput; this has happened as a normal occurrence over the years. Based upon data gathered from the Rivva Riddim site over the past two (2) years (Table 1), an average of 1.5 million gallons (6M L) of water leaks onto the one (1) kilometre (long) property per day. The pipe is approximately six feet (1.9m) in diameter and is calculated to transmit approximately 350,000m³/day. Leaks range from 75,000 gallons to 3.5 million gallons (3-23M L) per day on the property depending on the state of the pipe.

Figure 10: Components of a Woodstave Pipe



Source: <http://www.notechmagazine.com/pipelines/>

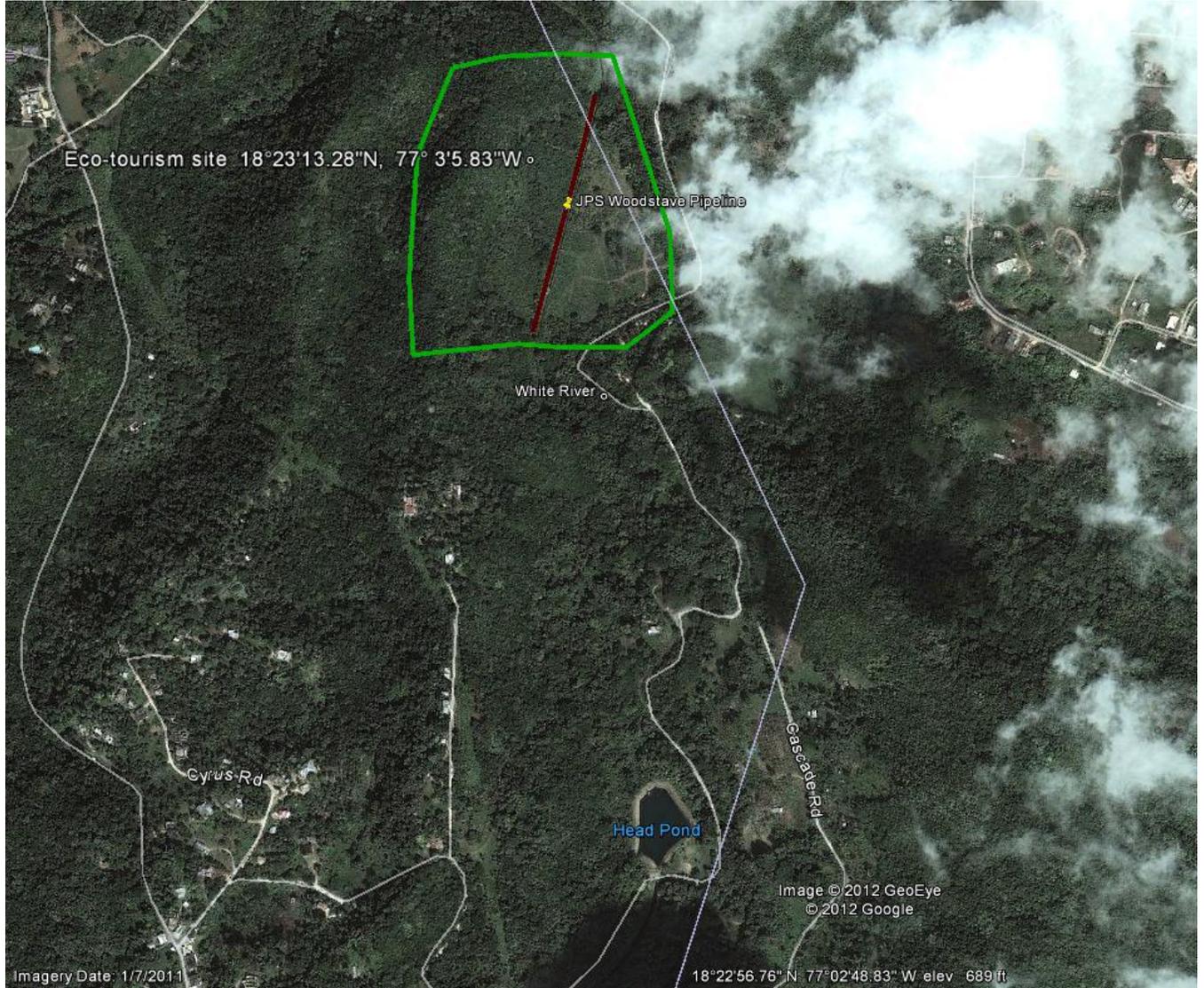
The JPS woodstave pipe was installed in 1943 to convey water from a head pond (Figure 11) fed by the White River to transport water to the JPS Lower White River Hydropower station. A “way leave” seventy feet (70 ft.) wide running through each property on the way to the station was agreed on with landowners.

The Rivva Riddim property is separated from the JPS head pond that feeds the woodstave pipe by a hill about a thousand feet (1,000 ft.) wide and about two hundred feet (200 ft.) high. The pipe runs through a tunnel to the property which is about the same level as the base of the JPS head pond which is about 35 feet (10m) deep. The water pressure there is low, about 20 psi (1.5Bar) compared to the Lower White River Hydropower station (4 km downstream) where it is about ten times higher.

From the head pond, the pipe travels via a half kilometre (0.5km) tunnel to the Rivva Riddim property and emerges about a hundred metres (100m) from the northern property boundary.

Approximately one kilometre (1km) of pipe, 1.9 metres in diameter, passes through the Rivva Riddim property conveying approximately 350,000 m³ of water per day.

Figure 11: JPS Head Pond's proximity to the Rivva Riddim Property



Source: Google Earth 2012

Figure 12: Woodstave Pipeline running through the Rivva Riddim Property



Source: Rivva Riddim

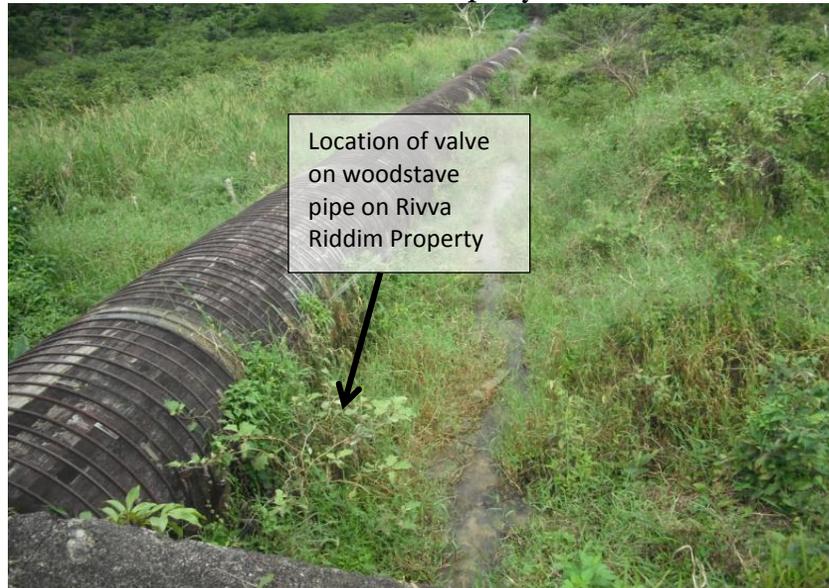
JPS abstracts water from the river which also runs through the property. It is understood that as a part of the compensation for running their woodstave pipe through the properties of landowners that they would provide water connections to the pipe for each landowner for use within their property. Valves were installed on the woodstave pipe based on owners needs as a part of the Riparian rights. The documents alluding to the Riparian rights of landowners are maintained by the JPS Legal Department. There is a valve on the pipe property which may be used if needed (Figure 13 and Figure 14).

Figure 13: Valve on JPS Woodstave pipe for the Rivva Riddim Property



Source: Rivva Riddim

Figure 14: Location of valve on JPS woodstave pipe (overgrown with bush) on Rivva Riddim Property



Source: Rivva Riddim

The most significant feature of the pipe on the properties is the almost continuous spray of water from seams in the pipe where the woodstaves are joined. Millions of gallons of water are lost over the four kilometre (4km) journey to the power station (Figure 15). While farmers have historically benefitted from irrigation water as a result of the leaking pipeline it has also caused ponding of water leading to the breeding of mosquitoes.

Figure 15: Leaking Woodstave Pipeline



Source: Rivva Riddim

6.0 Alternative Methods to Supply Water

Three (3) options are possible for supplying the water features of the park with water.

- a. Leaking JPS woodstave pipe
- b. Water from the White River
- c. Rainfall runoff from the surrounding hills

6.1 Leaking JPS Woodstave Pipe

As the ponds are well above the river they are kept full by the water leaking from the woodstave penstock. The leaks have been a constant feature over the past 70 years where millions of gallons of water are lost per kilometre. Other woodstave pipes in Jamaica have already been replaced and work to replace the JPS woodstave pipe at Maggoty is about to commence. It is expected that the woodstave pipe will eventually be replaced even though the terrain it traverses is far more precarious and would likely result in some damage to the flora.

A study of the legal arrangements in which the utility companies gained access to private properties to lay the pipe is being perused. While the title does not show any special mention of the terms of the “way leave”, the past owners mentioned special “Riparian rights” given to them when the purchase of the strip of land and the removal of water from the river was negotiated possibly eighty (80) years ago. It is therefore very likely that if the pipeline is replaced with a leak proof pipe, JPS will either continue to allow enough water to operate Rivva Riddim from a more efficient pipeline or make arrangements to pump some of the water remaining in the river to the ponds.

If JPS installs a leak proof pipe the Park would install a liner under the pond so the water requirement would be reduced by about 95% as only losses due to evaporation would occur. This is less than 90,000 litres per day.

6.2 Water from the river

The JPS has taken in approximately 90 % of the water from the White River before it flows through the Rivva Riddim property. Only about 8 million gallons (33 ML) of water flows in the river as it passes through the property. Figure 16 shows a picture of the White River adjacent to the Riva Riddim Property when JPS pipe is in operation.

Figure 16: Water level in the White River adjacent to the Rivva Riddim Property when the HPP is in operation



Source: Rivva Riddim

The water is usually less than knee high in most places and flows in a laminar manner. Several small springs are also observed near the edge of the water. When no water is taken out by JPS, it is chest high and very swift.

Figure 17: White River adjacent to River Riddim Property when the HPP is not in operation



Source: Rivva Riddim

Figure 17 shows the speed of the river (about $4\text{m}^3/\text{s}$) when JPS pipe is out of service.

The river runs over one kilometre (1km) through and beside the property. The lower pond is eight meters (8m) higher than the river. A small pump could therefore lift the water from the river to the lower lake (pond) on the property to replace losses due to evaporation and maintenance. As the Park owners are committed to solar power, an appropriate solar driven pump would be used.

The three hectares (3ha) of lake are naturally sealed by clay type soils at the bottom of the ponds thus minimizing seepage. Since the amount of water that comes from the woodstave pipe is in excess of the seepage and evaporation combined, seepage is not of much material value. If water from the woodstave pipe is unavailable, methods of retaining the water captured become critical. A pond liner would therefore be employed to remove the possibility of seepage. Only evaporation would take place which would be 2-6mm per day (64,000 - 180,000 L). Rainfall would cover almost all water needs except during dry times when the levels would fall faster. The rainfall chart at Figure 2 shows that at least half the year there will be enough rainfall to keep the ponds filled while during the remaining months rainfall will supply on average one half of the evaporation requirements.

An abstraction licence from the Water Resources Authority (WRA) would have to be obtained before the water from the river could be used if this option is pursued.

In summary, this second option would be to obtain approximately 90,000 litres of water from the river per day for 3 months (June to August) of the year when rainfall alone is not sufficient.

6.3 Rain fall runoff from the surrounding hills

Managing water resources available is a critical part of a park requiring water to operate. As mentioned earlier the western depression in the property is surrounded by hills on three sides (Figure 3). The total area of the slope that could drain water to that area is five hectares (5ha).

The flat areas slope gently northwards with many small depressions which trap water. These areas could be prepared by removing cow grass and small trees and building a berm to the north (Refer to Appendix 2). This would provide a water holding pond/lake. A liner would be employed to store the water captured. Storage ponds directly at the base of the foothills would hold water for 24-48 hours after showers reducing water turbidity. Clear water would then pass through a simple sand filter before it enters the lined pond.

The engineering necessary to operate this simple three stage rainwater purification would be put in place to obtain the maximum water possible without erosion with methods shown above in Section 4.1. Mosquito fish (Figure 21) would be added to the residual water in the preliminary and secondary ponds for vector control. Several preliminary ponds may be necessary to pick up water from the various naturally forming run off streams. While rainfall calculations show that one hundred and twenty million litres (120 ML) of water could come from rain in the hills over the rainy period, only as the stream is tapped successfully the final efficiency can be found. If only twenty per cent (20%) of rain fall is captured, about 24 million litres could be held for dry days. If eighty thousand litres (80,000L) of water is

needed per day the storage system would be sufficient. Figure 8 shows the schematic of the natural water catchment system which is being proposed.

6.4 NWC Option for water supply for the lake

A twenty centimetre (20cm) water main passes the property thus it is possible to use water from the NWC as a water source. While the swimming ponds could be topped up by NWC water it would not be desirable to use this as the commercial rate is \$251.84 per 1,000 litres. This would cost over \$600,000 per month (80 x 251.84 x 30) and will be subject to the cost of electricity. Construction of the western lake and tightly managing the water system would be much more desirable.

6.5 Conclusion

Water gained from the leaking JPS pipe even though historically sound, is not the most appropriate method of obtaining water for the project as it is vulnerable to various factors discussed above. While Rivva Riddim is not yet in possession of the original arrangements for water to be supplied to the site from the pipe we are made to understand that they exist. We expect therefore to continue to operate the lake with the water from the JPS woodstave pipeline until more suitable arrangements are made. Plans are to install a pond liner in the lower lake/pond within two (2) years as income is earned from operating the Park under the current arrangement.

7.0 Details of the Floating Restaurant

The Floating Restaurant will be located in the middle of the widest section of the lakes. It will have a capacity of fifty guests and staff. The restaurant will float on one hundred 55 gallon drums, less than half metre (0.5m) above the ground. This is to ensure that in the event someone falls over an adult could help them standing up in the water without difficulty breathing. (See plan engineering drawings) The restaurant will not be allowed to do major cooking and will be primarily powered by solar. Two portable toilets (1 male & 1 female) will be installed on the deck; each with a capacity of fifty flushes and will be serviced according to specifications.

Figure 18: Typical Floating Restaurant



Source:

http://www.trekearth.com/gallery/Asia/Philippines/Central_Visayas/Bohol/Loboc/photo336245.htm

Thetford (portable toilet) units will be used because of their quality. Water supply for washing and cleaning will be from a 500 gallon drum. A second drum of the same size will collect the water after use and this will be fed to the sewage system.

Figure 19: Thetford Portable Toilet Units



Source: marietta.patch.com

8.0 Water Treatment

The Park is designed to be eco-friendly so chemical water purification will be avoided. The main method of water purification therefore will be water ionization. Solar will be used to power the

pumps and water purification system. The system is designed for solar pool skimmers which collect floating elements like body oils and leaves.

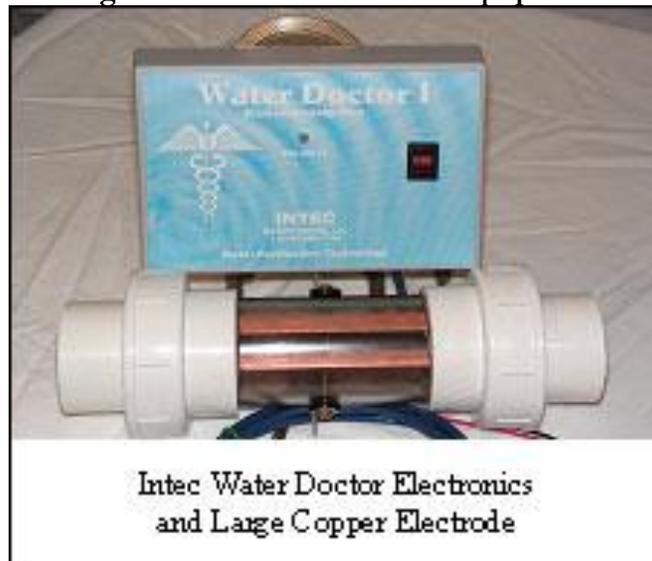
The total volume of water use for swimming and sliding is 3,076,000 litres

1. Water slides and slide pools 21,800 L
2. Adult swimming Pool 52,000 L
3. Kiddies splash & pool 12, 276 L
4. Recreational pond 2,722,000 L

Each of the smaller pools will use its own purification system. Ionization was chosen as it was developed by the *National Aeronautics and Space Administration (NASA)* and is most effective. It is also the least expensive of all disinfecting methods. Ionization is the only method that produces healthy pool water and is the easiest of all disinfecting methods to maintain and monitor. The system of choice is Pool Doctor developed by Intec Inc. USA. This system needs no chlorine or any other chemical.

<http://www.intec-america.com/products/commom%20questions%207.09.pdf>

Figure 20: Water Ionization Equipment



Source: <http://www.intec-america.com/products/pools.asp>

The following was extracted from the Intec's Water Doctor Brochure.

Transition Metal Ionization (TMI)

There is sufficient evidence that transition metal ionization can offer superior disinfection capabilities over currently utilized methods without producing harmful disinfection by-products.

How TMI Works

The biocidal effect of copper ions stems from a combination of mechanisms. These positively charged metallic ions attach to the negatively charged algae or bacteria cell membrane and causes cell

lysis and death. Metal ions will bind to the sulfhydryl, amino and carboxyl groups of amino acids, thereby denaturing the proteins they compose. This renders enzymes and other proteins ineffective, compromising the biochemical processes they control. Cell surface proteins necessary for transport of materials across cell membranes also are inactivated as they are denatured. When copper binds with the phosphate groups that are part of the structural backbone of DNA molecules, the result is the unravelling of the double helix and consequent destruction of the molecule. Unlike chlorine, transition metal ionization does not result in dangerous halogenated organic by-products such as trihalomethanes, chloramines and chloroform. Also, copper ions are stable, making it easier to maintain an effective residual. Furthermore, the ions will remain active until they are absorbed by a microorganism.

9.0 Aquatic Survey

The aquatic survey has been commissioned and should be completed by the second week of November 2012 at which time the report will be presented to NEPA.

10.0 Vector Control

Although there are still a small amount of ticks on the slopes they will die over time due to starvation. Over the two years, millions of mosquito fish (*Gambusia Affinis* - Figure 21) have entered the lake from the river via the JPS woodstave pipeline possibly via their eggs. They live where mosquitoes breed in the shallow edge of the pond and feast on the larvae. This has assisted in controlling mosquito breeding. Since that fish population has increased in the pond no larvae have been observed. These fish are indigenous to the river but thrive well in the pond.

Figure 21: Mosquito Fish



Source: Los Angeles County West Vector & Vector-Borne Disease Control District;
<http://www.lawestvector.org/MosquitoFish.htm>

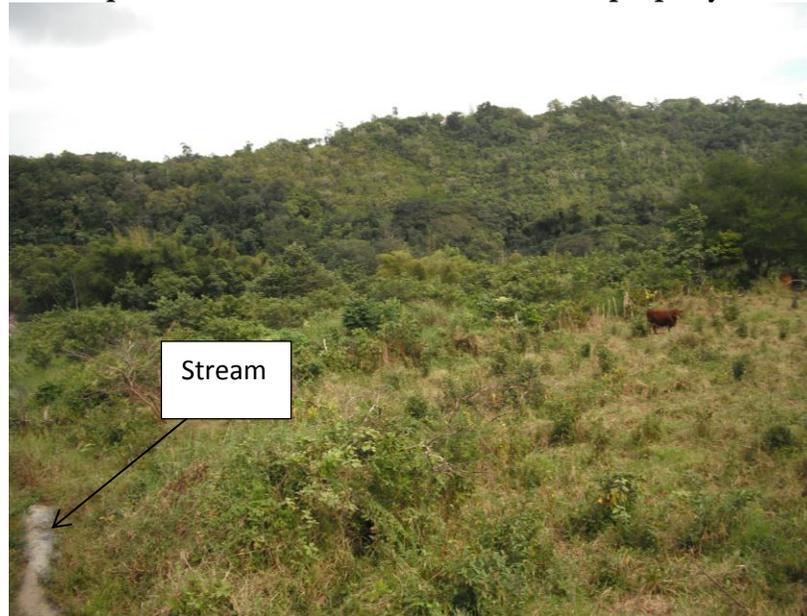
11.0 Drainage Plan

A drainage plan has been included at Appendix 2 and on separate drawings accompanying this submission.

11.1 History of Natural Ponds at Rivva Riddim

Lands for the proposed park have several natural features, which include lakes and ponds, waterfalls, rain forest, river and its natural rock formations. There are ruins of a sugar factory and even the JPS woodstave pipe which is of historical value. Even though the woodstave pipe is about seventy (70) years old, it is still seen as environmentally friendly. After being operated as a sugar cane plantation for over the 100 years, the property was maintained as a cattle farm for over another 100 years. Due to the poor viability of cattle farming in Jamaica over the past twenty years the farm failed.

Figure 22: 2010 picture of tick infested cows with the property in ruins



Source: Rivva Riddim

No maintenance of the drainage system for the depressions has been done over the years and channels that would lead water back to the river were not cleared creating these ponds. Some cows being left on the property for years without care have spread cattle ticks. These ticks live for years without food and can cause a disease (“lyme disease”) throughout the water-logged lands. Seen from above (Figure 23), the property looks like lush grass lands but it is mainly a haven for long living cattle ticks and breeding of mosquitoes.

Figure 23: Lush Green Vegetation at the Rivva Riddim Property



Source: Rivva Riddim

As a precaution against vector borne diseases and lyme disease, the grass and puddles of water had to be removed. As a test, sections of the property were drained and scraped to reduce the impact of these health nuisances. This revealed several ponds in slightly depressed areas on both sides of the JPS pipe and in particular the western section which is also supplied from runoff water from the surrounding hills. Most of the water after evaporation and seepage runs back to the river via the contour of the land formed over time. Figure 24 shows a stream and waterfall resulting from the leaking pipe. This water settles in the depressions and the excess flows to the river.

Figure 24: Water fall resulting from the leaking woodstave pipe



Source: Rivva Riddim

11.2 Lake/pond

Water flowing from the pipe has created a natural swampy pond/lake that looks like a pasture from afar but is unsuitable for cattle as cows walked in it knee deep and attendants and mechanical equipment could not venture in. Cattle ticks are therefore prevalent.

It was concluded that spraying the ticks is dangerous to the environment and has little guarantee of success and burning the grass would not be sufficient as the ticks are comfortable on the ground. This meant scraping the ground and removing the grass and allowing the natural area to be flooded to eliminate both the mosquitoes and ticks.

Using the Bernoulli method, daily observations and weekly measurements of water flowing from the woodstave pipe were taken. About two hundred (200) measurements were collected and collated over a two (2) year time frame in a study of water flowing from the woodstave pipe by Rivva Riddim engineers (Table 1). It was concluded that the amount of water flowing to the property from the leaking woodstave pipe could be very beneficial if harnessed.

**Table 1: Water flowing from leaking pipe to ponds at the Rivva Riddim Property
Oct 2010 - Aug 2012**

Dates	Weekly Samples (mgd ¹)					Average mgd
	1	2	3	4	5	
2010						
October	1.23	1.2	1.39	1.28	1.01	1.22
November	1.21	0	1.33	1.31		1.28
December	1.39	0	0.87	0		1.13
2011						
January	1.44	1.45	1.59	1.59	0	1.21
February	1.61	1.76	1.98	2.15		1.88
March	1.79	1.89	1.9	1.98		1.89
April	1.56	1.67	2.25	2.78	0	2.07
May	1.99	1.98	1.89	1.98		1.96
June	2.24	1.23	2.29	2.51		2.07
July	2.67	2.7	2.88	2.89	2.9	2.81
August	2.91	3.09	3.34	3.57		3.23
September	1.55	2.12	2.42	0		2.03
October	0	0	0	0	0	-
November	0	1.716	0.9	0.959		0.89
December	1.11	1.35	1.12	1.21		1.20
2012						
January	0	1.27	0	1.22	0.89	0.68
February	0.98	0.98	0	0		0.98

¹ mgd – million gallons per day

Dates	Weekly Samples (mgd ¹)					Average
March	1.47	1.59	1.63	1.61		1.58
April	1.77	1.83	1.92	1.97		1.87
May	1.98	2.01	2.21	2.36	2.35	2.18
June	2.34	2.53	2.77	2.81		2.61
July	2.87	8.51	3.49	3.52		4.60
August	0	2.38	0.77			0.63
Total average in 22 months						39.98908
Average day						1.904242

0 = no reading or pipe down for maintenance

Source: Rivva Riddim

Drainage channels (Figure 25) were cut to lead off water from the depressions which in time became dry with only scattered small pools of water. The grass was removed using a backhoe (Figure 26) and the tick infested grass burned.

Figure 25: Drainage Channel



Source: Rivva Riddim

Figure 26: Area cleared with backhoe



Source: Rivva Riddim

The drain canals were subsequently closed causing ponding to reoccur without the mosquitoes and ticks. Figure 27 shows water settled again after closing the drainage channels and no berms or special engineering was needed as the water resettled without the tick harbouring grass.

Figure 27: Cleared area filled with water from leaking JPS woodstave pipe



Source: Rivva Riddim

No significant berms are required to keep the water in place as the natural shape of the land promotes ponding. Excess water will be drained back to the river by cutting a drainage channel that leads to an existing JPS concrete drain which conveys leaking water to the White River. (Refer to Drainage Plan at Appendix 2 and provided separately).

This operation has provided a 1.5 hectare pond which keeps full as long as there is the normal leakage of water from the pipe. On one occasion when the pipe was shut down for over one month a significant amount of water remained at the deep section of the pond. Calculation of the exact amount of water that enters the lake area is difficult but it is estimated that about 30-50% of the water leaking from the pipe is able to be channelled to the lake which is about 700,000 gallons (2,500 m²) on average. When the lake is full it can hold 20,000m² about (5,000,000 gallons) and is 3.3m (10 ft.) at the deepest point.

The natural trenches made the soil soggy therefore the earth was built up to stabilize the soil to establish dry walkways close to the river. As the local soil is suitable no imported materials were required.

A system of re-grassing the lands that were cleared has been on-going as scars were evident due to the removal of grass during the mitigation management of the tick and mosquito infestation.

Most of the water on the Rivva Riddim Property originates from the leaking JPS woodstave penstock on a daily basis while other water is from rainfall. JPS as a part of the pipe works constructed two concrete drains to convey leaking water to the White River; one at the northern end and the other at the southern end of the Rivva Riddim property. These have worked well over the years as no erosion has been noticed. (Refer to Drainage Plan at Appendix 2 and drawings provided separately)

There will be very little hard surface added to the property to change the proven successful drainage pattern as the project is based on the environment that already exists. The gross surface area of the property is approximately twenty hectares (20ha) and the additional hard surface including access road, welcome areas and gazeboes scattered throughout the property is less than 0.5% of the total surface area. All pathways will be of sand and gravel.

Oil traps will be installed in the drainage paths in the parking area. The proposed park will have trained maintenance personnel who will be responsible for maintaining the drains and river.

The parking lot is one and a half metres (1.5m) below the public road. The access road will be constructed of 3,000 psi concrete, six inches (6") thick on a compacted marl base. It will have a length of twelve metres (12m) from the main road to the parking lot gate. (See Plan at Appendix 2)

The main roads from Ocho Rios to Lodge and Lodge to the property have all been upgraded over the past two years via the two main government programmes JEEP and JDIP.

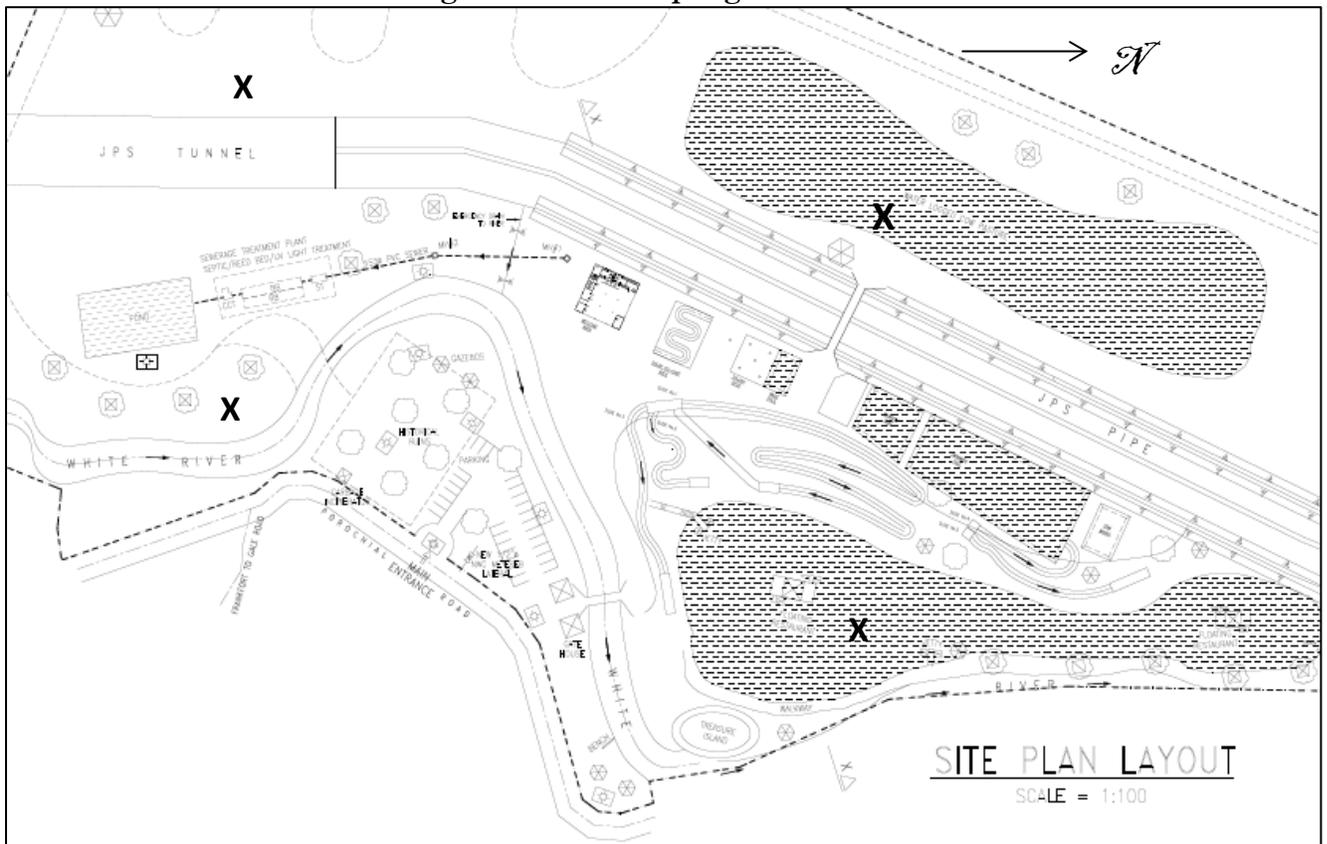
11.3 Flood Management

A sluice gate and paved canal at the northern end of the lake will lead water to the existing JPS paved drain. This will provide overflow protection for rainfall and other adverse weather conditions for up to two million gallons per day from the southern, western and northern hills sloping down to pasture land. (See Drainage Plan Diagram at Appendix 2)

12.0 Irrigated Soil Permeability

Hill Betty Report is attached at Appendix 3. Monitoring points indicated by the four Xs on Figure 28.

Figure 28: Soil Sampling Points



Source: Rivva Riddim

13.0 Project Phasing

Phase 1 of the Park will open with ten (10) attractions.

It is anticipated that within year one there will be about 100 persons per day, which would increase to about two hundred by year two and an additional one hundred in the following year before levelling off.

Phase 1 features offered are:

1. Kayaking, Solar boating, water deck and rafting on the lake.
2. Floating Restaurant.
3. Water slides on hillside
4. Gem Mining (Rough gems sold in bags with sand. Sand sifted off leaving gems)
5. Splash & Spray deck and kiddies pool
6. Tree houses and lake huts
7. Recreational pond with floating water toys
8. Beach volley ball
9. River touring
10. Alternative energy and eco training for students

Phase 2 estimated to start in year 2 will include the following depending on the success of Phase 1.

1. Solar go karting (small track)
2. Solar golf cart tours to top of property (View of sea, Zip lines)
3. Hillside slide
4. Solar bumper boat
5. Treasure island
6. Historical ruin tours
7. Hiking trails
8. Biking trails
9. Lake and Lake huts
10. Zip lines
11. Rope bridges

Planned activities for Phase 1 are described below. Detailed drawings have been provided separately for the main water features.

Lake activities including:

- a. Kayaking (**Figure 29**)
- b. Lake rafting
- c. Solar electric boating
- d. Floating decks (**Figure 30**)

Figure 29: Typical Kayak



Source: <http://www.outdoorleisuredirect.co.uk/product.php?id=25>

Figure 30: Typical Floating Restaurant



- e. Hillside slide Water slide (**Figure 31**) on the natural contour of the land between trees and gardens. The slide ends up in a small splash pool. A solar driven pump provides water the entire slide and the pond is made of concrete.

Figure 31: Typical Hillside Water Slide



- f. Pool side slide which is simply a waterslide that leads to the recreational pond. A solar driven pump provides water and the entire slide and pond is made of concrete.
- g. Pools and Recreation swimming pond

Kiddies Spray deck and pool consists of a concrete deck 12 m by 16 m with several pipes that spray water. The deck is connected to a small pool 3 m x 9 m with an average depth of 0.5 m.
- h. Swimming pool 10m x 12m dimensions, approximately 1.3m deep made of concrete.
- i. Recreational pond is a large swimming pool with pool toys like water chairs water sea saw etc. this pool is supplied by water from the JPS pipe. It is 60m x 30m in size with an average depth of 1.3m. The pond is lined with PVC liner on earth. **(Figure 32)**

Figure 32: Pool for Multiple Recreational Purposes



- j. Beach Volley ball on river sand court made to international standard
- k. Solar Bumper Boat - Solar electric motor which goes faster when pointed to the sun.
- l. Environment and Energy Show includes basic training in wind, hydro and solar energy and the care of the environment. Focused on school field trip business (Refer to Section 14.0 on Education Focus).
- m. Tree houses and cabins are built around trees but are not connected to them as they are supported on poles. They will promote rest and relaxation away from the recreational areas (See building plans provided separately).
- n. Hillside slides (like alpine slides) are concrete or stainless steel troughs in which guests slide on trolleys which have their own brakes and steering.

Figure 33: Hillside Slides



Source: <http://www.breckenridge.com/info/summer.aspx>

- o. Treasure Island (bury gifts in the sand and guests find it)
- p. Solar Mini Go Kart - A small go kart with 80 kg capacity powered with a solar panel and battery. The solar panel is adjustable to point to the sun which makes it go faster.
- q. Gem Mining (guest buy rough gems in a bag of sand, wash off sand and find gems)
- r. River hiking - Guests are taken on the banks of the river to see rock formations and the river's beauty.
- s. School Field trip - Solar demonstration, practical learning while having fun. (See Rivva Riddim Education Focus in Section 14.0).

13.1 Zip Lines

Zip lines are the main attractions in the second phase of the Park. That area has more hilly terrain. The concern for keeping the trees healthy has initiated a method of setting up

wooden posts in the vicinity of large trees and making decks on which zip lines are mounted. Lines will not therefore be connected to the trees but to the posts which will be planted and guyed like electricity poles. Zip line wooden posts will be aesthetically compatible as they will resemble tree trunks.

Figure 34: Typical Zip Line

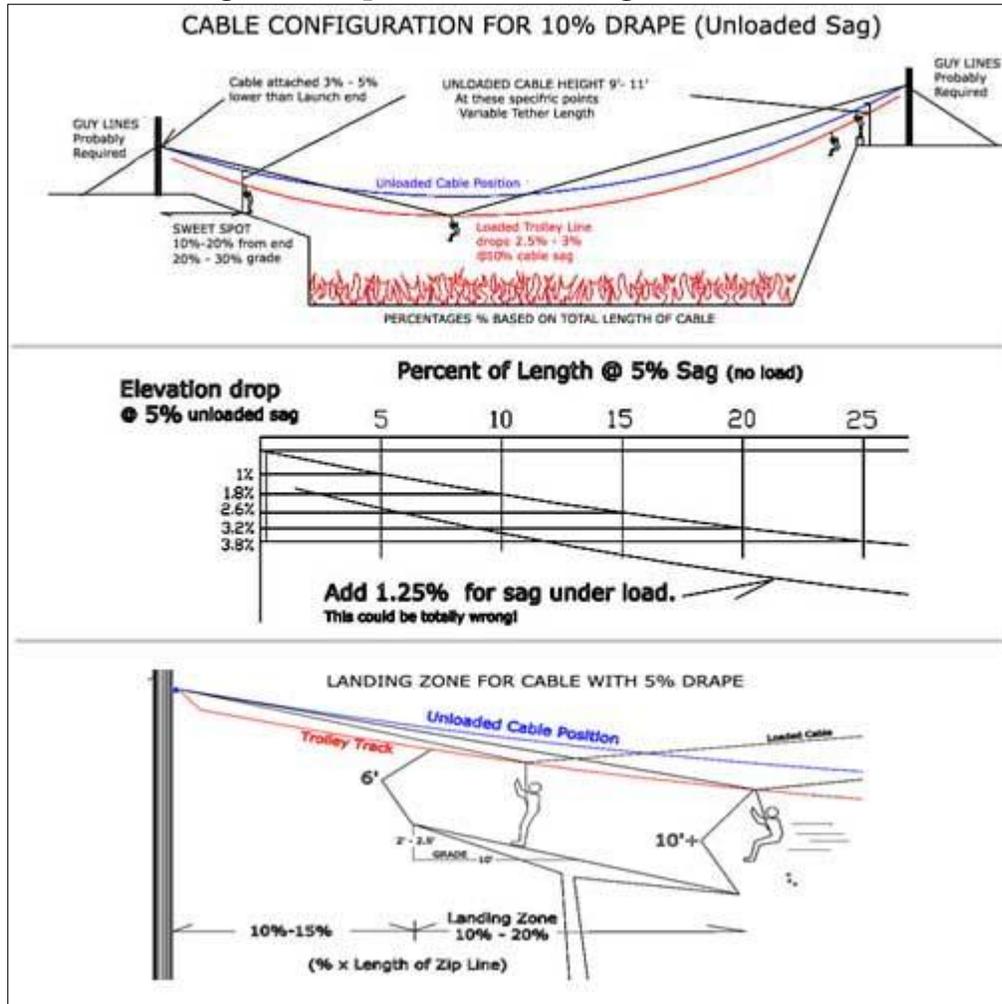


Source: Stephen S. Austin University USA

Figure 34 shows Zip lines connected to poles (similar to timber light poles) but giving the impression that the zip lines are coming from the trees.

Lines will be run as shown in Figure 35 in accordance with safety standards. The direction and length of the fifteen planned zip lines are shown in the site plan. The safety of the system will be guided by ANSI/API Specification 9A and ISO 10425:2003. The lines will be sited in such a way that no major trees will be removed.

Figure 35: Zip Line Cable Configuration



Source: adventureropegear.com

14.0 Education Focus

A significant part of the target market is young people at school. There are more than one thousand schools on the island many have never seen live eco activities like those to be offered by Rivva Riddim.

Many teachers and students who have heard of the proposed plans have enquired about school field trips. It was natural to offer meaningful educational aspects as a part of the product which would be beneficial to the next generation, the country and the environment. On the management team are professionals in alternative energy and teachers of various subjects. The Park will be solar energy powered, it will have a river in the property, a rainforest and the ruins of a sugar factory, subjects of interest for students to learn from real life. Furthermore as there will be controlled recreational facilities including life guards and guest assistant, the learning experience will be safe while having fun. Some of the main teaching activities will be the solar boat race (**Figure 36**) and solar go kart race.

Figure 36: Typical Solar Boating by University Students in the Netherlands with 2KW of panels seen on boat



Source: http://usatoday30.usatoday.com/tech/science/2006-06-26-solar-boat-race_x.htm

On the solar boat race students will learn about how much power may practically be gained when solar panels are pointed to the sun. Small boats are fitted with solar panels which can pivot in any upward direction. They drive electric boat motors without the assistance of a battery as they are turned to the sun. The boat is operated by two students one the navigator who pays attention to the direction in which the boat is travelling and the other the solar engineer who get the best angle to the sun wherever the boat turns. The team who does this best can win the race. Schools will be made to compete for a prize.

Figure 37: High school Students in California in a 2 panel boat with one student



Source: <http://www.californiasolarcenter.org/solareclips/2004.06/20040706-2.html>

Students will be taught how to make functional wind generators from scrap materials and how to cook with solar. Teaching will be on various levels depending on age.

Figure 38: Inner city children learning how to build wind 200W wind generator from a steel drum at Caribbean Maritime Institute



Source: Alternex Energy

Discussions are underway with various schools to understand their specific needs. Arrangements are also being made with environment professionals to teach about this vital subject.

We anticipate field trips on the following subjects:

1. Geography visit to look at the river and its peculiarities
2. Biology visit to learn river water species and their importance
3. Zoology visit to look at the rain forest and river life.
4. Botany visit for flowers and plants of the area.

5. History visit to the two sugar factory ruins and history of the Industry area
6. Physics visit to see the use of solar systems in business

After the educational aspect the entertainment aspect of the Park will be available.

Two days per week will be devoted to field trips. It is expected to host at least one hundred (100) high school and other students each day. A special price will be offered to schools to encourage attendance.

Appendix 1: Water Quality Results – White River in the vicinity of the Proposed Park



Microlabs Limited
 20 Melmac Avenue
 Kingston 5, Jamaica
 Tel: 876-926-6108 Fax: 876-754-5628
 email: info@microlabs-ltd.com
LABORATORY REPORT

Physician's/Client's Information
 ID#: 9985 Name: RIDDIM, RIVVA
 Address: 60 SUNSET AVENUE
 KINGSTON 8,
 Telephone: Fax:

Patient's Information
 ID#: 0000465572 Accession No.: 0120903264
 Name: RIVVA RIDDIM Insurance:
 Address: Gender: U DOB: Age:
 Reg/ID: Reported: 7/09/12 11:11 FINAL

Collected: 3/09/12 18:31 Received: 3/09/12 18:31

Details:

WATER 1
 JPS HYDRO PIPE
 Centre: Melmac Avenue

Test	In Range	Out of Range	Reference Ranges and Comments	Units
INDUSTRIAL MICROBIOLOGY				
SAMPLE	Water			
BATCH NUMBER	Riddim R			
DATE OF MANUFACT	N/A			
DATE COLLECTED	N/A			
STD PLATE COUNT	TNTC/100			
STAPHYLOCOCCUS	NOT FOUND			
E. COLI	NOT FOUND		NONE	
MPN COLIFORMS	NONE			
COLIFORMS	NOT FOUND			
SALMONELLA	NOT FOUND		NONE	
SHIGELLA	NOT FOUND		NONE	
C. DIFFICILE	NOT FOUND		NONE	
ALCALIGENES SP.	NOT FOUND		NONE	
PSEUDOMONAS	NOT FOUND		NONE	
YEAST	NOT FOUND			
MOLD COUNT	NONE			
OTHER	<u>Citrobacter</u>			

pH 5.0

Consultants
 Haematology: Doreen Brady-West, DM Clin. Chem.: Prof. Franklyn Bennett
 Managing Director: Trevor A. Campbell, F.S.M.T., MT (AMT)

Tech: _____ Reviewed by: 

End of report Total Pages 1

If no age or gender is given, reference ranges default to adult male values.
 *** All abnormal results are verified by repeat analysis



Microlabs Limited

20 Melmac Avenue
Kingston 5, Jamaica

Tel: 876-926-6108 Fax: 876-754-5628
email: info@microlabs-ltd.com

LABORATORY REPORT

Physician's/Client's Information

ID#: 9985 Name: RIDDIM, RIVVA
Address: 60 SUNSET AVENUE
KINGSTON 8,

Telephone: Fax:

Patient's Information

ID#: 000465573
Name: RIVVA RIDDIM
Address:

Accession No.: 0120903265
Insurance:
Gender: U DOB: Age:
Reg/ID:
Reported: 7/09/12 11:13 FINAL

Collected: 3/09/12 18:33 Received: 3/09/12 18:33

Details:

WATER 2
WHITE RIVER
Centre: Melmac Avenue

Test	In Range	Out of Range	Reference Ranges and Comments	Units
INDUSTRIAL MICROBIOLOGY				
SAMPLE	Water			
BATCH NUMBER	Riddim			
DATE OF MANUFACT	N/A			
DATE COLLECTED	N/A			
STD PLATE COUNT	TNTC/100			
STAPHYLOCOCCUS	NOT FOUND			
E.COLI	NOT FOUND		NONE	
MPN COLIFORMS	NONE			
COLIFORMS	NOT FOUND			
SALMONELLA	NOT FOUND		NONE	
SHIGELLA	NOT FOUND		NONE	
C.DIFFICILE	NOT FOUND		NONE	
ALCALIGENES SP.	NOT FOUND		NONE	
PSEUDOMONAS	NOT FOUND		NONE	
YEAST	NOT FOUND			
MOLD COUNT	NONE			
OTHER	<u>Citrobacter</u>			

pH 5.0

Consultants

Haematology: Doreen Brady-West, DM Clin. Chem.: Prof. Franklyn Bennett
Managing Director: Trevor A. Campbell, F.S.M.T., MT (AMT)

Tech: _____

Reviewed by: 

End of report Total Pages 1

If no age or gender is given, reference ranges default to adult male values.
*** All abnormal results are verified by repeat analysis

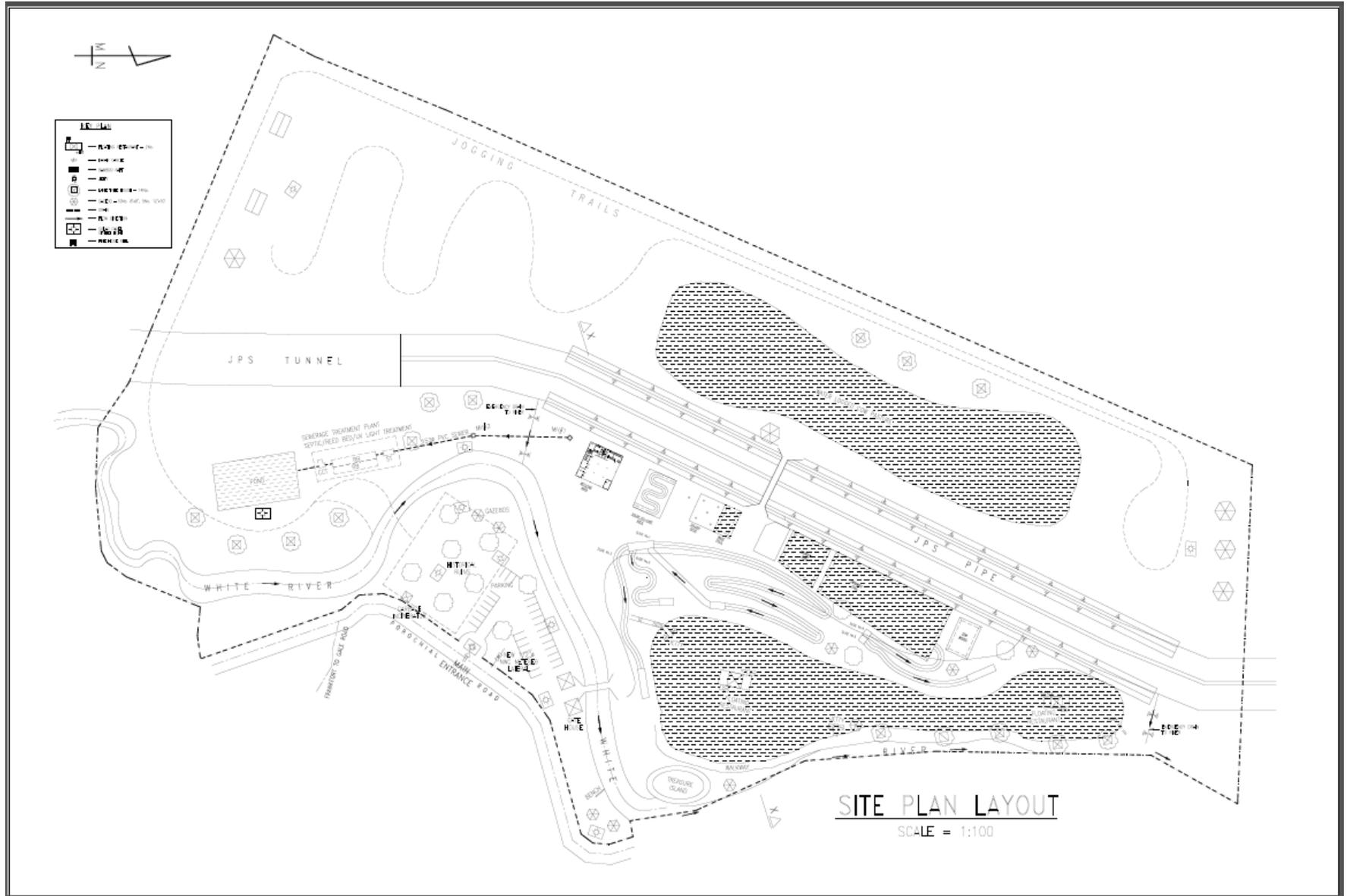
Appendix 2: Maps and Diagrams of Proposed Property

1. Site Layout in Colour
2. The Site Plan
3. The Park Site Plan
4. Site Plan Showing Pond East of JPS Woodstave Pipe
5. Drainage Plan with Cross Sections through Property
6. Drainage Plan with Details
7. Site Plan with Details
8. Slide Layout

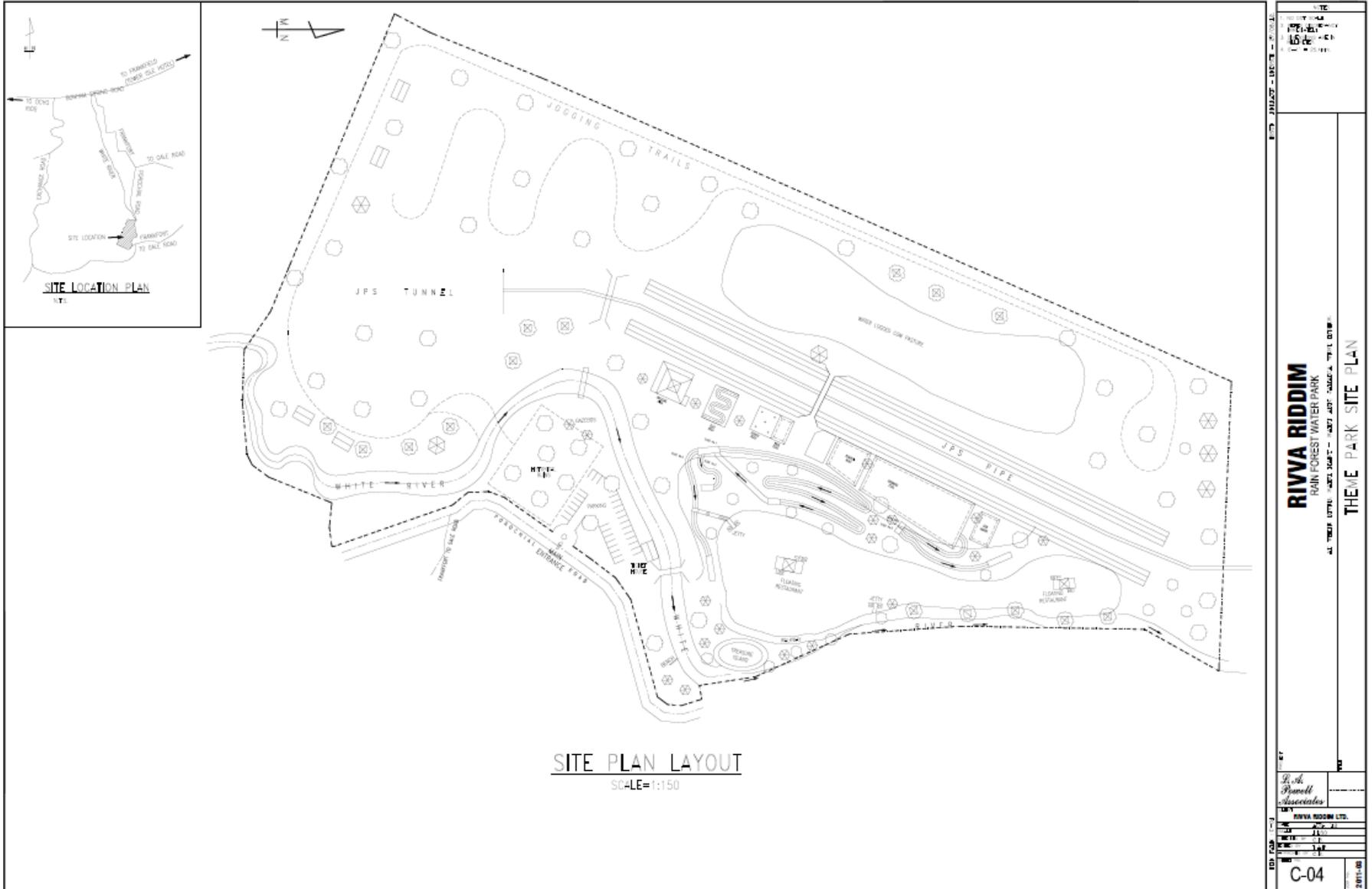
Site Layout in Colour



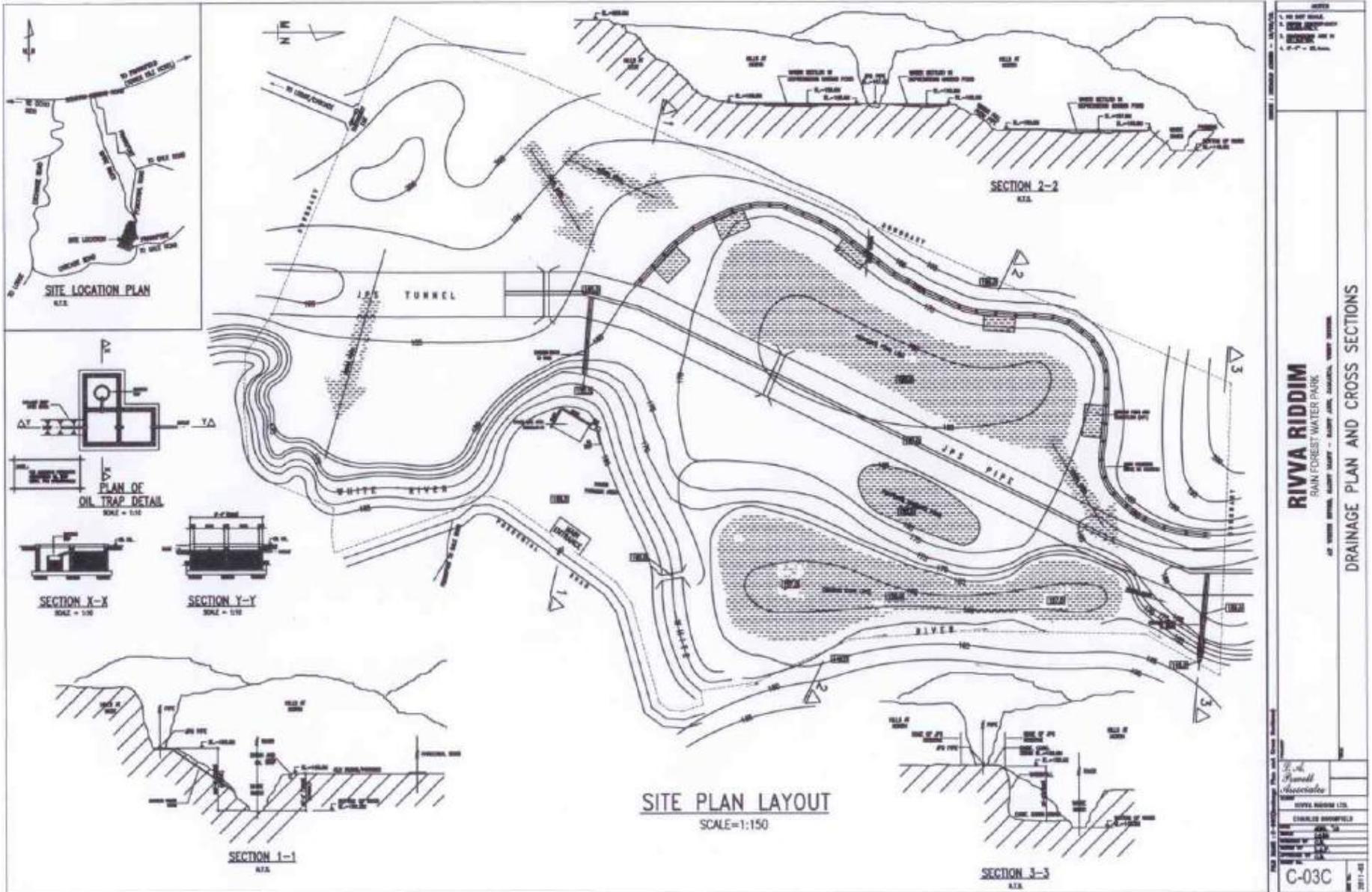
The Site Plan



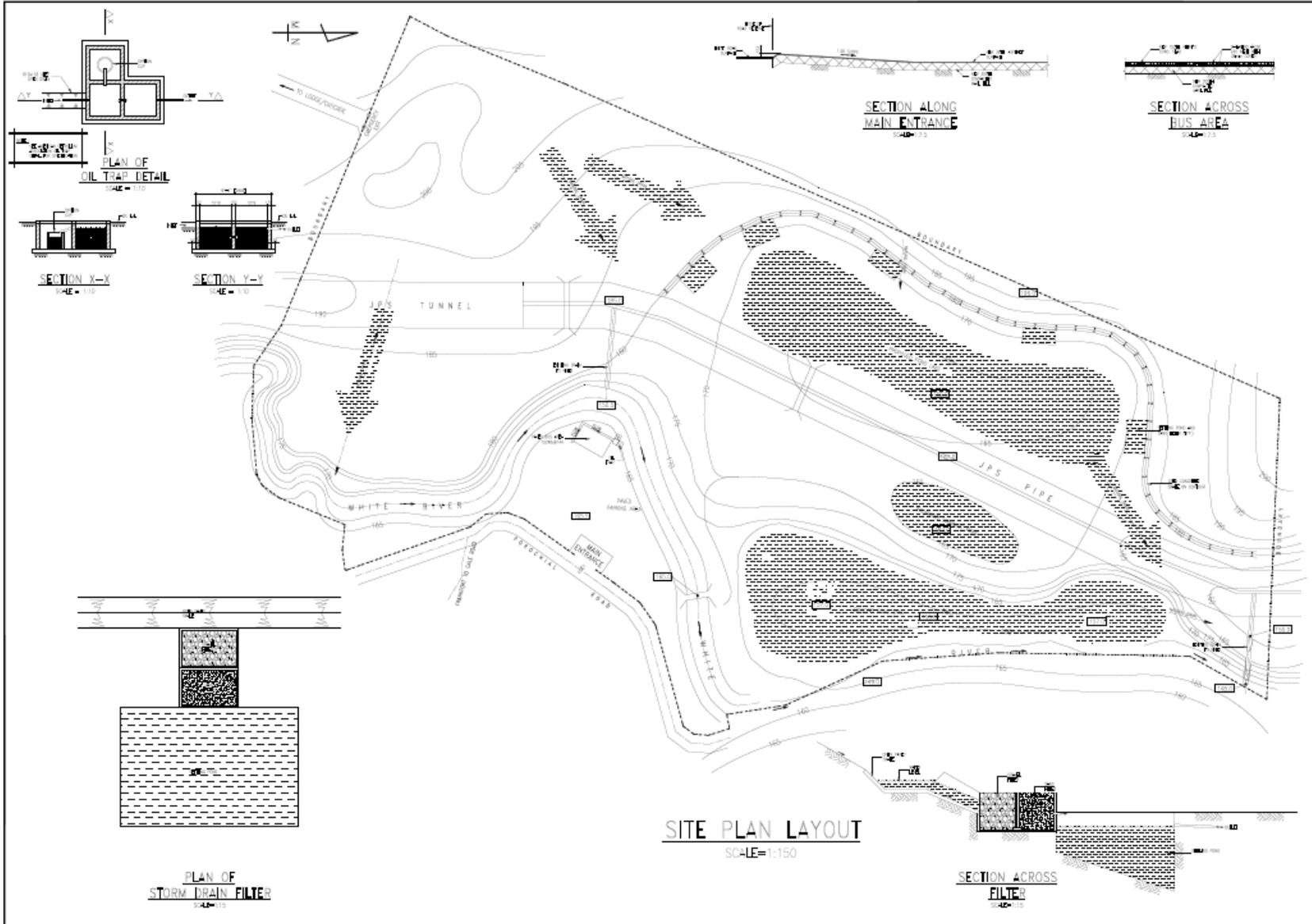
The Park Site Plan



Drainage Plan with Cross Sections through Property



Drainage Plan with Details



<p>RIVA RIDDIM RAIN FOREST WATER PARK AT THE CORNER OF ROAD NO. 10 & ROAD NO. 11, DUBLIN</p>	<p>DRAINAGE PLAN AND DETAILS</p>
<p><i>R. & P. Associates</i></p>	
<p>CHARLES BISHOPFIELD</p>	
<p>DATE: 11/01/01</p>	
<p>SCALE: 1:10</p>	
<p>C-06</p>	

Appendix 3: Hill Betty Irrigated Soils Report

HB HILL-BETTY (ENGINEERS) LTD.

CIVIL ENGINEERS AND CONTRACTORS

DIRECTORS:
K. R. HILL
N. O'CONNOR BETTY, B.Sc. (Eng.)

29 BURLINGTON AVENUE
KINGSTON 10
PHONE: 960-2961-2, 968-0015
FAX: 960-5648
Email: hbengineers@yahoo.com

September 15, 2012

Mr. Charles Bromfield
Riva Riddim Ltd.
60 Sunset Ave.
Kingston 10

Re: Tests done on soil samples –Industry, White River St. Ann.

This report presents the results of a soil investigation carried out on a site located in the above mentioned caption. Authority to proceed was obtained from Mr. Charles Bromfield of Riva Riddim Ltd. The objective of the investigation was to evaluate the subsurface conditions of the site for the proposed Theme Park.

An examination made of the soils in areas where there are slopes would necessitate some amount of grading to facilitate operations. Care needs to be taken to ensure that the volume of water does not cause degradation of the soils. An effective approach to safe guard against this is to use clayey silt (or silty clay) soils to construct the last 0.3m (one foot) to 0.46 m (1.5 feet) of the slope and to embed reasonably large stones into the silty clay matrix. An added protection would be the grassing of the finished slopes.

Sewage Disposal

The rate of percolation is expressed in minutes per inch (2.5cm) as the rate of the fall in water level of a thirty minute period.

TABLE 1

Borehole	Dimension	Rate of percolation (Mins. Per inch)
1	4.6m x 10 cm	40
2	4.6m x 10 cm	35
3	4.6m x 10 cm	25
4	4.6m x 10 cm	30

The rate of percolation obtained together with the quality of soils in the ponds suggest that only in areas with soils as represented by samples No. 1 and 2 would give reasonable disposal of effluent by using Absorbtion Pits. A combination Septic Tank/ Tile Field system or a Package Sewage Plant will be required for Sewage disposal across the site.

Roadway Design

The design of road ways is dependent on the soil type, climatic conditions, moisture movement in the sub- grade and the spectrum of load expected. The Bearing Values of the soils on the site which will be in the possible range of vehicular traffic would range from a low of 20.8 p.s.i. to a high of 55 p.s.i. This would be the equivalent California Bearing Ratio (C.B.R.) from 13 to 35.

Because of the nature of the proposed development it is not expected that much heavy traffic will use the roadways. With this in mind it is suggested that a maximum wheel load of 3175 kg. (7000 lbs.) be used in the design of the roadways.

For the areas represented by sample No. 1 the C.B.R is 35. The required pavement thickness for the suggested maximum wheel load is 20 cm. (8 inches). For the areas represented by sample No. 2 the C.B.R. is 27 . For the areas represented by samples outside Nos. 1 and 2 the C.B.R. is 22. Using the maximum wheel load suggested the required pavement thickness is 25 cm (10 inches).

Earth Pressure Values

For retaining walls and other such structures it is recommended that clayey silt and silty clay soils with values of 0.49 and 2.04 be used respectively for the active pressure (kg) and for the passive pressure (kp) . The density of the soil measured is 2000 kg/m³

JPS Penstock Pipe.

It should be noted that J.P.S Co. has a water main running through the existing property. There was cause for concern as to the structural integrity of the pipe which if ruptured could cause damage to both property and persons. Checks made on the pipe along with consultation with representatives from J.P.S. Co. maintenance department confirms that the pipe is structurally sound and maintained on a regular basis, thus eliminating or minimizing hazard to life and property especially as the property is at the top of the pipeline, pressure on the pipe would be significantly less than it would at the Hydro station over a hundred maters lower.

Closure

We trust that the above satisfies your requirements and we are available for any clarifications which you may require

HILL- BETTY (ENGINEERS) LTD.

N.O.' C. Betty

Neville O'C Betty, Civil Engineer.