DRAFT
ENVIRONMENTAL IMPACT ASSESSMENT
OF THE
PROPOSED WESTERN SPANISH TOWN WASTEWATER TREATMENT PLANT

HORIZON PARK, ST. CATHERINE

Submitted to
CAN-CARA DEVELOPMENT LTD
8 Cargill Avenue
Kingston 10

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JANUARY 2004

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EXECUTIVE SUMMARY

The genesis of the project surrounded the need to provide an adequate mechanism for the centralization of existing and new sewerage treatment facilities in the St. Catherine plains south of Spanish Town. This centralized system would remove the load and perhaps eventually the need for the Horizon Park, Ebony Vale, and Eltham sewage treatment systems as well as establish a wastewater treatment facility sufficient to allow the expected housing development expansions planned for this region.

The area to be serviced, the existing load and the projected demand were estimated and along with details of environmental conditions such as water quality, slope, land use and natural boundaries allowed for an assessment of the implications of site selection, construction and operation of a consolidated waste water treatment plant (WWTP) in the Horizon Park area. The conservative population estimate for complete sewering is 140,212 and the average water consumption rate for this estimation was 40 IGPD per capita. The design capacity is 5,860,878 IGPD and the area of the treatment plant site including buffer will be 112ha. The plant, which will be a secondary treatment design via tanks and pipes will utilize, waste stabilization ponds and constructed wetlands to achieve tertiary treatment.

Construction will involve laying pipes in public and private areas along roadways with full restoration after construction. While these activities are minor, major earth movements will accompany the pond and wetland construction since topsoil will not be used in the construction but rather placed in a landscaped berm. Operational phase will involve wastewater being piped to the WWTP as well as septage being trucked (8,400 GPD).

The Horizon Park proposed site, like the rest of the island, experiences a subtropical climate thus temperature is relatively constant throughout the year and rainfall is seasonal. Soils on the proposed wastewater treatment plant site consist of the Sydenham type where the soil texture is mainly clay. Due to the fact that the slope of the land is relatively flat and the soils are clayey, the erosion potential at the site is slight.

No rare, endangered or endemic terrestrial plant species were observed during the site visit and there was nothing untowardly special about the vegetation on the project site from either an ecological or commercial point of view. With this in mind, the proposed development will not have a significant negative impact on the vegetation observed at the site.

Water bodies with high algal content (indicated by chlorophyll *a* above 2 mg m^{-3}) and high phosphate values (greater than 1.0 mg L^{-1}) indicate poor water quality over the entire plains south of Spanish Town and renders these lands as inappropriate for housing construction or industrial development but adequate and for construction of a sewage treatment solution or agricultural waste management. The construction and operation of a sewage treatment facility in this area should be of little significance to the subsurface water quality especially near the southern portion of the area in question which has the worst well water quality.

The proposed development is not expected to have a major negative impact as it relates to noise pollution in and around Sydenham and Horizon Park developments, as the planned planting of trees and vegetation around the proposed wastewater treatment plant will act as a kind of noise barrier, by reducing attenuation of noise waves. It also forms a semi-porous barrier which will somewhat block the line of sight between the source and the receiver (most noise tends to travel along a line of sight) and simultaneously improve the aesthetics of the site.

Wastewater treatment plants have the potential to be odour nuisance if proper buffers between the treatment units and existing populations are not provided and the plant is not properly operated and maintained. A buffer of at least 100 metres has been provided on all boundaries as per NEPA recommendations. Agricultural use of the land being used for the development of the wastewater plant will be impacted negatively but will have a positive impact on existing housing the socio-economic conditions within the study area as it is expected to improve the collection and disposal of wastewater and reduce ground water pollution and the spread of gastrointestinal diseases. The benefits for the proposed development are further enhanced by the absence of any sites of historic or cultural importance within the area.

By using an appropriate monitoring programme over time and space the continued adequate operation of the WWTP will be assured and should problems arise they will be quickly identified and addressed. The alternative proposals are not deemed acceptable for this development since the no develop option confers no advantage to an already poor environment and alternative sites are less suitable and introduce new challenges.

The development of the Horizon Park WWTP is therefore recommended with the requisite monitoring programme accompanying all phases of site preparation, construction and operation. Moreover the significance of the constructed wetlands to the success of the operation may require design review and confirmation during construction phase. Overall the development should result in improvement of existing water quality and better land utilization while facilitating housing development and growth.

1.0 DESCRIPTION OF THE PROPOSED PROJECT

The lands of western Spanish Town have in recent times become very popular with both existing and potential homeowners, so much so, that there is a concentration of six to eight major developments underway of 150 lots or greater within an eight to ten kilometres radius. The Statistical Institute of Jamaica (STATIN) reported that "*between 1991 and 2001, the parish of St. Catherine grew at an annual rate of 2.3% nearly three times the rate observed for the country as a whole*". Development in this area is partially facilitated by the change of use of both old and recently used agricultural land (see Figure 1 for an overview).

Community development brings with it a direct need for both water and wastewater services. Unfortunately, both of these services are either under severe pressure or non-existent. In the case of water, the existing water supply system is under pressure and no new developments are being permitted to connect to the existing water mains. Fortunately, there is an initiative to relieve this situation (namely the KMA project) within the next three to four years. The KMA essentially aims to rationalize and develop the existing water resources in the area in a centralized way.

The situation with respect to sewage is not as advanced as that of water. Several developers have sought to get permits and licenses for the construction and operation of their own sewage treatment plants. Should such a situation be allowed to advance, the NWC (who are the likely operator of such systems) would be faced with the task of operating five to seven mechanical plants in relatively close proximity. This is in addition to the existing centralized treatment plants at:

- Horizon Park
- Ebony Vale, and
- Eltham.

The Ministry of Land and Environment (MLE) convened a meeting with the key developers in the area on the 20/8/2003 to discuss the overall situation and plan the strategy forward. Coming out of that meeting was the need to firstly undertake Conceptual Engineering for such a system. Such a conceptual document was prepared, circulated and presented to the MLE. The MLE and the developers have discussed the issue and it was agreed that CAN-CARA Development Ltd.

would develop, own and operate such a regional treatment plant as a utility. The MLE also stated that they fully supported the development. As a result of the foregone, CEAC Solutions Co. Ltd. was commissioned by CAN-CARA to plan and prepare final engineering designs for the treatment plant. Figure 1 shows the location of the proposed treatment plant (WWTP).

1.1 PROJECT DESCRIPTION

1.1.1 Planning and Design

1.1.1.1 Catchment and Population

It was necessary to delineate the project area or catchment in order to enable the estimation of the design population for the treatment plant. The catchment for the WWTP was delineated from the Western Spanish Town region. This catchment was arrived at after due consideration for:

- Limiting topographic features such as hills;
- Natural boundaries such as rivers;
- Likely contour limits of feasibility for pumping mains and lifts stations;
- Existing agriculture land use; and
- The need for the best possible lands for future expansion of Spanish Town.

The proposed catchment for this WWTP is illustrated in Figure 2.

1.1.1.2 Occupancy and Housing Densities

It was necessary to determine what the occupancy rates and housing densities in the catchment for both fully developed and developable areas were in order to arrive at design figures for the entire catchment. These important design parameters were determined as follows:

1. The enumeration districts for the project area was acquired from STATIN, scaled and geo-referenced and incorporated into the electronic database of the project (AutoCad®).
2. 2001 Enumeration data (including population and household numbers) for the relevant districts was retrieved and incorporated into a spreadsheet and the areas of the enumeration districts was estimated from AutoCad®.

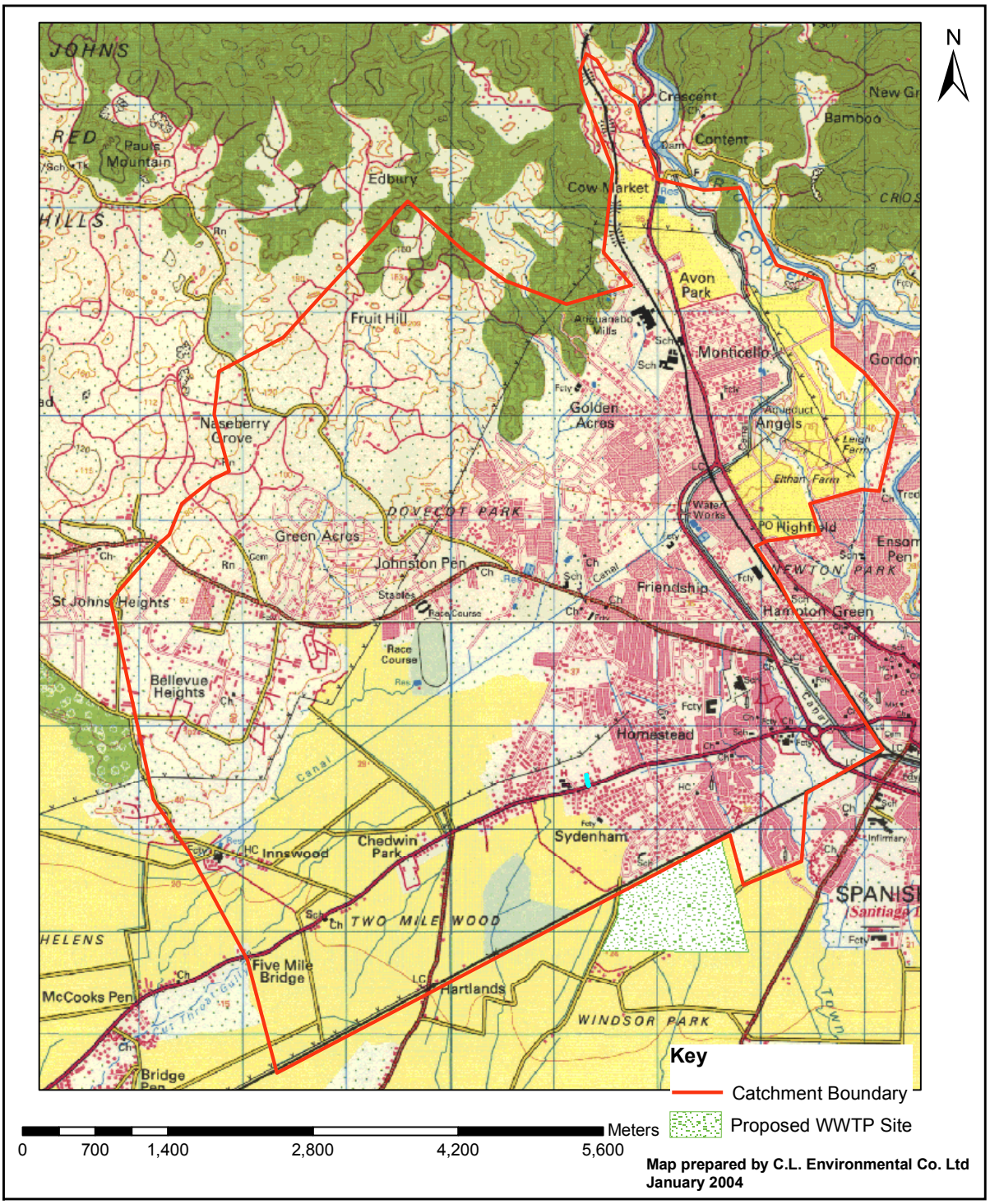

Figure 1 **Location map of the proposed WWTP site**

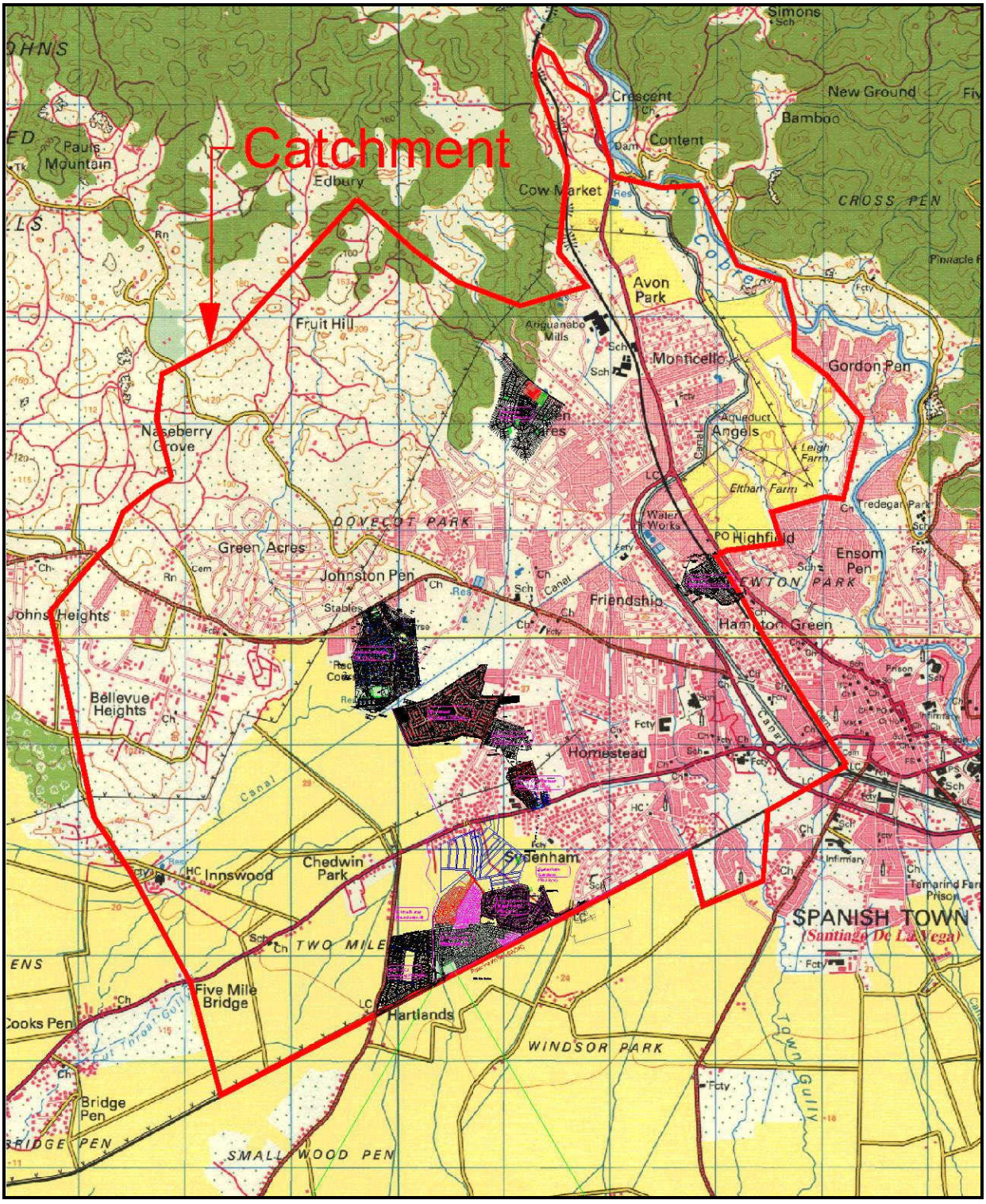

Figure 2 **Catchment boundaries for the proposed WWTP site (on 1:50,000 metric map)**

3. Densities and occupancy rates were then determined. A qualitative assessment of the project was then made in order to determine whether that area of the catchment had more developable lands and what densities were likely. Unpopulated hilly areas were assumed to be capable of only low densities and relatively flat empty areas were assumed to be capable of development at relatively high densities.

See Table 1 for a breakdown of the Enumeration Data and Figure 3 for a map showing the Enumeration Districts and Communities. The data and analysis of the data revealed some interesting facts. Firstly, the total population in the catchment presently is estimated to be about 62,754. Also, of the 25 STATIN Enumeration District communities, 14 are fully developed and 11 have some potential for future development. Inspection of the estimated occupancy levels of households revealed that there are 3.8 persons per household and 13.4 households per hectare in fully developed communities, barring multi-stories developments (at Tawes Pen) that have much higher densities.

1.1.1.3 Design Population

A design population estimate was arrived at by:

- Applying the project's design occupancy and housing density figures to the partially and undeveloped land areas. The observed averages from the enumeration community data (of 3.8 persons per household and 13.4 households per hectares) were used for the flat terrain. A lower average of 3.5 for the hilly terrain areas that could be developed was utilized for those empty hilly areas in the catchment. The 3.5 were determined from the inspection of the Enumeration data for St. Jago Heights (Spanish Town); and
- Using the existing population of the fully developed areas.

It is important to note that the resulting estimate is expected to be conservative given that it was assumed that the entire population within the catchment would be sewered. This is unlikely, given that there are some areas that would not be economical to sewer, given the likely high delinquency rates. A private effort (such as this) would justifiably avoid such areas in order to optimize the returns on capital investment (Table 2). The estimated fully developed population for the catchment was determined to be 140,212.

Table 1 Summary of Existing Enumeration Community data for the catchment

Spanish Town Communities											
Number	Community	ED that fall within Communities	Population	Housing	Area (Hectares)	Comments	Occupancy (persons per dwelling)	Population Density (Persons per hectares)	Housing Density (Housing/Hectare)	Existing Population
7	Winter's Gardens	C20,C21&C22	1995	523	83	Developable	3.81	24	6.3	1995
9	Westmore Gardens/ Sunnyside Villa	5,C46,C47,C74,C75,C76,C77,C78,C	5111	1237	110	Developable	4.13	47	11.3	5111
10	Eltham View	C26,C38,C39,C40,C42	3638	1083	160	Developable	3.36	23	6.8	3638
13	Hampton Green		1621	527	57	Developable	3.08			1621
22	Hopedale/ Leiba Gardens	C113,C114,SW38	2768	778	124	Developable	3.56	22	6.3	2768
23	Sydenham	SW39,SW40,SW42,SW43	1727	924	261	Developable	1.87	7	3.5	1727
31	Dovecot District	SW37,WC98	1669	372	311	Developable	4.49	5	1.2	1669
2	Stratmore Gardens	C8	981	200	90	Developable. Medium density likely	4.91	11	2.2	981
35	Green Acres	WC75,WC76,WC77,WC78	1943	519	334	Developable. Medium density likely with partially hilly terrain	3.74	6	1.6	1943
37	Bellevue	WC94,WC95,WC96,WC97	1063	312	418	Developable. Medium density likely with partially hilly terrain. 120 ha should be excluded from the catchment	3.41	3	0.7	1063
33	Fairview/Ebony/Friendship	C62,WC63,WC64,WC65,WC66,WC	7932	2177	261	Developable. Only low density likely due to hilly terrain (49 ha). The majority of the land can be developed at higher densities.	3.64	30	8.3	7932
					Sub-total					30,448
4	Eltham Park	C5,C6,C11,C12,C13,C14,C27&C28	4583	1495	71	Fully developed	3.07	64	21.0	4583
6	Golden Acres	C18,C19&C23	1449	337	43	Fully developed	4.30	34	7.9	1449
8	Irish Pen	C43,C44&C48	1615	538	31	Fully developed	3.00	53	17.5	1615
14	Tawes Pen	C90,C91,C92	1822	466	8	Fully developed	3.91	214	54.9	1822
18	Homestead Park	C83,C84	1200	337	34	Fully developed	3.56	35	9.9	1200
19	Homestead	C86,C87,C88,C89,C106,C107,C108,	6179	1527	88	Fully developed	4.05	70	17.3	6179
20	Willowdene Estate	C80,C81,C82	1618	432	32	Fully developed	3.75	51	13.6	1618
21	Willowdene	C110,C111,C112	1645	497	47	Fully developed	3.31	35	10.6	1645
24	Horizon Park	W99,SW100,SW101,SW102,SW10	2353	670	66	Fully developed	3.51	36	10.1	2353
25	Beggar's Bush	C104,C105	1121	254	15	Fully developed	4.41	73	16.5	1121
32	Cromaty/ Windsor	SW97,SW98	1724	472	132	Fully developed	3.65	13	3.6	1724
34	Frasers Content	WC72,WC73,WC74	1819	320	24	Fully developed	5.68	75	13.1	1819
3	Avon Park/Angels	C4,C7,C9,C10,C16,C17,C24&C25	3726	1029	235	Good potential except for hilly area	3.62	16	4.4	3726
1	Angel Estate	C1,C2&C3	1452	508	32	No further development likely. Hilly terrain left	2.86	45	15.7	1452
					Sub-total					32,306
45	Future Growth area 1				560	Developable at high density				
46	Future Growth area 2				520	Developable at low density				
					Sub-total					
					TOTAL					62,754

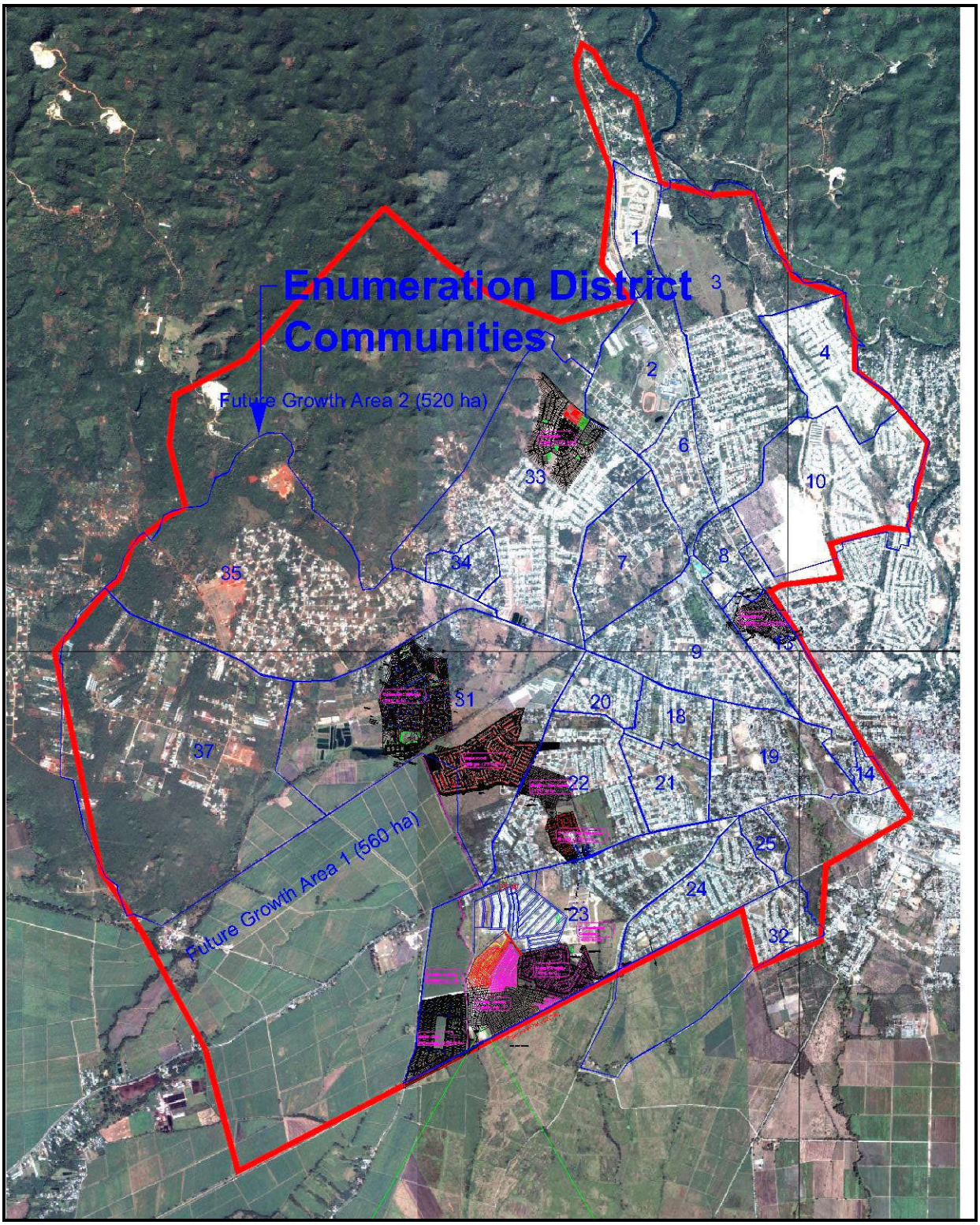

Figure 3 **Enumeration districts for the catchment of the proposed WWTP (on satellite imagery 2001)**

Table 2 Estimated fully developed population for the catchment

Spanish Town Communities											
Number	Community	ED that fall within Communities	Population	Housing	Area (Hectares)	Comments	Design Occupancy	Design Housing Density	Developable area (ha)	Projected Design Population	Existing Population
7	Winter's Gardens	C20,C21&C22	1995	523	83	Developable	3.7	13	83	4005	1995
9	Westmore Gardens/ Sunnyside Villa	5,C46,C47,C74,C75,C76,C77,C78,C	5111	1237	110	Developable	3.7	13	110	5272	5111
10	Eltham View	C26,C38,C39,C40,C42	3638	1083	160	Developable	3.7	13	160	7671	3638
13	Hampton Green		1621	527	57	Developable	3.7	13	57	2741	1621
22	Hopedale/ Leiba Gardens	C113,C114,SW38	2768	778	124	Developable	3.7	13	124	5969	2768
23	Sydenham	SW39,SW40,SW42,SW43	1727	924	261	Developable	3.7	13	261	12534	1727
31	Dovecot District	SW37,WC98	1669	372	311	Developable	3.7	13	311	14956	1669
2	Stratmore Gardens	C8	981	200	90	Developable. Medium density likely	3.7	3.5	90	1170	981
35	Green Acres	WC75,WC76,WC77,WC78	1943	519	334	Developable. Medium density likely with partially hilly terrain	3.7	3.5	334	4325	1943
37	Bellevue	WC94,WC95,WC96,WC97	1063	312	418	Developable. Medium density likely with partially hilly terrain. 120 ha should be excluded from the catchment	3.7	3.5	418	5416	1063
33	Fairview/Ebony/Friendship	C62,WC63,WC64,WC65,WC66,WC	7932	2177	261	Developable. Only low density likely due to hilly terrain (49 ha). The majority of the land can be developed at higher densities.	3.7	13	212	10188	7932
				Sub-total						74,246	30,448
4	Eltham Park	C5,C6,C11,C12,C13,C14,C27&C28	4583	1495	71	Fully developed				4583	4583
6	Golden Acres	C18,C19&C23	1449	337	43	Fully developed				1449	1449
8	Irish Pen	C43,C44&C48	1615	538	31	Fully developed				1615	1615
14	Tawes Pen	C90,C91,C92	1822	466	8	Fully developed				1822	1822
18	Homestead Park	C83,C84	1200	337	34	Fully developed				1200	1200
19	Homestead	C86,C87,C88,C89,C106,C107,C108,	6179	1527	88	Fully developed				6179	6179
20	Willowdene Estate	C80,C81,C82	1618	432	32	Fully developed				1618	1618
21	Willowdene	C110,C111,C112	1645	497	47	Fully developed				1645	1645
24	Horizon Park	SW99,SW100,SW101,SW102,SW10	2353	670	66	Fully developed				2353	2353
25	Beggar's Bush	C104,C105	1121	254	15	Fully developed				1121	1121
32	Cromaty/ Windsor	SW97,SW98	1724	472	132	Fully developed				1724	1724
34	Frasers Content	WC72,WC73,WC74	1819	320	24	Fully developed				1819	1819
3	Avon Park/Angels	C4,C7,C9,C10,C16,C17,C24&C25	3726	1029	235	Good potential except for hilly area			170	3726	3726
1	Angel Estate	C1,C2&C3	1452	508	32	No further development likely. Hilly terrain left				1452	1452
				Sub-total						32,306	32,306
45	Future Growth area 1				560	Developable at high density	3.7	13	560	26928	
46	Future Growth area 2				520	Developable at low density	3.7	3.5	520	6732	
				Sub-total						33,661	
				TOTAL						140,212	62,754

1.1.1.4 Wastewater Generation Rate

An estimate of the quantity of wastewater reaching the treatment plant was determined. The key pieces of information and assumptions used in the derivation of this estimate are discussed as follows:

1.1.1.4.1 Scenarios Considered

Two broad categories of scenarios were considered. These include a Regional Approach Scenario where the entire catchment contributes to the treatment plant. The second category is a Development Specific Approach where only specific developments are attached to the system (defined in Table 3). These are only being investigated for the sake of exploration as to the effect on the treatment plant's performance.

1.1.1.4.2 Water Consumption Rate

An average water consumption rate of 40 IGPD per capita was assumed for this project. This rate is consistent with JIE (1984) recommendations[1] for low-income communities in 1984 and much higher than the observed consumption for such communities, based upon very recent NWC observations.

1.1.1.4.3 Return Ratio and Infiltration

A return ratio of 95% was assumed for the sewage flows from water consumption. The return ratio is the relationship between what water a household consumes and that, which is returned in the sewers for treatment. The difference between water consumption and sewage flow (which is 5% in this case) is believed to be representative of the water consumption that is used for household purposes that do not discharge into the sewers, such as landscape irrigation, construction purposes and washing of floors, etc. An infiltration rate of 10% has been considered in the design, in order to make some allowance for infiltration due to groundwater.

[1] Jamaica Institution of Engineers (1984); Guidelines for the Design and Construction of Housing Infrastructure

Table 3 Definition of development specific scenario

		Number of lots			
		Phases			
		1 - Short-term			
		1.1	1.2	1.3	1.4
No.	Names	Immediate connection - Nearby development and developments that are already built and connected to HP WWTP	End of Year 1 - Exisitng planned developments that are going to be built out over time	End of Year 2 - Exisitng planned developments that are going to be built out over time and Ebony Vale WWTP	End of Year 3 - Exisitng planned developments that are going to be built out over time and Eltham WWTP
1.0 Existing Developments					
1.01	Crescent				
1.02	Cromarty				
1.03	Angels 1(New Era)				445
	Angels 2 (New Era)				460
1.04	Angels (WHICHON)				630
1.05	Friendship (Joabs Lane Community)				
1.06	Fair View Park				
1.07	Ebony Vale			400	
1.08	Golden Acres			377	
1.09	Royal Palace			120	
1.10	Dovecot Park			372	
1.11	Sydenham Cottages (~25 lots)				
1.12	Sydenham Villas (~502 lots)				
1.13	Sydenham Gardens – I				
1.14	Sydenham Gardens – II (~483 lots)				
1.15	White Water Meadows I (~760 lots)	760			
1.16	Horizon Park				
1.17	Willowdene				
1.18	Hampton Greene				
1.19	Eltham - Gore				
1.20	Eltham Park - 1				
1.21	Eltham Park - 2				
1.22	Eltham Park - 3				
1.23	Eltham Park - 4				
1.24	Eltham View 1				
1.25	Eltham View 2				
1.26	Eltham - WHICHON (Hampton/new)				
1.27	Homestead				
2.0 Known Planned Developments					
2.01	Magil Palms (460 lots)		460		
2.02	Spanish Village (514 lots)			514	
2.03	63 Old Harbour Road			70	
2.04	Innswood Village (750 lots)		750		
2.05	53-57 Old Harbour Road		150		
2.06	Ardenne Park (460 lots)				800
2.07	SCJ Housing (450 lots)			450	
2.08	White Water Meadows – II (350 lots)			350	
2.09	Hampton Meadows		215		
2.10	Reid's Savanna		150		
	Cumulative Number of units	**760**	**2,485**	**5,138**	**7,473**
	Total Number of units			**15,856**	
	Occupancy	3.7	3.7	3.7	3.7
	Population	**2,811**	**9,192**	**19,005**	**27,642**
	Total			**58,651**	

1.1.1.4.4 Design Domestic Wastewater Flow Rates

The resulting estimate of wastewater flows for the scenarios considered are shown in Table 4 and 5. The total flow to the treatment, including allowances for infiltration, is 26,374 cubic metres per day or 5,860,878 IGPD for the design scenario.

1.1.1.4.5 Provisions for Septage Treatment

The National Environment and Planning Agency (NEPA) and the Environmental Health Unit (EHU) made a special request for the WWTP to accommodate septage. Septage is the liquid and solid material pumped from septic tanks when they are cleaned. NEPA and EHU's request was considered and incorporated in the design. Special reference was made to the USEPA's Handbook (1984)[2] on this aspect of the treatment. A total of 52 – 1,400 gallon Septage trucks per week (≈7.4 trucks per day on average) were considered in the design. This is equivalent to making provisions for an unsewered population of 50,000 persons.

[2] United States Environmental Protection Agency (1984) Handbook of Septage Treatment and Disposal, EPA-625/6-84-009

Table 4 Wastewater flow estimate calculations

	Flow Scenarios					
	1	2	3	4	5	Units
Configuration	Regional Approach	Development Specific Approach	Development Specific Approach	Development Specific Approach	Development Specific Approach	
Number of lots		**760**	**2485**	**5138**	**7473**	
Design Parameters						
Wastewater Generation						
Water Consumption	180	180	180	180	180	l/day
Return Ratio	95%	95%	95%	95%	95%	
Infiltration	10%	10%	10%	10%	10%	
Data						
Number of lots		760	2485	5138	7473	Nr.
Occupancy per lot		3.7	3.7	3.7	3.7	persons per lot
Population - Total	140212	2811	9192	19005	27642	Nr.
Wastewater Generated	**26,374**	**529**	**1,729**	**3,575**	**5,200**	**m3/day**
Wastewater Generated	**5,860,878**	**117,508**	**384,222**	**794,419**	**1,155,448**	**IGPD**

Table 5 Septage volume calculations

	1	2	3	4	5		
Planning Strategy	Regional Approach	Development Specific Approach	Development Specific Approach	Development Specific Approach	Development Specific Approach		Units
Catchement parameters							
Unsewered Population	50000	12500	12500	12500	12500		
Occupancy	3.7	3.7	3.7	3.7	3.7		/household
Nr. of houses in catchment considered	13514	3378	3378	3378	3378		
Pumping interval	5	5	5	5	5		Yrs
Volume Estimation							
Number of trucks per day	7.4	1.9	1.9	1.9	1.9		
Size trucks	1400	1400	1400	1400	1400		USGallons
Volume of septage per day	39	10	10	10	10		m3/day

1.2 DESIGN WATER QUALITY STANDARDS

1.2.1 Influent Wastewater Quality: Domestic and Septage

Several references have design ranges for influent wastewater quality. The selected influent design water quality is summarized in Table 6. The USPEA (1984) Handbook on Septage was utilized for the determination of reasonable design value for the same. Inspection of the design values revealed that the septage is on average 20 times stronger than domestic wastewater and it has an extremely high oil and grease content.

Table 6 Design water for the influent streams and NEPA's effluent guidelines

	Design Influent		NEPA Eff Standard			Units
	Domestic	Septage	Direct discharge	Irrigation	WHO Irrigation	
COD	650	15000	100	<100	<12	mg/l
BOD	250	7000	20	15	15	mg/l
TSS	300	15000	20		15	mg/l
Total Nitrogen	45	700	10	15		mg/l
Phosphates-P	10	250	4			mg/l
Oil and Grease		8000			10	mg/l
pH	7		6.00	10		
Faecal Coliform	1.0E+07		1.0E+03	12	1.2E+01	MPN/100 ml
Residual Chlorine			1.5	0.5	0.5	mg/l
Giardia Cyst	30000			<1	<1	# per 100ml

The provision for septage treatment in the design necessitated due consideration of the blended or mixed strength that would result from the same. Provision for septage from 50,000 persons or 7.4 trucks per day (on average) and regional and development specific approach is shown in Table 7. The impact of adding septage to the domestic wastewater is expected to be marginal. This is illustrated in the BOD concentration that increases from 250 mg/l to 260 mg/l. The impact is however far more significant when the base flow of the domestic wastewater is low at the start of receiving wastewater. In such instance, the BOD is expected to increase to 373 mg/l. It needs to be clearly stated that the addition of septage to the system should occur at such times that there is significant base flow of domestic wastewater in order to have good dilution of this strong influent stream.

Table 7 "Blended" design influent water quality

Planning Strategy	1 Regional Approach	2 Development Specific Approach	3 Development Specific Approach	4 Development Specific Approach	5 Development Specific Approach
General					
Flow-daily	26,373,950	528,788	1,728,998	3,574,885	5,199,517
Population	140,212	2,811	9,192	19,005	27,642
Number of series in parallel	4	1	1	1	1
Flow-daily (per series)	6,593,488	528,788	1,728,998	3,574,885	5,199,517
Combined Water Quality					
COD	671	912	731	689	677
BOD	260	373	288	269	263
TSS	322	569	383	340	328
Total Nitrogen	46	57	49	47	46
Phosphates-P	10	14	11	11	10
Oil and Grease	12	146	45	22	15
PH	7	7	7	7	7
Faecal Coliform	1.0E+07	9.8E+06	9.9E+06	1.0E+07	1.0E+07
Residual Chlorine					
Giardia Cyst	29,955	29,451	29,830	29,918	29,943
Alkalinity	250	245	249	249	250

1.2.2 Effluent Wastewater Quality – NEPA Guidelines

Both NEPA's irrigation reuse standards and the direct discharge standards were utilized as the designs goals (See Table 6).

1.2.2.1 Sewerage

The sewerage considered under this project will consist of approximately 12km of both primary and secondary gravity and force mains that will collect the wastewater from discrete communities. It is envisaged that there will be a need of one regional lift station. The majority of the pipeline route will be along the existing National Irrigation Commission (NIC) reservation and to a lesser extent, along public roads between St. John's Road and Ardenne Farm. In summary, the system will consist of:

- Gravity mains ranging from 300mm to 900mm in diameter.
- Force mains ranging from 400mm to 600mm in diameter.
- A regional lift station at White Water Meadows.

Preliminary hydraulic calculations revealed that the natural slopes along the route of the pipelines can achieve the required pipe slopes. This fact implies that the pipelines will in general be laid in relatively shallow trenches, 1.2 to 2.0m deep.

1.2.2.2 Wastewater Treatment Plant

The treatment plant will receive the wastewater and septage from trucks that will have access to the plant. The area of the treatment plant site including buffer will be 112ha. The plant will consist of:

- Screens and Grit chambers;
- Septage Holding Tank;
- Waste Stabilization Ponds; and
- Constructed Wetlands.

(See Figures 4 - 10)

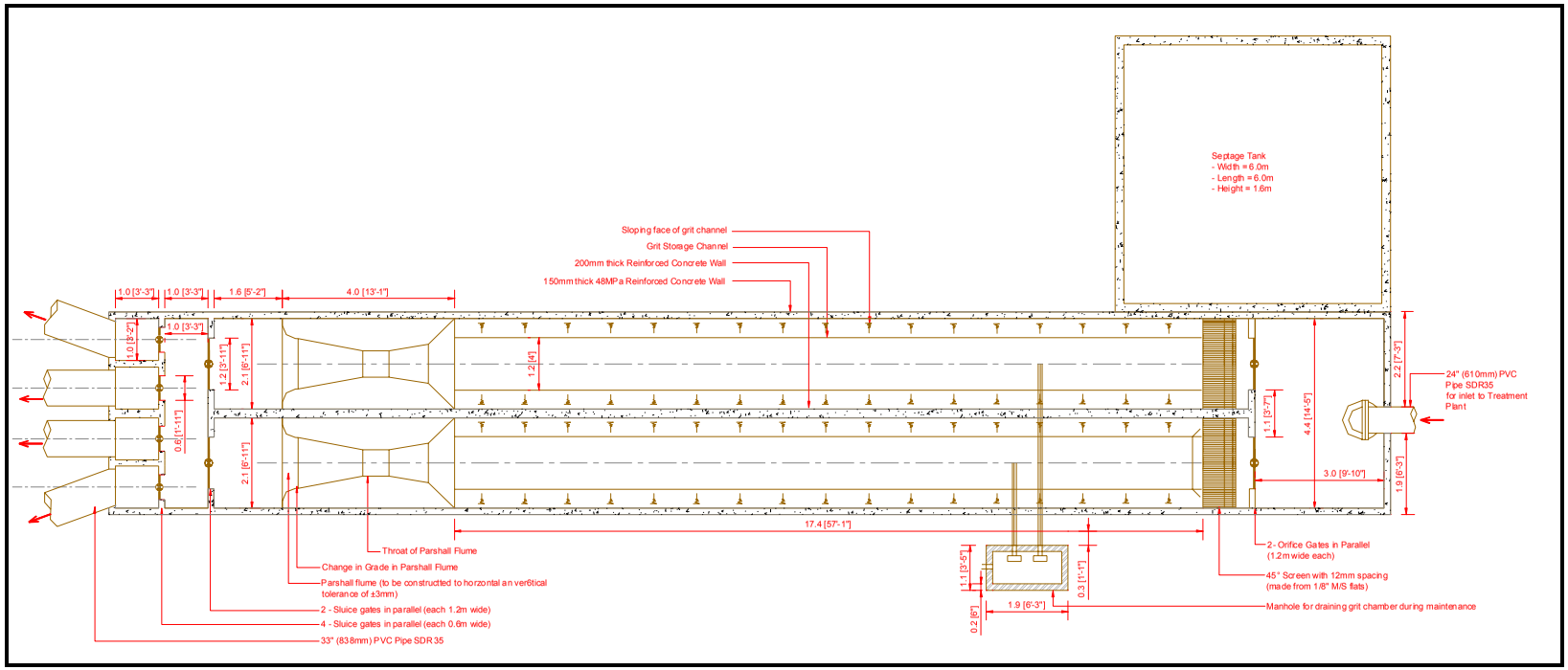

Figure 4 Plan and longitudinal elevation of flume

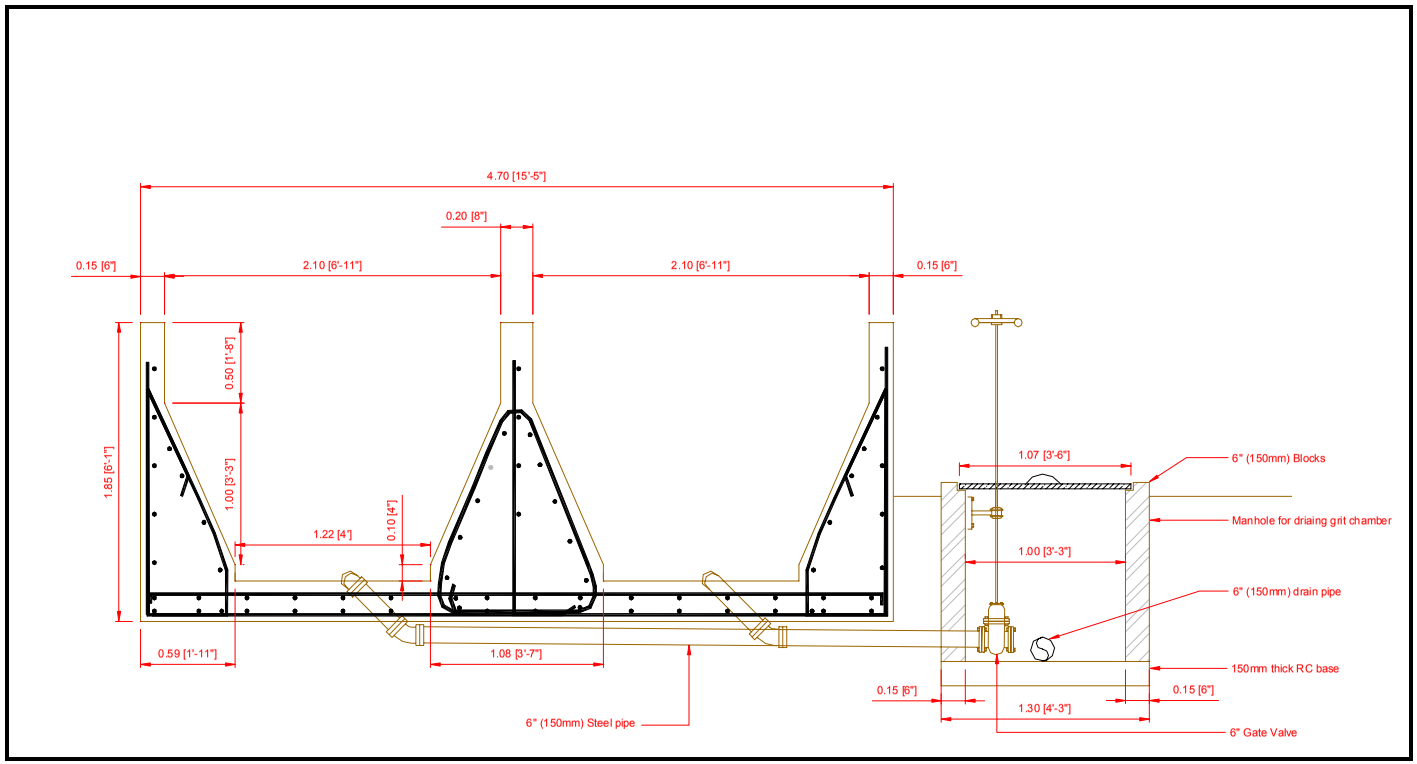

Figure 5 **Section through flume**

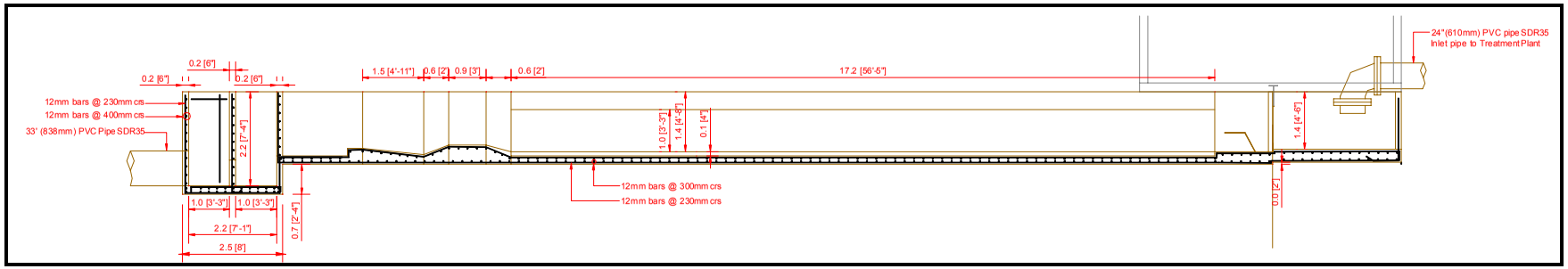

Figure 6 **Longitudinal elevation of flume**

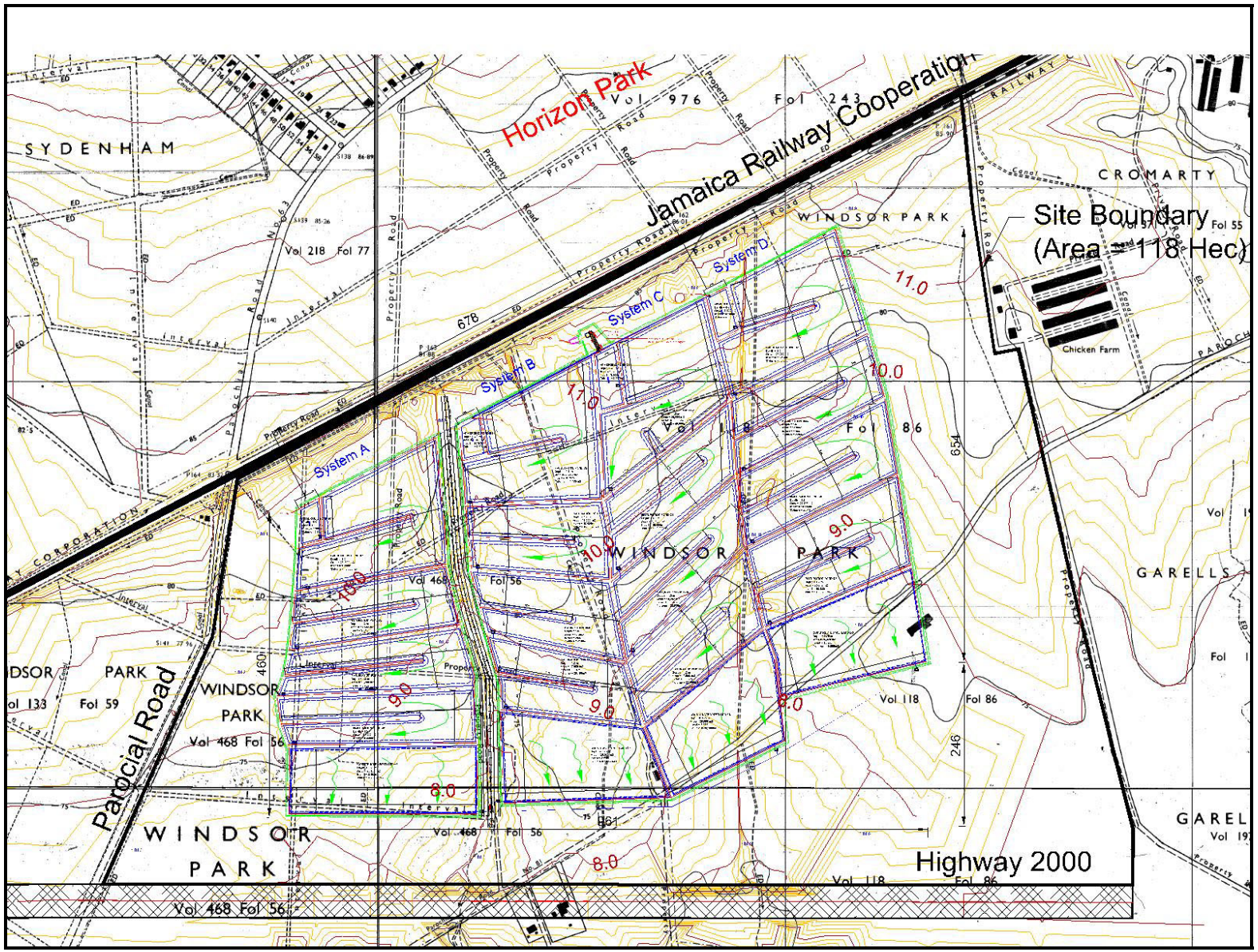

Figure 7 **Layout of proposed regional WWTP at Horizon Park**

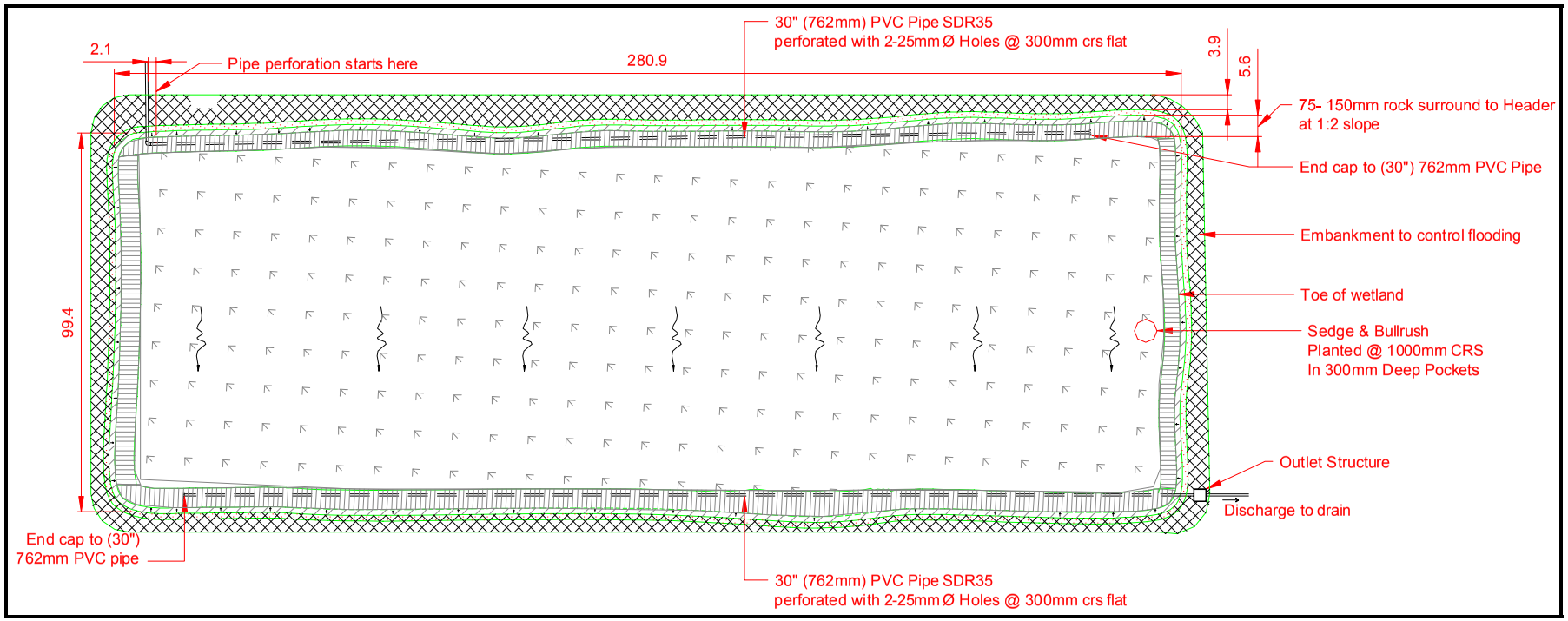

Figure 8 Layout of constructed wetland

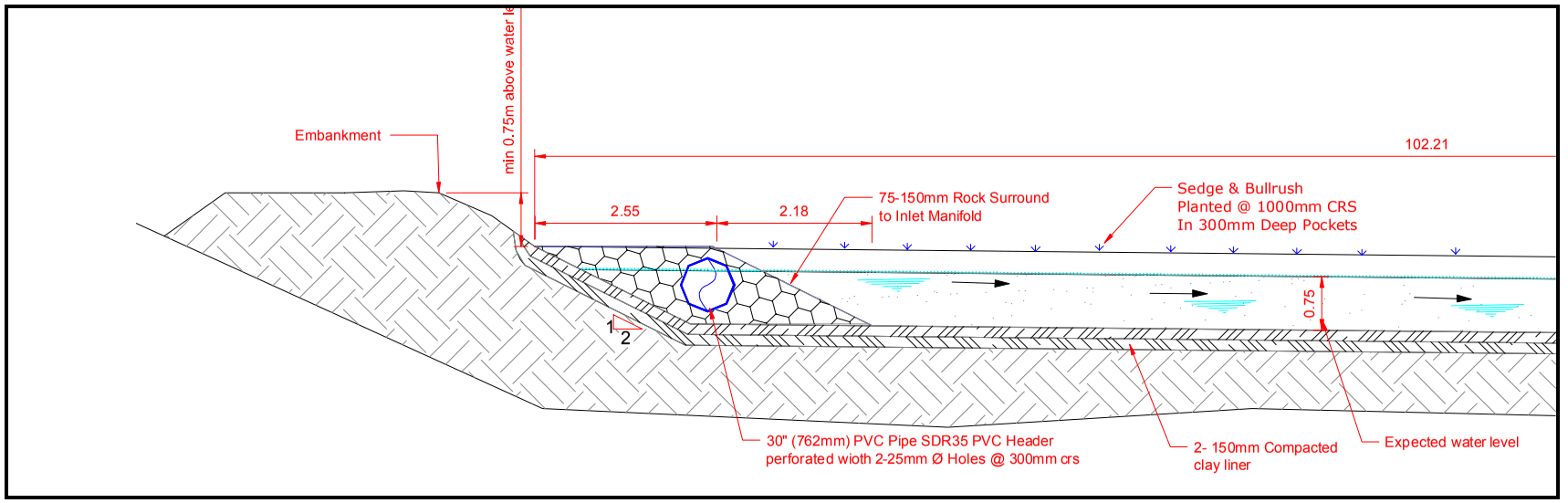

Figure 9 **Cross-section of inlet of constructed wetland**

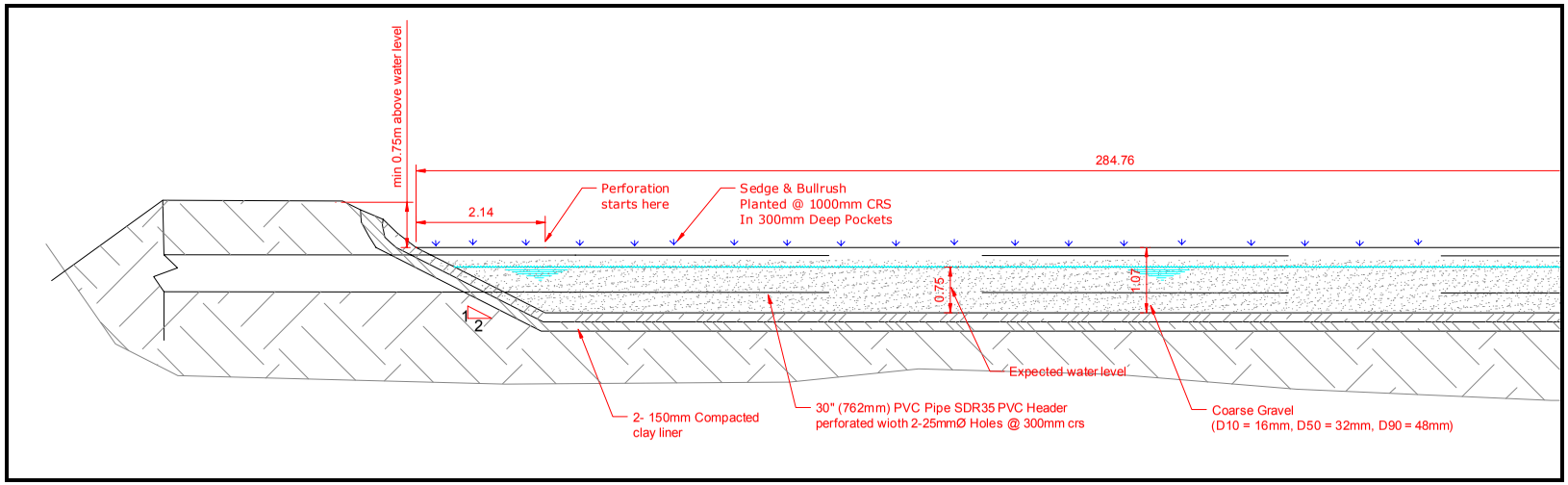

Figure 10 **Longitudinal profile through inlet of wetland**

1.3 CONSTRUCTION PHASE

1.3.1 Sewerage

Construction of the sewerage will take place in both the NIC's reservation and in public roads.

1.3.1.1 National Irrigation Commission Reservation

The NIC's reservation is an unpaved 6m wide reservation along the irrigation canal that is sufficiently wide for construction vehicles. The likely construction methodology in the NIC reservation is as follows:

1. Clear ground scrubs in trench alignment.
2. Survey alignment and place pegs.
3. Mobilize construction equipment and material into the reservation. Such equipment and material is likely to consist of:
    a. Trencher or excavator or backhoe;
    b. Sand for pipe laying; and
    c. Pipes for one days work at the start of each workday. This might be 15 to 20 lengths of pipeline.
4. Excavate trench to design trench invert. Material to stay over night if necessary.
5. Place pipe sand to invert of trench.
6. Place pipe in trench and fit to other length of pipe.
7. Continue to lay all the allocated pipes for the day.
8. Place pipe sand to surround and cover all pipe lengths.
9. Place backfill to pipe to ground level and level as best as possible.

Construction in the NIC's reservation has several significant advantages. These include:

1. Minimized obstruction to traffic flows;
2. Faster construction due to the construction itself not being hampered by other vehicles; and
3. Less construction traffic to remove trench material during construction.
4. Minimal vegetation disturbance due to mostly secondary vegetation.

1.3.1.2 Public Roadways

Construction in the public roadways will involve laying pipelines along the length of roads and crossing roads. Permission will be sought from both the National Works Agency (NWA) for:

a. Crossing Old Harbour Road.
b. Laying pipeline along and crossing St. John's Road.

The Parish Council's Superintendent of Roads (PC) will also be consulted about:

c. Laying pipeline in Ebony Vale to get to Ebony Vale Treatment Plant and Ardenne Park.

The likely construction methodology in the public roadways is as follows:

1. Survey alignment and paint trench edges.
2. Place safety barriers and signage for pedestrians and motorists.
3. Cut trench edges with asphalt saw.
4. Mobilize construction equipment and material to the site. Such equipment and material is likely to consist of:
    a. A Trencher
    b. Sand for pipe laying
    c. Pipes for one days work at the start of each work day. This might be 15 to 20 lengths of pipeline.
5. Excavate trench to design trench invert and remove immediately.
6. Place pipe sand to invert of trench.
7. Place pipe in trench and fit to other length of pipe.
8. Continue to lay all the allocated pipes for the day.
9. Place pipe sand to surround and cover all pipe lengths.
10. Place backfill to pipe to foundation level.
11. Temporarily reinstate road by placing and compacting marl to the foundation and applying cold mix asphalt to the surface.
12. Permanently reinstate road, two to three weeks later by removing cold mix asphalt and replacing with hot mix asphalt.

Construction in the public road has several disadvantages over construction in the NIC reservation. These include:

1. Obstruction to traffic;
2. Obligation to remove trench material every day; and
3. Obligation to reinstate road.

1.3.1.3 Wastewater Treatment Plant

Construction of the WWTP will essentially consist of concrete and masonary works for the inlet, extensive earth works for the ponds and wetlands and a small amount of pipe works for connecting the ponds.

1.3.1.4 Inlet Works

The inlet works will consist of the screens, grit chamber and septage holding tank. The construction of these works is expected to consist of minor earth moving to facilitate the foundations of these concrete structures and placing of formwork and casting of concrete.

1.3.1.5 Ponds and Wetlands

Pond and wetland construction is anticipated to be the most significant activity. The overall strategy is to remove as little soil as possible in order to make the embankments of the ponds. The cut and fill balance was therefore carefully scrutinized. The topsoil was not considered for use in the final structures and hence, this represents the most significant earth moving requirement of 180,000 cubic metres. The soils between the bottom of the topsoil (or top 0.3m) and the foundation level of the ponds were considered for use in the embankments. The volume of this material is estimated to be 181,000 cubic metres. A total length of embankment of 12,200m is expected to require 137,000 cubic metres of material. The majority of this will come from the foundation soils of the ponds (Table 8).

Excess cut material, estimated to be 223,000 cubic metres (made up mostly of top soil material), will be placed in a perimeter storage berm 2m high and 20m wide by some 3,800m long. This berm will be landscaped with trees and scrubs.

The wetland gravel fill that is estimated to be 106,000 cubic metres will have to be trucked in from an approved quarry. It is anticipated that the wetlands will take approximately 4 months to construct.

Table 8 Summary of Earthwork activities

Nr	Description	Unit	Quantity
1	**Excavation of Top soil**		
	Area to be cleared	ha	60
	Depth to be cleared	m3	0.3
	Volume to moved to storage area on site	m3	180,000
2	**Excavation to foundation level**		
	Area to be cleared	ha	45
	Depth to be cleared	m3	0.4
	Volume to moved to embankments	m3	181,344
3	**Embankments**		
	Length	m	12220
	Average height	m	1.5
	Side slopes		3
	Berm width	m	3
	Cross section area	m2	11.25
	Volume to be placed	m3	137,475
4	**Excess Cut and Fill Perimeter Storage Berms**		
	Volume	m3	223,869
	Depth of storage berm	m	2
	Width of storage berm	m	50
	Required length	m	2,239
	Perimeter of site	m	3,800
	Comment		Ök
5	**Wetland Gravel Fill**		
	Volume of fill	m3	106,400
6	**Construction Time and Equipment Requirements**		
	Production rate - Scrapers	m3/hr	90
	Number of crews	Nr.	3
	Total volume to be excavated	m3	361,344
	Time for construction - Ponds	months	1.45
	Volume per truck	m3	19
	Number of trips		5,533
	Trips per day		64
	Time for construction - Wetland	months	4

The anticipated construction methodology for the ponds is as follows:

1. Peg out designated pond (including invert and embankments) and associated excess cut berm area.
2. Excavate (Grub) first 0.3m of top soil by scraper and bulldozer combination and place directly in berm area.
3. Excavate to foundation level of ponds and place material directly into embankments.

4. Compact embankment in lifts of 0.2m as material is placed.
5. Scarify top 0.2m of foundation level of ponds and compact with sheep-foot roller.

The following is the anticipated construction methodology for the wetlands:

1. Trucks will deliver the aggregate from the quarry to the site.
2. This material will be placed in layers on the finished formation level of the wetland.
3. A bulldozer will spread the aggregate across the floor of the finished wetland bermed area until the design wetland thickness is achieved.

It is anticipated that with 3 or 4 crews of equipment (scraper and bulldozer), the works will take approximately 3 to 4 months to complete.

1.4 OPERATION PHASE

1.4.1 Wastewater Influent and Septage

Wastewater will be delivered to the site by way of a force main from the White Water Meadows lift station. The influent will be delivered to the screen and grit chamber directly. Septage will be delivered by trucks to the site. The trucks will have the option of using the Horizon Park or Sydenham routes. The trucks will discharge the effluent directly into the septage holding tank. The operator will release the septage during peak flows into the treatment plant.

1.4.2 Screenings and Grit Handling

Approximately 1.6 cubic metres per day of screenings will gather on the inclined bar screens in the grit chamber. These will be removed by the operator and placed on a drying tray temporarily. The partially dried screenings will be removed daily to a skip near the screens. This skip will be emptied, and the resulting solid waste load removed as needed to the Riverton Landfill.

Approximately 0.4 cubic metres of grit will gather in the invert of the grit chamber daily. These will be scraped and placed in the same skip as the screening for removal from the site. If 2 skips are permanently left on site, then it is anticipated that a solid waste truck will visit the site on a weekly basis.

1.4.3 Effluent Water Quality

Effluent quality through the system is summarized in Table 9 for the coolest month in the year (worst water quality). As is evident from the predictions, all of the effluent parameters are expected to pass NEPA and WHO guidelines. Effluent will be discharged at a location in the drain in between series 1 and 2 at 752120.68E and 647129.30N (location in JAD 2001).

Table 9 Summary of effluent water quality for the cool month (which is also the design month)

	Design Influent	NEPA Eff Standard			WHO	Effluent Quality (Scenario 1)					
		Direct Discharge	Marine	Irrigation	Irrigation	Cool Month					
						An. Pond	Fac. Pond	Mat. 1	Mat. 2	Mat. 3	Con. Wetland
COD	650	100		<100							
BOD (unfiltered)	250	20		15		130	33	24	18	14	5
BOD (filtered)							13	10	7	6	5
TSS	300	20		15							
Total Nitrogen	45	10	0.018			37.1	19.9	9.0	4.1	1.8	<1
Phosphates-P	10	4	0.018			10.0	8.1	6.9	6.1	5.4	3.9
Oil and Grease				10							
pH	7	6.00									
Faecal Coliform	1.0E+07	200	200	12	1000	1.4E+06	1.5E+05	1.7E+04	2.0E+03	2.4E+02	1.2E+01
Residual Chlorine		1.5		0.5							
Giardia Cyst	30000			<1							

1.5 MAINTENANCE PHASE

1.5.1 Sludge Handling

The anaerobic and facultative ponds will accumulate sludge that reduces the usable volume of the ponds. This sludge results from the settling of the influent wastewater and from the settling of both anaerobic and aerobic bacteria and algae. It is estimated that approximately 2,263 cubic metres of sludge will be generated every four years, after which time, the anaerobic ponds will need to be cleaned. The need for the desludging of the ponds should be determined by a "White-towel" test. This test should be done every year to determine if the depth has been reduced to an intolerable amount exceeding 33% of the liquid depth of the ponds.

Should the ponds require desludging, then the following procedure will be utilized:

1. The pond series to be maintained will be isolated from the distribution box at the inlet works.
2. The ponds will be allowed to stand for 4 days filled.
3. Under drain valves will be opened to allow the ponds to drain by discharge of the treatment plant.

4. The ponds will then be allowed to dry naturally.
5. The ponds will then be excavated to the finished levels by an excavator. The excavator will tip the material directly into a tipper truck waiting behind.
6. The material will be removed to the Riverton Landfill over a four to five day period, weather permitting.

1.5.2 Landscaping

Vegetation growing around the ponds will be trimmed to prevent entry into the ponds. The trimmings will be stockpiled and naturally composted to reduce the volume. Tipper trucks will be hired from time to time to remove this material to the Riverton Landfill.

A tree belt will be planted around the perimeter of the site. This belt will be made up of low, medium and tall trees. The result will be a wind breaker which will act to reduce the spread of any odours that might be produced, improve aesthetics and reduce any noise generated during the operation of the WWTP such as the emptying of cesspool trucks.

1.6 STUDY TEAM

Dr Dale Webber – Water Quality
Carlton Campbell, M. Phil. – Socio economics/Noise Assessment
Professor Edward Robinson - Geology
Christopher Burgess, M.Sc., P.E. – Hydrology
David Narinesingh, Msc. (PhD pending) – Fauna/ Vegetation
Laura Doctor (M. Phil. Pending) – Water Quality
Technical Assistants – Socio economics survey

2.0 POLICY, LEGAL AND ADMINISTRATIVE FRAMEWORK

BACKGROUND

An Environmental Impact Assessment (EIA) is "*a structured approach for obtaining and evaluating environmental information prior to its use in decision-making in the development process. This information consists, basically, of predictions of how the environment is expected to change if certain alternative actions are implemented and advice on how best to manage environmental changes if one alternative is selected and implemented*" (Bisset, 1996).

The basis of EIAs has been summarised as follows[3]:

1 *Beyond preparation of technical reports, EIA is a means to a larger end - the protection and improvement of the environmental quality of life.*

2 *It is a procedure to discover and evaluate the effects of activities on the environment - natural and social. It is not a single specific analytic method or technique, but uses many approaches as appropriate to the problem.*

3 *It is not a science but uses many sciences in an integrated inter-disciplinary manner, evaluating relationships as they occur in the real world.*

4 *It should not be treated as an appendage, or add-on, to a project, but regarded as an integral part of project planning. Its costs should be calculated as a part of adequate planning and not regarded as something extra.*

5 *EIA does not 'make' decisions, but its findings should be considered in policy - and decision-making and should be reflected in final choices. Thus it should be part of decision-making processes.*

6 *The findings of EIA should focus on the important or critical issues, explaining why they are important and estimating probabilities in language that affords a basis for policy decisions.*

[3] Wood, C., "Environmental Impact Assessment: A Comparative Review" p. 2. (from Caldwell, 1989, p.9)

Relevant Agencies and Laws of the Government of Jamaica

St. Catherine Parish Council

The St. Catherine Parish Council has portfolio responsibility for the provision of public services such as public health, fire protection, street cleaning and maintenance of recreational areas such as parks and play fields. The parish council's portfolio of solid waste collection and management of public markets was taken over by Eastern Parks and Markets. The government has however; more recently established the National Solid Waste Agency, which will be given overall responsibility of managing national solid waste.

It must be noted that one of the Parish Council's key responsibility is development control. This very important function serves to not just guide development but to shape and influence the pattern of development in any parish and or region. As a direct result development proposals have to be sent to the local parish council for development approval.

National Water Commission

The National Water Commission's chief portfolio responsibility in the land development process is to provide potable water and sewage services. Each proposal to develop land needs information and advice from the NWC as to whether or not the agency will be able to provide potable water. The issue of sewage is also important especially in the instances where central sewage plants are being used. The NWC is also the responsible body to comment and advice (approve or disprove) sewage proposals put forward by the project proponents.

The Solid Waste Management Authority

The new Solid Waste Management Authority Act (2001) subsumes the Litter Act and seeks to control the disposal of refuse in undesignated areas, as well as the delegation of garbage collection.

This Act seeks to control the disposal of refuse in undesignated areas, to include public places as described under Section 2 (c) of the Act, which includes public gardens, parks or open spaces,

or ‘any place of general resort to which the public have, or are permitted to have access with or without payment of any fees’…. Or ‘any other place in the open air to which the public has right of access without payment of any fees’. As such, disposal of refuse in the area during any phase of the development would constitute an offence under this Act.

Water Resources Authority

The Water Resources Authority was established to ensure the proper use of surface and ground water. This agency comments on proposed methods of sewage solutions in so much as it affects ground water contamination.

Environmental Health Unit (Ministry of Health)

The Environmental Health Unit of the Ministry of Health also comments proposed the methods of sewage disposal facilities. The agency is concerned about environmental degradation and human health, and ensures that sewage proposals are not designed to impact negatively on any of the two. (i.e. the environment and human health).

National Works Agency (NWA)

The National Works Agency focuses on the designs of drains and road network (layout).

National Environment and Planning Agency (NEPA)

This Executive agency is an amalgamation of three agencies, the Town Planning Department, The Land Development and Utilization Commission and the Natural Resources Conservation Authority. The National Environment and Planning Agency seeks to ensure that proposed developments do not have adverse negative impacts on the environment. To ensure this, proposed developments are submitted to NEPA for a permit and or license to develop.
The agency’s mission, is to ensure protection of the environment and orderly development locally and nationally.

The Natural Resources Conservation Authority Act (1991)

The Natural Resources Conservation Act was enacted in 1991, and created the then Government environmental agency, the Natural Resources Conservation Authority.

Under this Act, the NRCA was mandated to effectively manage the physical and natural resources of Jamaica so as to ensure their conservation, protection and proper use; promote public awareness on Jamaica's ecological systems and their importance to the social and economic life of Jamaica; manage national parks, marine parks, protected areas, public recreational facilities; and advise the Minister on general policies relevant to the management, development, conservation and care of the environment.

The Town and Country Planning Act (1948)

This Act was enacted in 1948. There have been substantial amendments to the Act in 1999 to provide for effective enforcement of development controls. The major objectives of this Act are to control the orderly development of lands comprised within the established development orders (now outdated), protecting amenities, and conserving and developing the resources of the area as prescribed.

This Act also provides for the making of Tree Preservation Orders whereby a local authority may seek to preserve trees or woodlands in their area and prohibit the lopping or wilful destruction of trees or securing the replanting of trees.

The Land Development and Utilization Act

This Act speaks to the usage of agricultural land. This Act tries to prevent Individual landowners and the state from having land, particularly good agricultural land idle. It aims to have good agricultural land be kept in production.

Water Resources Act (1995)

The Water Resources Authority Act was established in 1995 to regulate and manage the abstraction and allocation of water Resources. The Act also governs the preservation of water quality and the conservation of such resources. The Authority is required to gather data on the quantity and quality of water in above ground and underground resources.

The Public Health Act (1974)

The Public Health Act falls under the ambit of the Ministry of Health. Provisions are also made under this Act for the functions of the Environmental Health Unit of the Ministry of Health. The Environmental Health Unit functions through the Public Health Act to monitor and control pollution from point sources. The Central Health Committee would administer action against any breaches of this Act.

The Solid Waste Management Authority

The new Solid Waste Management Authority Act (2001) subsumes the Litter Act and seeks to control the disposal of refuse in undesignated areas, as well as the delegation of garbage collection.

This Act seeks to control the disposal of refuse in undesignated areas, to include public places as described under Section 2 (c) of the Act, which includes public gardens, parks or open spaces, or 'any place of general resort to which the public have, or are permitted to have access with or without payment of any fees'…. Or 'any other place in the open air to which the public has right of access without payment of any fees'. As such, disposal of refuse in the area during any phase of the development would constitute an offence under this Act.

The Office of Utilities Regulation Act 2000

This Act replaces the Public Utility Commission Act and to make new provisions with regard to the supervision of utility services, and for connected purposes. It seeks regulate the provision of prescribed Utility Services namely,

1. The provision of telecommunication services.
2. The provision of public passenger transportation by road, rail or ferry.
3. The provision of sewerage services.
4. The generation, transmission, distribution and supply of electricity.
5. The supply or distribution of water.

The Office of Utilities Regulation acts as a watchdog for the public when it relates to the provision of utility services. New utility developments have to apply to the Office for a licence to operate at which time the application is scrutinized to determine if it will provide the service as applied for in a manner that is both economical for both the public and the developer. It also has to approve the cost for the provision of the service.

Jamaican Environmental Requirements

EIAs are not only recommended in project design, but also required by Jamaican legislature. The following is a review of Jamaican *Environmental* policy and law that are relevant to the Unity Farm Development design, construction and operation.

National Environment and Planning Agency (NEPA)

NEPA is Jamaica's Regulatory Planning and Environmental Agency and represents a merger of the Natural Resources Conservation Authority (NRCA), the Town Planning Department (TPD) and the Land Development and Utilisation Commission (LDUC).

Town and Country Planning Authority (TCPA)

The Town and Planning Act, as amended (1987) establishes the Town and Country Planning Authority, which is responsible for land use zoning and planning regulations as described in their

local Development Orders. In particular for subdivisions, the Act is responsible, through the Development Orders, for:

a) *regulating the type of development to be carried out and the size and form of plots;*
b) *requiring the reservation of land for any of the public services referred to in Part V or for any other purposes referred to in this Schedule for which land may be reserved;*
c) *prescribing the character and type of public services or otter works which shall be undertaken and completed by the applicant for subdivision as a condition of the grant of authority to subdivide;*
d) *co-ordinating subdivision of contiguous properties in order to give effect to the scheme of development of such properties.*

The relevant local planning authority for the project is the St. Catherine Parish Council. The Wastewater Treatment Plant Development will need to be submit proposed subdivision and development concept plans to the Parish Council for approval.

Natural Resources Conservation Authority (NRCA) Act

The NRCA Act is Jamaica's umbrella environmental law. The purpose of the Act is to provide for the management, conservation and protection of the natural resources of Jamaica.

The Act has established the Natural Resources Conservation Authority (NRCA), which has a number of powers including, inter alia:-

- *issuing of permits to persons responsible for undertaking any construction, enterprise or development of a prescribed category in a prescribed area*
- *issuing licences for the discharge of trade or sewage effluent*
- *requesting an Environmental Impact Assessment (EIA) from an applicant for a permit or the person responsible for undertaking any construction, enterprise or development*
- *revocation or suspension of permits.*

The Act binds the crown and therefore takes precedence over the authority of other state in environmental matters.

NRCA's EIA Process

Under Section 9 of the NRCA Act, housing subdivisions of 10 units or more with facilities as proposed for Unity Farms will require a Permit for construction and may, under Section 10 of the Act, require an EIA.

1 *The NRCA permit procedure is initiated by the submission of the Project Information Form (PIF) to the Authority. The PIF screening form is reviewed to determine whether and EIA is required and to begin determining areas of environmental significance, especially in waste discharge.*

2 *Based on the plans for the development, an EIA is expected to be required for the Unity Farms Development. The consultants will liase with the NRCA to determine the scope of the EIA through proposed Terms of Reference (TORs). The TORs are proposed by the consultant using NRCA guidelines and are approved by the NRCA.*

3 *The EIA is then prepared by a multi-disciplinary team of professionals. The NRCA requires that the EIA include the following:*

- *A description of the present environment, i.e. physical, biological and social environment. This includes, for example, consideration of economic situations, cultural heritage and ecological preservation.*
- *A description of the significant impacts the environmental professionals expect the development to have on the environment, compared to the environment that would remain if there were no development. This will include indirect and cumulative impacts.*
- *An analysis of alternatives that were considered in order to consider means of minimising or eliminating the impacts identified above.*
- *An Environmental Management Plan, which includes a Monitoring & Hazard Management Plan and an Auditing schedule.*

4 *The NRCA guidance on EIAs states that this process "should involve some level of stakeholder consultation in either focus groups or using structured questionnaires." A draft EIA is submitted to the developer to solicit the proponents' input into the*

description of the project (to check for accuracy of statements, and to enter into realistic discussions on the analysis of alternatives, as well as to inform the proponents of any other relevant legislation with which they must comply).

5 *Eight copies of the finalised draft are then submitted to NRCA, two to the client, and the consultant keeps one (11 in all are produced). The NRCA distributes these to various other public sector institutions who sit on the Technical Committee (e.g. Water Resources Authority, Environmental Control Division of the Ministry of Health etc.) for their comments. Typically this depends on the nature of the project.*

6 *As deemed necessary by the NRCA, Public Meetings are then held, following the deposition of the Draft EIA at Parish Libraries (by the NRCA). A verbatim report of the public meetings is required, as well as a summary report of the main stakeholder responses which emerged.*

7 *The comments of the NRCA, the other GOJ interests and the public are compiled and submitted in writing to the consultant not only for finalisation of the report but for incorporation into the development's design.*

8 *The NRCA then reviews this report again, and if further clarifications are needed, these are again requested. Once the NRCA is satisfied, the EIA is submitted to the Technical Committee of the NRCA Board for final approval. If the EIA is not approved, the proponents may appeal to the Minister of Land and the Environment.*

In recent times, the dynamic NEPA EIA process has been requiring written confirmation of the feasibility of infrastructure access from companies providing amenities and utility services to the proposed development, including the National Water Commission, the National Solid Waste Management Authority and the Jamaica Public Service. Negotiations with these agencies will be critical in this development where water supply, sewage disposal, garbage collection/disposal and electricity access have been highlighted in the Subdivision Plan as limited.

Further information on NEPA and EIAs is available from the NEPA website (*www.nepa.gov.jm*). In particular, documents providing guidance on EIA preparation and public participation in EIAs are available at the site and accessible available through the environmental consultant.

3.0 DESCRIPTION OF THE ENVIRONMENT

3.1 METEOROLOGY

3.1.1 Rainfall

Meteorological data was available for Bernard's Lodge (St. Catherine) that is approximately 11km east of the site. The meteorological station is approximately at the same elevation as the wastewater treatment plant site and in the same geographical setting. Hence, little variation in actual climatic conditions is expected.

The data clearly indicates that February and March are likely to be the two coldest months with predicted water temperatures of 24.5°C. The warmest water temperatures are expected in August with temperatures of 27.3°C.

Rainfall data clearly indicates that May and October are the two rainiest months with rainfall depths of 123mm in May and 198mm in October.

3.1.2 Wind

Figures 11 and 12 represents the surface wind recorded at the Norman Manley International Airport (NMIA) station which is the closest station for which wind data was available. The data was collected from January 1981 to December 1990. The results show that the majority of the wind comes from an easterly direction with speeds ranging from 5.5 - 8.2m/s. This was further supported by observations when the fieldwork was being conducted. No seasonal wind data was received from the meteorological service to allow for a temporal analysis of the data.

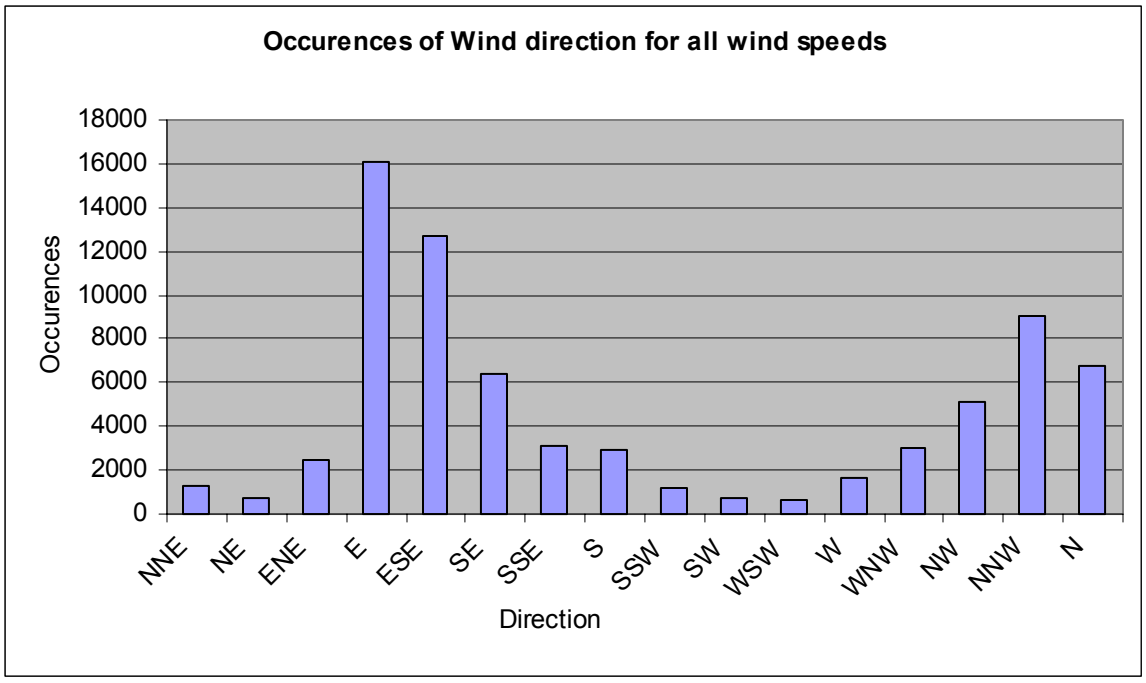

Figure 11 **Wind occurrences for Norman Manley Airport**

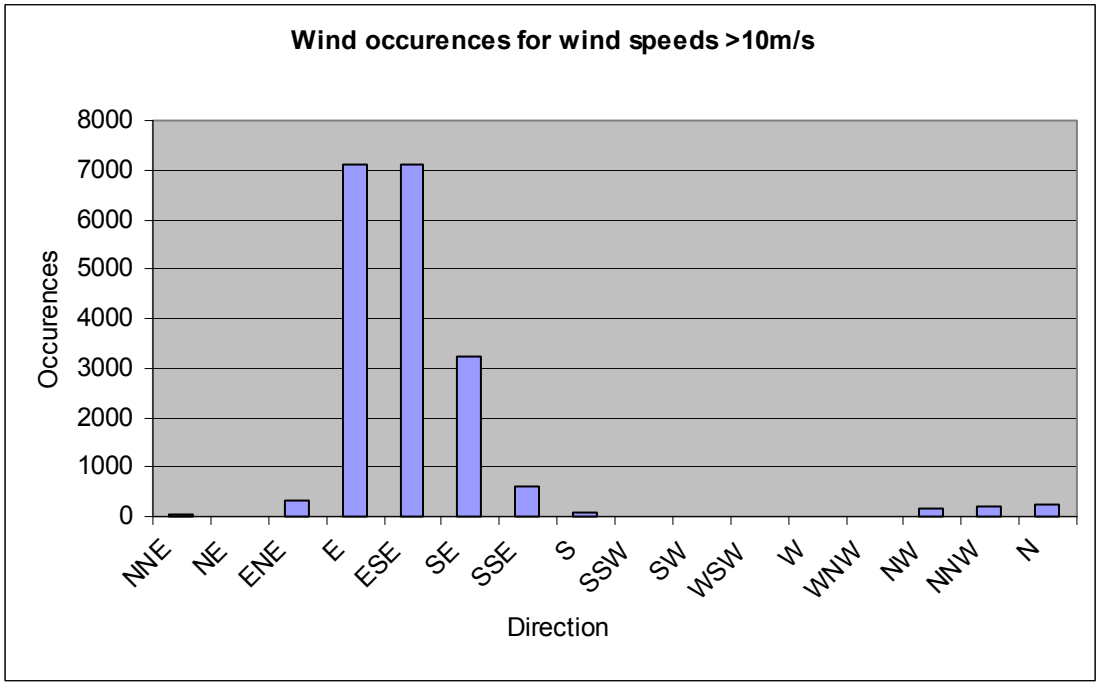

Figure 12 **Wind occurrences for wind speeds >10m/s for Norman Manley**

3.2 NATURAL HAZARD VULNERABILITY

Jamaica is located near the edge of the Caribbean tectonic plate and is therefore subjected to seismic activity and earthquakes. The earthquake risk zonation map for Jamaica (Figure 13), covering the period 1879 - 1978, shows that the project site is situated in an area susceptible to earthquakes, where 8-15 events of intensity VI or greater (Modified Mercalli scale) have occurred over the last century.

The island also lies within the Caribbean hurricane belt and has been directly affected by several hurricanes over the last century (Figure 14). Hurricanes that pass within 100 kilometres of the island have caused considerable damage although the eye has not passed directly over the island. Natural disasters associated with hurricanes include flooding and damage due to gale force winds.

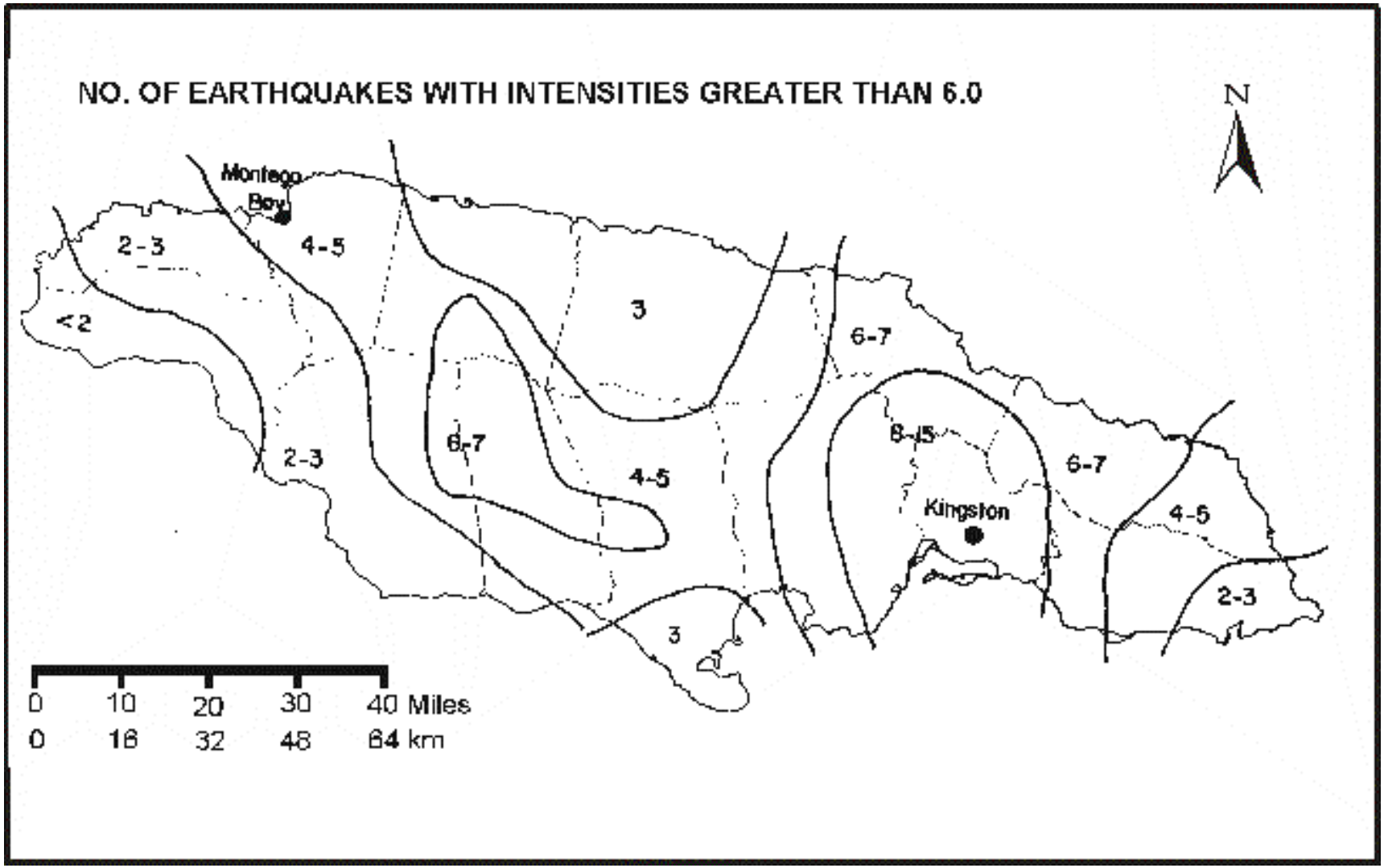

Figure 13 **Map of earthquake events greater than intensity VI (Modified Mercalli scale), occurring in Jamaica between 1879 and 1978**

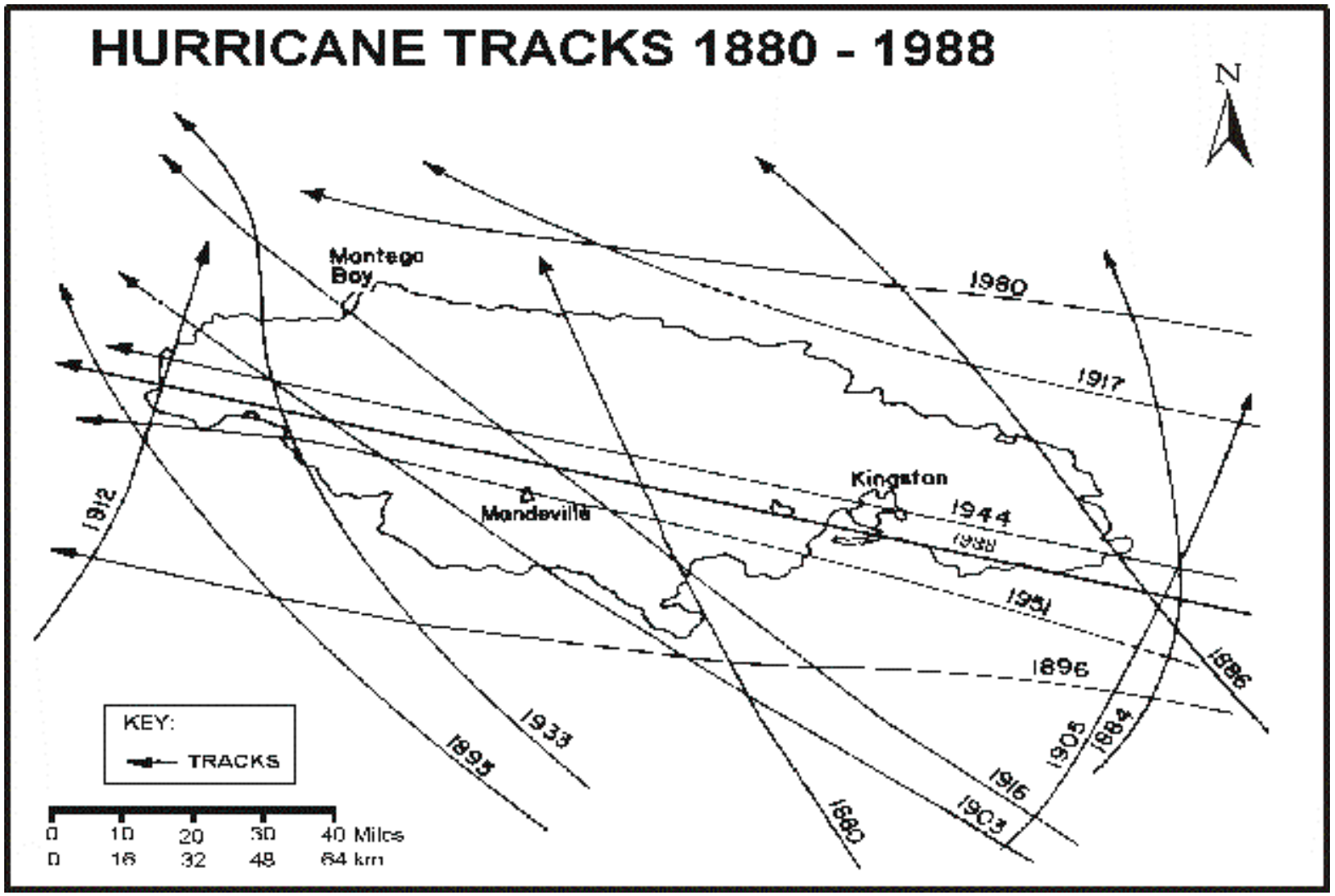

Figure 14 **Tracks of hurricanes (1880 - 1988) directly affecting Jamaica**

3.3 SOILS, TOPOGRAPHY AND GEOLOGY

3.3.1 Soils

Soils on the proposed wastewater treatment plant site consist of the Sydenham type. The soil texture is mainly clay. Due to the fact that the slope of the land is relatively flat and the soils are clayey, the erosion potential at the site is slight.

The soils within the study area are depicted in Figure 15.

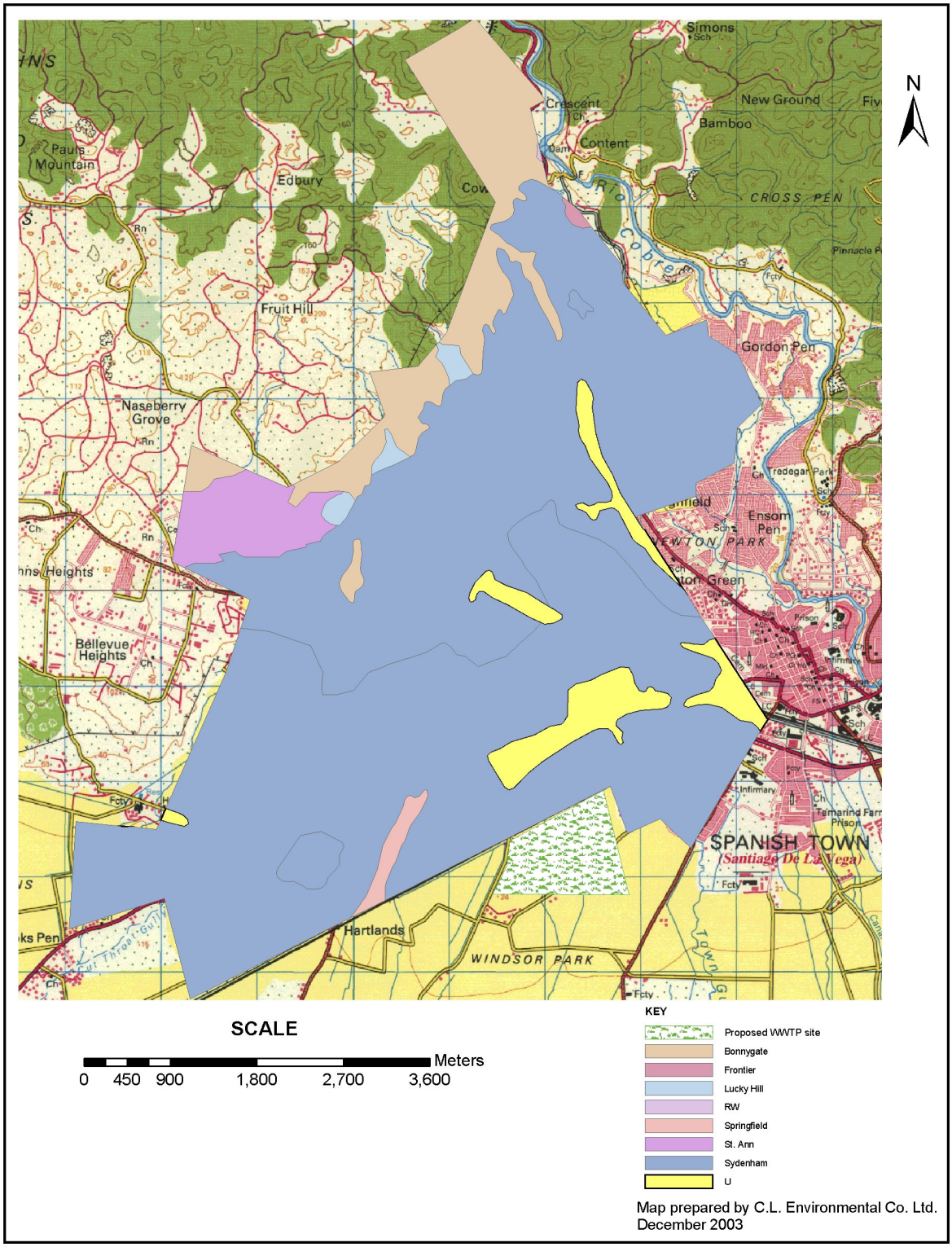

Figure 15 Soil types and texture in the WWTP study area

3.3.2 Geology

3.3.2.1 Background

A visit was made to the site of the proposed sewerage scheme at Horizon Park, Spanish Town. The site of the scheme lies south of the railway and north of the segment of Highway 2000 being constructed at the time of the visit.

3.3.2.2 Physiography and Geology

1. The area is flat-lying with a gentle slope towards the south (Figure 16). It is intersected by two or three minor gullies with drainage towards the south. Geological exposures in the area were poor, although spoil thrown up on the south side of the highway construction indicated a mixture of clay, silt and sand, with the clay apparently being dominant. A series of 14 boreholes drilled on the site provided additional data on the soil and subsoil conditions down to depths of some 4 metres. The elevations of the boreholes were not provided so elevations were derived by interpolation between the contours present on the 1:12,500 scale topographic sheet of the area (Figure 16). Seven of the boreholes were used in constructing two preliminary cross-sections over the site (Figures 17 and 18).

2. The physiography described above is a result of the site being on a part of the alluvial fan of the Rio Cobre. The apex of the fan is north of Spanish Town, but the present course of the river has cut down sharply on the eastern side of the fan. Thus most of the fan, including the site, is inactive, except for intermittent redistribution of fan sediments by streams originating on the fan itself. These can provide high storm flows, but are normally dry or with negligible low flows.

3. The southerly drainage over the site originates partly from the area of the site itself, and partly from sources north of the railway. Culverts through the railway bed provide access for gully flow into the site. From here, drainage continues south over the highway

construction. Culverts have been provided through the highway roadbed for free passage of gully runoff.

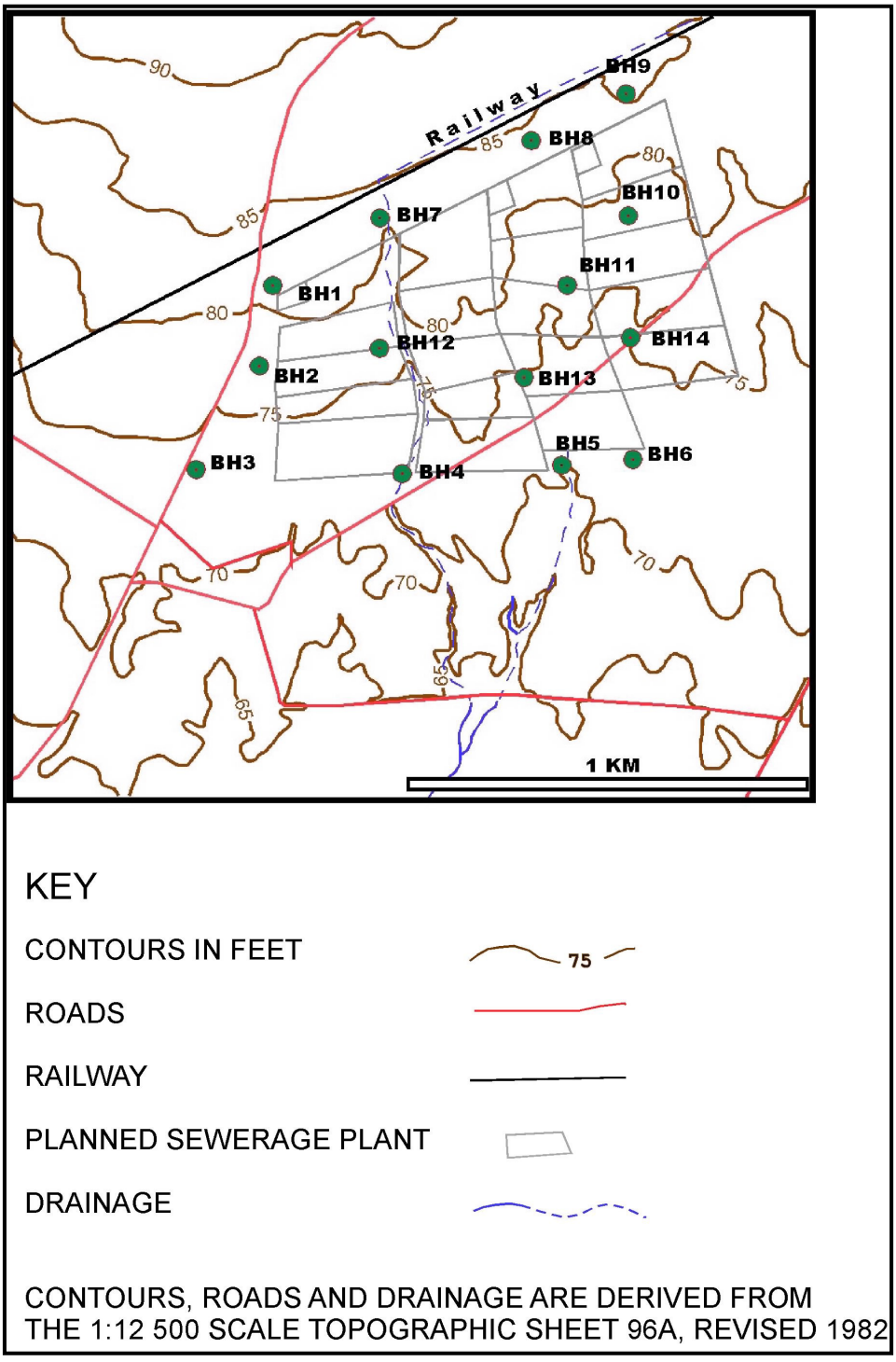

Figure 16 WWTP site with boreholes and contours added

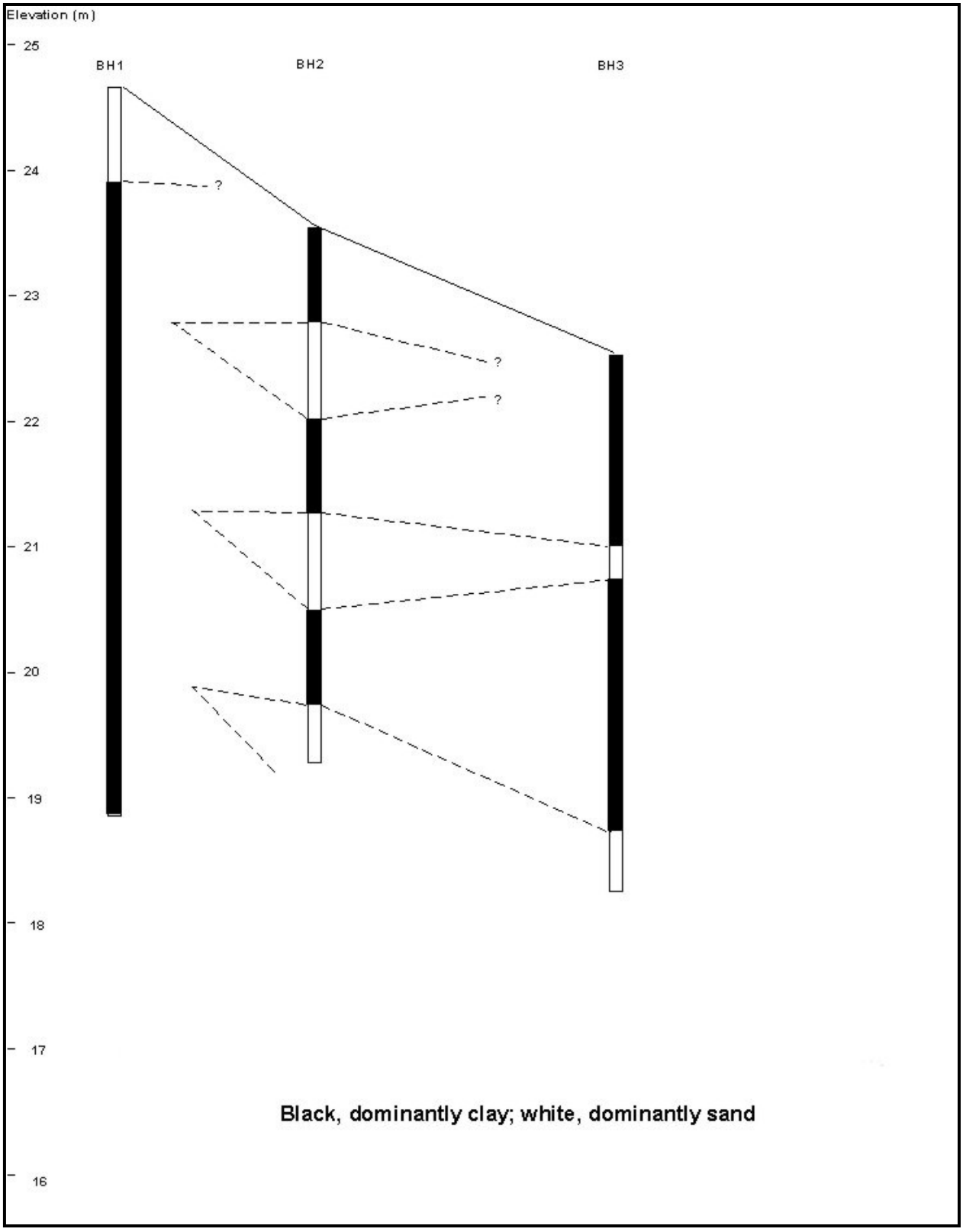

Figure 17 Cross section using boreholes 1 to 3 correlation of sand layers conjectural

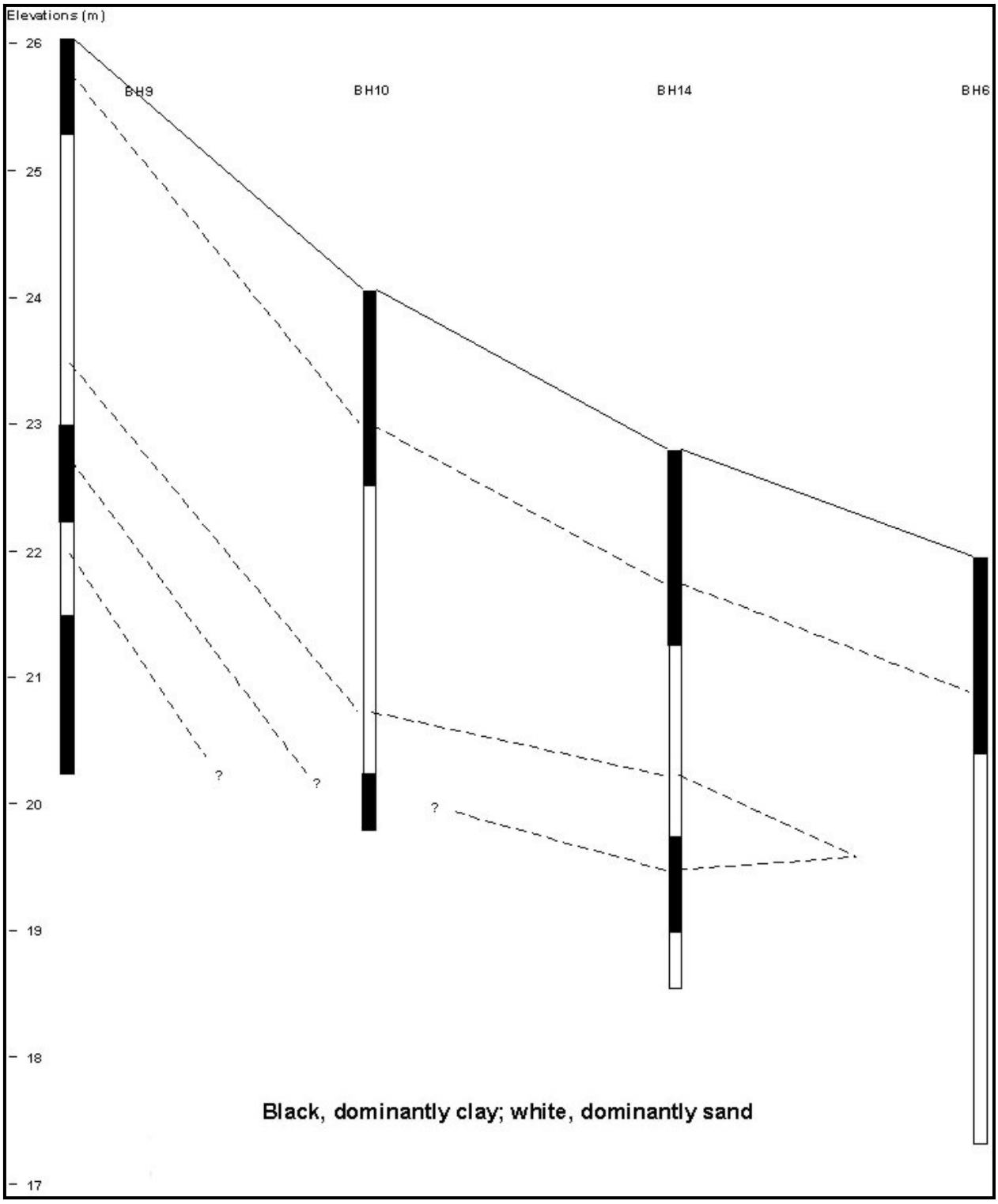

Figure 18 Cross section using boreholes 9, 10, 14 and 6 correlation of sand layers conjectural

3.3.2.3 Interpretation

The drainage pattern that existed prior to highway construction is indicated in Figure 16. The culverts provided under the highway have been sited to accommodate the pattern. However, it was noted that the largest culvert had been constructed to accommodate gully flow on the eastern side of the proposed sewerage scheme, whereas the scheme plan utilized drainage existing near the western side of the site. In the absence of a drainage plan for the highway itself and records of storm flow through the gullies concerned, only preliminary comments can be made at this time. However, it would seem reasonable to provide for exit of storm waters through the more easterly large culvert than through the more westerly pair of small culverts. With the latter, there could be the possibility of blockage by debris, resulting in ponding of storm waters behind the highway, in severe instances perhaps leading to flooding of the sewage ponds.

3.3.2.4 Conclusions

1. Construction of Highway 2000 to the immediate south of the proposed sewerage farm will provide a physical barrier to flood drainage of the site.

2. Although provision has been made to accommodate such drainage by means of culverts under the elevated roadbed, the possibility of blockage of the smaller culverts by debris exists during times of unusually heavy precipitation.

3. Although sand layers exist within the clay in the site area, as demonstrated by the borehole data, these are probably discontinuous and are not likely to provide a pollution threat, through leakage, to down slope sources of potable water. It is more likely that contamination would arise through flooding of the farm during very heavy downpours.

3.4 DRAINAGE AND HYDROLOGY

The area generally slopes from north to south. There are a number of drainage features within the study area. These include the Rio Cobre river which is located north east of the study area, irrigation canals, gullies and other drains, most of which are earthen.

A generalized illustration of the terrain and the drainage features are depicted in Figure 19.

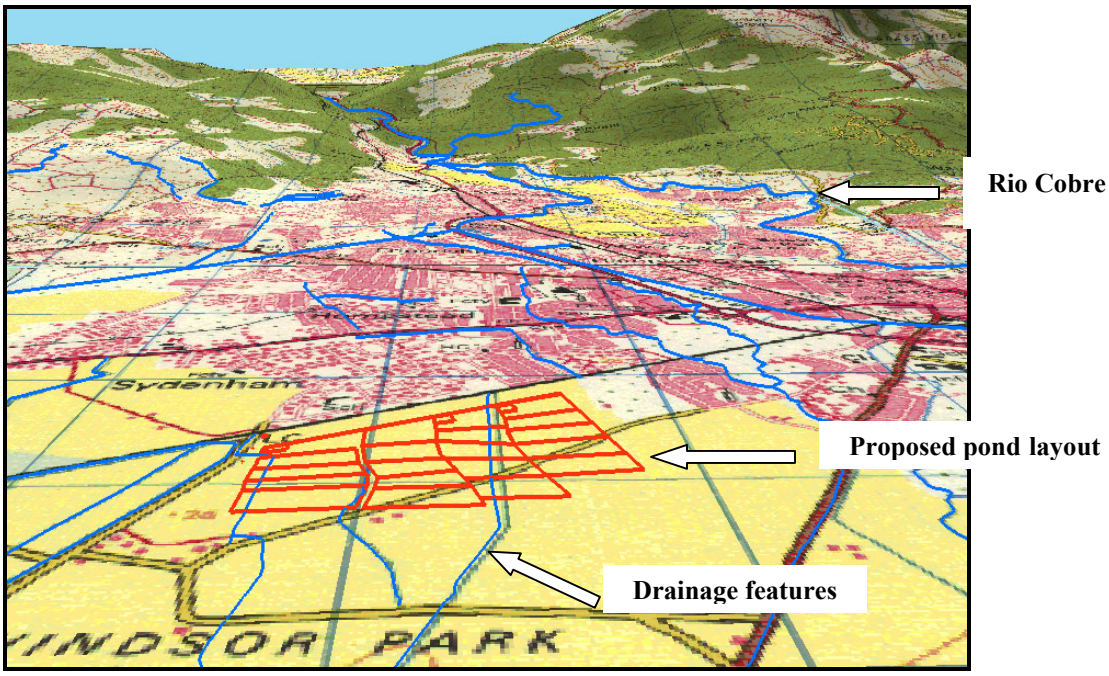

Figure 19 **Illustration of the terrain and drainage features looking north**

3.4.1 Hydrology

The hydrology for the area was determined by first delineating the catchments associated with the project (Figure 20). There are essentially two catchments associated with this project. These are an eastern and a central catchment. The eastern catchment is contained completely on the site. The central catchment covers part of Horizon Park and Sydenham Villas. The drain associated with this catchment runs through the site (Plates 1, 2 and 3).

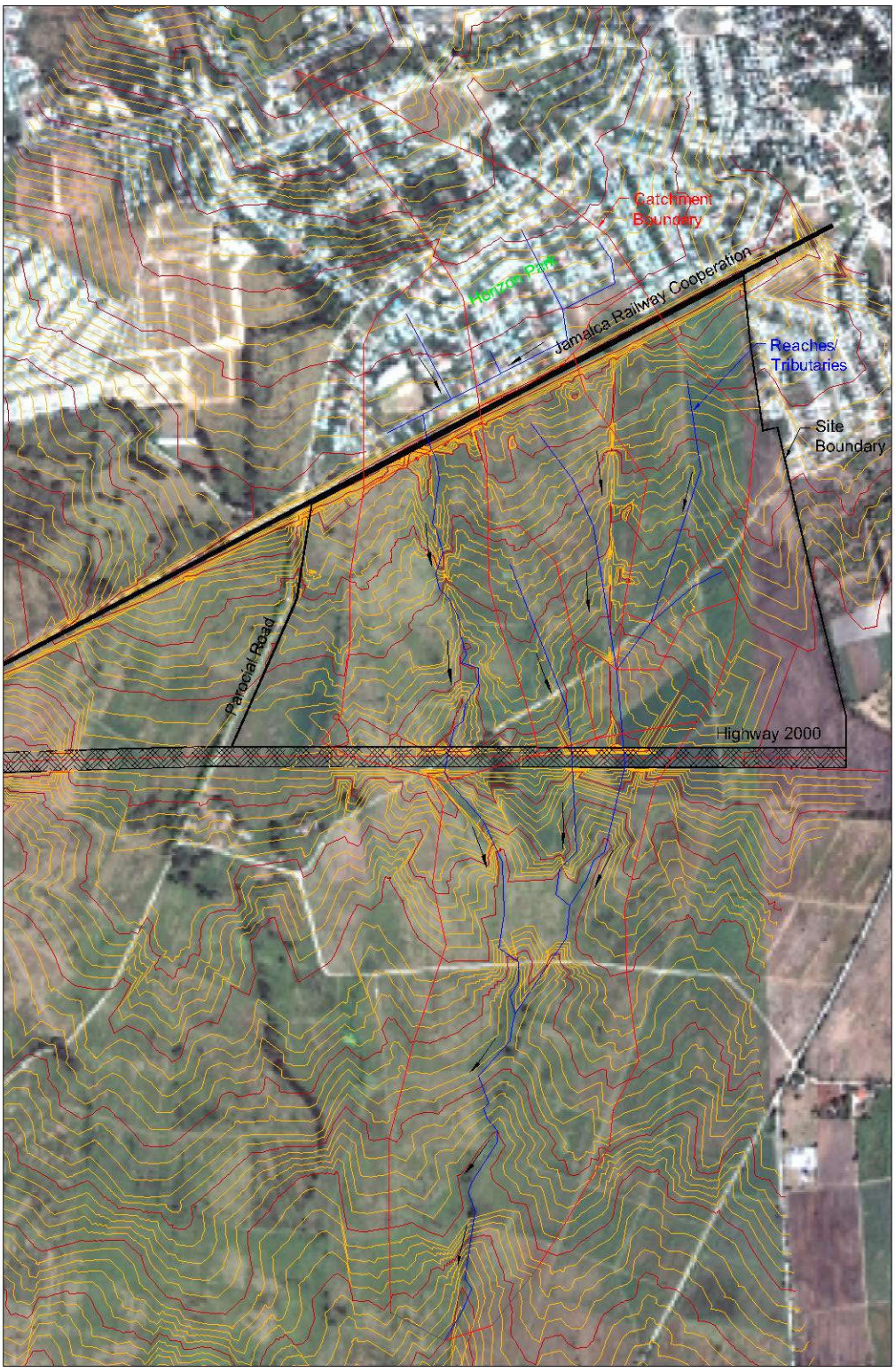

Figure 20 Catchment delineation for the WWTP site

Plate 1 Eastern drain 4' culvert along H2K

Plate 2 Central drain culvert along railway

Plate 3 Central drain 2X4' culvert along H2K

Extremal rainfall analysis for 24-hour rainfall records for Spanish Town, as provided by the Meteorological Service were utilized for this analysis. The rainfall data for varying Return Periods are shown in Table 10.

Table 10 24- Hour Extremal Analysis for Spanish Town, St. Catherine

Return Period (Years)	Rainfall Intensity (mm)
10	215
25	274
50	317
100	380

The hydrographs for each catchment is shown in Figures 21 and 22. The hydrological modelling indicates that the 50 Year Return Period event has a runoff of 9.5 m^3/sec and 12 m^3/sec for the eastern and central catchments respectively. This implies that the central catchment is more important than the eastern. This fact will become increasingly important as the eastern catchment becomes predominantly ponds and more of the rainfall is captured and released slowly from the ponds. The anticipated result will be that the eastern catchment will have far less storm water flows in comparison to the central drain.

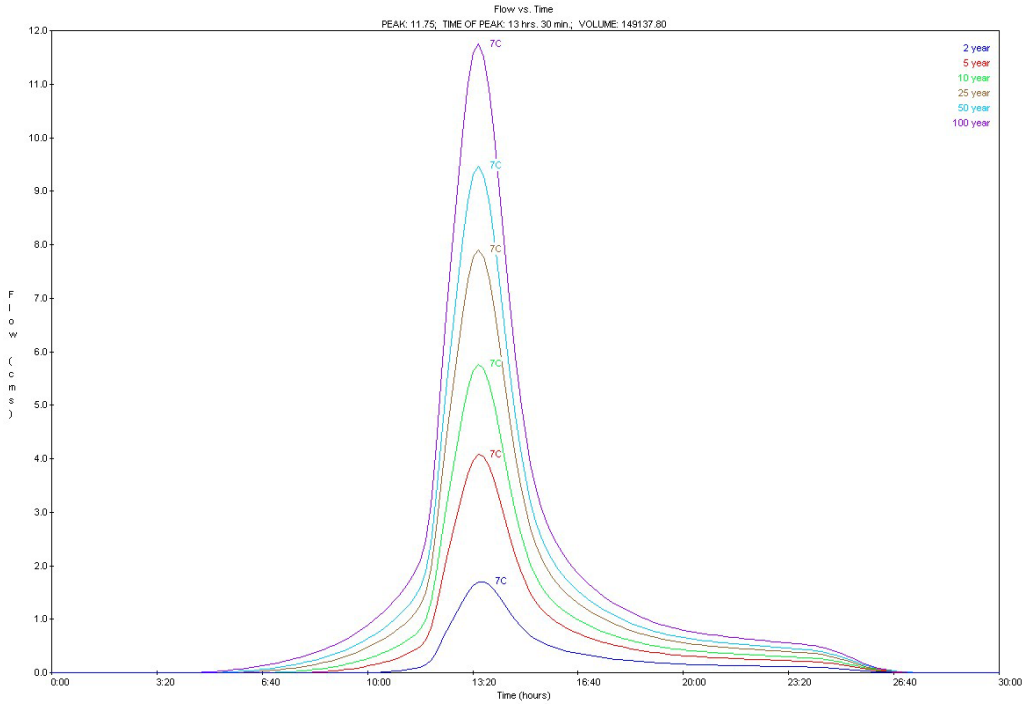

Figure 21 Hydrograph for eastern catchment for the: 2, 5, 10, 25, 50 and 100 Year Return Period

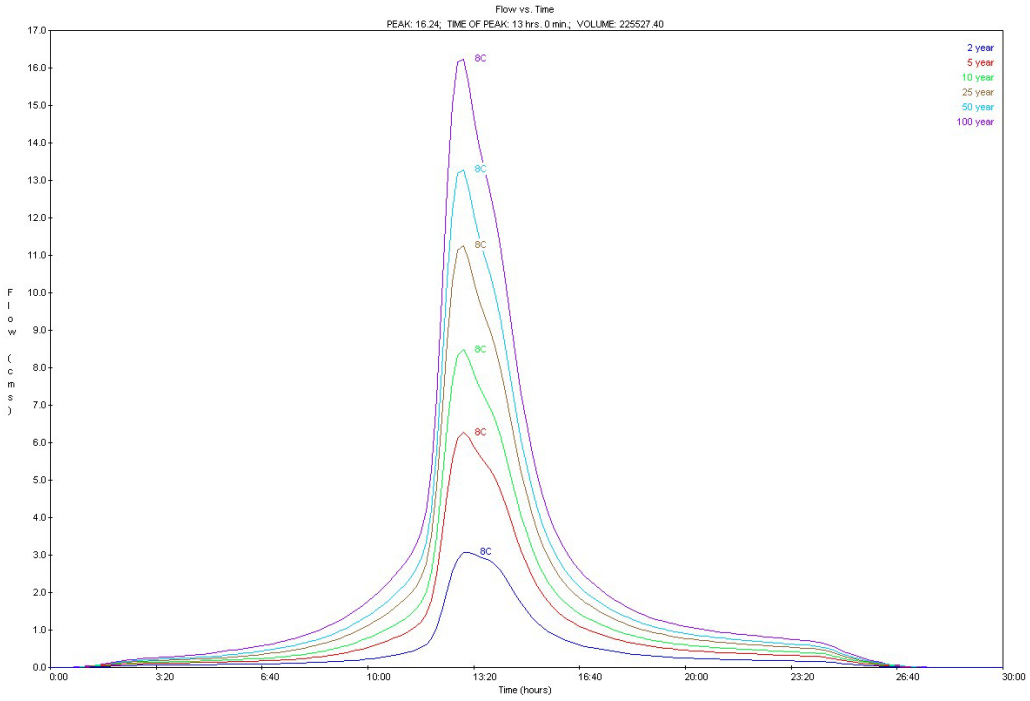

Figure 22 Hydrograph for central catchment for the: 2, 5, 10, 25, 50 and 100 Year Return Period

3.4.2 Floodplain Analysis

The hydrographs for each of the catchments were then applied to a hydraulic and flood plain model. The results of the floodplain analysis for the 1 in 50 Years Return Period is shown in Figures 23 and 24 for the:

1. Before Highway 2000 (H2K) scenario
2. After Highway 2000 scenario.

Inspection of the results, indicate firstly that the floodplain for both the east and central drains are increased as a result of Highway 2000 drainage provisions on the WWTP site. The area of coverage of the floodplains is estimated to have increased from 2.7 and 6.4ha for the central and eastern drains to 3 and 8.3ha respectively. This represents a 24% increase in the floodplain areas.

Secondly, the floodplain downstream of H2K is noted to decrease due to H2K implementation. The area of the floodplain before H2K was estimated to be 11ha, versus the predicted 8.8ha after H2K. This decrease is due to ponding (due to H2K) behind the H2K alignment. The flood plain upstream of the railway in the Horizon Park sub-division is noted to be unaffected by the implementation of H2K.

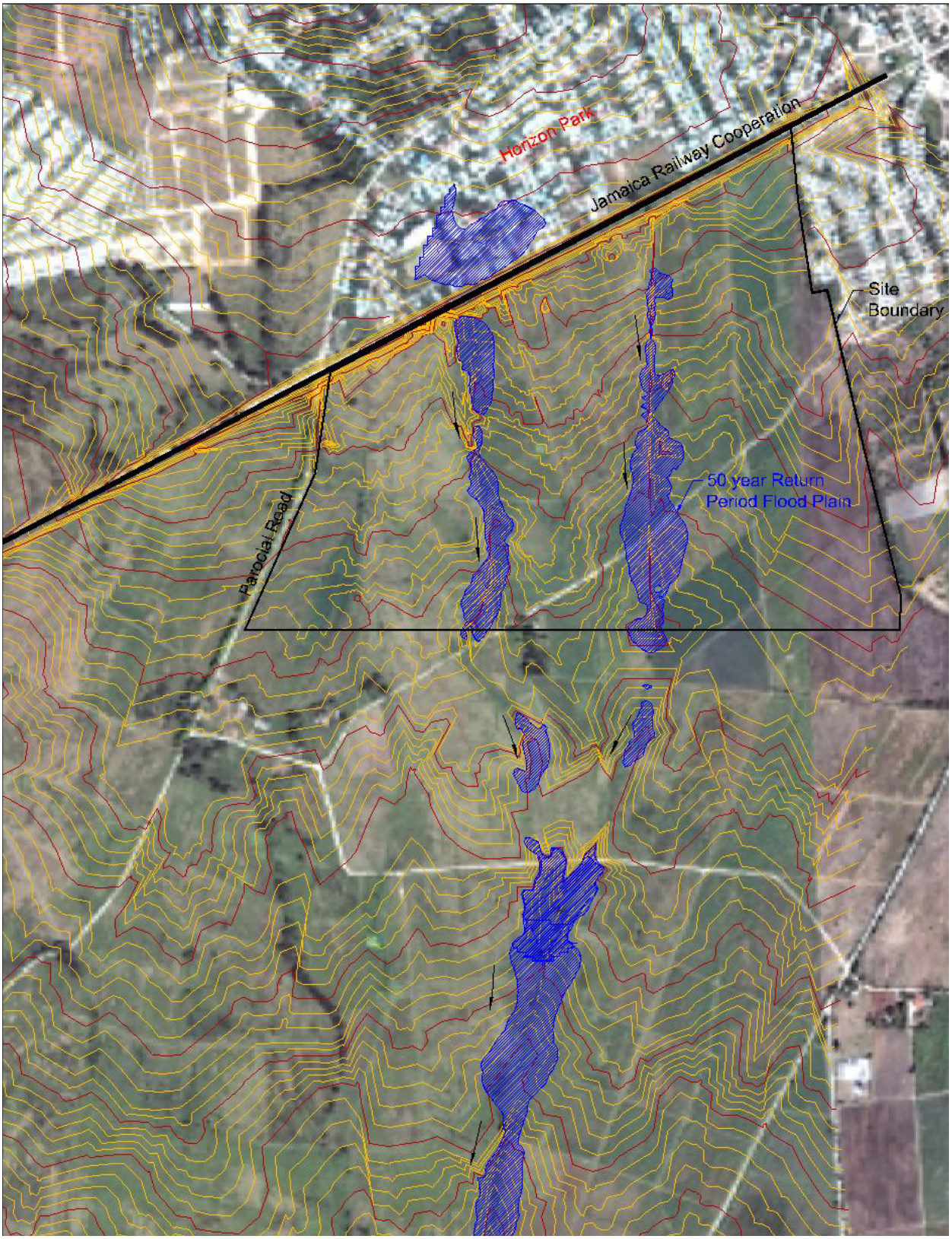

Figure 23 1 in 50 Year Return Period Flood Plain for the proposed WWTP site, before H2K

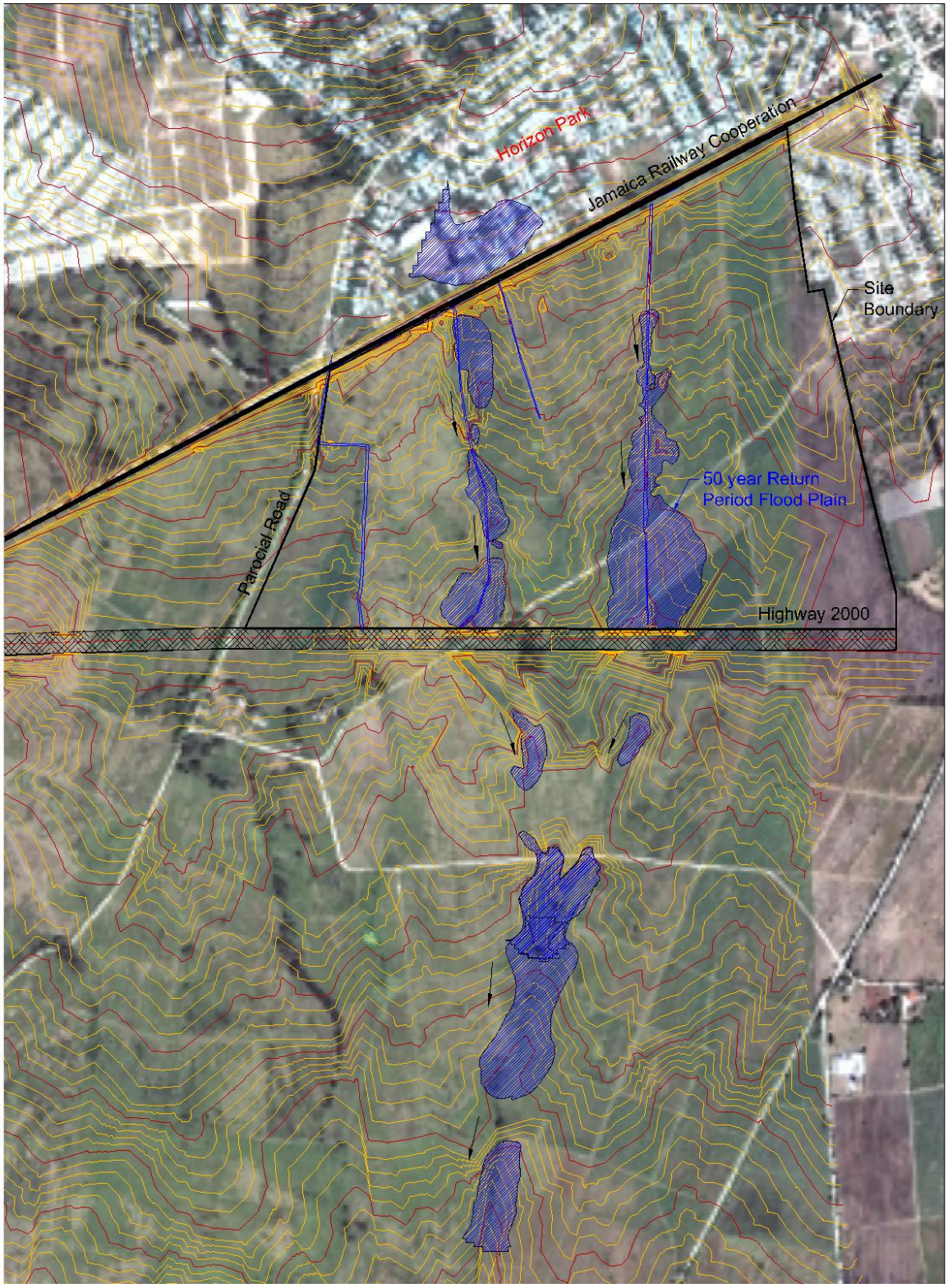

Figure 24 1 in 50 Year Return Period Flood Plain for the proposed WWTP site, after H2K

3.5 TERRESTRIAL VEGETATION AND FAUNAL STUDY

3.5.1 FLORA

3.5.1.1 Introduction

A walk-through of the property was done in order to assess the vegetation present. Plant species observed during this exercise were identified, the presence of rare and endemic plant species was determined, and an indication of the plant biodiversity on the site was obtained.

The proposed plan is to lay pipes parallel to the irrigation canal in the area in order to access individual communities, linking them to the sewage facility. In order to do this, vegetation adjacent to the present irrigation canal would be lost. The layout of the irrigation canal was followed (where possible) and the vegetation encountered at the nodes recorded.

3.5.1.2 Description of the Floral Environment

Terrestrial vegetation at the site consisted of open grassland, which supported frequent to occasional individuals of *Acacia sp.*, Christmas Candlestick (*Leonotis nepetifolia*), Mother-in-law Tongue (*Sansevieria metallica*) and Lead Tree (*Leucaena leucocephala*). Occasional stands of monoculture Sugarcane (*Saccharum officinarum*) may be found around the periphery of the site. Table 11 lists the plant species observed during the site visit.

No rare, endangered or endemic terrestrial plant species were observed during the site visit and there was nothing untowardly special about the vegetation on the project site from either an ecological or commercial point of view. With this in mind, the proposed development will not have a significant negative impact on the vegetation observed at the site.

Table 11 List of observed terrestrial plant species at the proposed site.

FAMILY	BOTANICAL NAME	COMMON NAME	DAFOR*	HABIT
Anacardiaceae	*Mangifera indica*	Mango	R	Tree
Asclepiadaceae	*Calotropis procera*	French Cotton	O	Tree
Gramineae	*Saccharum officinarum*	Sugar Cane	O	Grass
Lamiaceae	*Leonotis nepetifolia*	Christmas Candlestick	O	Herb
Liliaceae	*Sansevieria metallica*	Mother-in-Law's Tongue	O	Tree
Mimosaceae	*Acacia farnesinana*	Sweet Acacia	O	Shrub
Mimosaceae	*Acacia tortuosa*	Wild Poponax	O	Shrub
Mimosaceae	*Leucaena leucocephala*	Lead Tree	O	Shrub/Tree
Mimosaceae	*Samanea saman*	Guango	R	Tree

*** KEY:**

D	-	Dominant	-	Many dominate the site
A	-	Abundant	-	Many individuals observed
F	-	Frequent	-	Individuals observed frequently
O	-	Occasional	-	Individuals observed a few times
R	-	Rare	-	Individuals observed once or twice

Vegetation at the nodes

In general, the vegetation encountered at the nodes varied from agricultural crops to trees to herbs and shrubs and were of no significant importance. Care should be taken in assessing the area for pipe laying where large trees are encountered as the extent of their root system may pose a problem. In areas where large trees are encountered, the other side consisting of herbs and shrubs may prove to be more suitable for clearing.

At the beginning of the project site (node close to the Horizon Sewage Plant), there is a buffer zone, which consisted of *Blighia sapida* (Ackee), Lead Tree, *Guazuma ulmifolia* (Bastard Cedar), *Ziziphus mauritiana* (Coolie Plum) and Mango. *Momordica balsamina* (Cerasee) was observed creeping over the trees. The node at the end of the property exhibited vegetation similar to that of the project site. The two subsequent nodes, Magil Palm and Whitewater

Meadows (south-westerly direction) were already cleared for construction. The last node, parallel to the railway line was amidst Sugarcane.

The other two nodes were located northwest of Feather Bed Lane. The dominant vegetation adjacent to the nodes was Sugarcane. The node located at the base of Innswood had several large trees of Guango to the left. However, the right side exhibited a buffer area of herbs and shrubs, which would be more suitable for clearing.

Two other nodes were located off the St. John's Road/Feather Bed Lane intersection and by the entrance to the Ebony Vale Housing Scheme respectively. The St. John's Road/Feather Bed intersection exhibited Mango, *Artocarpus altilis* (Breadfruit), *Cocos nucifera* (Coconut), *Terminalia catappa* (Almond), Wild Poponax, Coolie Plum, *Ricinus communis* (Oil Nut), *Ipomoea* sp., *Mikania* sp. and *Syzygium malaccense* (Otaheite Apple). The other node exhibited vegetation of Oil Nut, *Ipomoea* sp., *Mikania* sp., Wild Poponax and Guango to name a few.

Another node was located close to the NWC plant along the Spanish Town-Linstead roadway. Wild Poponax, Mango, Guango, Almond, *Ipomoea* sp. and *Mikania* sp. were observed. The remaining nodes along the irrigation canal were not accessible and as such, were not assessed.

3.5.1.3 Historical Vegetation Changes

Historically, the vegetation at Horizon Park has undergone significant changes based on the vegetation maps obtained. In 1962, the dominant crop in the area was Sugarcane, representing 73% of the property. One section of the area showed evidence of reaping and represented 5% of the property. Twenty-two percent (22%) of the property was fallow (Figure 25).

In 1991, Sugarcane remained the dominant crop but had increased in acreage to 85% of the property. Fallow, however, was reduced by 15% (Figure 26). In contrast with the previous years, Sugarcane reduced in acreage, 17%. Areas of cleared field (evidence of reaping) were observed and represented 4% of the property. Fallow areas increased in comparison to the previous year, 26%. However, a portion of the property, referred to as Fallow 2, represented

53%. This area was termed Fallow 2, as it was unclear (from the aerial photo) whether the land was actually cleared or was unused for agriculture (Figure 27).

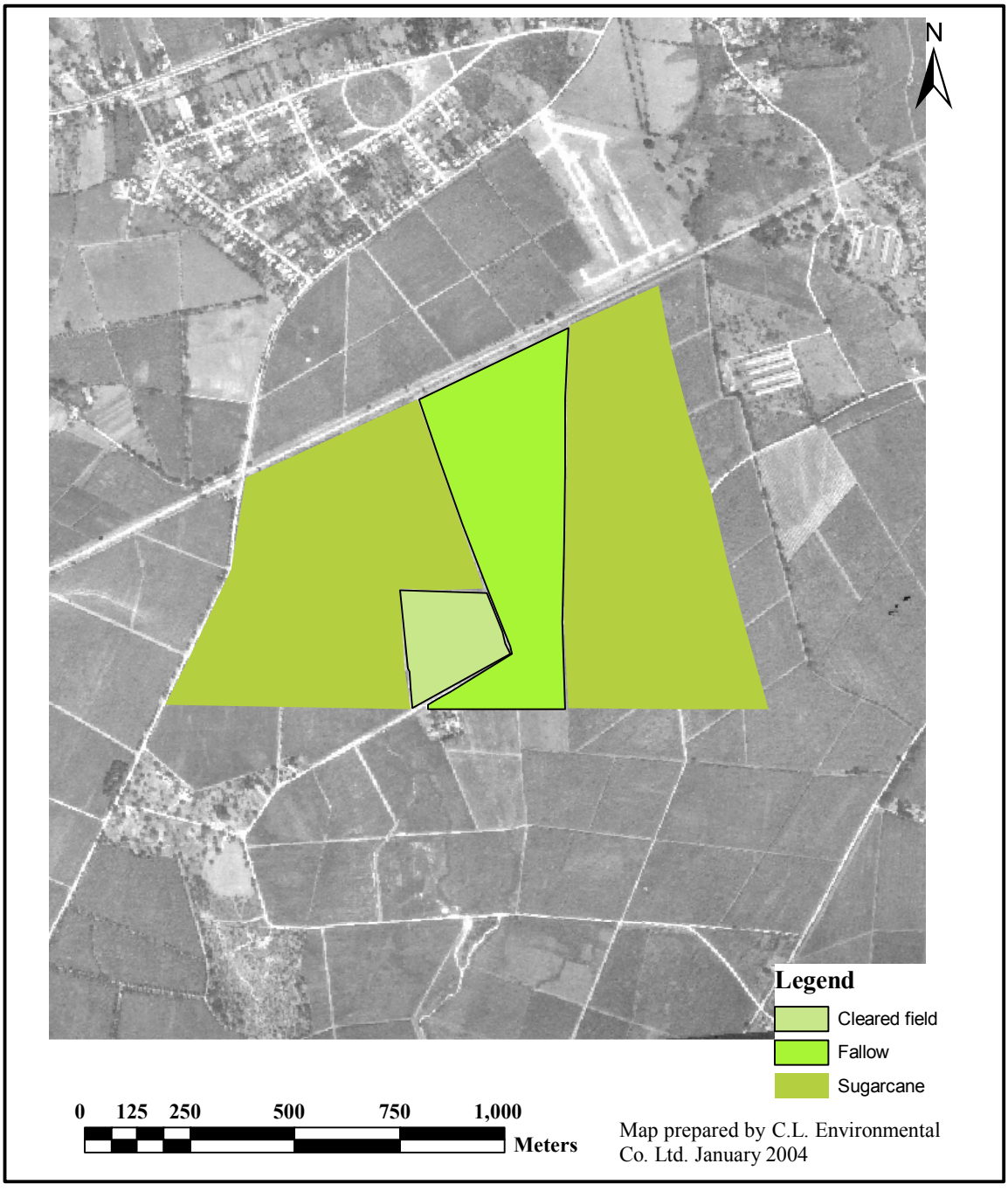

Figure 25 Vegetation map of Horizon Park, 1962

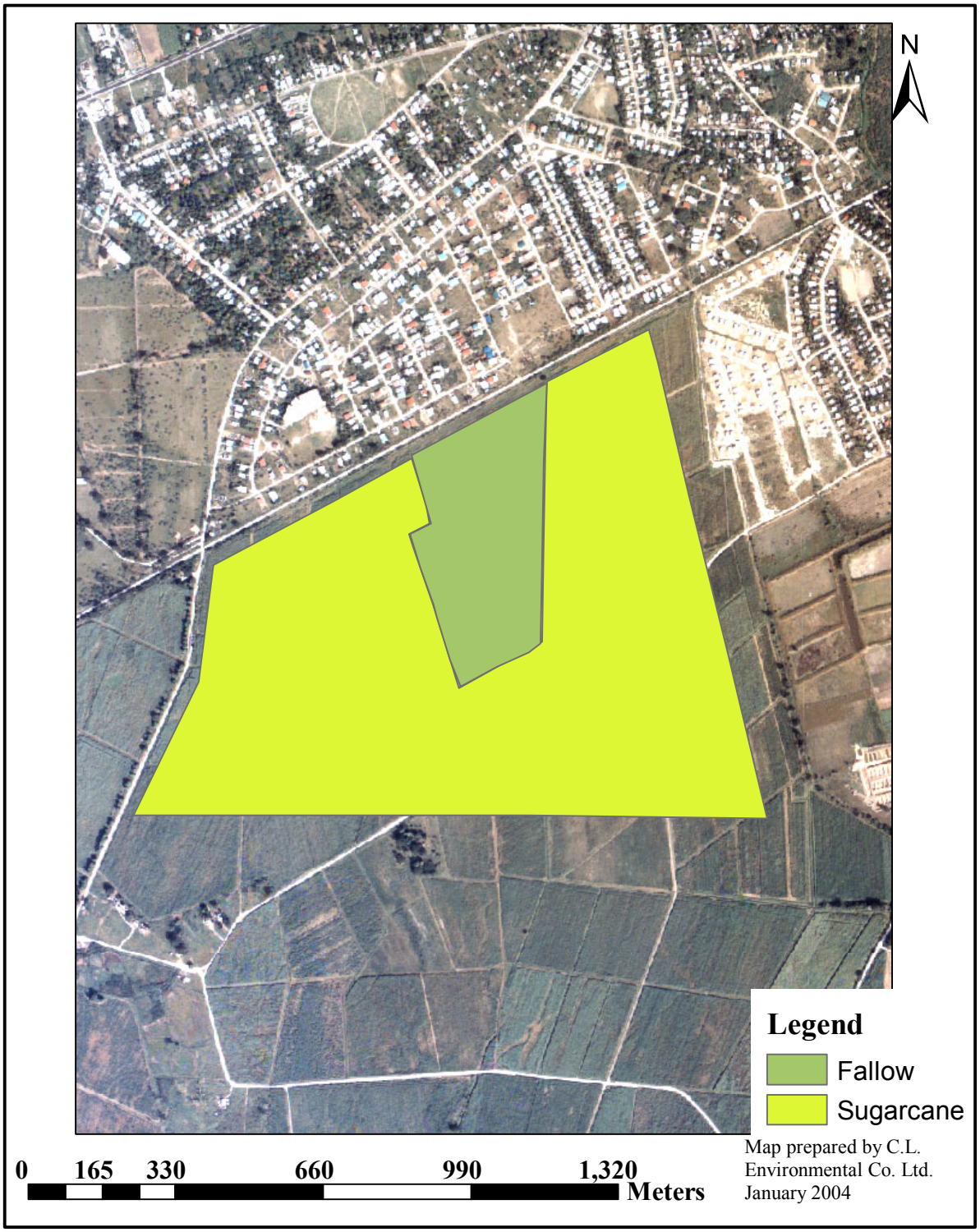

Figure 26 **Vegetation map of Horizon Park, 1991**

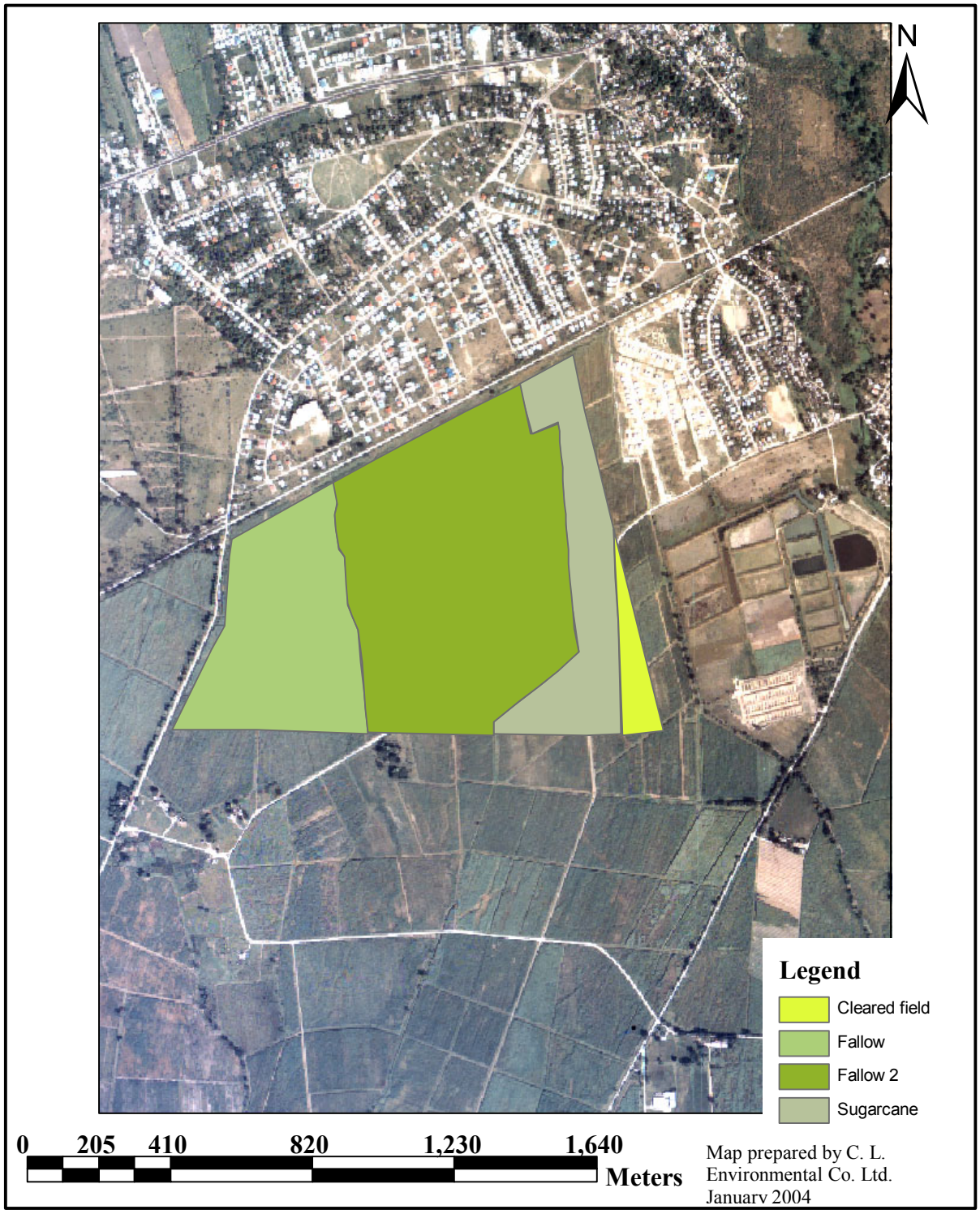

Figure 27 **Vegetation map of Horizon Park, 2001**

3.5.2 AVIFAUNA

A bird count survey was conducted during the vegetation survey. The approximate time of the avifauna survey was between the hours of 9:30 am and 12:30 pm. Species were recorded based on actual sightings and birdcalls. Species not immediately identifiable were noted and field guides (Bond, 1985; Downer *et al*, 1990) were used to verify their identity.

3.5.2.1 Introduction

Table 12 lists the avifauna species observed during the avifauna survey. Five (5) different bird species were observed, none of which were endemic. The low species diversity, and low numbers of individuals of each observed species, is attributable to poorly-covered, low-diversity vegetation habitats at the project site; coupled with the absence of important feeding/fruit trees. The project site appears to play an insignificant role as a bird habitat and bird foraging ground.

3.5.2.2 Results

Table 12 Bird species observed during the walk through survey

FAMILY	SPECIES NAME	COMMON NAME	NUMBERS	STATUS*
Ardeidae	*Bubulcus ibis*	Cattle Egret	3	VCR
Cathartidae	*Cathartes aura*	Turkey Vulture	5	CR
Columbidae	*Zenaida asiatica*	White-winged Dove	3	VCR
Cuculidae	*Crotophaga ani*	Smooth-billed Ani	5	CR
Emberizidae	*Tiaris bicolor*	Blacked-faced Grassquit	3	CR
TOTAL			19	

KEY:

Status*
CR - Common Resident
VCR - Very Common Resident
* Based on Downer & Sutton, 1990

3.5.3 PROTECTED AREA

A section of the Hellshire protected area and bird sanctuary falls approximately 6.5 kilometres (4 miles) south of the proposed wastewater treatment site (Figure 28). It should be noted that a tributary of the major drainage channel (Town Gully) drains the proposed site and ends up in Galleon Harbour. The route to Galleon Harbour takes the Town Gully and Salt Island Creek through the protected area. This means that the quality of water entering either of these drainage features is of utmost importance as it has the potential to impact negatively on the protected area. The importance of this cannot be overstated as Jamaica is a signatory to the third Protocol of the Cartagena Convention, which is the protocol concerned with marine pollution from land based sources and activities (LBS/LBA). This Protocol was signed in 1999 and is concerned with the protection of the coastal and marine environment from land based sources of pollution. Jamaica is in the process of finalizing their National Programme of Action.

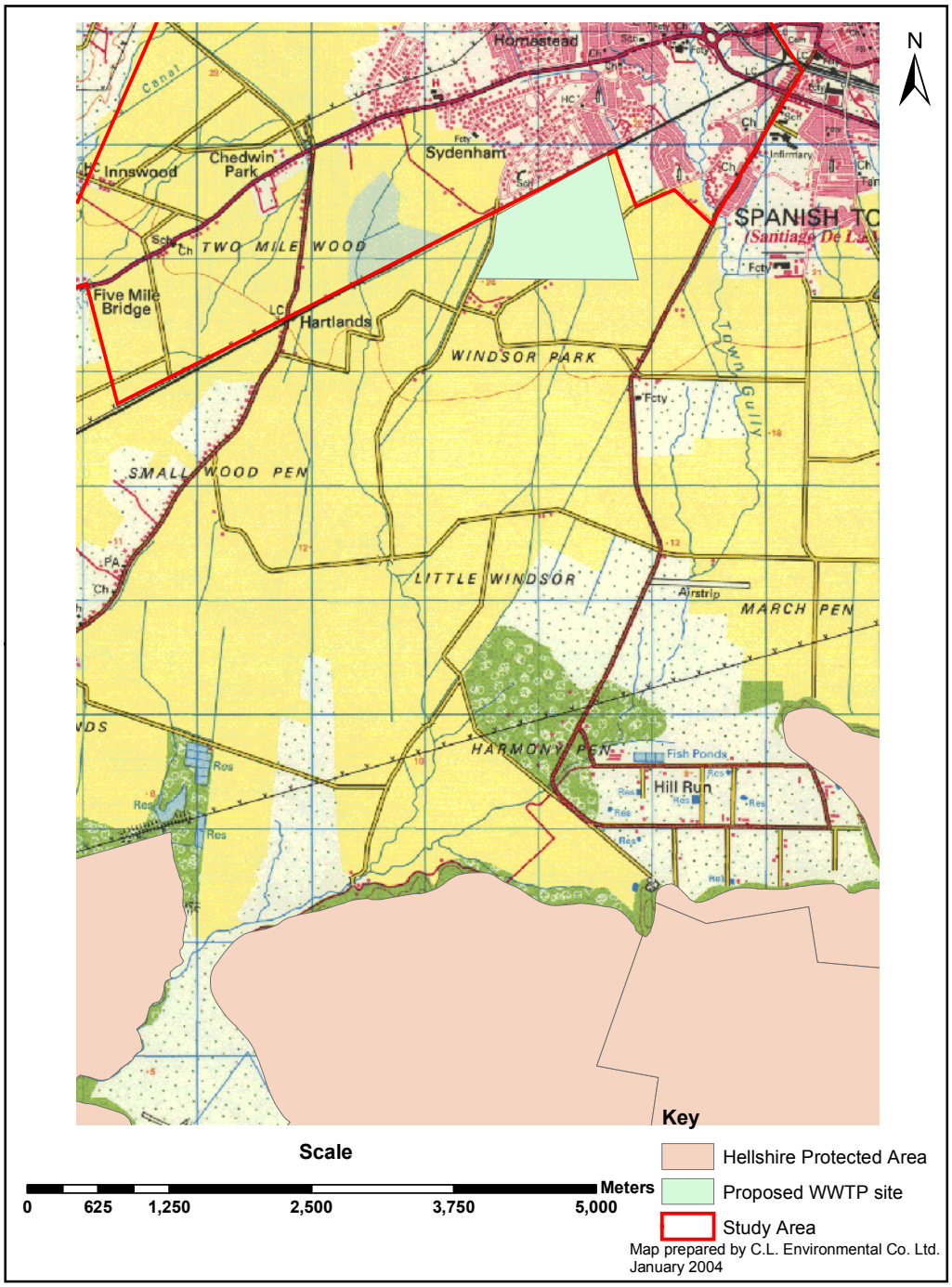

Figure 28 Location map of the Hellshire Protected area

3.5.4 WATER QUALITY

3.5.4.1 Methodology

Physical, chemical and biological data was collected at five (5) stations (Figure 29). The water quality sampling was conducted on a one off basis. The following parameters were collected (Table 13).

Temperature, dissolved oxygen, salinity, total dissolved solids, pH, specific conductivity and turbidity levels were recorded *in situ* using a Hydrolab H2O datalogger. Nitrates, ortho-phosphates, total chlorophyll *a*, faecal and total coliforms levels were conducted on water samples collected. These samples were stored on ice in a cooler and transported to University of the West Indies and the Environmental Technical and Analytical Services laboratory for analyses. The results of these tests were compared with established water quality standards.

Table 13 Water quality parameters collected

Temperature (TEMP)	Nitrates (NO_3)
Dissolved Oxygen (DO)	Ortho-Phosphates (PO_4)
Salinity (SAL)	Faecal Coliform (F. Coli)
Total Dissolved Solids (TDS)	Total Coliform (Tot. Coli)
pH	Biochemical Oxygen Demand $_5$ (BOD_5)
Specific Conductivity (SPC)	Total Chlorophyll *a* (Chl *a*)
Total Suspended Solids (TSS)	

The locations of the water quality stations are listed in Table 14.

Table 14 Water quality stations and locations in JAD 2001

STATION #	EASTINGS	NORTHINGS
WQ 1	751768.182	646835.987
WQ 2	752336.461	646549.415
WQ 3	753664.555	647687.628
WQ 4	751144.249	643197.642
WQ 5	750475.971	641834.574

Figure 29 **Locations of water quality stations**

3.5.4.2 Results

The results of the water quality monitoring exercise is listed below (Tables 15 and 16)

Table 15 Results of the Physiochemical monitoring

STN #	TEMP (^oC)	DO (mg/l)	SAL (ppt)	TDS (mg/l)	pH	SPC (mS/cm)	TSS (mg/l)	NO_3 (mg/l)	PO_4 (mg/l)
WQ1	28.21	1.83	0.55	0.6710	7.72	1,048	410	1.32	5.48
WQ2	22.13	2.54	0.45	0.5471	7.39	856.6	200	3.02	5.64
WQ3	24.41	2.93	0.29	0.3581	7.58	559.5	40	1.32	3.45
WQ4	25.53	2.03	1.66	1.957	7.00	3,059	30	1.32	12.84
WQ5	24.01	2.83	1.71	2.022	7.56	3,161	40	1.32	20.88

Table 16 Results of the biological monitoring

STN #	Chl *a* (mg/l)	BOD_5 (mg/l)	F. Coli (MPN/100 ml)	Tot. Coli (MPN/100 ml)
WQ1	8.33	4.78	≥ 16,000	≥ 16,000
WQ2	505.6	0.33	≥ 16,000	≥ 16,000
WQ3	5.86	0.89	≥ 16,000	16,000
WQ4	1.90	3.28	170	700
WQ5	9.27	2.3	700	9000

3.5.4.3 Findings and discussion

The water quality parameters examined allowed for important analysis and conclusive statement on the environmental condition of the area as indicated by water quality. Physicochemical monitoring parameters such as temperature, dissolved oxygen, salinity, total suspended solids, pH, specific conductivity, total dissolved solids, nitrates and phosphates and biological parameters of chlorophyll *a*, biochemical oxygen demand and coliform bacterial indicate poor water quality and significant contributions from surrounding developments and activities.

While temperature, salinity, total dissolved solids and pH indicate average water quality with little cause for concern, low dissolved oxygen (well below the 4.5 mg L^{-1} acceptable for aquatic organisms to thrive) and high total suspended solids at stations 1 and 2 are indicative of water courses affected by loading from non-point sources. This is confirmed by the high bacterial content (both total and faecal coliform bacteria) at stations 1, 2 and 3 as well as high microalgal

content (indicated by chlorophyll *a*), which suggests the non-point source to be sewage from nearby developments or activities. High nitrate and chlorophyll *a* values infer site 2 as amongst the poorest water quality on these plains.

Of significance is the apparent improvement in water quality at stations 4 and 5 with increased distance from the non-point sewage source near stations 1, 2 and 3. This is only an apparent improvement, as equally poor water quality exists in the southern waterways at stations 4 and 5 as evidenced by the increased specific conductivity, total dissolved solids and extremely high phosphate values. There is, however, a change in source impacting the water ways from high bacteria sewage near stations 1, 2 and 3 to a dominance from non-point agricultural run off from the vast cultivated and evidently over fertilised crop lands and fish farms.

The high algal content (indicated by chlorophyll *a* above 2 mg m^{-3}) and high phosphate values (greater than 1.0 mg L^{-1}) at all stations indicate poor water quality over the entire plains south of Spanish Town and renders these lands as inappropriate for housing construction or industrial development but adequate for construction of a sewage treatment solution or agricultural waste management.

3.5.4.4 Comments on data from Tennants, Windsor and Little Windsor and Fellowship Hall Wells

Data from these wells (Figure 30) while being over a long time period must be viewed with some concern since there are no replicates nor confidence limits or relevant information with which to interpret these data. This becomes significant where values are more than 100 times greater for some samples over others.

Overall, these four wells have experienced contamination or at least a reduction in water quality over time; the pH, total dissolved solids and nutrient changes over time. With the slope of the land, the expected change from north to south is evident in many parameters with the southernmost well showing signs of saline intrusion and nutrient accumulation which may be the result of agricultural practices over many years and materials getting into the water table.

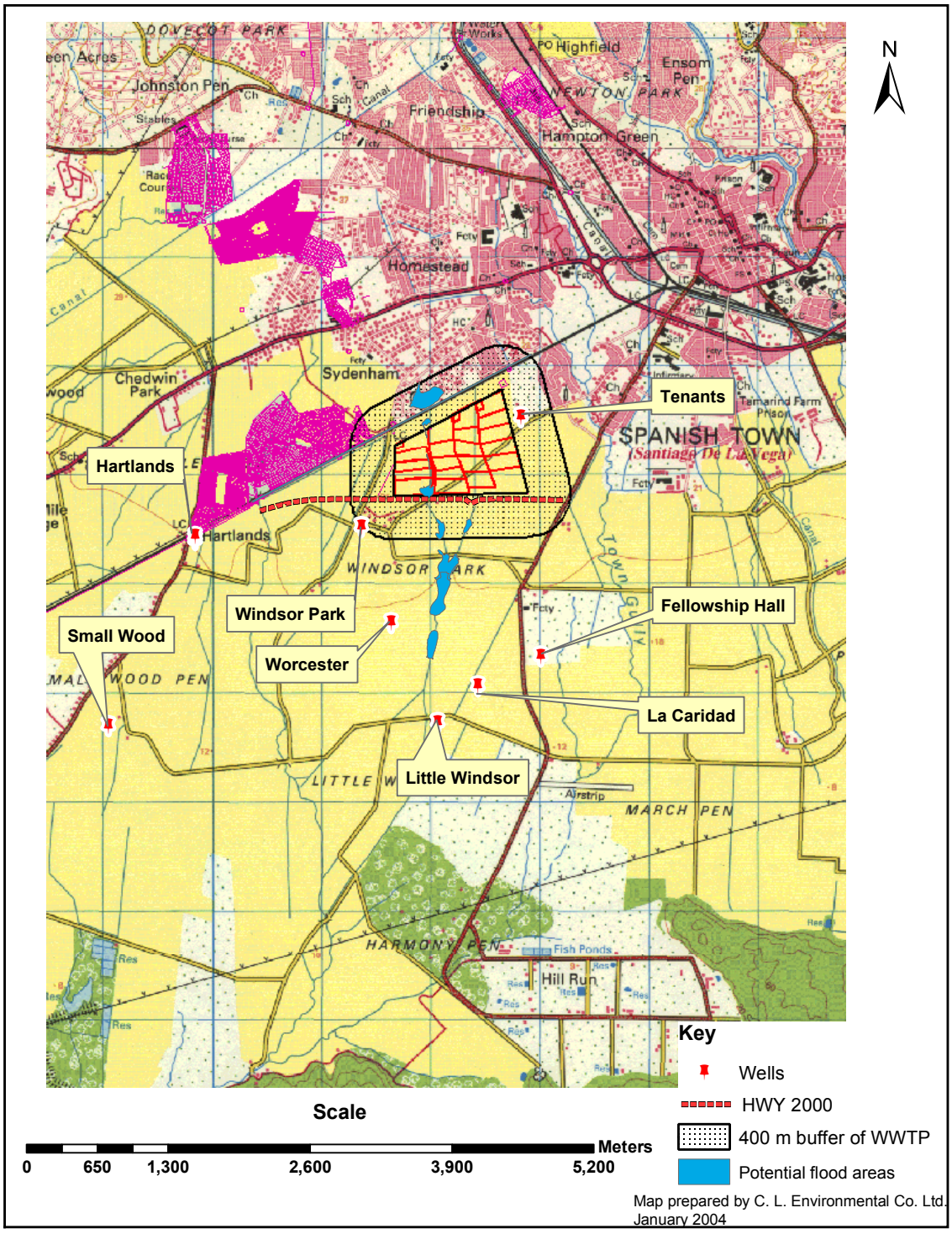

Figure 30 **Locations of wells in relation to the proposed WWTP site**

Without bacterial or BOD data, a clearer analysis is not possible but the general trend suggests wells with poor water quality evidently no longer used for potable water (if that was ever the purpose). The construction and operation of a sewage treatment facility in this area should be of little significance to the subsurface water quality especially near the southern portion of the area in question, which has the worst well water quality.

For the purpose of analysis, a 400m buffer was placed around the proposed WWTP site to determine if any wells could potentially be impacted from operations of the WWTP. Additionally, the flood plain analysis of expected drainage patterns after H2K and the WWTP have been built to see, what if anything, will be potentially impacted. Based on the analysis, only Tenants well would fall within the 400m buffer; however, due to the slope of the land and the intended flow of the effluent, it is not anticipated that the WWTP will have any impact on this well. Windsor Park well was however close to this buffer. The effluent discharge from the WWTP could potentially impact Little Windsor well; however based on the historic water quality data, the water quality in these three wells are already contaminated.

3.5.5 NOISE

3.5.5.1 Methodology

A one off baseline noise measurement was taken at eight (8) locations between 9 and 11:30 am using a Quest 2700 sound level meter (Figure 31). These locations are listed in Table 17. The sound level meter was calibrated with a Quest QC - 10 sound calibrator. The meter was turned on and the response was set to slow, the weighting to A and the mode to SPL. A windscreen (sponge) was placed over the microphone to prevent measurement errors due to noise caused by wind blowing across the microphone.

A baseline noise surface map was generated using the average noise levels measured at the eight stations and was generated using ArcGIS 8.3 Spatial Analyst using an analyst mask of 150m around the proposed site and a tension spline interpolation method (Figure 31).

Table 17 Noise station locations in JAD 2001

STATION #	EASTINGS	NORTHINGS
N 1	751768.182	646835.987
N 2	752336.461	646549.415
N 3	753664.555	647687.628
N 4	751516.993	646832.856
N 5	751709.209	647529.482
N 6	751820.396	648123.261
N 7	751888.796	647855.509
N 8	752402.932	648122.775

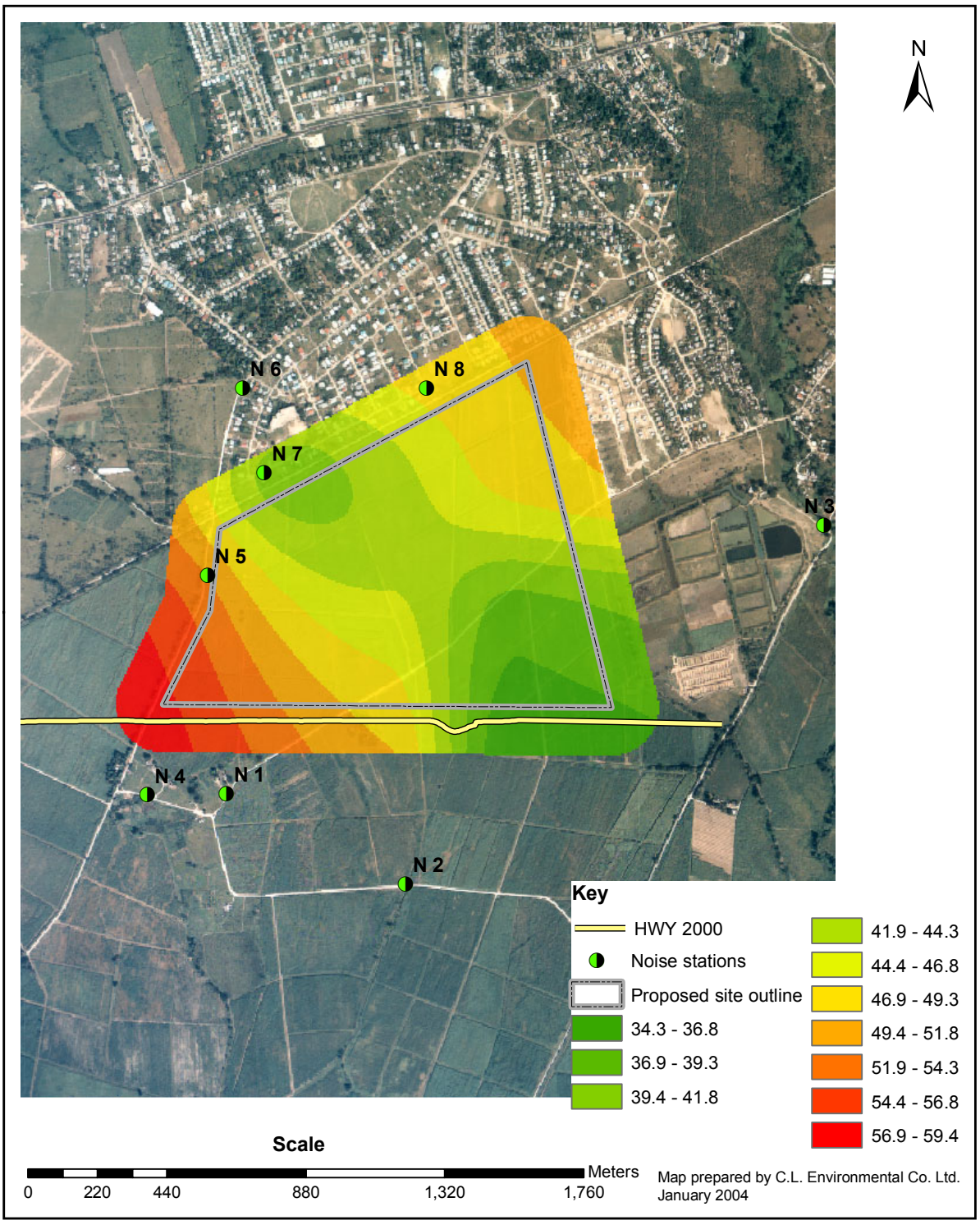

Figure 31 **Locations of noise stations and the predicted average baseline noise (dBA) map within 150m of the proposed WWTP**

3.5.5.2 Results

The results of the noise level assessment indicated that the noise on the proposed property was relatively low (Figure 32). Only stations N 1 and N 6 had average noise levels over 50 dBA. Average noise levels at all locations were within the World Health Organization guidelines of 55 dBA (serious annoyance) and the NEPA daytime guidelines (55 dBA) for residential areas.

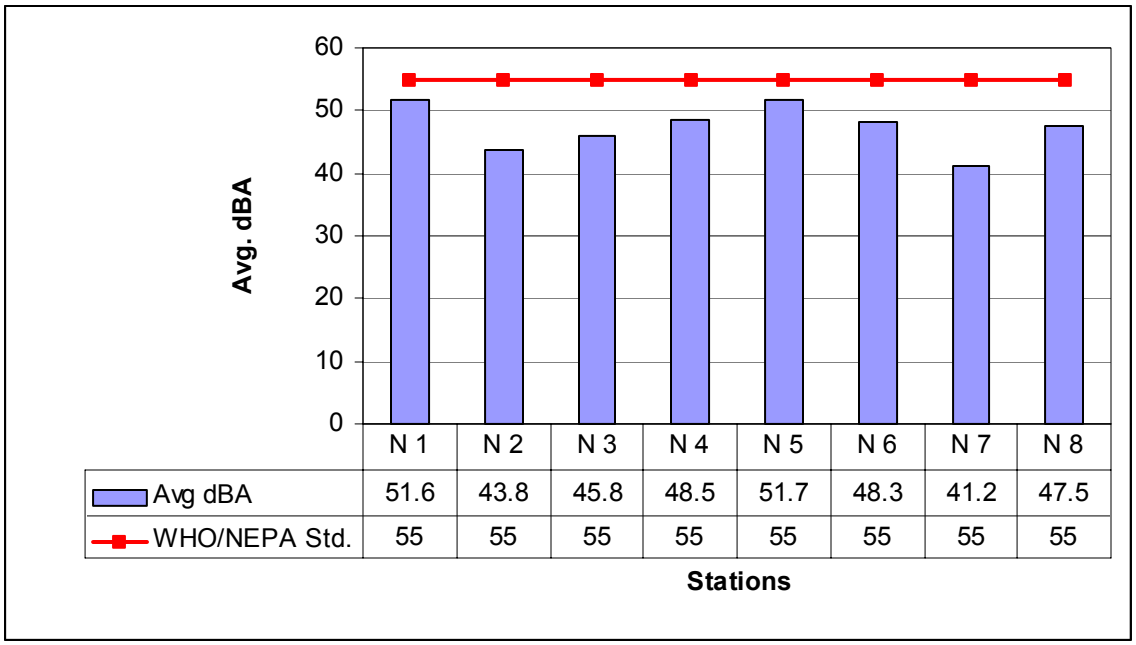

Figure 32 Average noise level readings in dBA

Noise will be generated from the cesspool emptiers that will access the proposed wastewater treatment plant. The areas that are anticipated to be impacted most are the houses that lie along the Sydenham and Horizon Park access routes.

Noise will also be generated along the pipeline due to construction activities. The commissioning of Highway 2000 will also result in an increase in noise generation, expected from engine and road/tyre friction noise from the increased vehicular traffic.

The proposed development is not expected to have a major negative impact as it relates to noise pollution in and around Sydenham and Horizon Park developments, as the planned planting of trees and vegetation around the proposed wastewater treatment plant will act as a kind of noise

barrier, thereby reducing attenuation of noise waves. It also forms a semi-porous barrier which will somewhat block the line of sight between the source and the receiver (most noise tends to travel along a line of sight).

3.5.6 AIR QUALITY

Actual ambient air quality readings were not conducted, however, due to the unpaved nature of the access roads and the relatively close proximity of housing to these access roads and the nature of the earthworks to be conducted at the proposed site, the potential for dust nuisance is high. Wastewater treatment plants have the potential to be odour nuisances if proper buffers between the treatment units and existing populations are not provided and the plant is not properly operated and maintained. A buffer of at least 100 metres has been provided on all boundaries as per NEPA recommendations.

Low influent sulphate levels in the water supply system associated with the WWTP can also reduce the chances of offensive odours from hydrogen sulphide generation. An influent sulphate level of 240 mg/l or higher is believed to be the threshold above which odour concerns might start to arise. Inspection of the water quality data for some non-brackish limestone wells in St. Catherine indicated that sulphate levels of up to 36 mg/l can be expected based on the data reviewed. If 40% is added for sulphates, due to the use of sulphate rich detergents, then levels as high as 60 mg/l might reach the WWTP. This is still significantly less than the 240 mg/l required for significant odour problems and it can therefore be concluded that odours are not expected to be a significant problem, if the actual conditions are similar to or better than the design assumptions.

The prevailing winds at the proposed site are from the east, which would in effect carry any dust or odour nuisance towards the White Water Meadows, Magil Palms, Sydenham and the proposed NHT Hartland housing developments. However, due to the distance of these developments from the proposed site and the expected wetting of earthworks and limited vegetation removal, it is not anticipated that dust or odour nuisance should be an issue. The proposed development has the potential to have a negative impact on the ambient air quality on the proposed site and areas in proximity.

4.0 SOCIAL BASELINE

The Social Impact Area (SIA) for this study was assumed to be the catchment for the proposed wastewater treatment plant.

4.1 INTRODUCTION

4.1.1 Methodology

Informal interviews and 100 structured interviews were conducted with some residents within the communities (Appendix 1). Additionally, windscreen surveys were conducted in the communities to verify and update the information on the maps. Current socio-economic data was obtained from the 2001 population census.

Population was calculated using the formula [$i_2 = i_1 (1 + p)^x$]; where i_1 = initial population, i_2 = final population, p = actual growth rate and x = number of years. The growth rate for the study area was determined from the 1991 to 2001 intercensal period. In the absence of the 2001 economic census data, the 1991 census data was used.

Water consumption was calculated based on the assumption that water usage is 227.12 litres/capita/day and sewage generation at 80% of water consumption.

Domestic garbage generation was calculated at 1 kg/capita/day and 4.11 kg/household/day (National Solid Waste Management Authority).

4.2 DEMOGRAPHY

4.2.1 Population

The population of St. Catherine in 2001 was 482,265 persons (STATIN 2001). The population within the catchment (referred to as study area from here onward) of the proposed wastewater plant site was approximately 72,916 persons in 2001, which represents approximately 15 % of the population of St. Catherine. Of this population, approximately 47.5% were males.

If the current growth trend in the study area continues (2.3% pa - based on the last intercensal change), then the population at this time within the study area is estimated to be 76,310 persons and is projected to grow to 134,731 persons over the next twenty five (25) years (2028).

An illustration of the population distribution in the study area based on the built environment is depicted in Figure 33.

The sex ratio (males per 100 females) within the parish in 2001 was 94.4 (Table 18), while in the study area it was 90.8. This means that within the study area (local) there were more females than males when compared to the regional context (parish).

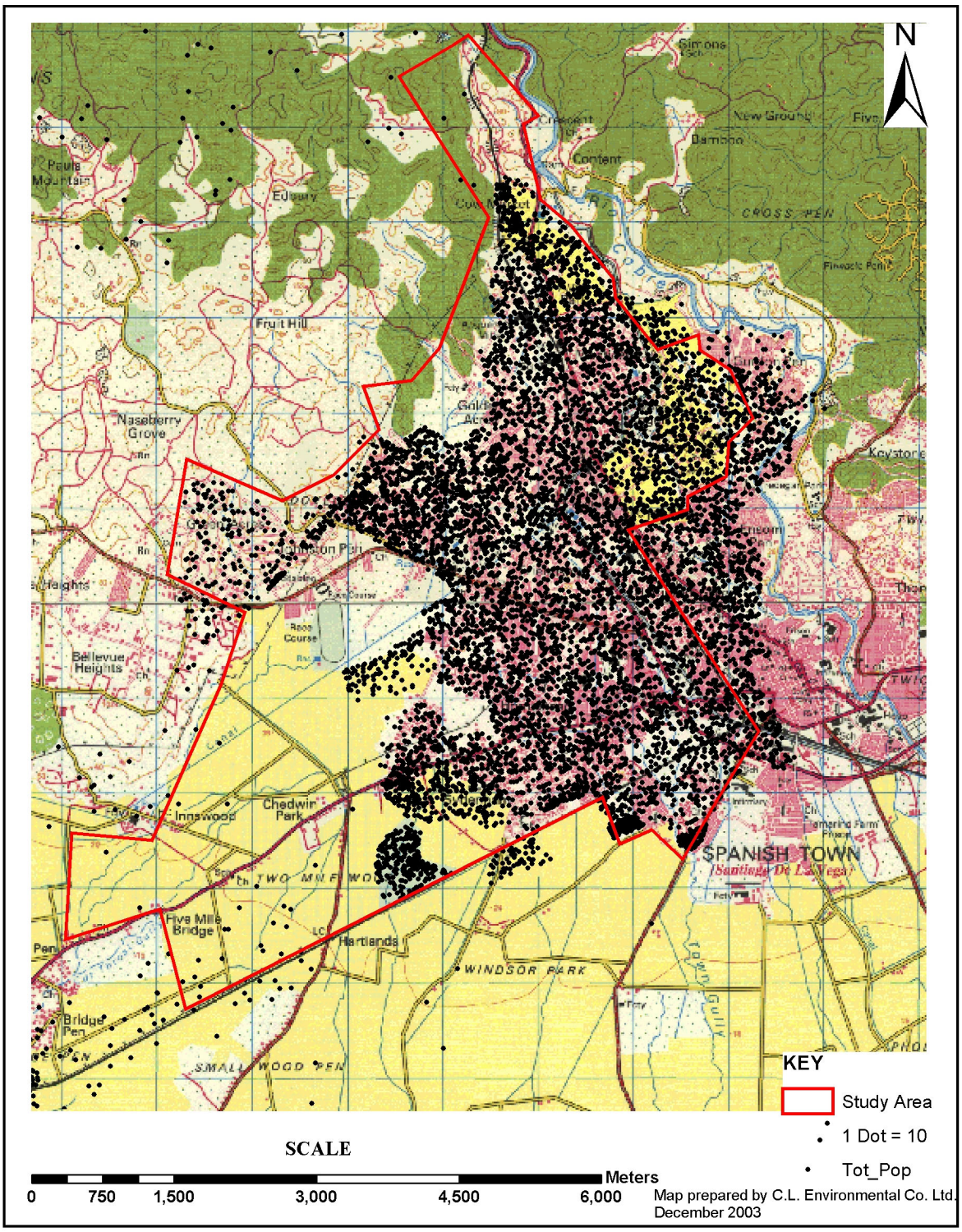

Figure 33 **Illustration of population distribution in the study area based on the built environment**

Table 18 **Sex Ratio (Males per 100 Females) of St. Catherine by Age Groups: 1970, 1982, 1991, 2001 and the Study Area**

AGE GROUP	1970	1982	1991	2001	STUDY AREA
0-4	102.5	102.4	100.8	102.9	100.5
5-14	100.1	100.8	100.3	101.8	100.2
15-29	94.6	92.5	93.8	94.1	90.9
30-44	91.5	96.1	90.7	86.4	82.6
45-64	97.8	94.8	98.0	96.2	87.7
65+	85.7	81.1	79.5	81.8	78.6
TOTAL	**97.0**	**96.1**	**95.1**	**94.4**	**90.8**

(Source: STATIN 2001 Census data)

Table 18 depicts a constant decline in the sex ratio of the parish from 1970 (97.0) to 2001 (94.4). This means that there has been a steady increase in the number of females in the population of the parish. The 0 – 14 age group continues to have a higher percentage of males when compared to females (Table 19), in fact, showing an overall increase over the thirty one years.

The child, old age and societal dependency ratios within the parish of St. Catherine in 2001 were 521, 95 and 616 per 1000 persons of labour force age respectively. The child, old age and societal dependency ratios for the study area were 528, 93 and 621 per 1000 persons of labour force age respectively. This indicates that there is an overall slight increase in dependency on the working population in the study area by the young in the population (0-14 years) when compared with the parish.

A comparison of the dependency ratios in 2001 revealed that the national dependency ratios were higher than both the parish and the study area dependency ratios (Figure 34).

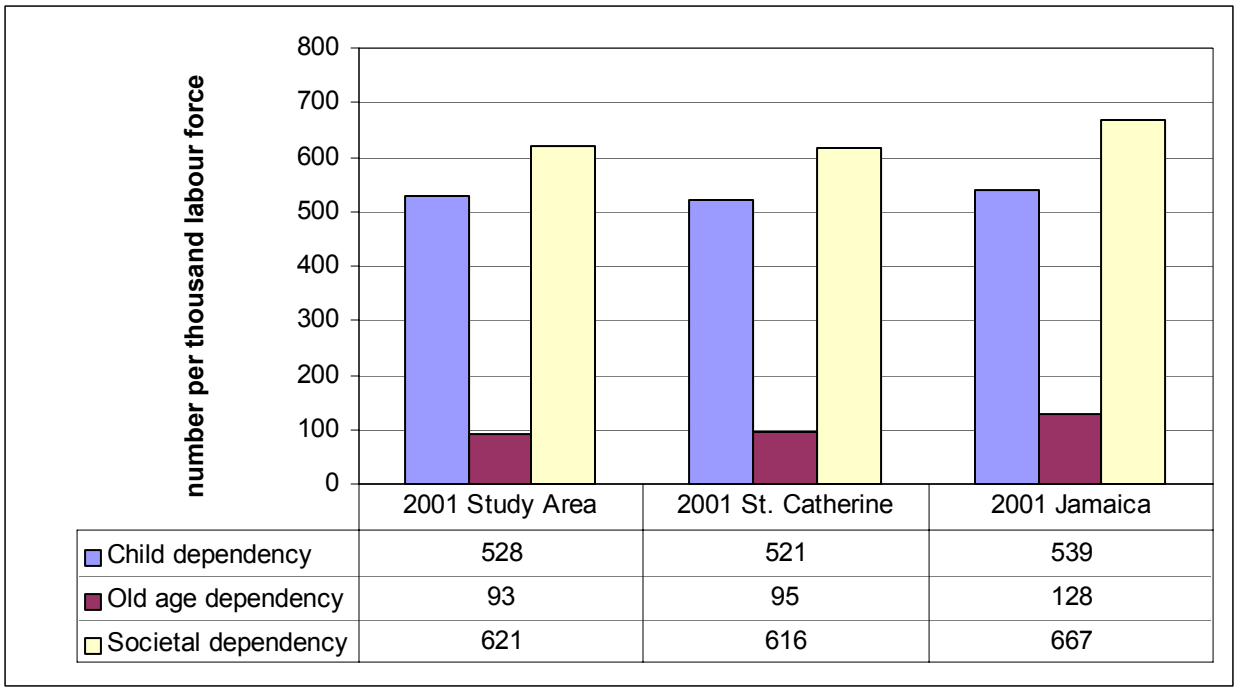

Figure 34 Dependency Ratios

The data suggests that there was a higher dependency on the working population by children in the study area for support when compared with the dependency ratio of the parish. There was however, a slightly lower dependency by old agers on the working population of the study area when compared to the parish. This maybe due to the fact that the study area is generally the area where new housing developments are being established, thereby attracting young professionals.

4.2.2 Population Density

It is estimated that the land area within the study area is 3,309 hectares. The average population density of the study area is approximately 22 persons per hectare (PPH). The average population density within the area is low (Figure 35), however, there are sections (settlements) within the area, which exceeds the average. The areas with the darker regions correspond to areas of population concentration (towns).

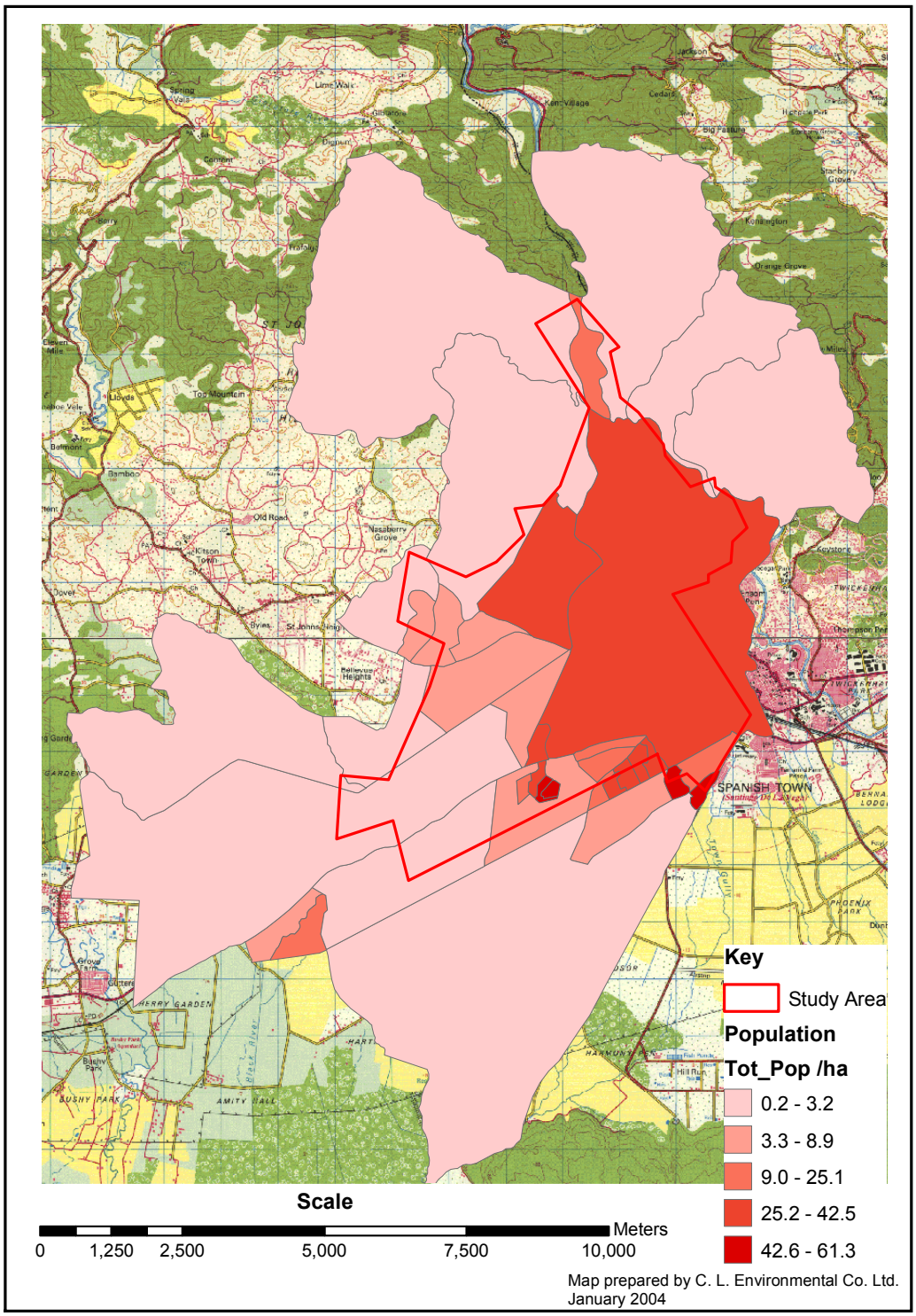

Figure 35 Population densities with the Study Area

Table 19 **Percentage composition of the population of the parish of St. Catherine over a thirty year period and the present time for the Study Area.**

AGE GROUP	1970	1982	1991	2001	STUDY AREA
0-4	16.6	12.7	11.6	10.7	10.8
5-14	31.1	27.6	23.5	21.5	21.7
15-29	20	29	30.5	26.9	27.1
30-44	13.3	15.2	17.6	21.7	21.3
45-64	13.6	9.7	11.3	13.3	13.2
65 & Over	5.4	5	5.5	5.9	5.9

(Source: STATIN 2001 Census data)

The parish shows a young but aging population (Table 19). This is evidenced by the shift in the percentage of the population from younger age groups (0-14 years) to the middle to upper age ranges (15-44, 45 and over years). This is further supported by the fact that the percentage of the population in the 65 and over age group generally increased.

A comparison of the study area within the parish in 2001 showed that the distribution of the population age categories in the study area was similar to the parish (Figure 36).

Further investigation of the parish characteristics showed that there was a general decline (trend) in the percentage of the population in the 0-4 years category over the last thirty years, an increase in the 15-44 years and generally, a decline of the population in the 45-64 and 65 and over years categories.

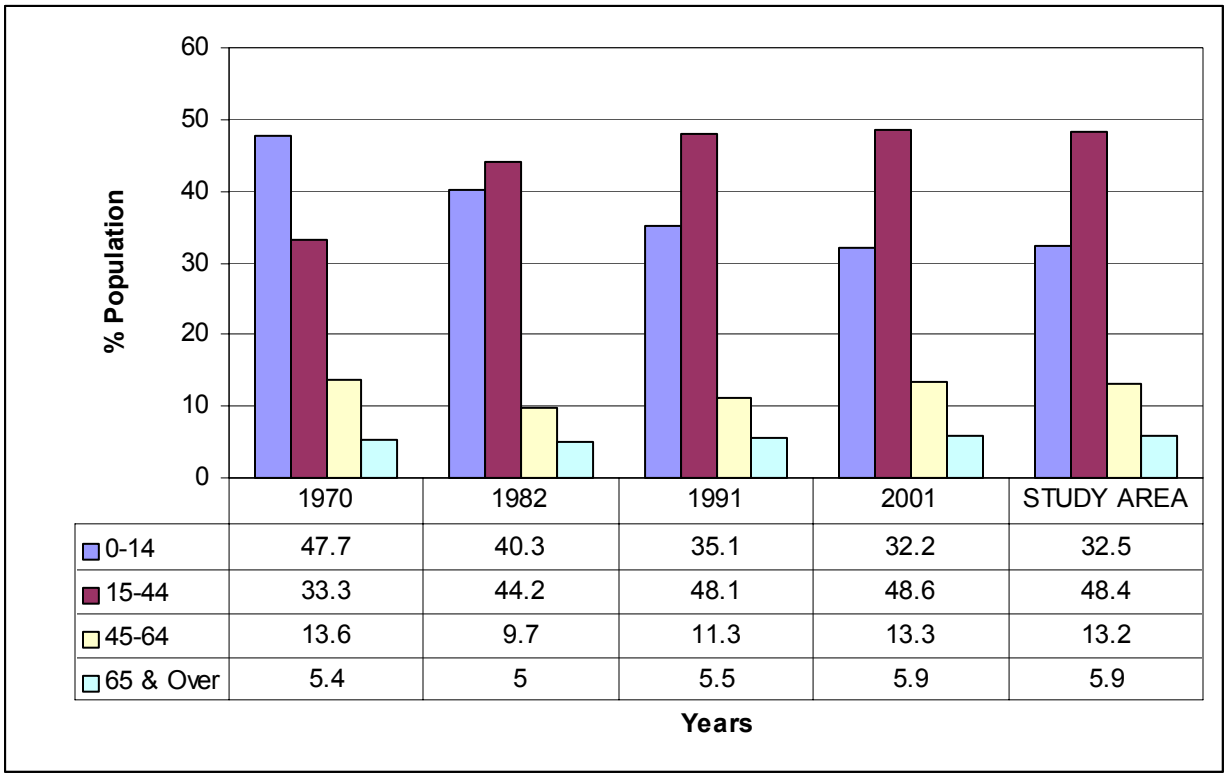

Figure 36 **Comparison of the population characteristics of the parish of St. Catherine (percentage) and the study area**

4.3 EMPLOYMENT AND INCOME

The unemployment rate among the labour force in the parish in 1991 stood at approximately 53.2%, while unemployment within the study area, stood at approximately 52%. The unemployment rate in the study area showed a slight reduction when compared to the parish. However, it is expected that the current situation would see a lowering of the unemployment rate in the study area, as with the increase in housing solutions over the last 14 years, one would see an influx of young professionals.

At the time of preparation of this report, the data for the income of persons within the study area was not available from STATIN.

The project is expected to employ some 50 persons, 47 during the site clearance and construction phase and three (3) during operation. The numbers are broken down in Table 20;

Table 20 Breakdown of project team

PROJECT TEAM	NUMBER OF PERSONS
Management Staff	3
Technical Staff	4
Construction earthworks - 4 teams @ (1 operator + 3 truck drivers)	16
Construction (structures)	5
Construction (pipelines)	5
Security	4
Operations (1 operator + 2 maintenance persons)	3
Sewerage construction 2 @ (5 persons)	10
TOTAL	**50**

4.4 EDUCATION

Educational attainment of persons within the study area when compared with the parish statistics showed that the population within the study area had a similar educational attainment when compared to the parish statistics. The exception to this is seen in the 'University' and 'Not Stated' categories, where the study area showed a higher percentage (Table 21). The higher percentage of persons that have attained a University education maybe a reflection of the study area being able to provide housing opportunities for young professionals that is relatively close to Kingston.

Table 22 lists some of the schools within proximity to the proposed development site. From the Table, schools that have generally exceeded their capacities (overcrowded) and those that are close to exceeding their capacities can be identified. An indication of overcrowding is the large numbers of persons attending educational facilities outside of the study area, going as far as Westmoreland. A large number attend schools in the Kingston Metropolitan Area.
Another indicator of crowding in schools is the advent of the shift system, which is a solution to deal with overcrowding in schools.

Table 21 Comparison of categories of educational attainment by the population in the Parish and the Study Area in 2001

Educational attainment	Parish	Study area
Pre-Primary	4.7	4.7
Primary	28.5	27.1
Secondary	49.3	48.8
University	3.7	4.4
Other Tertiary	7.7	7.8
Other	3.4	3.2
Not Stated	2.1	3.4
None	0.7	0.6

(Source: STATIN 2001 Census data)

Table 22 Schools, capacity, enrolment and percentage attendance

SCHOOL NAME	Enrolment	Capacities	% Attendance	Comments
Crescent Primary	1,538	825	76	Co-ed Shift
Horizon Park Primary & Junior High	**631**	**575**	**82**	Co-ed Whole Day
Ensom City Primary	1,365	800	38	Co-ed Shift
Mc Auley Primary	1,461	705	76	Co-ed Shift
St. Johns Primary	**1,948**	**885**	**91**	**Co-ed Shift**
Homstead Primary	**312**	**200**	**83**	**Co-ed Whole Day**
Spanish Town Primary	**2,514**	**1,185**	**95**	**Co-ed Shift**
Jonathan Grant High	**2,590**	**1,000**	**84**	**Co-ed Shift**
St. Jago High	**1648**	**1575**	**88**	**Co-ed Whole Day**
Tacius Golding High	1480	900	83	Co-ed Shift
St. Catherine High	**2,350**	**1,190**	**92**	**Co-ed Whole Day**
Spanish Town High	**2,309**	**900**	**95**	**Co-ed Shift**
Inswood High	1,069	1,350	Not Provided	Co-ed Shift
Eltham High	1,326	1,350	Not Provided	Co-ed Shift

NB. Enrolment based on the 2001- 2002 academic year. The names of schools that are in bold have exceeded their capacities.

Figure 37 depicts the highest education attained by the majority of the population. It shows that the majority of the persons within the study area have attained a secondary education.

The proposed development is expected to have a potential indirect positive impact on the educational system (those in proximity of the study area), as it has the potential to improve sewage collection and disposal at the schools, thereby improving the physical and social condition at the schools.

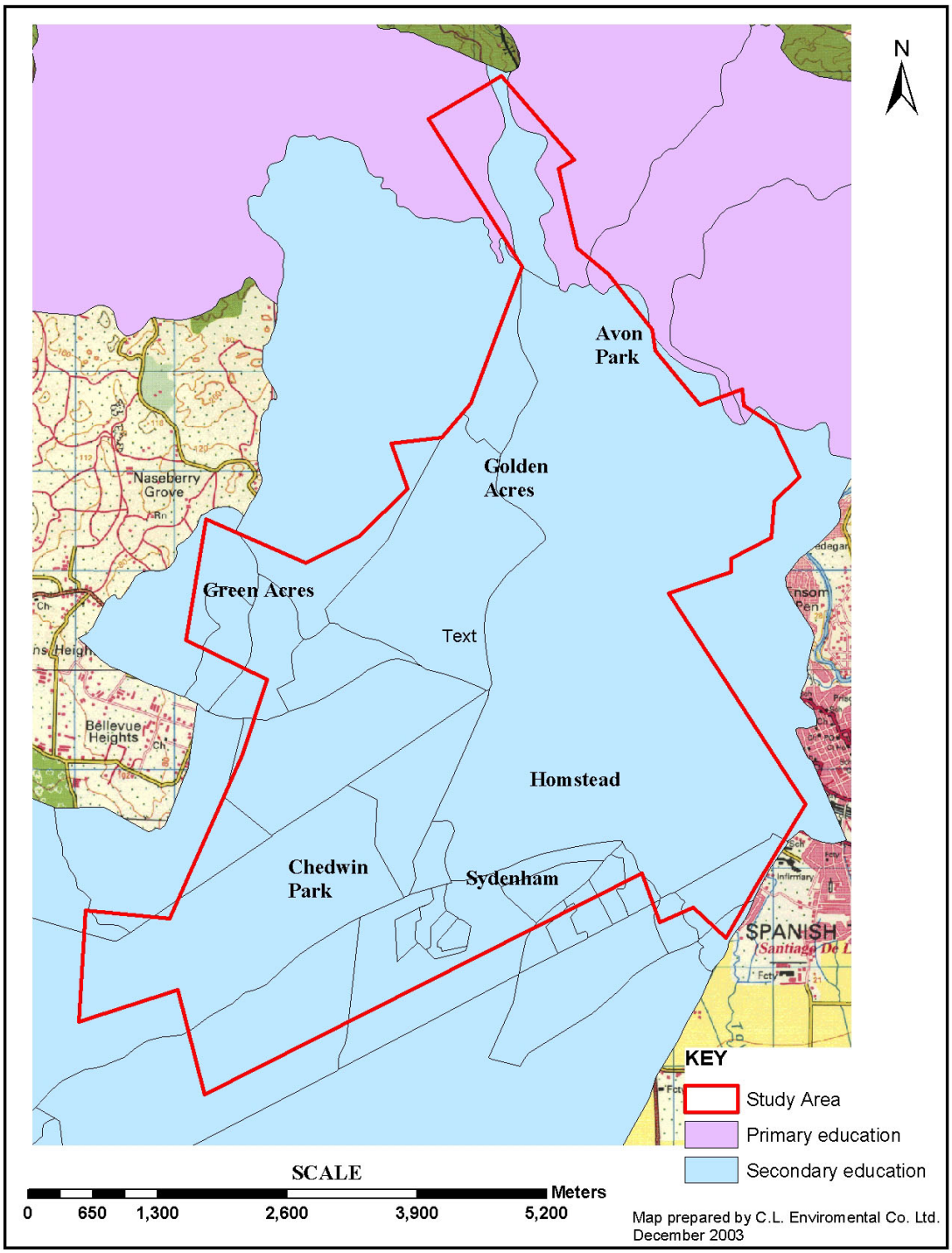

Figure 37 The educational standard attained by the majority of the population

4.5 LAND USE

Land use in the study area is mainly agricultural, commercial, residential, educational and recreational. The built environment dominates the land use of the study area. Agricultural practises are also significant with Sugarcane cultivation being the mainstay; the historic Innswood Sugar Factory is located in proximity to the southwest corner of the study area. Significant fish farming (aquaculture) occurs to the south east of the proposed development site. Cattle, pig and goat rearing are also done. Commercially, the study area has bars, shops and a future shopping centre. There are numerous existing and future housing schemes located in the study area. There are numerous educational facilities located in the study area; the most notable is the GC Foster College of Physical Education and Sport. Recreationally, there are parks and play fields located in the housing developments and a mini stadium at the GC Foster College.

Other land use practices within or in proximity to the study area include;

i. Improper solid waste disposal
ii. Charcoal burning
iii. Marl quarry
iv. An Agrochemical plant
v. Cemeteries (Dovecot Memorial Park and Crematorium and Meadowrest Memorial Gardens)
vi. A Chicken Farm (Featherbed Farm)
vii. Irrigation canals

The proposed site is currently a ruinate cane field as evidenced by Plates 4, 5 and 6. The total area is approximately 90 hectares.

The proposed development has the potential to impact negatively on the agricultural use of the land (that being used for the development of the wastewater plant) by preventing ("sterilizing") the land from being used for agricultural purposes in the future. This sterilization is an accumulation, as the area is being divided by the construction of Highway 2000 (see Figure 38 on page 99). It will however, have a potential positive impact in improving the sewage collection and disposal within the study area.

Plate 4 Section of the proposed WWTP site looking towards the north

Plate 5 Another section of the proposed WWTP site looking north showing improper solid waste disposal

Plate 6 Cows resting under a mango tree on the proposed WWTP site

4.5.1 Housing

For the purposes of this study the definition of housing unit, dwelling and household are those used in the conduction of the population census conducted by the Statistical Institute of Jamaica. This definition states that a "housing unit is a building or buildings used for living purposes at the time of the census. A dwelling is any building or separate and independent part of a building in which a person or group of persons lived at the time of the census". The essential features of a dwelling unit are both "separateness and independence". Occupiers of a dwelling unit must have free access to the street by their own separate and independent entrance(s) without having to pass through the living quarters of another household. Private dwellings are those in which private households reside. Examples are single houses, flats, apartments and part of commercial buildings and boarding houses catering for less than six boarders.

In 2001, there were approximately 98,523 housing units, 128,974 private dwellings and 134,377 households in St. Catherine. The average number of dwelling in each housing unit was 1.3 and the average household to each dwelling was 1.04. The parish had an average household size of approximately 3.58 persons/household. When compared to the national levels, the average number of dwelling in each housing unit (1.2) and the average household size (3.48) were higher in the parish. However, the average household to each dwelling (1.25) was lower in the parish.

Approximately seventy eight percent (78.5 %) of the housing units in St. Catherine in 2001 were of the separate detached type, 19.9% of the attached type, 0.5% part of a commercial building and 0.1% improvised housing, 0.1% other and 0.9% not stated.

Approximately 67% of the households in St. Catherine occupied between 1 and 3 rooms, 28% between 4 and 6 rooms and 5% occupied 7 and over rooms. Most of the households (37.1%) in St. Catherine used two (2) rooms for sleeping (Table 23).

Table 23 Breakdown of rooms used by households for sleeping as a percentage

LOCATION	1	2	3	4	5	NOT STATED
PARISH	32.6	37.1	20.1	6.2	3.3	0.6
STUDY AREA	32.3	34.4	20.0	6.8	4	2.5

(Source: STATIN 2001 Census data)

In 2001, there were approximately 16,734 housing units, 20,563 private dwellings and 21,409 households in the study area. The average dwelling in each housing unit was 1.2 and the average household to each dwelling was 1.04. The average household size was 3.41 persons/household. While the average household to each dwelling was similar to the parish statistics, the average dwelling in each housing unit and the average household size was lower than the parish average.

Separate housing accounted for 87.5% of the housing units in the study area in 2001. Over ten percent (10.7%) was attached housing and 0.3% part of a commercial building, 0.1% improvised housing, 1.3% did not state and approximately 0.1% had other type of housing.

In 2001, approximately sixty four percent (64.6%) of the households in the study area occupied between 1 and 3 rooms, 28.8% between 4 and 6 rooms, 3.4% occupying 7 and over rooms and 3.2% did not state. Most of the households (34.4%) in the study area occupied two (2) rooms for sleeping.

The majority of persons (47.3%) interviewed said that their household have been living in their community between 0 – 5 years, 19.4% from 6 – 11 years, 16% from 12 - 17 years, 6.5% from

18 – 4 years and 11% longer than 24 years. Approximately 45% of the houses that the respondents lived in were ≥ 15 years old.

Most persons interviewed moved to where they are presently because of the housing opportunities that presented itself. Sixty six (66%) owned the house in which they were living, 17% rented and the other 17% had other arrangements.

Some sugar workers live south of Highway 2000 (Plate 7).

Plate 7 An example of the sugar workers housing south of Highway 2000 and the proposed WWTP site

The proposed development will have an indirect positive impact on housing provisions in the study area, as it will provide an appropriate method for sewage collection and disposal within the area.

4.5.1.1 Tenure

Table 24 is a comparison of household tenure for the parish and the study area.

Table 24 Percentage household tenure for the parish and the study area

CATEGORY	ST. CATHERINE (%)	STUDY AREA (%)
Owned	29.6	32.4
Leased	7.3	14.3
Rented	9.6	14.4
Rent Free	11.6	9.1
Squatted	2.5	2.5
Other	0.7	0.9
Not Stated	38.7	26.5

Source STATIN 2001 Census data

In 2001, there were a higher percentage of households within the study area than the parish that had owned, leased or rented where they lived. This fact would suggest that a relatively high percent of households within the study area were generally stable. This is further supported by the fact that there were a lower percentage of the households in the study area living rent free when compared with the parish.

The probability of the success of the proposed development is likely, as the data would suggest that households within the study area will more likely have a vested interest in such a project as it has the potential to improve their housing conditions as it relates to sewage disposal and because they have security of tenure (low "squatter" percentage).

The Sugar Corporation of Jamaica (SCJ) owns the land that the proposed WWTP is to be situated on and discussions are underway with the SCJ in the aim of securing a lease arrangement. Apart from making arrangements with the owners of the proposed WWTP site, the owners of the lands on which the sewerage is to be laid needs to be identified and approached in an aim to arrive at mutual acceptable agreements.

4.5.2 Infrastructure

Electricity

Approximately 89.3% of the households in 2001 used electricity in the parish of St. Catherine. The use of kerosene was the next major source of lighting in households in the parish accounting for approximately 8.1%. Approximately two percent (2.2%) of the households did not report what means they used for lighting, while less than one percent (0.4%) of the households in the parish had other means of lighting.

In the study area in 2001, approximately 93% of the households used electricity and 4.3% used kerosene for lighting. Less than one percent of the households each used other means (0.3%) and 2.3% had not reported the type of lighting used in their households. There were a greater percentage of households within the study area using electricity than in the parish (St. Catherine). The percentage of households using kerosene in the study area was dramatically lower when compared with the parish.

It is not anticipated that there will be any problems as it relates to the supply of electricity to the proposed development.

Telephone/Telecommunications

The parish of St. Catherine and the study area are served with landlines provided by Cable and Wireless Jamaica Limited. Wireless communication (cellular) is provided by Cable and Wireless, Digicel Jamaica Limited and Oceanic Digital Jamaica Limited.

It is not anticipated that there will be any problems as it relates to the provision of telephone service to the proposed development.

Water Supply

Approximately 79% of the households in the parish in 2001 received water from the National Water Commission (NWC). Approximately 9% were supplied by private means, 4.9% from

springs and rivers, 4.8% had other means of receiving their water supply and 2.5% did not report the source of their water supply (Table 25).

In 2001, the percentage of households receiving water from the NWC in the study area was higher (≈ 91%) than that obtained in the parish. Approximately four percent (3.9%), of the households received water from private means, 2.6% did not report the means of their water supply, 2.5% had other means and 0.1% received water from a spring or river. Although the relative percentages were similar to that of the parish, the percentage of households using spring/rivers in the study area (2.5%) was markedly lower than that of the parish (Table 25).

Table 25 Water supply by categories as a percentage of total households for the parish and the study area (2001)

	CATEGORY	ST. CATHERINE (%)	STUDY AREA (%)
Public Source	Piped in Dwelling	55.6	62.7
	Piped in Yard	18	25.6
	Stand Pipe	2.7	1.5
	Catchment	2.2	1.1
Private Source	Into Dwelling	4.1	3.1
	Catchment	5.2	0.8
	Spring/River	4.9	0.1
	Other	4.8	2.5
	Not Reported	2.5	2.6

(Source: STATIN Population Census 2001)

Sewerage Disposal

A higher percentage of households in the study area compared to those within the parish use water closets to dispose of their sewage. With the higher percentage of households in the study area using water closets, there is a concomitant reduction in the percentage using pit latrines and those without an established means. There was, however, an increase in the households not reporting the method of sewage disposal they use, (Table 26).

Table 26 Comparison between the parish and the study area by sewage disposal methods as a percentage of the households.

METHOD OF DISPOSAL	LOCATION	
	ST. CATHERINE (%)	STUDY AREA (%)
Pit Latrine	33.3	29.2
Water Closet	63.5	67.5
Not Reported	1.4	1.8
No Facility	1.8	1.4

(Source: STATIN Population Census 2001)

The building of the proposed development is expected to have a potential positive impact on the socio-economic conditions within the study area as it is expected to improve the collection and disposal of wastewater. The proposed development has the potential to reduce ground water pollution and the spread of gastrointestinal diseases.

Solid Waste Generation

The Metropolitan Parks and Markets Waste Management Limited do solid waste collection within the study area. Presently, collection is done twice (2) per week. Areas have different days for solid waste collection for example Tuesday/Thursday for Sydenham, Monday/Thursday Willodene and Angels and Wednesday/Saturday for Horizon Park. This service is provided free (partial covered by property taxes) for the households within the area. The waste is transported to the Riverton City dump located in St. Catherine, approximately 19 km (≈ 12 miles) from the proposed WWTP site.

It is estimated that households in the study area generated approximately 72,916kg (≈ 73 tonnes) of solid waste in 2001. Based on the growth of the population, it has been estimated that at the time of this study, approximately 76,310 kg (≈ 76 tonnes) of solid waste was being generated and it is expected that within the next twenty five years, if the population growth rate remains the same to be 134,731 kg (≈ 134 tonnes).

The 2001 census data indicated that approximately 59% of the households in the parish of St. Catherine and the study area had their garbage collected by public means (North Eastern Parks and Markets Waste Management Limited). It showed that the preferred method of disposal was by public collection (Table 27). The data also showed that a higher percentage of the households

in the study area had their garbage collected by both public means. All the other categories of garbage disposal in the study area were lower than in the parish. However, the high percentage (22.1%) of households burning their garbage as a means of disposal is a cause for concern, as it has the potential to impact on ambient air quality by creating air pollution.

Table 27 Percentage households by method of garbage disposal

DISPOSAL METHOD	ST. CATHERINE (%)	STUDY AREA (%)
Public Collection	58.5	73.9
Private Collection	0.3	0.07
Burn	33.7	22.1
Bury	0.8	0.52
Dump	5.1	2.06
Other Method	0.3	0.08
Not reported	1.2	1.19

(Source: STATIN Population Census 2001)

It is anticipated that approximately 1.6 cubic metres per day of screenings and approximately 0.4 cubic metres of grit will be collected everyday. These will be removed by the operator and placed on a drying tray temporarily. The partially dry screenings and grits will be removed daily to a skip near the screens. Arrangements will be made with a private contractor to visit the site on a weekly basis to remove the solid waste to the Riverton Landfill as needed.

It is anticipated that the development will not have a negative impact on garbage collection within the study area.

Roads, Transportation and Traffic

The proposed development site is located approximately 19 km (≈ 12 miles) west of Kingston (capital of Jamaica) and approximately 6km (4 miles) southwest of Spanish Town (the old capital of Jamaica). Depending on the traffic conditions, it takes anywhere between half and hour to an hour to drive from Kingston. The Nelson Mandela Highway runs from Kingston to the Spanish Town by-pass, which connects to the Old Harbour main road, which runs north of the proposed site. The surface of these roads is in a relatively good state of repair. Access to the proposed site may be done from two directions, both via secondary roads, which have relatively poor road surface. They are located on the western side of the old Sydenham housing development (Figure 38) and through the Horizon Park housing scheme. The preferred access

road option is through the old Sydenham housing development, as this will provide easier access to the main by the larger vehicles. The access point from Horizon Park housing scheme /Old Harbour main road is located at an intersection of approximately three roads, thereby increasing the potential for accidents. Roads in other parts of the study area are in varying states of repair.

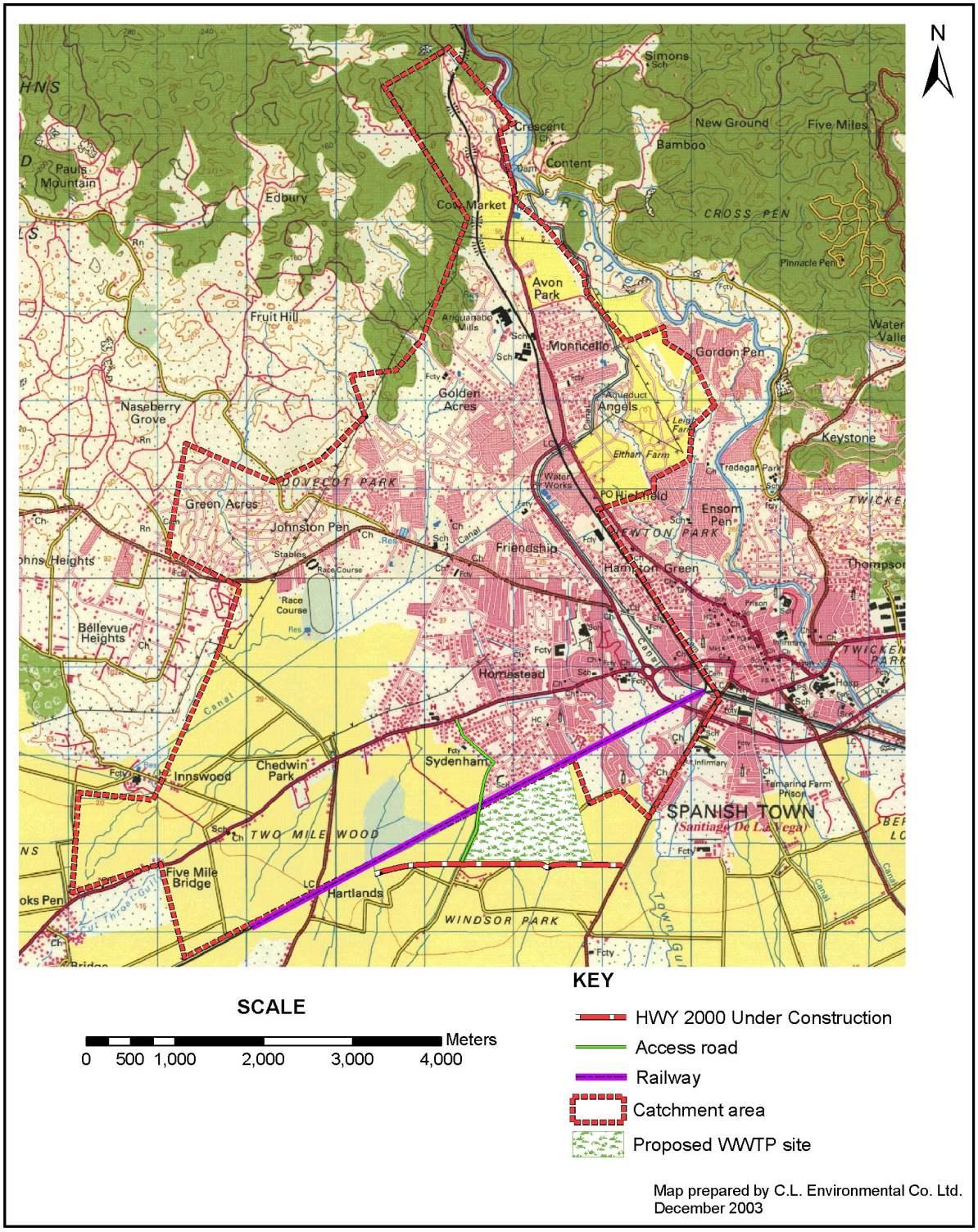

Figure 38 **Map depicting the proposed site and access road**

Although the railroad system in Jamaica at present is not functioning as a commuter transport, there are plans to resuscitate it. Presently, the railway line that the bauxite companies use, borders the northern edge of the proposed site. An example of this use is seen by West Indies Aluminium Company (WINDALCO) who transports both raw materials and finished products between its' plants in Kirkvine and Ewarton and its' port (Port Esquivel) situated in St. Catherine.

Transportation within the study area is provided by a fleet of taxis, "robot taxis" (unlicensed), buses and private cars.

The construction activities will have a negative impact on the area as there is expected to be an increase in heavy equipment moving along the access roads. The activities will also have the potential to increase traffic snarls in the short to medium term. During operation, it is expected that approximately 7 to 8 cesspool emptying trucks per day will visit the wastewater treatment plant. This has the potential to increase the incidence of accidents along the narrow Sydenham access road.

Health Care

Persons within the study area obtain their health care at a number of health centres and private doctors. The closest hospital to the proposed site is located in Spanish Town. It is a Type B Hospital, located at approximately 6km (4 miles) from the proposed site. This Hospital has approximately three hundred and twenty (320) beds and provides the following services; Internal Medicine, Obstetrics/Gynaecology, Laboratory, Radiology, Physiotherapy; Pharmacy, Accident/Emergency Services; Paediatric; Orthopaedics; Nutritional Counselling and Anaesthesiology. The Hospital sees approximately three hundred persons per day.

The construction and operation of the proposed development is not expected to have a negative impact on the health system within the study area. In fact, it has the potential to improve health conditions as it will improve the collection and disposal of sewage in the area.

4.5.3 Other Services

Fire Station

The fire station that would respond to an emergency at the proposed site is located within Spanish Town some 5.5 km (≈ 3.4 miles) from the proposed development site. Currently, this station has one fire engine with a water capacity of 1,818 – 2,273 litres (400-500 imperial gallons). There are fire hydrants within Horizon Park and Sydenham; however, their function ability could not have been ascertained. If the hydrants were non-functional, then water for fire fighting would have to be carried by a water tender truck. This truck has a water storage capacity of approximately 22,730 l (≈ 5,000 imperial gals.). If additional help were needed, backup would be called from the Old harbour fire station some 17 km (≈ 11 miles) away.

During the dry months, there are frequent bush fires in the Hartland area (in proximity of the proposed development area). The proposed development should have its own designed fire control system, with a series of fire hydrants and fire extinguishers. If these are put in place then, it is not anticipated that there will be any problems as it relates to a fire event.

Police Station

The Spanish Town police station is responsible for policing the area in proximity to the proposed WWTP site. They have reported that incidence of major crimes are low if not non-existent, however, the calls they mainly receive is for *domestic disputes and loud noises (music)*.

Crime is not expected to be a major problem in proximity to the proposed site.

Post Office

The residents in proximity to the proposed WWTP are served by the Spanish Town post office approximately 5.5 km away. The mail is delivered by a number of postmen.

4.5.4 Historical/Cultural Site

The Jamaica National Heritage Trust has no historical or cultural sites on its register for the proposed wastewater treatment plant site. Within and in proximity of the study area are 3 identified sites of historic interest. These are the Innswood Sugar Factory complex, a 19th century site, the 20th century Chedwin Park Sports Complex and Hanson Home (home for lepers).

The proposed development is not anticipated to infringe on any sites of historic or cultural importance.

4.5.5 Aesthetics and Security

The proposed development has the potential to impact negatively on the aesthetics of the proposed site from the standpoint of both residents in Sydenham and Horizon Park and also future vehicular traffic along Highway 2000, which is now being constructed.

The planting of vegetation such as trees and flowering plants such as *Bougainvillea* along the boundaries of the proposed property will have the potential for the site to become aesthetically pleasing to the observer.

To provide security and limited access to the proposed WWTP, the developer is planning to fence in the site. This will have the potential to sterilize the site, however, the site was already sterilized by the construction of Highway 2000.

4.5.6 Community Consultation and Perception

All of the persons interviewed were not aware of any environmental groups within the study area. However, there are other groups such as Citizens Associations (most frequently cited), youth clubs, service clubs, neighbourhood watches and church groups. Seventy two percent (72%) of the respondents characterized the organizations within their area as inactive to moderately active. Sixty three percent (63%) of these persons were not actively involved within these organizations.

Most persons interviewed (90%) were not aware of the pending development; the balance heard about the development from various sources, which included, the news and "word of mouth". A little more than half (51%) of those interviewed said that the area was suitable for the proposed development, 26% were not sure if the site was suitable and 15% said that it was not suitable and wanted a factory or a housing development instead. Eight percent (8%) had no response.

When asked how they thought the development of the WWTP at the proposed location would affect them, 70% did not see how it would affect them, 19% had concern over the generation of odour, 8% saw it as a positive development as it would increase their property value and decrease flooding and 3% saw it as increasing the potential for sewage back flow (e.g. overflow into streets).

Approximately fifty three percent (53%) of the persons interviewed said that they would be willing to pay a connection fee to be connected to the proposed WWTP. The amount that persons said that they would be willing to pay for connection, ranged from a low of J$200 to a high of J$<20,000.

Forty seven (47%) percent of persons when asked what else they would like to see done as it relates to sewage collection in their area said that at present, they had no problems with sewage collection, 30% wanted to see an improved sewage collection, 9% wanted proper drainage and decrease in odours, 5% wanted pits to be dug and 9% had no thoughts on the subject.

Persons interviewed expressed other things they would like done in their communities. These are listed below, not necessarily in the order of importance.

i. Improved sewage collection and disposal;
ii. A skills training centre;
iii. Better solid waste disposal;
iv. Adequate water supply;
v. Road improvements;
vi. Drain cleaning;

vii. Maintenance of green spaces;
viii. Installation and repair of street lights; and
ix. Mosquito control.

Special interest group

The area south of the proposed WWTP, in particular, the Hill Run region, is the centre of major aquaculture farming. In discussions held with the aquaculture farmers, they have expressed concerns about the development and the impact it will have on their production. Discussions are ongoing in the hope of addressing these concerns.

5.0 ANALYSIS OF ALTERNATIVES

The discussion and analysis of alternatives in Environmental Impact Assessments should consider other practicable strategies that will promote the elimination of negative environmental impacts identified. This section is a requirement of the National Environment and Planning Agency (NEPA), and is critical in consideration of the ideal development with minimal environmental disturbance.

This draft report has identified the major environmental impacts noted by scientific experts.

The following alternatives have been identified and discussed with CAN-CARA as a means of reducing environmental effects. They are discussed in further detail below:

- The "No-Action" Alternative.
- The proposed Development as described in the EIA.

5.1 THE "NO-ACTION" ALTERNATIVE

The "no action" alternative is required to ensure the consideration of the original environment without any development. This is necessary for the decision-makers in considering all possibilities.

The no-action alternative **would** potentially result in an increased ponding (increase flood plain) on the proposed WWTP site due to the construction of Highway 2000 (H2K). The construction of H2K may result in "sterilization" of the site of the proposed WWTP, in effect taking it out of Sugarcane production and leaving it in its present state. This would increase the potential of bush fires (a hazard that has the potential to impact on houses in proximity) and also increase the potential for the site to be used as an area for "informal dumping", for which the embryonic stages have been observed.

If the proposed site is still being used for Sugarcane production, then there will be the potential for particulate nuisance (soot) and fire hazard (uncontrolled fires), both occurring as a result of the reaping process.

In terms of the social environment, the "no-action" alternative would eliminate the opportunity for the provision of an improved and an appropriate system of sewage collection and disposal for approximately 21,000 households. It will also eliminate the possibility for the Sugar Company of Jamaica to obtain irrigation water for Sugarcane production.

5.2 THE PROPOSED DEVELOPMENT AS DESCRIBED IN THE EIA

The project will consist of approximately 12km of both primary and secondary gravity and force mains that will collect the wastewater from discrete communities. It is envisaged that there will be a need for one regional lift station. The majority of the pipeline route will be along the existing National Irrigation Commission reservation and to a lesser extent, along public roads between St. John's Road and Ardenne Farm. In summary, the system will consist of:

- Gravity mains ranging from 300mm to 900mm in diameter.
- Force mains ranging from 400mm to 600mm in diameter.
- A regional lift station at White Water Meadows.

The treatment plant will receive the wastewater and septage from trucks that will have access to the plant. The area of the treatment plant site including buffer will be 112ha. The plant will consist of:

- Screens and Grit chambers;
- Septage Holding Tank;
- Waste Stabilization Ponds; and
- Constructed Wetlands.

The designed system will produce an effluent quality that meets and exceeds both NEPA and WHO standards. It will also meet the standard for it to be used for irrigation water. The expected yield of irrigation quality effluent will be sufficient to irrigate approximately 659ha of cane lands.

5.3 THE PROPOSED DEVELOPMENT AS DESCRIBED IN THE EIA, AT A DIFFERENT LOCATION

This is the same development as described in the EIA, however another location, Smallwood Pen (approximately 3km southwest of the site) was investigated for the siting of the WWTP. This option was not explored further as the existing Sugarcane farmer, based on conversations with persons within the area, was considered productive.

5.4 THE PROPOSED DEVELOPMENT AS DESCRIBED IN THE EIA, USING A MECHANICAL SEWAGE TREATMENT SYSTEM

This option would utilize less land area for the treatment plant, however, the capital outlay for such a mechanical plant is prohibitive. An estimate for a mechanical plant to provide an adequate and appropriate treatment and disposal of the collected sewage within the study area is approximately $JA586M (≈$US10M) (based on ≈ $JA50M per 500,000 IGD of sewage to be treated and a $US exchange rate of $J61.00 to $US1.00). The estimated cost for the natural treatment of the sewage from the study area using lagoons (ponds) is $JA81M (≈$US1.3M).

The Jamaican experience in the use of mechanical plants in the treatment of domestic sewage is that they generally have a high maintenance cost usually requiring vast amounts of foreign exchange and parts quite frequently have to be repaired or purchased overseas. The result is that most if not all of the major mechanical plants are in a state of disrepair (malfunctioning) and are not providing adequate treatment of the collected sewage, thereby not performing up to NEPA and WHO effluent standards.

5.5 OVERVIEW OF ALTERNATIVE ANALYSIS

Based on the above, the most environmentally sound and cost effective option would be that described in section 5.4. It would "spin off" an indirect benefit of producing irrigation quality water that the SCJ can use for irrigating their Sugarcane fields.

6.0 ENVIRONMENTAL IMPACT IDENTIFICATION & MITIGATION

An environmental impact is defined as any change to an existing condition of the environment. The nature of the impacts may be categorised in terms of:

- Direction - positive or negative
- Duration - long or short term
- Location - direct or indirect
- Magnitude - large or small
- Extent - wide or local
- Significance - large or small

To systematically identify the impacts associated with the proposed development, an impact matrix was constructed which arrayed the main project activities against the relevant environmental factors. This matrix is shown in Tables 28 and 29.

Table 28 Impact Matrix for Site Preparation and Construction

ACTIVITY/IMPACT	DIRECTION		DURATION		LOCATION		MAGNITUDE		EXTENT		SIGNIFICANCE	
	Pos	Neg	Long	Short	Direct	Indirect	Major	Minor	Wide	Local	Large	Small
1. **Site Preparation**												
Vegetation Removal		x	x		x		x		x			x
Habitat Removal		x	x		x			x		x		x
Increased infiltration/runoff		x		x		x		x		x		x
Dust		x		x		x		x		x		x
Noise		x		x		x		x		x		x
2. **Cut, Fill & Levelling**												
Generated solid waste		x		x		x	x			x	x	
Dust		x		x		x		x		x		x
3. Material Transport												
Dusting & spillage		x		x		x		x	x			x
Traffic congestion, road wear		x		x		x		x	x			x
4. Improper Material Storage												
Dusting		x		x		x		x		x		x
Suspended solid runoff		x		x		x		x		x		x
5. Construction Works												
Noise		x		x		x		x		x		x
Dust		x		x		x		x		x		x
Changes in drainage network	x		x		x		x			x	x	
Visual intrusion		x		x		x	x			x		x
6. Construction Crew												
Sewage generation		x		x		x		x		x		x
Solid waste generation		x		x		x		x		x		x
Emergencies/Accidents		x		x		x	x	x		x		x
7. Landscape & Replanting												
Vegetation/habitat reintroduction	x		x		x			x	x			x
8. Employment												
Job creation	x			x		x	x			x		x

Table 29 Impact Matrix for Operational Phase

ACTIVITY/IMPACT	DIRECTION		DURATION		LOCATION		MAGNITUDE		EXTENT		SIGNIFICANCE	
	Pos	Neg	Long	Short	Direct	Indirect	Major	Minor	Wide	Local	Large	Small
1. Wastewater Treatment												
Odour		x		x		x		x		x		x
Solid waste		x		x		x		x		x		x
Septage		x	x			x	x			x		x
2.Wastewater Disposal												
Water quality	x		x			x	x		x		x	
Wastewater treatment	x		x		x		x		x		x	
Water resources (wells)	x		x			x	x		x		x	
3.Storm water												
Improved flood/drainage infrastructure	x		x			x	x			x		x
Improved soil erosion infrastructure	x		x			x		x		x		x
4.Water Resources												
Irrigation water for SCJ	x		x			x	x			x	x	
Water resource protection	x		x			x	x		x		x	
5. Transportation/Traffic												
Traffic nuisance		x	x			x		x	x			x
Traffic accidents		x	x			x		x	x			x
Noise		x	x			x		x	x			x
6. Emergency Response												
Emergencies/Accidents		x	x			x		x		x		x
7 Landscaping												
Local vegetation./habitat intro.	x		x			x	x			x	x	
Improved aesthetics	x		x		x		x			x	x	
8. Site Access Road												
Increased surface runoff		x	x			x		x		x		x
9. Security												
Fencing	x		x		x		x			x	x	
Visual intrusion		x	x			x	x			x		x
10. Employment												
Job creation	x		x			x		x		x		x

6.1 SITE PREPARATION AND CONSTRUCTION

Site Preparation and Vegetation Clearance

Impacts:

Site clearance and construction practices generally mean the removal of existing vegetation. These practices remove protective plant cover and expose the soil to erosive surface runoff during heavy rainfall. The inappropriate disposal of the cleared vegetation could lead to burning onsite and associated negative impacts on local air quality.

Approximately 60 hectares of land will be cleared of all vegetation. The perimeter of the site will be used to landfill the excess cut and will also be covered. As previously discussed under Section 3.5.1.2, the sections of the site proposed for construction are primarily exposed (open) grassland. As a result, there are no significantly important floral species or vegetation communities that would be negatively impacted by site clearance and construction practices.

Similarly, negative impacts on avifauna, associated with the loss of onsite vegetation/habitat, are expected to be insignificant. As previously mentioned under Section 3.5.2.1, diverse and abundant avifauna does not use the project site for nesting, breeding or feeding.

Mitigation:

i. Vegetation site clearance should be phased and the project site cleared as the need arises; as opposed to the practice of clearing the entire site in a single major clearance exercise. This will help to minimise the amount of bare/exposed soil present at the site, and thereby help reduce the risk of soil erosion during heavy rains and flash flooding.

ii. Areas of exposed soil should be replanted with grass as soon as possible after construction; to help mitigate against flash flood soil erosion.

iii. To reduce the amount of organic waste generated by the project, small- to medium-sized branches and bits of vegetation may be put through an onsite

commercial wood chipper. The resulting wood chips may then be recycled (i.e. onsite/offsite) as soil cover and similar soil amendment undertakings associated with either project-related or non-project related landscaping. With regards to a practical suggestion for recycling larger and harder tree trunks and branches, the latter may be made available to local charcoal burners.

Failing the feasibility of the above recycling recommendations, organic waste (generated during the site clearance/construction phases of the project) must be disposed of at an approved disposal site (Riverton dump). Burning of the waste vegetation must not be allowed to take place either on or off the project site.

Impact: Noise Pollution

Site clearance and construction of the proposed development necessitates the use of heavy equipment to carryout the nature of the job. These equipment include bulldozers, backhoes, etc. They possess the potential to have a direct negative impact on the environment.

Mitigation:

- Use equipment that has low noise emissions as stated by the manufacturers.
- Use equipment that is properly fitted with noise reduction devices such as mufflers.
- Operate noise-generating equipment during regular working hours (e.g. 7 am – 7 pm) so as to reduce the potential of creating a noise nuisance during the night.
- Construction workers operating equipment that generates noise should be equipped with noise protection. A guide is a worker operating equipment generating noise of ≥ 80 dBA (decibels) continuously for 8 hours or more should use ear muffs. Workers experiencing prolonged noise levels 70 - 80 dBA should wear earplugs.

Impact: Water Quality

Removal of the vegetation can result in high suspended sediment concentrations in the runoff from the site, during construction. Fortunately, the majority of the earth works are depressions and hence the storm water will be naturally retained in the basins.

Mitigation:

- Surface runoff will be controlled by temporarily berming the outlet of the significant storm water features to provide some detention behind the berms.

Impact: Air Quality

Site preparation and construction has the potential to have a two folded direct negative impact on air quality. The first impact is air pollution generated from the construction equipment and transportation. The second is from fugitive dust from site and access roads, cleared areas and raw materials stored on site. Fugitive dust has the potential to affect the health of construction workers, the resident population and the vegetation.

Mitigation:

i. Site roads should be dampened every 4-6 hours or within reason to prevent a dust nuisance and on hotter days, this frequency should be increased.
ii. The access roads (unpaved sections) through Sydenham and Horizon Park should also be wetted and the sections of the road monitored so that any material falling on it as a result of the construction activities be removed.
iii. Minimize cleared areas to those that are needed to be used.
iv. Cover or wet construction materials such as marl to prevent a dust nuisance.
v. Where unavoidable, construction workers working in dusty areas should be provided and fitted with N95 respirators.

Impact: Employment

During this phase, an average of approximately 47 persons will be employed. This has the potential to be a significant positive impact.

Mitigation

Not required.

Impact: Solid Waste Generation

During this construction phase of the proposed project, solid waste generation may occur mainly from two points:

i. From the construction campsite; and
ii. From construction activities such as site clearance and excavation.

Mitigation:

i. Skips and bins should be strategically placed within the campsite and construction site.
ii. The skips and bins at the construction campsite should be adequately designed and covered to prevent access by vermin and minimise odour.
iii. The skips and bins at the construction site should be adequately covered to prevent a dust nuisance.
iv. The skips and bins at both the construction campsite and construction site should be emptied regularly to prevent overfilling.
v. Disposal of the contents of the skips and bins should be done at an approved disposal site. The Riverton Landfill in Kingston is recommended. Appropriate permission should be sought (The National Solid Waste Management Authority).
vi. Trees that are removed from the proposed site may be given to local persons to be used for lumber or for charcoal burning.

Impact: Wastewater Generation and Disposal

With every construction campsite comes the need to provide construction workers with showers and sanitary conveniences. The disposal of the wastewater generated at the construction

campsite has the potential to have a minor negative impact on groundwater. No significant environmental impacts were identified from this activity.

Mitigation:

i. Provide portable sanitary conveniences for the construction workers for control of sewage waste. A ratio of approximately 25 workers per chemical toilet should be used.

Impact: Storage of Raw Material and Equipment

Raw materials, for example sand and marl, used in the construction of the proposed development will be stored onsite. There will be a potential for them to become air or waterborne. Stored fuels and the repair of construction equipment has the potential to leak hydraulic fuels, oils etc.

Mitigation:

i. Raw materials that generate dust should be covered or wetted frequently to prevent them from becoming air or waterborne.
ii. Raw material should be placed on hardstands surrounded by berms.
iii. Equipment should be stored on impermeable hard stands surrounded by berms to contain any accidental surface runoff.
iv. Bulk storage of fuels and oils should be in clearly marked containers (tanks/drums etc.) indicating the type and quantity being stored. In addition, these containers should be surrounded by berms to contain the volume being stored in case of accidental spillage.

Impact: Transportation of Raw Material and Equipment

The transportation and use of heavy equipment and trucks is required during construction. Trucks will transport raw materials and heavy equipment. This has the potential to directly impact traffic flow along the Old Harbour main road along the Sydenham or Horizon Park entrance. Additional traffic will occur as a result of:

- Construction of the inlet works;

- Mobilizing and demobilizing of the earth works equipment; and
- Construction of the wetland.

The mobilizing of all of the earth works equipment to site is not expected to take more than a week and is not expected to cause any significant inconveniences. The construction of the wetlands is expected to necessitate some 5,600 trips over a four month period or 64 trips per day.

Mitigation:

i. Adequate and appropriate road signs should be erected to warn road users of the construction activities. For example, reduced speed near the entrance roads. This should be done in conjunction with the Ministry of Transport and Works.
ii. Raw materials such as marl and sand should be adequately covered within the trucks to prevent any escaping into the air and along the roadway.
iii. The movement of equipment (trucks) during the construction of the wetland should be limited to the working hours, 8:00 am - 4:30 pm per day.
iv. Heavy equipment should be transported early morning (12 am – 5 am) with proper pilotage.
v. The use of flagmen should be employed to regulate when trucks have access to the main roads.

Impact: Traffic Obstruction

The laying of the sewerage will entail crossing the Old Harbour main road and laying of pipes along the St. Johns road. This has the potential to cause traffic snarls.

Mitigation:

i. The laying of sewer pipes across the Old Harbour main road should be done when traffic volumes are lowest, for example, early morning or on weekends (specifically on a Sunday).
ii. Adequate notices should be placed in the print and electronic media.

iii. Adequate signs, road furniture and flagmen should be put in place.

Impact: Emergency Response

Construction of the proposed development will involve approximately 47 construction workers. The possibility of accidental injury is high. There maybe either minor or major accidents.

Mitigation:

i. A lead person should be identified and appointed to be responsible for emergencies occurring on the site. This person should be clearly identified to the construction workers.
ii. Make prior arrangements with health care facilities such as a Health Centre in proximity, a private doctor or the Spanish Town Hospital to accommodate any eventualities.
iii. Material Safety Data Sheets (MSDS) should be store onsite.

6.2 OPERATIONAL PAHSE

Impact: Earthquake Hazard

From the catalogue of earthquakes impacting Jamaica over the past 300 years, most of the larger earthquakes recorded/reported were offshore. The earthquakes occurring on land tend to be of low magnitude.

The proposed site is in a zone where one of the highest frequency of earthquakes > 6 on the Modified Mercalli scale occurred. At this magnitude, there is the potential for earth movement. However, the nature of the substrate (clay) would mean that it would be self sealing thereby reducing the potential for leaks. Additionally, the sand layer below would reduce any potential contamination of ground water by coliforms.

Mitigation

i. Any structure to be constructed at the site are low-rise and this implies a moderate to low earthquake hazard with respect to life and property.

ii. To minimize earthquake impact, it is recommend that the buildings at the site should be designed and constructed to withstand moderate to large earthquakes.

Impact: Flooding

The construction of such large ponds could conceivably minimize the areas of natural detention and result in more peaked storm water runoff flows. The potential for this impact of the project on the storm water flow regime of the catchments involved was investigated.

The natural drainage on the site had to be modified in the design in order to minimize flooding and protect the treatment units. The flood plain analysis results indicated that the flood plains downstream of H2K would be reduced as a result of the reduction of the effective catchment area. Specifically, the floodplain before H2K was estimated to be 11 ha, versus the predicted 8.8 ha after H2K and 6.9ha after the WWTP site is fully developed. The flood plain upstream of the railway in the Horizon Park sub-division is noted to be unaffected by both implementations with an estimated area of 3.9ha. This is a positive impact of both projects. It can therefore be concluded that the implementation of the WWTP with the drainage provisions considered will have a positive impact on the flood plain characteristics of the catchments involved, by reduction of the likely flood plain area.

Mitigation:

No mitigation required.

Impact: Employment

During this phase, an average of approximately 3 staff (1 operator and 2 grounds men) will be needed for the proper operation of the development. This represents an increase in the level of employment within the study area. This has the potential to be a minor positive impact.

Mitigation

Not required.

Impact: Solid Waste Generation and Disposal

The operation of the development has the potential of significantly increasing the solid waste at the site. There will be a need to remove the screenings and grit from the site on an operational basis. This activity will require that a tipper truck visit the site every week to empty the two skips. This material can be handled with the same care as municipal solid waste and should be carried to the Riverton Landfill for proper burial. The volume of solid waste is not unnecessarily large either and thus does not warrant any special concerns. The removal of sludge from the facultative and anaerobic ponds will require that an estimated 2,263 cubic metres of sludge be removed every four years. The material will be removed to the Riverton Landfill over a four to five day period if weather is permitting, using covered tipper trucks.

Mitigation:

i. Provision of solid waste storage bins and skips.
ii. Provision of adequately designed bins and skips to prevent access by vermin.
iii. Monitor skips so that they do not become overfilled.
iv. Ensure that the solid waste collected is disposed of in an approved dumpsite such as the Riverton Landfill in Kingston.

Impact: Transportation/Traffic

The development is expected to increase the traffic along the access roads, as they will be approximately 7 to 8 septage trucks driving through Horizon Park and/or Sydenham every day.

Mitigation:

i. Limit sepatage delivery to the WWTP between the hours of 8 am and 5 pm daily. This will limit the noise nuisance to residents and possibly reduce the population exposed to potential accidents, as most persons would have already left their homes to go to work or school.
ii. Add adequate and appropriate signs including speed limits along the roadway in proximity to the access roads.

Impact: Septage Disposal

The proposed development will be a receptacle for septage disposal. This activity has the potential to have two negative impacts. The first being unscrupulous cesspool emptiers collecting funds to carry septage from the source to the WWTP and depositing it at an unapproved site closer to the source. The other impact is on the operations of the WWTP, in that it has the potential to impact the final effluent quality.

Mitigation:

i. Institute and maintain a ticketing system for cesspool emptiers, where upon successful disposal, the WWTP operator would issue a receipt to the cesspool emptier.
ii. Government and particularly NEPA, should put in place a system to monitor cesspool emptiers (maybe from their association) and in addition, have a public educational campaign to educate and inform the public about the system.
iii. Ensure that septage is only accepted at the WWTP when there is adequate flows in the lagoons (ponds).

Impact: Emergency Response

The operation of the proposed development will involve workers who may become ill or have accidents. In addition, disasters such as earthquakes, floods and fires are real possibilities.

Mitigation:

i. Make prior arrangements with health care facilities such as a Health Centre in proximity.
ii. Design and implement an emergency response plan.
iii. Coordinate with mutual aid organisations/agencies such as with the local fire brigade.
iv. Install fire hydrants within the proposed development.

Impact: Wastewater Disposal/Water Pollution

The discharge of treated effluent from the treatment plant will be continuous and will meet the NEPA guidelines for both irrigation and direct discharge. The discharge to the existing drainage features will result in improved water quality based upon the water quality survey results that have been done as a part of this study. The SCJ have been in discussions with the developer in an aim to use the effluent for irrigation of cane fields.

Mitigation:

No mitigation required.

Impact: Odour

Wastewater treatment plant carry a risk of odour nuisance if proper buffers between the treatment units and existing populations are not provided. A buffer of at least 100 metres has been provided on all boundaries as per NEPA recommendations. Additionally, the perimeter of the proposed site will be vegetated with trees and plants of varying heights thereby forming a windbreaker.

Mitigation:

i. Monitor and ensure that influent sulphate levels are below 240 mg/l.
ii. Ensure that the pond series have adequate water flow to reduce the potential of odour formation.

7.0 ENVIRONMENTAL MONITORING PROGRAMME/WASTE MANAGEMENT PLAN

7.1 MONITORING DURING SITE CLEARANCE AND PREPARATION OF THE PROPOSED DEVELOPMENT

- Daily inspections to ensure that construction activities are not being conducted outside of regular working hours (e.g. 7 am – 7 pm). In addition, a one off noise survey should be undertaken to determine workers and community exposure to noise emissions.

  The project engineer / construction site supervisor should monitor the construction work hours. NEPA should conduct spot checks to ensure that the hours are being followed.

  It is not anticipated that this exercise will incur additional costs.

- Daily monitoring to ensure that the cleared areas and access roads are not creating a dust nuisance.

  The project engineer / construction site supervisor should monitor or nominate a named person to carry out this activity. NEPA should conduct spot checks to ensure that this stipulation is followed.

  It is not anticipated that this exercise will incur additional costs.

- Undertake daily inspections of trucks carrying solid waste generated from site clearance activities to ensure that they are not over laden as this will damage the public thoroughfare and onsite lead to soil compaction.

  Person(s) appointed by the developer may perform this exercise.

  No additional cost is anticipated for this exercise.

- Daily monitoring of vehicle refuelling and repair should be undertaken to ensure that these exercises are carried out on hardstands. This is to reduce the potential of soil contamination from spills. Spot checks should be conducted by NEPA.

  Person(s) appointed by the developer may perform this exercise.

  No additional cost is anticipated for this exercise.

7.2 MONITORING DURING THE CONSTRUCTION PHASE OF THE PROPOSED DEVELOPMENT

- Daily inspection of site clearance activities to ensure that the proposed building plans are followed and to ensure that site drainage is being constructed as planned. NEPA and the local Parish Council can provide checks and balances.

  Person(s) appointed by the developer may perform this exercise.

  No additional cost is anticipated for this exercise.

- Undertake monthly water quality monitoring to ensure that the construction works are not negatively impacting on the river, streams, and gullies water quality. The parameters that should be monitored are **dissolved oxygen**, **nitrates**, **phosphates**, **turbidity and total coliforms**.

  Any organization with the capability to conduct monitoring of the listed parameters should be used to perform this exercise. It is recommended that a report should be given to NEPA at the end of each monitoring exercise.

  This is estimated to cost approximately **J$ 25,000** per monitoring exercise.

- Daily inspections to ensure that construction activities are not being conducted outside of regular working hours (e.g. 7 am – 7 pm). In addition, a one off noise survey should be undertaken to determine workers exposure and construction equipment noise emission.

  The project engineer / construction site supervisor should monitor the construction work hours. NEPA should conduct spot checks to ensure that the hours are being followed. CL Environmental Co. Ltd., Environmental Solutions Ltd. or any other suitable qualified company or individual may conduct the noise survey.

  The monitoring of the construction work hours is not expected to incur any costs. The noise survey is estimated to cost approximately **J$12,000**.

- Daily monitoring to ensure that fugitive dust from cleared areas, access roads and raw materials are not being entrained in the wind and creating a dust nuisance.

  The project engineer / construction site supervisor should monitor the construction work hours. NEPA should conduct spot checks to ensure that this stipulation is being followed. In addition, the NGO's within the area can be used to provide additional surveillance.

  It is not anticipated that this exercise will incur additional costs.

- Undertake daily inspections of trucks carrying raw material to ensure that they are not over laden as this will damage the public thoroughfare and onsite lead to soil compaction. Also to ensure that they are covered and not spilling materials along the roadway.

  Person(s) appointed by the developer may perform this exercise.

  No additional cost is anticipated for this exercise.

- Conduct daily inspections to ensure that trucks carrying raw materials and heavy equipment are parked at the designated area on the proposed site so as to prevent traffic congestion and accidents.

  Person(s) appointed by the developer may perform this exercise.

  No additional cost is anticipated for this exercise.

- Conduct daily inspections to ensure that flagmen are in place and that adequate signs are posted along the roadway. This is to ensure that traffic along the Old Harbour main road and the Sydenham and Horizon Park access roads have adequate warnings and direction.

  Person(s) employed by developer may perform this exercise.

  No additional cost is anticipated for this exercise.

- Undertake daily assessment of the quantity of solid waste generated and keep records of its ultimate disposal. Additionally, solid waste generation and disposal of the campsite should also be monitored.

  Person(s) appointed by the developer may perform this exercise.

  No additional cost is anticipated for this exercise.

- Weekly assessment to determine that there are adequate numbers of portable toilets and that they are in proper working order. This will ensure that sewage disposal will be adequately treated.

  Person(s) appointed by the developer may perform this exercise.

  No additional cost is anticipated for this exercise.

- Monitor and ensure that approved suppliers and sources of local materials are used. Inspection of quarry licences should be conducted to ensure that they are legal. Copies of these licences should be kept on file.

  Person(s) appointed by the developer may perform this exercise.

No additional cost is anticipated for this exercise.

- Daily monitoring of vehicle refuelling and repair should be undertaken to ensure that these exercises are carried out on hardstands. This is to reduce the potential of soil contamination from spills. Spot checks should be conducted by NEPA.

  Person(s) appointed by the developer may perform this exercise.

  No additional cost is anticipated for this exercise.

- Where possible, construction crews should be sourced from within the study area. This will ensure that the local community will benefit from the investment.

  Person(s) appointed by the developer may perform this exercise.

  No additional cost is anticipated for this exercise.

7.3 MONITORING DURING THE OPERATIONAL PHASE OF THE PROPOSED DEVELOPMENT

- Undertake quarterly water quality monitoring exercises for one year to ensure that the development is not negatively impacting on the river, streams and gullies water quality. The parameters that should be monitored are **dissolved oxygen**, **nitrates**, **phosphates**, **turbidity and faecal and total coliforms**.

- It is recommended that both influent and effluent water quality be monitored on a weekly basis using qualified grab sampling. This recommendation is based on NEPA guidelines for the monitoring of wastewater treatment plants with discharges above 1000 m3/day. It is further proposed that the flow rate be estimated from Parshall Flume measurements. This information should be compiled and stored in a database by the facility manager and compared with NEPA guidelines for compliance. Corrective action should be undertaken in the event of non-compliance. The recommended list of parameters and the point of sampling is summarized in Table 30.

Table 30 List of Parameters to be monitored at the WWTP

Influent at Grit chamber (weekly)	Effluent at end of Constructed Wetland (weekly)
COD	COD
BOD	BOD
TSS	TSS
OG	OG

Influent at Grit chamber (weekly)	Effluent at end of Constructed Wetland (weekly)
Phosphorous	Phosphorous
Ammonia	Ammonia
TKN	TKN
Nitrates	Nitrates
Faecal Coliform	Faecal Coliform

Dissolved oxygen and pH levels should also be monitored on a monthly basis in all of the ponds. Such monitoring should consist of monitoring of at least one location within each pond throughout the water column.

Any organization with the capability to conduct monitoring of the listed parameters should be used to perform this exercise. It is recommended that a report should be given to NEPA at the end of each monitoring exercise.

This is estimated to cost approximately **J$ 50,000** per monitoring exercise.

- Undertake daily assessment of the quantity of solid waste generated and keep records of its ultimate disposal. This is to ensure that the skips and bins do not become overfilled.

  Person(s) appointed by the developer may perform this exercise.

  No additional cost is anticipated for this exercise.

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APPENDICES

Appendix I Community Questionnaire

WESTERN SPANISH TOWN WASTEWATER TREATMENT PLANT, HORIZON PARK, ST. CATHERINE PROPOSED DEVELOPMENT

COMMUNITY QUESTIONNAIRE

DATE:_____ **INTERVIEWER:**_____

LOCATION:_____

DEMOGRAPHICS

1 How long have you (household) been living here?

0 - 5 yrs. [ ] 6 - 11 yrs. [ ] 12 - 17 yrs. [ ] 18 - 24 yrs. [ ] Over 24 yrs. [ ]

2 Where did you live immediately before moving to this location?

_____ _____

Location Distance (Km)

3 Why did you choose to live here?

_____

_____

EDUCATION

1 Which school did members of your household attend or attended?

NAME / TYPE OF SCHOOL	LOCATION OF SCHOOL

HOUSING & SOCIAL AMENITIES

1 Approximately how old is the house you are living in? _____ yrs.

2 Do you own the house you are living in? (i) Yes (ii) No (iii) Rent (iv) Squat (v) Other _____

3 Do you have telephone? (i) Yes (ii) No (iii) Cables are being laid

NATURAL HAZARDS

1 Are there problems with frequent flooding? (i) Yes (Where?)_____ (ii) No

2 Are there problems with frequent earthquakes? (i) Yes (ii) No

3 Are there problems with frequent bush fires? (i) Yes (Where?) _____ (ii) No

4 Are there any other problems that you think we should be aware of? (i) Yes (ii) No

COMMUNITY COHESIVENESS & DEVELOPMENT

1 Are there any environmental groups in your area? (i) Yes _____

(ii) No

2 Are there any other organizations in your area? (i) Yes _____

(ii) No

3 How active are the organizations?

_____

4 Are you actively involved in any of these groups? (i) Yes (ii) No (iii) Used to be

_____

RECREATION & CONSERVATION

1 Are there any recreational facilities nearby? (i) Yes (ii) No

2 If yes, name and location of facility

_____

3 Are you aware of any historic or cultural areas / sites in your community or nearby?
(i) Yes _____ (ii) No

4 If yes, what do you know about the site?

_____

5 Are you aware of any environmentally sensitive areas nearby? _____

_____

6 Are you aware of any nature reserves in your community or nearby? (i) Yes (ii) No

7 If yes, where is the site?

_____

8 Are there any wildlife in your community or nearby?

_____

PERCEPTION

1 Are you aware that CAN-CARA Development Ltd. will: develop, own and operate a regional wastewater treatment plant at Horizon Park?

(i) Yes (ii) No

2 If yes, how were you informed?

_____

3 Do you think the area is suitable for this type of development?

_____

4 If no, what kind of development would you like to see happen if any?

_____

5 How would the development of the wastewater treatment plant at this location affect you? _____

_____

6 Is there anything in particular about your area that you would like to tell us?

_____
_____
_____

7 Would you be willing to pay a connection fee to be connected to the proposed wastewater treatment plant at Horizon Park? (i) Yes (ii) No

8 What would be the highest fee you would be willing to pay for connection to the sewage main?

_____

8 What else would you like to see done in your area as it relates to sewage collection?

_____
_____

9 Any other comments:

Signature: .....
Interviewer