
CHAPTER 7

SOLID WASTE MANAGEMENT

7.1 Overview

The proposed development will result in increased population growth, increased visitation to the project site, and an increase in the temporary and full time labor force which, in turn will result in the production of solid waste on site. At project completion and at full occupancy, approximately 894 persons could be on site, which includes guests, residents, visitors and boaters. Although full occupancy is difficult to achieve, it is recommended that the solid waste management for the project meet and exceed the maximum occupancy rate of the development.

In view of this factor, the proposed project will implement a proper solid waste management plan aimed at identifying the source and offering disposal alternatives. In essence, a more comprehensive plan will be developed by PPM&YC after the project has been completed and in operation. Nevertheless, this chapter aims at identifying the possible production volumes and the type of waste that will be produced on the island as a result of its operation. It is important to note that all international waste will be handled and treated separately to avoid contamination. This will be primarily for the marina section which will service international vessels.

7.2 Solid Waste Categories

An essential component in the management of solid waste is that a proper procedure be devised to sort and categorize these wastes. In sorting solid waste the development intends to create a differential system, assigning each class of solid waste to a different treatment category. The four broad categories of solid waste are:

1. Construction and Field Waste (Waste category 1)
2. Domestic Waste (Waste category 2)
3. International Waste (Waste category 3)
4. Commercial Waste (Waste category 4)

7.3 Projected Solid Waste Generation

The proposed undertaking will be a commercial venture with a tourism and marina component. The nature and location of the project will require the installation of all basic infrastructure and services required for the success of the activities. At project completion, an estimated 894 persons could be on site and generating solid waste as a byproduct of their activities.

The expected occupancy was estimated based on the number of condo and cabaña units and average beds per these units as shown in Table 7.2. Included in the expected occupancy are the common public areas that may receive visitation from persons outside the project itself, from the local Belizean communities, or from passing tourists. This is separate from the marina which is

forecasted to be included in the general occupancy. It is estimated that 100 persons are expected to visit the project upon completion and this figure has been used in the two previous chapters to calculate the water demand and wastewater volume.

Considering the lack of data on the type and volumes produced by commercial projects, the EIA consultants have utilized solid waste production rates and types determined by the Belize Solid Waste Management Project (BSWMP) for Belize Municipalities. With this in mind, it is difficult to predict how much waste will be produced by each visitor/guest and staff of the development, however the proposed project will have the means and capacity to house up to 894 guests at full capacity (between the condo units and cabañas) who will be served by a complement of staff equivalent to 0.04 staff per guest or 30 persons at full capacity. Suffice it to mention that upper scale tourist resorts consume far more processed goods, cleaning products and disposable goods (Conservation International, 1999) than the local Belizean population.

In 1999, Stantec carried out the Belize Solid Waste Management Project in which it was estimated that the average person in San Pedro was generating about 4.8 lbs/capita/day of solid waste as described in Table 7.1 below. This figure was well above the normal values being produced in inland locations like Orange Walk Town (2.8 lbs/capita/day), Belmopan (2.6 lbs/capita/day) and Belize City (3.4 lbs/capita/day). For the interest of Pelican Point Marina & Yacht Club, it is estimated that the average residents and marina guest will be producing at least as much solid waste as the average San Pedrano. Likewise, the staff of the development along with the transient visitors will be producing the equivalent of the national average (3 lbs. per capita per day).

According to the BSWMP (Stantec 1999), there is no data on the volume of the municipal versus domestic waste, as there is no separation at source for Belize at the different municipalities. Municipal waste includes waste generated by the commercial and business sector located within or near municipalities. Municipal waste also includes very little industrial waste in Belize Municipalities.

Table 7.1: Estimated Solid Waste Generation for Belize Municipalities.

City/Town	Population	Tons per annum	Tons per day	lbs/capita/day
Belize City	50,050	29,770	81.6	3.4
Orange Walk	13,483	6,365	17.4	2.8
San Ignacio/Santa Elena	13,260	7,104	19.5	2.9
Stann Creek	7,888	4,680	12.8	3.3
San Pedro	4,499	3,900	10.7	4.8
Belmopan	8,130	3,510	9.6	2.6
Benque Viejo	5,088	2,080	5.7	2.5
Dangriga	8,814	3,120	8.5	2.1
Punta Gorda	4,329	1,560	4.3	2.2
TOTAL	115,541	62,089	170.1	26.6
MEAN		6,899	18.9	3.0

Source: Stantec 2001, & CS0 2000.

On the assumption that these extrapolated figures will hold for Pelican Point, then one arrives at the following figures for domestic/international waste production at the development recalling the following dwelling/accommodation capacities:

- Ocean Front Condo Units (I) = 24 rooms (>96 person capacity)
- Ocean Front Condo Units (II) = 24 rooms (>48 person capacity)
- Ocean Front Cabañas (I) = 45 rooms (180 person capacity)
- Canal Front Cabañas (II) = 28 rooms (56 person capacity)
- Marina = 64 boats (384 person capacity)
- Workers = 5 % occupancy (30 workers)
- Transient Visitors = 100 visitors to the site, including from neighboring San Pedro, Mainland Belize and Mexico.

Table 7.2: Projected Domestic Waste Production at PPM&YC during Operational Phase.

Type	Facility	No of Producers in Category	Lbs per Capita per day (ppcd)	Projected Solid Waste Production per Day (lbs)	Projected Solid Waste Production per week (lbs)
A	Condos Type I	96	4.8	460.8	2,304.00
B	Condos Type II	48	4.8	230.4	1,152.00
C	Cabanas Type I	180	4.8	864	4,320.00
D	Cabanas Type II	56	4.8	268.8	1,344.00
E	Marina (local)	384	4.8	1843.2	9,216.00
F	Employee	30	3.0	90	450.00
G	Transient Visitors	100	3.0	300	1,500.00
Total Solid Waste		894		4,057.20	20,286.00

Table 7.2 shows that at full occupancy (See Chapter 5), the proposed PPM&YC development can expect to produce in the order of 4,057 lbs or 4.1 cubic yards of domestic waste per day. Although full occupancy will not always be achieved, the system(s) adopted for the development must have enough capacity to accommodate the solid waste at full capacity continuously or otherwise it will be viewed as inadequate. The system adopted for managing this waste must be efficient and environmentally dependable. It should also be noted that in terms of waste management, volumes are a more useful quantity to consider than weight. This suggests that somewhere along the line it will be in the resort's interest to purchase a good quality compactor.

7.4 Construction and Field Waste (Waste category 1)

The following sections describe the construction and field waste that will be generated at the site. This will primarily be derived from the construction phase and some maintenance. It is expected that very little field waste will be produced because the site has already been previously cleared.

7.4.1 Construction Waste

Almost all the waste produced will come from the construction phase which will involve the erections of the proposed development infrastructure. The project intends to construct 48 Ocean Front Condo buildings, 73 Ocean Front Cabañas, besides a 140 slip marina and required ancillaries such as restaurants and bar and marina services to facilitate the operation of the proposed development.

It is normally assumed in the construction of buildings that between 5-10% of all the building materials will eventually be discarded as waste and purchasers will normally allow for this. Beside the usual bits and pieces and discards common to construction sites generally, the development must also get rid of wrappings and packing, which will be considerable given the amount of building materials and furnishing which will be imported.

Construction waste will include pieces of concrete, wood ends, nails and other ferrous products, casing materials, PVC piping, aluminum sheeting, and wires among others. An average of 5-10 yd³ of compact waste materials will be produced on average from each of the building structures and probably the same from the other structures giving an estimated total volume of between 120 – 240 cubic yards of discarded construction waste, which will be produced over the life of the project. The remaining facilities including the marinas will probably produce another 50 -75 yd³ of waste.

All inorganic construction waste produced at the site such as plasterboard, mortar, tiles will be retired to the lower areas on the rear of the property as landfill. Wood pieces will be recycled as will other materials that can find additional application around the site. Organic materials such as wood that cannot be recycled further will be collected and burned in open air fires or given to the communities as firewood.

7.4.2 Field Waste

Very little field waste will be produced from the clearing of land to erect structures, mainly due to the fact that the area had been previously cleared and only barren sand remains. The development plans to conserve the little mangrove fringes that have taken root on the canal sides and in front of the property. Therefore there will be no trees or vegetation that will be cleared to make way for the development. In fact, due to the dimensions and layout of the project, small gardens, lawns and hedgerows will be planted to add to the general landscape design.

7.5 Domestic Waste (Waste Category 2)

About 75 -85 % of all the domestic waste is produced during the operational phase of the project will fall into this category. It is important to consider that the domestic waste can run the full gamut of waste types. Therefore the project must ensure that the domestic waste is sorted into appropriate categories or classes before final disposal. To achieve this, the domestic waste will be stored in separate containers depending on whether they are biodegradable or non biodegradable.

As can be seen in Table 7.2, the projected domestic waste for the proposed development is about 20,286 lbs per week or just about 20.3 yd³. This amount of this type of waste produced on the island is large given the nature of the development and the fact that much of the food produced for the residents and guests will be by catered restaurant type arrangements.

The various offices and amenities will supplement this amount considerably by their daily production of waste paper etc. Presently, the occupancy rate for Belize is at 40 % which would indicate that at this rate, the projected solid waste volume would be about 8.1 yd³ a week which is considerably less than that at 100 % occupancy rate.

7.5.1 Domestic Waste Disposal

Due to the pre-existing conditions, the options for solid waste disposal are limited to two options: **Option A**, on site disposal, and **Option B**, disposal at the Caye Caulker dumpsite site. The solid waste is also classified into groups mainly organic and inorganic, with organic being further separated into combustible and non combustible.

Table 7.3 is a summary for the solid waste disposal for Pelican Point Marina & Yacht Club. The first option considered was Option A, the option to dispose solid waste at a site within the project area. The second option was to consider the incineration of combustible waste and the transportation of the non-combustible waste to the existing Caye Caulker dumpsite, after approval by the relevant authorities. The opportunity here is attractive since the plan is for a well-designed waste disposal with sound environmental management.

Table 7.3: Summary of Analysis of Alternatives for Solid Waste Disposal

Option A (On Site Disposal)		
	ADVANTAGES	DISADVANTAGES
Environmental /Ecological	Reduced transiting means less indirect impacts (e.g. fuel, noise, dust etc.),	Greater indirect impacts from noise, dust, odor
	Less volume transported to the existing site Caye Caulker dump site.	Increased impacts as a result of disturbing a new site, which is mainly a low lying area
	Potential land fill use	Poor site for solid waste disposal due to the proximity to the canals & Marine environment.
Social/ Administrative	Less dust, noise etc from transportation activities	Increase site emissions, noise, dust,
	Less traffic congestion, and less road damage	Greater social inconvenience & hazards due to increase in site traffic and its related activities,

Opt. A Cont'd	ADVANTAGES	DISADVANTAGES
	A reduction of administrative dependency on central government	Increase of administrative procedures requiring authorization and clearance at the local and national level
Economic	Reduced transportation & disposal cost,	Economic loss due to increased fuel cost, road damages etc
		Loss of available land for expansion & recreation,
		Loss of aesthetics may lead to loss in visitation & service sales,
		Loss of aesthetic value may lead to depreciation of property values
Technical	The area may be more readily accessible	No room for adequate management considerations (low –lying, etc. & no room for expansion),
	Initial investment high due to the need for new designs	Serious design flaws due to the low lying water table and marine environment.
OPTION B (DISPOSAL AT CAYE CAULKER SITE/BELIZE CITY)		
	ADVANTAGES	DISADVANTAGES
Environmental /Ecological	Use of site centralizes the impact to an already existing disturbed site	Greater cumulative impact of site use
	The present Caye Caulker Site will be transformed to a future transfer station, with the Mile 21 site as a Central Regional Landfill, providing the opportunity for final disposal at a safe site	Increase in transportation costs
Social	Financial cost of maintenance helped by tipping fees to the island authorities.	Increase in vehicular traffic, with risk of land spills
	Developer is willing to barge out all of the caye's waste to the Belize City Transfer Station.	Increased traffic activities onshore (congestion, noise, dust),
	Socially, this would alleviate any present environmental health concerns associated with the present dumpsite.	Requires greater social responsibilities such as contributions towards maintenance etc.

Opt. B Cont'd	ADVANTAGES	DISADVANTAGES
Economic	Decrease in unit cost of maintenance of site,	Greater cost of transportation due to haul distance, road damages etc. (cost passed on to users)
	Tipping fee associated with the transportation of the caye's waste to Belize City	Road haulage and road damages, increases costs on the island
Technical	Site management has better opportunities since there is greater technical capacity and more equipment, with a well-planned solid waste program as a long term opportunity	It is unknown when the Caye Caulker site will be transformed into a transfer site. Recently, the Inter Development Bank (IDB) surveyed the area and determined that it's essential to address the solid waste problem.

7.5.2 Selection of the preferred option

The advantages and disadvantages for each option were discussed and analyzed by dividing them into environmental/ecological, social, economic and technical categories. The analysis identified that it would not be environmentally and ecologically beneficial to use a local site, primarily since the proposed project site is relatively close to the marine environment, and the Caye Caulker Airstrip. Environmentally, it is better to continue using an already disturbed site instead of creating a new disturbance elsewhere. Furthermore, the use of a local site would reduce the aesthetic value of the project and the entire area, which is already affected by local disposal sites.

Taking into consideration the ecological sensitive nature of the area, Option B was chosen. The analysis identified that it would be environmentally and ecologically beneficial to temporarily utilize the existing dump site rather than to impact another considering the eventual barging out of solid waste to the Western Corridor Landfill at Mile 21, Western Highway (See Fig. 7.1).

Socially, however, the potential negative impacts of the transportation of waste would lead to certain inconveniences such as increased island traffic activity, as well as noise, dust and odor from vehicular traffic. Nonetheless these impacts would be periodic, and would occur only during transportation, which, would be twice a week from the project site. From an economic point of view, it would be cheaper for users to dispose at a local site in the short term. However, the impacts of local disposal may have long-term implications, and local sites in proximity to the coast have been deemed to have fatal flaws by the Stantec Report.

7.6 International Waste (Waste Category 3)

Solid waste from boats or international waste consist of food tainted waste and clean waste. It is unlawful for any water vessel to dispose of solid waste into the sea as per the MARPOL 73/78 Convention signed between Belize and the IMO. For the purpose of this convention, Pelican Point Marina & Yacht Club will provide the necessary facilities for the collection, transportation and disposal of the solid waste generated by the international water vessels.

7.6.1 International Waste Generation

Just as with the wastewater production, calculating the international solid waste generated is complicated. This is due to the fact that marine vessels vary in length, size and number of persons on the vessels. Nevertheless, taking into consideration of the marina design (See Fig. 10.4) and capacity of vessels it can accommodate, the following table illustrates the international solid waste generated by the vessels at 100 %.

Table 7.4 International waste generated by marine vessels

Solid Waste Generation					
Boat Length (feet)	Slips	Total Boats	Person/ Boat	Visiting Population	Factor 3lb/p/day
30	27	27	2	54	162
35	41	41	2	82	246
45	8	8	6	48	144
50	31	31	6	186	558
60	30	30	6	180	540
100	3	3	12	36	108
Total	140	140	34	586	1,758

7.6.2 International Waste Classification

Solid Waste will be separated into two categories, clean garbage and tainted waste (with food etc). Disposal containers will be located on land at the entrance of the main dock walkway. Each location will have two containers which will be clearly marked for separation process.

- a) Tainted Waste: When this waste is picked up by marina personnel at each finger location it will then be stored in a larger container for incineration on site.
- b) Clean Trash: This trash will be picked up by marina personnel at each finger location and will then be stored in a larger container for disposal by a licensed contractor to landfill or incinerated on site along with the tainted waste.

7.6.3 International Waste Disposal

All foreign vessels (yachts, catamarans, sailboats, houseboats ect) will be required to obtain permission from the marina supervisor to dispose of their solid waste. The marina supervisor will inform the vessel’s captain to properly dispose of their waste by placing their waste into the respective waste receptacle.

The proposed Pelican Point Marina & Yacht Club will install a low volume incinerator to incinerate all the international waste and any hazardous waste produced by the project during its operation. This incinerator will be located at the back of the project and will consist of a two chambered, diesel operated incinerator with scrubber capable of incinerating 220 lbs/day or 100 kg/day of waste.

Disposal signs and notices will be placed alongside the main marina entrance and fingers pier for collection and disposal. Also, a myriad of disposal signs will be placed through out the marina for the residents and guests to see and be aware.

7.7 Commercial Waste (Waste Category 4)

For the purpose of this assessment, commercial waste refers to all waste products produced from the operational aspect of the proposed project such as machinery (mechanized equipment), used tires, accumulators, used oil and grease and discarded electronic equipment among others. Most transportation type waste will come from the expected large fleet of golf carts and boats. Used tires will be stockpiled and taken out to the landfill when ready. Used batteries and waste oil will be contained in the containment walls constructed for the fuel tanks. These will be adequately stored and discarded by a certified disposal for recycling. Toxic waste is outright dangerous to human health and should only be handled with specialized equipment and carefully disposed of far away from any inhabited area.

7.8 Solid Waste Management Plan

The solid waste management plan for PPM&YC will focus on the storing, collection, and disposal of all the solid waste that is produced as a result of the construction and operation phases. This program will implement and develop waste minimization strategies designed to maximize the use of recyclable and reusable materials as well as to report the generated volumes and its reduction schemes. Both local and international waste will be treated according to the national laws.

With this in mind, the solid waste produced by the proposed project will be separated into organic and inorganic with the inorganic being further separated into combustible and non combustible. The following sections briefly describe the waste management plan.

7.8.1 Waste Minimization Strategies

Waste management by whatever means is an expensive proposition especially given the nature of the project and its location. The project proponent will bear this cost and therefore will aggressively pursue other less expensive options as long as they are compatible with maintaining sound environmental practices. With this in mind, the proponent will resort to the new terminology in waste management – the three Rs referring to Recycling, Reusing and Reduction. If incorporated, this new practice will greatly reduce the solid waste volume produced by the project and also the associated incineration costs and overhead expenditures that accompany the management program.

These options are now examined in turn with a view to applying them to solve the expected waste disposal problems of the site:

- (i) **Reduction** – The project proponent will work with all the guests, transient visitors and staff to create a hierarchy of waste management where simply reducing the amounts of waste produced by these individuals should be a priority. Such a

reduction can take many forms and shapes but it starts with the individual initiative. Examples include the reduction of shopping bags and packaging materials, purchasing in bulk, calculating dispensary use, materials and equipment use, purchasing recyclable containers for perishable goods, etc.

- (ii) **Reuse** - Once materials for the project are bought they should be reused as many times as possible. There are many opportunities for reusing products and most of them include simple substitution practices such as substituting Styrofoam plates and cups with washable regular plates, cups and utensils, reusing worn tires, purchasing returnable glass soft drinks and beer rather than those products in PET bottles.
- (iii) **Recycle** – Many of the items utilized by the guests and staff will have some degree of recyclability. These include aluminum materials; glass and plastics as well as garden waste. Composting kitchen waste is another example where useful products can be obtained for gardening, soil conditioning etc from waste which would otherwise be discarded. In Belize there are established business operations that will take paper cardboard and metal waste for recycling into useful products. Used tires can be recycled and used for road barriers or as plant pots.

7.8.2 Waste Minimization Volumes

The Belize Solid Waste Management Project (Stantec, 2000) and the Central Statistical Office, 2000, estimate that most domestic waste is organic (60%), while the remaining consists of metals, plastics; glass, other waste (5%) and paper comprises 20%. The production of waste for the proposed project is expected to be similar, except for the inclusion of construction material to be produced during the construction period.

Table 7.5P Waste Reduction Yield for PPM&YC

Composition	Percentages	Solid Waste Generated (lbs)	Volume Composition (lbs)	Waste Minimization Strategy
Organics	60		2,434.32	Composting
Plastic	5		202.86	Recy/Incin
Paper	20		811.44	Comp/Incin
Glass	5		202.86	Recycling
Metal	5		202.86	Landfill/Recy
Other Waste	5		202.86	Landfill/ Incin
	100%	4,057.20	4,057.20	

As can be seen from the table, about 60 % of the domestic waste produced on site can be recycled by composting, moreover, others such as paper and other wastes can be incorporated as well. The end result of the composting process is a rich fertilizer that can be added to the landscape.

In considering the final volume after management, it can be reduced that the waste minimization strategy can reduce the domestic waste volume considerably after composting from 4,057.2 lbs to 1,622.88 lbs a day. In theory, the weekly volume can be from 20,286 lbs (20.3 yd³) to 8,114.4 lbs (8.1 yd³). Considering also the volume of the waste to be composted the project will utilize a composting system with a processing capacity of 40 – 200 pounds per day of biomass per system (See Annex VII). This system is ideal considering the current national occupancy rate of Belize.

7.8.3 Solid Waste Collection

The solid waste generated on site will be divided into two sections as described in Section 7.8. Garbage receptacles will be placed at strategic locations for the collection and storage of garbage. This will be especially important in considering the marinas and its related activities. Non combustible wastes such as glass, iron, aluminum, some plastics and others will be further separated and recycled as much as possible.

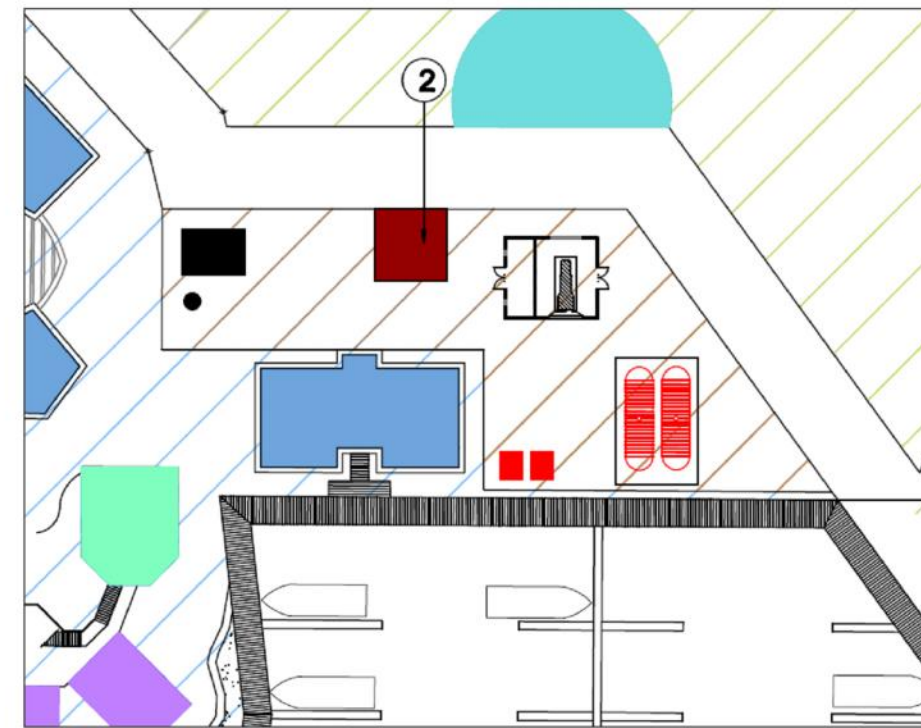
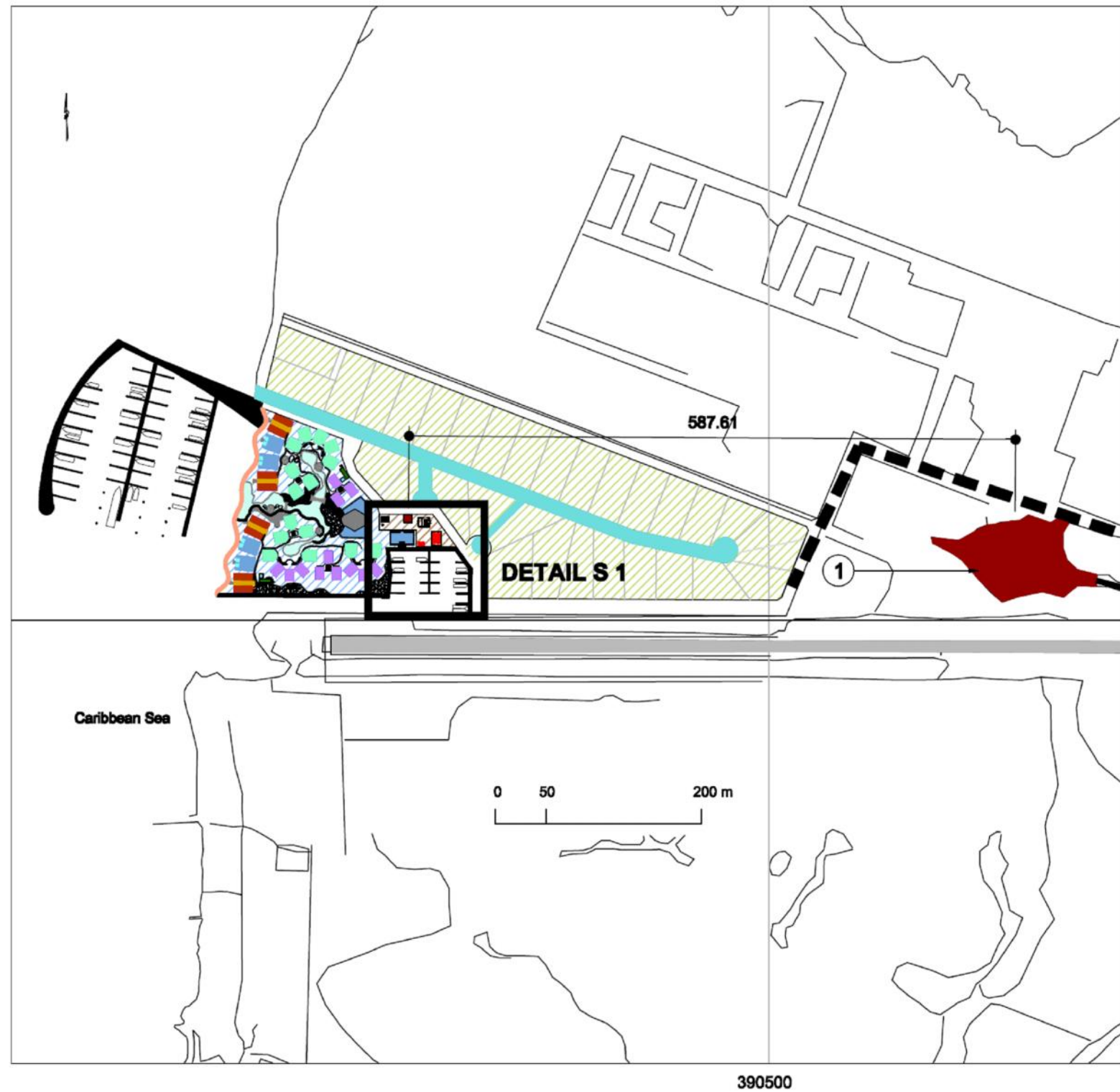
Waste from the condos and cabanas as well from the different project establishments will be collected on a regular basis and temporarily stored in the utility zone. The marina waste will also be collected on a regular basis but much more with new arrivals and when requested. The proposed project will implement a collection scheme that will be made available to all staff members and some guests. This is to sensitize the personnel on the importance especially considering the Caye Caulker dumpsite that is just east of the project site.

The collection schedule may vary from time to time depending on the volume and available human resources, nevertheless the endeavor will still remain a weekly operation. The precise collection days will be finalized after discussion with management and staff, and will be determined on the demand needs.

7.8.4 Educational and Sensitization Program

The Solid Waste Management Program for the proposed project will also include an educational and sensitization component to inform staff and guests (marina, and transient visitors) on the importance of solid waste management and its impact to the receiving environment. In addition, collection schedules, receptacle locations and other component will also be made known. It is anticipated that this component will be a dynamic and continuous effort in achieving the program's goal.

The project will also be utilizing signs and notices to convey the message of solid waste management. These signs and notices will be placed at strategic locations around the property and will be aimed at conservation of the receiving environment. More so, its importance is paramount considering the project's close proximity to the Caye Caulker landing strip.



KEY

- ① CAYE CAULKER MUNICIPAL DUMP SITE
- ② PROJECT SOLIDWASTE COLLECTION FOR DISPOSAL

LEGEND

- █ Municipal Airstrip
- ▨ Existing Subdivision
- ▨ Residential Boat Canal
- ▨ Roads
- ▨ Pool
- ▨ Project Development Area
- ▨ Utilities

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Fig. 7.1 Caye Caulker Dump Site (Note relation of dumpsite to proposed project)

7.9 Reporting Requirement and Compliance Monitoring

All pertinent and relevant information will be made available to all pertinent authorities such as the SWMA, Ministry of Health, and the Department of the Environment. Pelican Point Marina & Yacht Club will ensure that contractual obligations, if any, are fulfilled at all times, and any guidelines and the monitoring of these guidelines and practices will be done internally, wherever possible. Any gross violations requiring notification to the enforcement authorities will be done as soon as possible, if necessary.