THE REPUBLIC OF MAURITIUS
MINISTRY OF ENVIRONMENT, SUSTANAIBLE
DEVELOPMENT, DISASTER AND BEACH MANAGEMENT
(MOESDDBM)

THE PROJECT FOR CAPACITY DEVELOPMENT ON COASTAL PROTECTION AND REHABILITATION IN THE REPUBLIC OF MAURITIUS

FINAL REPORT

SUPPORTING REPORT

June 2015

JAPAN INTERNATIONAL COOPERATION AGENCY

KOKUSAI KOGYO CO., LTD.
NIPPON KOEI CO., LTD.
CENTRAL CONSULTANT INC.
FUTABA INC.

GE
JR
15-115

THE REPUBLIC OF MAURITIUS
MINISTRY OF ENVIRONMENT, SUSTANAIBLE DEVELOPMENT, DISASTER AND BEACH MANAGEMENT (MOESDDBM)

THE PROJECT FOR CAPACITY DEVELOPMENT ON COASTAL PROTECTION AND REHABILITATION IN THE REPUBLIC OF MAURITIUS

FINAL REPORT

SUPPORTING REPORT

June 2015

JAPAN INTERNATIONAL COOPERATION AGENCY

KOKUSAI KOGYO CO., LTD.
NIPPON KOEI CO., LTD.
CENTRAL CONSULTANT INC.
FUTABA INC.

Contents

1. Result of Shoreline Change Analysis

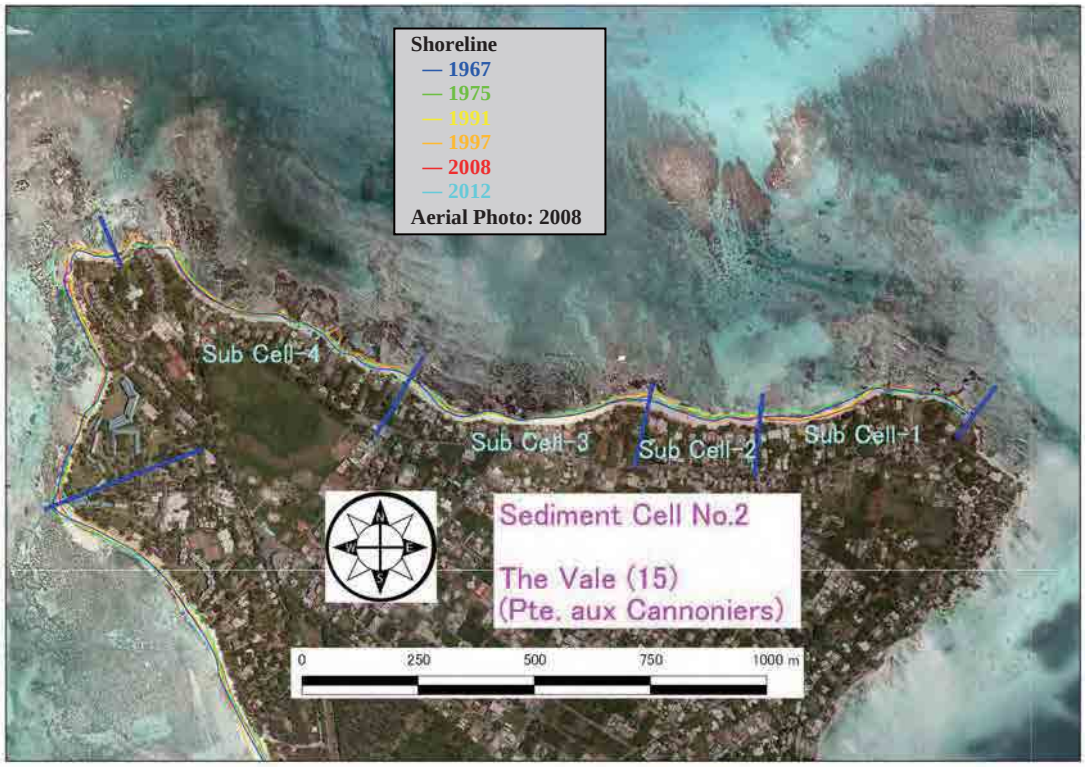
1.1 Regions Subject to Analysis by Topographic Interpretation of Aerial Photos

Sediment Cell No.1 – No.13 included in 20 coasts for basic survey are subject to the analysis by topographic interpretation of aerial photos. And each Sediment Cell was divided into some Sub Cell with separating points of the rocky point, river mouth, jetty, and other infection points of shoreline changes. Figure 1.1 to Figure 1.23 show the Sub Cells to be analyzed in each Sediment Cell.

For example, a series of coasts Sediment Cell No.2 locate in northwest of Mauritius Island was divided into 16 parts (Sub Cell 1-16) from north to south as shown in Figure 1.2 to Figure 1.6. The number in parentheses after location name in those figures, for example “Mon Choisy (14)”, means serial number of the declared public beaches of Mauritius. Moreover, interpreted shorelines were drawn on the satellite image in 2008 as shown in the legend.

Source: This figure was processed by JICA Study Team based on Satellite image obtained from MHL.

Figure 1.1 Area of analysis (Sediment Cell No.1, Sub Cell-1-4)

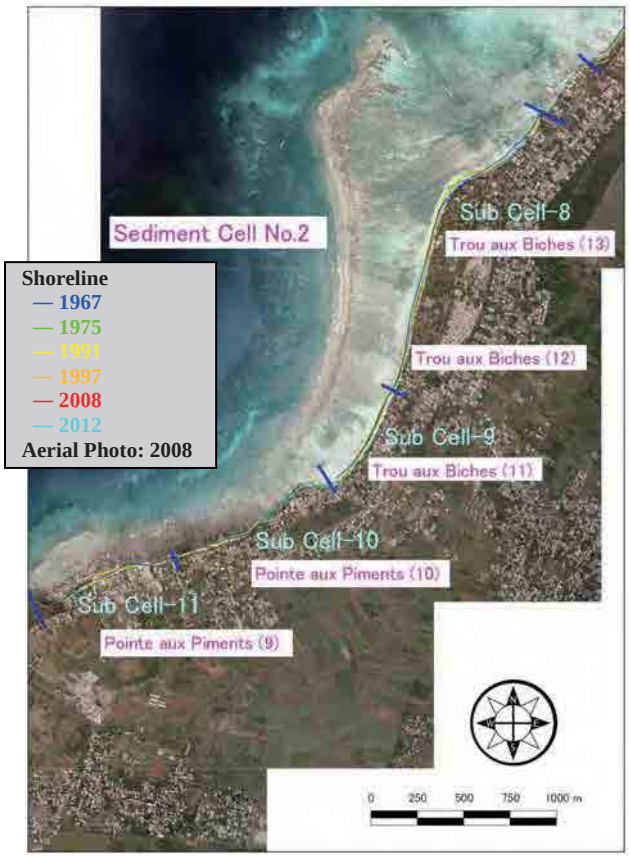


Source: This figure was processed by JICA Study Team based on Satellite image obtained from MHL.

Figure 1.2 Area of analysis（Sediment Cell No.2, Sub Cell-1-4）

Source: This figure was processed by JICA Study Team based on Satellite image obtained from MHL.

Figure 1.3 Area of analysis（Sediment Cell No.2, Sub Cell-5-7）

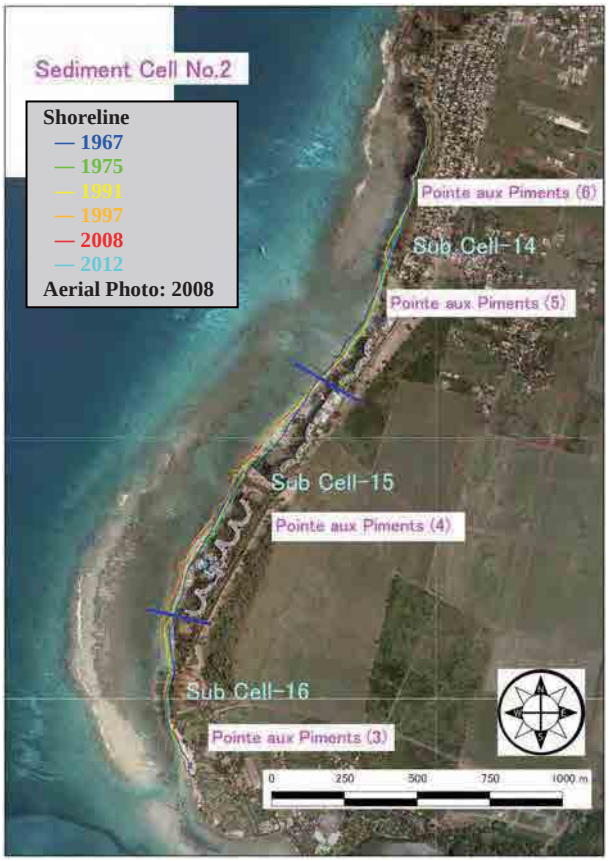


Source: This figure was processed by JICA Study Team based on Satellite image obtained from MHL.

Figure 1.4 Area of analysis（Sediment Cell No.2, Sub Cell-8-11）

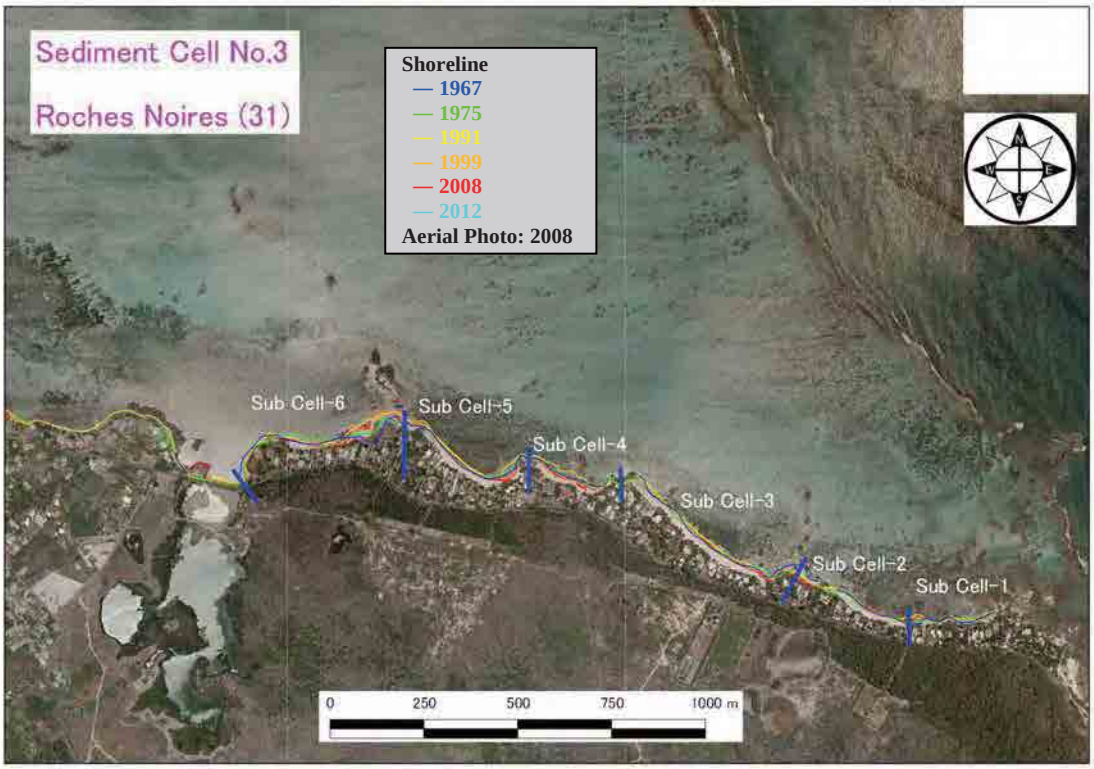
Source: This figure was processed by JICA Study Team based on Satellite image obtained from MHL.

Figure 1.5 Area of analysis（Sediment Cell No.2, Sub Cell-12-13）



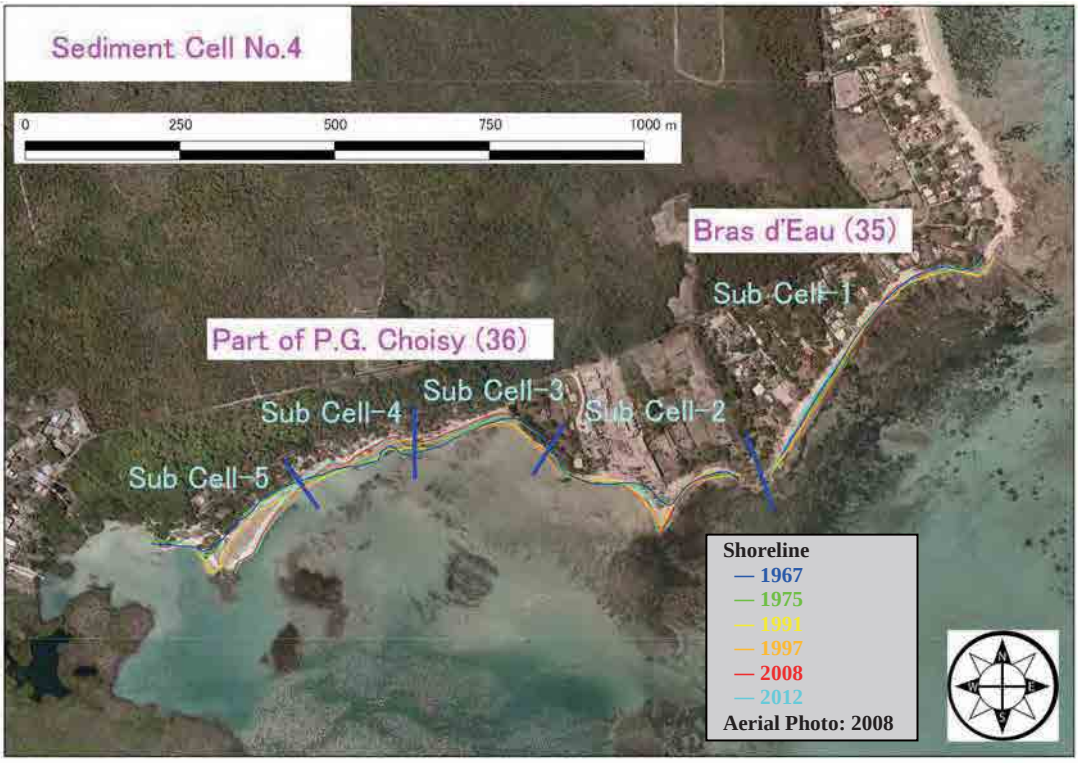
Source: This figure was processed by JICA Study Team based on Satellite image obtained from MHL.

Figure 1.6 Area of analysis（Sediment Cell No.2, Sub Cell-14-16）



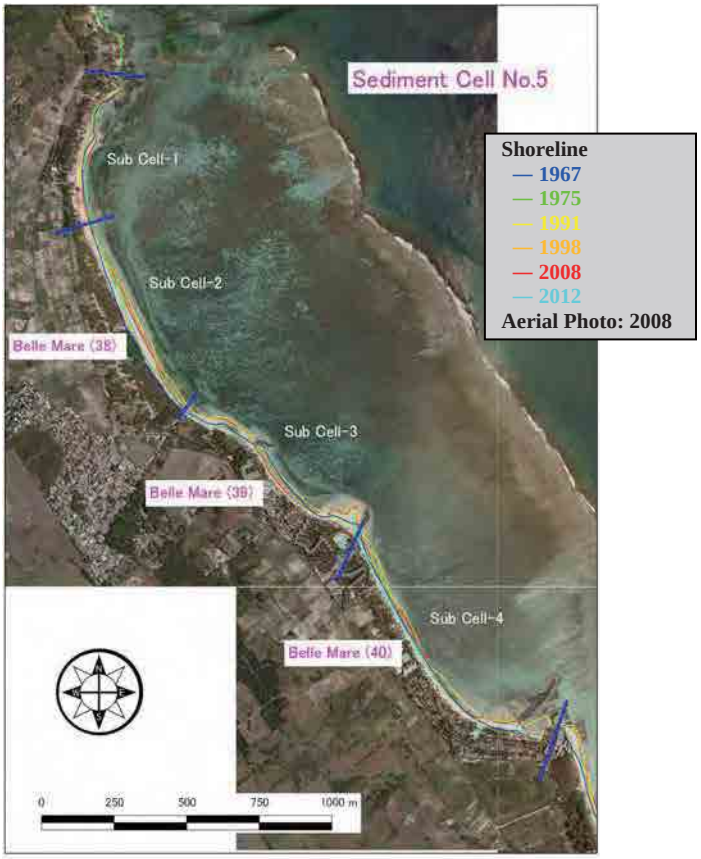
Source: This figure was processed by JICA Study Team based on Satellite image obtained from MHL.

Figure 1.7　Area of analysis（Sediment Cell No.3, Sub Cell-1-6）



Source: This figure was processed by JICA Study Team based on Satellite image obtained from MHL.

Figure 1.8　Area of analysis（Sediment Cell No.4, Sub Cell-1-5）

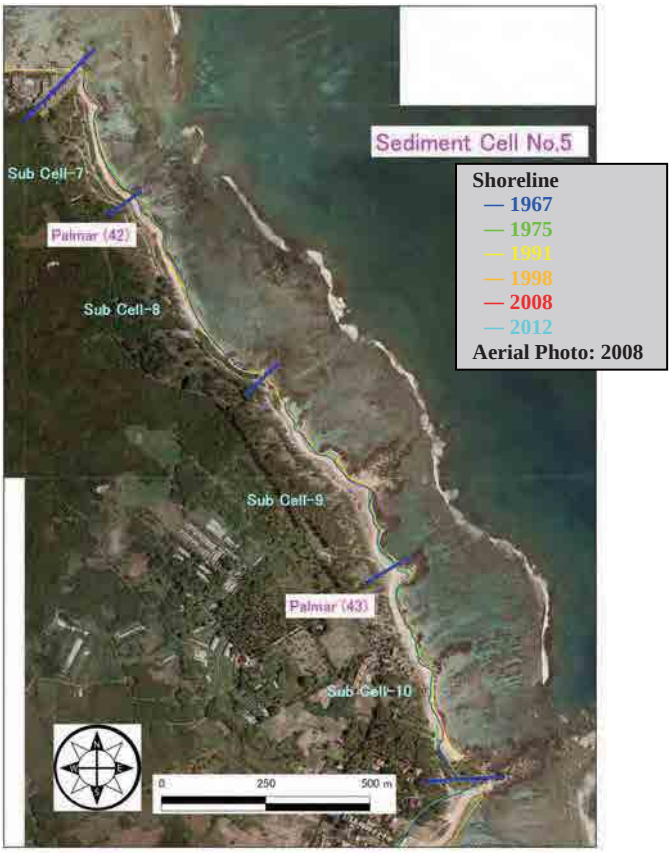


Source: This figure was processed by JICA Study Team based on Satellite image obtained from MHL.

Figure 1.9 Area of analysis（Sediment Cell No.5, Sub Cell-1-4）

Source: This figure was processed by JICA Study Team based on Satellite image obtained from MHL.

Figure 1.10 Area of analysis（Sediment Cell No.5, Sub Cell-5-6）

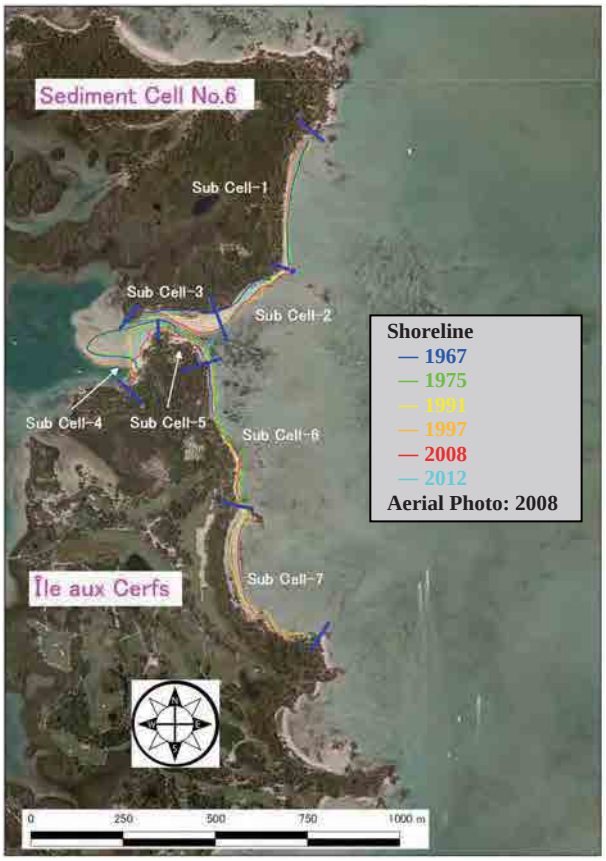


Source: This figure was processed by JICA Study Team based on Satellite image obtained from MHL.

Figure 1.11 Area of analysis（Sediment Cell No.5, Sub Cell-7-10）

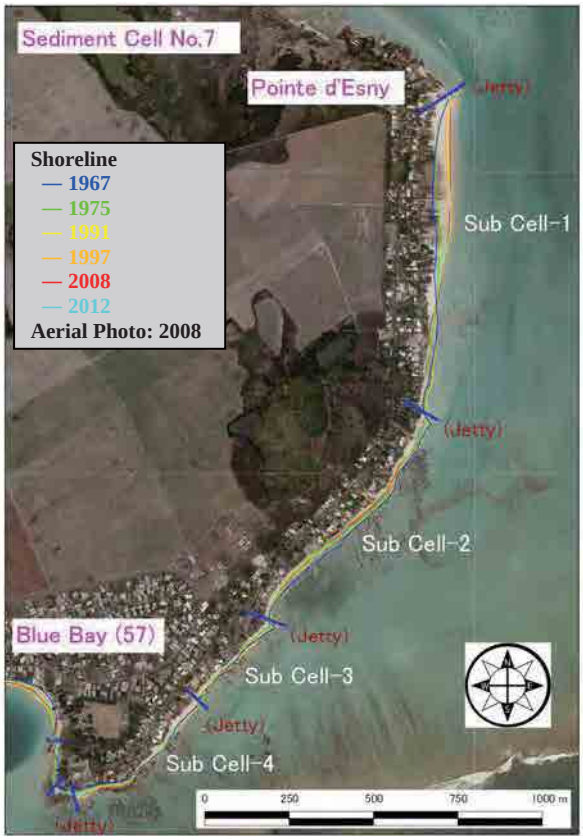
Source: This figure was processed by JICA Study Team based on Satellite image obtained from MHL.

Figure 1.12 Area of analysis（Sediment Cell No.5, Sub Cell-11-16）



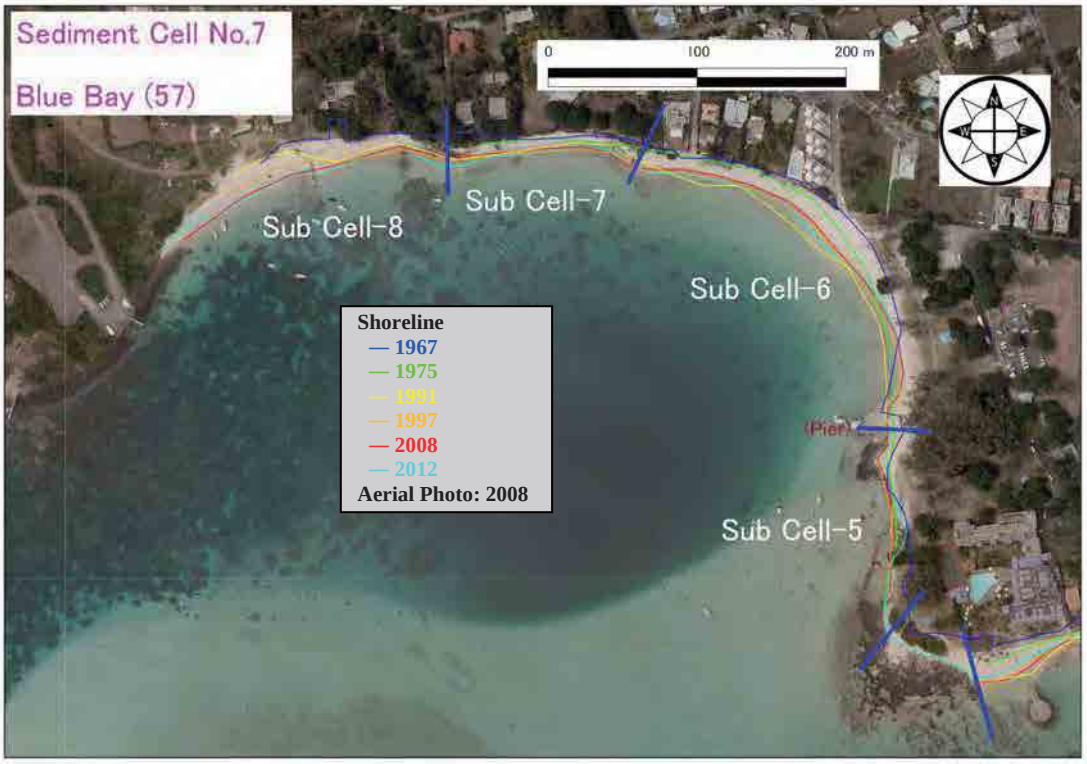
Source: This figure was processed by JICA Study Team based on Satellite image obtained from MHL.

Figure 1.13 Area of analysis（Sediment Cell No.6, Sub Cell-1-7）



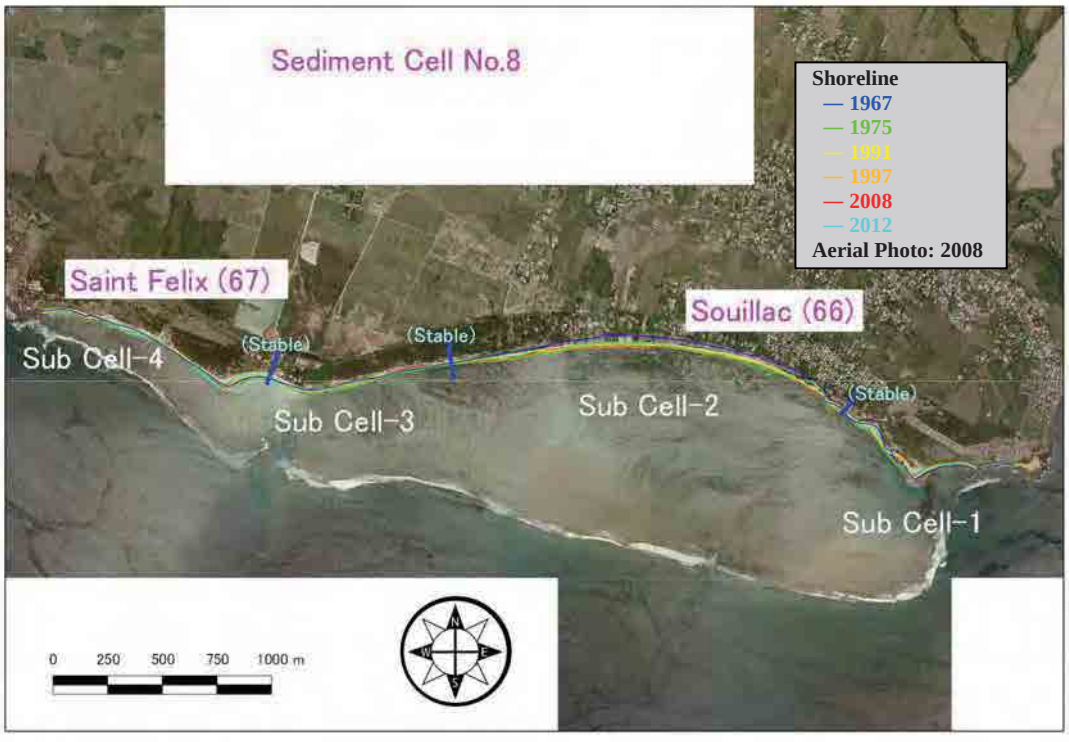
Source: This figure was processed by JICA Study Team based on Satellite image obtained from MHL.

Figure 1.14 Area of analysis（Sediment Cell No.7, Sub Cell-1-4）



Source: This figure was processed by JICA Study Team based on Satellite image obtained from MHL.

Figure 1.15 Area of analysis（Sediment Cell No.7, Sub Cell-5-8）

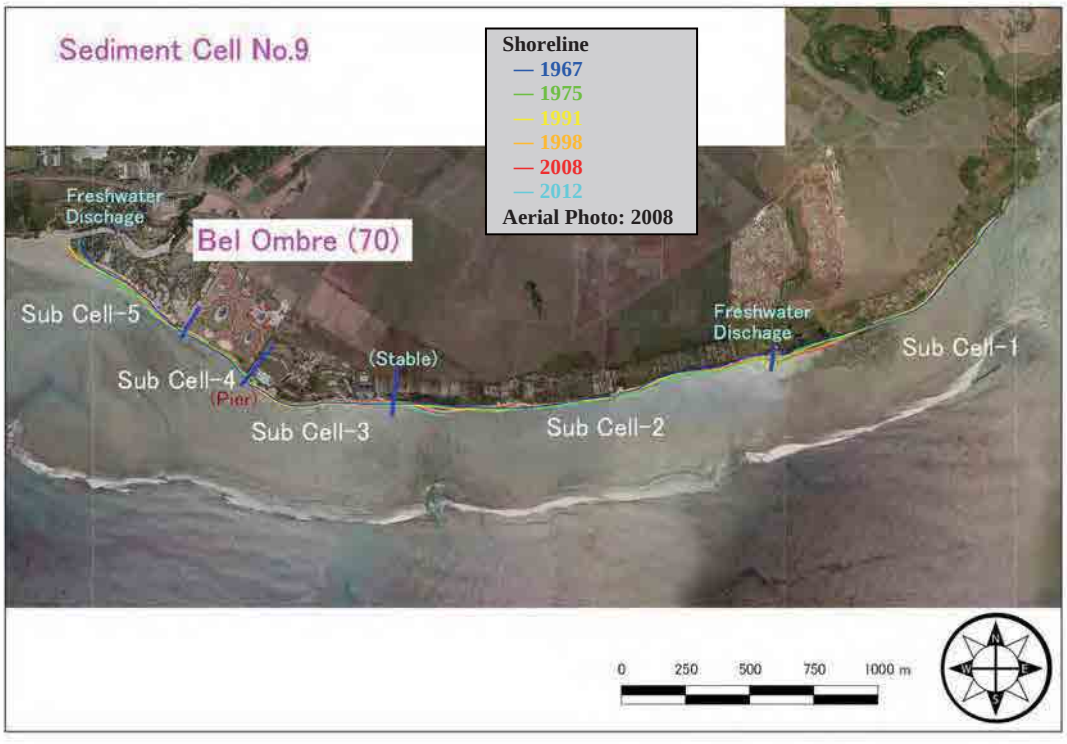


Source: This figure was processed by JICA Study Team based on Satellite image obtained from MHL.

Figure 1.16 Area of analysis（Sediment Cell No.8, Sub Cell-1-4）

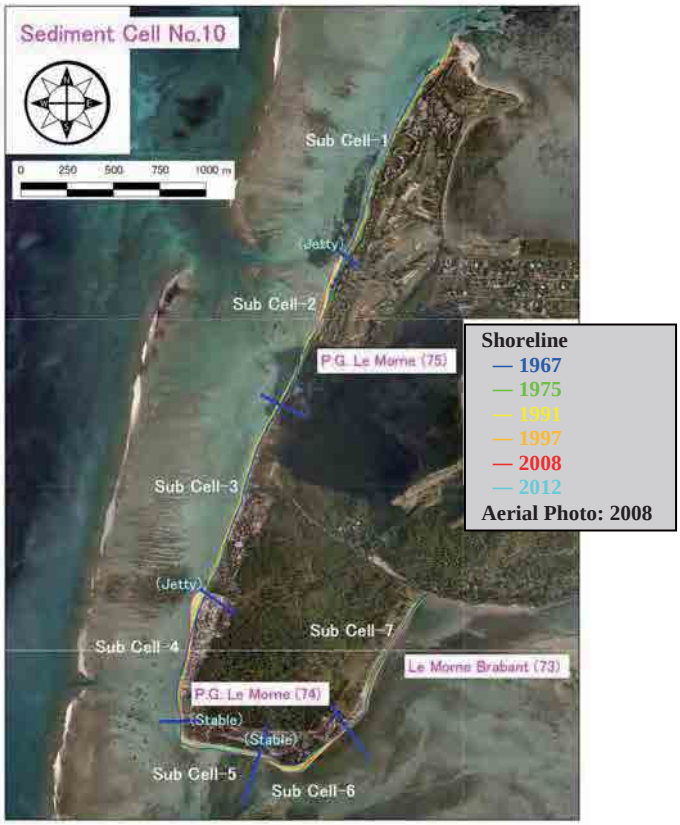
Source: This figure was processed by JICA Study Team based on Satellite image obtained from MHL.

Figure 1.17 Area of analysis（Sediment Cell No.8, Sub Cell-5-7）



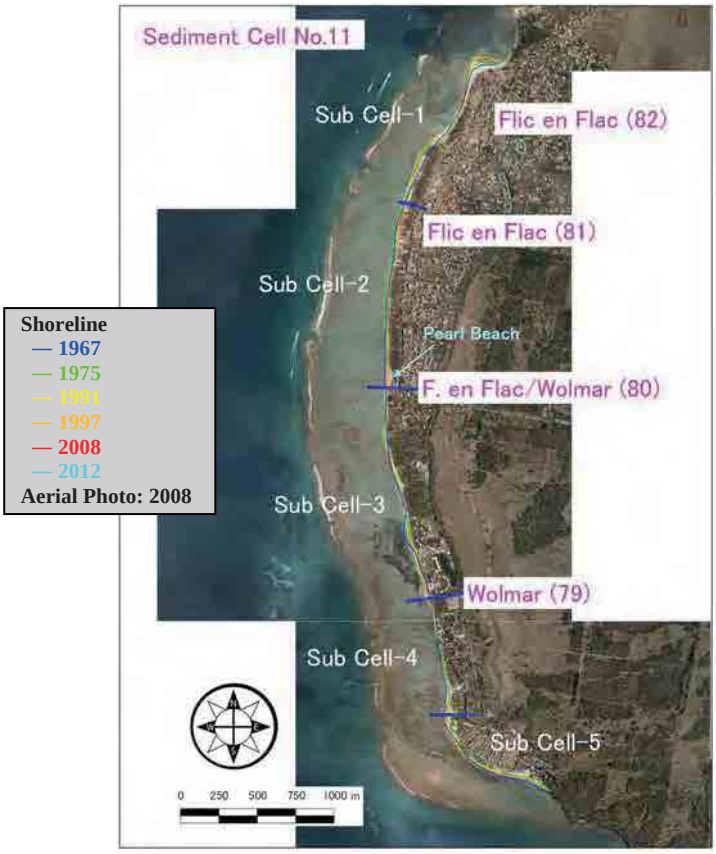
Source: This figure was processed by JICA Study Team based on Satellite image obtained from MHL.

Figure 1.18 Area of analysis（Sediment Cell No.9, Sub Cell-1-5）



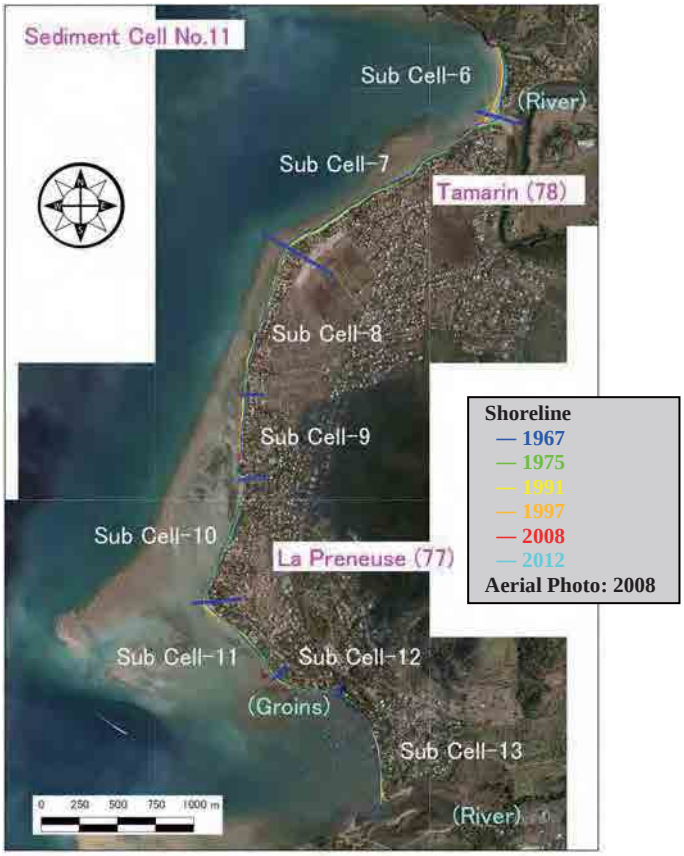
Source: This figure was processed by JICA Study Team based on Satellite image obtained from MHL.

Figure 1.19 Area of analysis（Sediment Cell No.10, Sub Cell-1-7）



Source: This figure was processed by JICA Study Team based on Satellite image obtained from MHL.

Figure 1.20 Area of analysis（Sediment Cell No.11, Sub Cell-1-5）



Source: This figure was processed by JICA Study Team based on Satellite image obtained from MHL.

Figure 1.21 Area of analysis（Sediment Cell No.11, Sub Cell-6-13）

Source: This figure was processed by JICA Study Team based on Satellite image obtained from MHL.

Figure 1.22 Area of analysis（Sediment Cell No.12, Sub Cell-1-5）

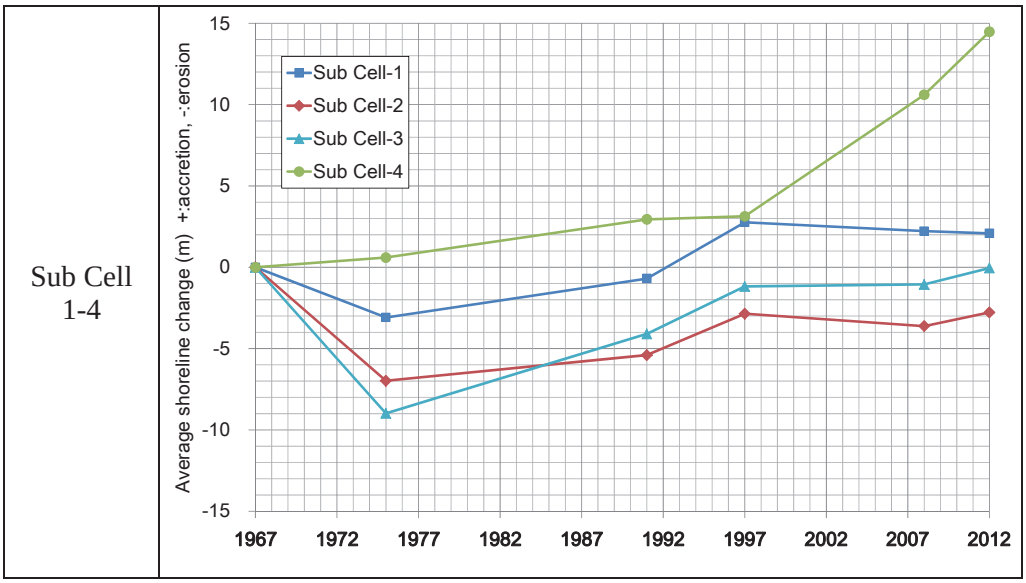
Source: This figure was processed by JICA Study Team based on Satellite image obtained from MHL.

Figure 1.1.23 Area of analysis（Sediment Cell No.13, Sub Cell-1-6）

1.2 Results of Shoreline Changes Analysis

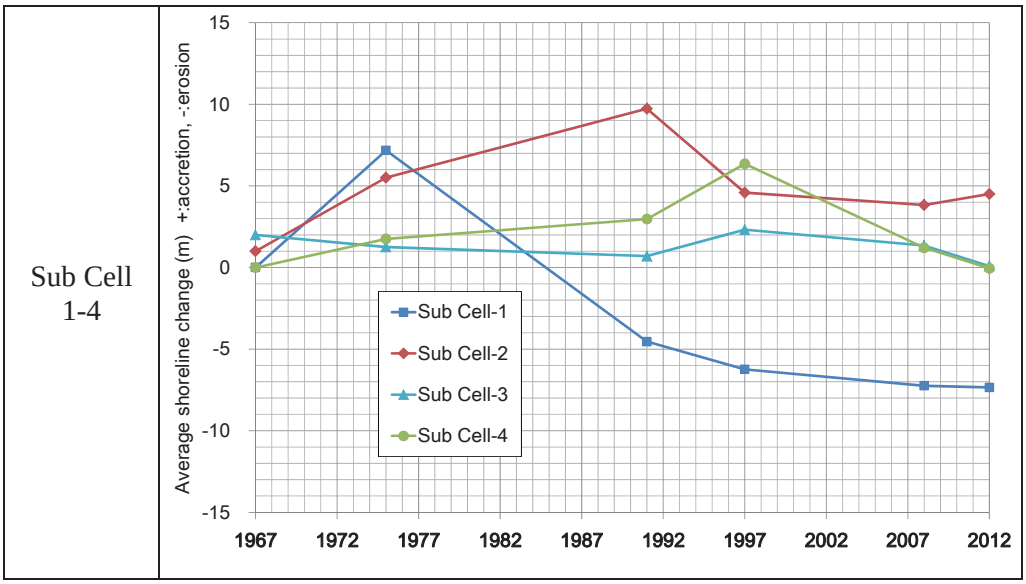
Figure 1.24 to Figure 1.37 show section averages of change lengths by advance (accretion) or retreat (erosion) of shorelines since 1967 (or 1975) in each Sub Cell.

For example, the shoreline of Sub Cell-4 in Figure 1.24 has relatively remarkable advanced since 1997. Moreover, although the shoreline of Sub Cell-3 in same figure had relatively large retreated during 1967 to 1975, it has moderately advanced after this period and recovered to same level of 1967 at present (2012). In addition, the shoreline of Sub Cell-7 in the Figure 1.26 has retreated for the long term.



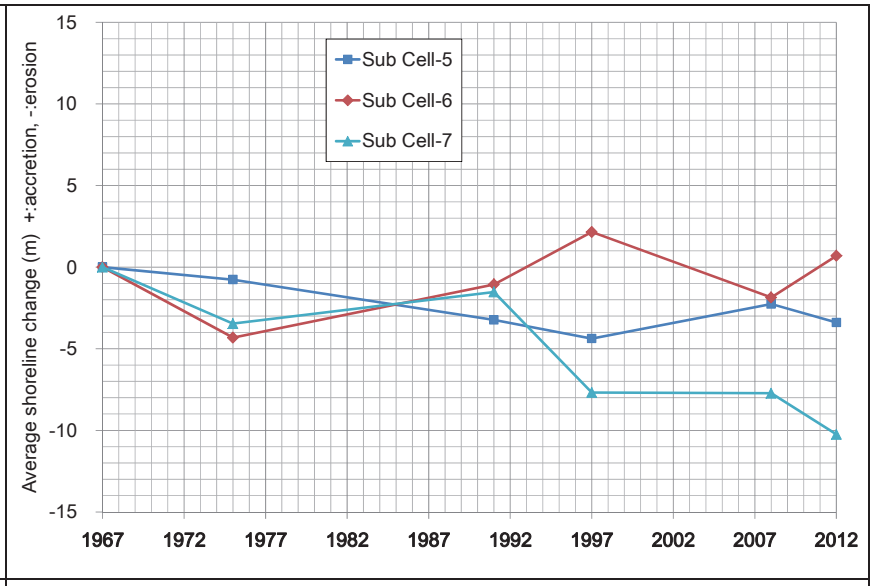
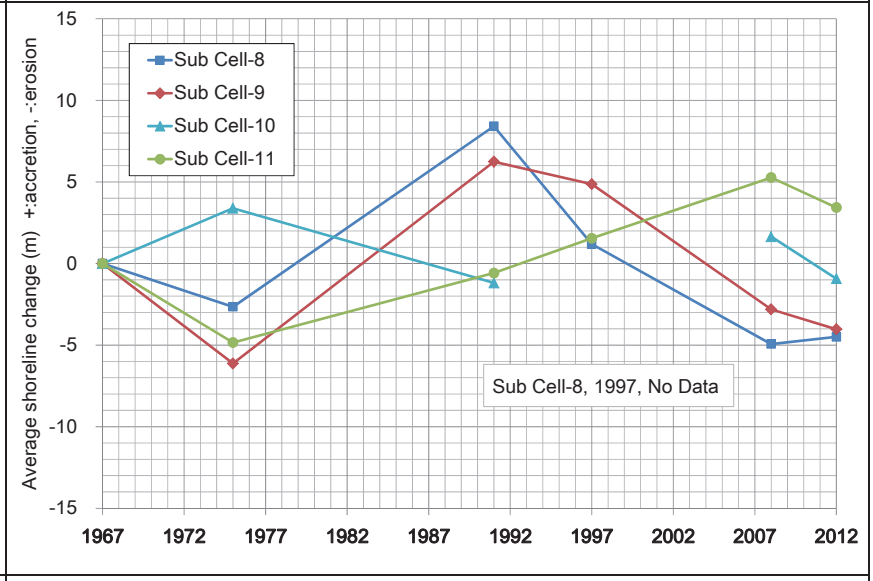
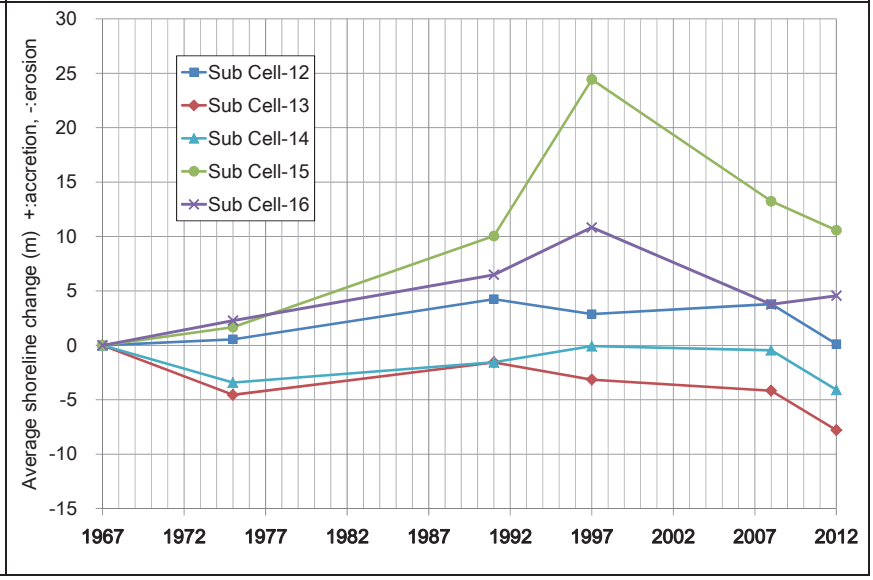
Source: JICA Study Team

Figure 1.24 Average Shoreline Changes (Sediment Cell No.1)



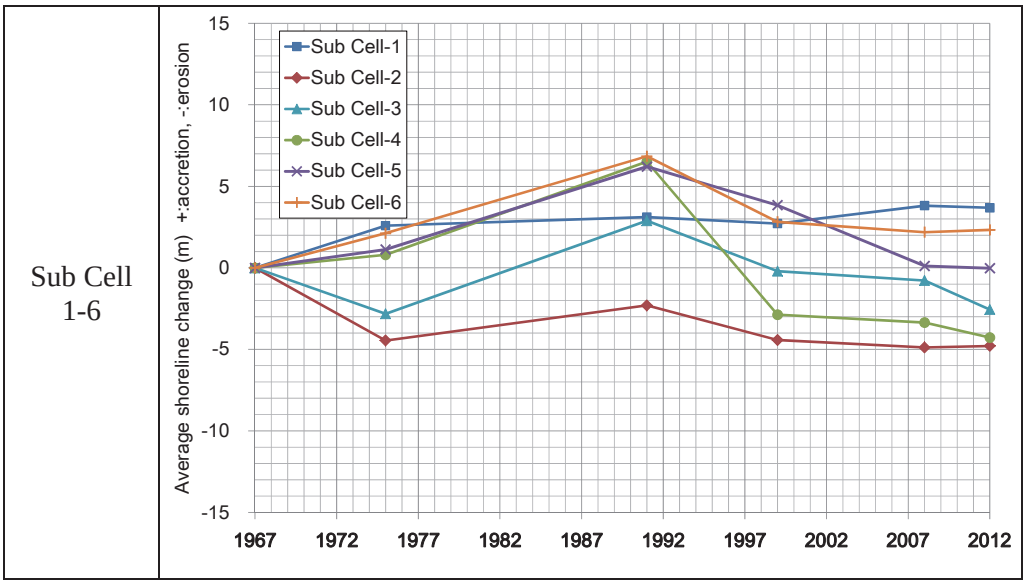
Source: JICA Study Team

Figure 1.25 Average Shoreline Changes (Sediment Cell No.2)

Sub Cell 5-7	
Sub Cell 8-11	
Sub Cell 12-16	

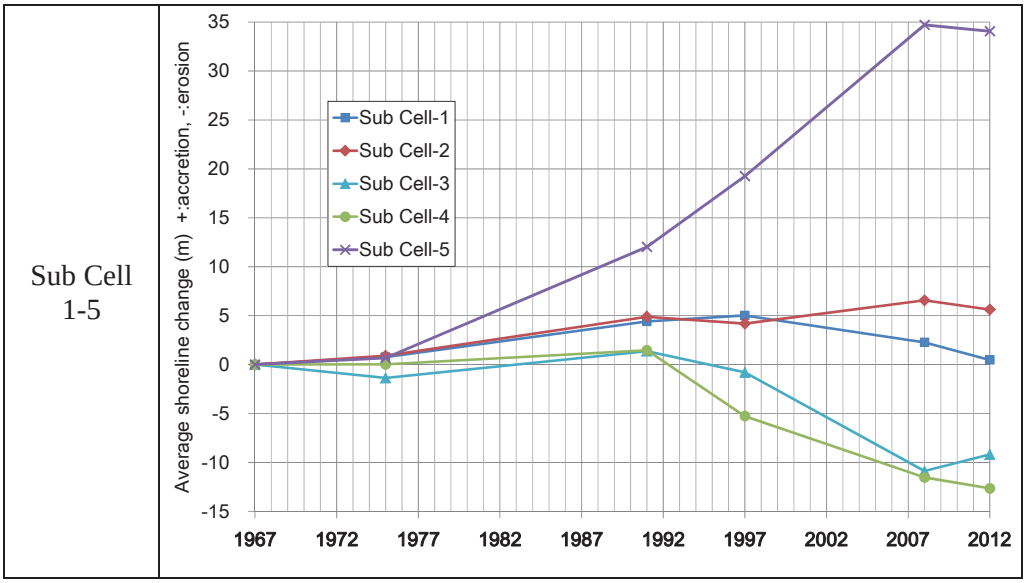
Source: JICA Study Team

Figure 1.26 Average Shoreline Changes (Sediment Cell No.2)



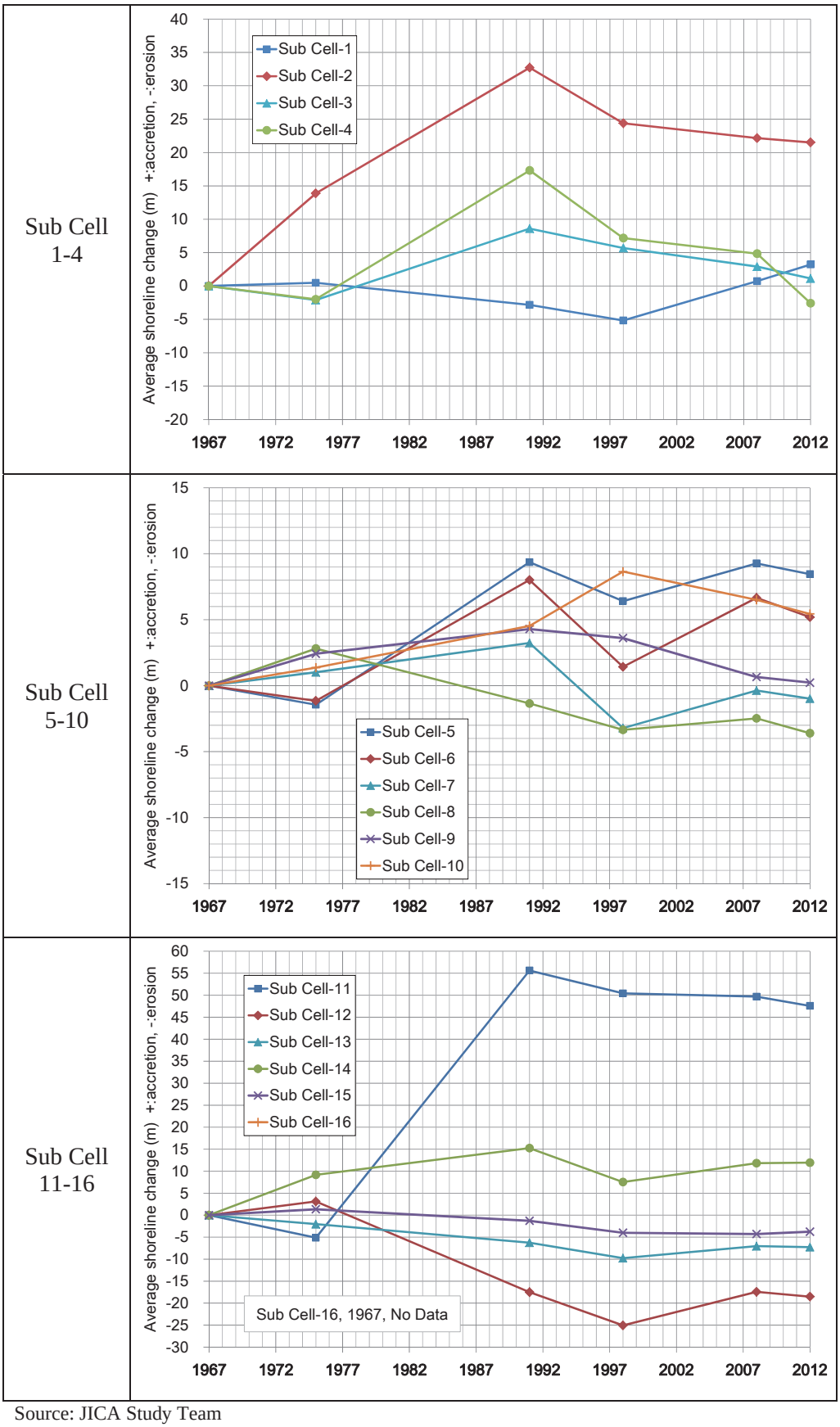
Source: JICA Study Team

Figure 1.27 Average Shoreline Changes (Sediment Cell No.3)



Source: JICA Study Team

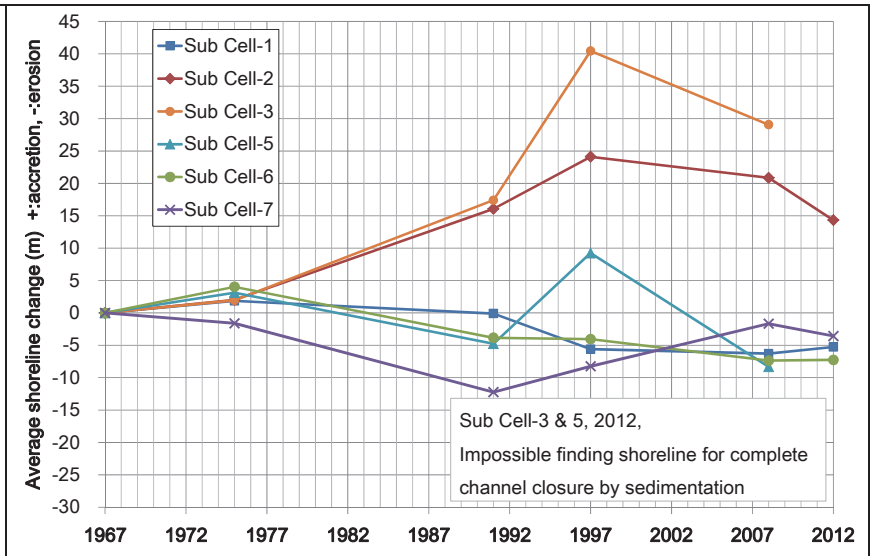
Figure 1.28 Average Shoreline Changes (Sediment Cell No.4)



Source: JICA Study Team

Figure 1.29 Average Shoreline Changes (Sediment Cell No.5)

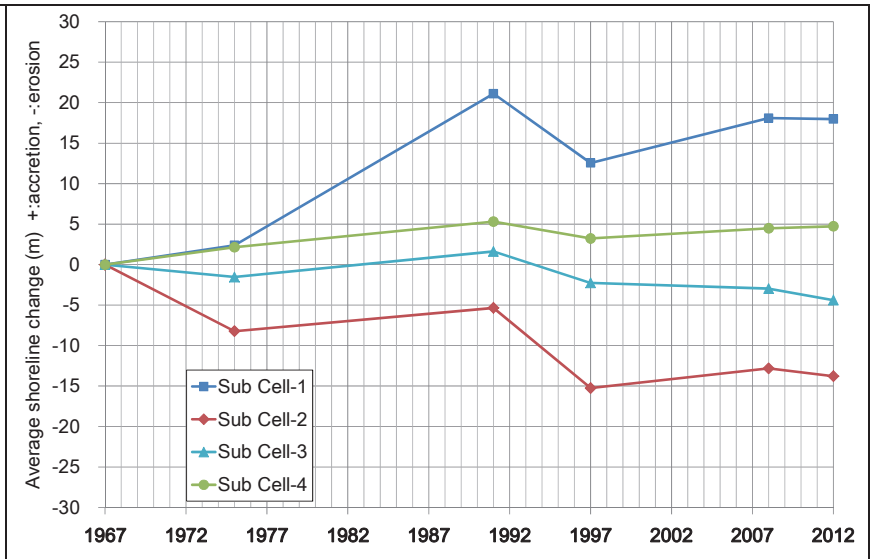
Sub Cell 1-7



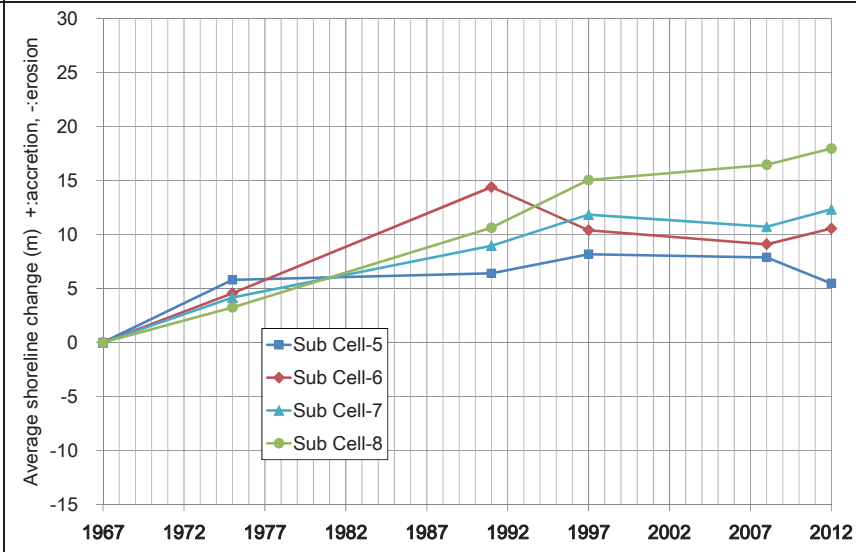
Source: JICA Study Team

Figure 1.30 Average Shoreline Changes (Sediment Cell No.6)

Sub Cell 1-4



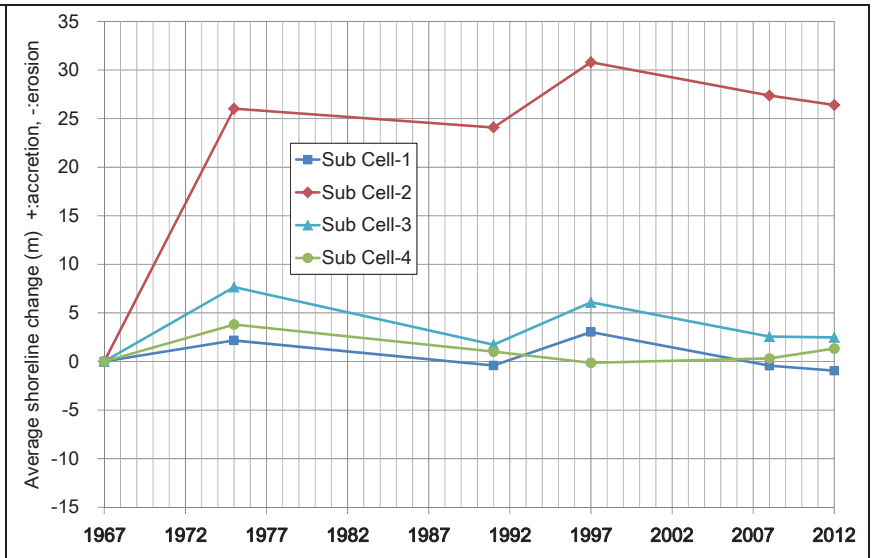
Sub Cell 5-8



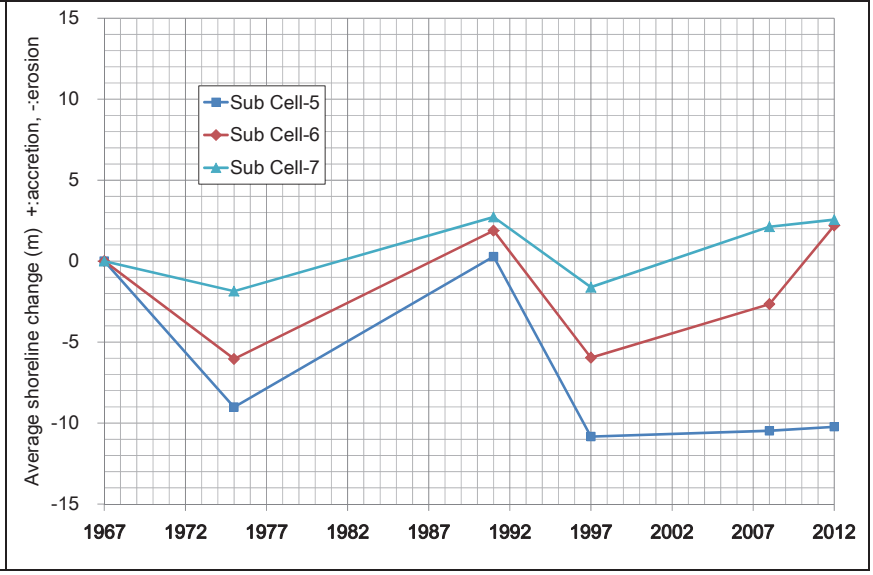
Source: JICA Study Team

Figure 1.31 Average Shoreline Changes (Sediment Cell No.7)

Sub Cell 1-4



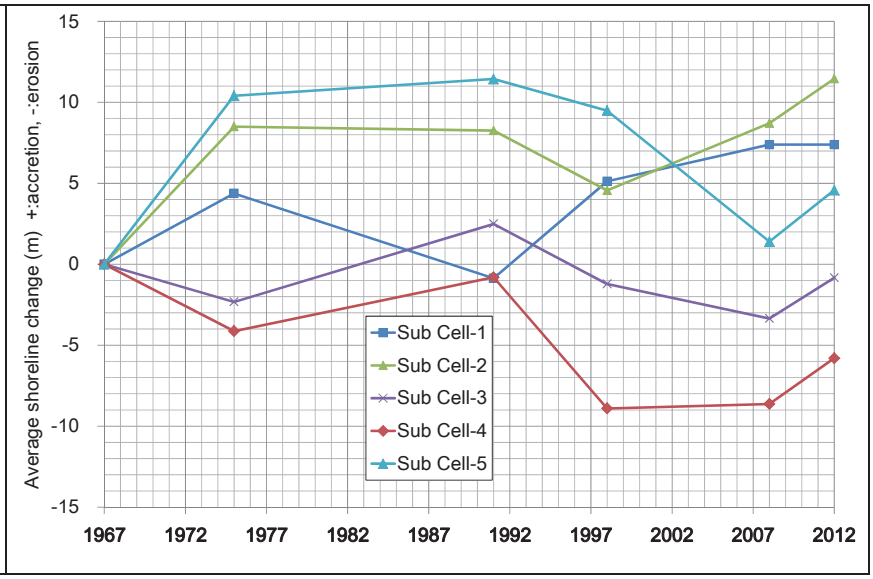
Sub Cell 5-7



Source: JICA Study Team

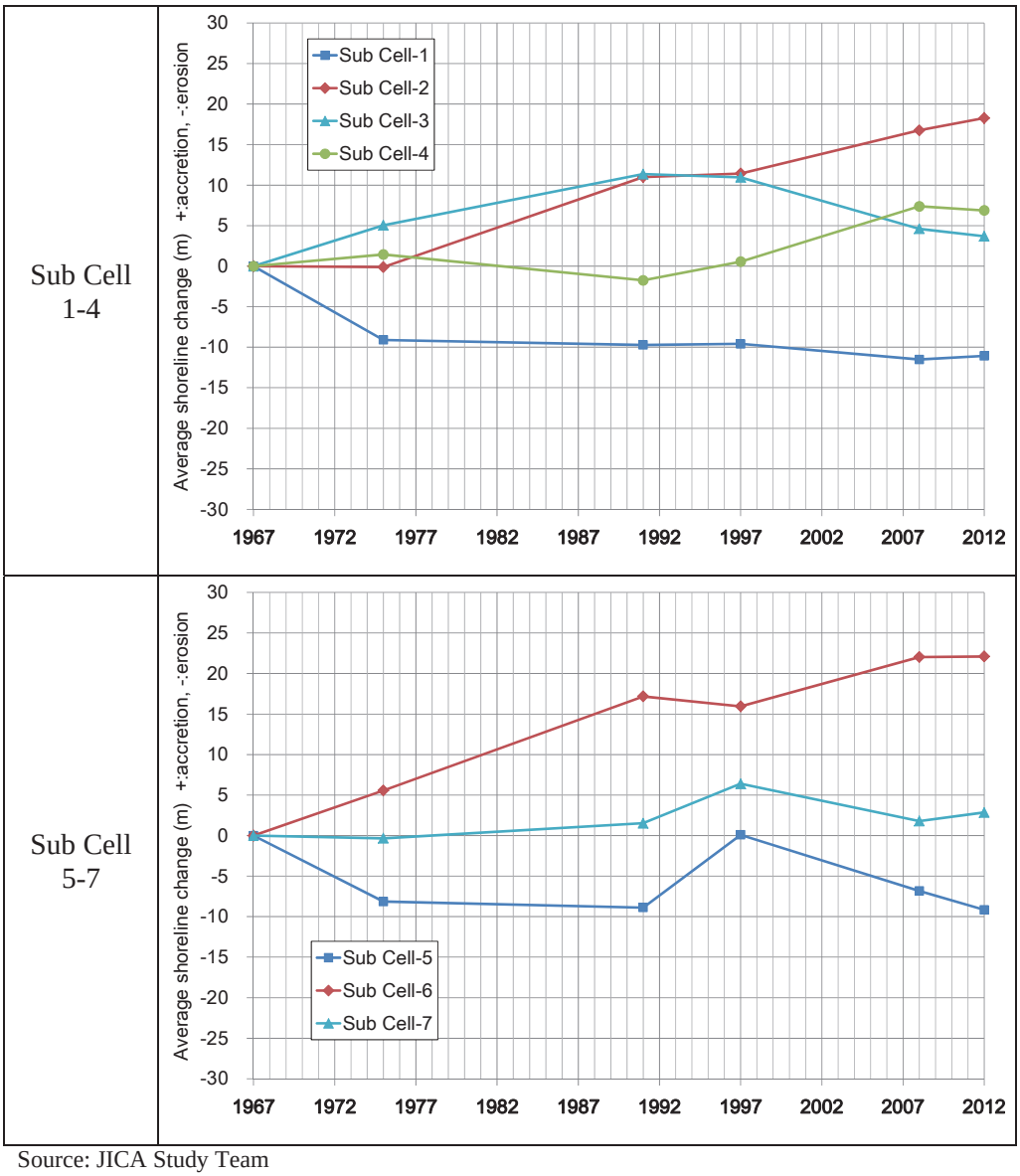
Figure 1.32 Average Shoreline Changes (Sediment Cell No.8)

Sub Cell 1-5



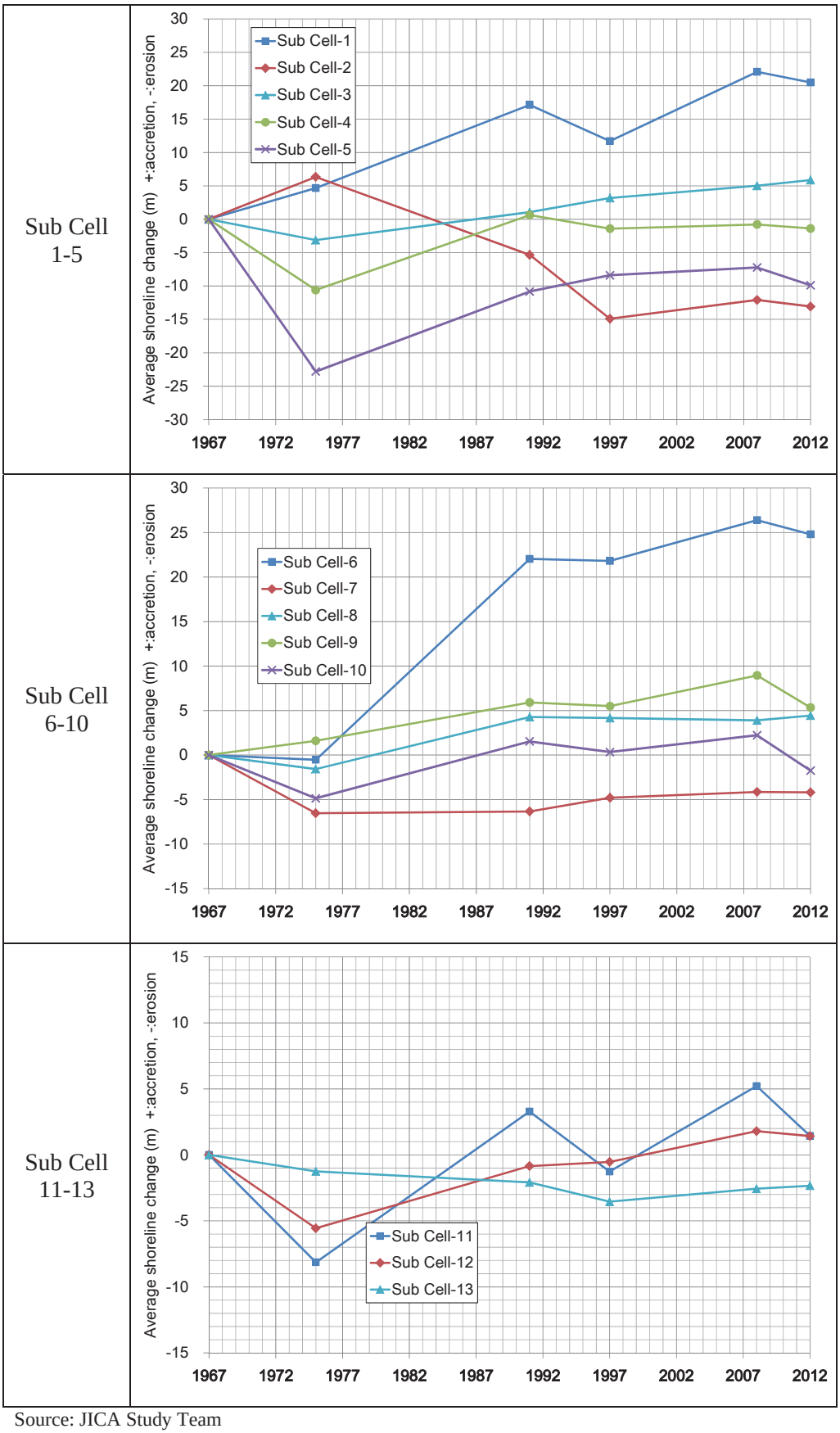
Source: JICA Study Team

Figure 1.33 Average Shoreline Changes (Sediment Cell No.9)



Source: JICA Study Team

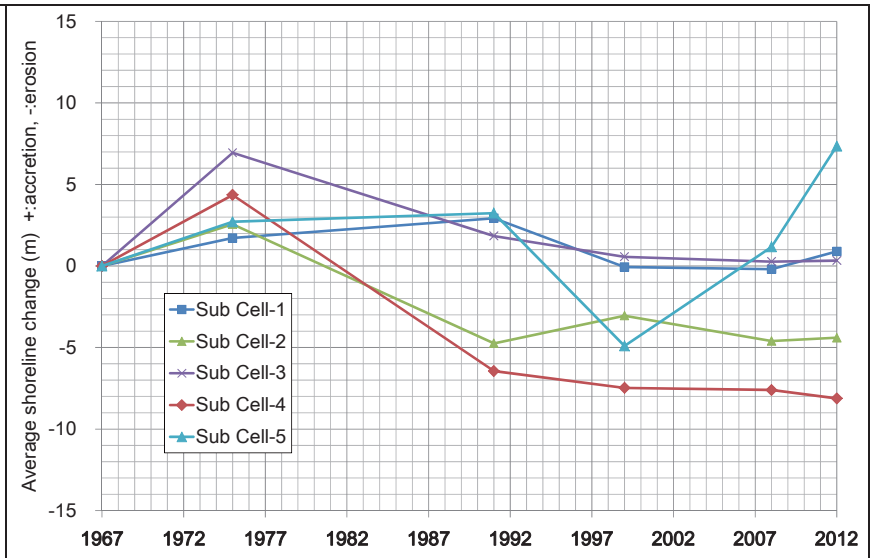
Figure 1.34 Average Shoreline Changes (Sediment Cell No.10)



Source: JICA Study Team

Figure 1.35 Average Shoreline Changes (Sediment Cell No.11)

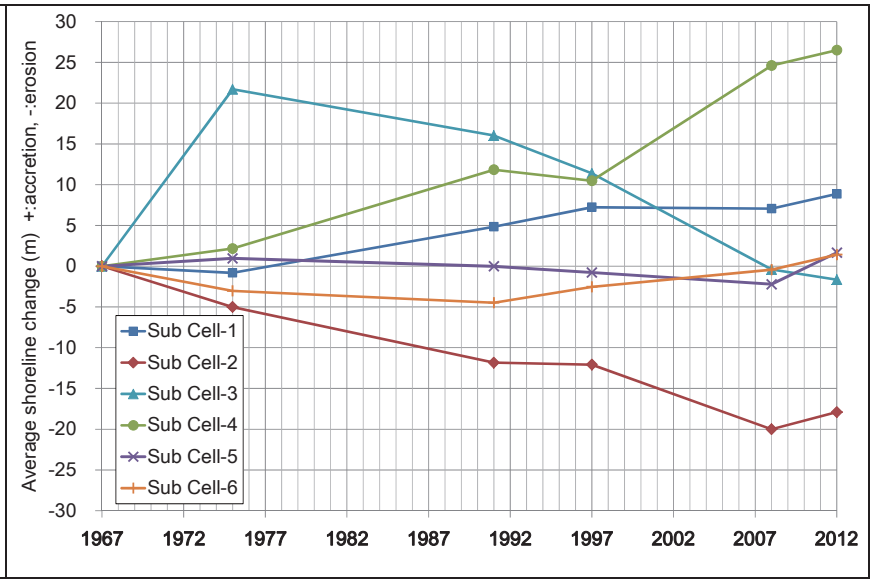
Sub Cell 1-5



Source: JICA Study Team

Figure 1.36 Average Shoreline Changes (Sediment Cell No.12)

Sub Cell 1-6



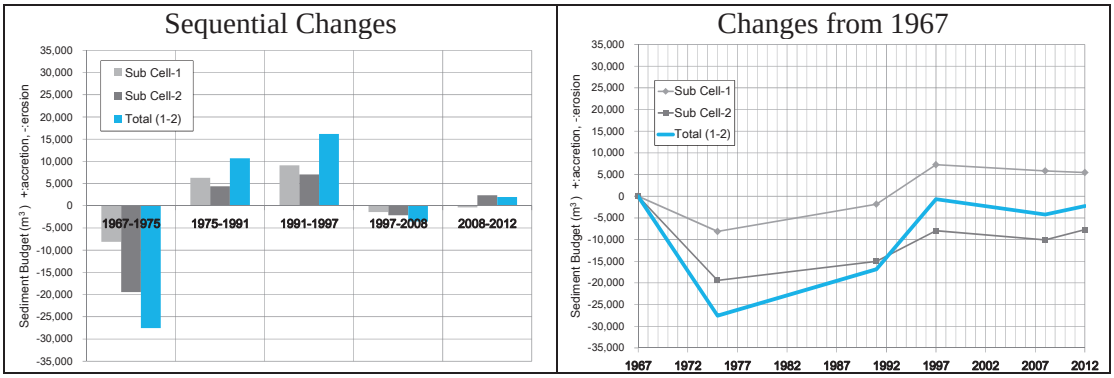
Source: JICA Study Team

Figure 1.37 Average Shoreline Changes (Sediment Cell No.13)

1.3 Results of Costal Sediment Budget Analysis

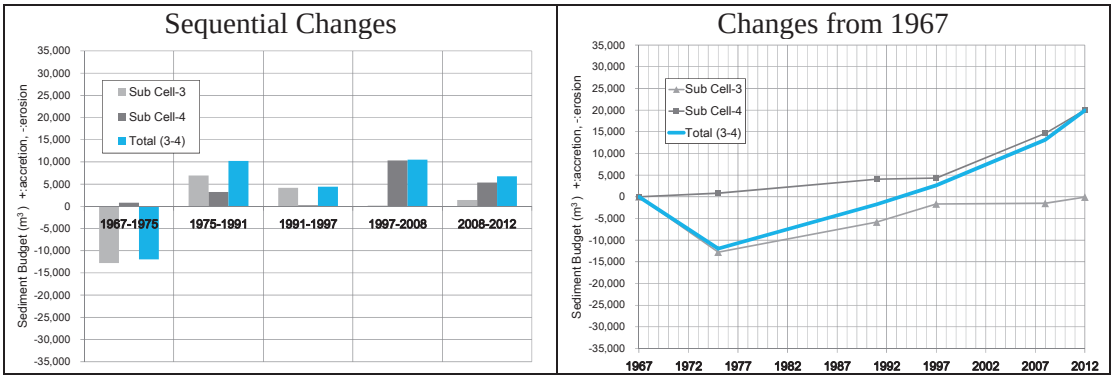
Figure 1.38 to Figure 1.70 show the sequential changes and changes since 1967 (or 1975) in sediment volume in each Sub Cell.

For example, although it is observed in the left hand of Figure 1.41 that Sub Cell-6 had been accreted and Sub Cell-7 had been eroded during 1991-1997, total is balanced and sediment budget is almost zero. On the other hand, it is observed that every location had been largely eroded during 1967-1975. The right hand of Figure 1.41 is the changes since 1967. It is observed that Sub Cell-7 has erosion trend for the long term. On the other hand, although it is observed that its adjacent Sub Cell-6 has been repetitively accreted and eroded, the sediment volume at present (2012) is same level as 1967. Therefore, it can be supposed that Sub Cell-6 is steady for the long term.



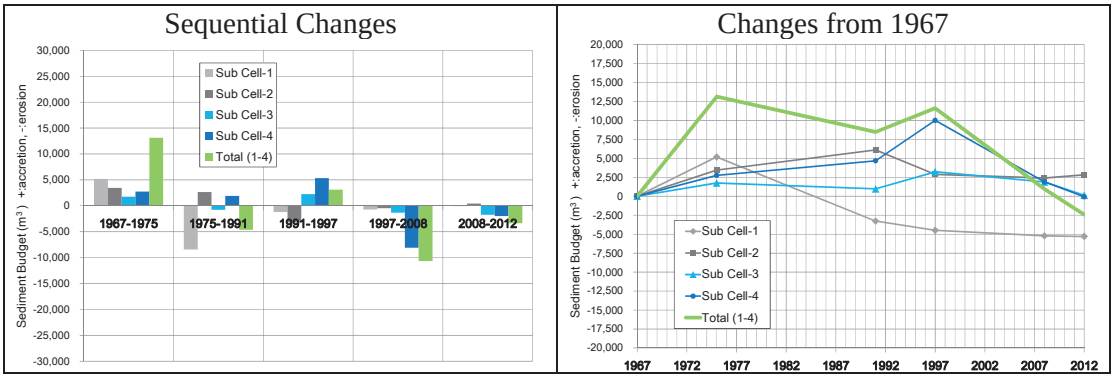
Source: JICA Study Team

Figure 1.38 Sediment Budget (Sediment Cell No.1, Sub Cell-1-2)



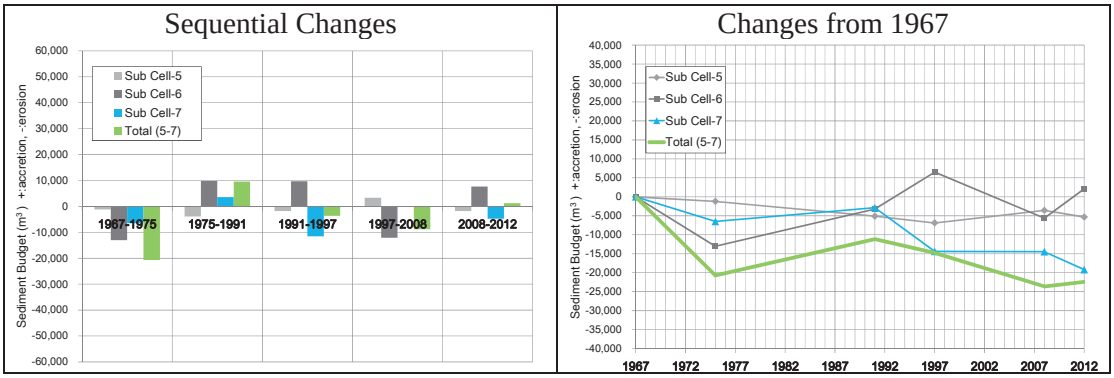
Source: JICA Study Team

Figure 1.39 Sediment Budget (Sediment Cell No.1, Sub Cell-3-4)



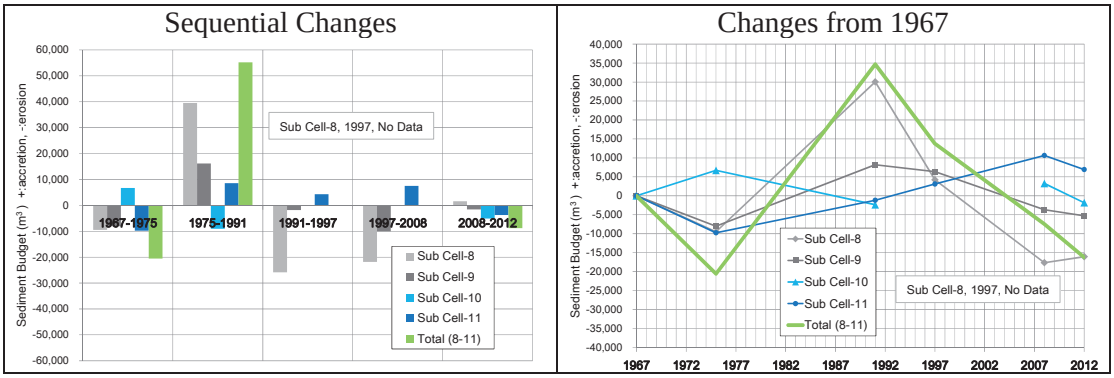
Source: JICA Study Team

Figure 1.40 Sediment Budget (Sediment Cell No.2, Sub Cell-1-4)



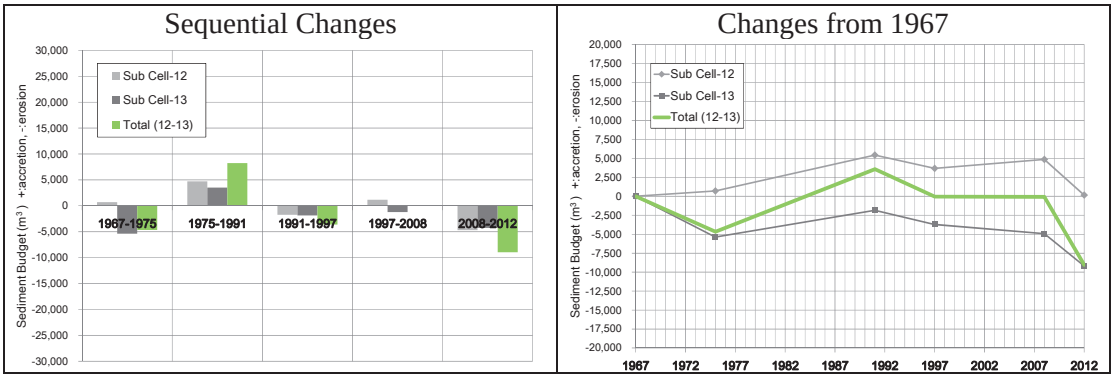
Source: JICA Study Team

Figure 1.41 Sediment Budget (Sediment Cell No.2, Sub Cell-5-7)



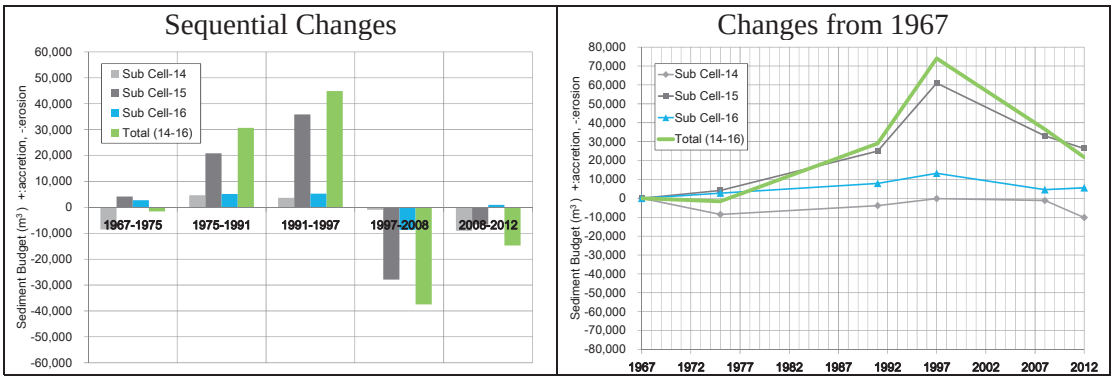
Source: JICA Study Team

Figure 1.42 Sediment Budget (Sediment Cell No.2, Sub Cell-8-11)



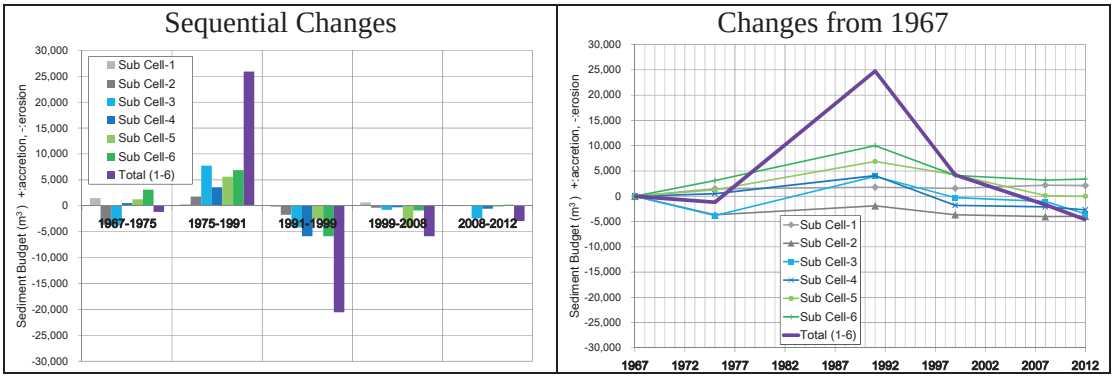
Source: JICA Study Team

Figure 1.43 Sediment Budget (Sediment Cell No.2, Sub Cell-12-13)



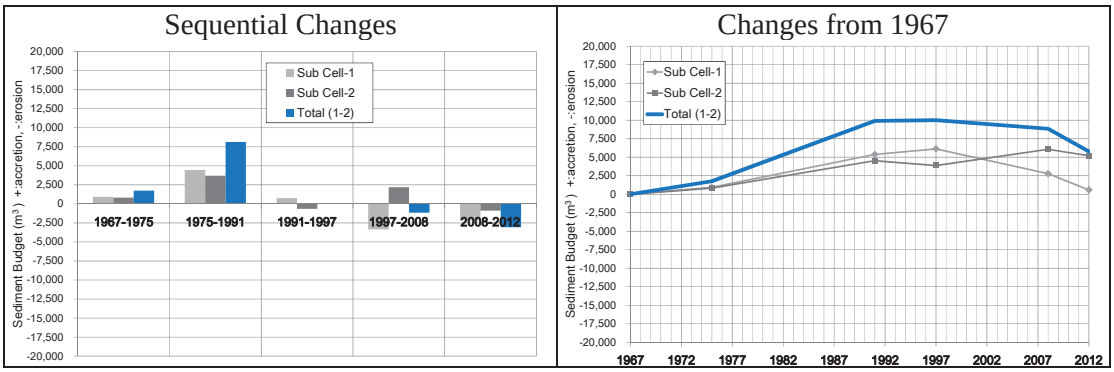
Source: JICA Study Team

Figure 1.44 Sediment Budget (Sediment Cell No.2, Sub Cell-14-16)



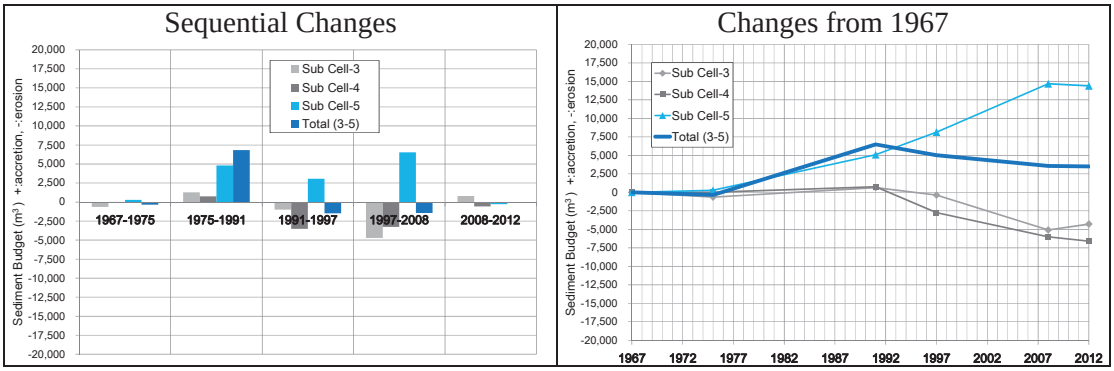
Source: JICA Study Team

Figure 1.45 Sediment Budget (Sediment Cell No.3, Sub Cell-1-6)



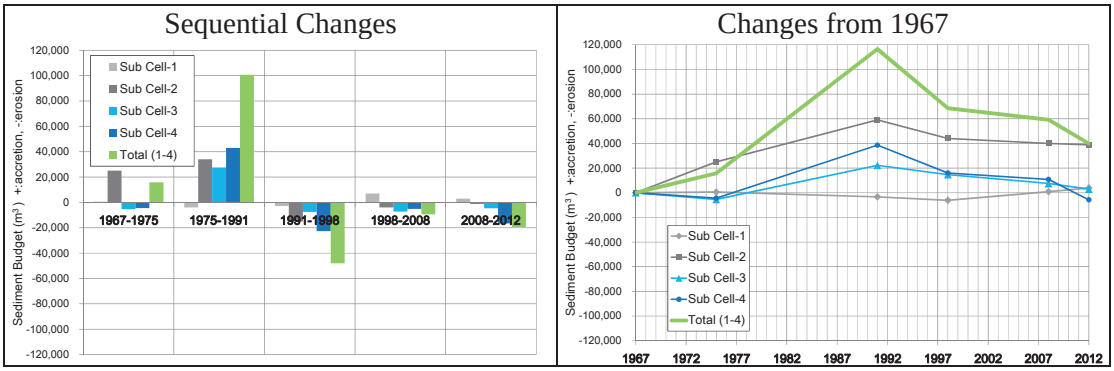
Source: JICA Study Team

Figure 1.46 Sediment Budget (Sediment Cell No.4, Sub Cell-1-2)



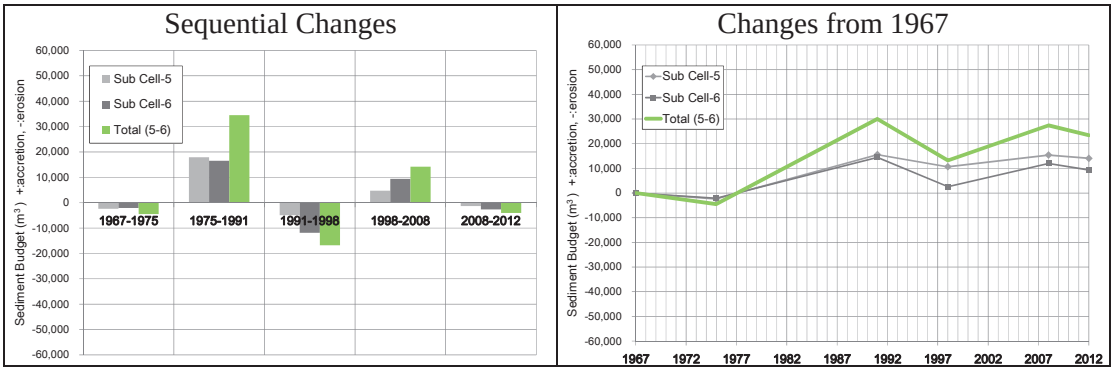
Source: JICA Study Team

Figure 1.47 Sediment Budget (Sediment Cell No.4, Sub Cell-3-5)



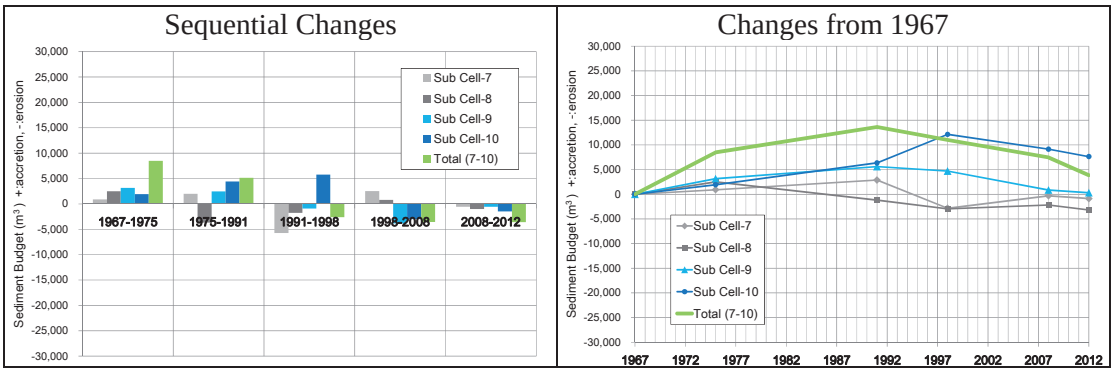
Source: JICA Study Team

Figure 1.48 Sediment Budget (Sediment Cell No.5, Sub Cell-1-4)



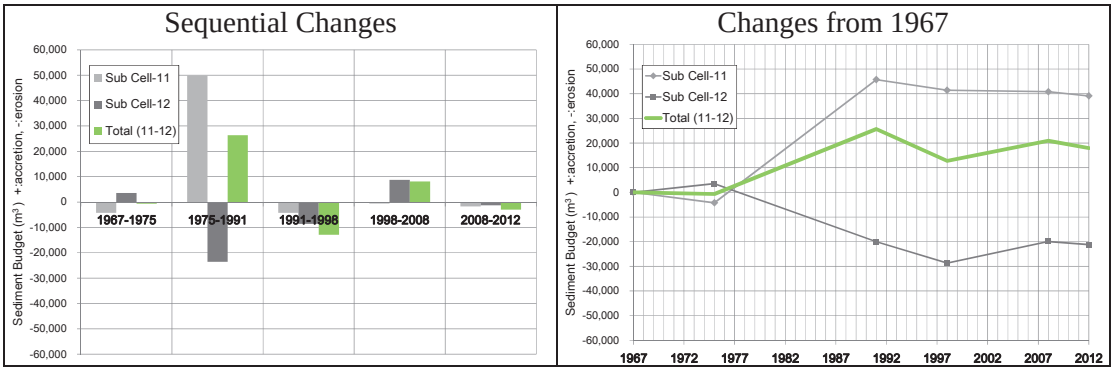
Source: JICA Study Team

Figure 1.49 Sediment Budget (Sediment Cell No.5, Sub Cell-5-6)



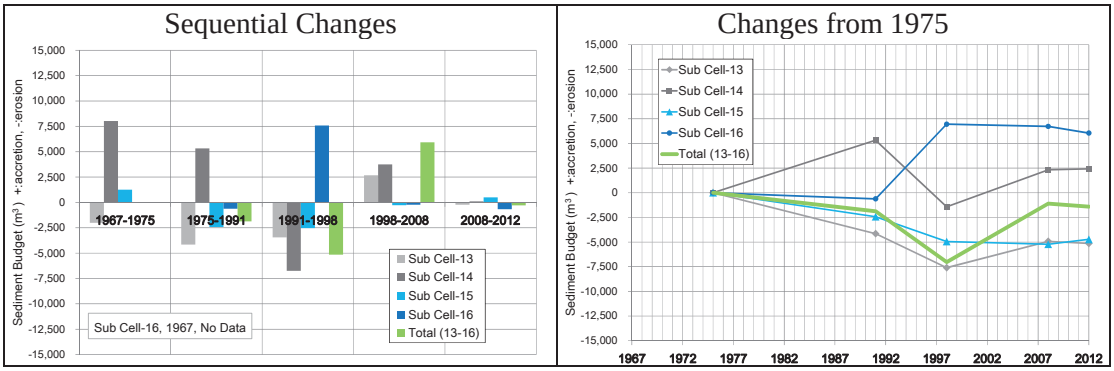
Source: JICA Study Team

Figure 1.50 Sediment Budget (Sediment Cell No.5, Sub Cell-7-10)



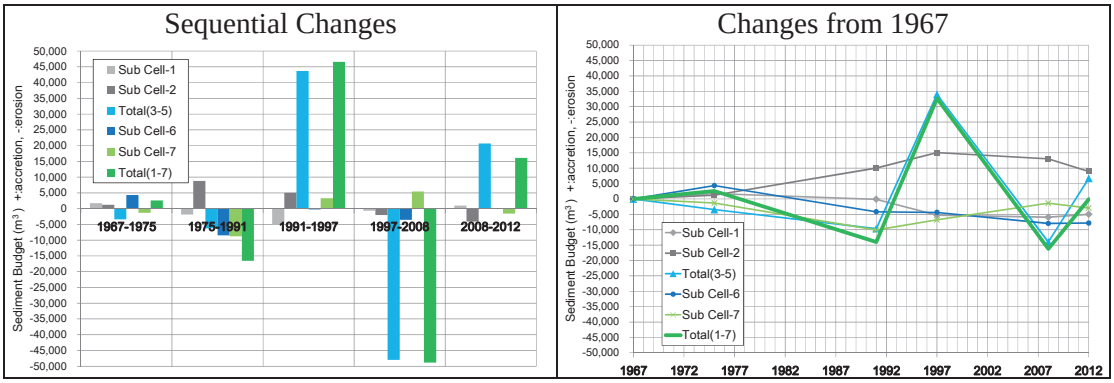
Source: JICA Study Team

Figure 1.51 Sediment Budget (Sediment Cell No.5, Sub Cell-11-12)



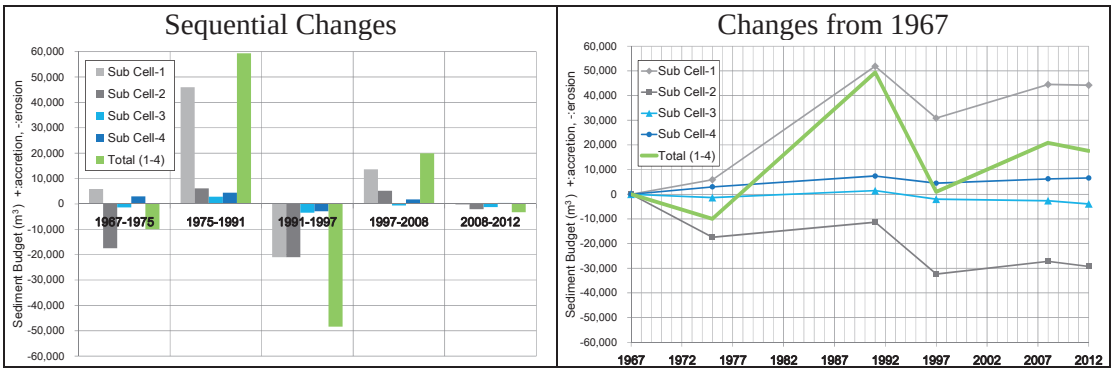
Source: JICA Study Team

Figure 1.52 Sediment Budget (Sediment Cell No.5, Sub Cell-13-16)



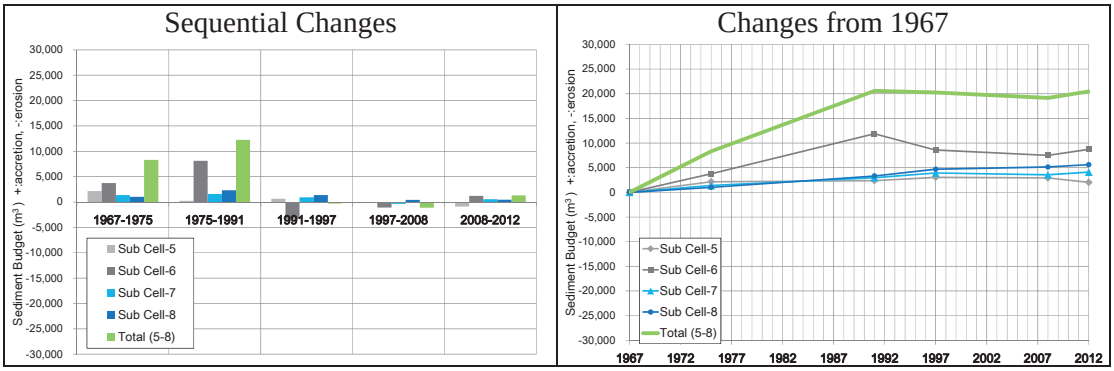
Source: JICA Study Team

Figure 1.53 Sediment Budget (Sediment Cell No.6, Sub Cell-1-5)



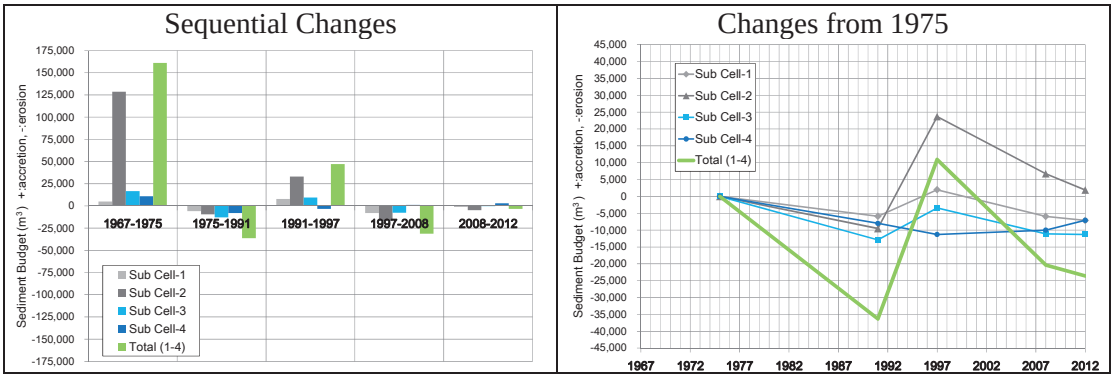
Source: JICA Study Team

Figure 1.54 Sediment Budget (Sediment Cell No.7, Sub Cell-1-4)



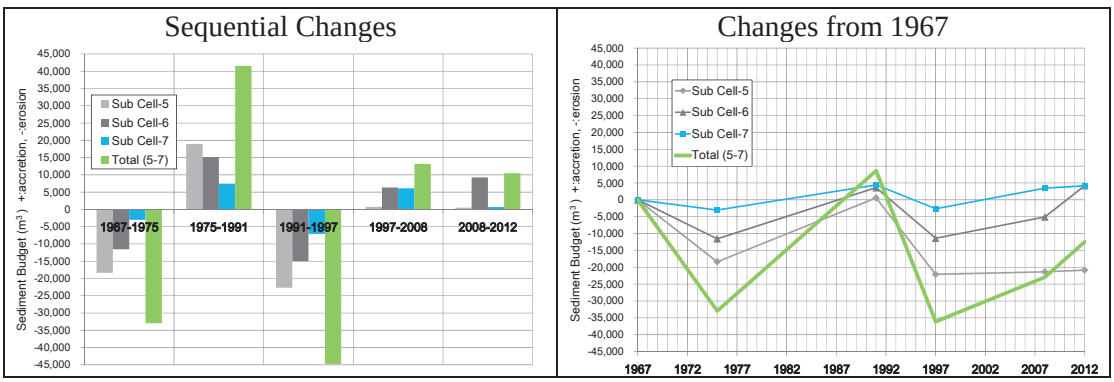
Source: JICA Study Team

Figure 1.55 Sediment Budget (Sediment Cell No.7, Sub Cell-5-8)



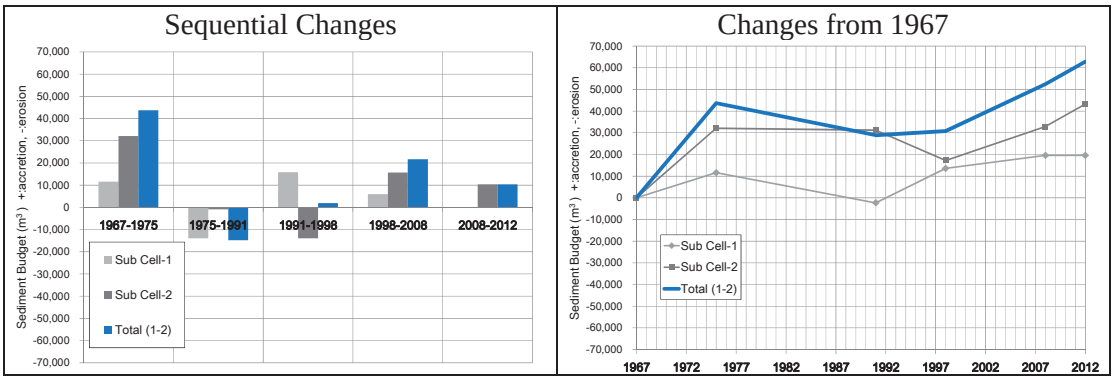
Source: JICA Study Team

Figure 1.56 Sediment Budget (Sediment Cell No.8, Sub Cell-1-4)



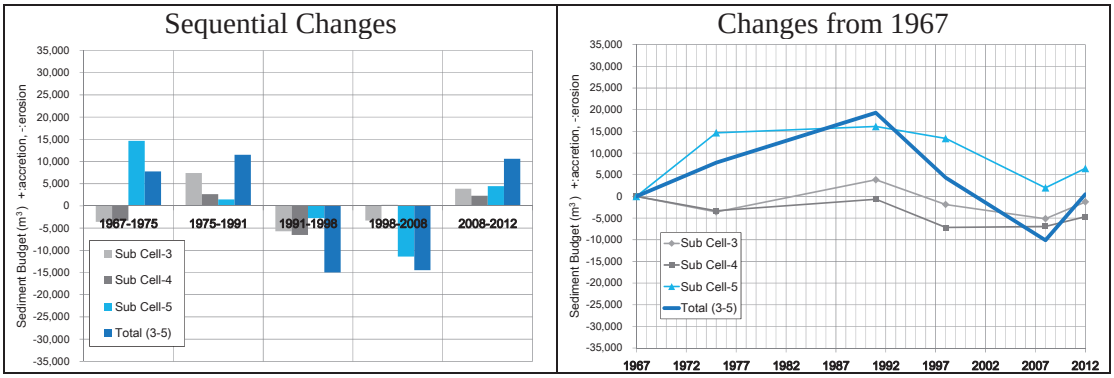
Source: JICA Study Team

Figure 1.57 Sediment Budget (Sediment Cell No.8, Sub Cell-5-7)



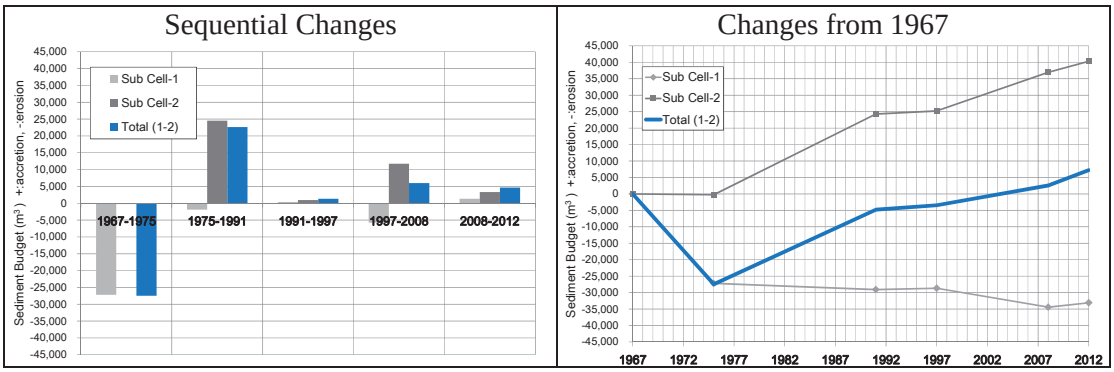
Source: JICA Study Team

Figure 1.58 Sediment Budget (Sediment Cell No.9, Sub Cell-1-2)



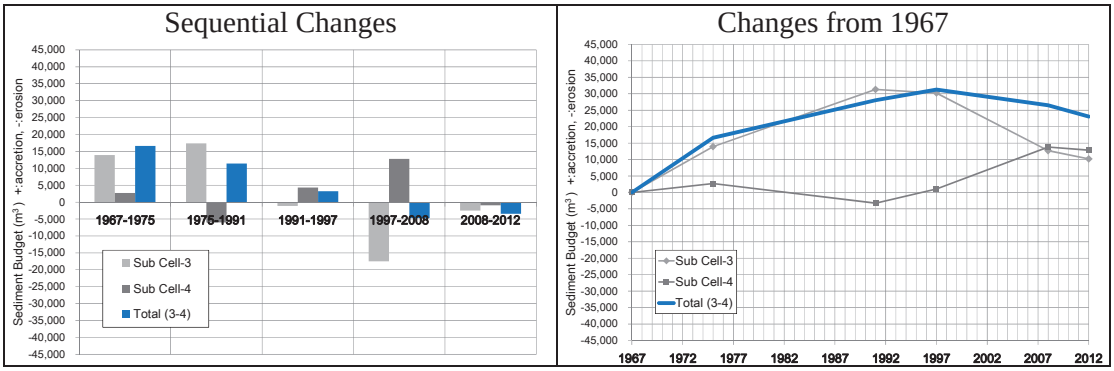
Source: JICA Study Team

Figure 1.59 Sediment Budget (Sediment Cell No.9, Sub Cell-3-5)



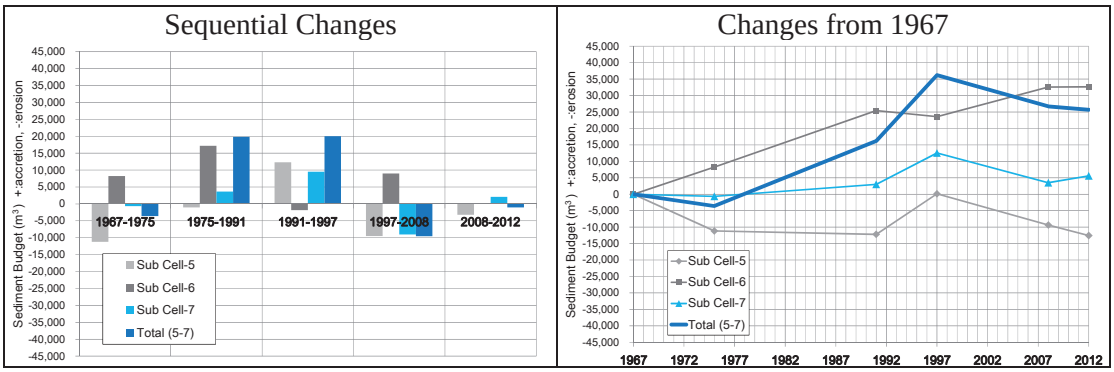
Source: JICA Study Team

Figure 1.60 Sediment Budget (Sediment Cell No.10, Sub Cell-1-2)



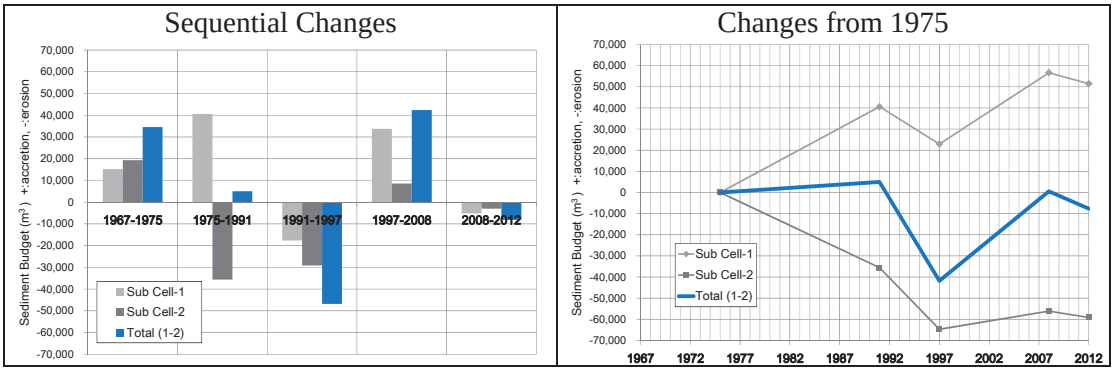
Source: JICA Study Team

Figure 1.61 Sediment Budget (Sediment Cell No.10, Sub Cell-3-4)



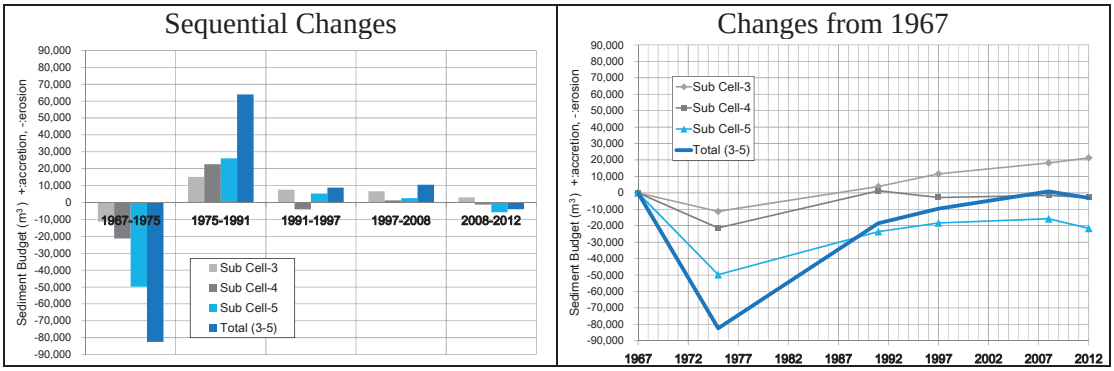
Source: JICA Study Team

Figure 1.62 Sediment Budget (Sediment Cell No.10, Sub Cell-5-7)



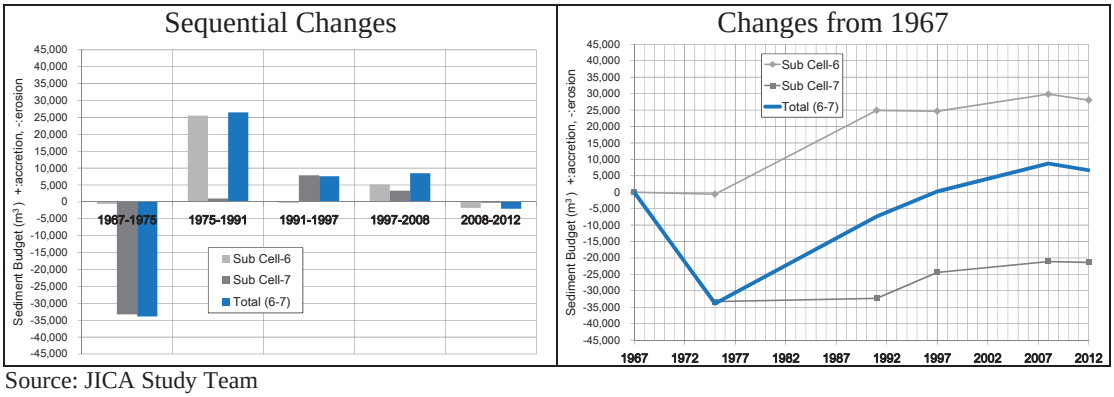
Source: JICA Study Team

Figure 1.63 Sediment Budget (Sediment Cell No.11, Sub Cell-1-2)



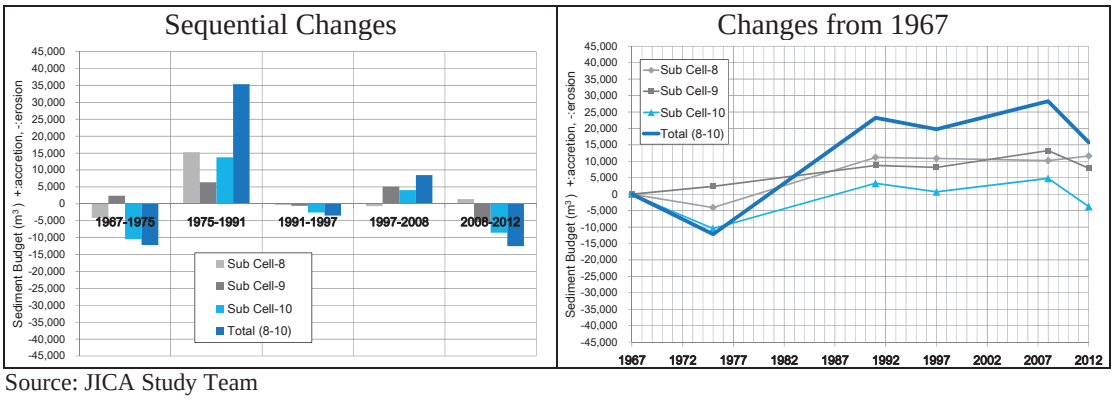
Source: JICA Study Team

Figure 1.64 Sediment Budget (Sediment Cell No.11, Sub Cell-3-5)



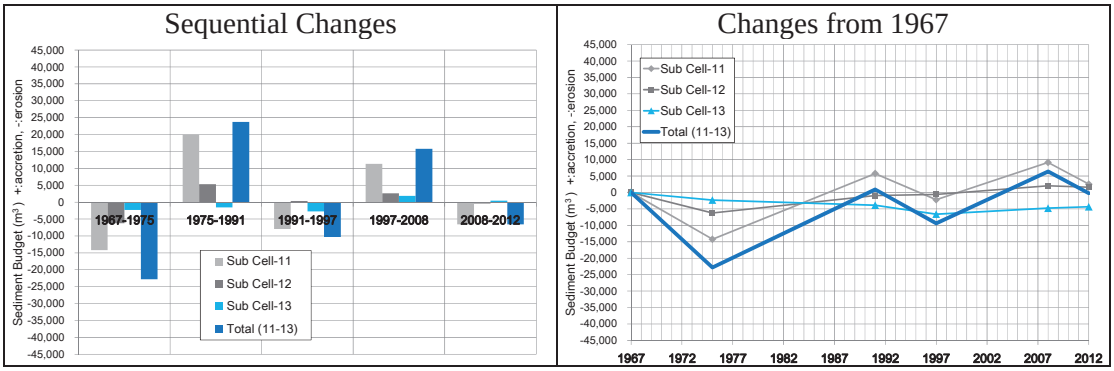
Source: JICA Study Team

Figure 1.65 Sediment Budget (Sediment Cell No.11, Sub Cell-6-7)



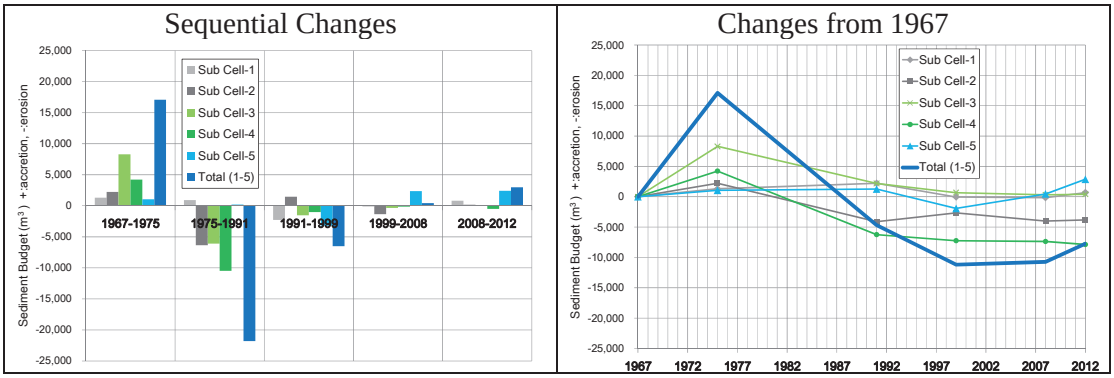
Source: JICA Study Team

Figure 1.66 Sediment Budget (Sediment Cell No.11, Sub Cell-8-10)



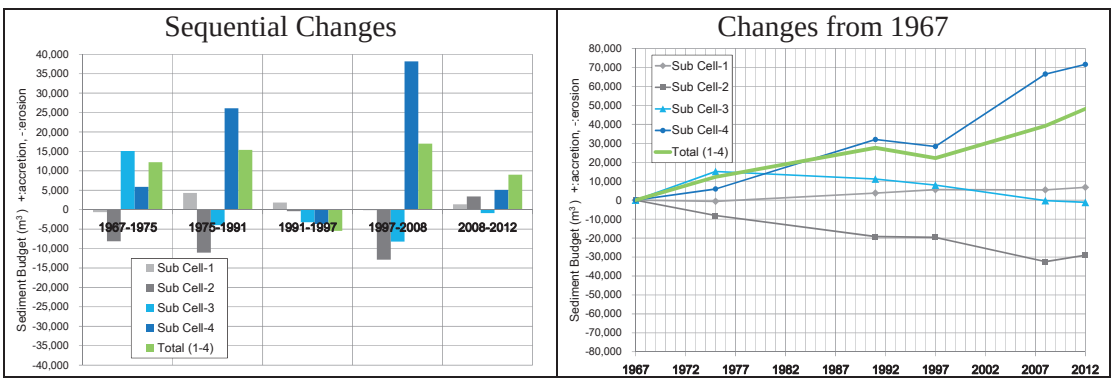
Source: JICA Study Team

Figure 1.67 Sediment Budget (Sediment Cell No.11, Sub Cell-11-13)



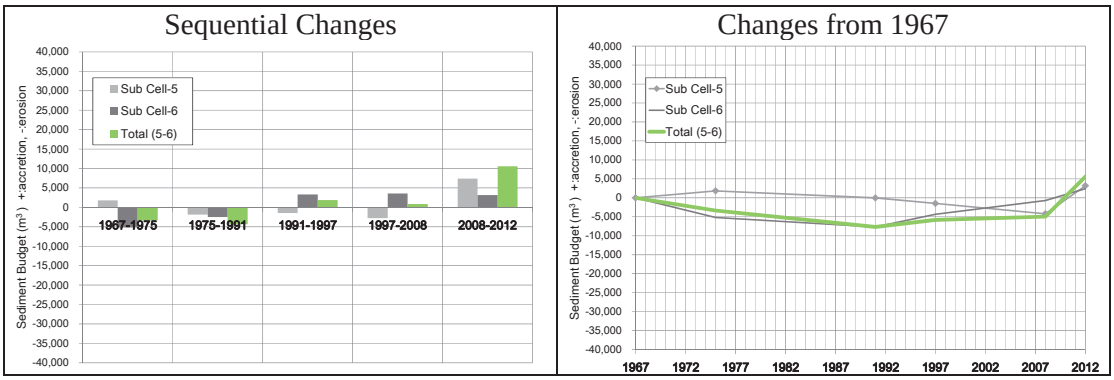
Source: JICA Study Team

Figure 1.68 Sediment Budget (Sediment Cell No.12, Sub Cell-1-5)



Source: JICA Study Team

Figure 1.69 Sediment Budget (Sediment Cell No.13, Sub Cell-1-4)



Source: JICA Study Team

Figure 1.70 Sediment Budget (Sediment Cell No.13, Sub Cell-5-6)

2. Summary of Target 20 Coasts

2 Summary of Target 20 Coasts

Among 58 project candidates, 20 coasts were selected for basic investigation. Listed below are the study results of each coast by JICA Study Team.

Basic investigation No.	No. 1 (Sediment Cell No.)	PB No.	No. 1
Coast name	Baie du Tombeau (Lorrette)、Le Goulet		

Coast location

Coast photo Baie du Tombeau

1

Coast photo Le Goulet

2

Natural and topographic characteristics	Sea state	Cyclonic waves are arriving from the north.
	Topography	Convex coast with about 500m-wide reef Most of the west side is a gravel beach, while the north side is a sand beach.
Environmental characteristics	Coral reef	Coral reef coverage near the beach is around 60%. According to the results of coral reef monitoring by AFRC, coral reef coverage around the reef edge is on a declining trend from 2000 to 2010.
	Water quality	Transparency is about 10m and siltation is low. According to the results of water quality monitoring by AFRC, though the water quality (COD, PO4) was deteriorated for a period of 2001 to 2003, the current water quality is relatively good.
Coastal transformation characteristics	Disaster and structures	The seawall was partially destroyed and trees fell down. This is not directly caused by erosion, but by the fact that the renter (personnel) has used the coast without securing buffer zone.
	Coastal transformation	According to the results of topographic interpretation by aerial photos, the shoreline is expanding at an eroding speed of 9cm/year at maximum. No wide-scaled coastal erosion is observed. However, the foundation of the pedestrian bridge crossing the river-mouth at north side of beach (Le Goulet) is exposed, and the river-mouth sandbar is varying.
Coastal utilization characteristics	Beach utilization	Though beach is public beach, beach utilization itself is restricted. The hinterland is a small-scaled cottage area.
General assessment		The coral reef is in good condition with a low eroding speed, and no development is planned for the hinterland. In light of these facts, the necessity of creating a protection program is considered not so high. More priority should be given to individual measures such as forest management and river-mouth processing rather than countermeasures against coastal erosion in the whole area under the project.

Basic investigation No.	No. 2 (Sediment Cell No.2)	PB No.	No. 3-14
Coast name	Pte aux Piments, Trou aux Biches, Mon Choisy,The Vale		

Coast location

Coast photo Trou aux biches

1

Coast photo Trou aux biches, Partially damaged seawall

2

Natural and topographic characteristics	Sea state	Considerably affected by cyclonic waves
	Topography	Though some of the west side is a rocky shore, but most of the coast is a sand beach. The width of the reef on the front is around 300 m. The slope of beach berm is within a range of 1/6 to 1/14 and a gentle slope is formed at Mon Choisy. The grain size of sea bed material with 0.2 mm of medium diameter is fine relative to the other beaches.
Environmental characteristics	Coral reef	Coral reef coverage behind reef edge is a range of 10 to 60%. According to the results of coral reef monitoring by AFRC, coral reef coverage around the reef edge at Trou aux Biches is on a declining trend from 2000 to 2010.
	Water quality	Transparency is 5m and siltation is at around a middle level. According to the results of water quality monitoring by AFRC, The high concentration of nitrogen and phosphorus above the environmental standards in Mauritius have not been reported. Water quality is relatively good.
Coastal transformation characteristics	Disaster and structures	The seawall was partially destroyed. A stone seawall was constructed (in 2008, 137m), and beach shaping was implemented in Mon Choisy (in 2010, 600m). The construction of artificial reef as coastal protection facility will be planned by AFB.
	Coastal transformation	According to the results of topographic interpretation by aerial photos, The eroding speed of beach is 29cm/year at the south side of Mon Choisy and 7 cm year at Pte aux Canonniers.
Coastal utilization characteristics	Beach utilization	Utilized as PB (public beach). The hinterland is a tourist spot where hotels, guest houses, residents' houses, coast roads, restaurants, and shops are located.
General assessment		A protection program should be developed for Mon Choisy where coastal erosion is progressing and the beach nourishment conducted as the coastal protection works caused little effect. The investigation and planning of countermeasures into the cause of poor coral reef coverage. AFB artificial reef construction plan in Mon Choisy is considered inappropriate because of its possible negative impact on the local sediment transport mechanism and environmental conditions.

Basic investigation No.	No. 3	PB No.	No.19.
Coast name	Bain Boeuf		

Coast location

Coast photo (1)

Coast photo (2)

Natural and topographic characteristics	Sea state	Considerably affected by cyclonic waves
	Topography	Sand beach with reef, rocky shore, and beach rocks located on the front
Environmental characteristics	Coral reef	Coral reef coverage is around 30%. According to the results of coral reef monitoring at Anse La Raie by AFRC, it gathers that coral reef coverage is on a declining trend from 2000 to 2010.
	Water quality	Transparency is 3m and siltation is high. According to the results of water quality monitoring at Anse La Raie by AFRC, it gathers that water quality is relatively good.
Coastal transformation characteristics	Disaster and structures	Coastal retaining walls have been constructed.
	Coastal transformation	The aerial photograph showed no remarkable indication of erosion. Judging from the existence of beach rocks, this coast seems be a stable beach with little movement.
Coastal utilization characteristics	Beach utilization	Utilized as PB (public beach). The frequency of beach utilization is middle. The houses are scattered at hinterland.
General assessment		Beach user is limited. In addition to the fact neither coastal erosion nor previous disaster has been observed, there is no development plan for the hinterland. In light of these facts, the necessity of creating a protection program is considered low.

Basic investigation No.	No. 4	PB No.	No.20
Coast name	Cap Malheureux		

Coast location

Coast photo ①

Coast photo Damaged gabions ②

Natural and topographic characteristics	Sea state	Considerably affected by cyclonic waves
	Topography	Coast with a narrow width of sand beach, having a cliff on the back and reef on the front
Environmental characteristics	Coral reef	Coral reef coverage is around 50%. According to the results of coral reef monitoring at Anse La Raie by AFRC, it gathers that coral reef coverage is on a declining trend from 2000 to 2010.
	Water quality	Transparency is 2m and siltation is high. According to the results of water quality monitoring at Anse La Raie by AFRC, it gathers that water quality is relatively good.
Coastal transformation characteristics	Disaster and structures	Gabions were constructed for prevention against overtopping waves to the hinterland as well as erosion.
	Coastal transformation	Prior to the construction of the gabions, erosion was observed in the cliff area. The current erosion state is unknown.
Coastal utilization characteristics	Beach utilization	Utilized as PB (public beach). The frequency of beach utilization is middle. The hinterland is a cemetery.
General assessment		The previously eroded scarp has been improved with constructions. The hinterland is a cemetery. Beach user is limited. In light of these facts, the necessity of creating a protection program is considered low.

Basic investigation No.	No. 5	PB No.	No.29
Coast name	Poudre Dor (Sediment Cell No.3)		

Coast location

Coast photo

1

Coast photo

Natural and topographic characteristics	Sea state	Considerably affected by cyclonic waves The reef existing on the east side greatly contributes to attenuation of incoming waves.
	Topography	Sand beach and gravel beach, with around 600m-wide reef existing on the east side
Environmental characteristics	Coral reef	Coral reef coverage is 0%. According to the results of coral reef monitoring by AFRC, coral reef coverage behind the reef edge was about 60% in 2000 and have been 0% from 2009.
	Water quality	Transparency is 1m or less, and siltation is very high. Algal coverage is 50% or more. According to the results of water quality monitoring by AFRC, contamination of water quality from textile factories had been observed until about 2003. Water quality has been being improved since then, though PO_4, which causes eutrophication, still remains relatively high.
Coastal transformation characteristics	Disaster and structures	-
	Coastal transformation	The aerial photograph showed no remarkable indication of erosion. However, local erosion has caused scarps.
Coastal utilization characteristics	Beach utilization	Utilized as PB (public beach). The frequency of beach utilization is not high. The houses are scattered at hinterland.
General assessment		A problem is that water quality rather than coral reef is deteriorated. From the viewpoint of coastal protection, however, the necessity of creating a protection program is considered low and partial or local protection seems to be a sufficient countermeasure.

Basic investigation No.	No. 6	PB No.	No.30
Coast name	Roches Noires (Sediment Cell No.3)		

Coast location

Coast photo Damaged seawall (1)

Coast photo Barachos fish farm (2)

Natural and topographic characteristics	Sea state	Considerably affected by cyclonic waves The reef widely existing on the northeast side contributes to attenuation of waves.
	Topography	Gravel beach and sand beach with around 600m-wide reef on the northeast side
Environmental characteristics	Coral reef	Shore side is affected by fresh water, where is unsuitable for coral habitat.
	Water quality	The hinterland is a mangrove forest and affected by fresh water. Water quality is relatively good because the houses and hotels are little and the polluting effect from hinterland is low.
Coastal transformation characteristics	Disaster and structures	Von Molke PB: Damages (holes) are observed on the seawall. There is Barachos fish farm here.
	Coastal transformation	According to the results of topographic interpretation by aerial photos, an eroding velocity of up to 23cm/year was measured at partial shoreline. As a whole, no remarkable indication of erosion was found.
Coastal utilization characteristics	Beach utilization	Utilized as PB (public beach). The frequency of beach utilization is not high. There are residents' houses behind.
General assessment		Though this coast is affected by cyclones, its eroding rate is relatively small due to wide reef. Damage is limited to some facilities and no facility fell down. Countermeasures and protection intended for individual facility rather than the whole coast seem sufficient. In light of these, the necessity of creating a protection program is considered low.

Basic investigation No.	No. 7 (Sediment Cell No.4)	PB No.	No.35
Coast name	Bras d'Eau		

Coast location

Coast photo Eroded area

1

Coast photo Sedimentation area

2

Natural and topographic characteristics	Sea state	Affected by waves from the east
	Topography	Sand beach with around 1,400m-wide reef on the front, and located at the back of the bay
Environmental characteristics	Coral reef	The back of the bay is affected by river (fresh water), where is unsuitable for coral habitat and seaweeds flourish. Coral reef coverage near beach is 0%. Near the edge of the reef, it is around 30%.
	Water quality	Transparency is 2m at the back of the bay, and 20m near the edge of the reef. The hinterland is a mangrove forest, and water quality at the back of the bay is affected by fresh water. Water quality off shore is relatively good.
Coastal transformation characteristics	Disaster and structures	Beach shaping was performed for the scarp.
	Coastal transformation	According to the results of topographic interpretation by aerial photos, the erosion with maximum rate of 31cm/year and the sedimentation with maximum rate of 68 cm year were observed at partial shoreline. The moving forward (sedimentation) of shoreline arise from not only the alongshore sediment transport but also cross-shore sediment transport.
Coastal utilization characteristics	Beach utilization	Utilized as PB (public beach). The frequency of beach utilization is not high. There is a coastal forest behind.
General assessment		Although the elucidation of sedimentation mechanism is important due to the relatively-large erosion and sedimentation, there is no damage problem because the number of structures is limited. The necessity of creating a protection program is considered low. Although the coral reef is underdeveloped at the back of bay, the problem of water quality is not.

Basic investigation No.	No. 8 (Sediment Cell No.5)	PB No.	No.37-46
Coast name	Belle Mare、Palmar、Trou d'Eau Douce		

Coast location

Coast photo T.d'Eau Douce Erosion in front of the hotel

1

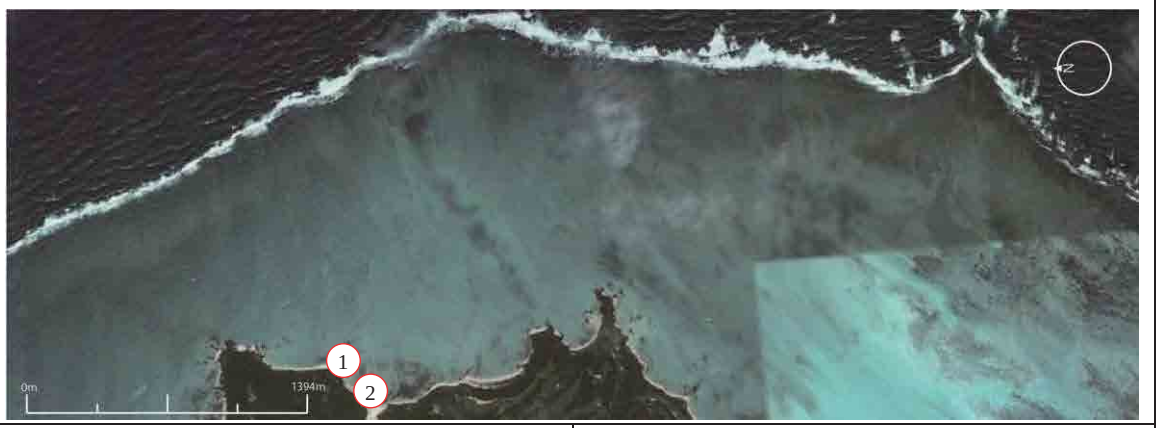
T.d'Eau Douce Short groin and wave-dissipating works

2

Natural and topographic characteristics	Sea state	Affected by waves from the east
	Topography	Sand beach with around 500m-wide reef on the front
Environmental characteristics	Coral reef	At T.d'Eau Douce, coral reef coverage varies widely depending on point, in a range of 1 to 99%. At Belle Mare/Palmar, coral reef coverage is around 60%. According to the results of coral reef monitoring by AFRC, coral reef coverage around the reef edge from 2000 to 2010 is stable at both coasts. The coral reef coverage near beach at T.d'Eau Douce has been decline from 70% to 15%.
	Water quality	At T.d'Eau Douce, transparency is 3 to 5m, and siltation is decreasing as coral reef coverage is increasing. Water quality is relatively good, but salinity is low at the back of the bay because of effects by fresh water. At Belle Mare/Palmar, transparency is 5 to 10m, and siltation is low. Water quality is relatively good, but salinity is low at some points because of effects by groundwater.
Coastal transformation characteristics	Disaster and structures	Beach shaping was implemented (in 2006, 1km) Installation of gabions and groins was implemented in La Tropical.
	Coastal transformation	According to the results of topographic interpretation by aerial photos, the beach at Belle Mare is relatively stable. At Palmar and T.d'Eau Douce, large-scaled alongshore sediment transport has generated the remarkable eroded area (21cm/year) and sedimentation area (64cm/year).
Coastal utilization characteristics	Beach utilization	Utilized as PB (public beach). There are hotels and residents' houses behind. The frequency of beach utilization by local residents and tourists is high.
General assessment		Judging from the fact that some structures for controlling sediment transport such as groins have been provided, wide-scaled alongshore sediment transport has generated the remarkable eroded area and sedimentation area. The hinterland has been considerably utilized such as hotels, and the existence of the scarp can be trouble. In light of these facts, it is required to study the current situation and devise a coastal protection program as well as countermeasures based on the study results.

Basic investigation No.	No. 9 (Sediment Cell No.6)	PB No.	No.
Coast name	Ile aux Cerfs		

Coast location



Coast photo Alongshore eroded area

1

Coast photo Completely closed waterway

2

Natural and topographic characteristics	Sea state	Affected by waves from the east
	Topography	Sand beach with around 1,600m-wide reef on the front. There is a waterway between the islands.
Environmental characteristics	Coral reef	Coral reef coverage offshore waterway between the islands varies widely depending on point, in a range of 0 to 5%. Coral reef coverage around the reef edge is 50% or more and coral reef is relatively good.
	Water quality	Offshore waterway between the islands, transparency is 3m and siltation is middle. According to the results of water quality survey by this study, turbidity and PO4-P are high in a water area between small islands (Ile aux Cerfs) and capital island lets. Offshore, water quality is relatively good.
Coastal transformation characteristics	Disaster and structures	The problems are the closed waterway between the islands and erosion along the seashore.
	Coastal transformation	According to the results of topographic interpretation by aerial photos, only near waterway sedimentation (68 cm/year) is observed. At other coastal areas, erosion (maximum 23cm/year) is observed.
Coastal utilization characteristics	Beach utilization	Utilized as a popular tourist spot. There are hotels and camp sites behind.
General assessment		The closed waterway between the islands prevents tidal movement of materials, which will possibly result in some problems including deterioration of water quality. Since this coast is a popular tourist spot, coastal protection is important. Based on EIA evaluation, and monitoring, and study of the current situation, a long-term coastal protection program should be proposed.

Basic investigation No.	No. 10	PB No.	No.47
Coast name	GRSE		

Coast location

Coast photo

1

Coast photo

Natural and topographic characteristics	Sea state	Waves due to the trade wind are arriving from the southeast, but attenuated by reefs.
	Topography	Gravel beach with wide reef expanding on the east front side
Environmental characteristics	Coral reef	This coast is be subject to effects of GRSE River, where is unsuitable for coral habitat. Coral reef coverage near beach is 0%.
	Water quality	Transparency is around 2m, and siltation is high. According to the results of water quality survey by this study, salinity is low due to effects by fresh water of GRSE River and turbidity and chlorophyll a.
Coastal transformation characteristics	Disaster and structures	The inclined wharf was provided, but damaged.
	Coastal transformation	The aerial photograph showed no remarkable indication of erosion.
Coastal utilization characteristics	Beach utilization	Utilized mainly as inclined wharf
General assessment		Since there are a few topographic data, numerical data on coastal transformation is not available. This coast is utilized as inclined wharf rather than beach, and the importance and potential for development of the hinterland are found low. In light of these facts, the necessity of creating a coastal protection program is considered low.

Basic investigation No.	No. 11	PB No.	No.
Coast name	Grand Sable		

Coast location

Coast photo Coast situation	Coast photo Coast situation
1 	2 

Natural and topographic characteristics	Sea state	Waves due to monsoon are arriving from the south, but attenuated by wide reef (around 2km-wide).
	Topography	Reef attenuates waves in a wide area with 5km-wide, leading to silt sedimentation. Especially in the wide reef in the southeast area, there are native mangroves. There are some gravel beaches. The medium diameter of sea bed material (under water) is within a range of 0.5 mm to 0.7 mm. The medium diameter from beach berm is around 8 mm partially.
Environmental characteristics	Coral reef	The back of the bay is affected by river (fresh water), where is unsuitable for coral habitat and seaweeds flourish. Coral reef coverage near beach is 0%.
	Water quality	Transparency is 1m or less, and siltation is very high. The hinterland (beach berm) is a mangrove forest. Water quality at the back of the bay is affected by fresh water and is polluted due to the domestic wastewater.
Coastal transformation characteristics	Disaster and structures	Since waves are attenuated, no damaged structure is observed. The impact to hinterland by storm surge is concerned.
	Coastal transformation	The results of the analysis through the aerial photograph and field work show this coast is stable.
Coastal utilization characteristics	Beach utilization	A coast road was built and has been fully utilized as a community road. The importance of this coast seems high.
General assessment		Since the widely used road was built at a low altitude, countermeasures against overtopping waves are required. A protection program such as bank raising of road and construction of seawall (revetment) should be considered.

Basic investigation No.	No. 12 (Sediment Cell No.7)	PB No.	No.
Coast name	Pte. D'Esny		

Coast location

Coast photo Seawall in the eroded area

1

Coast photo Groins and rocky shore

2

Natural and topographic characteristics	Sea state	Overtopping waves are arriving from the south Alongshore current to the north caused by reef
	Topography	The width of reef at the north side is within a range of 0.5km to 2km, wide compared to the south side. Littoral drift sand to the north is predominant due to the topographic characteristics. The slope of beach berm is within a range of 1/8 to 1/10. The height of beach berm is around 2m. The grain size of sea bed material with 0.3 mm of medium diameter is fine relative to the other beaches.
Environmental characteristics	Coral reef	Coral reef coverage near the beach is around 1%. Coral reef coverage near the reef edge is around 70% and coral reef is relatively good.
	Water quality	Transparency is 10 to 15m, and siltation is little. Water quality is relatively good due to little pollution load from river, compared to Blue Bay
Coastal transformation characteristics	Disaster and structures	Several groins have been installed. There are damages on the seawall and groins. At a high tide time, overtopping waves caused damages in the cottage area. Some groins were removed (in 2008).
	Coastal transformation	Erosion due to alongshore sediment transport is observed. According to the results of the analysis through the aerial photograph, the sedimentation area at north side is 40cm/year (shoreline advance) and the erosion area at south side is 31cm/year (shoreline recession).
Coastal utilization characteristics	Beach utilization	The hinterland has been utilized as a cottage area for a long time. Besides, the beach is actively utilized as a bathing beach or mooring spot, for example.
General assessment		The convex shape causes alongshore current over the reef to the north as well as coastal transformation. Though a groin removal plan is under consideration, it is important to reach mutual agreement on the personal right of cottage owners and stability of the entire coast. Further study should be carried out and the coastal protection program should be devised because of difficult mechanism for sediment transport.

Basic investigation No.	No. 13 (Sediment Cell No.8)	PB No.	No.65-68.
Coast name	Riambel、Saint Felix, Riviere des Galets		

Coast location

Coast photo Partially damaged Riambel gabion

Coast photo Partially damaged seawall

Natural and topographic characteristics	Sea state	Located at the southernmost edge of the island and affected by monsoonal waves.
	Topography	Sand beach with a 400m-wide reef on the front, except for the river-mouth area, some of which is a gravel beach without reef
Environmental characteristics	Coral reef	As for the coral reef scattered near beach, coral reef coverage is 30% at St. Felix and 0% at Riambel. At Riambel seaweeds flourish.
	Water quality	At St.Felix, transparency is 5m and siltation is middle. At Riambel, transparency is 10m and siltation is little. At both coasts, seawater exchange with open sea is active due to the strong wave and wind and water quality is relatively good.
Coastal transformation characteristics	Disaster and structures	Riviere des Galets: The seawall has been often restored with gabions. (A 800m-wide seawall was built in 1995 with its 215m-wide part restored in 2003 and 104m-wide part restored in 2011)
	Coastal transformation	According to the results of topographic interpretation by aerial photos, an eroding velocity of up to 23cm/year was measured at partial shoreline. As a whole, no remarkable indication of erosion was found.
Coastal utilization characteristics	Beach utilization	Utilized as PB (public beach). The frequency of beach utilization is not high. There are a coast road and houses behind.
General assessment		Though gabions are damaged, the damage is limited to the expected degree. There is no important facility in the hinterland, and erosion degree is very small with an eroding velocity of 8cm/year. In light of these facts, the necessity of creating a protection program is considered low.

Basic investigation No.	No. 14 (Sediment Cell No.9)	PB No.	No.
Coast name	Bel Ombre		

Coast location

Coast photo

① 

Coast photo

② 

Natural and topographic characteristics	Sea state	Located on the south side of the island, and affected by waves from the south and southwest.
	Topography	Sand beach with around 500m-wide reef on the south side.
Environmental characteristics	Coral reef	Near beach, seaweeds flourish and coral reef coverage is 0%. Coral reef coverage behind reef edge is 20%. According to the results of coral reef monitoring by AFRC, coral reef coverage varies widely depending on year and does not show the distinct decline trend from 2000 to 2010.
	Water quality	Near beach, transparency is 5m and siltation is low. According to the results of water quality monitoring by this study, water quality parameters above the environmental standards (standards for type A1 sea areas) in Mauritius was observed and water quality is relatively good.
Coastal transformation characteristics	Disaster and structures	The seawall has been continuously constructed while groins, detached breakwaters (or similarly shaped structures) and pies are observed in some places.
	Coastal transformation	According to the results of topographic interpretation by aerial photos, coastal erosion with (14cm/year) has been observed at west side.
Coastal utilization characteristics	Beach utilization	Utilized for the hotel. The frequency of beach utilization is relatively high.
General assessment		Coral reef is on the verge of a crisis and still expanding erosion is observed. In front of hotel, the seawall and jetty have been constructed by the hotel. The broad-based protection program should be devised for this coast, because some structure has a potential to foster the coastal erosion and the projection of hotel facility might be implemented.

Basic investigation No.	No. 15	PB No.	No.
Coast name	Baie du Cap		

Coast location

Coast photo

1

Coast photo

Natural and topographic characteristics	Sea state	Low-altitude beach located on the south side of the island, and affected by waves from the south and southwest
	Topography	A narrow sand beach with reef at the front south side, of which width is unknown because of unclear edges
Environmental characteristics	Coral reef	Coral reef coverage near beach is 30 to 50%and coral reef is relatively good.
	Water quality	Transparency near beach is 10 to 15m and siltation is low. Though three rivers including Baie du Cup River inflow, water quality is relatively good due to small river flow.
Coastal transformation characteristics	Disaster and structures	Though a seawall was constructed, it is small and no damage has been observed. However, the partial beach has a problem with inundation in the coastal lower area due to insufficient drainage.
	Coastal transformation	According to the aerial photograph and the result of field work, though slight erosion was observed on the Village coast road, no erosion was observed as a whole.
Coastal utilization characteristics	Beach utilization	Utilized as PB (public beach) and for a coast road, but the frequency of beach utilization is not high.
General assessment		As for this beach, the good conditions keep into place. As a whole, the necessity of devising a protection program is considered low because significant erosion has not been observed and important facility at hinterland is little.

Basic investigation No.	No. 16 (Sediment Cell No.10)	PB No.	No.
Coast name	Le Morne		

Coast location

Coast photo Erosion near the groin for the hotel

1

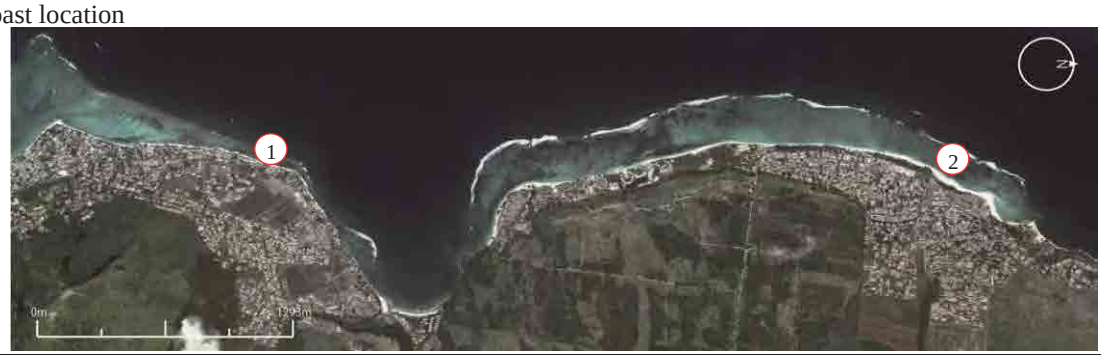
Coast photo Scarp of the public beach

2

Natural and topographic characteristics	Sea state	Located at the edge of the southwest and affected by waves from the southwest
	Topography	Sand beach with around 650 to 900m-wide reef on the front Convex sand beach. The slope of beach berm is around 1/8. The medium diameter of sea bed material within coral reef is around 0.6 mm and that near the coral reef edge is coarse slightly. .
Environmental characteristics	Coral reef	Behind reef edge, coral reef coverage is 0% and algal coverage is 20%. According to the results of coral reef monitoring at Ile aux Benitiers by AFRC, it gathers that coral reef coverage near reef edge is on a declining trend from 2000 to 2010.
	Water quality	Transparency is 15m and siltation is little. Seawater exchange with open sea is active due to the strong wave and wind and water quality is relatively good.
Coastal transformation characteristics	Disaster and structures	Damaged by Cyclone Caro (in 1960) Even now, scarps are observed. .
	Coastal transformation	According to the results of topographic interpretation by aerial photos, a lot of places are on a sedimentation trend and this beach is regarded as stable. At the north side of a groin near Paradis Hotel, coastal erosion with erosion rate of 25 cm/year occurs. Further, the results of the field work show scarps are observed in PB and Le Morne Village.
Coastal utilization characteristics	Beach utilization	Utilized as PB (public beach), where the hotel and guest house are available. Also this coast is famous for kite surfing and a good coast road is provided.
General assessment		As a whole, though this beach is on a stable trend, erosion occurs in some place due to the construction of training wall. The protection program by the non-physical measures including maintenance management plan should be considered. Further special attention should be considered because of active utilization of the beach as well as the hinterland.

Basic investigation No.	No. 17 (Sediment Cell No.11)	PB No.	No.
Coast name	Preneuse、Tamarin, Flic en Flac		

Coast location



Coast photo Condition of Preneuse seawall

① 

Coast photo Utilization of Flic en Flac beach

② 

Natural and topographic characteristics	Sea state	Located at the west side of the island and affected by waves from the west as well as cyclones
	Topography	Convex sand beach with around 500m-wide reef on the front. The slope of beach berm is within a range of 1/8 to 1/10 and the grain size of sea bed material with 0.3 mm of medium diameter is fine relative to the other beaches.
Environmental characteristics	Coral reef	Coral reef coverage ranges from 1 to 30%. The coverage tends to become lower near the river-mouth (Black River, Grand River Noire).
	Water quality	Transparency is 2.5 to 8m. Siltation is high at Preneuse and low at Tamarin and Flic en Flac. According to the results of water quality monitoring by AFRC, water quality at Tamarin and Flic en Flac is relatively good. Meanwhile, water quality at Preneuse is affected by Black River and is polluted.
Coastal transformation characteristics	Disaster and structures	Gabions (in 1995, a total length of 700m), groins (in 1995, 10 units), removal of the seawall (in 2007), implementation of sand bypass (in 2008), and removal of the gabions (in 2008)
	Coastal transformation	According to the results of topographic interpretation by aerial photos, the south side of the Pearle Beach is stable. But the north side is erosion area with erosion rate of 12cm/year and scarps are observed in Manisa PB. In the area extending from Manisa to Villas Caroline, sand spit at the north end is on a sedimentation trend with a rate of 48 cm//year is. It seems that scarps easily occur on this coast. In the case of the cyclone in January 2013, a scarp of around 1.5m occurred.
Coastal utilization characteristics	Beach utilization	Utilized as PB (public beach) as well as hotel's private beach. Most of the hinterland is a tourist spot where restaurants and shops are located. At its inland side, there are houses.
General assessment		This coast is one of the most popular tourist spots on the island, and both beach and hinterland are intensively utilized. Countermeasures against scarps are important because of the troubles in utilization and safety. In light of these facts, a protection program should be considered for this coast.

Basic investigation No.	No. 18 (Sediment Cell No.12)	PB No.	No.
Coast name	Albion		

Coast location

Coast photo Albion sand beach

1

Coast photo Albion sand beach

2

Natural and topographic characteristics	Sea state	Located at the west side of the island, and affected by waves from the west as well as cyclones
	Topography	Pocket beach with around 400m-wide reef on the front. Reef width is narrow compared with Le Morne, Flic en Flac and Pointe D' Esny. The medium diameters is around 1 mm and coarse relative to the other beaches
Environmental characteristics	Coral reef	Coral reef coverage ranges from 2 to 33%, and it tends to become lower near the coast line. According to the results of coral reef monitoring by AFRC, coral reef coverage around the reef edge from 2000 to 2010 has been decline from 60% to 0%.
	Water quality	Transparency is 3m, and siltation is low. Thought water quality has been relatively good, PO4-P and fecal coliform bacteria above the environmental standards in Mauritius is detected, and water pollution is advancing. This coast is subject to coral bleaching because of the increased water temperature in the lagoon which is very shallow.
Coastal transformation characteristics	Disaster and structures	Small retaining walls and fences have been installed, but some of which were damaged by scarps.
	Coastal transformation	As a whole, this coast is an eroded area with a rate of 31 to 49cm/year. Though PB (public beach) is stable, erosion at the front side of AFRC and scarps (1 to 2m) were observed between 2007 and 2008.
Coastal utilization characteristics	Beach utilization	Utilized as PB (public beach), where Albion Laboratory (AFRC) is located. A hotel was built at the south end (in 2008).
General assessment		Since this coast is an eroded area as a whole, there is a fear that coral reef will be deteriorated. In light of the existence of scarps on the front of the laboratory and damaged fences, a protection program should be devised.

Basic investigation No.	No. 19	PB No.	No.
Coast name	Albion(Cliff)		

Coast location

Coast photo

① 

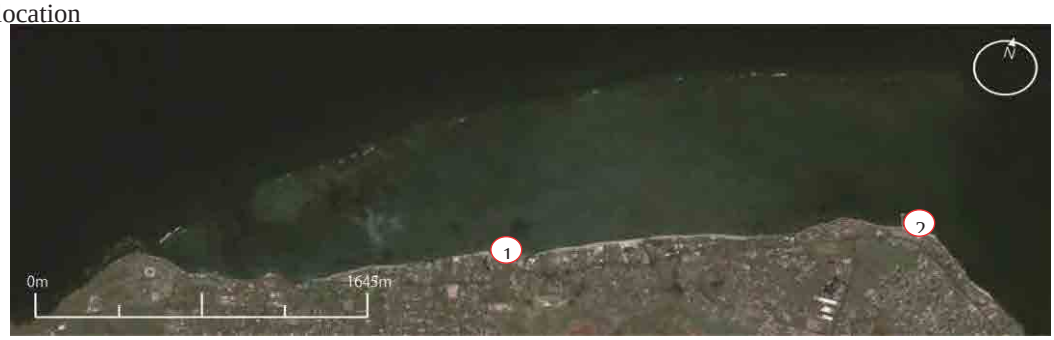
Coast photo Condition of the cliff coast

② 

Natural and topographic characteristics	Sea state	Located at the west side of the island, and affected by waves from the west as well as cyclones
	Topography	A coast consisting of rocky shore and beach rocks There are sand beaches, but a few, at the north side.
Environmental characteristics	Coral reef	It is assumed that the coral reef is in a relatively good condition, but the actual condition has not been investigated.
	Water quality	Coral reef is inexistent offshore. Coastal water is affected strongly by open sea, and water quality is relatively good.
Coastal transformation characteristics	Disaster and structures	Unknown
	Coastal transformation	This coast consists of rocky shore and beach rocks, without any remarkable transformation observed. Slope failure occurs partially.
Coastal utilization characteristics	Beach utilization	Currently not utilized because this is a cliff coast.
General assessment		This coast is one of typical coast as cliff coast in Mauritius. Since a coal-fired plant will be designed at hinterland, it will be important to establish the setback line taking into account long-term erosion of cliff.

Basic investigation No.	No. 20 (Sediment Cell No.13)	PB No.	No.
Coast name	Pte aux Sables		

Coast location



Coast photo Erosion condition at the west side

①

Coast photo Sedimentation condition at the east side

②

Natural and topographic characteristics	Sea state	Located at the west side of the island Slightly facing to the north, and affected by cyclones
	Topography	Sand beach with rocky shore in some places Around 800m-wide reef at the north side
Environmental characteristics	Coral reef	Coral reef coverage is 7% around fore reef and 1% within reef. According to the results of coral reef monitoring by AFRC, coral reef coverage around the reef edge from 2000 to 2010 has been decline from 60% to 0%.
	Water quality	Transparency is 3m, and siltation is high. Water quality is affected by Grand North West River. According to the results of water quality monitoring by this study, turbidity and chlorophyll a are very high and water pollution is advancing due to domestic pollution load.
Coastal transformation characteristics	Disaster and structures	A masonry seawall was installed (in 2010, 241m). The seawall normal at the front side of the leased premises is irregular.
	Coastal transformation	Remarkable alongshore sediment transport is observed at the east side. A sand beach width is narrow at the west side and wide at the east side. According to the results of topographic interpretation by aerial photos, sedimentation with a rate of up to 62cm/year is observed at the east side. At the west side, alongshore sediment transport has caused erosion with a velocity of 32cm/year.
Coastal utilization characteristics	Beach utilization	Utilized as a beach, where some pleasure boats are found.
General assessment		The downstream side of the seawall constructed by Mauritian government is on an erosion trend. It is necessary to formulate a protection program taking into account the impact of upstream side at the seawall and the impact of itself. As for the formulation of protection program, the priority for urgency and necessity is high due to land outflow and expanding of erosion area at downstream side. Coral reef and water quality are on a declining trend.

Source: Coast location maps were processed by JICA Study Team based on Google maps

3. Survey Results of Beach Management Issues for Target 14 Coasts

3 Survey Results of Beach Management Issues for Priority 14 Coasts

3.1 Baie du Tombeau

This beach is located in the north side of port in Port Louise and a lot of fishing boats are drawn and moored at the south end of this beach. Houses stand together in large number behind the beach. The beach shows a tendency of remarkable accumulation at the south end of this beach, erosion at the center of this beach that foreshore does not exist and revetments were constructed in front of houses as countermeasure of beach erosion. A small island exists in the lagoon at the south area of this beach and the area of this island has been increasing to approximately 2.5 times in the past decade. It seems that the beach was formed at accumulated area by effect of tombolo behind a sandy island due to rapid growth of island and eroded area was formed on the north side of accumulated area. It is thought that the balance of the beach has been changing due to growth of the island. The transition of an island based on aerial and satellite photographs since 2003 is shown as follows.

Year 2003 : 10,024 m^2

Year 2006 : 12,594 m^2

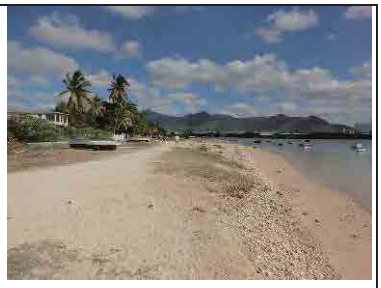
Year 2008 : 22,814 m^2

Year 2011 : 26,141 m^2

Source: JICA Study Team

Source: JICA Study Team

Figure 3.1.1 Transition of an island on the lagoon

		
Fishing boats and an island at the south of the beach	Disappearance of sandy beach in the center part of the beach.	Accumulated area at the south of the beach

Source: JICA Study Team

According to Volume 1 Section 5.3.2_C, three area such as erosion area, potential risk area of erosion and accumulation area are set up and classified considering beach erosion rate in past. Figure 3.1.2 shows regulation map of land use for this beach. Erosion and accumulation area are intermixed in this beach. This beach consists of potential risk area (-0.06 m/y - +0.01 m/y at Sub-cell- 2 and Sub-cell-3) and accumulation area at other areas. The accumulation is remarkable at Suc-cell-4 of south part of the beach. It is necessary to carry out continuous monitoring and to understand tendency of erosion at potential risk area. In addition, it is necessary to carry out periodic monitoring at the whole area of the beach because there is some possibility of reuse of sand from Sub-cell-4 at accumulated area to eroded area.

Source: JICA Study Team

Figure 3.1.2 Regulation map of land-use (Plan) (Baie du Tombeau)

3.2 Pte. aux Cannoniers

The present issues and point of concern on beach management at this beach is summarized as follows.

1	Characteristics of Beach Space	As houses and leisure homes built on the leased land stand side by side behind the beach, the public beach is limited in the east end of this beach. Some pleasure boats are moored in the reef and on the beach. Beach users of the public beach are very limited because sandy beach does not exist at some places due to presence of vertical impermeable walls .The width of this beach vary up to 70 m only. At this beach, there is a tendency toward coarse sand and steep slope on the west side whereas toward fine sand and gentle slope on the east side. Beach users are very limited because most properties behind the beach are leased to the individual sand public access from the road to the beach is limited to non existent.
2	Present Issues	1) A lot of driftage is left on the beach in front of most of the leased properties. 2) Two private slipways to draw leisure boats up were built on the beach. 3) Sandy beach does not exist in front of the impermeable masonry vertical revetment and sand deposits on either side of the revetment. It seems that sand has not accumulated in front of the revetment due to occurrence of the reflective waves. 4) A part of land projects into the beach and it is reinforced by vertical seawall. Bench and sunshades were put on the land. 5) Refer to pictures below
3	Points of Concern for Countermeasures	1) Leaving of driftage is undesirable from a standpoint of landscaping and sanitation. It is proposed that driftage should be backfilled in the sand of foreshore considering the ecological system for the marine organism. The periodic collection and disposal is also recommended. 2) It seems that reflected waves are amplified by concrete structures with base on the beach and these waves have an impact on blocking the trapping of

		sand and expanding erosion area. Therefore, demolition of the structure is required through discussion with proprietary. 3) It seems that reflected waves are amplified by vertical revetment and these waves have caused erosion in and around the revetment. To reduce the reflective waves, setback or review of the structure type is required in consideration of utilization and landscaping. Or alternatively, the structures should be redesigned into sloping, permeable structures with provision of public passage along the shore. 4) The projection of land on the beach will obstruct continuity of sediment transport. It is necessary to resolve unbalance of shoreline position by modification of revetment type to moderate slope and/or set back from mid and long term viewpoint through coordination with lessee.

Scarp and driftage on the west side of the beach

Lot of driftage on the beach

Slipway for private leisure boat on the beach(1)

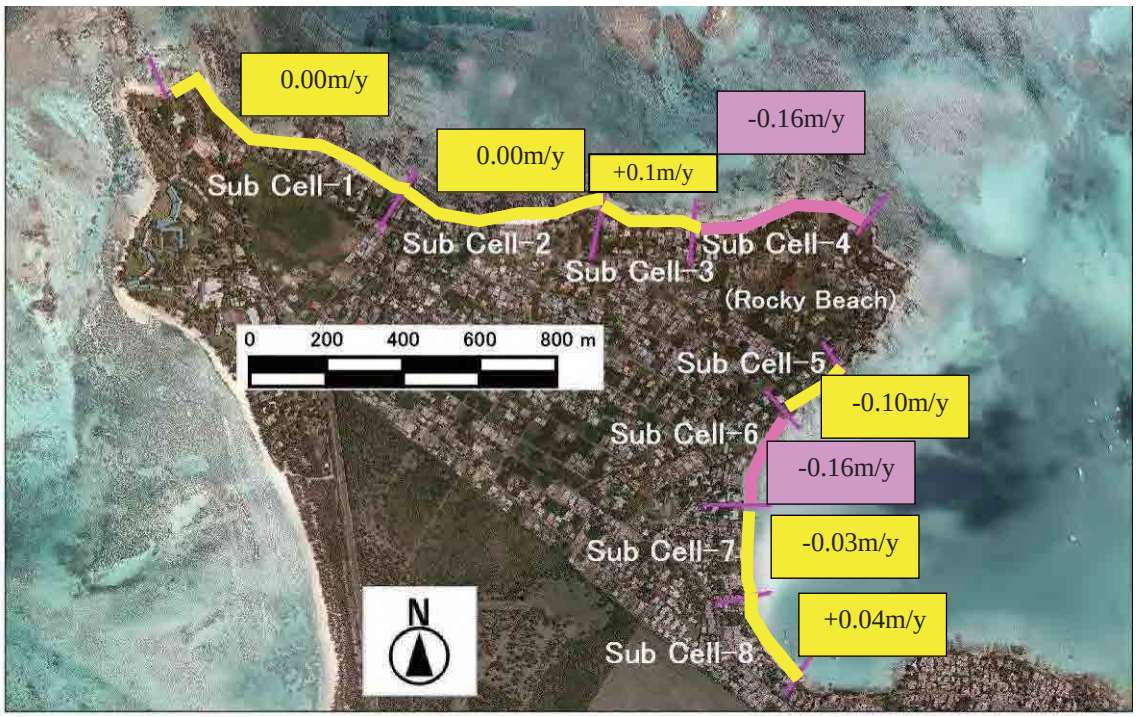
No sandy beach in front of the vertical revetment due to the reflected waves

Slipway for private leisure boat on the beach(2)

Projection of land on the beach

Source: JICA Study Team

According to Volume 1 Section 5.3.2_C, three area such as erosion area, potential risk area of erosion and accumulation area are set up and classified considering beach erosion rate in past. Figure 3.2.1 shows regulation map of land use for this beach. This beach consists of potential risk area (between -0.10 and +0.10m/y on north and east side) and erosion area (-0.16m/y on east side). It is necessary to carry out continuous monitoring and to understand tendency of erosion at potential risk area and to implement short-term, and mid- and long- term beach conservation measures at erosion area.



Source: JICA Study Team

Figure 3.2.1 Regulation map of land-use (Plan)(Pte. aux Cannoniers）

3.3 Mon Choisy (Priority beach)

The present issues and point of concern on beach management at this beach is summarized as follows.

1	Characteristics of Beach Space	Some hotels exist on the north side of this beach and properties behind hotels including beach are leased to hotels. A large part of this beach is public beach and coast forest and park exist behind this beach. The public beach is always crowded with families and tourists not only weekend but also weekday because this is typical public beach in the northwest of Mauritius. Public beach that has sandy beach, coast forest, toilet, shower, etc is kept in clean condition since Beach Authority cleans up every day.
2	Present Issues	1) High trees (especially, Casuarina) were planted in foreshore and backshore of public beach. These trees are not appropriate within the dynamic beach zone as it does not favor sand accumulation, thereby resulting in beach erosion causing scarp formation. 2) The beach nourishment was conducted on the south of this beach in 2012. However, uses of this area is much less than in other areas because slope is steep as shown in the following photo. 3) Many cars and motorcycles were parked on backshore of public beach because they can come and go freely in coast forest. This activity has influences on environment and utilization in terms of impacts on trees and sea animals, car exhaust, reduction of utilization space and accidents to the beach users. (Car parking issue is improved because car barriers were installed behind beach during this study. But motorcycles are still parked on backshore.) In addition vehicles cause compaction of sand. During heavy rainfall, the water is not absorbed by the compacted sand resulting in overflows which creates gullies and erosion of the softer part of the beach by action of storm water. 4) Beach cleaning is carried out by the Beach Authority in public beach every day. On the other hand, lots of garbage and driftage are left on the beach in

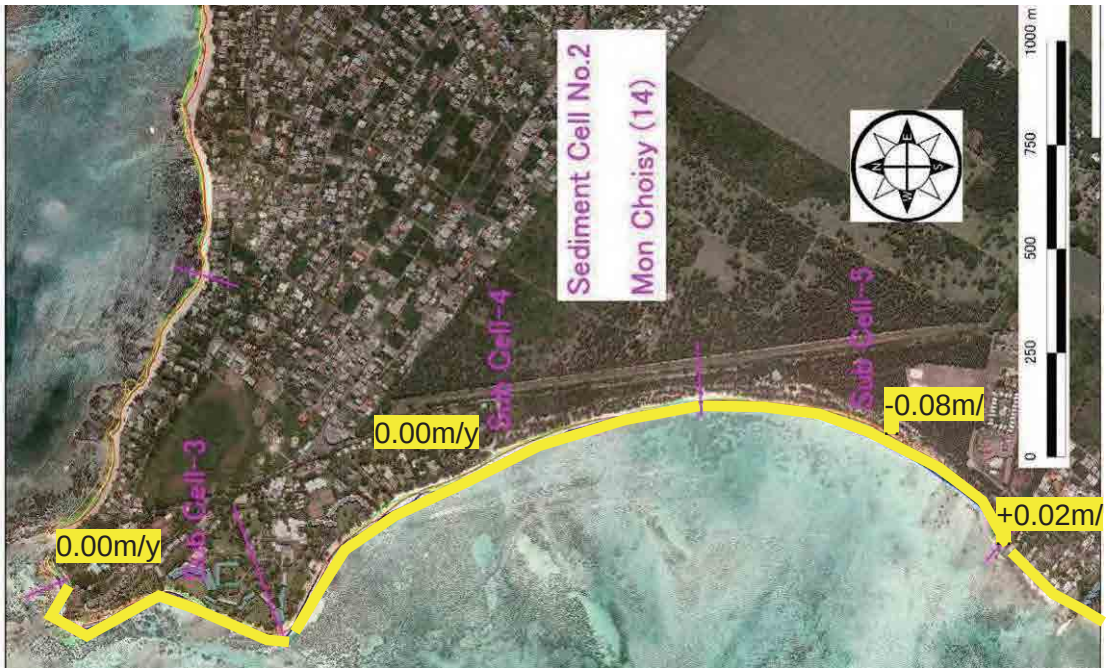
		front of some leased sites. These garbage and driftage cause sanitary and landscape issues. 5) Sand beach does not exist in front of vertical impermeable revetment at Club Med on the northern end of this beach. The area of down-drift of the revetment also has no sand. It is necessary to confirm and analyze past records of shifting of revetment to offshore side and possibility of the cause of erosion due to the revetment. Vertical impermeable revetments cause an increase in wave reflection thereby entraining sand located at the foot of the structure. In the long run, the sand found at the structure move offshore and erosion occurs. The vertical structures do not favor sand accumulation.
3	Points of Concern for Countermeasures	1) High trees should not be planted within the dynamic beach zone. It is necessary to plant high trees in stable zone behind beach considering wave run-up and natural vegetation condition. 2) The original foreshore slope of this beach is 1 to 6 or 7. It is necessary to adjust and form the slope of beach nourishment to the original slope as same as possible. In order to make effective use of this beach, nourished area with steep slope should be formed to gentle slope as early as possible. In addition, beach monitoring such as profiling survey should continuously be carried out until it becomes stable condition. 3) Public beach of St. Felix in the south of Mauritius has parking area behind the coast forest and driving into the beach and coast forest is prohibited. It is recommended that the parking space should be prepared in the whole Mauritius in a phased manner considering various impacts. 4) At Mon Choisy the Beach Authority has already created parking areas for cars. It is recommended that BA proceed with the closure of the public space for all vehicles including motorcycles . 5) At the foreshore in front of hotels in the south of Le Morne, driftage is backfilled in the sand by some janitors every morning. The beach is kept in a good condition. Backfilled driftage has a positive impact on conservation of ecosystems, especially on various organisms and sea animals because it becomes feeds for them. It is recommended that this activity should be applied to the other beaches in front of the leased properties such as hotels, leisure homes, houses, etc. and also at public beaches in order to keep good landscape and clean condition continuously. 6) The erosion has been occurring due to reduction of sand supply (volume) by shifting of revetment offshore and construction of groin because longshore sediment transport is continuing along the beach. In this area, it seems that reflected waves are enlarged by mortal masonry vertical revetment and these waves have an impact on blocking of trapping sand and expanding erosion area. Therefore, setback or review of structure type is required.

		
High trees were planted at foreshore and backshore.	Stairs are put at area of scarp	Nourished beach area on the south of the beach has posed a problem for beach utilization due to steep slope

		
Many motor cycle are parked at backshore. Car not exist at backshore after installed parking space behind beach during this study.	Driftage in front of the leased sites on the north of the beach	No sandy beach in front of Club Med due to existence of vertical revetment

Source: JICA Study Team

According to Volume 1 Section 5.3.2_C, three area such as erosion area, potential risk area of erosion and accumulation area are set up and classified considering beach erosion rate in past. Figure 3.3.1 shows regulation map of land use for this beach. This beach belong to potential risk area because erosion speed is between -0.08 and +0.02m/year at whole area. It is necessary to carry out continuous monitoring and to understand a mid-and long-term tendency of erosion. The review of setback line is also required at leased areas during a renewal of contract.



Source: JICA Study Team

Figure 3.3.1 Regulation map of land-use (Plan)(Mon Choisy)

3.4 Bras D'Eau

This beach is located in the Bras D' Eau national park and residences and hotels do not exist behind the public beach. A lot of local people come to this beach on the weekends but very few people use this beach on weekdays. There is a public toilet and car barrier as beach facility in the public beach. However, cars are parked on the coastal planting area because the parking area is unpaved. Hotel and leased empty land exist on the north side of public beach. The concrete revetment and a jetty are located in front of the hotel and the masonry upright

seawall is located in front of the leased land. It seems that northern sediment transport around the hotel predominates north because sand accumulates on the south side of the jetty according to visual checking of left-and-right sedimentation condition of the jetty. On the other hand, the public beach shows a tendency of accumulation on the south side of it on a long-term basis and tombolo was formed behind a small island on the lagoon. In the center area of the public beach shows a tendency of erosion because forming of scarps and fallen mangrove trees were found. Therefore, it seems that southern sediment transport is predominant due to the effect of a small island and shallow bottom on the lagoon. The mangrove area in and around a small island has been increasing by little and little. Sea algae and grass in large quantity drift onto the beach because they grow extensively offshore. Sometimes about 4tons of sea algae and grass drift onto the beach, but they are cleaned by Beach Authority every day.

It should be noted here that much sand clung to sea algae and grass is carried to the disposal site. It seems that once-daily cleaning activity will not affect beach erosion. However, it is necessary to consider impact on beach erosion by daily activity because sand supply sediment transport is very limited at this beach.


Sea algae an grass in large quantity on the beach


Sand clung to sea algae and grass


Accumulated sand on loading platform of the truck


Scarp at public beach


Fallen mangrove trees due to beach erosion


Toilet facility in public area


Stone masonry-type seawall in front of leased area


Revetment in Hotel property


Jetty in Hotel property

Source: JICA Study Team

According to Volume 1 Section 5.3.2_C, three area such as erosion area, potential risk area of erosion and accumulation area are set up and classified considering beach erosion rate in past. Figure 3.4.1 shows regulation map of land use for this beach. Erosion and accumulation area are intermixed in this beach. This beach consists of potential risk area (+0.01 m/y at Sub-cell-1) and erosion area (-0.20 and -0.28 m/y at Sub-cell-3 and 4). It is necessary to carry out

continuous monitoring and to understand tendency of erosion at potential risk area and to implement short-term, and mid- and long- term beach conservation measures at erosion area. In addition, it is necessary to carry out periodic monitoring at the whole area of the beach because there is some possibility of reuse of sand from Sub-cell-5 at accumulated area to eroded area.

Source: JICA Study Team

Figure 3.4.1 Regulation map of land-use (Plan) (Bras d'Eau)

3.5 T. d'Eau Douce

The present issues and point of concern on beach management at this beach are summarized as follows.

1	Characteristics of Beach Space	Houses and leisure homes built on the leased properties stand side by side behind the beach. Hotels exist on the east of the beach. There are two public beaches on the west end and east end of the beach. Some pleasure boats are moored at the reef and beach. There is a tendency for sand to accumulate in these public beaches. These beaches are kept in good condition and a lot of inhabitants and tourists are using this beaches. Many groins are constructed on the boundary of the leased properties of houses, leisure homes and hotels which nestle between the public beaches. The shoreline is uneven because of these groins.
2	Present Issues	1) The slipways to draw a boat ashore were constructed on the beach. They have little impact on littoral drift but the small difference in level was formed on the both sides of the slipways. 2) Many garbage and driftage are deposited at some leased properties and on public beaches . It is assumed that this occurs in front of the leisure homes which the owners are not living at all times.

		3) Many groins made by gabions and sandbags are constructed at the erosion area. Erosion is ongoing at the down-drift of this area. It is assumed that groins have been constructed from the up-drift to the down-drift in turn judging from the situation of erosion and accumulation. These groins are blots on the landscape of the coral reef. 4) Sandy beach does not exist in front of the vertical revetment. There is a tendency for sand to accumulate at both ends of the revetment. 5) Absence of grasses and vegetation cover at the public beaches 6) Vehicular access up to HWM 7) Corals and algae are being collected and disposed away.
3	Points of Concern for Countermeasures	1) There is concern that that reflected waves are amplified by concrete structures with base on the beach and amplified waves block trapping of sand and expand erosion area. Therefore, demolition of the structure is required through discussion with proprietary or in case infrastructure is at risk and setback is not possible then to consider modification of existing structure into sloping and permeable structures with public passage 2) It is difficult to do the cleaning every day at the leased properties of the leisure home areas. In order to solve this issue, it is necessary to study to establish a new beach cleaning system or to modify the existing system to keep clean condition at the whole area. It is also necessary to consider to impose a condition in the lease agreement that the lessee shall keep the beach clean of plastics and other solid wastes and have the local authorities or the MoHL to monitor or even have the enforcement done by police des terres . 3) The algae and corals should be collected and buried in the sand, in priority at places where there are escarpments and gullies. 4) The beach condition is different by location because the coastal protection facilities such as groins have been constructed based on the judgment of the leaseholders and EIA conducted separately. It is necessary to conduct EIA with due consideration for large-scale impact on longshore sediment transport area if there are some plans to construct the coastal protection facilities on the coastal area. Sufficient and careful EIA is required for construction of some coastal facilities. 5) It seems that reflected waves are amplified by the vertical revetment and these amplified waves have caused erosion in and around the revetment. To reduce the reflective waves, setback or review of structure type is required in consideration of utilization and landscaping. 6) To create parking areas to restrict vehicular access on the public space 7) To plant grasses and shrubs to protect the beach

The sand spit at the west end of this beach. The sand accumulates on the west of sand spit and the shallow area exists.

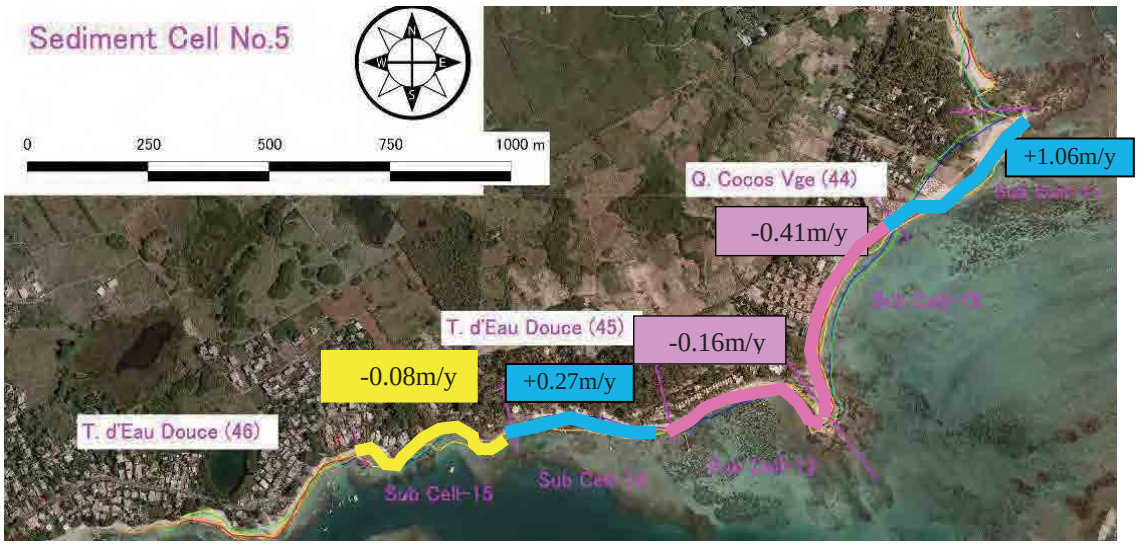
Slipway on the beach. It is used for drawing a boat ashore.

Large volume of sea grass and rubbish accumulate on the beach. Cleaning may not be done for a long time.

 Groin that constructed on the boundary between leased properties. Shape and elevation are uneven on the sides of groin.	 Same as the left	 Same as the left
 No sandy beach in front of the revetment with steep slope.	 Same as the left	 Garbage and seaweed accumulate on the beach in front of the leisure homes. It seems that periodic beach cleaning has not been carried out.

Source: JICA Study Team

According to Volume 1 Section 5.3.2_C, three area such as erosion area, potential risk area of erosion and accumulation area are set up and classified considering beach erosion rate in past. Figure 3.5.1 shows regulation map of land use for this beach. This beach consists of potential risk area (-0.08 m/y on the west side) and erosion area (between -0.16 and -0.41 m/y on the east side) It is necessary to carry out continuous monitoring and to understand tendency of erosion at potential risk, area and to implement the short-term and mid-and-long term beach conservation measures at erosion area.



Source: JICA Study Team

Figure 3.5.1 Regulation map of land-use (Plan) (T. d'Eau Douce)

3.6 Ile aux Cerfs (Priority Beach)

The present issues and point of concern on beach management at this beach is summarized as follows.

1	Characteristics of Beach Space	Hotels have leased two islands (Il aux Cerfs on the north and Ilot Mangenie on the south) for a long term. These islands have been used for various marine sports and golf for tourists. These islands have very beautiful sandy beach, clear seawater and coral reef and this beach is a typical beach with aesthetic landscape in Mauritius.
2	Present Issues	1) Small scarps are formed in some places of the erosion area. 2) The sand recycle which moves accumulated sand to the erosion areas has been carried out at channel between islands. But monitoring is insufficient after sand recycle. In addition, there is a possibility that setting of shape of beach nourishment and management of beach nourishment are insufficient.
3	Points of Concern for Countermeasures	1) It is important to keep in good beach condition by controlling sand between the erosion area and accumulation area because these areas are nearby. 2) It is necessary to adjust and form the slope of beach nourishment and to make the slope as close as possible to the original slope. In order to use this beach effectively, nourished area with steep slope should be formed to gentle shape as early as possible. In addition, beach monitoring such as profiling survey should continuously be carried out until the slope becomes stable condition.

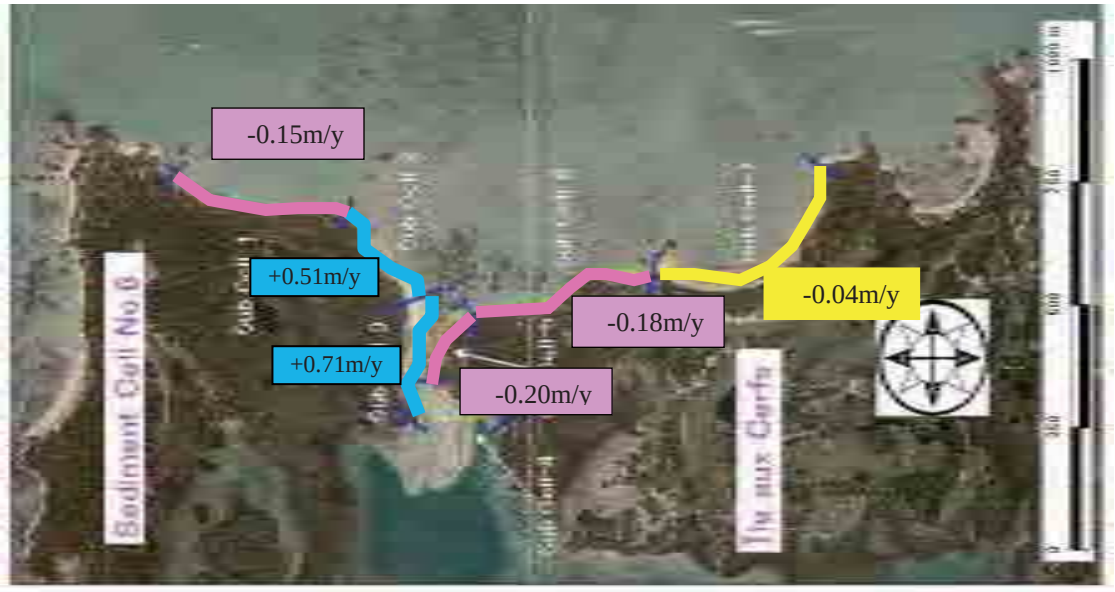
Sandbagged groin that installed at the erosion area on the north of Ile aux Cerf

Scarp that formed around a borderline between the erosion and accumulation area

Scarp that formed at the erosion area in IlotMangenie

Source: JICA Study Team

According to Volume 1 Section 5.3.2_C, three area such as erosion area, potential risk area of erosion and accumulation area are set up and classified considering beach erosion rate in past. Figure 3.6.1 shows regulation map of land use for this beach. This beach consists of potential risk area (-0.04 m/y on the south side) and erosion area (between -0.15 and -0.20 m/y on the south side of channel) It is necessary to carry out continuous monitoring and to understand tendency of erosion at potential risk, area and to implement short, mid and long term beach conservation measures at erosion area.



Source: JICA Study Team

Figure 3.6.1 Regulation map of land-use (Plan)（Ile aux Cerfs）

3.7 Pte. d'Esny (Priority Beach)

The present issues and point of concern on beach management at this beach are summarized as follows.

1	Characteristics of Beach Space	Houses and leisure homes built on the leased properties stand side by side behind the beach of Pte. D'Esny. There is no public beach and hotels exist on the south end of the beach. Some pleasure boats are moored at the reef and beach. On the other hand, most of Blue Bay is public beach and this beach is always crowded with families and tourists not only on the weekends but also on weekdays because this beach is a typical public beach in the south east of Mauritius. Public beach that has sandy beach, coast forest, bench, Kiosk, camping space, toilet, parking space, etc. is kept in a clean condition. Driving into coastal forest and beach is not permitted. In front of the leased sites there are presence of vertical wall at the HWM and groins interspaced along the shore. Some areas where there is no wall or groins show accumulation tendency.
2	Current Issues	1) Unplanted coastal sand grass was removed by the leaseholders with their own decisions at some places in the sedimentation area on the north of Pte. D'Esny. Coastal sand grass keeps coastal ecosystem and also controls erosion and blown sand by reduction of external forces such as the waves and winds. In addition, the grass is very effective for relieving temperature rise of sand itself. As a result, in addition to protection for the beach from erosion and promoting dune construction , the grass makes a contribution to providing amenity recreational space. 2) A lot of groins were constructed at every house, leisure home and hotel property individually based on the judgment of leaseholders and EIA. As a result, there are some cases such as retreat of shoreline and complete disappearance of sandy beach due to ongoing erosion after construction of groins. In addition, accumulation of sand on one side and erosion on the other groin has also caused a deterioration in the relation between neighbors . 3) Sandy beach does not exist in front of the impermeable masonry vertical revetment and sand deposits on either side of the revetment. It seems that

		sand has not accumulated in front of the revetment due to occurrence of the reflective waves. 4) The impermeable masonry vertical revetment was reconstructed in front of a new hotel under construction. A new wall was erected on the existing wall base. Although the building has the required setback of 30 m, the retaining wall is at 10 m . 5) High trees (especially, Casuarina) were planted in the foreshore and backshore in the public beach. These trees cause scarp forming combined with erosion. 6) The removal of the existing revetments and beach nourishment work were carried out to improve coastal environment on the south east of Blue Bay in 2012. But the number of people who can use this area is less compared to stable areas because slope of the beach is steep(1:1.7 to 1:3.8, 1: 2.6 in average) as compared with planning shape (1:6).
3	Points of Concern for Countermeasures	1) Coast sand grass has various effects as mentioned above, so it is necessary to facilitate the conservation of it and make leaseholders understand the effects. A condition may be added to the lease agreement or else a policy be developed not to removed grasses on beaches. The policy would be more easy to apply and enforce. 2) The beach condition is different by location because the coastal protection facilities such as groins have been constructed based on the judgment of the leaseholders and EIA. It is necessary to conduct EIA considering large-scale impact on longshore sediment transport area if there are some plans to construct the coastal protection facilities at the coastal area. Sufficient and careful EIA are required for construction of some coastal facilities. 3) It seems that reflected waves are amplified by the vertical revetment and these amplified waves have increased erosion in and around the revetment. To reduce reflective waves, setback or review of structure type of the revetment is required in consideration of utilization and landscaping. 4) EIA for construction plan at coastal area is carried out by MoESD and a building permit after EIA is granted by District Council. After granting building permit, it is necessary to impose restrictions on construction of permanent structure in setback area by enforcing joint survey and inspection both in the middle of construction and after completion of construction. 5) High trees should not be planted in the unstable zone of foreshore and in the semi-unstable zone of backshore (Dynamic beach zone). It is necessary to plant high trees in the stable zone behind the beach considering wave run-up and natural vegetation condition. 6) The similar cases of foreshore slope issues are seen at the other beaches. It is necessary to improve construction management and government institutes which are related to beach management should acquire skill of beach monitoring such as beach profiling survey. It is also necessary to carry out periodic beach monitoring in order to grasp shoreline change after nourishment and timing of maintenance. These activities and data will be helpful for beach nourishment in Mauritius in future.

Removal of unplanted coastal sand grass on the north of the beach

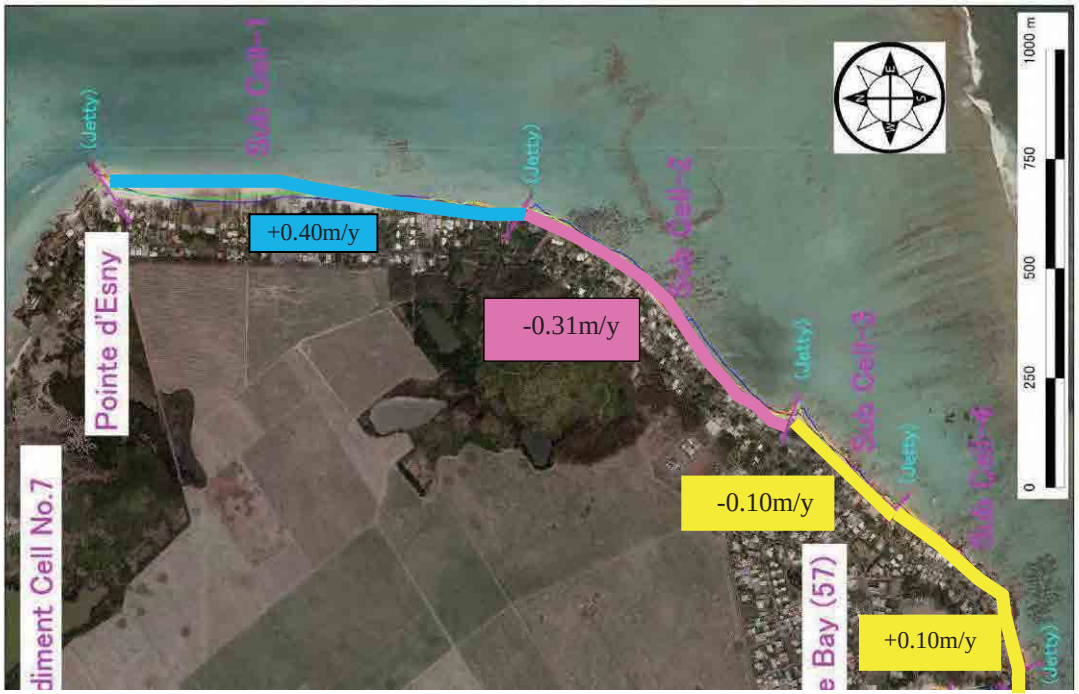
Disappearance of sandy beach due to construction and modification of groin on the up-drift side (① point)

A groin located at the up-drift of left photo. The condition of beach on the down-drift of groin has been worsening

		because of modification of groin according to information from inhabitant.
 Vertical revetment at the erosion area	 The revetment in front of hotel under construction of is installed. The distance between the revetment and HWM is about 10 m.	 Same as the left
 Difference of erosion area and accumulation area on the sides of groin. Excess beach width has been formed on the right side of groin.	 High trees were planted at foreshore and backshore.	 Revetment was removed and sand of 520 m^3 was filled in this area in 2012.(South-east of Blue Bay)

(Source : JICA Study team)

According to Volume 1 Section 5.3.2_C, three area such as erosion area, potential risk area of erosion and accumulation area are set up and classified considering beach erosion rate in past. Figure 3.7.1 shows regulation map of land use for this beach. The beach shows tendency of accumulation on the north side and erosion on the south side. The beach consists of potential risk area (-0.10 and +0.10 m/y) on the south side and erosion area (-0.31 m/s) at the center part. It is necessary to carry out continuous monitoring and to understand tendency of erosion at potential risk area and to implement the short-term and mid-and- long term conservation measures at erosion area. In addition, it is important to carry out periodic monitoring at the whole area considering reuse of sand of the accumulation area.



(Source : JICA Study team)

Figure 3.7.1 Regulation map of land-use (Plan) (Pte. d'Esny)

3.8 Bel Ombre (Priority Beach)

The present issues and point of concern on beach management at this beach are summarized as follows.

1	Characteristics of Beach Space	Some large hotels exist on the east and the west end of this beach and coastal forest nestling among hotels is infrequently-used. Various marine sports are done in the reef actively in the area of the hotels. Restaurants, swimming pools, parasols, etc. are located close to the shoreline and/or on the foreshore. Extensive sugarcane fields stretch behind the hotels and coastal forest.
2	Present Issues	1) Some groins made of natural stones are constructed at random in front of the hotels. Erosion is ongoing on the down-drift of groins. 2) Restaurants of some hotels project to the edge of shoreline. 3) Some hotels put parasols with foundation on the edge of shoreline. 4) The scarp was formed in some areas of public beach. 5) Old training wall exists at the river mouth where marine sports such as kite surfing is very active.
3	Points of Concern for Countermeasures	1) Hotel should not plan and construct groins independently because groins block continuity of longshore transport. It causes erosion, especially at the down-drift of groin. It is necessary to consider large-scale impact on the longshore sediment transport area. 2) In case that structures such as restaurant are built on the shoreline and erosion worsens in the future, there is a possibility that structures will suffer damage from erosion and erosion increases at the down-drift of structures. It is necessary to plan to scale down that structure or shift it on the shore as much as possible. In addition, it is also necessary to confirm position of setback line in that hotel property and to carry out periodic monitoring against unacceptable and illegal buildings and structures within setback line. 3) Some facilities with foundation should not be put or installed on the foreshore. 4) The scarp is often formed at the roots of trees. It is important to carry out suitable arrangement plan of trees in the coastal area. In addition, it is also necessary to do periodic monitoring from the up-drift to the down-drift at the

area where the scarp is formed.

5) It is desirable that coastal protection facilities which have no effect on protection and conservation of the beach are demolished in order to secure continuous sediment transport and promote the safety of various marine sports.

Groin made of natural rocks was constructed at random in front of the hotel.

Restaurant of the hotel close to the shoreline

Parasols installed on foreshore

Erosion on the west side of old warehouse for sugar

Scarp at public beach

Training wall at river mouth on the east side of public beach

(Source : JICA Study team)

According to Volume 1 Section 5.3.2_C, three area such as erosion area, potential risk area of erosion and accumulation area are set up and classified considering beach erosion rate in past. Figure 3.8.1 shows regulation map of land use for this beach. The beach shows tendency of accumulation on erosion on the east side. The erosion rate is -0.02 to +0.10 m/y on the west side as potential risk area. It is necessary to carry out continuous monitoring and to understand tendency of erosion at potential risk area.

(Source : JICA Study team)

Figure 3.8.1 Regulation map of land-use (Plan) (Bel Ombre)

3.9 Le Morne

The present issues and point of concern on beach management at this beach are summarized as follows.

1	Characteristics of Beach Space	The beach exists around the oblong landform which extends north and south. Some large hotels stand side by side behind the beach in the south and north side of Le Morne. Public beach exists in the southeast and west of the beach. Various marine sports are done actively in the west of the beach and a lot of pleasure boats are moored at the reef and beach. Public beaches which have coastal forest are always crowded with families and tourists not only on the weekends but also on weekdays because these beaches are typical public beaches in the southwest of Mauritius.
2	Present Issues	1) The hotel facility stands on the backshore close to shoreline as shown in Photo 1) . Space of the backshore to the facility is about only two meters. 2) Trees are planted in the foreshore in front of the hotels. 3) Hotel is under construction at the erosion area in the south of the beach. 4) High trees (especially, Casuarina) are planted in the foreshore and the backshore in the public beach. These trees cause beach erosion and scarp forming. 5) The dredging work is carried out for pleasure boats in the channel between hotels at least once a year. The dredged material is stocked on the beach. The erosion occurs in the north side of the channel. 6) Many cars and motorcycles were parked on the backshore of the public beach because they could come and go freely at the coastal forest. But car parking issue was improved because car barriers were installed behind the beach during this study. On the other hand, cars are still parked on the backshore in the south side of the public beach. This activity has an influence on environment and utilization such as impacts on trees and sea animals, car exhaust, reduction of utilization space and accidents to the beach users. 7) Rainwater drainage from landside washes away sandy beach locally.
3	Points of Concern for Countermeasures	1) When structures such as restaurant are built on the shoreline and erosion worsens, there is a possibility that structures will suffer damage from erosion and erosion increases at the down-drift of structures. It is necessary to plan to scale down the structure or shift it on the shore as much as possible. In addition, it is necessary to confirm the position of setback line in the hotel property and to carry out periodic monitoring against unacceptable and illegal buildings and structure within setback line. 2) Trees and some facilities with foundation should be shifted to the place where sufficient clearance from the foreshore can be kept because there is a risk that trees fall and facilities collapse due to high waves and erosion. 3) On construction of the hotels and houses along the coast at the erosion area, not only regulation of setback line (30 m from HWL) but also clearance space should be considered, making an assumption of erosion rate and effect of the sea level rise in the future. 4) High trees should not be planted in both the unstable zone at the foreshore and the semi-unstable zone (Dynamic beach zone). It is necessary to plant high trees in the stable zone behind the beach considering wave run-up and natural vegetation condition. 5) It is necessary to manage and control the wide-area longshore sediment transport because movement of supplied sand to the down-drift is blocked due to construction of training wall and periodic dredging works in the channel. 6) Although car parking issue is gradually changing for the better after

		installation of car barriers in some beaches, but car and motorcycle parking issue are still seen at many public beach in Mauritius. It is recommended that parking space should be prepared in the whole Mauritius in a step-by-step manner considering various impacts. 7) It is necessary to prepare a drainage plan behind the coastal zone, especially at the area where local scouring of sandy beach occurs due to rain drainage.

① Hotel facilities on backshore

② Tress on foreshore

③ Hotel under construction at erosion area

④ Forming scarp at public beach

⑤ Forming scarp on the north side of public beach

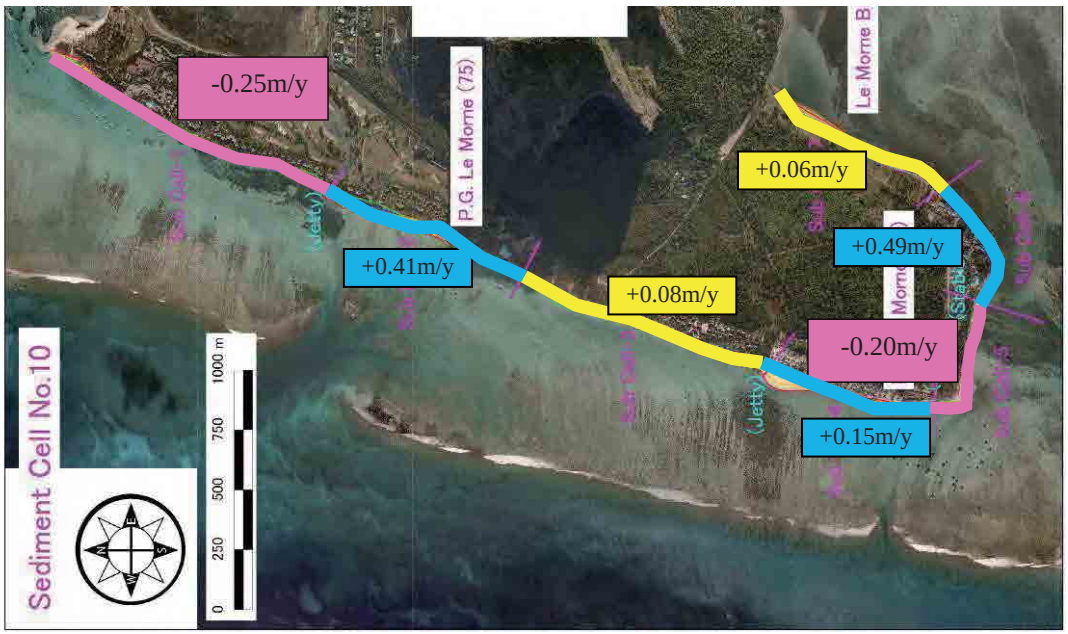
⑥ Training wall for channel between hotels and dredged sand was stocked on land

⑦ Cars are parked on backshore

⑧ Scouring at public beach due to rainwater discharging

Source: JICA Study Team

According to Volume 1 Section 5.3.2_C, three area such as erosion area, potential risk area of erosion and accumulation area are set up and classified considering beach erosion rate in past. Figure 3.9.1 shows regulation map of land use for this beach. Erosion area and accumulation area are intermixed in this beach. The beach consists of potential risk area (+0.06 and +0.08 m/y) at Sub-cell-3 and 7 and erosion area (-0.20 and -0.25 m/s) at Sub-cell-1 and 5. It is necessary to carry out continuous monitoring and to understand tendency of erosion at potential risk area and to implement the short-term and mid-and- long term conservation measures at erosion area.



(Source : JICA Study team)

Figure 3.9.1 Regulation map of land-use (Plan) (Le Morne)

3.10 Flic en Flac (Priority Beach)

The present issues and point of concern on beach management at this beach is summarized as follows.

1	Characteristics of Beach Space	Hotels stand side by side on the south of this beach and the public beach exists on the north of this beach. The public beach is at a long distance from the north end of hotel area. Various marine sports are played actively at the hotel area and on the north of the public beach and a lot of pleasure boats are moored at the reef and the beach. The public beach is always crowded with families and tourists not only on the weekends but also on weekdays because this beach is a typical public beach in the west of Mauritius. Public beach that has sandy beach, coastal forest, toilet, shower, etc. is kept in clean condition since the Beach Authority cleans up every day.
2	Present Issues	1) In some hotels, flowerbed, planting and parasols with foundation are arranged on the backshore and foreshore close to the shoreline. 2) A lot of garbage and driftage are left on the beach at undeveloped area nestled between hotels. It is a problem from a standpoint of landscape and utilization. 3) Sandy beach hardly exists in front of the fence of the hotel. Peal Beach Hotel and Hilton Hotel face this issue. According to a manager of Peal Beach Hotel, the vertical revetment had already existed when owner purchased the existing hotel in 2004. It is assumed that the revetment was built in 1970' to 1980'. 4) Many cars and motorcycles were parked on the backshore of public beach because they could come and go freely at the coastal forest. But car parking issue is improving because car barriers were installed behind the beach during this study. But motorcycles are still parked. In addition, many cars are parked at the backshore in the northern end of this beach, where a lot of boats for diving, fishing and dolphin watch are anchoring. 5) High trees (especially, Casuarina) were planted in the foreshore and the backshore in the public beach. These trees cause beach erosion and scarp

		forming. 6) There are some problems with beach nourishment which carried out at public beach as sand recycle in June, 2004. The foreshore slope was not formed and leveled and the foreshore slope was totally different from existing slope nearby.
3	Points of Concern for Countermeasures	1) Some facilities with foundation and trees should not be arranged on the foreshore. 2) It is difficult to do the cleaning every day at the leased properties of the leisure home areas. In order to solve this issue, it is necessary to study to establish a new beach cleaning system or to modify the existing system to keep clean condition at the whole area. It is also necessary to consider to impose a condition in the lease agreement that the lessee shall keep the beach clean of plastics and other solid wastes and have the local authorities or the MoHL to monitor or even have the enforcement done by police des terres . 3) There is a possibility that structures close to the shoreline will suffer damage from erosion and erosion increases at the down-drift if further erosion occurs. It is necessary to plan to scale down the structure or shift it on the shore as much as possible, especially during the renovation. In addition, it is also necessary to confirm the position of setback line in the hotel property and to carry out periodic monitoring against unacceptable and illegal buildings and structure within setback line in accordance with previous aerial photographs and records. 4) Public beach of St. Felix in the south of Mauritius has parking area behind the coastal forest and driving into the beach and coastal forest is prohibited. It is recommended that parking space should be prepared in the whole Mauritius in a step-by-step manner considering various impacts. Although car parking issue is improving after installation of car barriers in some beaches, car and motorcycle parking issue is still seen at many public beaches in Mauritius. 5) High trees should not be planted in both the unstable zone of the foreshore and the semi-unstable zone（Dynamic beach zone）. It is necessary to plant high trees in the stable zone behind the beach considering wave run-up and natural vegetation condition. 6) It is necessary to make the foreshore slope after sand nourishment equal to the existing foreshore slope nearby as close as possible in order to reduce outflow of sand and forming scarp after sand nourishment. Therefore, it is important to confirm the existing foreshore slope by survey before sand nourishment and necessary sand volume by calculation and finished work quality after sand nourishment.

Trees and flower bed on foreshore and backshore

Parasols on foreshore in front of the hotel

Accumulated garbage and exuberant weed in front of the green field nestled between the hotels

		
Narrow beach in front of the hotel	Parking in public beach	High trees were planted in foreshore and backshore.
		
Sand recycle work with 400m3 from accumulated area at the northern end to eroded area in June, 2014.	Nourished beach at public beach as described left (1). Foreshore was not formed.	Nourished beach at public beach as described left (1). Foreshore slope is different from existing beach.

Source: JICA Study Team

According to Volume 1 Section 5.3.2_C, three area such as erosion area, potential risk area of erosion and accumulation area are set up and classified considering beach erosion rate in past. Figure 3.10.1 shows regulation map of land-use for this beach. Erosion area and accumulation area are intermixed in this beach. The beach consists of potential risk area (-0.03 and +0.13 m/y) at Sub-cell-3 and 4 and erosion area (-0.22 and +0.29 m/s) at Sub-cell-2 and 5. It is necessary to carry out continuous monitoring and to understand tendency of erosion at potential risk area and to implement the short-term and mid-and- long term conservation measures at erosion area.

(Source : JICA Study team)

Figure 3.10.1 Regulation map of land-use (Plan) (Flic en Flac)

3.11 Albion (beach)

The present issues and point of concern on beach management at this beach are summarized as follows.

1	Characteristics of Beach Space	Public beach of 300 m in length exists in the central part of the beach. Residential area and fishery research station exist in the north and south side of the beach respectively. Outlet and hotels exist in the south side of the research station. In other words, this beach space surrounded by capes with 1.5 km in length consists of residential area, public beach, public facilities, mouth of a river, hotel, wetland, etc. The public beach has coastal forest and is crowded with families and tourists, especially on the weekends. Public beach which has sandy beach, coastal forest, toilet etc. is kept in clean condition since the Beach Authority cleans up every day.
2	Present Issues	1) Sandy beach does not exist in front of the mortal masonry vertical revetment and sand deposits on either side of the revetment. It seems that sand has not accumulated in front of the revetment due to occurrence of the reflective waves. 2) People cannot pass thorough the beach because large scarp is formed in front of the research station. There is a possibility that trees and fence will fall down and flow out due to erosion. 3) Beach cleaning is carried out by the Beach Authority every day at the public beach. On the other hand, lots of garbage and driftage are left on the beach in front of the fishery research station. 4) Garbage accumulates in the ditch next to the beach. It might flow into the sea after the rain. 5) There is a plan to construct a hotel in the south side of the fishery research station including site of the research station and wetland exists behind the planned construction site. The construction works might exert a great influence on wetland. It is concerned that this will have an effect on corals due to the change of pattern of sediment flow and the inflow of freshwater from a river.
3	Points of Concern for Countermeasures	1) It seems that reflected waves are amplified by the vertical revetment and these amplified waves increase erosion in and around the revetment. To reduce reflective waves, setback or review of structure of revetment is required in consideration of utilization and landscape. 2) The beach erosion in front of the fishery research station is one of the worst conditions. It is necessary to take measures as early as possible based on the studies for countermeasures against beach erosion as mentioned above. 3) The beach in front of the fishery research station leads to the public beach. A lot of people use this beach, especially on the weekends. Therefore, it is necessary to confirm who is responsible and establish a cooperative framework with the Beach Authority. 4) It is necessary to carry out periodic removal and collection of garbage in the drainage. 5) It is necessary to pay attention to the impact on Wetland by construction of a hotel because the wetland has a function as a balancing reservoir.

 Vertical wall was built in front of property in the north of this beach	 Same as the left	 Coastal forest and beach are kept clean and well maintained.
 Erosion area in front of the research institute. Scarp with approx. 1.7m in height was formed at this area.	 Collapse of fence and trees at erosion area in front of the research institute.	 Same as the left
 Accumulated garbage in the drainage next to the beach	 A lot of garbage is left on the beach in front of the research station. This beach leads to the public beach.	 Lots of garbage and seaweed drifted onto the beach in front of the research station..

Source: JICA Study Team

According to Volume 1 Section 5.3.2_C, three area such as erosion area, potential risk area of erosion and accumulation area are set up and classified considering beach erosion rate in past. Figure 3.11.1 shows regulation map of land-use for this beach. The beach shows tendency of erosion over almost the whole area. This beach consists of potential risk area (between -0.10 to +0.02 m/y at Sub-cell-1 to 3 and erosion area (-0.18m/y at Sub-cell-4). It is necessary to carry out continuous monitoring and to understand tendency of erosion at potential risk area and to implement short-term, and mid- and long- term beach conservation measures at erosion area.

(Source : JICA Study team)

Figure 3.11.1 Regulation map of land-use (Plan) (Albion)

3.12 Pte. aux Sable (Priority Beach)

The present issues and point of concern on beach management at this beach are summarized as follows.

1	Characteristics of Beach Space	The beach with 4 km in length stretches in the east-west direction. Some hotels and guest houses exist along the beach, but most of the beach are residential area and undeveloped area. Sandy beach disappeared because the revetment was constructed at approx. 30 m offshore from existing beach and sand was backfilled in the public beach. The beach was not often used as compared with other public beaches.
2	Present Issues	1) No sandy beach in front of the vertical revetment 2) The erosion area has been expanding at the down-drift due to construction of the revetment in the public area as mentioned above. 3) The beach on the east side shows tendency of accumulation and the shoreline has been increasing.
3	Points of Concern for Countermeasures	1) It seems that reflected waves are amplified by the vertical revetment and these amplified waves increase erosion in and around the revetment. To reduce reflective waves, setback or review of structure of the revetment is required in consideration of utilization and landscaping. 2) The revetment made offshore raises the risk of expanding erosion area. The revetment should not be constructed offshore not only at the public beach but also at the personal leased land and hotel properties. It is necessary to take measures such as setback, beach nourishment, etc. based on the result of study and analysis regarding longshore sediment transport mechanism and tendency of erosion in the wide area. 3) It is necessary to consider reuse of sand at accumulated area in the eroded area as sand recycle because the beach on the east side shows tendency of accumulation and is almost underdeveloped.

 Collapse of vertical revetment at eroded area on the west side of the beach	 Vertical revetment at eroded area on the west side of the beach	 Revetment was constructed at approx. 30 m offshore from the existing beach and sand was backfilled between them in the public beach
 The beach on the west side of public beach shows tendency of accumulation	 Masonry revetment was constructed on the east side of public beach due to erosion	 The erosion is going on at the down-drift of the guest house.
 Accumulated area on the east side of this beach (1)	 Accumulated area on the east side of this beach (2)	

Source: JICA Study Team

According to Volume 1 Section 5.3.2_C, three area such as erosion area, potential risk area of erosion and accumulation area are set up and classified considering beach erosion rate in past. Figure 3.12.1 shows regulation map of land use for this beach. Erosion area and accumulation area are (inter)mixed in this beach. This beach consists of potential risk area (between -0.04 and +0.04 m/y at Sub-cell-3, 5 and 6) and erosion area (-0.40m/y at Sub-cell-2). It is necessary to carry out continuous monitoring and to understand tendency of erosion at potential risk area and to implement the short-term, and mid- and long- term beach conservation measures at erosion area. In addition, it is necessary to carry out periodic monitoring at the whole sea area because there is a possibility that sand of Sub-cell-4(accumulated area) will be reused in the eroded area.

Source: JICA Study Team

Figure 3.12.1 Regulation map of land-use (Plan) (Pte. aux Sables)

3.13 Grand Sable (Priority Beach)

The main road runs behind the coastal line and houses and stores stand side by side on the west of the road. Flat ground is very limited on the west side of houses because of steep geological formation. A lot of garbage, driftage and tires accumulate on the beach, and they are giving off a strong and bad odor around the beach. It seems that this bad odor comes from not only decomposed garbage and driftage but also living drainage. Therefore, this beach is a very bad environment at present. The overtopping measures for coastal road are first priority in this area, but improvement of the coastal environment should also be considered. It is recommended that both hard and soft measures should be considered as an improvement plan at this area. In addition, as afforestation of mangrove was carried out by local elementary school students on the south side of the planned construction site in 2012, such volunteer activities should also be considered in making an improvement plan from a viewpoint of sustainable management.

On the other hand, the condition of beach after implementation of the physical project has been remarkably improving regarding water quality, bad odor, and accumulation of garbage and so on as shown in following photographs that was taken in June, 2014, after 6 months passed after completion of the project. Although it is difficult to evaluate quantitatively whether self-motivating beach cleaning by local residents and water purification effects cause improvement of environment, the project seems to contribute to improvement of environment. Areas except the project area are still significantly poor condition regarding accumulation of garbage, marine algae on the beach and turbidity. It is necessary to evaluate this difference of two areas from environment aspects hereafter.

Condition of the beach before the implementation

		
Present condition of the candidate site	A lot of wastes and seaweeds are deposited on the beach	A lot of wastes and tires are deposited on the beach. They are given off a bad smell.
		
Road and houses behind the beach	Unplanted mangrove trees exist on the south side of the candidate site (They are approx. three years old according to hearing)	Young mangrove trees were planted by local elementary school students about three months ago.

Source: JICA Study Team

Condition of the beach after the implementation

		
See grave nourishment area from south to north	See grave nourishment area from north to south	Accumulation of garbage and sea algae on the north side of nourished area

Source: JICA Study Team

3.14 Albion (cliff)

The highland behind the cliff coast has been used for a sugarcane field and residential area. There is a construction plan for coal fired power plant behind cliff coast on the north of lighthouse.

It is necessary to set up setback line for important facilities such as public facilities, power generation facility, etc, in consideration of long-term cliff coast erosion and slope failure. The minimum setback line is set up at line of 45 degree as angle of rupture from slope area as shown in the schematic diagram above.

An empirical value of erosion rate of basalt is at 5 cm per year in average. If a period of use is 100 years as important facility, space required is calculated at 5 m in consideration of the above erosion rate.

Therefore, the following formula is applied for calculation of setback line for important facility.

Minimum Setback line = Slope area + Horizontal area (Considering 45 degree as angle of rupture) + 5m

		
Planned construction site of coal fired power plant behind cliff	Cliff coast and planned construction site of coal fired power plant	Present condition of cliff coast

Source: JICA Study Team

4. Proposal for the Construction of a Flexible Revetment

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)
MINISTRY OF ENVIRONMENT AND SUSTAINABLE DEVELOPMENT (MOESD)

THE DEMONSTRATION PROJECT FOR CAPACITY DEVELOPMENT ON COASTAL PROTECTION AND REHABILITATION IN THE REPUBLIC OF MAURITIUS

GRAND SABLE

DESIGN REPORT

September 2013

JICA EXPERT TEAM
KOKUSAI KOGYO CO., LTD.
NIPPON KOEI CO., LTD.
CENTRAL CONSULTANT INC.
FUTABA CONSULTING SERVICE CO., LTD.

Table of Contents

Chapter 1 Introduction

1.1 Background

The Project for Capacity Development on Coastal Protection and Rehabilitation started from the request of the Government of Mauritius to the Government of Japan. Japan International Cooperation Agency (JICA) sent the JICA Expert Team (JET) to Mauritius. In the Project demonstration projects are planned to show the effectiveness of the coastal conservation measures. Grand Sable was selected for the site and the flexible revetment was proposed as physical measures. The plan and design of the revetment were conducted by the JET.

1.2 Purpose and Structure of the Design Report (PDR)

The purpose of the Preliminary Design Report is to present

- The protection measures to be provided at the Grand Sable site, with due to wave run-up
- Preliminary drawings for the project components
- Preliminary cost estimates for the proposed works

The structure of this report, which comprises 6 chapters, is as follows:

- **Chapter 1** (Introduction) gives the project background and sets out the purpose and structure of the report
- **Chapter 2** (Design Approach and Criteria) presents the design philosophy, parameters and method used for the design of the protection works
- **Chapter 3** (Field Investigations and Surveys) details the various surveys and investigations carried out during the preliminary design stage of the project
- **Chapter 4** (Preliminary Engineering Design) outlines the development requirements, design criteria and the proposed works
- **Chapter 5** (Preliminary Cost Estimates) highlights the major work components with estimated costs and recommendations.

Chapter 2 Design Approach and Criteria

2.1 General

The main purpose of this present report is to undertake and environmental impact assessment for the chosen counter measure in view of controlling coastal disasters occurring at Grand Sable. At present, the site is affected by overtopping and erosion of waves with infrastructure being at risk of being greatly damaged during an event such as cyclone. The shoreline in the area has escarpment of over 2 m which lies immediately adjacent to the B28 road.

2.2 Design Approach

A proposal for shore protection of relatively recent origin is the use of "flexible revetments" or can be also termed as "rubble beaches". The approach involves the construction of a gravel (shingle) or cobble beach at the shore, in front of the area to be protected. In this respect, a constructed flexible revetment represents a transitional strategy between a conventional riprap revetment of large stones and a beach nourishment project. The name "flexible revetment" reflects this transition in that by consisting of gravel and cobbles, the material is expected to be moved by waves and nearshore currents — it is "flexible", contrasting with a conventional "static" riprap revetment where the boulder-sized quarry stone is designed not to move under the expected forces of waves during extreme storms. Thus a flexible revetment is designed for the wave action to rearrange the gravels into an equilibrium profile. In this regard, the flexible revetment is constructed to provide protection to coastal developments and infrastructure while remaining more flexible than a conventional riprap revetment, not failing when movement occurs.

In application, the constructed flexible revetment either fronts directly into the water or is located landward of a sandy beach that is providing inadequate buffer protection from erosion by waves and currents. Such morphologies are relatively common on some coasts, so the placement of a flexible revetment constitutes a more natural and aesthetic solution than a conventional revetment or seawall. Indeed, the objective is to construct the flexible revetment to be as close as possible to the form of natural cobble beaches in order to be compatible with the natural environment and to insure its stability wherein it responds to ocean processes like a natural cobble beach.

The dynamic structure is effective in defending properties because the sloping, porous cobble beach is able to disrupt and dissipate the wave energy (Ahrens 1990; Ward and Ahrens 1991), even during intense storms. There are a number of practical advantages in using a flexible revetment for property protection (Ahrens 1990; Ward and Ahrens 1991), including the following:

- Stone size is smaller and is typically less expensive than the large armor stones used in a conventional riprap revetment.

- Placement of the material does not require special care. As a result, the material may be dumped in place rather than the stones being individually placed, making the construction process much simpler.
- Movement does not constitute failure. In fact movement is desirable in that the flexible revetment adjusts its shape to reflect the predominant storm wave conditions.
- Flexible revetments are more aesthetically acceptable when compared with a conventional seawall or riprap revetment so that it conforms to the setting of the coast, being indistinguishable from natural cobble beaches. This may make its construction more acceptable by management authorities, even on coasts that do not permit the use of conventional "hard" structures.

Although flexible revetments require more material to construct than a riprap revetment, its construction is generally less expensive than “hard” engineering structures. However, it cannot be expected that a flexible revetment will provide the same level of shore protection as a conventional riprap revetment or seawall. Since the gravel and cobbles can be moved by the waves, the placed material may be transported alongshore or offshore by extreme storm waves (Allan, et al. 2003), so that maintenance requirements can be expected to be more frequent than in the use of "static" structures. The flexible revetment itself may also become a hazard to shore-front properties if the cobbles become projectiles during a storm, flung by the waves against houses. Because of this potential, the use of flexible revetments is safest if backed by a bluff or substantial sand dune, or if developments are sufficiently set back beyond the reach of wave-flung cobbles. Another problem that may limit their acceptance as a form of soft engineering is identification of suitable gravel sources at acceptable costs (i.e., supply and transportation costs).

2.3 Reference and Standards

2.3.1 CUR CIRIA Publications

- The Rock Manual – The use of rock in hydraulic engineering (second edition)
- Beach Management Manual (second edition), CIRIA C685, London, 2010

2.3.2 British Standard

- BC 6349 Maritime Structures

  -Part 1: General criteria

  -Part 7: Guide to the design and construction of breakwaters

2.4 Design Philosophy

2.4.1 Design Policy

In addition to ensuring safety of the infrastructures and residential area adjacent to the projected coastal area, other considerations were made in the design of the revetment especially with regard to utilization of the seashore such as for docking fishing boats and access to the sea for fishermen and residents as well as the natural environment including existing vegetation and biological diversity such

as habitats of clams and other shellfish. With these considerations, it was thus recommended to use local materials which are easily available on the local market such as soil, sand and rocks for the revetment construction. However, man-made materials such as concrete would have to be applied in minimum.

The design policy can be summarized as follows.

- Disturbance of drainage system on backside land by the construction have to be avoided.
- The section of the revetment should be harmonized with existing environment by applying similar condition of construction materials from the projected coast.
- With considering current use of the projected beach, an appropriate space for the construction work and gradient will be ensured.
- For minimum maintenance and assurance of its function, by the construction project, stability of coastal environment for a long period of time has to be ensured.

2.4.2 Stakeholder Consultation

The public consultation for relevant stakes folder was held on 21st August and 16th September to share the information about the construction project and have discussion about prospects of the Grand Sable with the new revetment as well as environmental and social impacts for the project. The results of discussion is mentioned on the EIA report developed separately.

2. 5 Design Method

The design of the flexible revetment in shallow water can be based on the study of multi criteria analysis with several axes of evaluation categories such as the aspect of functionality, environment, utilization and adoptability. Overall evaluation will reflect to the adaptation of design for the flexible revetment. Addition to the analysis based on the method above, the study of substantial example on the beach of Mauritius is carried out due to a lack of information about the flexible revetment. It is practical to study actual stable coastal situation of similar beach to Grand Sable and the size and ratio of the rock size for the designed revetment can be applied by the study.

2. 6 Revetment

2.6.1 Elevation of the Revetment

(1) Division of design section

The design of the revetment has been divided into two sections depending on the elevation of the existing situation and as such:

North section: Top height of +2.0 m, slope of 1:5 with gravel

South section: Top height of +2.0 m, slope of 1:5 with gravel at upper part and slope of 1:8 with sand at lower part.

The sections were considered the change of bed material from gravel at the south to sand at the

north.

(2) Mitigation of disastrous risk

The height of the revetment top will be kept as low as possible not to block drainage from the catchment area. In addition to providing protection against wave overtopping and erosion of external forces from the sea such as big wave and high tide, consideration of ensuring safety of community following of heavy rainfall will be as follows:.

Elevation of revetment top has been set to +2.0 m. By securing the revetment height based on the design condition of tide level in addition to a foreseen sea level rise and wave-setup (MSL+1.39 m), the structure against the wave will be controlled and safety is ensured.

2.6.2 Alignment

The wave run-up will be prevented over the southern section of the proposed revetment by having an appropriate increased width of the revetment top. Thus it will be necessary to align the southern section towards the seaward side thus deviating seaward from the existing shoreline. If the alignment followed the general orientation of the shoreline in the southern area, wave convergence will occur and may increase wave height with possible disaster to the community. Therefore, the alignment has to be altered and be as smooth as possible and will deviate from the existing shoreline.

2.7 Specification of Materials

2.7.1 General Specification

General specification of the materials will be applied based on function of the materials and details of the specification will be confirmed after discussion with relevant authorities and contractors. The function of the materials for the flexible revetment at Grand Sable is shown below.

- Gravel Fill: The function of the gravel fill is stabilizing the body of the revetment either under or above the sea level. The size and mixture ratio of the washed material A, B, and C will be determined also by availability and economic value as follows.
  Gravel A: diameter of 14-20mm (50% of total volume)
  Gravel B: diameter of 20-31.5mm (30% of total volume)
  Gravel C: diameter of 10-14mm (20% of total volume)
- Sand layer: Sand layer should be installed on the half of total demonstration area to analyze future changes of the revetment shape and compare with adjacent standard section without the sand layer as an experimental section.
  Sand: rock sand, diameter of 2-4mm (washed)

Chapter 3 Field Survey at Grand Sable

3. 1 Location of the Revetment as demonstration site

The flexible revetment structure shall be located at its southern extremity at the GPS coordinate of 20° 19' 21.16" S and 57° 46' 12.93" E. this area is some 25 m north of the existing mangrove plants is adjacent to a covered drain box culvert. The northern extremity of the structure is located at the GPS coordinate of 20° 19' 14.60" S and 57° 46' 11.85" E which is some 15 m north of the Bus Stop. The structure would include the area immediately in front of the Bus Stop.

The flexible revetment structure will be placed as part of the demonstration project site over a total length of 200m (including the slope to its foot), see design at Annex 4. The revetment shall be terminated at the extremities by providing an appropriate slope to avoid reflection and which would dissipate the wave energy. Proper monitoring would eventually follow both the structure and extremities in view of assessing the efficiency of the structure.

3. 2 The Existing Situation

The projected area is a part of Grand Sable beach located on east coast of Mauritius and lies along the road about 400m. Most of the coast is covered by the rocks or pebbles approximately 10 to 20 cm in diameter. Topographically, although the area around the river mouse on south is characterized as flat beach filled with only rocks, rest of area has about 20 % of gradient of seashore line to the road.

Residential area is attached to the road along the projected site and the distance to the sea is comparatively close. Followed by the request about environment of the residential area, most of the tall trees blocking the view to the ocean have been cut.

As a part of the social activities of the site, local fishermen use the beach when they maneuver their fishing boats to go fishing and catch calms. For them accessibility of fishing boats to the sea is crucial concern against the revetment construction project.

Detailed descriptions of natural and social environment will be depicted on following chapter of environment consideration section.

The projected area, about 400m long, can be divided into two parts. One's elevation of existing revetment is same as road elevation at +2.5m and the other is +1.5m. Length of the former area is approximately 250m whereas the latter is approximately 150m.

The area of +1.5m elevation is expected to have flooding during high tide because the elevation is lower than the analyzed design wave height adding expected wave run-up (+1.64m). Additionally there is a steep mountain behind the projected site, therefore, the area has a risk of flooding during the time of heavy rain.

3. 3 General Site Conditions

3.3.1 Site Limits

The site is located on Grand Sable as a part of the whole coast al area. Since the construction of the revetment is in the coast, no private properties will be involved with the settlement, whereas construction activity may temporarily affect surrounding areas of the construction site. Limitation of the construction area on the land side would be defined as the boarder of the road adjacent to the projected coast, while the offshore side can be identified the end edge of the slope planned as approximately 30m from the top of the revetment.

Based on the current coastal condition having comparatively gentle slope on the beach, length of the revetment is designed as 150m, where the area having high risk of natural disaster including over topping wave.

Figure 3-1 Location of the Projected Site

3.3.2 Land Use Survey

Regarding to the proposed demonstration site, since it is located on coastal area, land use of the site is defined as public area where local residence and fishermen usually use for their daily activity including recreation. The site is located along to public road, Flacq – Mahebourg Road B28, and bus stop is located at the north end of the demonstration area. In the section of the future development area, next to the demonstration area, the public beach with facilities for local landscape amenity is located on the north.

3.3.3 Topographic Survey

(1)Topographic survey

The projected site has been topographically surveyed and mapped. The survey and mapping include existing facilities such as roads, natural wetland, buildings, trees etc..

Contour lines at 0.5m vertical intervals have been generated from the mapping.

The topographical survey would be the base of design and other analytical work.

For the purpose of determination of levels and elevations for site surveys and engineering design of the work, the datum based on the Admiralty Chart of Mauritius has been used and the survey provides seven station point with certain elevation to be used for construction activity.

3.3.4 Storm water Drainage Survey

The projected site is located near the residential area where rainfall flows into from the catchment area on the back of mountainous calculated approximately 10.95ha. Two main rivers on north and south edge of Grand Sable cover most of the runoff. The catchment area of the projected site is relatively small (Figure 3-2). There are eight open drainage channels in the both future development area and demonstration project area, whereas four out of three existing channels have to be extended for the project. One of the drainages in the demonstration area is a precast concrete pipe with its size of 0.7cm in inside diameter, and other three are box culverts with various size. The table shows the size of existing drainage channels.

Drainage at the section 21: H330mm, W600mm

Drainage at the section 20: H480mm, W420mm

Drainage at the section 19: H600, W560mm

Drainage at the section 12: Φ700mm

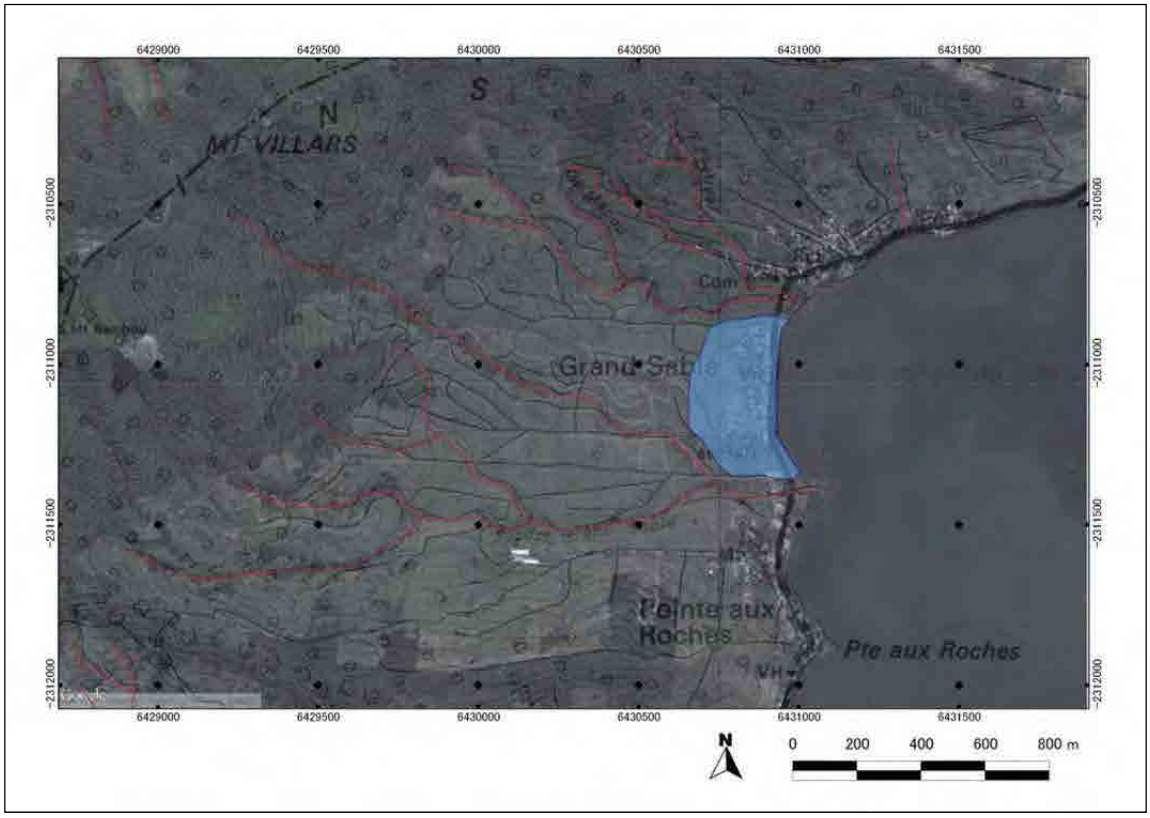


Figure 3-2 Catchment Area of the Projected Site

3.3.5 Ecological Survey

Analysis of existing biological diversity in the area would be required for current or future conservation of the coastal environment.

The Environment Impact Assessment(EIA) is developed separately.

Chapter 4 Preliminary Engineering Design

4. 1 Functional Requirements

4.1.1 Specified in Terms of Reference

- Clearing and pruning brunches at the projected site.
- Installation
- Filling gravels for the base of the revetment.
- Installation of gravels for the flexible revetment, 160m in length of demonstration area with 83m of adjustment section and 20m in width at Grand Sable.

4.1.2 Observations on the Terms of Reference

- At the site, there is a public beach, slipway for a fishing boat, and 8 drainage channels in the future development area.
- Fishermen routinely use the beach to collect clams and other shellfish.
- Coastal erosion has occurred between the road and the seashore, and the seawall has been repaired with old tires.
- Existing bus stop and vehicles stopping lane are protruded into the coast so that the existing seawall is not straightly aligned.
- Elevation of the area behind the existing seawall is between 2.5 m and 1.5 m.

Figure-4.1 public coastal park, a wharf

Figure-4.2 drainage channels

4. 2 Design Criteria

Based on the study about lifespan, cost effectiveness, and feasibility of the civil engineering structures, it is determined that the design external force is equivalent to a return period of 30 years.

4.2.1 Design High Tide Level

A statistical analysis was undertaken using the annual maximum values from the observed tide levels at Port Louis between 1986 and 2012. The analysis shows that the 30-year probable tide level

for Mauritius, in general, is MSL+0.67 m.

From observation records of the tide levels at Port Louis, the rise in sea level caused by global climate change was set at 3.9 mm/year, therefore, the rise in tide level over the next 30 years was estimated to be of the order of +0.12 m. Furthermore, the wave-setup volume on the reef was analyzed and +0.6 m rise in the mean water level was added.

Adding the rise in tide level and wave-setup volume to the 30-year probable tide levels, the high tide level for the design was determined to be at MSL+1.39 m.

4.2.2 Design Wave Condition

Analysis of wave conditions was conducted based on the data of the previous cyclone hitting Mauritius. The results from this analysis shows that the 30-year probable wave height and periods are estimated at H=10.3m and T=14.1 second respectively through the extreme value statistics method.

Based on the wave condition analyzed above, the analysis of wave deformation between the reef edge and designated point of the projected site results in the value of H=0.4m and T=8.0second and these values are used in the design of the flexible revetment as wave condition to be expected.

4. 3 Scheme Components

4.3.1 Flexible Revetment

(1) Structure

The proposed flexible revetment to be built with gravels which can easily be obtained and shall have a slope of 1:5. Since the revetment composed of natural materials such as gravels and sands, it is considered as being environment friendly and easy to repair and maintain.

The revetment mainly is made with gravels of 20 mm in diameter. At the north part the lower part is covered with sand. The structure and section is designed from the analysis of the characteristics of existing and similar beaches where located at the south coast with low wave energy. The beach has a slope of 1:5 around mean sea level with gravels. Below that the slope becomes gentler towards 1:5 to 1:20 with sands. The study of Bradbury (2003) supports the results which show the same trends from 1:5 to gentler one of slope with gravel and sand mixed beach.

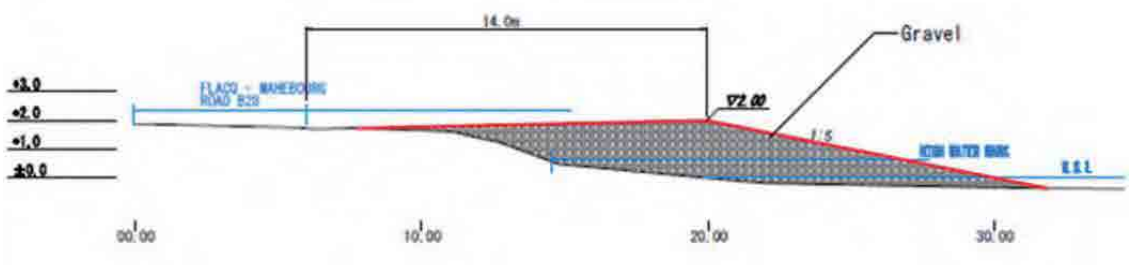


Figure-4.2 Typical cross section of the proposed revetment

(2) Coastline

Along the current coastline, there is a bus stop and stopping lane for vehicles, and the facilities which protrudes into the shoreline. The length of the protrusion area is approximately 5.0m. A smooth coastal line for the design will have to be set to prevent wave convergence while also ensuring that sediment movement is not inhibited.

(3) Gradient

Slope gradient of the revetment is designed at 1:5 at the upper part and 1:8 at the lower part. This gradient is best for dissipating waves, and it will also allow boats to be pulled up to land. Additionally, this gradient also allows for easy access to and from the land side or seaside. Furthermore, it is expected that, by having this gradient, accumulation of sand will occur at the bottom of the revetment, which may contribute to conservation of biological diversity at the adjoining environment.

(4) Top Elevation and Width

The elevation of the revetment top is set at +2.0 m nearly as the current conditions. The width of the revetment top is set at 10 to 14meters. The width was calculated and designed taking into consideration the expected wave condition and following analysis of optimized gradient projection method such that there shall not be over topping of waves.

(5) Length of the Revetment

The revetment will extend to 165 m without the smooth alignment region and shall see the installation of recreational open space on the top surface area of the structure which could be used as a public facility at coastal area in future.

4.3.2 Treatment of Side Edge

The side edge of the revetment will be designed as a smooth alignment to the adjacent beaches to prevent erosion and accretion cause by the change of sediment transport rate and concentration of waves.

4.3.3 Drainage Channels

At the Demonstration Site, there exist a total of 8 drainage channels with an approximate size of inside diameter of 700 m and 550mm. In order good drainage after the construction, circular culverts of appropriate size and amount will be installed as necessary in accordance with its required length.

4.3.4 Design plan and cross section

The design cross section for the flexible rock revetment at the Demonstration Site in Grand Sable is given in Annex 1.

(1)Technical details

The proposed flexible revetment for the demonstration site as shown in the plan and cross section at annex 4 shall run over a total distance of around 200 m including adjustment section to existing escarpment and shall have a width of about 10 to 15 m. The flexible revetment shall be having a

maximum height of 2.0 m.

The methodology of work for the construction of the flexible revetment structure would be simple and is as follows:

a) The site limits shall first be established and a silt fencing made of geotextile would be set up on the seaward boundary shall be placed temporarily around the area so as to secure any material during the construction of the structure.
b) Trees along the shoreline shall be pruned so as to allow ease of access to heavy trucks and excavators working on the site. No trees shall be cut from the site except if required for the construction. All mangrove plants shall be left untouched.
c) A site shall be identified in the immediate vicinity of the demonstration are for the stock piling of materials such as gravel and sand.
d) 2 backhoe loader of the type JCB 3CX on wheels will ensure the distribution of the materials from the stock pile to the heavy trucks for transportation to the site.
e) The construction site shall be cleared from any debris that may exist. The debris shall be disposed at an appropriate disposal facility.
f) An excavator on track shall place and fill appropriately the gravels for the installation of drainage channels connected to existing.
g) A specific location and level of the designed drainage channels shall be identified by topographic and levelling survey.
h) An excavator shall form the base of the drainage channel and place the crusher run to be compacted by a vibratory roller afterward.
i) An excavator on truck shall load precast concrete pipes for the drainage channels from the stock piling to be installed with an appropriate section specified in the drawings.
j) The specification of materials for the drainage channels would be as follows:
   (i) for the one connected to existing culvert located adjacent to S21, 8 units of precast concrete pipes with its size of 533mm in inside diameter would be required.
   (ii) for the one connected to existing culvert located adjacent to S20, 6 units of precast concrete pipes with its size of 533mm in inside diameter would be required.
   (iii) for the one connected to existing concrete pipe located adjacent to S19, 8units of precast concrete pipes with its size of 685mm in inside diameter would be required.
k) The heavy trucks shall then deposit the gravels from the road. The gravel shall be of appropriate size.
l) 2 backhoe loader of the type JCB 3CX on wheels shall flatten the stack of gravel over the sloping edge including adjustment sections of both north and south edge of the revetment.
m) A backhoe loader on wheels shall install the layer of rocks at the mouse of new and existing drainage channels with an appropriate section specified in the drawing.
n) Heavy trucks shall deposit on site the gravel of appropriate size for the main body of the revetment.
o) The backhoe loader shall place the stack of sand over the sloping edge to form the tip layer and finalize the whole form of flexible revetment.
p) The estimated volume of materials required for the flexible rock revetment structure would be as follows:
   (i) for the main body of the structure, around 4,600 m^3 of gravels with specified size would be required.
   (ii) for the sand layer, a volume of 400 m^3 of washed rock sand of specified size will be required.

All works shall be done from sunrise to sunset. The construction of the flexible revetment is expected to last for around 2 months.

Chapter 5 Preliminary Cost Estimates

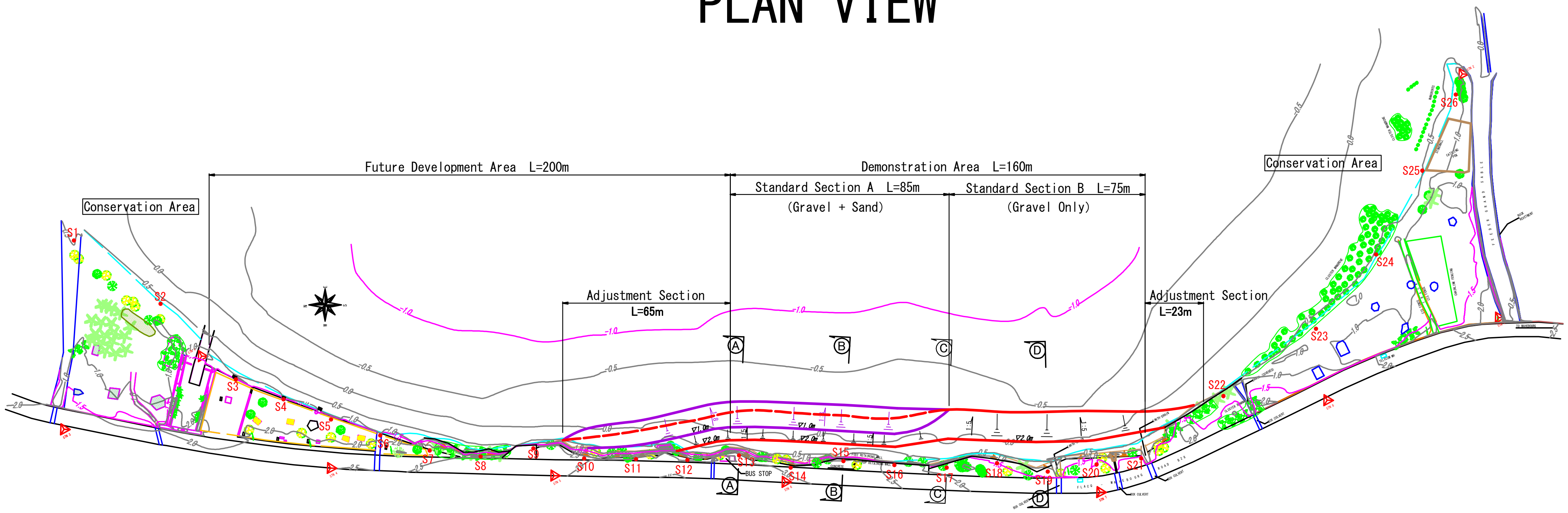
5. 1 Preliminary Cost Estimates

The preliminary cost estimates of the proposed works are detailed in Table 5.1 below.

Table 5-1 Gland Sable - Preliminary Cost Estimates

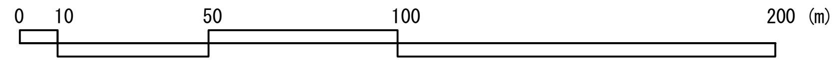
No	Work Description	Unit	Quantity	Rate	Amount	Remarks
				(MUR)	(MUR)	
1	Preparatory Works	sum	1		200,000	
2	Aggregate	ton	7,178	540	3,875,986	
3	Sand	ton	756	810	611,961	
4	Earth Works	m^3	7,933	100	793,326	
5	Drainage	unit	3	100,000	300,000	
	Sub Total				5,781,274	
6	Preliminaries & General Items			20%	1,156,255	
7	Contingencies			10%	578,127	
	Total Exc VAT				7,515,656	

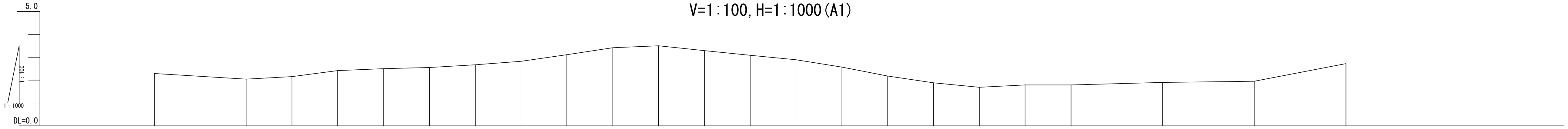
PLAN VIEW



Longitudinal Section

V=1:100, H=1:1000 (A1)





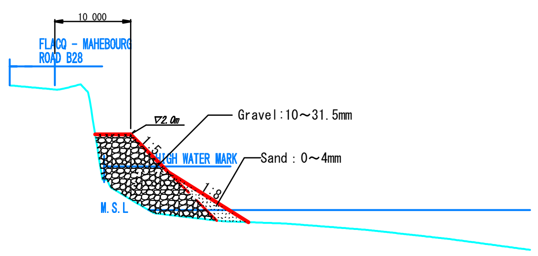
():Left Edge (coastal side) Level

Station	Distance (m)	Length (m)	Right Edge Road Level
S1	0	0	
S2	40	40	2.29
S3	40	80	2.04 (1.92)
S4	20	100	2.15 (2.08)
S5	20	120	2.41 (2.29)
S6	20	140	2.50 (2.39)
S7	20	160	2.55 (2.44)
S8	20	180	2.67 (2.54)
S9	20	200	2.82 (2.69)
S10	20	220	3.11 (2.97)
S11	20	240	3.41 (3.24)
S12	20	260	3.50 (3.31)
S13	20	280	3.29 (3.18)
S14	20	300	3.08 (2.91)
S15	20	320	2.89 (2.74)
S16	20	340	2.57 (2.38)
S17	20	360	2.18 (2.02)
S18	20	380	1.88 (1.73)
S19	20	400	1.74 (1.50)
S20	20	420	1.79 (1.55)
S21	20	440	1.79 (1.61)
S22	40	480	1.90 (1.80)
S23	40	520	1.95
S24	40	560	2.72
S25	40	600	
S26	40	640	

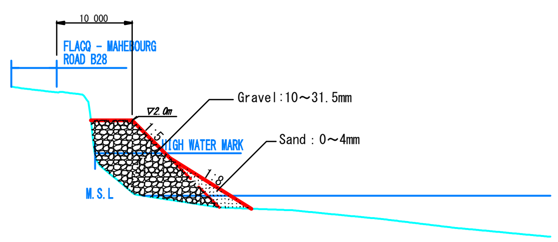
Standard Cross Section

V=1:100, H=1:500 (A1)

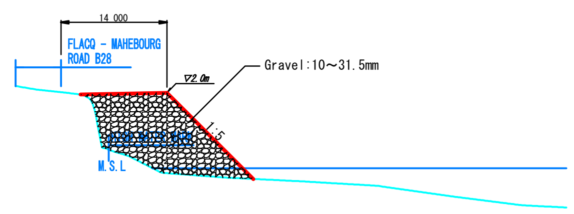
A — A (S13)



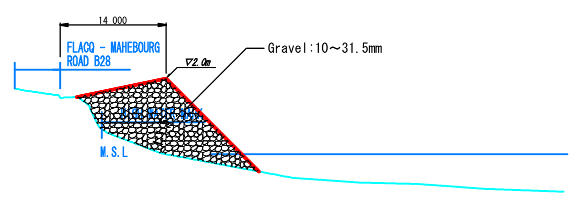
B — B (S15)



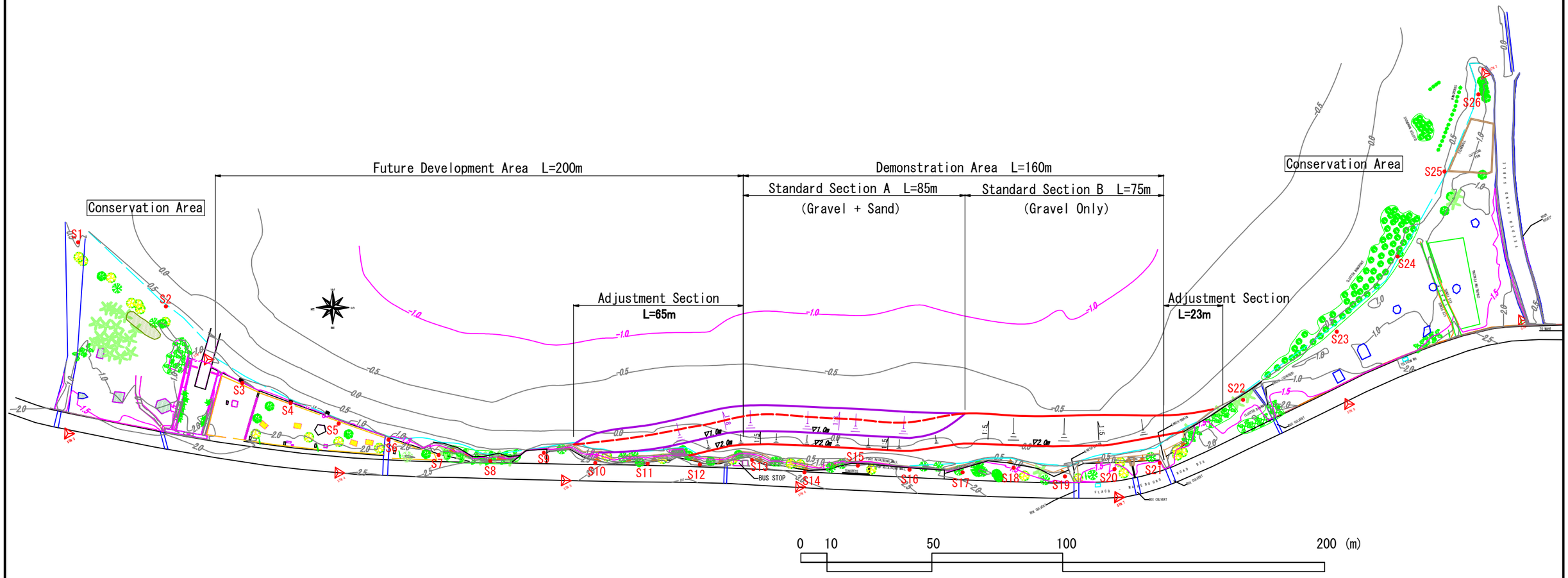
C — C (S17)



D — D (S19)

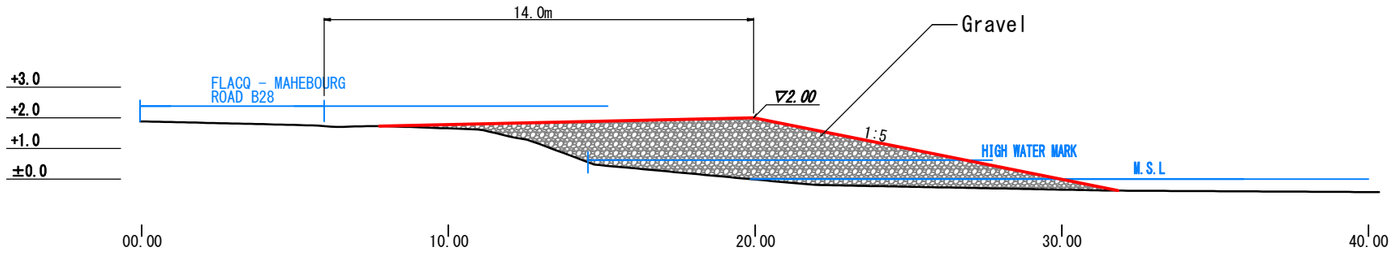


PLAN VIEW

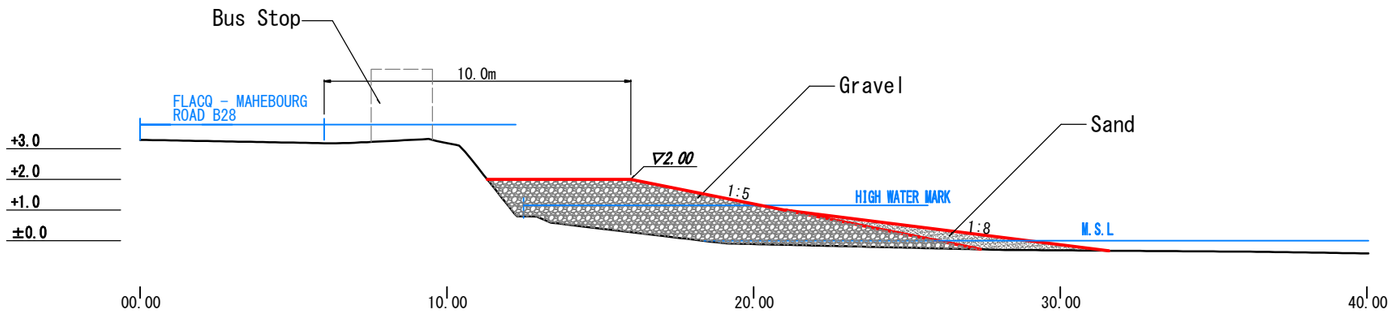

Future Development Area L=200m
Demonstration Area L=160m
Standard Section A L=85m
(Gravel + Sand)
Standard Section B L=75m
(Gravel Only)
Conservation Area
Conservation Area
Adjustment Section
L=65m
Adjustment Section
L=23m
S1
S2
S3
S4
S5
S6
S7
S8
S9
S10
S11
S12
S13
S14
S15
S16
S17
S18
S19
S20
S21
S22
S23
S24
S25
S26
BUS STOP
0 10 50 100 200 (m)

STANDARD CROSS SECTION

S18 (Standard Section B, Gravel Only)



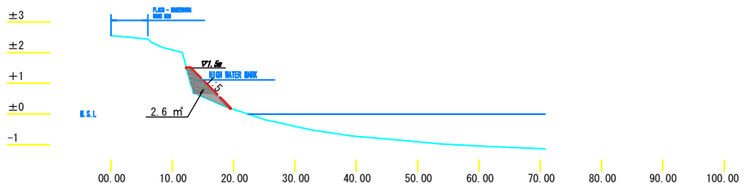
S13 (Standard Section A, Gravel + Sand)



CROSS SECTION (2/5)

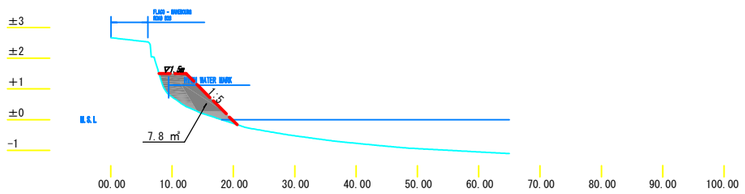
ALIGNMENT: S7 SECTION 7

Elevation displayed at 5 X scale.



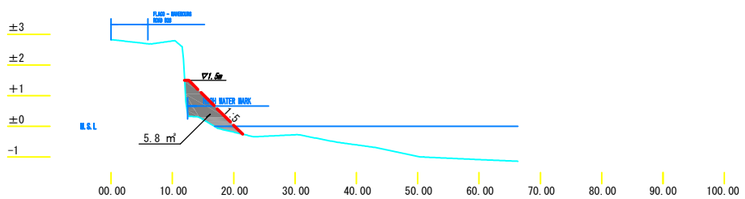
ALIGNMENT: S8 SECTION 8

Elevation displayed at 5 X scale.



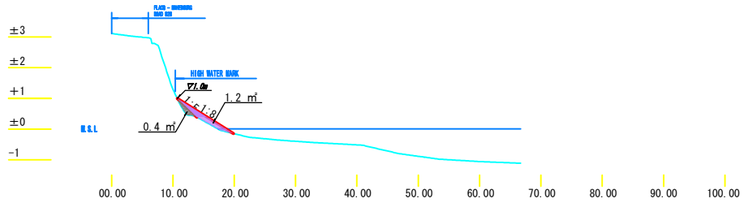
ALIGNMENT: S9 SECTION 9

Elevation displayed at 5 X scale.



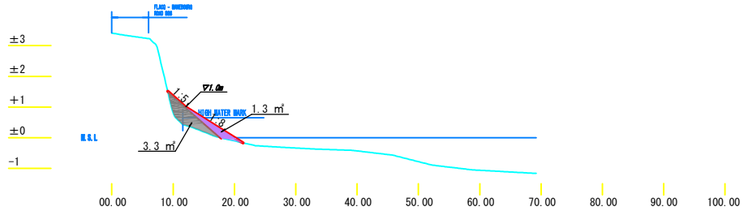
ALIGNMENT: S10 SECTION 10

Elevation displayed at 5X scale.



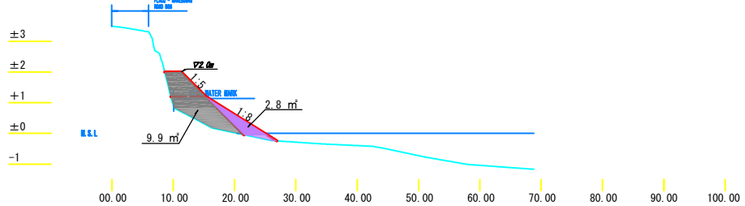
ALIGNMENT: S11 SECTION 11

Elevation displayed at 5X scale.



ALIGNMENT: S12 SECTION 12

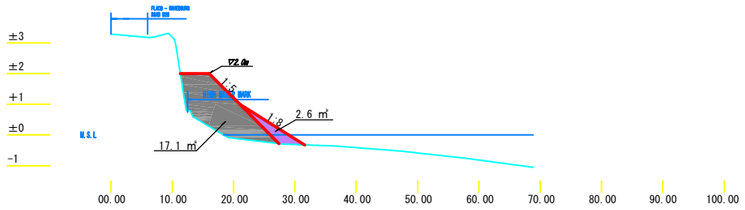
Elevation displayed at 5X scale.



CROSS SECTION (3/5)

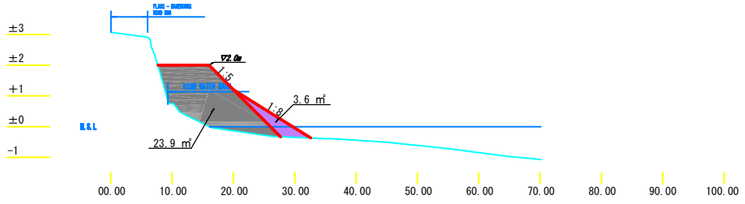
ALIGNMENT: S13 SECTION 13

Elevation displayed at 5X scale.



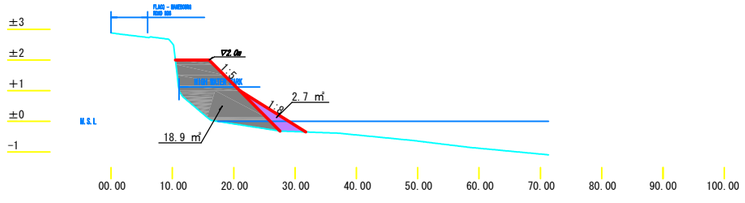
ALIGNMENT: S14 SECTION 14

Elevation displayed at 5X scale.



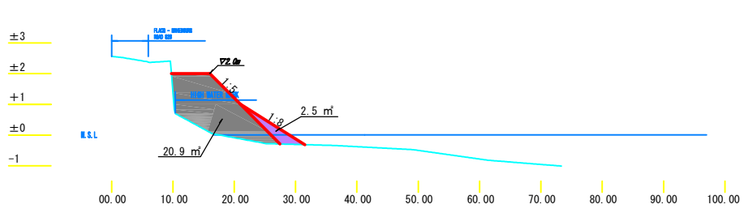
ALIGNMENT: S15 SECTION 15

Elevation displayed at 5X scale.



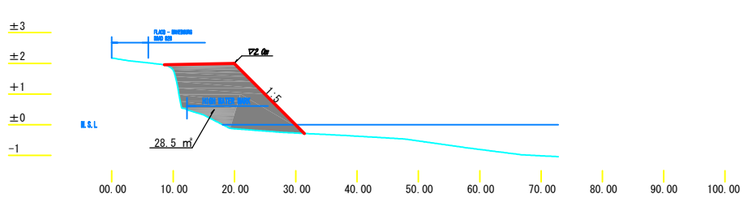
ALIGNMENT: S16 SECTION 16

Elevation displayed at 5X scale.



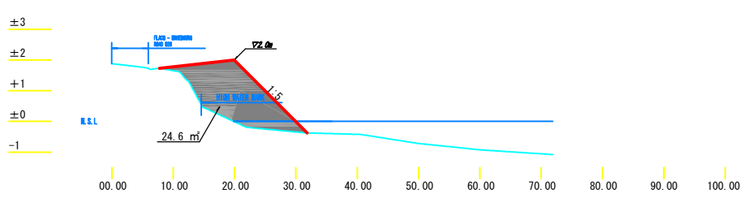
ALIGNMENT: S17 SECTION17

Elevation displayed at 5X scale.



ALIGNMENT: S18 SECTION 18

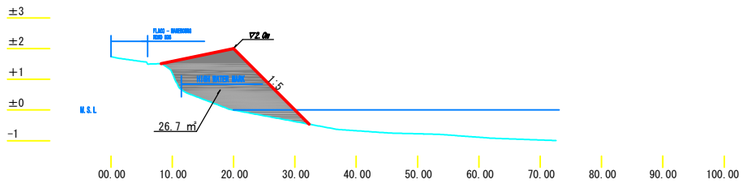
Elevation displayed at 5X scale.



CROSS SECTION (4/5)

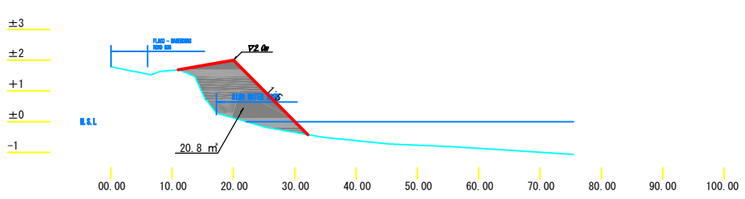
ALIGNMENT: S19 SECTION 19

Elevation displayed at 5 X scale.



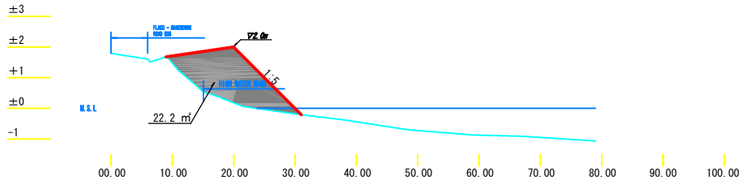
ALIGNMENT: S20 SECTION 20

Elevation displayed at 5 X scale.



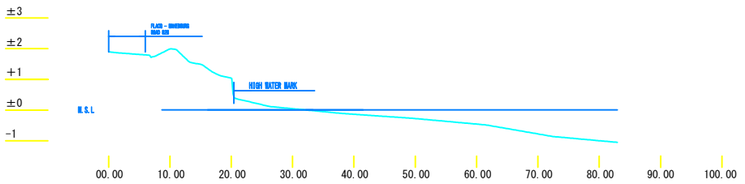
ALIGNMENT: S21 SECTION 21

Elevation displayed at 5 X scale.



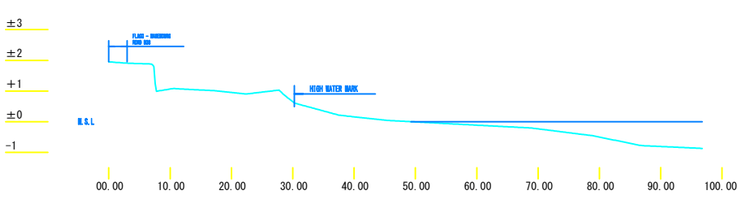
ALIGNMENT: S22 SECTION 22

Elevation displayed at 5 X scale.



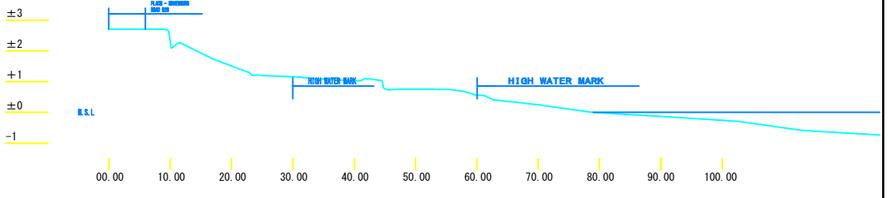
ALIGNMENT: S23 SECTION 23

Elevation displayed at 5 X scale.



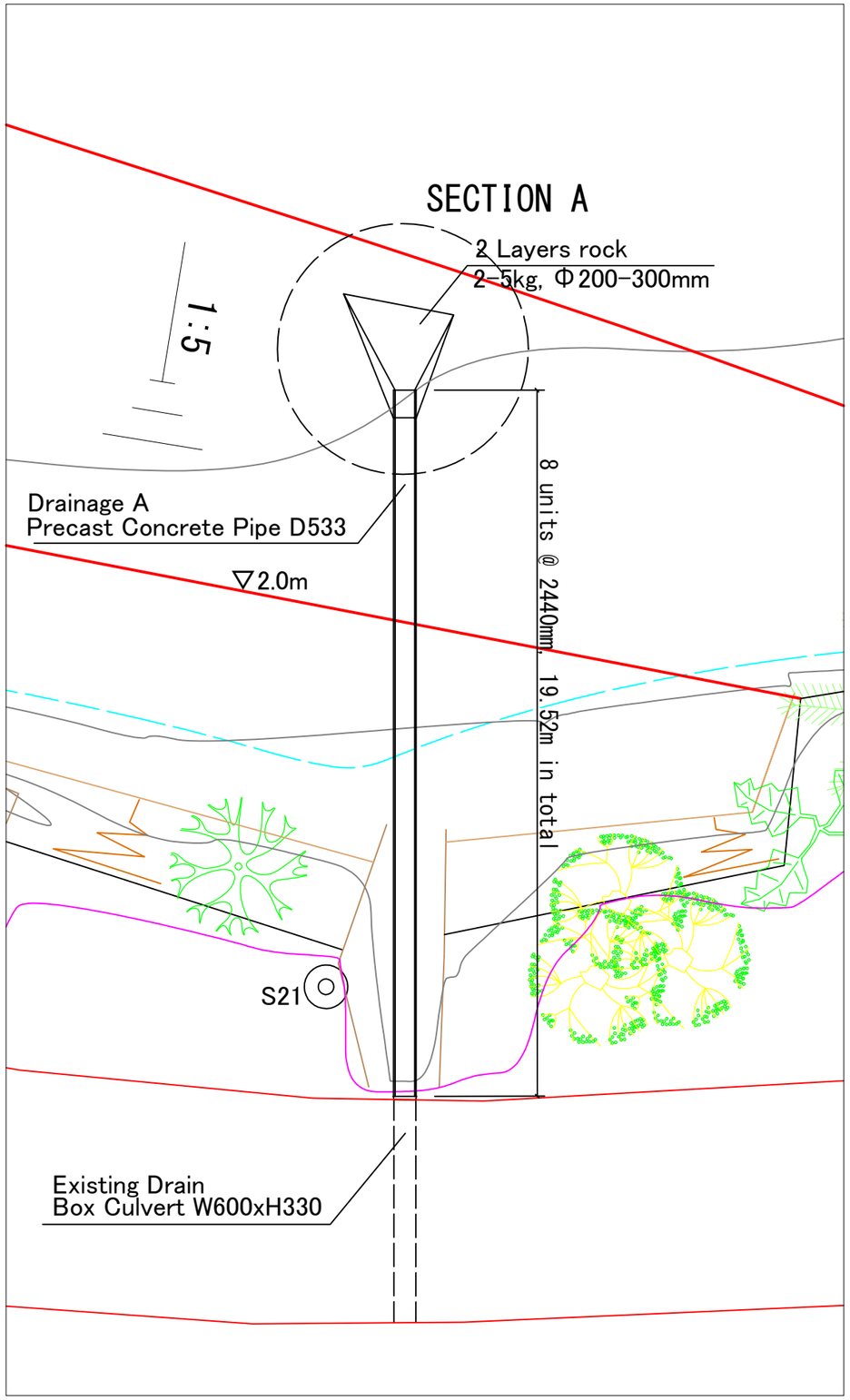
ALIGNMENT: S24 SECTION 24

Elevation displayed at 5 X scale.

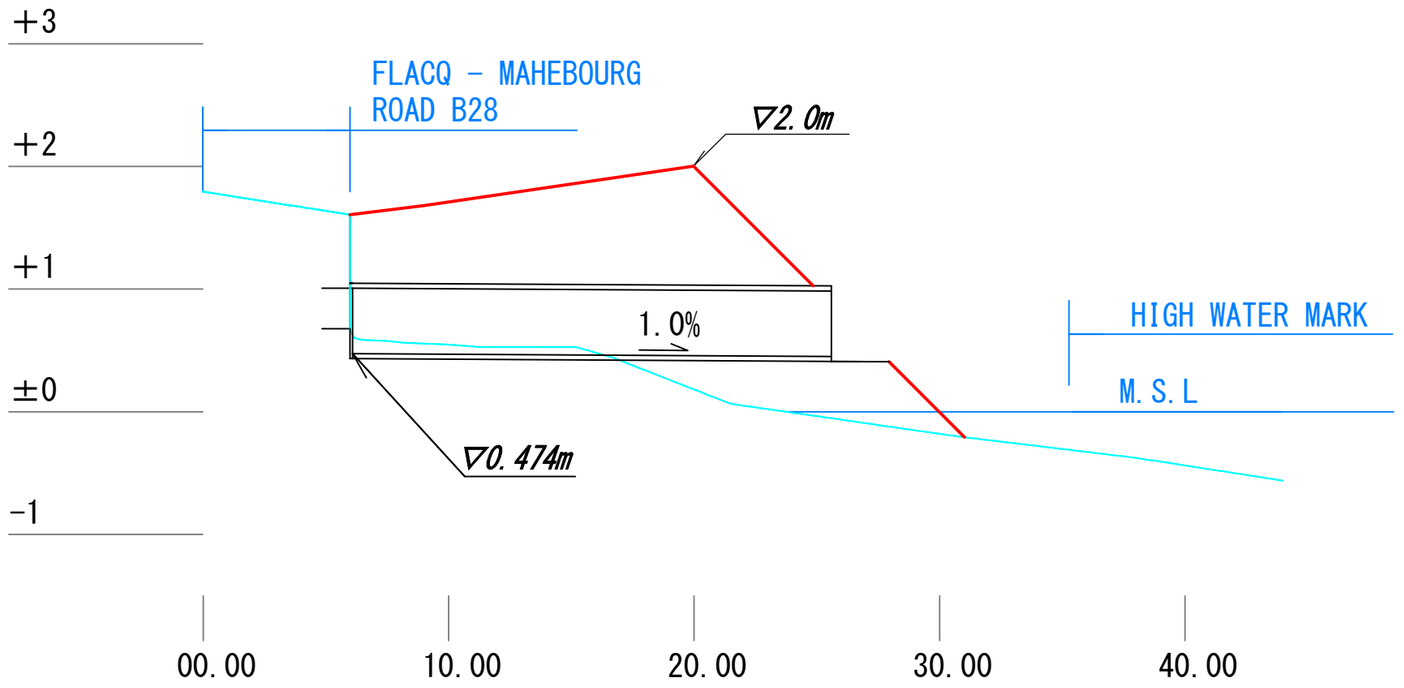


DRAINAGE DETAILS (Drainage A)

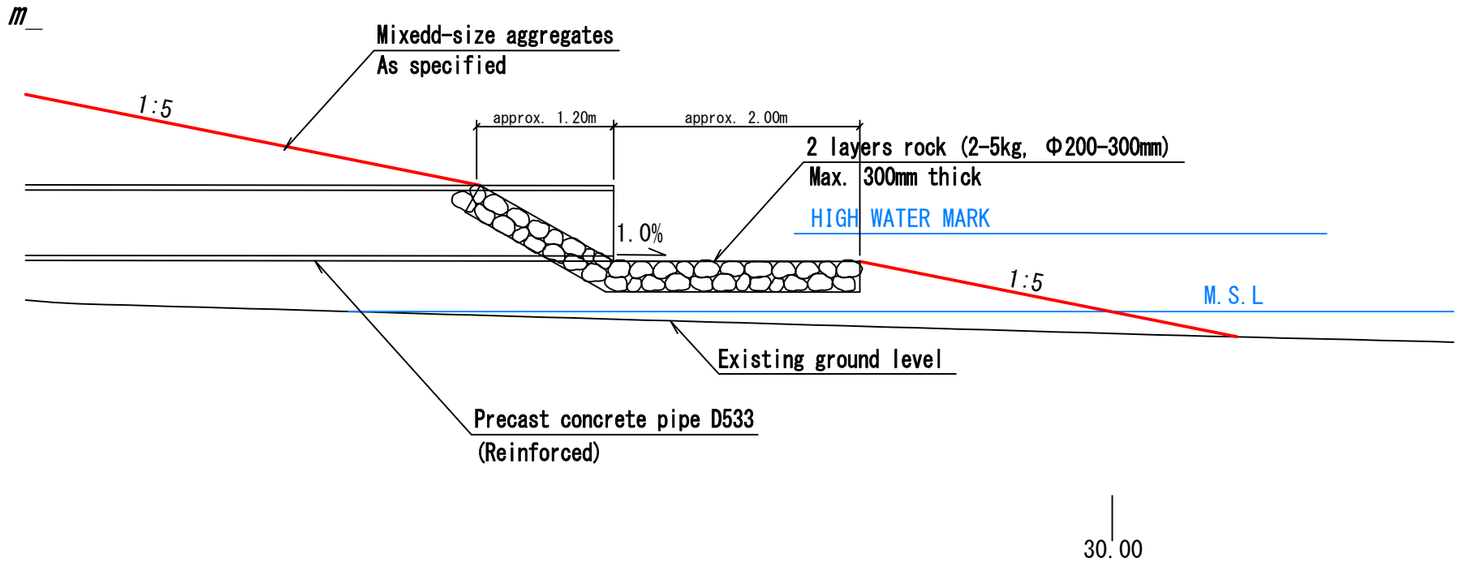
OVERALL PLAN



PROFILE (Location: S21)

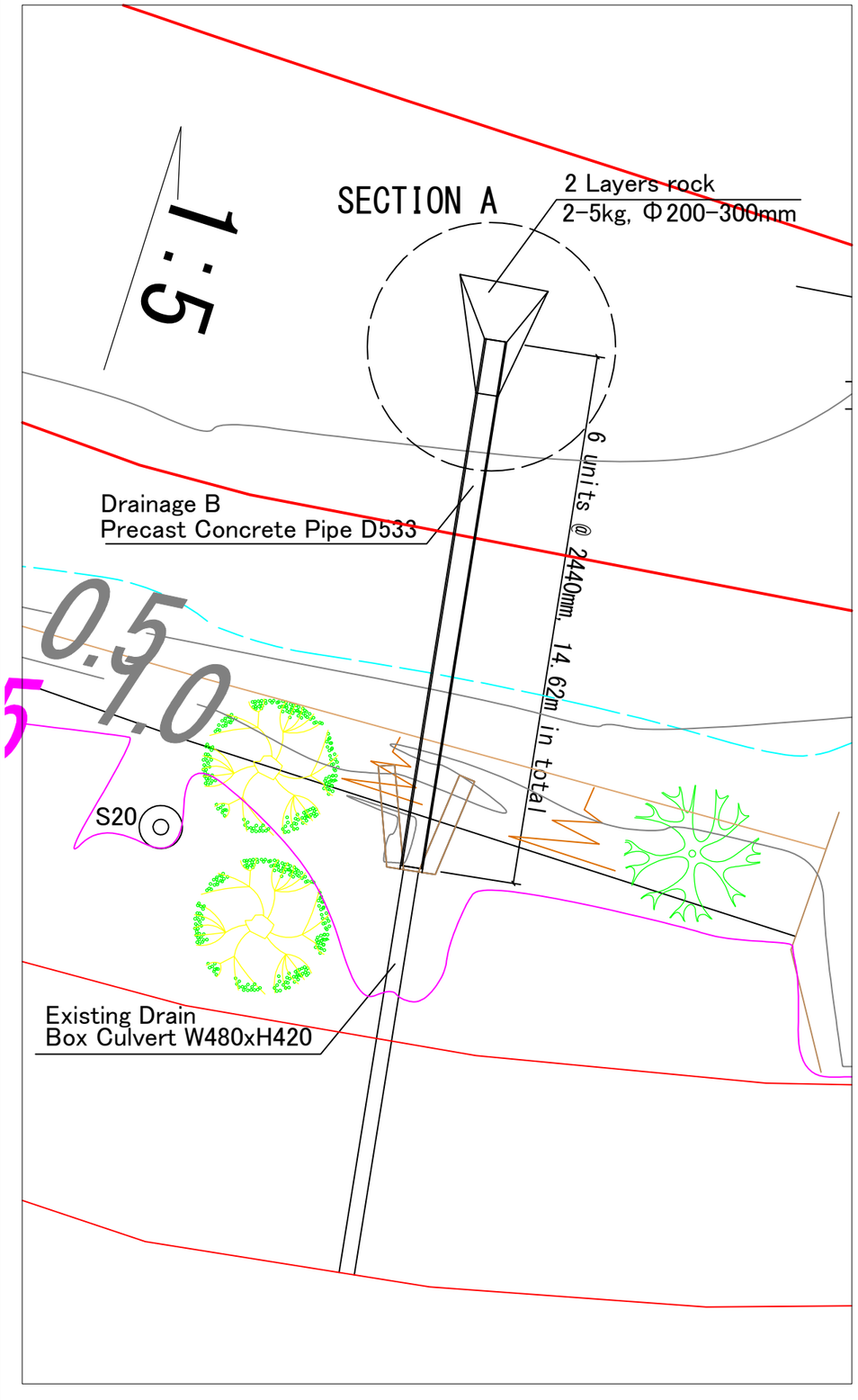


SECTION A

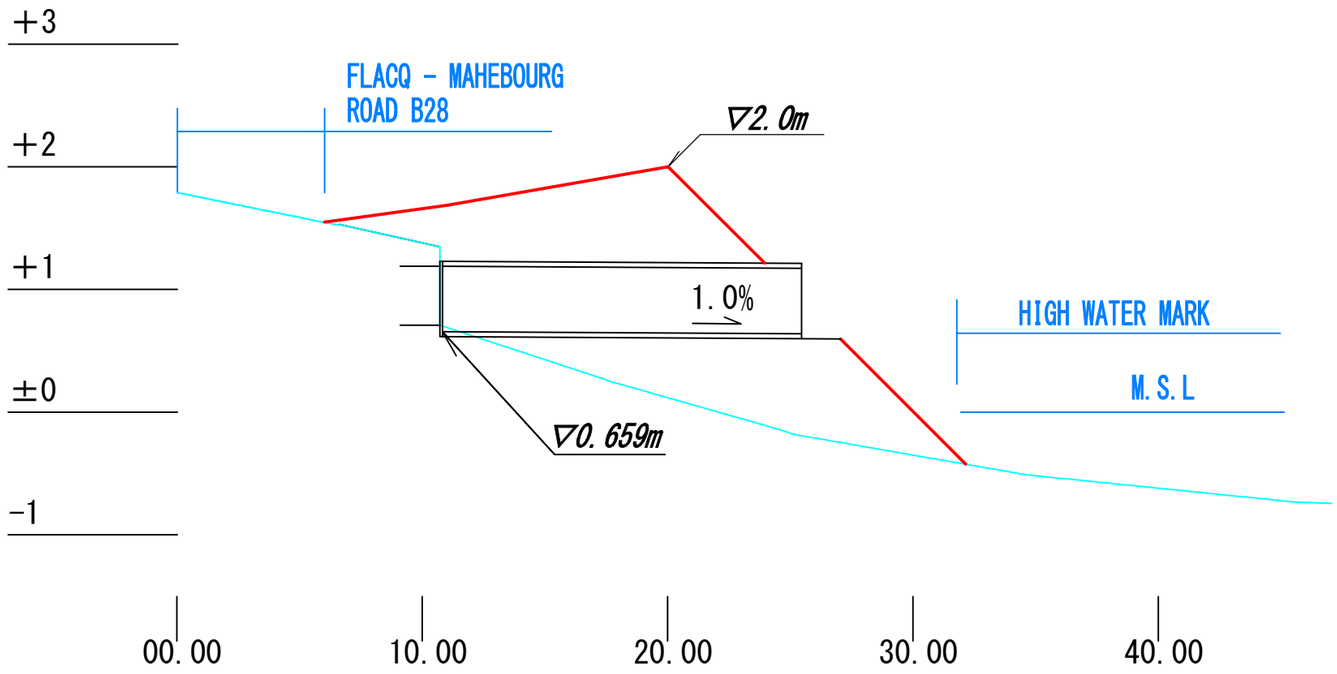


DRAINAGE DETAILS (Drainage B)

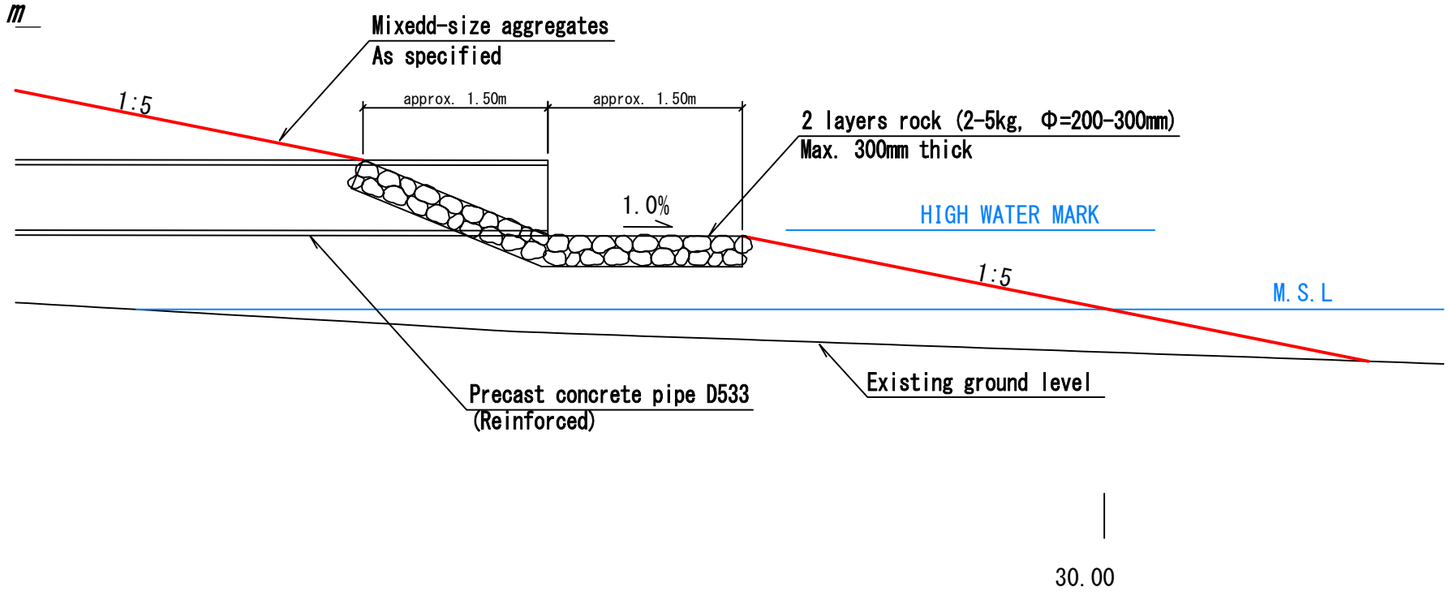
OVERALL PLAN



PROFILE (Location: B/W S20 & S21)

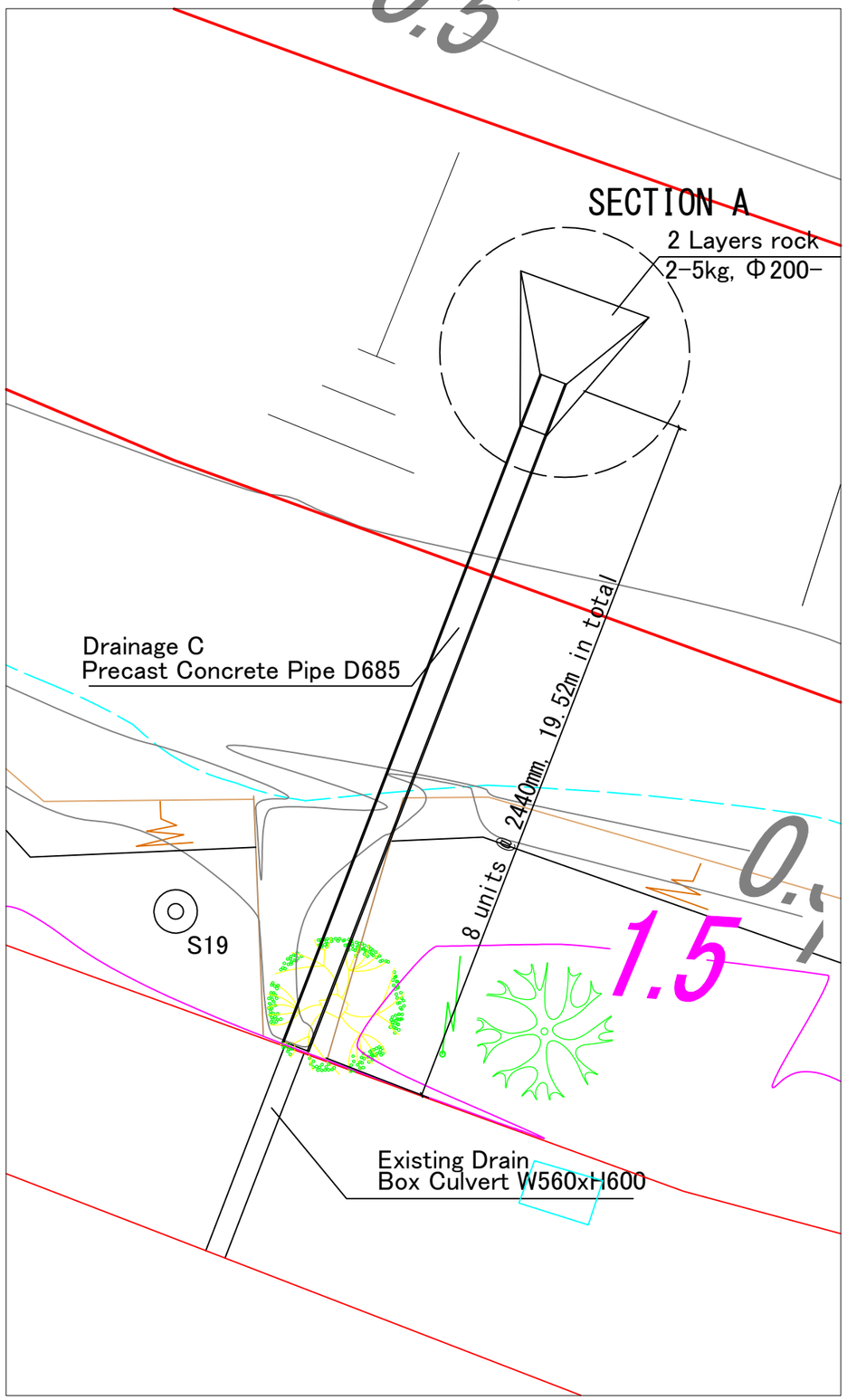


SECTION A

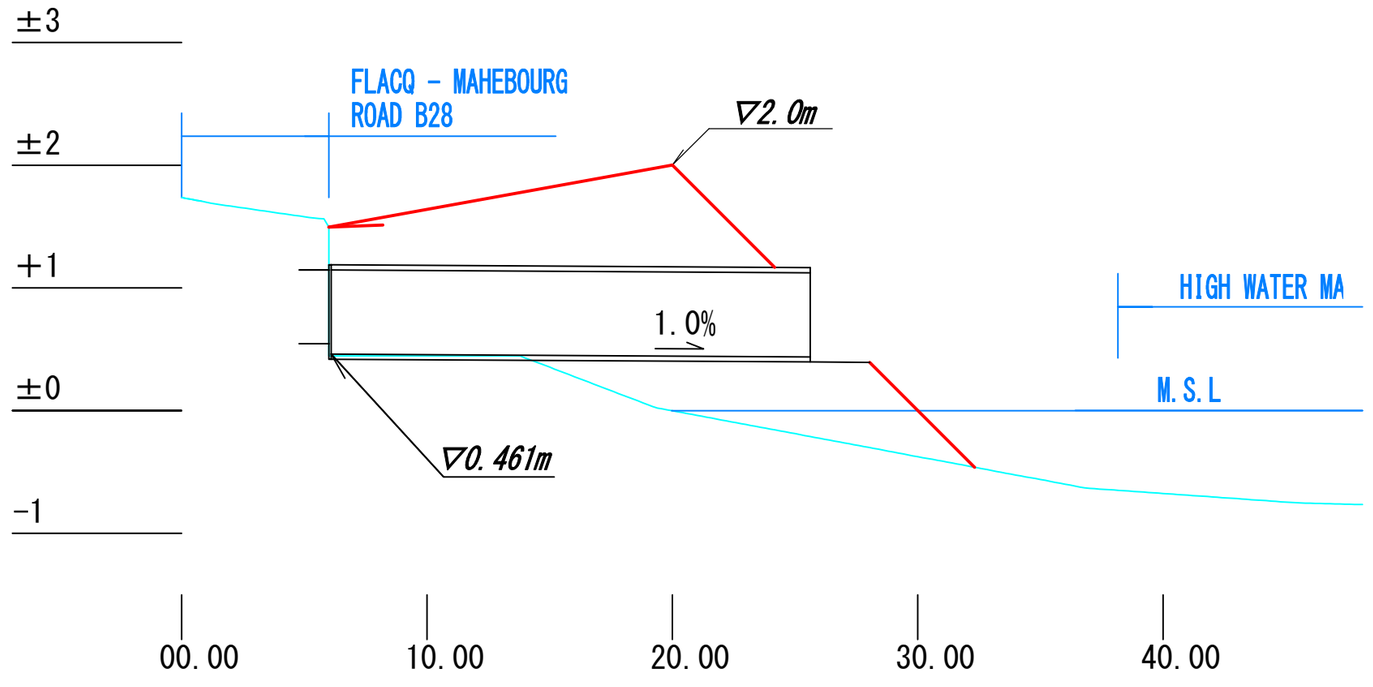


DRAINAGE DETAILS (Drainage C)

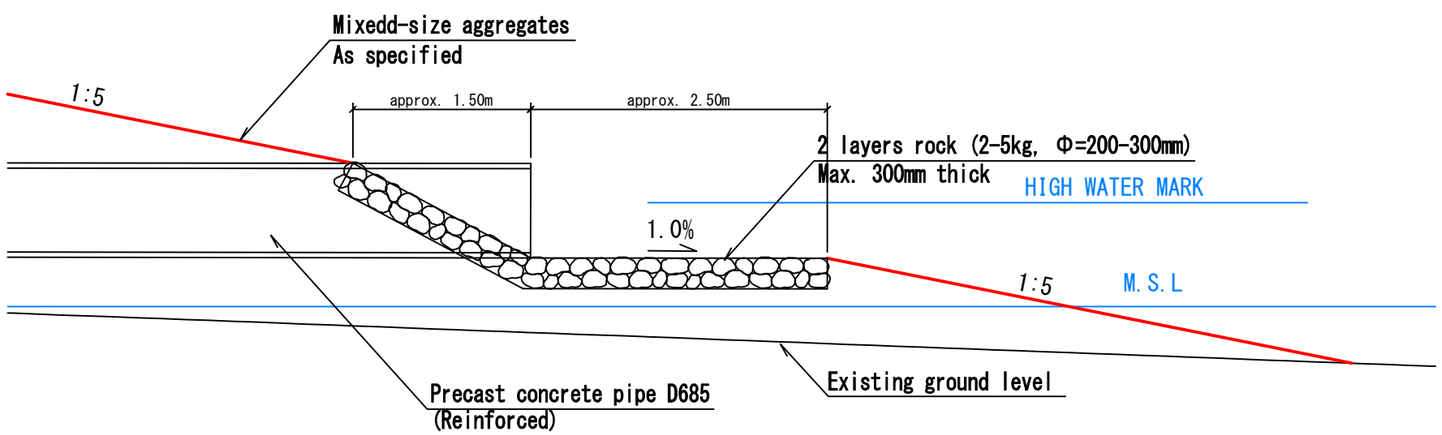
OVERALL PLAN



PROFILE (Location: S19)



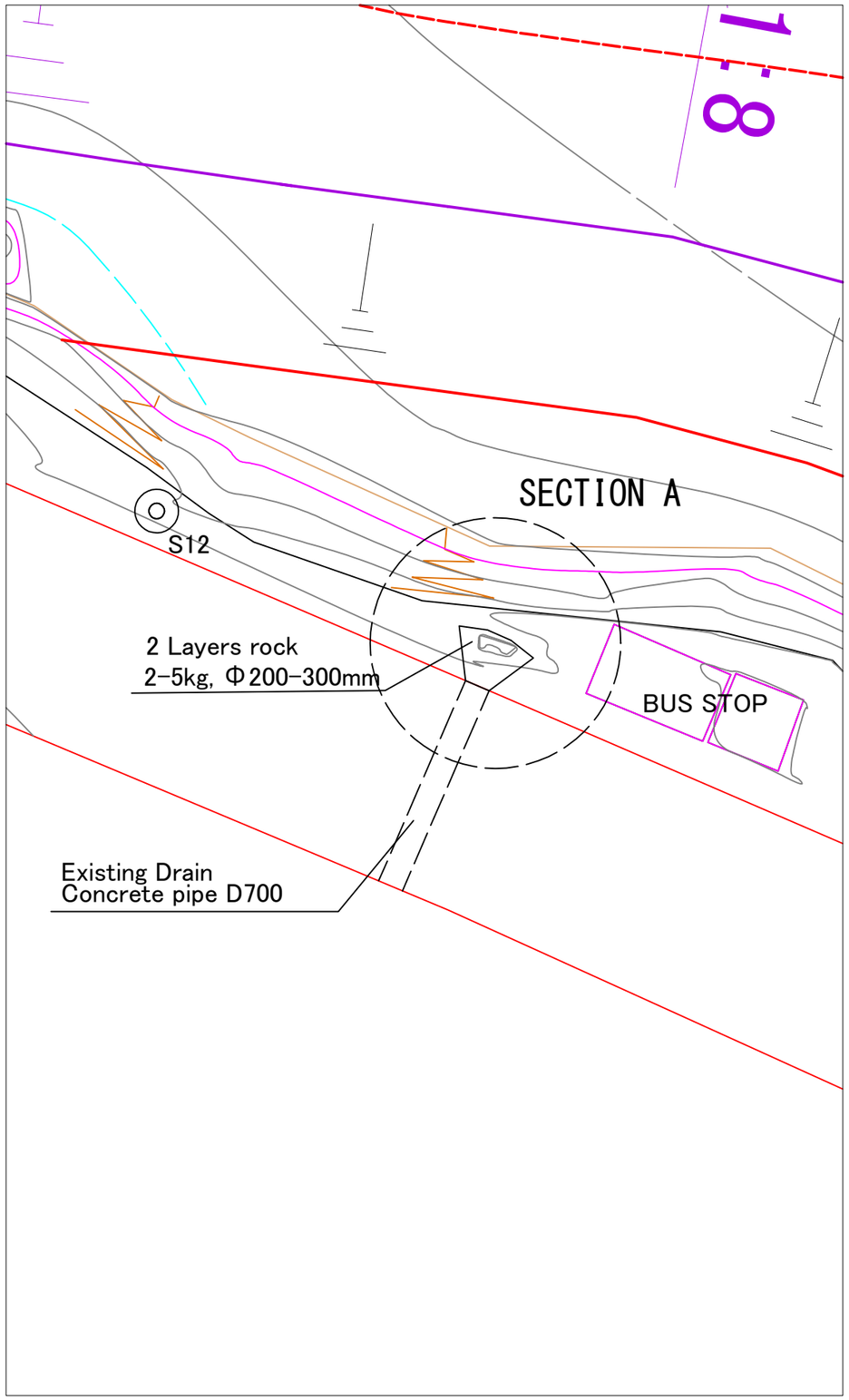
SECTION A



30.00

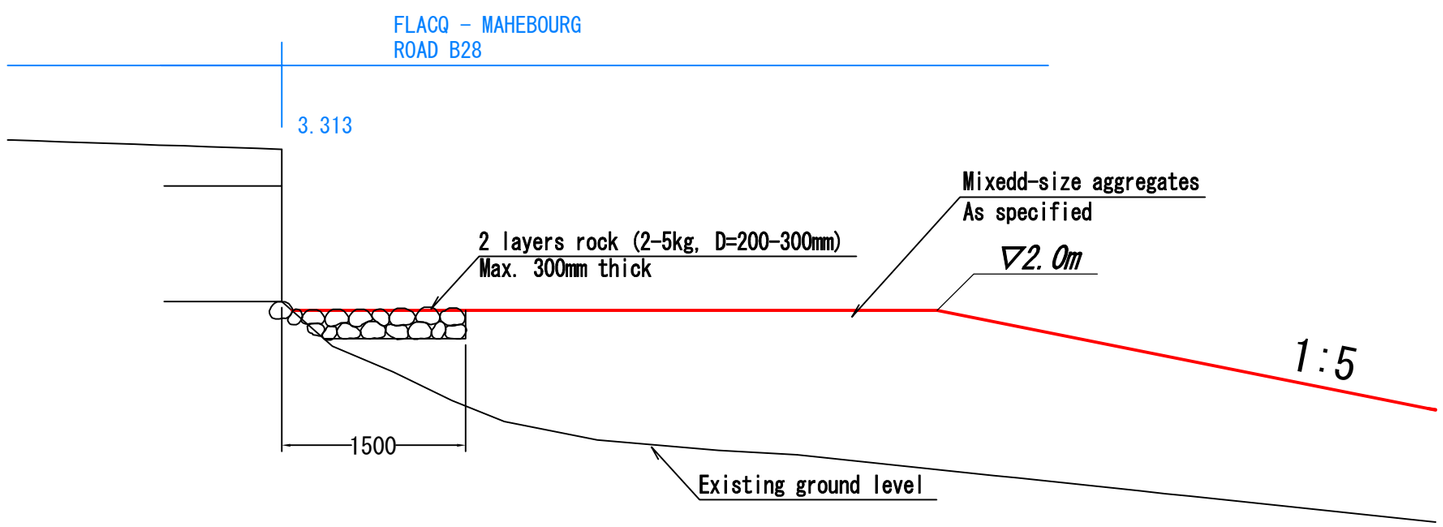
DRAINAGE DETAILS (Drainage D)

OVERALL PLAN



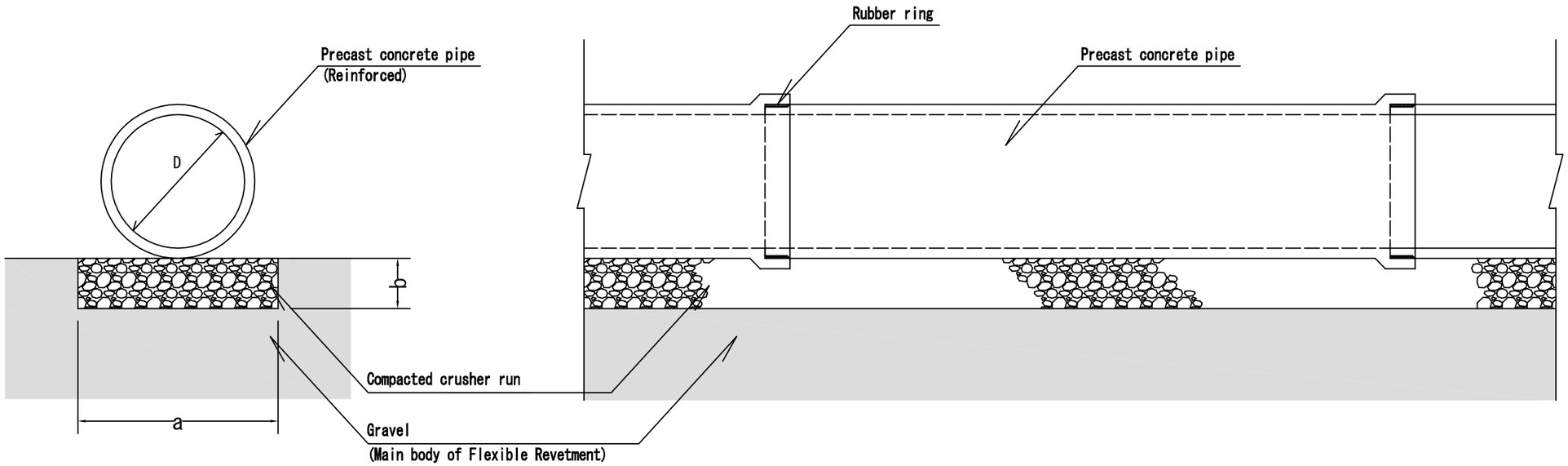
PROFILE

SECTION A (Location: S12)



DRAINAGE DETAILS (Precast Concrete Pipe)

SECTION (Precast concrete pipe)

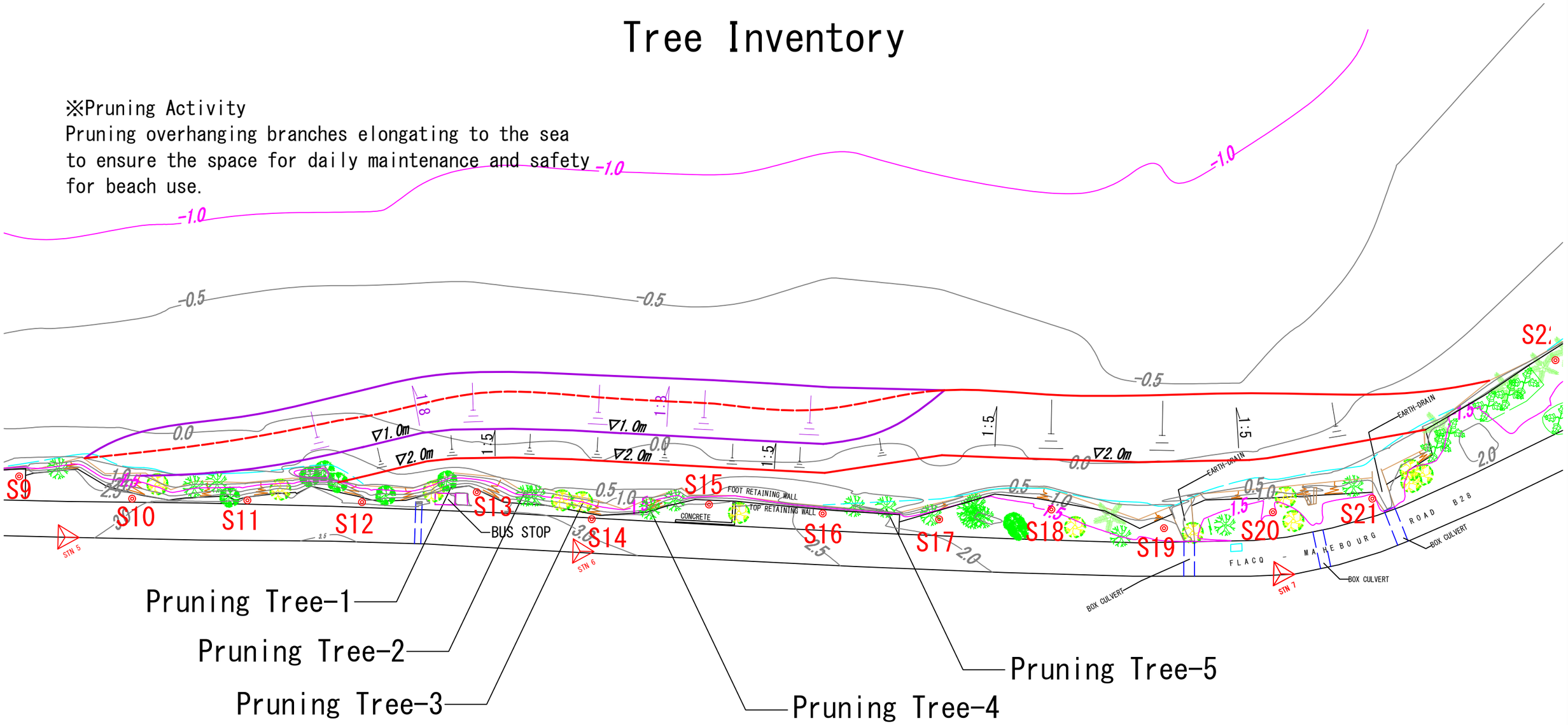


Precast concrete pipe

D	a	b
533 mm	800 mm	200 mm
685 mm	950 mm	200 mm

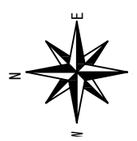
Tree Inventory

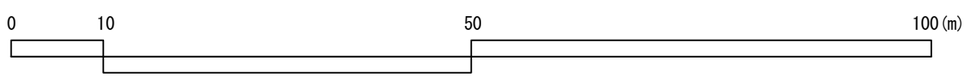
※Pruning Activity
Pruning overhanging branches elongating to the sea
to ensure the space for daily maintenance and safety
for beach use.



LEGEND

ID	H(m)	W(m)	D(mm)	Spp.	Remarks
Pruning Tree-1	5.5	5.0	25		
Pruning Tree-2	6.0	8.0	35,35,50,15,10		Multi-Trunk
Pruning Tree-3	3.5	8.0	25		
Pruning Tree-4	6.0	5.0	45,20,20,16,12		Multi-Trunk
Pruning Tree-5	6.0	8.0	40,20		Multi-Trunk





5. Tender Document of a Flexible Revetment

KOKUSAI KOGYO CO. LTD.

Requests

Tender for Construction of Flexible Revetment at Grand Sable

Bid No: ***Tender No.JICA/GS/2013***

JICA
17 September 2013

Kokusai Kogyo Co. Ltd.

JICA Project Expert Team

Ministry of Environment and Sustainable Development

6th Floor, Ken Lee Tower

Cnr Barracks and St Georges Streets

Port Louis

KOKUSAI KOGYO CO. LTD.

The Project for Capacity Development on Coastal Protection and Rehabilitation, the Project of Landslide Management in the Republic of Mauritius.

Construction of Flexible Revetment at Grand Sable

Bidding Documents

Prepared by
JICA Project Expert Team
and CLAMS Ltd

20 September 2013

The template from the Public Procurement Office of the Republic of Mauritius has been used in the preparation of this Bidding Document. However, this present procurement procedure remains Private and the successful Contractor shall be under a private contract with the Employer. The Laws in force in Mauritius shall prevail over the present procurement.

Standard Bidding Document

Table of Contents

PART 1 – Bidding Procedures

Section 1 - Instructions to Bidders

Table of Clauses

Section I - Instructions to Bidders

A. General

1. Scope of Bid

1.1 The Kokusai Kogyo Co. Ltd. as defined in Section II "Bidding Data Sheet" **(BDS)** also referred to herein as Employer invites bids for Construction of Flexible Revetment at Grand Sable, as **described in the BDS** and Section VII, "Particular Conditions of Contract" (PCC).

The name and identification number of the Contract are **provided in the BDS and the PCC**.

1.2 The successful Bidder shall be expected to complete the Works by the Intended Completion Period **specified in the BDS.**

1.3 Throughout these bidding documents, the terms:

(a) "writing" means any typewritten or printed communication, including e-mail and facsimile transmission,

(b) "day" means calendar day, and

(c) Singular also means plural.

2. Source of Fund

2.1 The Works shall be financed by the Kokusai Kogyo Co. Ltd., **unless otherwise stated in the BDS.**

3. Challenge and Appeal

3.1 Unsatisfied bidders shall follow procedures as legally prescribed in the Republic of Mauritius to challenge procurement proceedings and award of procurement contracts.

4. Fraud and Corruption

4.1 The Kokusai Kogyo Co. Ltd. and Government of the Republic of Mauritius require that bidders / suppliers / contractors, participating in procurement in Mauritius, observe the highest standard of ethics during the procurement process and execution of contracts.

4.2 The Employer will reject a proposal for award if it determines that the Bidder recommended for award has, directly or through an agent, engaged in corrupt, fraudulent, collusive, coercive or obstructive practices in competing for the contract in question;

For the purposes of this Sub-Clause:

(i) "corrupt practice" is the offering, giving, receiving or soliciting, directly or indirectly, of anything of value to

influence improperly the actions of another party;

(ii) "fraudulent practice" is any act or omission, including a misrepresentation, that knowingly or recklessly misleads, or attempts to mislead, a party to obtain a financial or other benefit or to avoid an obligation;

(iii) "collusive practice" is an arrangement between two or more parties designed to achieve an improper purpose, including to influence improperly the actions of another party;

(iv) "coercive practice" is impairing or harming, or threatening to impair or harm, directly or indirectly, any party or the property of the party to influence improperly the actions of a party;

(v) "obstructive practice" is deliberately destroying, falsifying, altering or concealing of evidence material to the investigation or making false statements to investigators in order to materially impede an investigation into allegations of a corrupt, fraudulent, coercive or collusive practice; and/or threatening, harassing or intimidating any party to prevent it from disclosing its knowledge of matters relevant to the investigation or from pursuing the investigation.

5. Eligible Bidders 5.1 Only the companies short-listed and invited by the Employer shall be eligible for submitting their proposal.

6. Qualifications of Bidders 6.1 All bidders shall provide in Section III, a preliminary description of the proposed work method and schedule, including drawings and charts, as necessary.

6.2 Bidders shall include the information and documents listed hereunder with their bids, unless otherwise **stated in the BDS**. If, after opening of bids, it is found that any document is missing, the Employer may request the submission of that document subject to clause 30. The non-submission of the documents by the Bidder within the prescribed period may lead to the rejection of its bid.

(a)copies of original documents defining the constitution or legal status, place of registration, and principal place of business of the Bidder;

(b) total monetary value of construction works performed for each of the last five years;

(c) experience in works of a similar nature and size for each of the last five years or as otherwise **stated in the BDS**; and clients who may be contacted for further information on those contracts;

(d) major items of construction equipment proposed to carry out the Contract;

(e) qualifications and experience of key site personnel and technical personnel proposed for the contract;

(f) evidence of adequacy of working capital for this Contract (access to line(s) of credit and availability of other financial resources);

7. Cost of Bidding

7.1 The Bidder shall bear all costs associated with the preparation and submission of its Bid, and the Employer shall in no case be responsible or liable for those costs irrespective of the outcome of the bidding process.

8. Site visit/Pre-bid meeting

8.1 Bidders, at the Bidders' own responsibility and risk, are encouraged to visit and examine the Site of Works and its surroundings and obtain all information that may be necessary for preparing their Bids and entering into a contract for construction of the Works. The costs of visiting the Site shall be at the Bidders' own expense.

8.2 The Bidder or its designated representative is invited to attend a pre-bid meeting, as **provided for in the BDS**. The purpose of the pre-bid meeting will be to clarify issues and to answer questions on any matter that may be raised at that stage.

Non-attendance at the pre-bid meeting will not be a cause for disqualification of a bidder.

B. Contents of Bidding Document

9. Sections of

9.1 The Bidding Document consists of all the Sections indicated

Bidding Document

below, and should be read in conjunction with any Addenda issued in accordance with ITB 10.

Section I - Instructions to Bidders (ITB)
Section II- Bidding Data Sheet
Section III - Bidding Forms
Section IV- Evaluation Criteria
Section V -Employer's Requirements
Section VI–General Conditions of Contract
Section VII-Particular Conditions of Contract
Section VIII-Contract Forms

9.2 The Invitation for Bids issued by the Employer is not part of the Bidding Document.

10. Clarification of Bidding Document

10.1 A prospective Bidder requiring any clarification of the Bidding Document shall contact the Employer in writing at the Employer's address **indicated in the BDS.**

The Employer will respond in writing to any request for clarification, provided that such request is received 5 days prior to the deadline for submission of bids.

Should the Employer deem it necessary to amend the Bidding Document as a result of a request for clarification, it shall do so following the procedure under ITB 10.

11. Amendment of Bidding Document

11.1 At any time prior to the deadline for submission of bids, the Employer may amend the Bidding Document by issuing addenda and extend the deadline for submission of bids, if needed.

C. Preparation of Bids

12. Language of Bid

12.1 The Bid, supporting documents as well as all correspondence relating to the bid exchanged by the Bidder and the Employer shall be in English Language.

13. Documents Comprising the Bid

13.1 The Bid shall comprise the following:

(a) Bid submission Form (in the format indicated in Section III);

(b) Qualification information and documentary evidence establishing the Bidder's qualifications to perform the contract;

(c) completed Breakdown of Prices and Activity Schedule;

(d) Bid Security as a subscription to a Bid Securing Declaration in the Bid Submission Form;

and any other material required to be completed and submitted by

bidders, as specified in ITB **and the BDS**.

14. Bid Submission Form and Schedules

14.1 The Bid Submission Form, Schedules, and all documents listed under ITB 13.1 shall be prepared using the relevant forms, if so provided.

15. Alternative Proposal

15.1 Alternative Technical Proposals and completion dates if allowed shall be indicated in Section V-Specifications. The evaluation methodologies for their consideration shall be given in Section IV.

16. Bid Prices and Discounts

16.1 The Contract shall be for the whole Works, as described in ITB Sub-Clause 1.1, based on the priced Activity Schedule submitted by the Bidder.

16.2 Bidders shall fill in rates and prices for all items of the Works described in the drawings and specifications and listed in the Activity Schedule. Items for which no rate or price is entered by Bidders, shall not be paid for by the Kokusai Kogyo Co. Ltd. when executed and shall be deemed covered by the other rates and prices in the Breakdown of prices and Activity Schedule. Corrections, if any, shall be made by crossing out, initialing, dating and rewriting.

16.3 All duties, taxes, and other levies payable by the Contractor under the Contract, or for any other cause, as of the date 14 days prior to the deadline for submission of bids, and total Bid price submitted by Bidders.

16.4 The price to be quoted in the Bid Submission Form shall be the total price of bid after any discount offered.

The discount if any and the conditions of its application shall be indicated separately.

17. Currencies of Bid and Payment

17.1 The bid price and rates shall be in Mauritian Rupees and fixed for the duration of the contract unless otherwise **specified in the BDS.**

18. Documents Comprising the Technical Proposal

18.1 The Bidder shall furnish a Technical Proposal including a statement of work methods, equipment, personnel, schedule and any other information as stipulated in the Bidder Qualification Form(section III), in sufficient details to demonstrate the understanding and adequacy of the Bidders' proposal to meet the work requirements and the completion time.

19. Period of Validity of Bids

19.1 Bids shall remain valid for a period of 90 days after the bid submission deadline prescribed by the Employer unless otherwise **specified in the BDS.**

19.2 In exceptional circumstances, prior to expiry of the original bid validity period, the Employer may request that the bidders extend the period of validity for a specified additional period. The request and the responses thereto shall be made in writing.

20. Bid Security/Bid Securing Declaration

20.1 The Bidder shall furnish either a subscription to a Bid Securing Declaration or a Bid Security in its original form with its bid as part of its bid, if so **required in the BDS**.

20.2 Any bid not accompanied by an enforceable and substantially compliant subscription to a Bid Securing Declaration in the Bid Submission Form, if required in accordance with ITB 20.1, shall be rejected by the Employer as non-responsive.

21. Format and Signing of Bid

21.1 The Bidder shall prepare one original of the documents comprising the bid as described in ITB 13.1 and clearly mark it "ORIGINAL". In addition, the Bidder shall submit two copies of the bid and clearly mark each of them "COPY." In the event of any discrepancy between the original and the copies, the original shall prevail.

21.2 The original and all copies of the bid shall be typed or written in indelible ink and shall be signed by a person duly authorized to sign on behalf of the Bidder.

D. Submission and Opening of Bids

22. Sealing and Marking of Bids

22.1 Bidders may always submit their bids by mail or by hand. Procedures for submission, sealing and marking are as follows:

(a) Bidders submitting bids by mail or by hand shall enclose the original and the two copies of the Bid in the same sealed envelopes.

22.2 The envelope shall:

(a) bear the name and address of the Bidder;

(b) be addressed to the Employer as specified in ITB 23.1;

(c) bear the specific identification of this bidding process indicated in accordance with ITB 1.1; and

(d) bear a warning not to open before the time and date for bid opening.

23. Deadline for Submission of Bids

23.1 Bids shall be delivered to the Employer at the address and no later than the time and date **specified in the BDS**.

The Employer may, at its discretion, extend the deadline for the submission of bids by amending the Bidding Document in

accordance with ITB 10.

24. Late Bids

24.1 Late bids shall not be considered. They will be returned unopened

25. Withdrawal, Substitution, and Modification of Bids

25.1 No bid may be withdrawn, substituted, or modified in the interval between the deadline for submission of bids and the expiration of the period of bid validity specified by the Bidder on the Bid submission Form or any extension thereof.

26. Bid Opening

26.1 The Employer shall open the bids at the time place and address **specified in the BDS** in the presence of Bidders` designated representatives who choose to attend.

26.2 The bidders' names, the Bid Prices, the total amount of each bid, any discounts, any alternative bid, bid modifications and withdrawals, the presence or absence of bid security, and such other details as the Employer may consider appropriate, will be announced and recorded by the Employer at the opening.

E. Evaluation and Comparison of Bids

27. Confidentiality

27.1 Information relating to the examination, evaluation, comparison, and post-qualification of bids and recommendation of contract award, shall not be disclosed to Bidders or any other person not officially concerned with such process.

27.2 Any attempt by a Bidder to influence the Employer in the evaluation of the bids or Contract award decisions may result in the rejection of its bid.

28. Clarification of Bids

28.1 To assist in the examination, evaluation, and comparison of the bids, and qualification of the Bidders, the Employer may, at its discretion, ask any Bidder for a clarification of its bid. No change in the prices or substance of the bid shall be sought, offered, or permitted, except to confirm the correction of arithmetical errors discovered by the Employer in the evaluation of the bids, in accordance with ITB 31.

29. Determination of Responsiveness

29.1 The Employer’s determination of a bid’s responsiveness is to be based on the contents of the bid itself, as defined in ITB13.

29.2 A substantially responsive bid is one that meets the requirements of the Bidding Document without material deviation, reservation, or omission.

29.3 The Employer shall examine the technical aspects of the bid submitted in accordance with ITB 18, Technical Proposal, in particular, to confirm that all requirements of Section IV (Employer’s Requirements) have been met without any material deviation, reservation or omission.

29.4 If a bid is not substantially responsive to the requirements of the Bidding Document, it shall be rejected by the Employer and may not subsequently be made responsive by correction of the material deviation, reservation, or omission.

30. Nonconformities, Errors, and Omissions

30.1 Provided that a bid is substantially responsive, the Employer may waive any non-material non-conformity in the bid, request that the Bidder submit the necessary information or documentation, to rectify nonmaterial nonconformities in the bid related to documentation requirements but not related to any aspect of the price of the bid; and shall rectify quantifiable nonmaterial nonconformities related to the Bid Price.

31. Correction of Arithmetical Errors

31.1 Provided that the bid is substantially responsive, the Employer shall correct arithmetical errors on the following basis:

(a) only for unit price contracts, if there is a discrepancy between the unit price and the total price that is obtained by multiplying the unit price and quantity, the unit price shall prevail and the total price shall be corrected, unless in the opinion of the Employer there is an obvious misplacement of the decimal point in the unit price, in which case the total price as quoted shall govern and the unit price shall be corrected;

(b) if there is an error in a total corresponding to the addition or subtraction of subtotals, the subtotals shall prevail and the total shall be corrected; and

(c) if there is a discrepancy between words and figures, the amount in words shall prevail, unless the amount expressed in words is related to an arithmetic error, in which case the amount in figures shall prevail subject to (a) and (b) above.

32. Margin of Preference

32.1 **Unless otherwise specified in the BDS**, Margin of preference shall not apply.

33. Evaluation of Bids

33.1 The Employer shall use the criteria and methodology defined in this clause and no other evaluation criteria or methodologies shall be permitted.

33.2 To evaluate a bid, the Employer shall consider the following:

(a) the bid price, excluding Provisional Sums and the provision, if any, for contingencies in the Summary Bill of Quantities for admeasurement contracts or Schedule of Prices for lump sum contracts, but including Daywork items, where priced competitively; and

(b) price adjustment for correction of arithmetic errors, discounts, non-conformities, due to the supplementary criteria as defined in Section IV, and Margin of

Preference, if applicable.

34. Comparison of Bids

34.1 The Employer shall compare all substantially responsive bids in accordance with ITB 33 to determine the lowest evaluated bid.

35. Qualification of the Bidder

35.1 The Employer shall determine to its satisfaction whether the Bidder that is selected as having submitted the lowest evaluated substantially responsive bid meets the qualifying criteria.

36. Employer's Right to Accept Any Bid, and to Reject Any or All Bids

36.1 The Employer reserves the right to accept or reject any bid, and to annul the bidding process and reject all bids at any time prior to contract award, without thereby incurring any liability to Bidders.

F. Award of Contract

37. Award Criteria

37.1 Subject to ITB 36.1, the Employer shall award the Contract to the Bidder whose offer has been determined to be the lowest evaluated bid and is substantially responsive to the Bidding Document, provided further that the Bidder is determined to be qualified to perform the Contract satisfactorily.

38. Notification of Award

38.1 Prior to the expiration of the period of bid validity, the Employer shall, for contract amount above the prescribed threshold, notify the selected bidder of the proposed award and accordingly notify unsuccessful bidders. Subject to Challenge and Appeal the Employer shall notify the selected Bidder, in writing, by a Letter of Acceptance for award of contract. The Letter of Acceptance shall specify the sum that the Employer will pay the Contractor in consideration of the execution and completion of the Works (hereinafter and in the Conditions of Contract and Contract Forms called "the Contract Price") and the requirement for the Contractor to remedy any defects therein as prescribed by the Contract.

38.2 Until a formal contract is prepared and executed, the notification of award shall constitute a binding Contract.

39. Signing of Contract

39.1 Promptly upon issue of Letter of Acceptance, the Employer shall send to the successful Bidder the Contract Agreement.

39.2 Within seven (7) days of receipt of the Contract Agreement, the successful Bidder shall sign, date, and return it to the Employer.

40. Performance Security	40.1 Within Fourteen (14) days of the receipt of the Letter of Acceptance from the Employer, the successful Bidder shall furnish the Performance Security in accordance with the conditions of contract, using for that purpose the Performance Security Form included in Section VIII (Contract Forms).
	40.2 Failure of the successful Bidder to submit the above-mentioned Performance Security or to sign the Contract Agreement within the prescribed delay shall constitute sufficient grounds for the annulment of the award and forfeiture of the bid security.
41. Advance Payment and Security	41.1 The Employer shall provide an Advance Payment on the Contract Price as stipulated in the GCC, subject to a maximum amount, as stated in the BDS. The Advance Payment shall be guaranteed by a security as per the format contained in Section VIII.
42. Plant and Materials on site	42.1 Unless otherwise **specified in BDS** interim payment for Plant and Material on site is not applicable as per GCC 38.7.

Section II- Bidding Data Sheet

A. General	
ITB 1.1	The Employer shall be The **KOKUSAI KOGYO CO. LTD.** The Works are: **Construction of Flexible Revetment at Grand Sable** The name and identification of the Contract are: **JICA/GS/2013** The Project is: **Construction of Flexible Revetment at Grand Sable**
ITB 1.2	The Intended Completion period is: **8 weeks from the date specified in Letter to Commence**
ITB 2.1	**KOKUSAI KOGYO CO. LTD.**
ITB 3.2	The address to file Challenges in respect of this procurement is: ***The Commercial Court***
ITB 5.1	Only the companies short-listed and invited by the Employer shall be eligible for submitting their proposal. The invitation to tender is not transferable to any other firm.
ITB 6.2	The information required from bidders as in ITB 6.2 and using the appropriate form as required
ITB 6.2 (c)	Bidders should have experience in similar works; i.e. Construction of revetment and beach works
ITB 6.2 (d)	The essential equipment to be made available for the Contract by the successful Bidder shall be: **excavator loader, backhoe loader, skid steer loader, transportation vehicles (>20 Tons) amongst others**.
ITB 6.2 (e)	QUALIFICATIONS OF KEY PERSONEL Project Manager: preferably a registered Civil Engineer having at least 5years Surveyor: A Diploma in Building & Civil Engineering having 3 years experience in construction works/civil works Foreman:10 years experience dealing with construction works/civil works
ITB 6.2 (f)	The assessment of the financial soundness of the company shall be on a pass/fail basis on its overall performance including its profitability.
ITB 8.1	A Site visit will be effected on **Tuesday 24th September 2013 at Grand Sable** starting **at 10.00 hrs.** The meeting point for the site visit shall be the Village Hall of Grand Sable

B. Bidding Documents	
ITB 10.1	The Contact address for clarification is: **Mr Tomomi Fujita** **JICA Project Expert Team** **Ministry of Environment and Sustainable Development** **6th Floor, Ken Lee Tower** **Cnr Barracks & St Georges Streets** **Port Louis** **Tel: 203 6200** **Fax: 212 7397** **Email: tofujita@central-con.co.jp** **Sharveen PERSAND** **Project Manager** **CLAMS Ltd, B10, Lai Wan Chut Building,** **5 -7 R. Seeneevassen St,** **Port Louis,** **Tel: 216 0070** **Fax: 216 0069,** **Mobile: 54925213, 59175145** **Email: spersand@gmail.com**
C. Preparation of Bids	
ITB 13	Any additional materials required to be completed and submitted by the Bidders are : none
ITB 17.1	The Contract is **NOT** subject to price adjustment in accordance with GCC Clause 43.
ITB 19.1	The Bid shall be valid for **90 days** after the deadline set for the submission of bid, the deadline being counted as day one of the validity period; i.e. the bid shall be valid up to **Monday 06th January 2014**
ITB 20.1	Bid shall include a subscription to a Bid Securing Declaration
D. Submission of Bids	
ITB 22.2(b) And ITB 23.1	The Employer's address for the purpose of Bid submission is **Kokusai Kogyo Co. Ltd** **c/o JICA Project Expert Team** **Ministry of Environment and Sustainable Development,** **3rd Floor, Conference Room, Ken Lee Tower,**

	cnr Barracks and St Georges St, **Port Louis**
ITB 23.1	The deadline for submission of bids shall be : **Tuesday 8 October 2013 up to1400 hrs (local time) at the latest**
ITB 26.1	Bids shall be opened on the **8th of October 2013** **Address: Ministry of Environment,** **3rd Floor, Conference Room, Ken Lee Tower,** **cnr Barracks and St Georges St,** **Port Louis,** Time: after 1400 hrs and after the Employer has declared that all of the bids are ready to open.
E. Evaluation and Comparison of Bids	
F. Award of Contract	
ITB 40.1	The Standard Form of Performance Security acceptable to the Employer shall be "a Bank Guarantee". The Bank guarantee shall be 20 % of the contract price inclusive of provisional and contingencies sum and VAT.
ITB 41	The Advance Payment shall be limited to **20 percent** of the Contract Price less the provisional and contingencies sums.
ITB 42.1	Interim Payment for Plant and Material on site "**is not**" applicable.

Section III - Bidding Forms

Table of Forms

Bid Submission Form

The Bidder must prepare the Bid Submission Form on stationery with its letterhead clearly showing the Bidder's complete name and address.

Note: All italicized text is for use in preparing these form and shall be deleted from the final document.

Date: _____
Bidder's Reference No.: _____
Procurement Reference No:……

To:

We, the undersigned, declare that:

(a) We have examined and have no reservations to the Bidding Documents, including Addenda issued in accordance with Instructions to Bidders (ITB) Clause 10;

(b) We offer to execute in conformity with the Bidding Documents the following Works:
_____;

(c) The total price of our Bid after discounts, if any, offered in item (d) below is:
_____;-

(d) The discounts offered and the methodology for their application are:
_____

_____ ;

(e) Our bid shall be valid for a period of _____ *[insert validity period as specified in ITB 19.1.]* days from the date fixed for the bid submission deadline in accordance with the Bidding Documents, and it shall remain binding upon us and may be accepted at any time before the expiration of that period;

(f) We hereby confirm that we have read and understood the content of the Bid Securing Declaration attached hereto and subscribe fully to the terms and conditions contained therein, if required. We understand that non-compliance to the conditions mentioned may lead to disqualification.

(g) If our bid is accepted, we commit to obtain a Performance Security in accordance with the Bidding Document;

(h) We are not participating, as a Bidder in more than one bid in this bidding process other than alternative offers submitted in accordance with ITB 15;

(i) Our firm, its affiliates or subsidiaries, including any Subcontractors or Suppliers for any part of the contract, has not been declared ineligible under the laws of Mauritius;

(j) We understand that this bid, together with your written acceptance thereof included in your notification of award, shall constitute a binding contract between us, until a formal contract is prepared and executed;

(k) We understand that you are not bound to accept the lowest evaluated bid or any other bid that you may receive; and

(l) If awarded the contract, the person named below shall act as Contractor's Representative:

_____

Name: _____

In the capacity of: _____

Signed: _____

Duly authorized to sign the Bid for and on behalf of: _____

Date: _____

Seal of Company _____

Appendix to Bid Submission Form

Bid Securing Declaration

By subscribing to the undertaking in respect of paragraph (f) of the Bid Submission form:

I/We* accept that I/we* may be disqualified from bidding for any contract with any Public Body for the period of time that may be determined by the Procurement Policy Office under section 35 of the Public Procurement Act, if I am/we are* in breach of any obligation under the bid conditions, because I/we*:

(a) have modified or withdrawn my/our* Bid after the deadline for submission of bids during the period of bid validity specified by the Bidder in the Letter of Bid; or

(b) have refused to accept a correction of an error appearing on the face of the Bid; or

(c) having been notified of the acceptance of our Bid by the Kokusai Kogyo Co. Ltd. during the period of bid validity, (i) have failed or refused to execute the Contract, if required, or (ii) have failed or refused to furnish the Performance Security, in accordance with the Instructions to Bidders.

I/We* understand this Bid Securing Declaration shall cease to be valid (a) in case I/we am/are the successful bidder, upon our receipt of copies of the contract signed by you and the Performance Security issued to you by me/us ; or (b) if I am/we are* not the successful Bidder, upon the earlier of (i) the receipt of your notification of the name of the successful Bidder; or (ii) thirty days after the expiration of the validity of my/our* Bid.

In case of a Joint Venture, all the partners of the Joint Venture shall be jointly and severally liable.

……

Signature of Bidder

Qualification Information

*[The information to be filled in by **bidders** in the following pages shall be used for purposes of post-qualification or for verification of prequalification as provided for in ITB Clause 6. This information shall not be incorporated in the Contract. Attach additional pages as necessary. Pertinent sections of attached documents should be translated into English. If used for prequalification verification, the Bidder should fill in updated information only.]*

1. Individual Bidders or Individual Members of Joint Ventures

1.1 Constitution or legal status of Bidder: *[attach copy]*

Place of registration: *[insert]*

Principal place of business: *[insert]*

Evidence of signatory authorized to sign the bid (if applicable): *[attach]*

1.2 Annual amounts of construction works performed during the last *[insert number]* years *[insert amounts in the national currency equivalent]*

1.3 Number *[insert number]* of works of a nature and amount similar to the Works performed as prime Contractor over the last *[insert number]* years. *[Also list details of work under way or committed, including expected completion date(s).]*

Project/Contract name and country	Name of client and contact person	Type of work performed and year of completion	Value of contract (national currency)
(a) (b)			

1.4 Major items of Contractor's Equipment proposed for carrying out the Works. *[List all information requested below. Refer also to ITB Sub-Clause 6.3 (c).]*

Item of equipment	Description, make, and age (years)	Condition (new, good, poor) and number available	Owned, leased (from whom?), or to be purchased (from whom?)
(a) (b)			

1.5 Qualifications and experience of key personnel proposed for administration and execution of the Contract. *[Attach biographical data. Refer also to ITB Sub-Clause 6.3 (d).]*

Position	Name	Years of experience (general)	Years of experience in proposed position
(a) (b)			

1.6 Proposed subcontracts and firms involved. Refer to General Conditions of Contract Clause 7.

Sections of the Works	Value of subcontract	Subcontractor (name and address)	Experience in similar work
(a) (b)			

1.7 Financial reports for the last *[insert number; usually 3]* years: Financial Statements, Audited Accounts, etc. *[List below and attach copies.]*

1.8 Evidence of access to financial resources to meet the qualification requirements: cash in hand, lines of credit, etc. List below and attach copies of support documents.

1.9 Information on current litigation(s) in which the Bidder is involved.

Other party(ies)	Cause of dispute	Amount involved
(a) (b)		

1.11 Proposed Program (work method and schedule). Descriptions, drawings, and charts, as necessary, to comply with the requirements of the Bidding Documents.

2. Additional Requirements

2.1 Bidders should provide any additional information requested in the Bidding Document.

Breakdown of Prices

CONSTRUCTION OF FLEXIBLE REVETMENT AT GRAND SABLE

No.	Description	Unit	Qty	Unit Price (MUR)	Total Price (MUR)
1	Site Preparation and Temporary Works Including Installation, Maintenance, Management and Removal of Silt Fence, Guard Post, Pruning Brunch, Public Consultation, Project Information Board, etc.	Ls			
2	Safety Control of Existing Traffic	Ls			
3	Environmental Control and Monitoring	Ls			
4	Supply, Installation and earth work of Gravel with the Specified Mixed Rate of Specified Size.	m3			
5	Supply, Installation and earth work of Sand with the Specified Size.	m3			
6	Supply and Installation of drainage channels (ID533mm) including base.	set			
7	Supply and Installation of drainage channels (ID685mm) including base.	set			
8	Supply and Installation of rock layer at the mouth of drainage.	m3			
9	Site Survey and as built drawing	Ls			
10	Contingency	%		-	
	Subtotal	-	-	-	
	VAT	%	15	-	
	Total	-	-	-	

Section IV - Evaluation Criteria

This section contains supplementary criteria that the Employer shall use to evaluate bids.

1. Evaluation

In addition to the criteria listed in ITB 33 the following criteria shall apply:

The evaluation shall be based on an assessment of the rates quoted as per clause 33 of the instruction to Bidders.

(a) Adequacy of Technical Proposal

Evaluation of the Bidder's Technical Proposal will include an assessment of the Bidder's technical capacity to mobilize key equipment and personnel for the contract consistent with its proposal regarding work methods, scheduling, and material sourcing in sufficient detail and fully in accordance with the requirements stipulated in Section V (Employer's Requirements).

(b) Multiple Contracts : Not Applicable

PART 2 – Employer’s Requirements

Section V - Employer's Requirements

Table of Contents

A. SCOPE OF WORK

1. Background Information

1) Name of the Project

Construction of Flexible Revetment at Grand Sable

2) Client

The Client is **Kokusai Kogyo Co. Ltd**
Address: C/o JICA Project Expert Team
Ministry of Environment and Sustainable Development
6th Floor, Ken Lee Tower
Cnr Barracks and St Georges St, Port Louis

3) Consultant

The Consultants are:
Kokusai Kogyo Co. Ltd
Nippon Koeico.,Ltd.
Central Consultant Inc.
Futaba Consulting Service Co., Ltd
Address: C/o JICA Project Expert Team
Ministry of Environment and Sustainable Development
6th Floor, Ken Lee Tower
Cnr Barracks and St Georges St, Port Louis
CLAMS Ltd
Address: B10, Lai Wan Chut Building,
5-7 R. Seeneevassen St.
Port Louis

4) Project Manager:

The Project Manager is:
CLAMS Ltd
Address: B10, Lai Wan Chut Building,
5-7 R. Seeneevassen St.
Port Louis
Tel: 216 0070
Fax: 216 0069
Email: spersand@gmail.com

5) Location

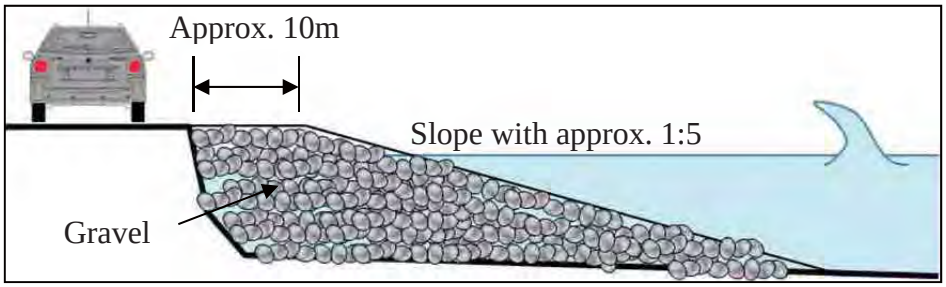
The flexible revetment structure shall be located at its southern extremity at the GPS coordinate of 20˚ 19' 21.16" S and 57˚ 46' 12.93" E. this area is some 25 m north of the existing mangrove plants is adjacent to a covered drain box culvert. The northern extremity of the structure is located at the GPS coordinate of 20˚ 19' 14.60" S and 57˚ 46' 11.85" E which is some 15 m north of the Bus Stop. The structure would include the area immediately in front of the Bus Stop.

The flexible revetment structure will be placed as part of the demonstration project site over a total length of 200m (including the slope to its foot), see design as Annexed. The revetment shall be terminated at the extremities by providing an appropriate slope to avoid reflection and which would dissipate the wave energy

6) Background of the Project

The approach involves the construction of a gravel (shingle) or cobble beach at the shore, in front of the area to be protected. In this respect, a constructed flexible revetment represents a transitional strategy between a conventional riprap revetment

of large stones and a beach nourishment project. The name "flexible revetment" reflects this transition in that by consisting of gravel and cobbles, the material is expected to be moved by waves and near shore currents — it is "flexible", contrasting with a conventional "static" riprap revetment where the boulder-sized quarry stone is designed not to move under the expected forces of waves during extreme storms. The flexible revetment is designed for the wave action to rearrange the gravels into an equilibrium profile. The flexible revetment is constructed to provide protection to coastal developments and infrastructure while remaining more flexible than a conventional riprap revetment, not failing when movement occurs.



Flexible revetment at the Project Site

2. Definition

The words "the Technical Specifications" and "the Specifications" shall have the same meaning in the Tender Documents of the project.

3. Scope of Works

The work of the Project is to form the gravel beach which is called "Flexible Revetment".

The construction shall be in accordance with the approved designs and under the supervision of the Consultants.

Construction works for the Flexible Revetment including:

- Construction of Flexible Revetment (Filling and leveling of gravel and rock sand)
- Extension of Existing Drainage

The section of the flexible revetment construction for the demonstration projects is summarized in the table below and the scope of the construction is defined in the Drawings.

Section of the Flexible Revetment

Name	Approximate Length	Description
Standard Section A	85m	Crest widths of 10m from seaside edge of road to corner of crest with 1:5 gradient of gravel and 1:8 of sand at the lower part
Standard Section B	75m	Crest widths of 14m from seaside edge of road to corner of crest with 1:5 gradient of gravel
Adjustment Section(South)	23m	Side edge of the revetment with gravel to be aligned with smooth adjustment to the existing topography
Adjustment Section(North)	65m	Side edge of the revetment with gravel and sand at the lower part to be aligned with smooth adjustment to the existing topography

B. General Information

1. Description

The following general information gives some indication of the site conditions which might be useful for the Contractor in formulating his construction programs, but shall not relieve the Contractor in any way from the obligation to consult all available data.

The Client and Consultant will take no responsibility whatsoever for the accuracy of the information.

2. General Information at the Project Site

The projected area is a part of Grand Sable beach located on east coast of Mauritius and lies along the road about 200m. Most of the coast is covered by the rocks or pebbles approximately 10 to 20 cm in diameter.

Residential area is attached to the road along the projected site and the distance to the sea is comparatively close. Followed by the request about environment of the residential area, most of the tall trees blocking the view to the ocean have been cut.

As a part of the social activities of the site, local fishermen use the beach when they maneuver their fishing boats to go fishing and catch calms.

The area of +1.5m elevation is expected to have flooding during high tide because the elevation is lower than the analyzed design wave.

3. Design Tide Level

A statistical analysis was undertaken using the annual maximum values from the observed tide levels at Port Louis between 1986 and 2012. The analysis shows that the 30-year probable tide level for Mauritius, in general, is MSL+0.67 m.

From observation records of the tide levels at Port Louis, the rise in sea level caused by global climate change was set at 3.9 mm/year, therefore, the rise in tide level over the next 30 years was estimated to be of the order of +0.12 m. Furthermore, the wave-setup volume on the reef was analyzed and +0.6 m rise in the mean water level was added.

4. Design Wave

Analysis of wave conditions was conducted based on the data of the previous cyclone hitting Mauritius. The results from this analysis shows that the 30-year probable wave height and periods are estimated at H=10.3m and T=14.1 second respectively through the extreme value statistics method.

Based on the wave condition analyzed above, the analysis of wave deformation between the reef edge and designated point of the projected site results in the value of H=0.4m and T=8.0second and these values are used in the design of the flexible revetment as wave condition to be expected.

5. Coordinate and Elevation

Coordinate and Elevation on this project should be based on the Standard Bench Mark of STN 1 and STN 2 as established by GIBB during the topography survey of the region.

XY Coordinates of Survey Stations

Point ID	Easting (m)	Northing (m)	Elevation (m)
STN1	271494.27	345182.82	1.358
STN2	271603.34	344694.92	1.404

STN1 is located between Profiles S2 and S3 as a nail hammered in the concrete ramp. STN2 is located around 8 m east of Profile S26 as a steel peg in concrete.

C. General Provision

1. Contractor's Responsibility for the Work

(1) The Contractor shall perform and complete the Work under the supervision of the Consultant in accordance with Conditions of Contract, Technical Specifications, Drawings and Addenda being issued prior to the tender closing.

(2) The Contractor shall conduct the following:

a) to submit to the Consultant the Master List for the import and re-export items of materials and equipment in case that the Master List submitted in the Tender is revised in the course of negotiations before signing of the Contract;

b) to submit to the Consultant a list of sub-contractors and origins of materials and equipment which the Contractor proposes to employ in the Work;

c) to prepare time-to-time working, progress schedule and other technical documents to the Consultant;

d) to submit weekly to the Consultant photographs showing the actual physical progress of the respective construction site; and

e) to submit to the Consultant As-built Drawings in Auto CAD files prior to the Taking-over Inspection to be carried out by the Client and the Consultant.

(3) Even though approved by the Consultant under the Technical Specifications, the Contractor shall be responsible for construction methods, techniques, sequence and procedure, or for safety precautions and programs in connection with the Work, and for his failure if any to carry out the Work.

(4) The Contractor shall be fully responsible for the acts or omissions of any subcontractor, any supplier, any of the Contractor's, subcontractor's or supplier's officers, employees or agents or any other persons performing any part of the Work.

(5) The Contractor shall have full responsibility for any damage resulting from any act of the Contractor, sub-contractors or suppliers that is not in accordance with the Contract Documents or the Consultant's instructions.

(6) The Contractor shall furnish one resident representative with sufficient power and good command of English for executing the Work smoothly.

(7) Starting from the date of signing the Contract, the Contractor shall, at his own

expense, take necessary measures, in accordance with the Contract Documents and relevant laws, ordinances and regulations, to prevent damage to the Work, construction materials, adjacent structures or a third party, until the completion of the Work.

(8) The Contractor shall be responsible for making necessary arrangement with manufactures and/or handling agents to safe-guard against uninterrupted supply of materials (such as fuel, stone, sand, etc) required in the Work.

(9) The Contractor shall be responsible for security or safety measures being taken throughout the construction period as specifically.

(10) The Contractor shall not enter, across or through any land, building or place of private property before they are authorized in writing by the Consultant to do so.

2. Unit of Measure and Standards

1) Unit of Measure

Units of measure used for all documents shall be according to the International System of Units (SI) except for measurements to be adopted in Bill of Quantities, which shall be according to the standard metric system.

2) Standards

The following documents were used as references in the design of the proposed flexible rock revetment

- The Rock Manual – The use of rock in hydraulic engineering (second edition)
- Beach Management Manual (second edition), CIRIA C685, London, 2010
- BC 6349 Maritime Structures

  Part 1: General criteria
  Part 7: Guide to the design and construction of breakwaters

3. Security and Safety

1) Accident Prevention

The Contractor shall take all necessary precautions against risks of whatsoever kind to any person employed on the Work or to employees of the Client and Consultant or to any other third party having good and sufficient reasons to be around the Work and to this end he shall properly carry out safety measures in and around the Work to the satisfaction of the Consultant.

2) Safety Measures

These safety measures shall consist of, but not be necessarily bound by, the following:

(1) Notice board for detours, warning or arrow signs indicating the direction to go both for vehicles and pedestrians are to be renewed or replaced according to the progress of the Work, primarily of wooden construction but with fluorescent (or luminescent) paint applied.

(2) Temporary fencing or other means to keep pedestrians' safe shall be provided in the manner and materials accepted by the Consultant.

(3) The Contractor shall, furthermore, take all necessary precautions against any

damage to the property of the Client, the Consultant or of any other third party located at or next to the Site, inclusive of public utilities, in connection of which the Contractor is required of extremely careful in execution of the Work.

(4) The Contractor shall at all times comply with any accident prevention regulations and any safety regulations peculiar to the various trades being employed on the Work and safety regulations published by the Government of the Mauritius.

(5) The Contractor shall pay any security cost by own expense, if the construction program, method, equipment and others are approved the Consultant.

4. Reports and Records

1) Monthly Progress Reports

The Contractor shall submit to the Consultant, not later than first week in every month, a progress report for the previous month, which shall include the following items and information:

(1) Essential activities in the previous month

(2) Work reports on each of the main sections in the previous month

(3) Summary of staff and labor employed at the Site in the previous month

(4) Schedule of all construction plants at the Site

(5) Work program on each of the main sections in the coming month

(6) Updated revisions of the bar chart program, the latter showing the progress during the period and cumulative progress to date (program and result)

2) Weekly Reports

The Contractor shall submit Weekly Reports every first working day of the week describing work items to be performed for next two (2) weeks when requested by the Consultant, in an approved form. These will be materials for weekly meeting between the Consultant and Contractor.

Weekly Reports shall contain, but not necessarily be limited to, the following:

(1) Weather conditions

(2) Staff and labor force employed in the Work

(3) Materials at the Site

(4) Equipment at the Site and the condition of such equipment

(5) Work items in progress or in preparation

(6) Accidents and other information relevant to the progress of the Work

5. Progress Photographs

The Contractor shall submit to the Consultant five copies of photographs accompanied with the key plan showing the place each photograph was taken, before start of the works and thereafter monthly showing the progress of the works and also such particular sections of the works, site, machinery or materials as the Consultant may direct.

6. Technical Work Record

The Contractor shall prepare and submit his technical work records to the Consultant weekly in a form proposed by the Contractor and accepted by the Consultant.

7. Works to be Kept Clean

The Contractor shall keep the works well drained of water until completion of the Work, and shall ensure that as far as it is practicable in the opinion of the Consultant all works shall be carried out in dry condition.

8. Abatement of Nuisance

The Contractor shall not discharge into watercourses any oil, solid, noxious or floating materials, and all water discharged shall be reasonably free of impurities. The Contractor shall remove from the water, at his own expense, any debris therein arising out of the execution of the Work.

The Contractor shall be responsible for ensuring that no earth, debris, or mud are deposited on public or private rights of way during the execution of the Work, including any deposits arising from the transportation of plants and vehicles. The Contractor shall provide sufficient labor, plant, equipment etc. as is necessary and as required by the Consultant to ensure that deposits are kept to the absolute minimum and are cleaned and removed immediately.

The Contractor shall be responsible for adopting such measures as required by any local regulations and/or as required by the Consultant to minimize nuisance from vibration, dust, noise or other causes.

9. Construction Program

In preparing the construction program, the Contractor shall be allowed for non-working days due to possible bad weather, holidays, difficult access and any other such factors as contingencies in his estimates of activity duration.

The construction program shall clearly define the principal activities, the construction sequence, application and obtaining permits to relevant authority (if required), the allocation of resources, and the procurement of major materials.

The Contractor shall submit a detailed time programme to the Consultant within 7 days after the issued date of notice of commencement. The Contractor shall also submit a revised programme whenever the previous programme is inconsistent with actual progress or with the Contractor's obligation. Each programme shall include:

(1) the order in which the Contractor intends to carry out the Works, including the anticipated timing of each stage of Contractor's Documents, procurement, delivery to Site, construction, erection and testing,

(2) each of these stages for work by each nominated Subcontractor,

(3) the sequence and timing of inspection and test specified in the Contract, and

(4) a supporting report which includes:

a) a general description of the methods which the Contractor intends to adopt, and the major stages, in the execution of the Works, and

b) details showing the Contractor's reasonable estimate of the number of each class of Contractor's Personnel and of each type of Contractor's Equipment, required on the Site for each major stage.

Unless the Consultant, within 7 days after receiving a programme, gives notice to the Contractor stating the extent to which it does not comply with the Contract, the Contractor shall proceed in accordance with the programme, subject to his other obligation under the Contract. The Employer's Personnel shall be entitled to rely upon the programme when planning their activities.

The Contractor shall promptly give notice to the Consultant of specific probable future events or circumstances which may adversely affect the work, increase the Contract Price, or delay the execution of the Works. The Consultant may require the Contractor to submit an estimate of the anticipated effect of the future event or circumstances, and / or a proposal of variation procedure.

If, at any time, the Consultant gives notice to the Contractor that a programme fails (to the extent stated) to comply with the Contract or to be consistent with actual progress and the Contractor's stated intentions, the Contractor shall submit a revised programme to the Consultant in accordance with this Sub-Clause.

10. Construction Equipment

(1) According to the construction program, the Contractor shall submit to the Consultant a detailed list of the construction equipment that he will bring to the Site for the execution of the Work. This list shall satisfy the Consultant as to date of arrival, types, sizes, capacities or powers and quantities of the items included.

Type, origin, identification number and year of manufacture and whether or not reconditioned shall be stated for each equipment. The Contractor shall in due time place on the Site all the construction plant listed. In no case, shall the Contractor remove equipment or positions thereof from the Site without the written approval of the Consultant.

(2) The Contractor shall furnish all the construction equipment necessary for the execution of the Work, and it must be on the Site and inspected and approved by the Consultant before the Work starts. Any equipment or portion thereof that becomes unduly worn or defective, shall be immediately repaired or replaced to the satisfaction of the Consultant.

11. Drawings

The Contractor shall work in conformity with the exact lines, grades, cross sections and dimensions as indicated in the original drawings (the Drawings), unless any change or adjustment on or deviation from the Drawings is approved by the Consultant in writing, due to any of the following unavoidable reasons:

(1) Unforeseen (or unexpected) site conditions occurring, exigencies (or difficulties) of the Work requiring some different solution that was anticipated in the detailed design stage;

(2) Simple and apparent error made during preparation of the Drawings; or

(3) Discrepancy between the Drawings and other Contract Documents.

The Contractor shall not be entitled to raise claims against such unavoidable changes, adjustment on or deviation from the Drawings.

12. Setting Out of the Work

The Contractor shall set construction stakes by establishing lines and grades in

accordance with the Drawings and shall secure the approval of the Consultant before starting the Work. The Consultant will, if he deems it necessary, revise the line or grade and require the Contractor to adjust the stakes accordingly.

The Contractor shall give the Consultant not less than 24 hours notice of his intention to stake out or establish levels for any part of the Work, in order that arrangements may be made for checking. The Contractor shall carry out staking and the Consultant will check the measurement.

The Contractor shall, as a requirement of the Contract and without extra charge, furnish for the exclusive use of the Consultant all necessary instruments, appliances, survey personnel and labors, transportation, and any other materials that the Consultant may require for checking the setting out or for any other relevant works to be done. Any permanent marks having been disturbed or destroyed shall be immediately replaced by the Contractor at his own expense to the satisfaction of the Consultant. No work shall be carried out in any section until the necessary setting out in that section has been approved by the Consultant.

13. Notice of Operation

No permanent work shall be undertaken without notice to the Consultant sufficiently in advance of the time of the operation for him to be able to make such arrangements as he may deem necessary for its inspection.

14. Materials

1) Approval of Source and Types of Materials

The Contractor shall, before placing any order to procure materials or manufactures articles for the permanent works, submit to the Consultant for his approval a complete description of such items along with the names of the suppliers. When so directed by the Consultant, the Contractor shall submit samples and certificates for his approval.

2) Inspection and Testing

The Consultant and Consultant's Representative shall be entitled at all reasonable time's access to the Contractor's premises or elsewhere and they shall be afforded every facility for making inspections and taking samples for testing and analysis. The Contractor shall provide free of charge, and to the satisfaction of the Consultant, all applicants required for convenient testing of the material at the Contractor's premises and he shall supply samples and arrange the carriage thereof, to enable tests and analysis, if made, at the Site laboratory or other laboratory approved by the Consultant. Such inspection, testing and analysis, if made, shall not release the Contractor from any obligation under the Contract.

In besides any special provision made herein as to sampling and testing material by particular methods, samples of material and workmanship proposed to be employed in the execution of the Work may be called for at any time by the Consultant and these shall be furnished without delay by the Contractor at his own cost.

15. Drawings and Documents to be Prepared by the Contractor

1) Shop Drawings

The Contractor is not required to submit the Shop Drawing.

2) As-built Drawings

Before the Substantial Taking-over Inspection that leads to the provision of

completion of the Work, the Contractor shall prepare "As-built Drawings" in an approved Auto Desk Auto CAD program and submit to the Consultant one set of the original and three sets of submitted to the Client as a part of the Completion Report. The As-built Drawings shall be of the finally constructed plans or structures for the Work.

D. Technical Specifications

1. General Work

1) Site Preparation and Temporary Works Including Installation, Maintenance, Management and Removal of Silt Fence, Guard Post, Public Consultation, Project Information Board, etc.

(1) The Contractor shall provide, maintain and completion of the Work and remove the temporary works before commencement of the defect liability period which include silt fence, guard post, public consultation, survey equipment and others provided the areas of the Contractor's stock yard compound.

(2) Overhanging branches to the offshore areas which is expected to be obstacles to the works and future coastal activity shall be pruned or trimmed only without felling any tree and in accordance with the drawing.

(3) The Contractor shall construct suitable entry and exit road to and from the compound and the site of the compound shall be surrounded with fencing with adequate height or other appropriate devices approved by the Consultants.

(4) The Contractor shall provide adequate protection to the existing underground utilities and pipe lines located along the entrance, exit and service roads of the yard as approved by the Consultants.

(5) The Contractor shall erect a temporary project information board at the designated point which is to be determined by the Consultants within the mobilization period.

(6) The Contractor shall undertake the public consultation meeting with the representatives of the resident to inform them detail of the construction works. Time, venue and participants shall be arranged by the Consultants.

2) Site Survey

(1) Prior to commencement of the earth works, the Contractor shall survey the existing site conditions and verify the designated station point level in accordance with the Specifications in the presence of the Consultants.

(2) The Contractor shall carry out the topographical and profile survey for inspection after completion of works. The interval of the profile survey is every 10m including existing section point established during the previous survey conducted by the project. Detail shall be included in the method statement.

3) Safety Control of Personnel, Materials and Existing Traffic

The Contractor shall maintain the existing traffic condition and protect all works on the ground and in around the site from potential dangers or risks of normal hazards associated with all construction work, taking all measures to ensure the maximum safety in working conditions at all time, except those due to "Force Majeure" of the

Conditions of Contract. The details of this item are described as below but not limited to:

(1) The Contractor shall supply to all personnel on Site a safety helmet of approved design and any other safety equipment or accessories as required by law as well as provide fixed access ladders, walkways and handrails to all working areas where required;

(2) The Contractor shall, at his own expense, carefully protect all works, materials and plants and equipment from damage by weather and flood;

(3) The Contractor shall erect and maintain at required points on the work and at the approaches to the work, traffic signs, lights, barricades, and other facilities as required by the Consultants for the safety control of the existing traffic. Where required, or where directed by the Consultants, the Contractor shall furnish and station competent flag-men whose sole duty shall consist of directing the movement of traffic on the roads;

(4) The Contractor shall plan on the possible traffic interruption in the course of site construction work well in advance and discuss at the time of coordination meeting with the Employer, Consultant or Project Manager to be held at least one week before the date of traffic interruption. Also such plan shall be discussed at on-call ad hoc meeting inviting all stakeholders. Arrangements for necessary clearances, permits or licences with the relevant authorities shall be the responsibility of the Contractor.

(5) The Contractor shall provide sufficient number of traffic control aid at the location of traffic interruption and in the vicinity.

2. Revetment Work

1) Gravel fill in General

(1) The material of Gravel Class A, B, C shall be crushed and washed gravels provided by appropriate quarry plant.

(2) Prior to commence gravel work, the Contractor shall submit the samples and test results from the proposed quarry plant of all gravel demonstrating. The test results shall include the Specific Gravity and sieve distribution

2) Gravel and Rock Sand Placing

(1) The washed gravel shall be employed for the placing.

(2) Gravels and rocksand shall be placed from appropriate place and method approved by the Consultant.

(3) The completed work shall consist of layers of gravel and rocksand conforming to the grading and profile specified in the Drawings.

(4) The Contractor shall be responsible for protecting all uncompleted work from the action of the sea during construction. Damage shall be made good before work proceeds and any displaced material shall be removed and not used for any part therein.

(5) Placing tolerances shall be: Crown part + 250 mm, - 0mm, Slope part + 250 mm, - 0 mm.

(6) The designed total estimated volume of the each material is defined as follows.

• Gravel: 4,566m^3

• Rocksand: 334m3

3) Gravel Size, Composition

The gravels shall be mixed as tabulated below. The mixing of gravels shall be conducted at quarry plant **prior to the transportation**.

Gravel Class A (10 -14 mm) 20%
Gravel Class B (14 -20 mm) 50%
Gravel Class C (20 -31.5 mm) 30%

4) Rocksand Size

(1) The material of rocksand shall be washed and sized between 2 and 4mm in its diameter and provided by appropriate quarry plant.

(2) Prior to commence earth work, the Contractor shall submit the samples and test results from the proposed quarry plant of all sand demonstrating. The test results shall be included the Specific Gravity and sieve distribution.

3. Drainage Works

1) General

Installation of the drainage pipe including compaction of basement made of crusher run with an appropriate section specified in the drawings.

At the end of the installed drainage pipe, the 2 layers of rocks with specified size and section shall be placed.

Treatment of the connection point with existing drainage channels shall be required with adequate strength of RC concrete structure, and conducted by the approval of the Consultant.

2) Drainage Pipe

The reinforced precast concrete with its specified size below shall be installed at the site specified in the drawing for the work.

(1) General Specification:

Overall Length: 2600mm, Effective Length: 2440mm,
Concrete: Reinforced concrete grade 40
Reinforcement: Hard drawn nail wire – SAE 1008 – Ø6mm

(2) Individual Specification:

Drainage A and B: Inside Diameter: of Ø533mm, Wall thickness of 41mm. Drainage C: Inside Diameter of Ø685mm, Wall thickness of 42mm.

3) Crusher run

The base of the drainage pipe shall be applied by compacted crusher run with its size as specified below:

Crusher run: Ø0-20mm

4) Rock

(1) Two layers of rock shall be installed for avoiding disturbance with the revetment form. The size of the rock is designed as its size of 200mm to 300mm in diameter. The work of installation of the rock layers shall be deployed by the approval of the Consultants.

(2) The designed total estimated volume of rock is 6.0m^3

The Contractor is responsible for cross-checking the estimated volumes of materials and ensure that the materials required is of sufficient quantity to complete the works as per the drawings and further cater for any loss by any means whether and including, but not limited to, through transportation or washed off by the sea and that prior to tendering their bid and before the deadline. No adjustment can be made once bid is placed.

Drawings

12 (Twelve) pages are annexed in this Bidding Document.

1. Cross Section (2/5)
2. Cross Section (3/5)
3. Cross Section (4/5)
4. Drainage Details (Drainage A)
5. Drainage Details (Drainage B)
6. Drainage Details (Drainage C)
7. Drainage Details (Drainage D)
8. Drainage Details (Precast Concrete Pipe)
9. Plan View
10. Plan View
11. Tree Inventory
12. Standard Cross Section

PART 3 – Conditions of Contract and Contract Forms

Section VI. General Conditions of Contract

The General Conditions of Contract (GCC) applicable for this procurement is based on the GCC from the Procurement Policy Office and has been amended as required.

Section VII. Particular Conditions of Contract

Except where otherwise indicated, all PCC *should be filled in by the* Employer *prior to issuance of the Bidding Documents. Schedules and reports to be provided by the* Employer *should be annexed.*

These clauses should be read in conjunction with the General Conditions of Contract

A. General	
GCC 1.1 (r)	The Employer is: **Kokusai Kogyo Co. Ltd.** **c/o JICA Project Expert Team** **Ministry of Environment and Sustainable Development,** **6th Floor, Ken Lee Tower,** **cnr Barracks and St Georges St,** **Port Louis**
GCC 1.1 (v)	The Intended Completion Date for the whole of the Works shall be: **15 December 2013**
GCC 1.1 (y)	The Project Manager is CLAMS Ltd, B10, Lai Wan Chut Building, 5-7 R. Seeneevassen St. Port Louis
GCC 1.1 (aa)	The Site is located at Grand Sable and as shown on the layout design provided
GCC 1.1 (dd)	The Start Date shall be within **7 days from the date of the Letter to Commence**
GCC 1.1 (hh)	The Works consist of : The Construction of Flexible Revetment at Grand Sable Project comprises the following: a) Preparatory works (silt fencing along the shoreline (approx. 250m), site clean-up, temporary construction site fencing, build-up construction sign, pruning of trees etc.) b) Installation of drainage channel (Precast concrete pipe) i. for the one connected to existing culvert located adjacent to Profile S21, 8 units of precast concrete pipes of inside diameter 533mm. ii. (ii) for the one connected to existing culvert located adjacent to Profile S20, 6 units of precast concrete pipes of inside diameter 533mm.

	iii. (iii) for the one connected to existing concrete pipe located adjacent to Profile S19, 8units of precast concrete pipes of inside diameter 685mm. c) Installation of aggregates and rock sands Estimated volume of Mixed aggregates is 4,566$m^3$and Estimated volume of rocksand (D4mm) is 334m^3 The materials shall be placed along the shoreline as per the design and profiles provided. The flexible revetment structure shall be 230m in length along the B28 road at Grand Sable with a maximum height of 2.0 m and would have a slope facing seaward of gradient approximately 1:5 and 1:8. d) Earth work to form and finalize the flexible revetment
GCC 2.2	Sectional Completions are: As described at **GCC 1.1 (v)**
GCC 2.3(i)	The following documents also form part of the Contract: None
GCC 3.1	The language of the contract is English The law that applies to the Contract is the laws of Mauritius.
GCC 5.1	The Project manager **may** delegate any of his duties and responsibilities.
GCC 8.1	Schedule of other contractors: ***Not Applicable***
GCC 13.1	Except for the cover mentioned in (d)(i) hereunder, the other insurance covers shall be in the joint names of the Contractor and the Employer and the minimum insurance amounts shall be: (a) for the Works, any third party, Plant and Materials: (for *the full amount of the works including removal of debris, professional fee etc...)* (b) for loss or damage to Equipment: (*for the replacement value of the equipment that the contractor intends to use on site until the taking over by the Employer.* (c) for loss or damage to property (except the Works, Plant, Materials, and Equipment) in connection with Contract *for an amount representing the value of the properties that are exposed to the action of the contractor in the execution of the works. It will extend to the property of the Procuring Entity as well).* (d) for personal injury or death: (i) of the Contractor's employees:*[The Contractor shall take an adequate insurance cover for its employees for any claim arising in the execution of the works]*. (ii) of other people: *[This cover shall be for an adequate amount for Third Party extended to the Employer*

	and its representatives]. (e) for loss or damage to materials on-site and for which payment have been included in the Interim Payment Certificate, where applicable. The Contractor shall choose to take the insurance covers indicated above as separate covers or a combination of the Contractor's All Risks coupled with the Employer's liability and First Loss Burglary, after approval of the Employer. All insurance covers shall be of nil or the minimum possible deductibles at sole expense of the contractor.
GCC 14.1	Site Data are: ***Provided in the detail designs section of the Bidding Document***
GCC 20.1	The Site Possession Date(s) shall be: ***The Date of the Letter to Commence***
GCC 23.1 & GCC 23.2	Appointing Authority for the Adjudicator: **No Adjudicator shall be appointed for this Contract.**
GCC 24.2	In case a dispute of any kind arises between the Employer and the Contractor in connection with, or arising out of, the contract or the execution of works or after completion of works and whether before or after repudiation or other termination of Contract, including any dispute as to any opinion, instruction, determination, certificate or valuation of the Employer's Representative, the matter in dispute shall, in the first place, be referred in writing to the employer's representative, with a copy to the other party. The Employer and the Contractor shall make every effort to resolve the dispute amicably by direct informal negotiation. If, after twenty-eight (28) days, the parties have failed to resolve their dispute or difference by such mutual consultation, then either the Employer or the Contractor may give notice to the other party of its intention to refer the matter to: The competent Courts of Mauritius
GCC 24.3	Hourly rate and types of reimbursable expenses to be paid to the Adjudicator: **Not applicable.**
GCC 24.4	Any dispute or difference in respect of which a notice of intention to commence arbitration has been given shall be finally settled by arbitration in accordance with Mauritian Laws by an Arbitrator to be appointed by both parties to the dispute or in any case of disagreement, by an Arbitrator to be appointed by a judge in Chambers of Mauritius. The Arbitrator fees will be borne by the losing party. Any decision of the Arbitrator shall be final and binding to both parties". **Not Applicable**
B. Time Control	
GCC 25.1	The Contractor shall submit for approval a Program for the Works within 7 days from the date of the Letter of Acceptance.

GCC 25.3	The period between Program updates "**is not** "applicable. The amount to be withheld for late submission of an updated Program is **" Not Applicable"**
C. Quality Control	
GCC 33.1	The Defects Liability Period is: **30 days.**
GCC 39.7	Interim Payment for Plant and Material on site "**is not**" applicable.
D. Cost Control	
GCC 41.1 (l**)**	Heavy rainfall (25mm and above) and heavy swells at sea that would render works impossible. A Certificate from the Meteorological Services Mauritius will be required.
GCC 43.1	The currency of the Employer's country is: **Mauritian Rupees.**
GCC 44.1	The Contract *"**is not**"* subject to price adjustment in accordance with GCC Clause 43, and the formula regarding coefficients *"**does not**"* apply.
GCC 45.1	The proportion of payments retained is: **0 %** **Payment Schedule will be** **20 % Advance payment upon presentation of Performance Bond** **80 % Final payment upon satisfactory completion of works**
GCC 46.1	The liquidated damages for the work are **Rs 50,000 per calender day**. The maximum amount of liquidated damages for each of the works is 10% of the contract value for each respective site.
GCC 47.1	The Bonus for the whole of the Works is ***NOT APPLICABLE***
GCC 48.1	Advance Payment : **20% of the Contract Amount inclusive of Taxes**
GCC 49.1	The Performance Security amount is **20 % of the Contract amount inclusive of Taxes**
E. Finishing the Contract	
GCC 56.1	The date by which operating and maintenance manuals are required is : ***NOT APPLICABLE*** The date by which "as built" drawings are required is :1 week after completion of works. The "as built" drawings should be provided in 1 soft copy in CAD format and 3 sets of hard copies at appropriate scale. The drawings should show the adjusted High Water Mark over the revetment.
GCC 56.2	The amount to be withheld for failing to produce "as built" drawings by the

	date required in GCC 56. is **2%**
GCC 57.2 (g)	The maximum number of days is: **10 calendar days**
GCC 59.1	The percentage to apply to the value of the work not completed, representing the Employer's additional cost for completing the Works, is ***20%***

Section VIII - Contract Forms

This Section contains forms which, once completed, will form part of the Contract. The forms for Performance Security and Advance Payment Security, when required, shall only be completed by the successful Bidder after contract award.

Table of Forms

Letter of Acceptance

[on letterhead paper of the Employer***]***

. . . . . ***[date]***. . . . . .

To: . . . . . ***.[name and address of the Contractor]*** . . . . . .

Subject: . . . . . ***.[Notification of Award Contract No]***. . . . . .

This is to notify you that your Bid dated . . . . ***[insert date]*** . . . . for execution of the . . . . . ***.[insert name of the contract and identification number, as given in the Appendix to Bid]***. . . . . for the Accepted Contract Amount of the equivalent of . . . . . ***.[insertamount in numbers and words and name of currency]***, as corrected and modified in accordance with the Instructions to Bidders is hereby accepted by Kokusai Kogyo Co. Ltd.

You are requested to furnish the Performance Security within 7 days in accordance with the General Conditions of Contract, using for that purpose of the Performance Security Form included in Section VI (Contract Forms) of the Bidding Document.

Authorized Signature: .....

Name and Title of Signatory: .....

Name of Agency: .....

Attachment: Contract Agreement

Contract Agreement

THIS AGREEMENT made the . . . . . .day of . . . . . ., ..., between . . . . . ***[name of the*** Employer***]***. . . . . (hereinafter "the Employer"), of the one part, and . . . . . ***[name of the Contractor]***. . . . .(hereinafter "the Contractor"), of the other part:

WHEREAS the Employer desires that the Works known as . . . . .***[name of the Contract]***. . . . .should be executed by the Contractor, and has accepted a Bid by the Contractor for the execution and completion of these Works and the remedying of any defects therein,

The Employer and the Contractor agree as follows:

1. In this Agreement words and expressions shall have the same meanings as are respectively assigned to them in the Contract documents referred to.

2. The following documents shall be deemed to form and be read and construed as part of this Agreement. This Agreement shall prevail over all other Contract documents**.**

(a) the Letter of Acceptance

(b) the Bid

(c) the Addenda Nos . . . . . ***[insert addenda numbers if any]***. . . . .

(d) the Appendix to the General Conditions of Contract

(e) the General Conditions of Contract;

(f) the Specification

(g) the Drawings*;* and

(h) the completed Schedules,

3. In consideration of the payments to be made by the Employer to the Contractor as indicated in this Agreement, the Contractor hereby covenants with the Employer to execute the Works and to remedy defects therein in conformity in all respects with the provisions of the Contract.

4. The Employer hereby covenants to pay the Contractor in consideration of the execution and completion of the Works and the remedying of defects therein, the Contract Price or such other sum as may become payable under the provisions of the Contract at the times and in the manner prescribed by the Contract.

IN WITNESS whereof the parties hereto have caused this Agreement to be executed in accordance with the laws of Mauritius on the day, month and year indicated above.

Signed by: _____
for and on behalf of the Employer

in the presence of: _____
Witness, Name, Signature, Address, Date

Signed by: _____
for and on behalf the Contractor

in the presence of: _____
Witness, Name, Signature, Address, Date

Performance Security

.....Bank's Name and Address of Issuing Branch or Office.....

Beneficiary:.....*Name and Address of Employer*.....

Date.....

PERFORMANCE GUARANTEE No.:.....

We have been informed that .....*name of the Contractor*..... (hereinafter called "the Contractor") has entered into Contract No.....*reference number of the Contract*..... dated..... with you, for the execution of ..... *name of Contract and brief description of Works*.....(hereinafter called "the Contract").

Furthermore, we understand that, according to the conditions of the Contract, a performance security is required.

At the request of the Contractor, we ..... *name of Bank* .....hereby irrevocably undertake to pay you any sum or sums not exceeding in total an amount of ..... *amount in figures (amount in words)*.....such sum being payable in the types and proportions of currencies in which the Contract Price is payable, upon receipt by us of your first demand in writing accompanied by a written statement stating that the Contractor is in breach of its obligation(s) under the Contract, without your needing to prove or to show grounds for your demand or the sum specified therein.

This guarantee shall expire not later than twenty-eight days from the date of issuance of the Certificate of Completion/Acceptance Certificate, calculated based on a copy of such Certificate which shall be provided to us, or on the.....day of ....., ..., whichever occurs first. Consequently, any demand for payment under this guarantee must be received by us at this office on or before that date.

……..Seal of bank and

***Signature(s)*.....**

KOKUSAI KOGYO CO. LTD.

The Project for Capacity Development on Coastal Protection and Rehabilitation, the Project of Landslide Management in the Republic of Mauritius.

GENERAL CONDITIONS OF CONTRACT

(WORKS)

17 September 2013

This document has used the General Conditions of Contract from the Public Procurement Office of the Republic of Mauritius as template for the purpose of drafting the general Condition of Contract for the construction of the flexible revetment works at Grand Sable

Kokusai Kogyo Co. Ltd.
General Conditions of Contract

Table of Clauses

General Conditions of Contract

A. General

1. Definitions

1.1 Boldface type is used to identify defined terms.

(a) The Accepted Contract Amount means the amount accepted in the Letter of Acceptance for the execution and completion of the Works and the remedying of any defects.

(b) The Activity Schedule is a schedule of the activities comprising the construction, installation, testing, and commissioning of the Works in a lump sum contract. It includes a lump sum price for each activity.

(c) The Adjudicator is the person appointed jointly by the Employer and the Contractor to resolve disputes in the first instance, as provided for in GCC 23.

(d) Bill of Quantities means the priced and completed Bill of Quantities forming part of the Bid.

(e) Compensation Events are those defined in GCC Clause 41 hereunder.

(f) The Completion Date is the date of completion of the Works as certified by the Project Manager, in accordance with GCC Sub-Clause 53.1.

(g) The Contract is the Contract between the Employer and the Contractor to execute, complete, and maintain the Works. It consists of the documents listed in GCC Sub-Clause 2.3 below.

(h) The Contractor is the party whose Bid to carry out the Works has been accepted by the Employer.

(i) The Contractor's Bid is the completed bidding document submitted by the Contractor to the Employer.

(j) The Contract Price is the Accepted Contract Amount stated in the Letter of Acceptance and thereafter as adjusted in accordance with the Contract.

(k) Days are calendar days; months are calendar months.

(l) Dayworks are varied work inputs subject to payment on a time basis for the Contractor's employees and Equipment, in addition to payments for associated Materials and Plant.

(m) A Defect is any part of the Works not completed in accordance with the Contract.

(n) The Defects Liability Certificate is the certificate issued by Project Manager upon correction of defects by the

Contractor.

(o) The Defects Liability Period is the period **named in the PCC** pursuant to Sub-Clause 33.1 and calculated from the Completion Date.

(p) Adjudicator means the single person appointed under Clause 23.

(q) Drawings means the drawings of the Works, as included in the Contract, and any additional and modified drawings issued by (or on behalf of) the Employer in accordance with the Contract, include calculations and other information provided or approved by the Project Manager for the execution of the Contract.

(r) The Employer is the party who employs the Contractor to carry out the Works, **as specified in the PCC**.

(s) Equipment is the Contractor's machinery and vehicles brought temporarily to the Site to construct the Works.

(t) "In writing" or "written" means hand-written, type-written, printed or electronically made, and resulting in a permanent record;

(u) The Initial Contract Price is the Contract Price listed in the Employer's Letter of Acceptance.

(v) The Intended Completion Date is the date on which it is intended that the Contractor shall complete the Works. The Intended Completion Date is **specified in the PCC**. The Intended Completion Date may be revised only by the Project Manager by issuing an extension of time or an acceleration order.

(w) Materials are all supplies, including consumables, used by the Contractor for incorporation in the Works.

(x) Plant is any integral part of the Works that shall have a mechanical, electrical, chemical, or biological function.

(y) The Project Manager is the person **named in the PCC** (or any other competent person appointed by the Employer and notified to the Contractor, to act in replacement of the Project Manager) who is responsible for supervising the execution of the Works and administering the Contract.

(z) PCC means Particular Conditions of Contract

(aa) The Site is the area **defined as such in the PCC**.

(bb) Site Investigation Reports are those that were included in the bidding documents and are factual and interpretative reports about the surface and subsurface conditions at the Site.

(cc) Specification means the Specification of the Works included in the Contract and any modification or addition made or approved by the Project Manager.

(dd) The Start Date is **given in the PCC**. It is the latest date when the Contractor shall commence execution of the Works. It does not necessarily coincide with any of the Site Possession Dates.

(ee) A Subcontractor is a person or corporate body who has a Contract with the Contractor to carry out a part of the work in the Contract, which includes work on the Site.

(ff) Temporary Works are works designed, constructed, installed, and removed by the Contractor that are needed for construction or installation of the Works.

(gg) A Variation is an instruction given by the Project Manager which varies the Works.

(hh) The Works are what the Contract requires the Contractor to construct, install, and turn over to the Employer, **as defined in the PCC**.

2. Interpretation

2.1 In interpreting these GCC, words indicating one gender include all genders. Words indicating the singular also include the plural and words indicating the plural also include the singular. Headings have no significance. Words have their normal meaning under the language of the Contract unless specifically defined. The Project Manager shall provide instructions clarifying queries about these GCC.

2.2 If sectional completion is **specified in the PCC**, references in the GCC to the Works, the Completion Date, and the Intended Completion Date apply to any Section of the Works (other than references to the Completion Date and Intended Completion Date for the whole of the Works).

2.3 The documents forming the Contract shall be interpreted in the following order of priority:

(a) Agreement,

(b) Letter of Acceptance,

(c) Contractor's Bid,

(d) Particular Conditions of Contract,

(e) General Conditions of Contract,

(f) Specifications,

(g) Drawings,

(h) Activity Schedule and

(i) any other document **listed in the PCC** as forming part of

the Contract.

3. Language and Law	3.1	The language of the Contract and the law governing the Contract are **stated in the PCC**.
4. Project Manager's Decisions	4.1	Except where otherwise specifically stated, the Project Manager shall decide contractual matters between the Employer and the Contractor in the role representing the Employer.
5. Delegation	5.1	Otherwise specified in the PCC, the Project Manager may delegate any of his duties and responsibilities to other people, except to the Adjudicator, after notifying the Contractor, and may revoke any delegation after notifying the Contractor.
6. Communications	6.1	Communications between parties that are referred to in the Conditions shall be effective only when in writing. A notice shall be effective only when it is delivered.
7. Subcontracting	7.1	The Contractor may subcontract with the approval of the Project Manager, but may not assign the Contract without the approval of the Employer in writing. Subcontracting shall not alter the Contractor's obligations.
8. Other Contractors	8.1	The Contractor shall cooperate and share the Site with other contractors, public authorities, utilities, and the Employer between the dates given in the Schedule of Other Contractors, as **referred to in the PCC.** The Contractor shall also provide facilities and services for them as described in the Schedule. The Employer may modify the Schedule of Other Contractors, and shall notify the Contractor of any such modification.
9. Personnel and Equipment	9.1	The Contractor shall employ the key personnel and use the equipment identified in its Bid, to carry out the Works or other personnel and equipment approved by the Project Manager. The Project Manager shall approve any proposed replacement of key personnel and equipment only if their relevant qualifications or characteristics are substantially equal to or better than those proposed in the Bid.
	9.2	If the Project Manager asks the Contractor to remove a person who is a member of the Contractor's staff or work force, stating the reasons, the Contractor shall ensure that the person leaves the Site within seven days and has no further connection with the work in the Contract.
10. Employer's and Contractor's Risks	10.1	The Employer carries the risks which this Contract states are Employer's risks, and the Contractor carries the risks which this Contract states are Contractor's risks.
11. Employer's Risks	11.1	From the Start Date until the Defects Liability Certificate has been issued, the following are Employer's risks:
		(a) The risk of personal injury, death, or loss of or damage to

property (excluding the Works, Plant, Materials, and Equipment), which are due to

(i) use or occupation of the Site by the Works or for the purpose of the Works, which is the unavoidable result of the Works or

(ii) negligence, breach of statutory duty, or interference with any legal right by the Employer or by any person employed by or contracted to him except the Contractor.

(b) The risk of damage to the Works, Plant, Materials, and Equipment to the extent that it is due to a fault of the Employer or in the Employer's design, or due to war or radioactive contamination directly affecting the country where the Works are to be executed.

11.2 From the Completion Date until the Defects Liability Certificate has been issued, the risk of loss of or damage to the Works, Plant, and Materials is an Employer's risk except loss or damage due to

(a) a Defect which existed on the Completion Date,

(b) an event occurring before the Completion Date, which was not itself an Employer's risk, or

(c) the activities of the Contractor on the Site after the Completion Date.

12. Contractor's Risks

12.1 From the Starting Date until the Defects Liability Certificate has been issued, the risks of personal injury, death, and loss of or damage to property (including, without limitation, the Works, Plant, Materials, and Equipment) which are not Employer's risks are Contractor's risks.

13. Insurance

13.1 The Contractor shall provide, in the joint names of the Employer and the Contractor, insurance cover from the Start Date to the end of the Defects Liability Period, in the amounts and deductibles **stated in the PCC** for the following events which are due to the Contractor's risks:

(a) loss of or damage to the Works, Plant, and Materials;

(b) loss of or damage to Equipment;

(c) loss of or damage to property (except the Works, Plant, Materials, and Equipment) in connection with the Contract; and

(d) personal injury or death.

13.2 Policies and certificates for insurance shall be delivered by the Contractor to the Project Manager for the Project Manager's approval within 7 days after issue of letter of Acceptance. All

such insurance shall provide for compensation to be payable in the types and proportions of currencies required to rectify the loss or damage incurred.

13.3 If the Contractor does not provide any of the policies and certificates required, the Employer may effect the insurance which the Contractor should have provided and recover the premiums the Employer has paid from payments otherwise due to the Contractor or, if no payment is due, the payment of the premiums shall be a debt due.

13.4 Alterations to the terms of an insurance shall not be made without the approval of the Project Manager.

13.5 Both parties shall comply with any conditions of the insurance policies.

13.6 The policies which are in the joint names of the Contractor and the Employer shall contain a clause to include a waiver of subrogation of the Contractor's rights to the insurance carrier against the Employer.

14. Site Data

14.1 The Contractor shall be deemed to have examined any Site Data **referred to in the PCC**, supplemented by any information available to the Contractor.

15. Contractor to Construct the Works

15.1 The Contractor shall construct and install the Works in accordance with the Specifications and Drawings.

16. The Works to Be Completed by the Intended Completion Date

16.1 The Contractor may commence execution of the Works on the Start Date and shall carry out the Works in accordance with the Program submitted by the Contractor, as updated with the approval of the Project Manager, and complete them by the Intended Completion Date.

17. Approval by the Project Manager

17.1 The Contractor shall submit Specifications and Drawings showing the proposed Temporary Works to the Project Manager, for his approval.

17.2 The Contractor shall be responsible for design of Temporary Works.

17.3 The Project Manager’s approval shall not alter the Contractor’s responsibility for design of the Temporary Works.

17.4 The Contractor shall obtain approval of third parties to the design of the Temporary Works, where required.

17.5 All Drawings prepared by the Contractor for the execution of the temporary or permanent Works, are subject to prior approval by the Project Manager before this use.

18. Safety

18.1 The Contractor shall be responsible for the safety of all activities on the Site.

19. Discoveries

19.1 Anything of historical or other interest or of significant value unexpectedly discovered on the Site shall be the property of the Employer. The Contractor shall notify the Project Manager of such discoveries and carry out the Project Manager's instructions for dealing with them.

20. Possession of the Site

20.1 The Employer shall, after receiving the Performance security, the insurance covers and the Program for the Works all as per requirements, give possession of all parts of the Site to the Contractor within seven days for execution of works in accordance to the Program for the Works. If possession of a part is not given by the date **stated in the PCC or as thereafter reviewed and agreed by the parties,** the Employer shall be deemed to have delayed the start of the relevant activities, and this shall be a Compensation Event.

21. Access to the Site

21.1 The Contractor shall allow the Project Manager and any person authorized by the Project Manager access to the Site and to any place where work in connection with the Contract is being carried out or is intended to be carried out.

22. Instructions

22.1 The Contractor shall carry out all instructions of the Project Manager which comply with the applicable laws where the Site is located.

22.2 The Contractor shall permit persons appointed by the Employer to inspect the Site and/or the accounts and records of the Contractor and its sub-contractors relating to the performance of the Contract, and to have such accounts and records audited by auditors appointed by the Employer if required by the Employer. The Contractor's attention is drawn to Sub-Clause 57.1 which provides, inter alia, that acts intended to materially impede the exercise of the inspection and audit rights provided for under Sub-Clause 22.2 constitute a prohibited practice subject to contract termination.

23. Appointment of the Adjudicator

23.1 The Adjudicator shall be appointed jointly by the Employer and the Contractor, at the time of the Employer's issuance of the Letter of Acceptance. If, in the Letter of Acceptance, the Employer does not agree on the appointment of the Adjudicator, the Employer will request the Appointing Authority **designated in the PCC**, to appoint the Adjudicator within 14 days of receipt of such request.

23.2 Should the Adjudicator resign or die, or should the Employer and the Contractor agree that the Adjudicator is not functioning in accordance with the provisions of the Contract, a new Adjudicator shall be jointly appointed by the Employer and the Contractor. In case of disagreement between the Employer and the Contractor, within 30 days, the Adjudicator shall be designated by the Appointing Authority **designated in the PCC** at the request of either party, within 14 days of receipt of such request.

24. Procedure for Disputes

24.1 If the Contractor believes that a decision taken by the Project Manager was either outside the authority given to the Project Manager by the Contract or that the decision was wrongly taken, the decision shall be referred to the Adjudicator within 14 days of the notification of the Project Manager's decision.

24.2 The Adjudicator shall give a decision in writing within 28 days of receipt of a notification of a dispute.

24.3 The Adjudicator shall be paid by the hour at the **rate specified in the PCC,** together with reimbursable expenses of the types **specified in the PCC**, and the cost shall be divided equally between the Employer and the Contractor, whatever decision is reached by the Adjudicator. Either party may refer a decision of the Adjudicator to an Arbitrator within 28 days of the Adjudicator's written decision. If neither party refers the dispute to arbitration within the above 28 days, the Adjudicator's decision shall be final and binding.

24.4 The arbitration shall be conducted in accordance with the arbitration procedures published by the institution named and in the place specified **in the PCC.**

B. Time Control

25. Program

25.1 Within the time **stated in the PCC**, after the date of the Letter of Acceptance, the Contractor shall submit to the Project Manager for approval a Program showing the general methods, arrangements, order, and timing for all the activities in the Works. In the case of a lump sum contract, the activities in the Program shall be consistent with those in the Activity Schedule.

25.2 An update of the Program shall be a program showing the actual progress achieved on each activity and the effect of the progress achieved on the timing of the remaining work, including any changes to the sequence of the activities.

25.3 The Contractor shall submit to the Project Manager for approval an updated Program at intervals no longer than the period **stated in the PCC.** If the Contractor does not submit an updated Program within this period, the Project Manager may withhold the amount **stated in the PCC** from the next payment certificate and continue to withhold this amount until the next payment after the date on which the overdue Program has been submitted. In the case of a lump sum contract, the Contractor shall provide an updated Activity Schedule within 14 days of being instructed to by the Project Manager.

25.4 The Project Manager's approval of the Program shall not alter the Contractor's obligations. The Contractor may revise the Program and submit it to the Project Manager again at any time. A revised Program shall show the effect of Variations and Compensation Events.

26. Extension of the Intended Completion Date

26.1 The Project Manager shall extend the Intended Completion Date if a Compensation Event(as defined in GCC 41) occurs or a Variation is issued which makes it impossible for Completion to be achieved by the Intended Completion Date without the Contractor taking steps to accelerate the remaining work, which would cause the Contractor to incur additional cost.

26.2 The Project Manager shall decide whether and by how much to extend the Intended Completion Date within 21 days of the Contractor asking the Project Manager for a decision upon the effect of a Compensation Event or Variation and submitting full supporting information. If the Contractor has failed to give early warning of a delay or has failed to cooperate in dealing with a delay, the delay by this failure shall not be considered in assessing the new Intended Completion Date.

27. Acceleration

27.1 When the Employer wants the Contractor to finish before the Intended Completion Date, the Project Manager shall obtain priced proposals for achieving the necessary acceleration from the Contractor. If the Employer accepts these proposals, the Intended Completion Date shall be adjusted accordingly and confirmed by both the Employer and the Contractor.

27.2 If the Contractor's priced proposals for an acceleration are accepted by the Employer, they are incorporated in the Contract Price and treated as a Variation.

28. Delays Ordered by the Project Manager

28.1 The Project Manager may instruct the Contractor to delay the start or progress of any activity within the Works.

29. Management Meetings

29.1 Either the Project Manager or the Contractor may require the other to attend a management meeting. The business of a management meeting shall be to review the plans for remaining work and to deal with matters raised in accordance with the early warning procedure.

29.2 The Project Manager shall record the business of management meetings and provide copies of the record to those attending the meeting and to the Employer. The responsibility of the parties for actions to be taken shall be decided by the Project Manager either at the management meeting or after the management meeting and stated in writing to all who attended the meeting.

30. Early Warning

30.1 The Contractor shall warn the Project Manager at the earliest opportunity of specific likely future events or circumstances that may adversely affect the quality of the work, increase the Contract Price, or delay the execution of the Works. The Project Manager may require the Contractor to provide an estimate of the expected effect of the future event or circumstance on the Contract Price and Completion Date. The estimate shall be provided by the Contractor as soon as reasonably possible.

30.2 The Contractor shall cooperate with the Project Manager in making and considering proposals for how the effect of such an event or circumstance can be avoided or reduced by anyone involved in the work and in carrying out any resulting instruction of the Project Manager.

C. Quality Control

31. Identifying Defects

31.1 The Project Manager shall check the Contractor's work and notify the Contractor of any Defects that are found. Such checking shall not affect the Contractor's responsibilities. The Project Manager may instruct the Contractor to search for a Defect and to uncover and test any work that the Project Manager considers may have a Defect.

32. Tests

32.1 If the Project Manager instructs the Contractor to carry out a test not specified in the Specification to check whether any work has a Defect and the test shows that it does, the Contractor shall pay for the test and any samples. If there is no Defect, the test shall be a Compensation Event.

33. Correction of Defects

33.1 The Project Manager shall give notice to the Contractor of any Defects before the end of the Defects Liability Period, which begins at Completion, and is **defined in the PCC.** The Defects Liability Period shall be extended for as long as Defects remain to be corrected.

33.2 Every time notice of a Defect is given, the Contractor shall correct the notified Defect within the length of time specified by the Project Manager's notice.

34. Uncorrected Defects

34.1 If the Contractor has not corrected a Defect within the time specified in the Project Manager's notice, the Project Manager shall assess the cost of having the Defect corrected, and the Contractor shall pay this amount.

D. Cost Control

35. Contract Price

35.1 In the case of an admeasurement contract, the Bill of Quantities shall contain priced items for the Works to be performed by the Contractor. The Bill of Quantities is used to calculate the Contract Price. The Contractor will be paid for the quantity of the work accomplished at the rate in the Bill of Quantities for

each item.

35.2 In the case of a lump sum contract, the Activity Schedule shall contain the priced activities for the Works to be performed by the Contractor. The Activity Schedule is used to prepare interim valuations of works done.

Any errors or inconsistencies including front loading detected in the Activity Schedule at any time during the execution of the project shall be resolved as directed as by the Project Manager.

36. Changes in the Contract Price

36.1 In the case of an admeasurement contract:

(a) If the final quantity of the work done differs from the quantity in the Bill of Quantities for the particular item by more than 25 percent, provided the change exceeds 1 percent of the Initial Contract Price, the Project Manager shall adjust the rate to allow for the change.

(b) The Project Manager shall not adjust rates from changes in quantities if thereby the Initial Contract Price is exceeded by more than 15 percent, except with the prior approval of the Employer.

(c) If requested by the Project Manager, the Contractor shall provide the Project Manager with a detailed cost breakdown of any rate in the Bill of Quantities.

36.2 In the case of a lump sum contract, the Activity Schedule shall be amended by the Contractor to accommodate changes of Program or method of working made at the Contractor's own discretion. Prices in the Activity Schedule shall not be altered when the Contractor makes such changes to the Activity Schedule.

37. Variations

37.1 All Variations shall be included in updated Programs, and, in the case of a lump sum contract, also in the Activity Schedule, produced by the Contractor.

37.2 The Contractor shall provide the Project Manager with a quotation for carrying out the Variation when requested to do so by the Project Manager. The Project Manager shall assess the quotation, which shall be given within seven (7) days of the request or within any longer period stated by the Project Manager and before the Variation is ordered.

37.3 If the Contractor's quotation is unreasonable, the Project Manager may order the Variation and make a change to the Contract Price, which shall be based on the Project Manager's own forecast of the effects of the Variation on the Contractor's costs.

37.4 If the Project Manager decides that the urgency of varying the work would prevent a quotation being given and considered without delaying the work, no quotation shall be given and the Variation shall be treated as a Compensation Event.

37.5 The Contractor shall not be entitled to additional payment for costs that could have been avoided by giving early warning.

37.6 In the case of an admeasurement contract, if the work in the Variation corresponds to an item description in the Bill of Quantities and if, in the opinion of the Project Manager, the quantity of work above the limit stated in Sub-Clause 38.1 or the timing of its execution do not cause the cost per unit of quantity to change, the rate in the Bill of Quantities shall be used to calculate the value of the Variation. If the cost per unit of quantity changes, or if the nature or timing of the work in the Variation does not correspond with items in the Bill of Quantities, the quotation by the Contractor shall be in the form of new rates for the relevant items of work.

38. Cash Flow Forecasts

38.1 When the Program, or, in the case of a lump sum contract, the Activity Schedule, is updated, the Contractor shall provide the Project Manager with an updated cash flow forecast. The cash flow forecast shall include different currencies, as defined in the Contract, converted as necessary using the Contract exchange rates.

39. Payment Certificates

39.1 The Contractor shall submit to the Project Manager monthly statements of the estimated value of the work executed less the cumulative amount certified previously.

39.2 The Project Manager shall check the Contractor's monthly statement and certify the amount to be paid to the Contractor.

39.3 The value of work executed shall be determined by the Project Manager.

39.4 The value of work executed shall comprise:

(a) In the case of an admeasurement contract, the value of the quantities of work in the Bill of Quantities that have been completed; or

(b) In the case of a lump sum contract, the value of work executed shall comprise the value of completed activities in the Activity Schedule.

39.5 The value of work executed shall include the valuation of Variations and Compensation Events.

39.6 The Project Manager may exclude any item certified in a previous certificate or reduce the proportion of any item previously certified in any certificate in the light of later information.

39.7 Unless otherwise specified in the SCC Interim Payment may be made for Plant and Material delivered on site ready for incorporation within reasonable period of time in the permanent works, subject to the Contractor transferring ownership to the

Employer and providing, where applicable, the right of the transfer of ownership vested upon the Contractor by its supplier.

Notwithstanding the transfer of ownership the responsibility for care and custody thereof together with the risk of loss or damage thereto shall remain with the Contractor until taking over of the works or part thereof in which such Plant and Materials are incorporated and shall make good at its own cost any loss or damage that may occur to the works or part thereof from any cause whatsoever during such period prior to the taking over.

40. Payments

40.1 Payments shall be adjusted for deductions for advance payments and retention. The Employer shall pay the Contractor the amounts certified by the Project Manager within 28 days of the date of each certificate. If the Employer makes a late payment, the Contractor shall be paid interest on the late payment in the next payment. Interest shall be calculated from the date by which the payment should have been made up to the date when the late payment is made at the prevailing rate of interest at the legal rate for each of the currencies in which payments are made.

40.2 If an amount certified is increased in a later certificate or as a result of an award by the Adjudicator or an Arbitrator, the Contractor shall be paid interest upon the delayed payment as set out in this clause. Interest shall be calculated from the date upon which the increased amount would have been certified in the absence of dispute.

40.3 Unless otherwise stated, all payments and deductions shall be paid or charged in the proportions of currencies comprising the Contract Price.

40.4 Items of the Works for which no rate or price has been entered in shall not be paid for by the Employer and shall be deemed covered by other rates and prices in the Contract.

41. Compensation Events

41.1 The following shall be Compensation Events:

(a) The Employer does not give access to a part of the Site by the Site Possession Date pursuant to GCC Sub-Clause 20.1.

(b) The Employer modifies the Schedule of Other Contractors in a way that affects the work of the Contractor under the Contract.

(c) The Project Manager orders a delay or does not issue Drawings, Specifications, or instructions required for execution of the Works on time.

(d) The Project Manager instructs the Contractor to uncover or to carry out additional tests upon work, which is then found to have no Defects.

(e) The Project Manager unreasonably does not approve a subcontract to be let.

(f) Ground conditions are substantially more adverse than could reasonably have been assumed before issuance of the Letter of Acceptance from the information issued to bidders (including the Site Investigation Reports), from information available publicly and from a visual inspection of the Site.

(g) The Project Manager gives an instruction for dealing with an unforeseen condition, caused by the Employer, or additional work required for safety or other reasons.

(h) Other contractors, public authorities, utilities, or the Employer does not work within the dates and other constraints stated in the Contract, and they cause delay or extra cost to the Contractor.

(i) The advance payment is delayed.

(j) The effects on the Contractor of any of the Employer's Risks.

(k) The Project Manager unreasonably delays issuing a Certificate of Completion.

(l) In situations of Force Majeure which makes the contractor's performance of its obligations under the Contract impossible or so impractical as to be considered impossible under the circumstances. Such events shall be limited to:

(a) reason of any exceptionally adverse weather conditions (as specified in the BDS) and

(b) reason of civil commotion, strike or lockout affecting any of the trades employed upon the Works or any of the trades engaged in the preparation, manufacture or transportation of any of the goods or materials required for the Works.

41.2 If a Compensation Event would cause additional cost or would prevent the work being completed before the Intended Completion Date, the Contract Price shall be increased and/or the Intended Completion Date shall be extended. The Project Manager shall decide whether and by how much the Contract Price shall be increased and whether and by how much the Intended Completion Date shall be extended.

41.3 As soon as information demonstrating the effect of each Compensation Event upon the Contractor's forecast cost has been provided by the Contractor, it shall be assessed by the

Project Manager, and the Contract Price shall be adjusted accordingly. If the Contractor's forecast is deemed unreasonable, the Project Manager shall adjust the Contract Price based on the Project Manager's own forecast. The Project Manager shall assume that the Contractor shall react competently and promptly to the event.

41.4 The Contractor shall not be entitled to compensation to the extent that the Employer's interests are adversely affected by the Contractor's not having given early warning or not having cooperated with the Project Manager.

42. Tax

42.1 The Project Manager shall adjust the Contract Price if taxes, duties, and other levies are changed between the date 28 days before the submission of bids for the Contract and the date of the last Completion certificate. The adjustment shall be the change in the amount of tax payable by the Contractor, provided such changes are not already reflected in the Contract Price or are a result of GCC Clause 44.

43. Currencies

43.1 Where payments are made in currencies other than the currency of the Employer's country **specified in the PCC,** the exchange rates used for calculating the amounts to be paid shall be the exchange rates stated in the Contractor's Bid.

44. Price Adjustment

44.1 Prices shall be adjusted for fluctuations in the cost of inputs only if **provided for in the PCC.** If so provided, the amounts certified in each payment certificate, before deducting for Advance Payment, shall be adjusted by applying the respective price adjustment factor to the payment amounts due in each currency. A separate formula of the type indicated below applies to each Contract currency:

$$\mathbf{P_c = A_c + B_c\ Imc/Ioc}$$

where:

P_c is the adjustment factor for the portion of the Contract Price payable in a specific currency "c."

A_c and B_c are coefficients[1] **specified in the PCC,** representing the nonadjustable and adjustable portions, respectively, of the Contract Price payable in that specific currency "c;" and

Imc is the index prevailing at the end of the month being invoiced and Ioc is the index prevailing 28 days before Bid opening for inputs payable; both in the specific currency "c."

---

[1] *The sum of the two coefficients A_c and B_c should be 1 (one) in the formula for each currency. Normally, both coefficients shall be the same in the formulae for all currencies, since coefficient A, for the nonadjustable portion of the payments, is a very approximate figure (usually 0.15) to take account of fixed cost elements or other nonadjustable components. The sum of the adjustments for each currency are added to the Contract Price. [To be transferred to the User Guide]*

44.2 If the value of the index is changed after it has been used in a calculation, the calculation shall be corrected and an adjustment made in the next payment certificate. The index value shall be deemed to take account of all changes in cost due to fluctuations in costs.

45. Retention

45.1 The Employer shall retain from each payment due to the Contractor the proportion **stated in the PCC** until Completion of the whole of the Works.

45.2 Upon the issue of a Certificate of Completion of the Works by the Project Manager, in accordance with GCC 53.1, half the total amount retained shall be repaid to the Contractor and half when the Defects Liability Period has passed and the Project Manager has certified that all Defects notified by the Project Manager to the Contractor before the end of this period have been corrected. The Contractor may substitute retention money with an "on demand" Bank guarantee.

46. Liquidated Damages

46.1 The Contractor shall pay liquidated damages to the Employer at the rate per day **stated in the PCC** for each day that the Completion Date is later than the Intended Completion Date. The total amount of liquidated damages shall not exceed the amount **defined in the PCC.** The Employer may deduct liquidated damages from payments due to the Contractor. Payment of liquidated damages shall not affect the Contractor's liabilities.

46.2 If the Intended Completion Date is extended after liquidated damages have been paid, the Project Manager shall correct any overpayment of liquidated damages by the Contractor by adjusting the next payment certificate. The Contractor shall be paid interest on the overpayment, calculated from the date of payment to the date of repayment, at the rates specified in GCC Sub-Clause 40.1.

47. Bonus

47.1 The Contractor shall be paid a Bonus calculated at the rate per calendar day **stated in the PCC** for each day (less any days for which the Contractor is paid for acceleration) that the Completion is earlier than the Intended Completion Date. The Project Manager shall certify that the Works are complete, although they may not be due to be complete.

48. Advance Payment

48.1 The Employer shall make advance payment to the Contractor of the amounts **stated in the PCC** by the date **stated in the PCC,** against provision by the Contractor of an Unconditional Bank Guarantee in a form and by a bank acceptable to the Employer in amounts and currencies equal to the advance payment. The Guarantee shall remain effective until the advance payment has been repaid, but the amount of the Guarantee shall be progressively reduced by the amounts repaid by the Contractor.

Interest shall not be charged on the advance payment.

48.2 The Contractor is to use the advance payment only to pay for Equipment, Plant, Materials, and mobilization expenses required specifically for execution of the Contract. The Contractor shall demonstrate that advance payment has been used in this way by supplying copies of invoices or other documents to the Project Manager.

48.3 The advance payment shall be repaid by deducting proportionate amounts from payments otherwise due to the Contractor, following the schedule of completed percentages of the Works on a payment basis. No account shall be taken of the advance payment or its repayment in assessing valuations of work done, Variations, price adjustments, Compensation Events, Bonuses, or Liquidated Damages.

49. Securities

49.1 The Performance Security shall be provided to the Employer no later than the date specified in the Letter of Acceptance and shall be issued in an amount **specified in the PCC,** by a bank and denominated in the types and proportions of the currencies in which the Contract Price is payable. The Performance Security shall be valid until a date 28 days from the date of issue of the Certificate of Completion in the case of a Bank Guarantee.

49.2 (a)Where the contractor has benefitted from the application of the Margin of Preference for employment of local manpower, it shall:

(i) in the execution of the contract, fulfill its obligation of maintaining local manpower force for 80 % or more of the man-days deployed in the execution of the Works with which it satisfied the criteria of eligibility for being awarded the contract in application of the Margin of Preference; and

(ii) concurrently with the above performance security, provide a preference security to guarantee it will fulfill its obligation in that respect.

(b) For contracts above Rs 100M, the preference security shall be in the form of an “on demand” bank guarantee for an amount in a convertible currency equivalent to the difference between its bid price and the bid price of the lowest bid if the Margin of Preference was not applicable. It shall be issued by a commercial bank located in the Republic of Mauritius.

(c) For contracts up to Rs 100m, an amount equal to the value of the preference security shall be retained from progressive payments to the contractor, to constitute the guarantee for the preference security.

(d) The preference security shall be valid until the Contractor has completed the Works and a Completion Certificate has been issued by the Employer's Representative as per GCC 53.

(e) The cost of providing the security shall be borne by the Contractor.

49.3 Where a Preference Security is applicable:

(i) the Employer's Representative shall monitor the employment of local manpower throughout the execution of the contract and shall from time to time request a report from the contractor on the percentage of total men-days deployed using local manpower.

(ii) the Contractor shall submit the local manpower employment reports as often as it is reasonably requested by the Employer's Representative.

(iii) the Employer's and Contractor's representatives shall consult each other to ensure that the Contractor's obligation towards local manpower employment is met during the Works execution.

(iv) At the time of works completion, the Contractor shall submit a certified audited report to the Employer to substantiate the actual percentage of local manpower employed throughout the execution of the works.

(v) The preference security shall be forfeited by the employer in case of failure on the part of the contractor to employ at least 80% of the local manpower in the execution of the Works.

50. Dayworks

50.1 If applicable, the Dayworks rates in the Contractor's Bid shall be used only when the Project Manager has given written instructions in advance for additional work to be paid for in that way.

50.2 All work to be paid for as Dayworks shall be recorded by the Contractor on forms approved by the Project Manager. Each completed form shall be verified and signed by the Project Manager within two days of the work being done.

50.3 The Contractor shall be paid for Dayworks subject to obtaining signed Dayworks forms.

51. Cost of Repairs

51.1 Loss or damage to the Works or Materials to be incorporated in the Works between the Start Date and the end of the Defects Correction periods shall be remedied by the Contractor at the Contractor's cost if the loss or damage arises from the Contractor's acts or omissions.

52. Labour Clause

52.1 (a) The rates of remuneration and other conditions of work of the employees of the Contractor shall not be less favourable than

those established for work of the same character in the trade concerned-

(i) by collective agreement applying to a substantial proportion of the workers and employers in the trade concerned;

(ii) by arbitration awards; or

(iii) by Remuneration Regulations made under the Employment Relation Act 2008.

(b) Where remuneration and conditions of work are not regulated in a manner referred to at (a) above, the rates of the remuneration and other conditions of work shall be not less favourable than the general level observed in the trade in which the contractor is engaged by employers whose general circumstances are similar.

52.2 No Contractor shall be entitled to any payment in respect of work performed in the execution of the contract unless he has, together with his claim for payment, filed a certificate:

(a) stating the rates of remuneration and hours of work of the various categories of employees employed in the execution of the contracts;

(b) stating whether any remuneration payable in respect of work done is due;

(c) containing such other information as the Project Manager or Employer administering the contract may require to satisfy himself that the provisions under this clause have been complied with.

52.3 Where the Project Manager or Employer administering the contract is satisfied that remuneration is still due to an employee employed under this contract at the time the claim for payment is filed under subsection 4.3, he may, unless the remuneration is sooner paid by the Contractor, arrange for the payment of the remuneration out of the money payable under this contract.

52.4 Every Contractor shall display a copy of this clause of the contract at the place at which the work required by the contract is performed.

E. Finishing the Contract

53. Completion

53.1 The Contractor shall request the Project Manager to issue a Certificate of Completion of the Works, and the Project Manager shall do so upon deciding that the whole of the Works is completed.

54. Taking Over

54.1 The Employer shall take over the Site and the Works within seven days of the Project Manager's issuing a certificate of Completion.

55. Final Account

55.1 The Contractor shall supply the Project Manager with a detailed account of the total amount that the Contractor considers payable under the Contract before the end of the Defects Liability Period. The Project Manager shall issue a Defects Liability Certificate and certify any final payment that is due to the Contractor within 56 days of receiving the Contractor's account if it is correct and complete. If it is not, the Project Manager shall issue within 56 days a schedule that states the scope of the corrections or additions that are necessary. If the Final Account is still unsatisfactory after it has been resubmitted, the Project Manager shall decide on the amount payable to the Contractor and issue a payment certificate.

56. Operating and Maintenance Manuals

56.1 If "as built" Drawings and/or operating and maintenance manuals are required, the Contractor shall supply them by the dates **stated in the PCC.**

56.2 If the Contractor does not supply the Drawings and/or manuals by the dates **stated in the PCC** pursuant to GCC Sub-Clause 55.1**,** or they do not receive the Project Manager's approval, the Project Manager shall withhold the amount **stated in the PCC** from payments due to the Contractor.

57. Termination

57.1 The Employer or the Contractor may terminate the Contract if the other party causes a fundamental breach of the Contract.

57.2 Fundamental breaches of Contract shall include, but shall not be limited to, the following:

(a) the Contractor stops work for 28 days when no stoppage of work is shown on the current Program and the stoppage has not been authorized by the Project Manager;

(b) the Project Manager instructs the Contractor to delay the progress of the Works, and the instruction is not withdrawn within 28 days;

(c) the Employer or the Contractor is made bankrupt or goes into liquidation other than for a reconstruction or amalgamation;

(d) a payment certified by the Project Manager is not paid by the Employer to the Contractor within 84 days of the date of the Project Manager's certificate;

(e) the Project Manager gives Notice that failure to correct a particular Defect is a fundamental breach of Contract and the Contractor fails to correct it within a reasonable period of time determined by the Project Manager;

(f) the Contractor does not maintain a Security, which is required;

(g) the Contractor has delayed the completion of the Works by

the number of days for which the maximum amount of liquidated damages can be paid, as **defined in the PCC**; or

(h) if the Contractor, in the judgment of the Employer, has engaged in corrupt or fraudulent practices in competing for or in executing the Contract, pursuant to GCC Clause 57.1.

57.3 When either party to the Contract gives notice of a breach of Contract to the Project Manager for a cause other than those listed under GCC Sub-Clause 56.2 above, the Project Manager shall decide whether the breach is fundamental or not.

57.4 Notwithstanding the above, the Employer may terminate the Contract for convenience.

57.5 If the Contract is terminated, the Contractor shall stop work immediately, make the Site safe and secure, and leave the Site as soon as reasonably possible.

58. Fraud and Corruption

58.1 If the Employer determines that the Contractor has engaged in corrupt, fraudulent, collusive, coercive or obstructive practices, in competing for or in executing the Contract, then the Employer may, after giving 14 days notice to the Contractor, terminate the Contractor's employment under the Contract and expel him from the Site, and the provisions of Clause 57 shall apply as if such expulsion had been made under Sub-Clause 57.5 [Termination by Employer].

58.2 Should any employee of the Contractor be determined to have engaged in corrupt, fraudulent, collusive, coercive, or obstructive practice during the execution of the Works, then that employee shall be removed in accordance with Clause 9.

58.3 For the purposes of this Sub-Clause:

(i) “corrupt practice” is the offering, giving, receiving or soliciting, directly or indirectly, of anything of value to influence improperly the actions of another party;

(ii) “fraudulent practice” is any act or omission, including a misrepresentation, that knowingly or recklessly misleads, or attempts to mislead, a party to obtain a financial or other benefit or to avoid an obligation;

(iii) “collusive practice” is an arrangement between two or more parties designed to achieve an improper purpose, including to influence improperly the actions of another party;

(iv) “coercive practice” is impairing or harming, or threatening to impair or harm, directly or indirectly, any party or the property of the party to influence improperly the actions of a party;

(v) “obstructive practice” is

(a) deliberately destroying, falsifying, altering or concealing of evidence material to the investigation

or making false statements to investigators in order to materially impede an investigation into allegations of a corrupt, fraudulent, coercive or collusive practice; and/or threatening, harassing or intimidating any party to prevent it from disclosing its knowledge of matters relevant to the investigation or from pursuing the investigation; or

(b) acts intended to materially impede the exercise of an inspection and audit rights provided for under Sub-Clause 22.2.

59. Payment upon Termination

59.1 If the Contract is terminated because of a fundamental breach of Contract by the Contractor, the Project Manager shall issue a certificate for the value of the work done and Materials ordered less advance payments received up to the date of the issue of the certificate and less the percentage to apply to the value of the work not completed, as **indicated in the PCC.** Additional Liquidated Damages shall not apply. If the total amount due to the Employer exceeds any payment due to the Contractor, the difference shall be a debt payable to the Employer.

59.2 If the Contract is terminated for the Employer's convenience or because of a fundamental breach of Contract by the Employer, the Project Manager shall issue a certificate for the value of the work done, Materials ordered, the reasonable cost of removal of Equipment, repatriation of the Contractor's personnel employed solely on the Works, and the Contractor's costs of protecting and securing the Works, and less advance payments received up to the date of the certificate.

60. Property

60.1 All Materials on the Site, Plant, Equipment, Temporary Works, and Works shall be deemed to be the property of the Employer if the Contract is terminated because of the Contractor's default.

61. Release from Performance

61.1 If the Contract is frustrated by the outbreak of war or by any other event entirely outside the control of either the Employer or the Contractor, the Project Manager shall certify that the Contract has been frustrated. The Contractor shall make the Site safe and stop work as quickly as possible after receiving this certificate and shall be paid for all work carried out before receiving it and for any work carried out afterwards to which a commitment was made.

6. Results of Water Quality Survey

1st Water Quality Survey (04/12/2012-07/12/2012)

Location Name	Site	No.	Salinity	Turbidity	Chlorophyll a	DO	pH	NH4-N	NO2-N	NO3-N	TKN*	T-N**	PO4-P	T-P	Coverage of coral	
			(PSU)	(NTU)	(ug/L)	(mg/L)		(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(%)	Reference
Ponte aux Sable	Shore	PAS-4	34.66	**9.05**	**1.20**	7.74	8.19	<0.01	<0.005	0.07	0.40	0.47	0.005	0.01	0	(1)
	Center	PAS-5	34.95	**1.49**	0.69	7.79	8.22	0.01	<0.005	0.01	0.30	0.31	0.01	0.02	0	
	Back reef	PAS-6	35.05	**1.31**	0.71	8.29	8.21	0.01	<0.005	<0.01	0.30	0.31	0.01	0.02	1	
Albion	Shore	ALB-4	35.04	0.49	0.29	7.31	8.15	<0.01	0.01	<0.01	0.40	0.41	<0.005	0.01	0-2	(1), (2)
	Center	ALB-5	35.00	**1.09**	0.61	8.34	8.23	<0.01	<0.005	<0.01	0.40	0.41	0.01	0.02	-	
	Back reef	ALB-6	34.99	**1.54**	**1.50**	8.4	8.22	<0.01	<0.005	<0.01	0.30	0.31	0.01	0.02	0-33	
Le Morne/Ile aux Benitiers	Center	LMIB-5	35.01	**1.42**	0.47	9.41	8.30	0.01	<0.005	<0.01	0.30	0.31	<0.005	<0.005	0	(1), (2)
	Center	LMIB-8	35.31	**3.48**	**1.08**	7.68	8.25	0.01	<0.005	**0.20**	0.20	0.40	**0.06**	0.08	0	
	Back reef	LMIB-6	35.26	**2.08**	0.92	7.3	8.23	0.01	<0.005	<0.01	0.30	0.31	<0.005	<0.005	0-15	
Bel Ombre	Shore	BO-4	35.00	0.77	0.28	9.44	8.29	0.01	<0.005	0.01	0.40	0.41	0.02	0.03	0-17	(1), (2)
	Center	BO-5	35.00	**1.14**	0.63	8.45	8.24	0.01	<0.005	0.05	0.30	0.35	<0.005	0.01	-	
	Back reef	BO-6	35.00	0.85	0.29	8.3	8.24	0.01	<0.005	0.03	0.30	0.33	<0.005	<0.005	20	
Blue Bay	Shore	BB-5	35.00	0.28	0.33	7.79	8.20	**0.02**	<0.005	**0.25**	0.40	0.65	**0.21**	0.28	10	(2)
	Center	BB-6	35.08	0.34	0.27	8.38	8.23	**0.03**	<0.005	0.02	0.40	0.42	0.02	0.08	20	
	Back reef	BB-7	35.07	0.71	0.45	10.06	8.35	**0.03**	<0.005	0.02	0.40	0.42	0.05	0.08	70	
Ile de I'Est and Ile aux Cerfs	Shore	IC-6	35.14	**1.31**	0.49	6.12	8.15	<0.01	<0.005	<0.01	0.20	0.21	0.02	0.03	0	(2)
	Center	IC-7	35.07	0.70	0.69	7.15	8.18	<0.01	<0.005	0.04	0.30	0.34	0.008	0.02	5	
	Back reef	IC-8	35.05	0.53	0.37	7.87	8.24	<0.01	<0.005	0.01	0.30	0.31	0.01	0.02	70	
Trou d'Eau Douce	Shore	TD-4	27.26	0.85	0.73	7.27	8.10	<0.01	<0.005	0.17	0.40	0.58	0.03	0.04	13-90	(1), (2)
	Center	TD-5	34.95	**1.03**	0.26	7.33	8.20	<0.01	0.01	0.11	0.30	0.41	0.04	0.06	1	
	Back reef	TD-6	35.03	0.43	0.42	7.79	8.23	0.01	<0.005	0.12	0.30	0.42	0.006	0.008	20	
Bell Mare/Palmar	Shore	BMP-4	35.05	**1.16**	0.21	8.14	8.18	**0.03**	<0.005	0.03	0.40	0.43	<0.005	0.05	0-60	(1), (2)
	Center	BMP-5	35.04	**1.40**	0.53	8.05	8.19	**0.04**	<0.005	**0.27**	0.30	0.57	**0.10**	0.63	0-60	
	Back reef	BMP-6	35.05	0.82	0.42	7.47	8.20	**0.03**	<0.005	0.03	0.30	0.33	0.01	0.09	0-60	

*: TKN(Total Kjeldahl Nitrogen) = Organic Nitrogen + Ammonium Nitrogen = O-N+NH4-N

**: T-N(Total Nitrogen) = TKN+NO2-N+NO3-N

Higher than the Mauritian water quality guideline for conservation of coral community in coastal water (water body A1)

Higher than the Japanese water quality guideline for conservation of the natural environment in coastal water (water body class I)

The Japanese water qualiy standard for conservation of the natural environment in coastal water (water body class I) ≤0.2 mg/L for T-N, ≤0.02 mg/L for T-P

(1): Monitoring data by AFRC

(2): The coral survey data by this study

2nd Water Quality Survey (18/06/2013-21/06/2013)

Location Name	Site	No.	Salinity	Turbidity	Chlorophyll a	DO	pH	NH4-N	NO2-N	NO3-N	TKN*	T-N**	PO4-P	T-P	Coverage of coral	
			(PSU)	(NTU)	(ug/L)	(mg/L)		(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(%)	Reference
Ponte aux Sable	Shore	PAS-4	34.79	**2.28**	0.72	8.93	8.48	<0.01	<0.005	0.04	0.10	0.14	<0.005	<0.005	0	(1)
	Center	PAS-5	35.36	**2.09**	0.52	9.96	8.48	<0.01	<0.005	0.05	0.10	0.15	<0.005	0.006	0	
	Back reef	PAS-6	35.36	**1.51**	0.53	8.45	8.43	<0.01	<0.005	0.06	0.20	0.26	<0.005	<0.005	1	
Albion	Shore	ALB-4	35.35	**1.88**	0.61	8.70	8.24	<0.01	<0.005	0.04	<0.01	0.04	<0.005	<0.005	0-2	(1), (2)
	Center	ALB-5	35.34	0.81	0.28	8.36	8.31	<0.01	<0.005	0.04	<0.01	0.04	0.008	0.008	-	
	Back reef	ALB-6	35.26	0.63	0.35	7.97	8.15	<0.01	<0.005	0.04	0.10	0.14	0.007	0.007	0-33	
Le Morne/Ile aux Benitiers	Center	LMIB-5	35.43	**2.01**	0.66	8.96	8.33	<0.01	<0.005	0.04	0.10	0.14	<0.005	<0.005	0	(1), (2)
	Center	LMIB-8	35.57	**1.17**	0.16	8.80	8.30	<0.01	<0.005	0.03	0.10	0.13	<0.005	<0.005	0	
	Back reef	LMIB-6	35.41	**1.41**	0.55	10.82	8.39	<0.01	<0.005	0.05	0.10	0.15	**0.09**	**0.12**	0-15	
Bel Ombre	Shore	BO-4	35.39	1.03	0.49	8.95	8.30	<0.01	<0.005	0.05	<0.01	0.05	<0.005	<0.005	0-17	(1), (2)
	Center	BO-5	35.39	0.98	0.27	9.00	8.29	<0.01	<0.005	0.04	0.10	0.14	<0.005	0.01	-	
	Back reef	BO-6	35.37	0.00	0.00	7.68	8.26	<0.01	<0.005	0.04	0.10	0.14	<0.005	<0.005	20	
Blue Bay	Shore	BB-5	35.37	0.85	0.28	8.20	8.28	<0.01	<0.005	0.02	0.10	0.12	<0.005	<0.005	10	(2)
	Center	BB-6	35.38	0.40	0.13	8.29	8.25	<0.01	<0.005	0.02	0.20	0.22	**0.03**	**0.05**	20	
	Back reef	BB-7	35.37	0.32	0.10	8.20	8.36	<0.01	<0.005	0.03	0.20	0.23	<0.005	<0.005	70	
Ile de I'Est and Ile aux Cerfs	Shore	IC-6	35.46	**1.63**	0.39	7.38	8.35	<0.01	<0.005	0.02	<0.01	0.02	0.006	0.007	0	(2)
	Center	IC-7	35.41	**1.56**	0.35	7.45	8.35	<0.01	<0.005	0.02	<0.01	0.02	0.008	0.009	5	
	Back reef	IC-8	35.64	**1.41**	0.28	8.28	8.27	<0.01	<0.005	0.02	0.10	0.12	0.006	0.008	70	
Trou d'Eau Douce	Shore	TD-4	35.40	**1.24**	0.97	7.87	8.13	**0.08**	<0.005	0.05	0.20	0.25	<0.005	<0.005	13-90	(1), (2)
	Center	TD-5	35.49	**2.33**	0.23	8.30	8.08	<0.01	<0.005	0.03	0.20	0.23	0.005	0.006	1	
	Back reef	TD-6	35.40	**1.02**	0.22	7.77	8.13	<0.01	<0.005	0.03	0.10	0.23	<0.005	<0.005	20	
Bell Mare/Palmar	Shore	BMP-4	35.34	**1.57**	0.39	7.34	8.30	<0.01	<0.005	0.04	<0.01	0.04	0.006	0.008	50-60	(1), (2)
	Center	BMP-5	35.34	**1.59**	0.21	8.46	8.28	<0.01	<0.005	0.04	<0.01	0.04	<0.005	<0.005	50-60	
	Back reef	BMP-6	35.45	0.48	0.50	7.58	8.36	<0.01	<0.005	0.03	0.10	0.13	<0.005	<0.005	50-60	

*: TKN(Total Kjeldahl Nitrogen) = Organic Nitrogen + Ammonium Nitrogen = O-N+NH4-N

**: T-N(Total Nitrogen) = TKN+NO2-N+NO3-N

Higher than the Mauritian water quality guideline for conservation of coral community in coastal water (water body A1)

Higher than the Japanese water quality guideline for conservation of the natural environment in coastal water (water body class I)

The Japanese water qualiy standard for conservation of the natural environment in coastal water (water body class I): ≤0.2 mg/L for T-N, ≤0.02 mg/L for T-P

(1): Monitoring data by AFRC

(2): The coral survey data by this study

1st Water Quality Survey in Lagoon

	Sampling Date	Latitude	Longitude	Salinity	Turvidity	Chl-a	DO	pH
PAS-1	05/12/2012	20°10′ 22.94″	57°26′ 24.80″	34.27	3.13	0.45	8.23	8.19
PAS-2	05/12/2012	20°10′ 17.08″	57°26′ 22.78″	34.75	2.43	0.33	9.09	8.23
PAS-3	05/12/2012	20°10′ 9.38″	57°26′ 19.38″	34.98	1.51	0.96	9.63	8.24
PAS-4	05/12/2012	20°10′ 6.78″	57°27′ 3.46″	34.66	9.05	1.20	7.74	8.19
PAS-5	05/12/2012	20°9′ 56.29″	57°26′ 58.28″	34.95	1.49	0.69	7.79	8.22
PAS-6	05/12/2012	20°9′ 46.92″	57°26′ 54.01″	35.05	1.31	0.71	8.29	8.21
PAS-7	05/12/2012	20°9′ 52.14″	57°27′ 45.81″	34.55	2.35	0.62	6.95	8.17
PAS-8	05/12/2012	20°9′ 42.61″	57°27′ 42.27″	34.74	1.23	0.75	7.12	8.18
PAS-9	05/12/2012	20°9′ 32.07″	57°27′ 37.30″	35.01	1.67	0.47	8.22	8.24
				34.77	2.69	0.69	8.12	8.21

	Sampling Date	Latitude	Longitude	Salinity	Turvidity	Chl-a	DO	pH
ALB-1	05/12/2012	20°12′ 56.80″	57°24′ 4.83″	34.98	0.43	0.41	3.15	7.97
ALB-2	05/12/2012	20°12′ 55.60″	57°23′ 58.91″	34.53	0.67	0.23	3.97	7.98
ALB-3	05/12/2012	20°12′ 53.94″	57°23′ 52.56″	34.92	0.44	0.28	6.85	8.18
ALB-4	05/12/2012	20°12′ 39.17″	57°24′ 8.00″	35.04	0.49	0.29	7.31	8.16
ALB-5	05/12/2012	20°12′ 38.64″	57°24′ 4.34″	35.00	1.09	0.61	8.34	8.23
ALB-6	05/12/2012	20°12′ 38.18″	57°23′ 59.72″	34.99	1.54	1.50	8.40	8.22
ALB-7	05/12/2012	20°12′ 23.19″	57°24′ 14.42″	35.04	0.64	0.56	5.56	8.07
ALB-8	05/12/2012	20°12′ 22.57″	57°24′ 8.82″	35.04	0.59	0.60	7.62	8.17
ALB-9	05/12/2012	20°12′ 22.21″	57°24′ 1.75″	35.00	0.90	0.66	7.95	8.19
				34.95	0.75	0.57	6.57	8.13

	Sampling Date	Latitude	Longitude	Salinity	Turvidity	Chl-a	DO	pH
LMIB-1	04/12/2012	20°27′ 1.64″	57°18′ 44.64″	35.01	0.69	0.35	6.31	8.26
LMIB-2	04/12/2012	20°26′ 58.90″	57°18′ 36.29″	35.01	0.97	0.58	7.63	8.24
LMIB-3	04/12/2012	20°26′ 55.72″	57°18′ 26.46″	35.00	0.67	0.25	7.13	8.21
LMIB-4	04/12/2012	20°26′ 10.63″	57°20′ 58.02″					
LMIB-5	04/12/2012	20°25′ 50.84″	57°20′ 7.61″	35.26	2.08	0.92	7.30	8.23
LMIB-6	04/12/2012	20°25′ 26.18″	57°19′ 11.84″	35.01	1.42	0.47	9.41	8.30
LMIB-7	04/12/2012	20°24′ 50.75″	57°21′ 45.45″					
LMIB-8	04/12/2012	20°24′ 33.39″	57°20′ 53.39″	35.31	3.48	1.08	7.68	8.25
LMIB-9	04/12/2012	20°24′ 6.30″	57°19′ 56.53″	35.11	1.12	0.54	8.65	8.26
				35.10	1.49	0.60	7.73	8.25

	Sampling Date	Latitude	Longitude	Salinity	Turvidity	Chl-a	DO	pH
BO-1	04/12/2012	20°30′ 40.47″	57°24′ 48.95″	34.98	1.08	0.55	7.99	8.20
BO-2	04/12/2012	20°30′ 47.02″	57°24′ 46.19″	34.99	1.06	0.53	7.90	8.20
BO-3	04/12/2012	20°30′ 52.18″	57°24′ 43.64″	34.98	1.21	0.66	7.80	8.20
BO-4	04/12/2012	20°30′ 28.12″	57°24′ 27.14″	35.00	0.77	0.28	9.44	8.29
BO-5	04/12/2012	20°30′ 35.67″	57°24′ 24.37″	35.00	1.14	0.63	8.45	8.24
BO-6	04/12/2012	20°30′ 44.62″	57°24′ 20.32″	35.00	0.85	0.29	8.30	8.24
BO-7	04/12/2012	20°30′ 21.96″	57°24′ 1.91″	35.01	1.24	0.85	9.66	8.37
BO-8	04/12/2012	20°30′ 31.69″	57°23′ 57.65″	34.99	0.59	0.17	7.66	8.21
BO-9	04/12/2012	20°30′ 40.23″	57°23′ 52.98″	34.99	1.02	0.45	7.33	8.20
				34.99	1.00	0.49	8.28	8.24

	Sampling Date	Latitude	Longitude	Salinity	Turvidity	Chl-a	DO	pH
BB-1	07/12/2012	20°26′ 36.47″	57°42′ 51.00″	35.05	0.66	0.42	6.22	8.14
BB-2	07/12/2012	20°26′ 42.43″	57°42′ 52.98″	35.07	0.39	0.21	8.25	8.22
BB-3	07/12/2012	20°26′ 51.89″	57°42′ 55.40″	35.05	1.18	0.73	8.45	8.26
BB-4	07/12/2012	20°27′ 0.11″	57°43′ 0.02″	35.05	0.42	0.47	8.40	8.26
BB-5	07/12/2012	20°26′ 40.81″	57°42′ 35.20″	35.00	0.28	0.33	7.79	8.20
BB-6	07/12/2012	20°26′ 50.27″	57°42′ 34.12″	35.03	0.34	0.27	8.38	8.23
BB-7	07/12/2012	20°27′ 2.17″	57°42′ 31.07″	35.07	0.71	0.45	10.06	8.35
BB-8	07/12/2012	20°26′ 37.32″	57°42′ 23.16″	32.73	0.86	0.46	7.05	8.15
BB-9	07/12/2012	20°26′ 38.16″	57°42′ 7.35″	31.01	0.49	1.11	7.27	8.14
				34.34	0.59	0.49	7.99	8.22

1st Water Quality Survey in Lagoon

	Sampling Date	Latitude	Longitude	Salinity	Turvidity	Chl-a	DO	pH
IC-1	06/12/2012	20°16′ 54.59″	57°47′ 32.12″	35.11	1.46	0.59	7.32	8.17
IC-2	06/12/2012	20°16′ 52.98″	57°48′ 10.33″	35.08	0.62	0.21	7.73	8.20
IC-3	06/12/2012	20°16′ 31.52″	57°48′ 42.59″	35.07	0.38	0.26	7.99	8.24
IC-4	06/12/2012	20°16′ 31.84″	57°49′ 11.25″	35.05	0.41	0.31	7.42	8.25
IC-5	06/12/2012	20°16′ 23.55″	57°47′ 46.94″	35.04	1.20	0.93	6.46	8.15
IC-6	06/12/2012	20°15′ 52.04″	57°47′ 58.00″	35.14	1.31	0.49	6.12	8.15
IC-7	06/12/2012	20°15′ 51.05″	57°48′ 31.09″	35.07	0.70	0.69	7.15	8.18
IC-8	06/12/2012	20°15′ 50.84″	57°49′ 4.66″	35.05	0.53	0.37	7.87	8.24
IC-9	06/12/2012	20°15′ 26.12″	57°47′ 48.08″	34.74	1.69	0.65	5.90	8.10
IC-10	06/12/2012	20°15′ 8.68″	57°48′ 1.55″	35.07	2.09	0.46	6.87	8.14
				35.04	1.04	0.50	7.08	8.18

	Sampling Date	Latitude	Longitude	Salinity	Turvidity	Chl-a	DO	pH
TD-1	06/12/2012	20°14′ 45.52″	57°47′ 33.25″	28.38	0.42	0.78	6.92	8.11
TD-2	06/12/2012	20°14′ 58.99″	57°47′ 58.99″	35.07	0.94	0.55	7.09	8.18
TD-3	06/12/2012	20°14′ 44.71″	57°48′ 33.11″	35.02	0.47	0.49	7.63	8.22
TD-4	06/12/2012	20°14′ 31.61″	57°47′ 22.00″	27.26	0.85	0.73	7.27	8.10
TD-5	06/12/2012	20°14′ 30.48″	57°47′ 46.19″	34.95	1.03	0.26	7.33	8.20
TD-6	06/12/2012	20°14′ 30.14″	57°48′ 21.83″	35.03	0.43	0.42	7.79	8.23
TD-7	06/12/2012	20°14′ 25.05″	57°47′ 28.47″	30.52	0.58	0.61	6.84	8.14
TD-8	06/12/2012	20°14′ 21.52″	57°47′ 47.89″	33.48	0.87	0.69	6.46	8.13
TD-9	06/12/2012	20°14′ 9.52″	57°48′ 18.41″	35.02	0.40	0.29	7.59	8.23
				32.75	0.67	0.54	7.21	8.17

	Sampling Date	Latitude	Longitude	Salinity	Turvidity	Chl-a	DO	pH
BMP-1	07/12/2012	20°12′ 37.62″	57°47′ 33.60″	34.94	1.80	0.52	7.30	8.20
BMP-2	07/12/2012	20°12′ 36.18″	57°47′ 39.98″	35.04	2.30	0.48	7.70	8.20
BMP-3	07/12/2012	20°12′ 33.71″	57°47′ 45.48″	35.04	2.30	1.79	7.40	8.20
BMP-4	07/12/2012	20°12′ 6.24″	57°47′ 6.73″	35.05	1.20	0.21	8.10	8.20
BMP-5	07/12/2012	20°12′ 4.38″	57°47′ 15.53″	35.04	1.40	0.53	8.10	8.20
BMP-6	07/12/2012	20°12′ 2.11″	57°47′ 26.09″	35.05	0.82	0.42	7.50	8.20
BMP-7	07/12/2012	20°11′ 32.39″	57°46′ 34.81″	35.05	0.76	0.35	6.60	8.10
BMP-8	07/12/2012	20°11′ 30.31″	57°46′ 47.78″	35.05	0.54	0.34	6.90	8.10
BMP-9	07/12/2012	20°11′ 26.99″	57°47′ 0.10″	35.04	0.54	0.27	7.50	8.20
				35.03	1.30	0.55	7.46	8.18

2nd Water Quality Survey in Lagoon

	Sampling Date	Latitude	Longitude	Salinity	Turvidity	Chl-a	DO	pH
PAS-1	19/06/2013	20°10′ 22.94″	57°26′ 24.80″	34.95	2.06	0.64	10.93	8.44
PAS-2	19/06/2013	20°10′ 17.08″	57°26′ 22.78″	35.35	2.93	0.70	11.50	8.45
PAS-3	19/06/2013	20°10′ 9.38″	57°26′ 19.38″	35.31	1.99	0.78	9.04	8.48
PAS-4	19/06/2013	20°10′ 6.78″	57°27′ 3.46″	34.79	2.28	0.72	8.93	8.48
PAS-5	19/06/2013	20°9′ 56.29″	57°26′ 58.28″	35.36	2.09	0.52	9.96	8.48
PAS-6	19/06/2013	20°9′ 46.92″	57°26′ 54.01″	35.36	1.51	0.53	8.45	8.43
PAS-7	19/06/2013	20°9′ 52.14″	57°27′ 45.81″	34.94	1.07	0.36	9.07	8.41
PAS-8	19/06/2013	20°9′ 42.61″	57°27′ 42.27″	35.35	1.26	0.39	10.38	8.43
PAS-9	19/06/2013	20°9′ 32.07″	57°27′ 37.30″	35.34	1.68	0.45	10.40	8.52
				35.19	1.87	0.57	9.85	8.46

	Sampling Date	Latitude	Longitude	Salinity	Turvidity	Chl-a	DO	pH
ALB-1	19/06/2013	20°12′ 56.80″	57°24′ 4.83″	35.35	1.24	0.33	7.49	7.98
ALB-2	19/06/2013	20°12′ 55.60″	57°23′ 58.91″	34.11	0.61	0.23	8.02	8.00
ALB-3	19/06/2013	20°12′ 53.94″	57°23′ 52.56″	35.27	0.45	0.23	7.47	7.99
ALB-4	19/06/2013	20°12′ 39.17″	57°24′ 8.00″	35.35	1.88	0.61	8.70	8.24
ALB-5	19/06/2013	20°12′ 38.64″	57°24′ 4.34″	35.34	0.81	0.28	8.36	8.31
ALB-6	19/06/2013	20°12′ 38.18″	57°23′ 59.72″	35.26	0.63	0.35	7.97	8.15
ALB-7	19/06/2013	20°12′ 23.19″	57°24′ 14.42″	35.36	1.38	0.62	9.53	8.12
ALB-8	19/06/2013	20°12′ 22.57″	57°24′ 8.82″	35.36	2.30	0.99	8.73	8.11
ALB-9	19/06/2013	20°12′ 22.21″	57°24′ 1.75″	35.30	1.03	0.43	8.19	8.12
				35.19	1.15	0.45	8.27	8.11

	Sampling Date	Latitude	Longitude	Salinity	Turvidity	Chl-a	DO	pH
LMIB-1	18/06/2013	20°27′ 1.64″	57°18′ 44.64″	35.38	1.10	0.47	9.19	8.31
LMIB-2	18/06/2013	20°26′ 58.90″	57°18′ 36.29″	35.37	0.40	0.27	8.15	8.28
LMIB-3	18/06/2013	20°26′ 55.72″	57°18′ 26.46″	35.36	0.11	0.31	7.69	8.26
LMIB-4	18/06/2013	20°26′ 10.63″	57°20′ 58.02″					
LMIB-5	18/06/2013	20°25′ 50.84″	57°20′ 7.61″	35.43	2.01	0.66	8.96	8.33
LMIB-6	18/06/2013	20°25′ 26.18″	57°19′ 11.84″	35.41	1.41	0.55	10.82	8.39
LMIB-7	18/06/2013	20°24′ 50.75″	57°21′ 45.45″					
LMIB-8	18/06/2013	20°24′ 33.39″	57°20′ 53.39″	35.57	1.17	0.16	8.80	8.30
LMIB-9	18/06/2013	20°24′ 6.30″	57°19′ 56.53″	35.42	1.34	0.71	9.32	8.36
				35.42	1.08	0.45	8.99	8.32

	Sampling Date	Latitude	Longitude	Salinity	Turvidity	Chl-a	DO	pH
BO-1	18/06/2013	20°30′ 40.47″	57°24′ 48.95″	35.38	1.02	0.39	8.07	8.26
BO-2	18/06/2013	20°30′ 47.02″	57°24′ 46.19″	35.38	0.52	0.03	7.96	8.26
BO-3	18/06/2013	20°30′ 52.18″	57°24′ 43.64″	35.37	0.30	0.07	7.65	8.25
BO-4	18/06/2013	20°30′ 28.12″	57°24′ 27.14″	35.39	1.03	0.49	8.95	8.30
BO-5	18/06/2013	20°30′ 35.67″	57°24′ 24.37″	35.39	0.98	0.27	9.00	8.29
BO-6	18/06/2013	20°30′ 44.62″	57°24′ 20.32″	35.37	0.00	0.00	7.68	8.26
BO-7	18/06/2013	20°30′ 21.96″	57°24′ 1.91″	35.08	0.44	0.22	8.63	8.28
BO-8	18/06/2013	20°30′ 31.69″	57°23′ 57.65″	35.38	0.48	0.13	7.88	8.27
BO-9	18/06/2013	20°30′ 40.23″	57°23′ 52.98″	35.38	0.57	0.16	7.62	8.25
				45.45	0.76	0.25	10.49	10.63

	Sampling Date	Latitude	Longitude	Salinity	Turvidity	Chl-a	DO	pH
BB-1	21/06/2013	20°26′ 36.47″	57°42′ 51.00″	35.36	0.50	0.29	7.66	8.13
BB-2	21/06/2013	20°26′ 42.43″	57°42′ 52.98″	35.35	0.64	0.33	7.33	8.15
BB-3	21/06/2013	20°26′ 51.89″	57°42′ 55.40″	35.43	0.29	0.12	8.02	8.30
BB-4	21/06/2013	20°27′ 0.11″	57°43′ 0.02″	35.36	0.12	0.08	7.59	8.31
BB-5	21/06/2013	20°26′ 40.81″	57°42′ 35.20″	35.37	0.85	0.28	8.20	8.28
BB-6	21/06/2013	20°26′ 50.27″	57°42′ 34.12″	35.38	0.40	0.13	8.29	8.25
BB-7	21/06/2013	20°27′ 2.17″	57°42′ 31.07″	35.37	0.32	0.10	8.20	8.36
BB-8	21/06/2013	20°26′ 37.32″	57°42′ 23.16″	28.66	0.58	0.58	7.85	8.40
BB-9	21/06/2013	20°26′ 38.16″	57°42′ 7.35″	25.18	1.65	2.44	9.75	8.10
				33.50	0.59	0.48	8.10	8.25

2nd Water Quality Survey in Lagoon

	Sampling Date	Latitude	Longitude	Salinity	Turvidity	Chl-a	DO	pH
PD-1	21/06/2013	20°26′ 28.24″	57°43′ 28.54″	35.37	0.30	0.05	7.93	8.24
PD-2	21/06/2013	20°26′ 15.02″	57°43′ 39.12″	35.36	0.16	0.08	8.06	8.19
PD-3	21/06/2013	20°26′ 47.81″	57°43′ 13.90″	35.38	0.43	0.12	8.14	8.14
				35.37	0.30	0.08	8.04	8.19

	Sampling Date	Latitude	Longitude	Salinity	Turvidity	Chl-a	DO	pH
IC-1	20/06/2013	20°16′ 54.59″	57°47′ 32.12″	35.49	1.76	0.40	7.64	8.40
IC-2	20/06/2013	20°16′ 52.98″	57°48′ 10.33″	35.38	1.07	0.33	7.51	8.36
IC-3	20/06/2013	20°16′ 31.52″	57°48′ 42.59″	35.40	1.33	0.23	7.65	8.29
IC-4	20/06/2013	20°16′ 31.84″	57°49′ 11.25″	35.40	0.66	0.10	7.82	8.32
IC-5	20/06/2013	20°16′ 23.55″	57°47′ 46.94″	35.44	1.02	0.30	7.67	8.29
IC-6	20/06/2013	20°15′ 52.04″	57°47′ 58.00″	35.46	1.63	0.39	7.38	8.35
IC-7	20/06/2013	20°15′ 51.05″	57°48′ 31.09″	35.41	1.56	0.35	7.45	8.35
IC-8	20/06/2013	20°15′ 50.84″	57°49′ 4.66″	35.64	1.41	0.28	8.28	8.27
IC-9	20/06/2013	20°15′ 26.12″	57°47′ 48.08″	34.81	1.75	0.32	7.92	8.32
IC-10	20/06/2013	20°15′ 8.68″	57°48′ 1.55″	34.41	0.96	0.12	8.23	8.20
				35.28	1.32	0.28	7.76	8.32

	Sampling Date	Latitude	Longitude	Salinity	Turvidity	Chl-a	DO	pH
TD-1	20/06/2013	20°14′ 45.52″	57°47′ 33.25″	33.93	3.37	0.88	7.23	8.07
TD-2	20/06/2013	20°14′ 58.99″	57°47′ 58.99″	35.42	1.38	0.44	7.90	8.01
TD-3	20/06/2013	20°14′ 44.71″	57°48′ 33.11″	35.37	0.84	0.28	8.25	8.10
TD-4	20/06/2013	20°14′ 31.61″	57°47′ 22.00″	35.40	1.24	0.97	7.87	8.13
TD-5	20/06/2013	20°14′ 30.48″	57°47′ 46.19″	35.39	2.33	0.23	8.30	8.08
TD-6	20/06/2013	20°14′ 30.14″	57°48′ 21.83″	35.40	1.02	0.22	7.77	8.13
TD-7	20/06/2013	20°14′ 25.05″	57°47′ 28.47″	30.00	1.00	0.56	7.70	8.25
TD-8	20/06/2013	20°14′ 21.52″	57°47′ 47.89″	32.07	0.66	0.31	7.72	8.16
TD-9	20/06/2013	20°14′ 9.52″	57°48′ 18.41″	35.37	1.21	0.26	7.85	8.19
				34.26	1.45	0.46	7.84	8.12

	Sampling Date	Latitude	Longitude	Salinity	Turvidity	Chl-a	DO	pH
BMP-1	21/06/2013	20°12′ 37.62″	57°47′ 33.60″	35.30	1.31	0.57	8.81	8.18
BMP-2	21/06/2013	20°12′ 36.18″	57°47′ 39.98″	35.31	1.96	0.61	8.57	8.38
BMP-3	21/06/2013	20°12′ 33.71″	57°47′ 45.48″	35.32	1.63	0.31	7.65	8.32
BMP-4	21/06/2013	20°12′ 6.24″	57°47′ 6.73″	35.34	1.57	0.39	7.34	8.30
BMP-5	21/06/2013	20°12′ 4.38″	57°47′ 15.53″	35.34	1.59	0.21	8.46	8.28
BMP-6	21/06/2013	20°12′ 2.11″	57°47′ 26.09″	35.34	0.48	0.50	7.58	8.36
BMP-7	21/06/2013	20°11′ 32.39″	57°46′ 34.81″	34.69	1.57	0.30	7.71	7.98
BMP-8	21/06/2013	20°11′ 30.31″	57°46′ 47.78″	35.38	1.06	0.29	7.77	8.32
BMP-9	21/06/2013	20°11′ 26.99″	57°47′ 0.10″	35.28	1.10	0.40	7.75	8.27
				35.26	1.36	0.40	7.96	8.27

1st Water Quality Survey (04/12/2012-07/12/2012)

Location Name	Latitude	Longitude	Salinity	Turbidity	Chlorophyll a	DO	pH	NH4-N	NO2-N	NO3-N	TKN*	T-N**	PO4-P	T-P
			(PSU)	(NTU)	(ug/L)	(mg/L)		(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)
Bel Ombre small river	S20°30′ 16.7″	E57°24′ 49.0″	0.20	6.59	1.98	6.21	7.83	0.03	<0.005	0.20	0.30	0.50	0.02	0.03
Riviere Noir river	S20°22′ 00.0″	E57°22′ 48.6″	32.49	7.46	6.71	4.93	7.73	0.01	<0.005	<0.01	1.50	1.50	0.02	0.04
Albion small river	S20°12′ 40.3″	E57°24′ 20.5″	0.33	2.15	3.89	2.53	7.74	<0.01	0.02	4.60	0.60	5.20	0.06	0.08
GRNW river	S20°10′ 37.5″	E57°28′ 22.6″	0.19	2.61	1.89	8.33	7.96	<0.01	0.01	2.10	0.20	2.30	0.01	0.02
GRSE river mouth	S20°12′ 40.3″	E57°24′ 20.5″	34.16	4.17	2.01									

*: TKN(Total Kjeldahl Nitrogen) = Organic Nitrogen + Ammonium Nitrogen = O-N+NH4-N
**: T-N(Total Nitrogen) = TKN+NO2-N+NO3-N

2nd Water Quality Survey (18/06/2013-21/06/2013)

Location Name	Latitude	Longitude	Salinity	Turbidity	Chlorophyll a	DO	pH	NH4-N	NO2-N	NO3-N	TKN*	T-N**	PO4-P	T-P
			(PSU)	(NTU)	(ug/L)	(mg/L)		(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)
Bel Ombre small river	S20°30′ 16.7″	E57°24′ 49.0″	0.18	5.73	0.97	9.06	8.17	0.08	<0.005	0.13	0.10	0.23	<0.005	<0.005
Riviere Noir river	S20°22′ 00.0″	E57°22′ 48.6″	0.22	2.55	1.16	7.36	8.03	0.27	<0.005	0.08	0.30	0.38	<0.005	<0.005
Albion small river	S20°12′ 40.3″	E57°24′ 20.5″	0.31	10.70	1.38	9.55	5.49	0.05	0.007	<0.005	0.10	0.11	0.15	0.17
GRNW river	S20°10′ 37.5″	E57°28′ 22.6″	0.15	2.59	1.98	10.10	5.06	0.15	<0.005	1.09	0.18	1.27	<0.005	<0.005

*: TKN(Total Kjeldahl Nitrogen) = Organic Nitrogen + Ammonium Nitrogen = O-N+NH4-N
**: T-N(Total Nitrogen) = TKN+NO2-N+NO3-N

7. Survey Results of Public Awareness

Questionnaire about Coastal Disaster and Protection
on
The Project for Capacity Development on Coastal Protection and Rehabilitation in the Republic of Mauritius

This questionnaire is conducted as a part of the title project by the technical committee members and JICA (Japan International Cooperation Agency) Expert Team. The output of the questionnaire is only used for this project and never be used for other purposes. Please read carefully explanation below and answer the following questions.

< Overview of the Questionnaire >

The objective of the questionnaire is to survey following 5 items to prepare for the future coastal conservation plan. The sites for conducting questionnaires include following 9 coastal areas (Figure 1) where the sandy beach has been eroded seriously in recent years.

1) **Damage on the coastal area by one event of extreme weather condition such as a cyclone**
2) **Erosion Tendency for Long Time Period**
3) **Possible Impacts of Climate Change on Coastal Zone**
4) **Desirable Adaptation to the Beach Erosion and SLR (Sea Level Rise)**
5) **Other**

(1)Pte aux Cannoniers
(2) Mon Choisy
(3) Pts. Sable
(4) Albion
(5) Flic en Flac
(6) Le Morne
(7) Bel Ombre
(8) Pte. D' Sny
(9) Q. Cocos Vge, T. d'Eau Douce, Ile Cerf

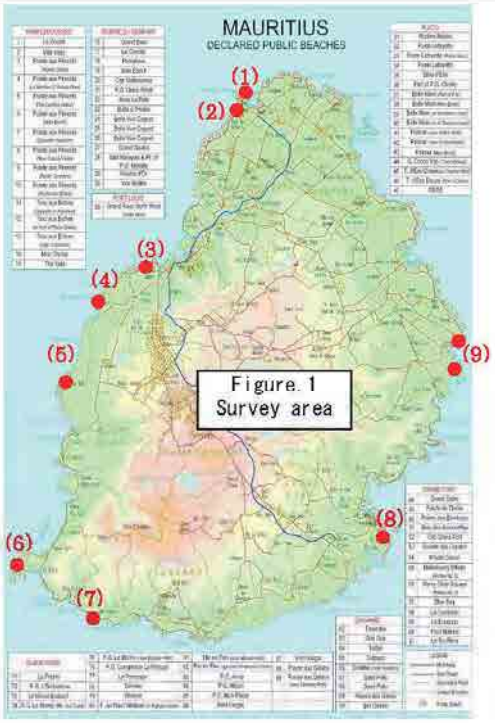


Figure. 1
Survey area

1. Damage on the coastal area by one event of extreme weather condition such as a cyclone

Q1. Please tell us about a cyclone (or storm) which caused maximum damage on coastal area you have ever experienced/ heard before

(Length of residence)

a. Less than 1 year b. 1~5years c. 6~10 years d. 11~20 years
e. 21~30 years e. 31~40 years f. 41~50 years g. More than 50 years

(Way to know about the damage)

a. Experienced b. Heard from someone
c. Book / newspaper etc. d. Other (_____)

(Cause of the damage)

a. Cyclone Carol(1960)
b. Other cyclones/ storms :
Hennie(2005), Darius(2004), Dina(2002), Davina(1999), Daniella(1996)
Hollanda(1994), Krissy(1989), Claudette(1979), Gervaise(1975), Jenny(1962)
Name(_____), Year(_____)
c. Don't remember
d. Don't know

(Damaged area / place) *Mark on map by interviewer, or recording with GPS

Area/ Place (_____)

Q2. What kinds of damages were caused by the extreme weather condition in Q1? (multiple choices). In addition, please describe details of damages as far as you remembered.

a. Wave overtopping (splash) : about (_____)m height from (_____)
b. Wave inundation (overflow): about (_____)m distance from shoreline
c. Beach scarp*: dimensions (_____)
d. Retreat of shoreline: amount (_____)
e. Damage on houses or structure: (_____)
f. Damage on infrastructures such as roads: (_____)
g. Damage on vegetations such as trees (_____)
h. Others (_____)

Notes:


*Beach Scarp (Albion)

2. Erosion tendency for long time period

At any time, sandy beach is facing the risk of erosion due to waves and currents at coastal area. In this sense, it is important to know the erosion tendency for long time period for the beach conservation project.

Q1. When do you first aware that the beach was eroding?

a. Year of (_____)	b. Before 1950s	c. 1950s	d.1960s
e. 1970s	f. 1980s	g. 1990s	h. 2000~2005
i. 2006~2010	j. After 2010		

k. Beach seems not to be eroded.

l. Not aware, because not watch the beach in erosion viewpoint.

m. Not aware, because not watch the beach condition so often.

o. Others (_____)

Q2. Please describe the details of the beach erosion for long time period.

(Damaged area / place) *Mark on map by interviewer, or recording with GPS

Area/ Place (_____)

(Retreat amount of shoreline from a year in Q.1 until Present)

a. Less than 1.0m	b. 1m~5m	c. 5m~10m
d. 10m~20m	e. 20m~30m	f. 30m~50m

g. More than 50m

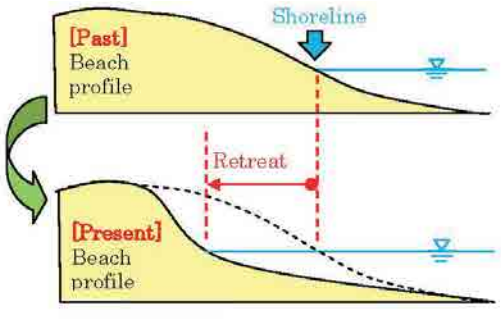
h. Not sure but it is guessed that the retreat is little amount.

i. Not sure but it is guessed that the retreat is considerable amount .

j. No idea.

k. Others (_____)

▼ Image of shoreline retreat in cross section



2. Erosion tendency for long time period

At any time, sandy beach is facing the risk of erosion due to waves and currents at coastal area. In this sense, it is important to know the erosion tendency for long time period for the beach conservation project.

Q1. When do you first aware that the beach was eroding?

a. Year of (_____)	b. Before 1950s	c. 1950s	d.1960s
e. 1970s	f. 1980s	g. 1990s	h. 2000~2005
i. 2006~2010	j. After 2010		

k. Beach seems not to be eroded.

l. Not aware, because not watch the beach in erosion viewpoint.

m. Not aware, because not watch the beach condition so often.

o. Others (_____)

Q2. Please describe the details of the beach erosion for long time period.

(Damaged area / place) *Mark on map by interviewer, or recording with GPS

Area/ Place (_____)

(Retreat amount of shoreline from a year in Q.1 until Present)

a. Less than 1.0m	b. 1m~5m	c. 5m~10m
d. 10m~20m	e. 20m~30m	f. 30m~50m

g. More than 50m

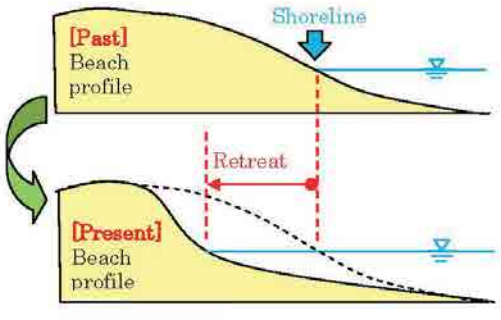
h. Not sure but it is guessed that the retreat is little amount.

i. Not sure but it is guessed that the retreat is considerable amount .

j. No idea.

k. Others (_____)

▼ Image of shoreline retreat in cross section



2. Effects on Coastal Environment

*SLR: Sea Level Rise

c. Effect on the animals living at coastal area (e.g. sea turtle)

- Reduction of sand beach area due to erosion and SLR will results in less habitat area for coastal animals such as sea turtles

d. Increase of coral bleaching and mortality due to the increase of sea surface temperatures

- Corals have a preferred temperature range in which they live
- When the temperature increases, corals become stressed and may undergo beaching, result in mortality

e. Death of mangroves due to the rapid SLR

- If the rate of SLR is too rapid for mangroves to adjust their habitat area, they would be drown, which result in mortality.

3. Effects on Beach Utilization

f. Reduction of utilizable beach area

- Reduction of sand beach restricted leisure activities such as marine sports, picnic, sunbathing and so on.

g. Negative impacts on coastal tourism

- Coastal tourism is heavily dependent on "sun, sea and sand"
- Warmer air and sea temperatures would make existing resort too warm for tourists.
- Reduction of sand beach area also have negative affect an area's value for tourism

Q.1 Are you aware any effects on coastal area by SLR recently? (multiple choices)

a. Yes, about (_____)
b. No
c. Don't know

Q.2 Among the effects in explanation, please mark on the items which you didn't know before reading questionnaire. (multiple choices)

*SLR: Sea Level Rise

(Impacts on coastal protection)
a. Reduction of the coastal land area and Increase of shoreline erosion.
b. Increase of probability of flooding in coastal zone

(Impacts on coastal environment)
c. Impact on the animals living at coastal area (e.g. sea turtle)
d. Increase of coral bleaching and mortality due to the increase of sea surface temperatures
e. Drown of mangroves due to the rapid SLR

(Impacts on beach utilization)
f. Reduction of utilizable beach area
g. Negative impacts for coastal tourism area

---

h. Know all of them
i. Know none of them
j. Know other impacts ( )

Q.3 Among the effects in Q1, which effect do you think most serious for coastal zone and why do you think so?

- Most serious effects, especially considering your own situation:
  a. Effects on Coastal Protection
  b. Effects on Coastal Environment
  c. Effects on Beach Utilization
  d. Cannot select one because all issues are very important.
  e. Other (_____)
- Reason
  a. To protect the national land is important.
  b. To protect human lives and properties is important.
  c. Environmental conservation is important to protect biodiversity.
  d. To maintain enough beach area is important for leisure activities.
  e. To protect tourism industries is important for economic growth.
  f. Other ( )

Notes:

4. Desirable adaptation to the beach erosion and SLR

There are a few adaptations which enable coastal communities reduce the impacts by beach erosion and SLR. Representative types of adaptations are follows.

<Representative methods of adaptations against beach erosion and SLR>

*SLR: Sea Level Rise

1. Protect

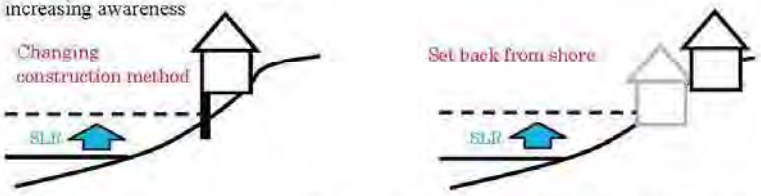
Defend vulnerable areas by seawalls, beach nourishment (filling sand or gravels) etc.

2. Accommodate

Continue to occupy vulnerable areas, but accommodate by changing land use, construction method and/or increasing awareness

3. Retreat

Abandon structures in vulnerable areas and set back from shore.



Source: Drawn by JICA Study Team based on IPCC CZMS (1990)

Q.1 Among above, which methods do you think most desirable as adaptations?

a. Protect
b. Accommodate
c. Retreat
d. Combination of above (& &)
e. None of the above ( )

Q.2 Why do you prefer the method in Q.1.? (multiple choices)

a. Low cost (from a long term standpoint)
b. Most effective against (erosion, SLR)
c. Easiest method to avoid coastal disaster
d. Safest method against costal disaster
e. Want to live at near shore area
f. Don't want to make any changes to place to live
g. Preferred if enough compensation is guaranteed.
h. Others( )

5. WTP(Willingness to Pay) for the Coastal Conservation Project

The sandy beaches in Mauritius play important roles as follows.

1) Protection against coastal disaster
2) Recreational area for local people and foreign tourists
3) Environmental conservation of coastal ecosystem.

On the other hand, the coastal area is getting more vulnerable to the disasters such as beach erosion and wave overtopping due to the effect by climate change. The necessity of coastal protection, therefore, is increasingly important these days.

The representative measures of coastal protection are described in next page with typical advantages and disadvantages. Please refer to next page first, then answer following questions.

Q.1 Which measures do you think most desirable as coastal protection?

a. Beach nourishment
b. Seawalls, Revetments
c. Groin
d. Offshore breakwater
e. None of the above ( )

Q.2 Why do you prefer the method in Q.1.? (multiple choices)

a. Natural beach condition is kept in terms of beach utilization.
b. Natural beach condition is kept in terms of beach environment.
c. More stable against coastal disaster
d. Less maintenance work would be needed
e. It's effective to prevent sediment transport along the shore
f. Wave height at projected area is reduced and it makes the area safer for beach use.
g. The sand outflow is prevented
h. Others( )

Representative measures of coastal protection

1. **Beach nourishment (sand / gravel filling)**

Advantage : Natural beach conditions in environment and utilization are maintained.
Disadvantage : Periodic maintenance would be needed if the filled materials are unstable.

2. **Seawalls, Revetments (concrete or rocks): Prevention of beach erosion and wave overtopping**

Advantage : More stable against coastal disaster
Disadvantage : It could waste the natural environment of beach and be obstacles for beach use.

3. **Groin(concrete or rocks): Prevention of sand outflow along the shore**

Advantage: Prevent sediment transport along the shore effectively
Disadvantage:
- Need to be constructed at periodic intervals.
- Prevent natural sediment transportation

4. **Offshore breakwater (rocks): Prevention of sand outflow to offshore and reduction of wave height.**

Advantage: Wave height is reduced and sand outflow to offshore is prevented.
Disadvantage:
- The beach shape become unnatural with a combination of eroded and accumulated areas
- It could waste the environment and utilization at offshore

Without the beach conservation project, the beach erosion would continue and in some years would be damaged irreversibly. To avoid such situations, the coastal protection would be needed in the early stages.
However, the implementation of coastal protections generally needs a considerable cost.

Please note that following questionnaires are asked hypothetically – not a real one.
The word "Donation" is just used to evaluate the "Value" of your thought about coastal protection.
Here, please imagine that the beach, close to your house or you often to visit, is facing the beach erosion. **IF** you are asked to share a part of cost of the coastal conservation project for the beach: Do you agree or disagree to donation with the amounts below?

Q.3 If your household was asked to pay a monthly donation to support the plan, would you agree or disagree to donate Rs 100 / month?

a. Agree (Go to Q.4) b. Disagree(Go to Q.5)

Q.4 If your household was asked to pay a monthly donation to support the plan, would you agree or disagree to donate Rs 200 / month?

a. Agree (Go to Q.7) b. Disagree(Go to Q.7)

Q.5 If your household was asked to pay a monthly donation to support the plan, would you agree or disagree to donate Rs 50 /month?

a. Agree (Go to Q.7) b. Disagree(Go to Q.6)

Q.6 (For those who disagree with Q. 5), why would you disagree for the donation?

a. The donation amount is too expensive.
b. It' should be collected by other ways such as tax etc.
c. The project cost has to be totally covered by the government budget
d. The coastal protection itself is not needed.
e. The proposed measures would not solve the problem.
f. Others (_____)

Q.7 (For those who agree with Q3-5 at least one time), why would you agree for the donation?

a. For the protection purpose: (erosion, wave overtopping, cyclones)
b. For the recreational purpose: (leisure activities, marine sports)
c. For the environmental purpose: (scenery, coastal ecosystem)
d. Others ( )
Additional comments if any: (_____
_____)

(Socio –Economic Characteristics)

The following questionnaires are to ask your personal matters. Please answer following as long as you don't have any difficulties. The results of the questionnaire is only applied for this project and never be used for other purposes.

Q.1 Age

a. 20s b. 30s c. 40s d. 50s e. 60s f. 70s or more

Q.2 Sex

a. Male b. Female

Q.3 Occupation

a. Company employee
b. Civil servant
c. Independent business
d. Homemaker (household responsibility)
e. College student
f. Unemployed
g. Others (_____)

Q.4 Household composition

Number of living together (_____)

- Among above, Number of who are receiving income (_____)

Q.5 Household income per month (total amount in household)

a. Less than Rs 10,000
b. Rs 10,000 – Rs20,000 c. Rs 20,000 – Rs30,000
d. Rs 30,000 – Rs40,000 e. Rs 40,000 – Rs50,000
f. Rs 50,000 – Rs60,000 g. Rs 60,000 – Rs70,000
h. Rs 70,000 – Rs80,000 i. Rs 80,000 – Rs 120,000
j. More than 120,000

Q.6 Contact

- Name: _____
- Tel or Email: _____

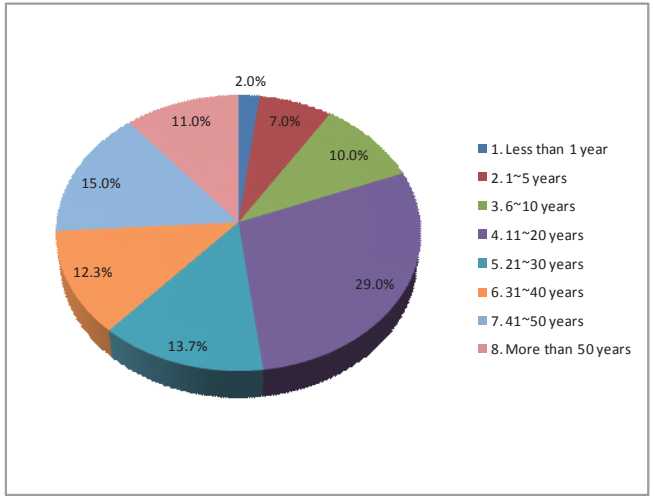
That's all for the questionnaire. We do appreciate for your cooperation!!

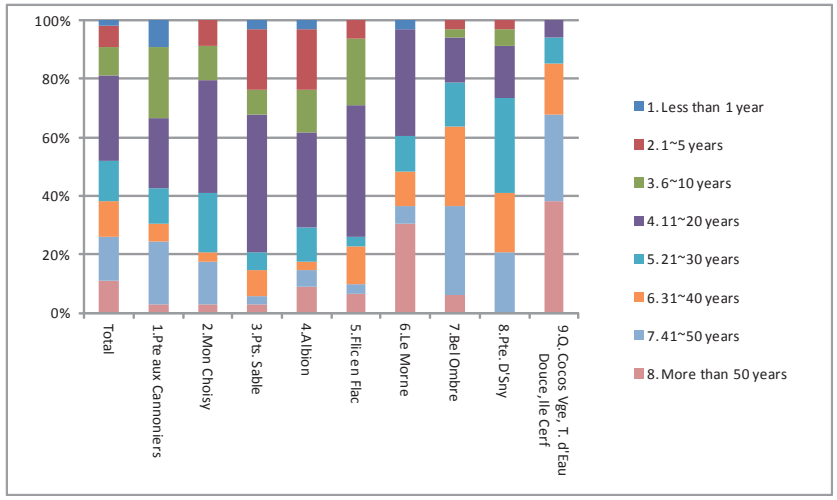
1. Damage on the coastal area by one event of extreme weather condition such as a cyclone

Q1. Please tell us about a cyclone (or storm) which caused maximum damage on coastal area you have ever experienced/ heard before.

(Length of residence)

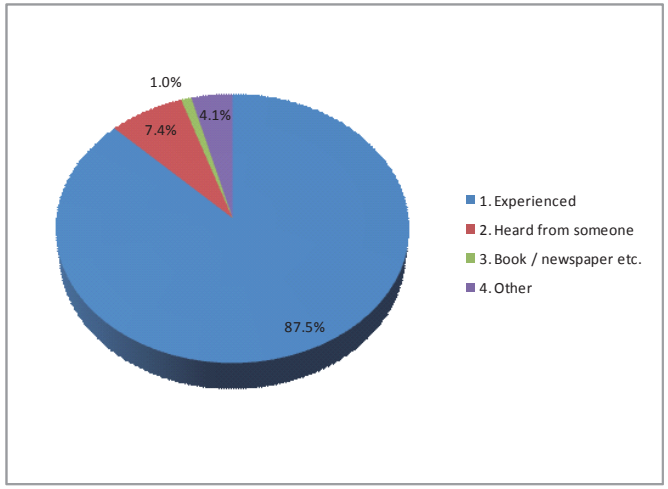
	Total		1.Pte aux Cannoniers		2.Mon Choisy		3.Pts. Sable		4.Albion		5.Flic en Flac		6.Le Morne		7.Bel Ombre		8.Pte. D'Sny		9.Q. Cocos Vge, T. d'Eau Douce, Ile Cerf	
1. Less than 1 year	6	(2.0%)	3	(9.1%)	0	(0.0%)	1	(2.9%)	1	(2.9%)	0	(0.0%)	1	(3.0%)	0	(0.0%)	0	(0.0%)	0	(0.0%)
2. 1~5 years	21	(7.0%)	0	(0.0%)	3	(8.8%)	7	(20.6%)	7	(20.6%)	2	(6.5%)	0	(0.0%)	1	(3.0%)	1	(2.9%)	0	(0.0%)
3. 6~10 years	30	(10.0%)	8	(24.2%)	4	(11.8%)	3	(8.8%)	5	(14.7%)	7	(22.6%)	0	(0.0%)	1	(3.0%)	2	(5.9%)	0	(0.0%)
4. 11~20 years	87	(29.0%)	8	(24.2%)	13	(38.2%)	16	(47.1%)	11	(32.4%)	14	(45.2%)	12	(36.4%)	5	(15.2%)	6	(17.6%)	2	(5.9%)
5. 21~30 years	41	(13.7%)	4	(12.1%)	7	(20.6%)	2	(5.9%)	4	(11.8%)	1	(3.2%)	4	(12.1%)	5	(15.2%)	11	(32.4%)	3	(8.8%)
6. 31~40 years	37	(12.3%)	2	(6.1%)	1	(2.9%)	3	(8.8%)	1	(2.9%)	4	(12.9%)	4	(12.1%)	9	(27.3%)	7	(20.6%)	6	(17.6%)
7. 41~50 years	45	(15.0%)	7	(21.2%)	5	(14.7%)	1	(2.9%)	2	(5.9%)	1	(3.2%)	2	(6.1%)	10	(30.3%)	7	(20.6%)	10	(29.4%)
8. More than 50 years	33	(11.0%)	1	(3.0%)	1	(2.9%)	1	(2.9%)	3	(8.8%)	2	(6.5%)	10	(30.3%)	2	(6.1%)	0	(0.0%)	13	(38.2%)
Total	300	(100.0%)	33	(100.0%)	34	(100.0%)	34	(100.0%)	34	(100.0%)	31	(100.0%)	33	(100.0%)	33	(100.0%)	34	(100.0%)	34	(100.0%)

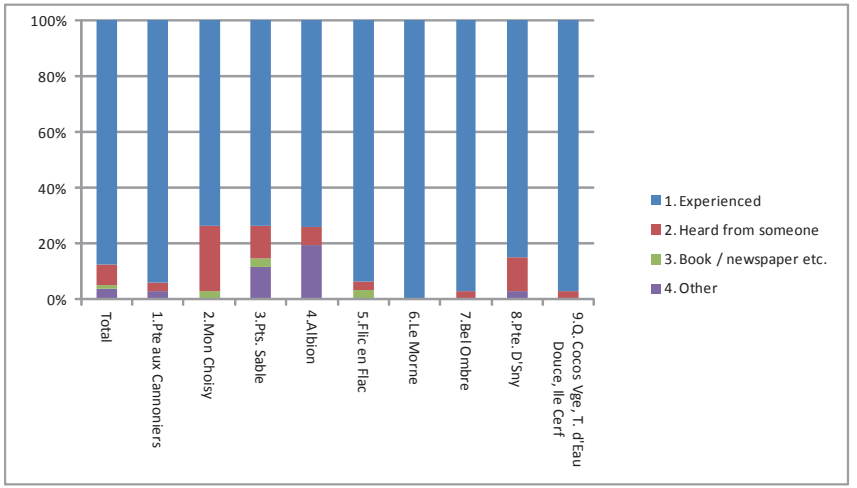




(Way to know about the damage)

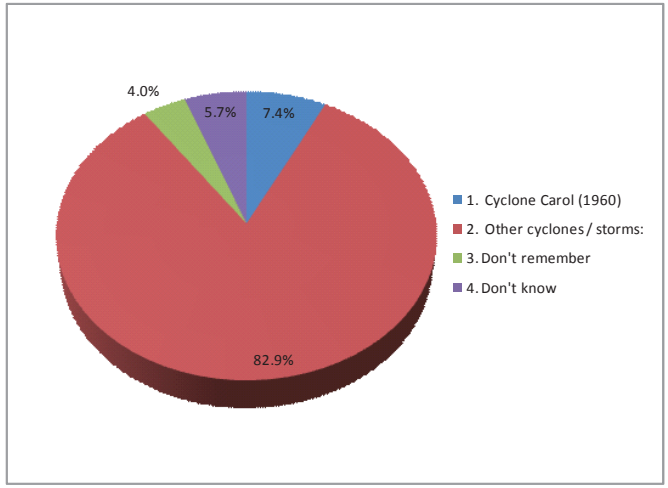
	Total		1.Pte aux Cannoniers		2.Mon Choisy		3.Pts. Sable		4.Albion		5.Flic en Flac		6.Le Morne		7.Bel Ombre		8.Pte. D'Sny		9.Q. Cocos Vge, T. d'Eau Douce, Ile Cerf	
1. Experienced	259	(87.5%)	31	(93.9%)	25	(73.5%)	25	(73.5%)	23	(74.2%)	29	(93.5%)	33	(100.0%)	32	(97.0%)	28	(84.8%)	33	(97.1%)
2. Heard from someone	22	(7.4%)	1	(3.0%)	8	(23.5%)	4	(11.8%)	2	(6.5%)	1	(3.2%)	0	(0.0%)	1	(3.0%)	4	(12.1%)	1	(2.9%)
3. Book / newspaper etc.	3	(1.0%)	0	(0.0%)	1	(2.9%)	1	(2.9%)	0	(0.0%)	1	(3.2%)	0	(0.0%)	0	(0.0%)	0	(0.0%)	0	(0.0%)
4. Other	12	(4.1%)	1	(3.0%)	0	(0.0%)	4	(11.8%)	6	(19.4%)	0	(0.0%)	0	(0.0%)	0	(0.0%)	1	(3.0%)	0	(0.0%)
Total	296	(100.0%)	33	(100.0%)	34	(100.0%)	34	(100.0%)	31	(100.0%)	31	(100.0%)	33	(100.0%)	33	(100.0%)	33	(100.0%)	34	(100.0%)

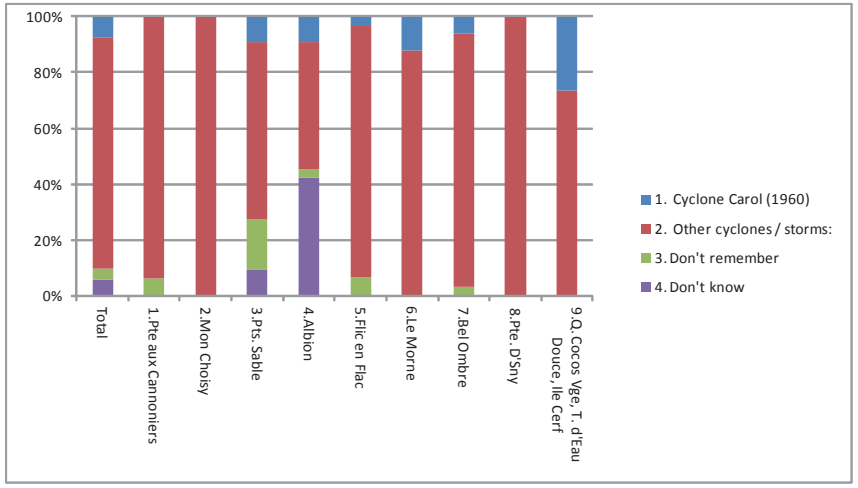




(Cause of the damage)

	Total		1.Pte aux Cannoniers		2.Mon Choisy		3.Pts. Sable		4.Albion		5.Flic en Flac		6.Le Morne		7.Bel Ombre		8.Pte. D'Sny		9.Q. Cocos Vge, T. d'Eau Douce, Ile Cerf	
1. Cyclone Carol (1960)	22	(7.4%)	0	(0.0%)	0	(0.0%)	3	(9.1%)	3	(9.1%)	1	(3.2%)	4	(12.1%)	2	(6.1%)	0	(0.0%)	9	(26.5%)
2. Other cyclones / storms:	247	(82.9%)	31	(93.9%)	34	(100.0%)	21	(63.6%)	15	(45.5%)	28	(90.3%)	29	(87.9%)	30	(90.9%)	34	(100.0%)	25	(73.5%)
3. Don't remember	12	(4.0%)	2	(6.1%)	0	(0.0%)	6	(18.2%)	1	(3.0%)	2	(6.5%)	0	(0.0%)	1	(3.0%)	0	(0.0%)	0	(0.0%)
4. Don't know	17	(5.7%)	0	(0.0%)	0	(0.0%)	3	(9.1%)	14	(42.4%)	0	(0.0%)	0	(0.0%)	0	(0.0%)	0	(0.0%)	0	(0.0%)
Total	298	(100.0%)	33	(100.0%)	34	(100.0%)	33	(100.0%)	33	(100.0%)	31	(100.0%)	33	(100.0%)	33	(100.0%)	34	(100.0%)	34	(100.0%)

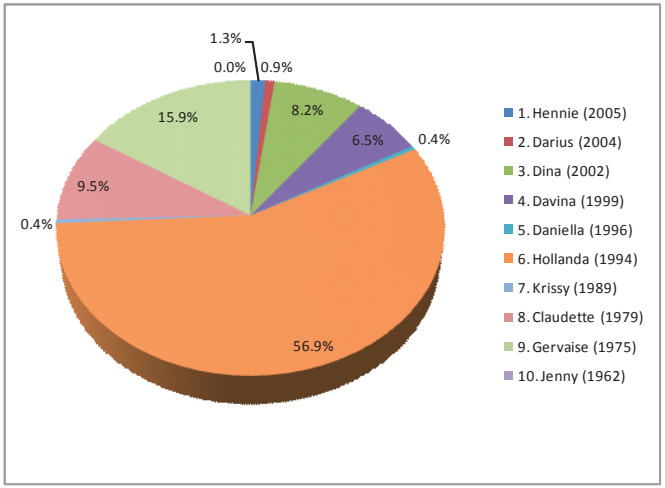


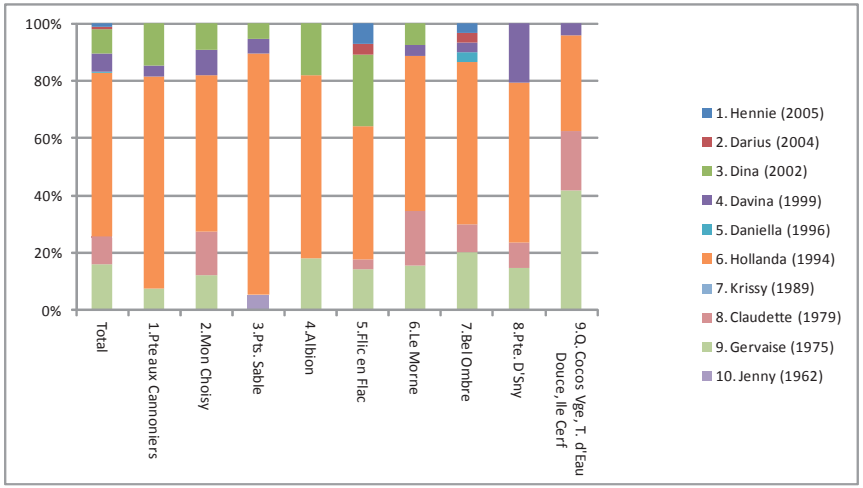


(Cause of the damage)

2. Other cyclones / storms:

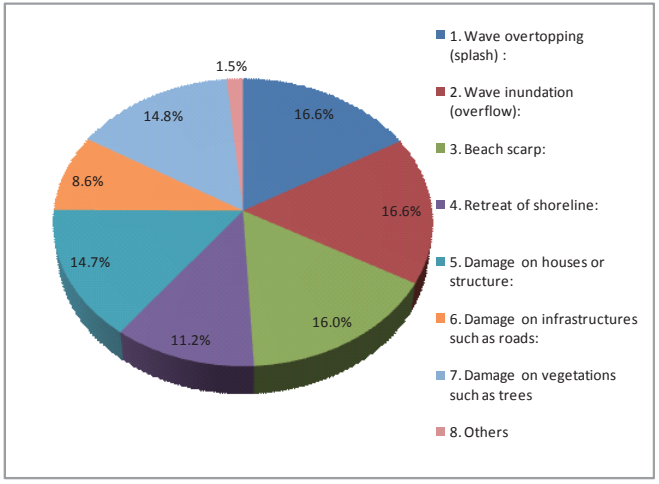
	Total		1.Pte aux Cannoniers		2.Mon Choisy		3.Pts. Sable		4.Albion		5.Flic en Flac		6.Le Morne		7.Bel Ombre		8.Pte. D'Sny		9.Q. Cocos Vge, T. d'Eau Douce, Ile Cerf	
1. Hennie (2005)	3	(1.3%)	0	(0.0%)	0	(0.0%)	0	(0.0%)	0	(0.0%)	2	(7.1%)	0	(0.0%)	1	(3.3%)	0	(0.0%)	0	(0.0%)
2. Darius (2004)	2	(0.9%)	0	(0.0%)	0	(0.0%)	0	(0.0%)	0	(0.0%)	1	(3.6%)	0	(0.0%)	1	(3.3%)	0	(0.0%)	0	(0.0%)
3. Dina (2002)	19	(8.2%)	4	(14.8%)	3	(9.1%)	1	(5.3%)	2	(18.2%)	7	(25.0%)	2	(7.7%)	0	(0.0%)	0	(0.0%)	0	(0.0%)
4. Davina (1999)	15	(6.5%)	1	(3.7%)	3	(9.1%)	1	(5.3%)	0	(0.0%)	0	(0.0%)	1	(3.8%)	1	(3.3%)	7	(20.6%)	1	(4.2%)
5. Daniella (1996)	1	(0.4%)	0	(0.0%)	0	(0.0%)	0	(0.0%)	0	(0.0%)	0	(0.0%)	0	(0.0%)	1	(3.3%)	0	(0.0%)	0	(0.0%)
6. Hollanda (1994)	132	(56.9%)	20	(74.1%)	18	(54.5%)	16	(84.2%)	7	(63.6%)	13	(46.4%)	14	(53.8%)	17	(56.7%)	19	(55.9%)	8	(33.3%)
7. Krissy (1989)	1	(0.4%)	0	(0.0%)	0	(0.0%)	1	(5.3%)	0	(0.0%)	0	(0.0%)	0	(0.0%)	0	(0.0%)	0	(0.0%)	0	(0.0%)
8. Claudette (1979)	22	(9.5%)	0	(0.0%)	5	(15.2%)	0	(0.0%)	0	(0.0%)	1	(3.6%)	5	(19.2%)	3	(10.0%)	3	(8.8%)	5	(20.8%)
9. Gervaise (1975)	37	(15.9%)	2	(7.4%)	4	(12.1%)	0	(0.0%)	2	(18.2%)	4	(14.3%)	4	(15.4%)	6	(20.0%)	5	(14.7%)	10	(41.7%)
10. Jenny (1962)	0	(0.0%)	0	(0.0%)	0	(0.0%)	0	(0.0%)	0	(0.0%)	0	(0.0%)	0	(0.0%)	0	(0.0%)	0	(0.0%)	0	(0.0%)
Total	232	(100.0%)	27	(100.0%)	33	(100.0%)	19	(100.0%)	11	(100.0%)	28	(100.0%)	26	(100.0%)	30	(100.0%)	34	(100.0%)	24	(100.0%)

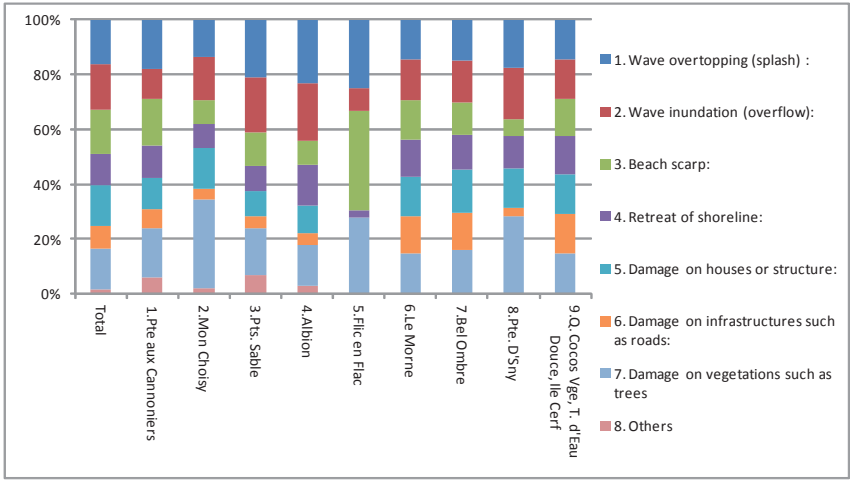




Q2. What kinds of damages were caused by the extreme weather condition in Q1? (multiple choices). In addition, please describe details of damages as far as you remembered.

	Total		1.Pte aux Cannoniers		2.Mon Choisy		3.Pts. Sable		4.Albion		5.Flic en Flac		6.Le Morne		7.Bel Ombre		8.Pte. D'Sny		9.Q. Cocos Vge, T. d'Eau Douce, Ile Cerf	
1. Wave overtopping (splash) :	244	(16.6%)	18	(18.0%)	14	(13.7%)	16	(21.3%)	16	(23.5%)	9	(25.0%)	32	(14.5%)	30	(14.9%)	17	(17.7%)	34	(14.4%)
2. Wave inundation (overflow):	244	(16.6%)	11	(11.0%)	16	(15.7%)	15	(20.0%)	14	(20.6%)	3	(8.3%)	33	(14.9%)	31	(15.3%)	18	(18.8%)	34	(14.4%)
3. Beach scarp:	236	(16.0%)	17	(17.0%)	9	(8.8%)	9	(12.0%)	6	(8.8%)	13	(36.1%)	32	(14.5%)	24	(11.9%)	6	(6.3%)	32	(13.6%)
4. Retreat of shoreline:	165	(11.2%)	12	(12.0%)	9	(8.8%)	7	(9.3%)	10	(14.7%)	1	(2.8%)	30	(13.6%)	26	(12.9%)	11	(11.5%)	33	(14.0%)
5. Damage on houses or structure:	217	(14.7%)	11	(11.0%)	15	(14.7%)	7	(9.3%)	7	(10.3%)	0	(0.0%)	32	(14.5%)	31	(15.3%)	14	(14.6%)	34	(14.4%)
6. Damage on infrastructures such as roads:	127	(8.6%)	7	(7.0%)	4	(3.9%)	3	(4.0%)	3	(4.4%)	0	(0.0%)	30	(13.6%)	28	(13.9%)	3	(3.1%)	34	(14.4%)
7. Damage on vegetations such as trees	218	(14.8%)	18	(18.0%)	33	(32.4%)	13	(17.3%)	10	(14.7%)	10	(27.8%)	32	(14.5%)	31	(15.3%)	27	(28.1%)	34	(14.4%)
8. Others	22	(1.5%)	6	(6.0%)	2	(2.0%)	5	(6.7%)	2	(2.9%)	0	(0.0%)	0	(0.0%)	1	(0.5%)	0	(0.0%)	1	(0.4%)
Total	1473	(100.0%)	100	(100.0%)	102	(100.0%)	75	(100.0%)	68	(100.0%)	36	(100.0%)	221	(100.0%)	202	(100.0%)	96	(100.0%)	236	(100.0%)

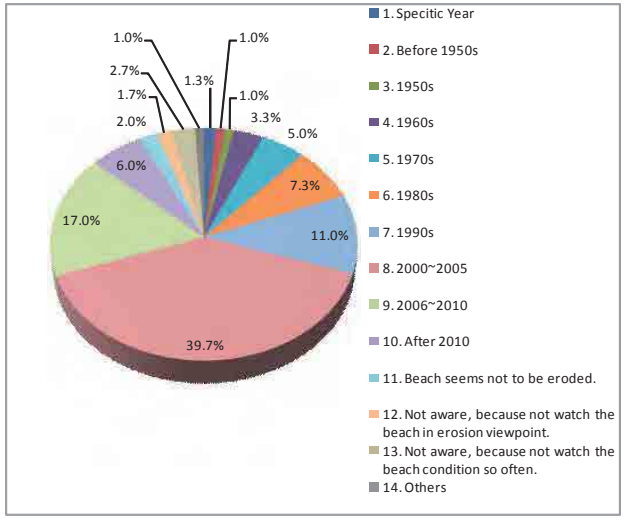


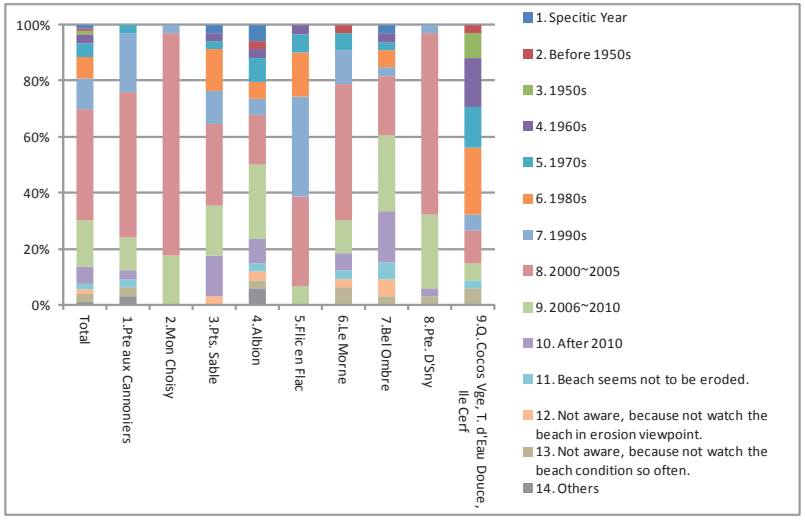


2. Erosion tendency for long time period

Q1. When do you first aware that the beach was eroding?

	Total		1.Pte aux Cannoniers		2.Mon Choisy		3.Pts. Sable		4.Albion		5.Flic en Flac		6.Le Morne		7.Bel Ombre		8.Pte. D'Sny		9.Q. Cocos Vge, T. d'Eau Douce, Ile Cerf	
1. Specitic Year	4	1.3%	0	0.0%	0	0.0%	1	2.9%	2	5.9%	0	0.0%	0	0.0%	1	3.0%	0	0.0%	0	0.0%
2. Before 1950s	3	1.0%	0	0.0%	0	0.0%	0	0.0%	1	2.9%	0	0.0%	1	3.0%	0	0.0%	0	0.0%	1	2.9%
3. 1950s	3	1.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	3	8.8%
4. 1960s	10	3.3%	0	0.0%	0	0.0%	1	2.9%	1	2.9%	1	3.2%	0	0.0%	1	3.0%	0	0.0%	6	17.6%
5. 1970s	15	5.0%	1	3.0%	0	0.0%	1	2.9%	3	8.8%	2	6.5%	2	6.1%	1	3.0%	0	0.0%	5	14.7%
6. 1980s	22	7.3%	0	0.0%	0	0.0%	5	14.7%	2	5.9%	5	16.1%	0	0.0%	2	6.1%	0	0.0%	8	23.5%
7. 1990s	33	11.0%	7	21.2%	1	2.9%	4	11.8%	2	5.9%	11	35.5%	4	12.1%	1	3.0%	1	2.9%	2	5.9%
8. 2000~2005	119	39.7%	17	51.5%	27	79.4%	10	29.4%	6	17.6%	10	32.3%	16	48.5%	7	21.2%	22	64.7%	4	11.8%
9. 2006~2010	51	17.0%	4	12.1%	6	17.6%	6	17.6%	9	26.5%	2	6.5%	4	12.1%	9	27.3%	9	26.5%	2	5.9%
10. After 2010	18	6.0%	1	3.0%	0	0.0%	5	14.7%	3	8.8%	0	0.0%	2	6.1%	6	18.2%	1	2.9%	0	0.0%
11. Beach seems not to be eroded.	6	2.0%	1	3.0%	0	0.0%	0	0.0%	1	2.9%	0	0.0%	1	3.0%	2	6.1%	0	0.0%	1	2.9%
12. Not aware, because not watch the beach in erosion viewpoint.	5	1.7%	0	0.0%	0	0.0%	1	2.9%	1	2.9%	0	0.0%	1	3.0%	2	6.1%	0	0.0%	0	0.0%
13. Not aware, because not watch the beach condition so often.	8	2.7%	1	3.0%	0	0.0%	0	0.0%	1	2.9%	0	0.0%	2	6.1%	1	3.0%	1	2.9%	2	5.9%
14. Others	3	1.0%	1	3.0%	0	0.0%	0	0.0%	2	5.9%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Total	300	100.0%	33	100.0%	34	100.0%	34	100.0%	34	100.0%	31	100.0%	33	100.0%	33	100.0%	34	100.0%	34	100.0%

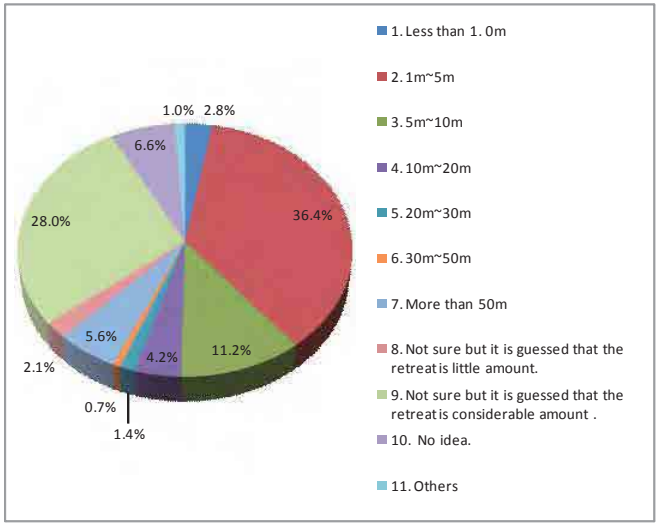


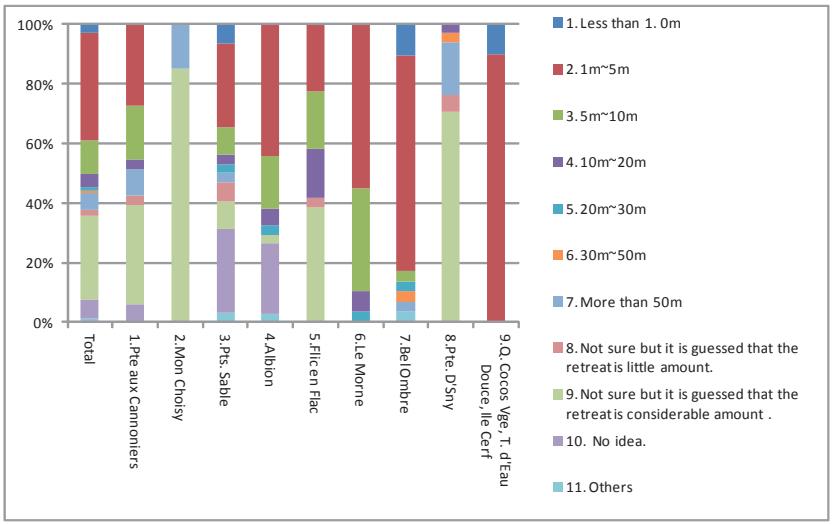


Q2. Please describe the details of the beach erosion for long time period.

(Retreat amount of shoreline from a year in Q.1 until Present)

	Total		1.Pte aux Cannoniers		2.Mon Choisy		3.Pts. Sable		4.Albion		5.Flic en Flac		6.Le Morne		7.Bel Ombre		8.Pte. D'Sny		9.Q. Cocos Vge, T. d'Eau Douce, Ile Cerf	
1. Less than 1. 0m	8	(2.8%)	0	(0.0%)	0	(0.0%)	2	(6.3%)	0	(0.0%)	0	(0.0%)	0	(0.0%)	3	(10.3%)	0	(0.0%)	3	(10.0%)
2. 1m~5m	104	(36.4%)	9	(27.3%)	0	(0.0%)	9	(28.1%)	15	(44.1%)	7	(22.6%)	16	(55.2%)	21	(72.4%)	0	(0.0%)	27	(90.0%)
3. 5m~10m	32	(11.2%)	6	(18.2%)	0	(0.0%)	3	(9.4%)	6	(17.6%)	6	(19.4%)	10	(34.5%)	1	(3.4%)	0	(0.0%)	0	(0.0%)
4. 10m~20m	12	(4.2%)	1	(3.0%)	0	(0.0%)	1	(3.1%)	2	(5.9%)	5	(16.1%)	2	(6.9%)	0	(0.0%)	1	(2.9%)	0	(0.0%)
5. 20m~30m	4	(1.4%)	0	(0.0%)	0	(0.0%)	1	(3.1%)	1	(2.9%)	0	(0.0%)	1	(3.4%)	1	(3.4%)	0	(0.0%)	0	(0.0%)
6. 30m~50m	2	(0.7%)	0	(0.0%)	0	(0.0%)	0	(0.0%)	0	(0.0%)	0	(0.0%)	0	(0.0%)	1	(3.4%)	1	(2.9%)	0	(0.0%)
7. More than 50m	16	(5.6%)	3	(9.1%)	5	(14.7%)	1	(3.1%)	0	(0.0%)	0	(0.0%)	0	(0.0%)	1	(3.4%)	6	(17.6%)	0	(0.0%)
8. Not sure but it is guessed that the retreat is little amount.	6	(2.1%)	1	(3.0%)	0	(0.0%)	2	(6.3%)	0	(0.0%)	1	(3.2%)	0	(0.0%)	0	(0.0%)	2	(5.9%)	0	(0.0%)
9. Not sure but it is guessed that the retreat is considerable amount .	80	(28.0%)	11	(33.3%)	29	(85.3%)	3	(9.4%)	1	(2.9%)	12	(38.7%)	0	(0.0%)	0	(0.0%)	24	(70.6%)	0	(0.0%)
10. No idea.	19	(6.6%)	2	(6.1%)	0	(0.0%)	9	(28.1%)	8	(23.5%)	0	(0.0%)	0	(0.0%)	0	(0.0%)	0	(0.0%)	0	(0.0%)
11. Others	3	(1.0%)	0	(0.0%)	0	(0.0%)	1	(3.1%)	1	(2.9%)	0	(0.0%)	0	(0.0%)	1	(3.4%)	0	(0.0%)	0	(0.0%)
Total	286	(100.0%)	33	(100.0%)	34	(100.0%)	32	(100.0%)	34	(100.0%)	31	(100.0%)	29	(100.0%)	29	(100.0%)	34	(100.0%)	30	(100.0%)

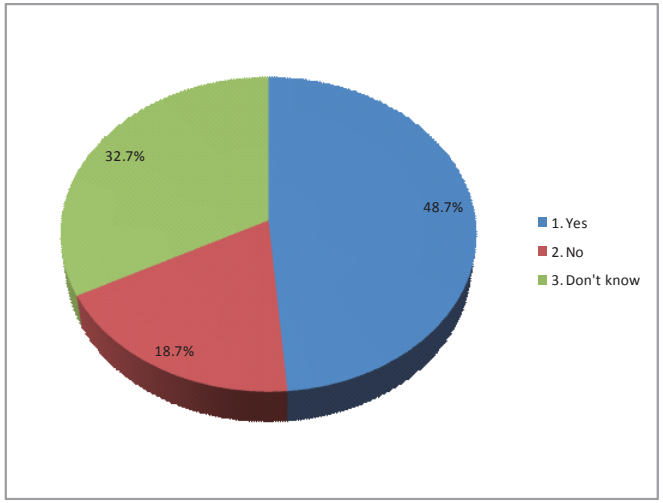


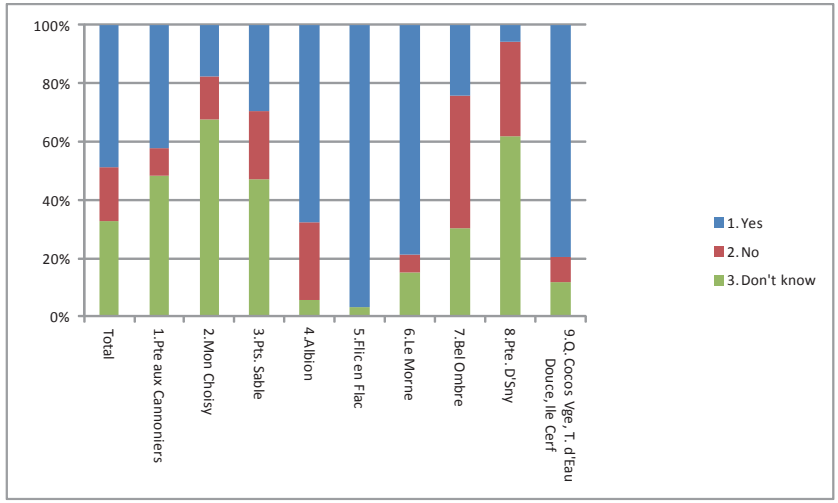


3. Possible Effects of Climate Change on Coastal Zone

Q.1 Are you aware any effects on coastal area by SLR recently? (multiple choices)

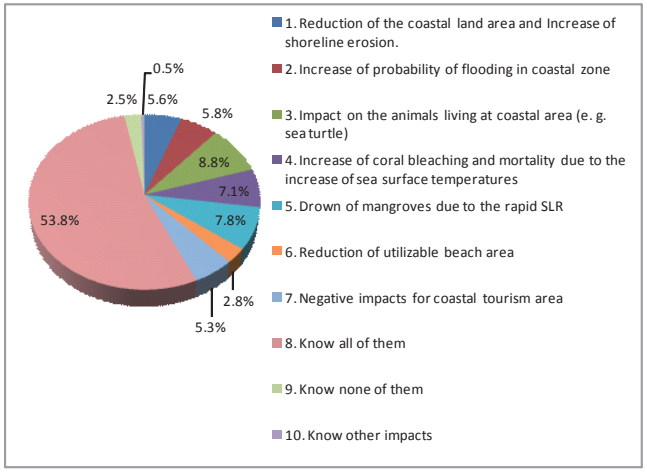
	Total		1.Pte aux Cannoniers		2.Mon Choisy		3.Pts. Sable		4.Albion		5.Flic en Flac		6.Le Morne		7.Bel Ombre		8.Pte. D'Sny		9.Q. Cocos Vge, T. d'Eau Douce, Ile Cerf	
1. Yes	146	(48.7%)	14	(42.4%)	6	(17.6%)	10	(29.4%)	23	(67.6%)	30	(96.8%)	26	(78.8%)	8	(24.2%)	2	(5.9%)	27	(79.4%)
2. No	56	(18.7%)	3	(9.1%)	5	(14.7%)	8	(23.5%)	9	(26.5%)	0	(0.0%)	2	(6.1%)	15	(45.5%)	11	(32.4%)	3	(8.8%)
3. Don't know	98	(32.7%)	16	(48.5%)	23	(67.6%)	16	(47.1%)	2	(5.9%)	1	(3.2%)	5	(15.2%)	10	(30.3%)	21	(61.8%)	4	(11.8%)
Total	300	(100.0%)	33	(100.0%)	34	(100.0%)	34	(100.0%)	34	(100.0%)	31	(100.0%)	33	(100.0%)	33	(100.0%)	34	(100.0%)	34	(100.0%)

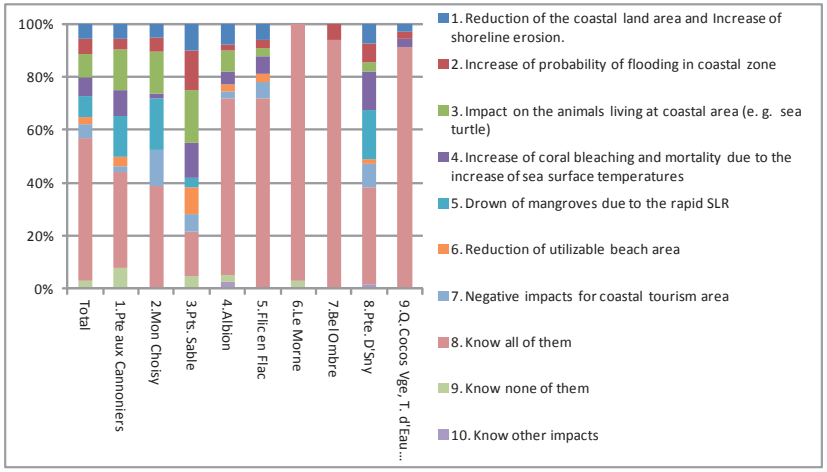




Q.2 Among the effects in explanation, please mark on the items which you didn't know before reading questionnaire. (multiple choices)

	Total		1.Pte aux Cannoniers		2.Mon Choisy		3.Pts. Sable		4.Albion		5.Flic en Flac		6.Le Morne		7.Bel Ombre		8.Pte. D'Sny		9.Q. Cocos Vge, T. d'Eau Douce, Ile Cerf	
1. Reduction of the coastal land area and Increase of shoreline erosion.	22	(5.6%)	3	(5.8%)	3	(5.3%)	6	(10.0%)	3	(7.7%)	2	(6.3%)	0	(0.0%)	0	(0.0%)	4	(7.3%)	1	(2.9%)
2. Increase of probability of flooding in coastal zone	23	(5.8%)	2	(3.8%)	3	(5.3%)	9	(15.0%)	1	(2.6%)	1	(3.1%)	0	(0.0%)	2	(6.3%)	4	(7.3%)	1	(2.9%)
3. Impact on the animals living at coastal area (e. g. sea turtle)	35	(8.8%)	8	(15.4%)	9	(15.8%)	12	(20.0%)	3	(7.7%)	1	(3.1%)	0	(0.0%)	0	(0.0%)	2	(3.6%)	0	(0.0%)
4. Increase of coral bleaching and mortality due to the increase of sea surface temperatures	28	(7.1%)	5	(9.6%)	1	(1.8%)	8	(13.3%)	2	(5.1%)	2	(6.3%)	0	(0.0%)	0	(0.0%)	8	(14.5%)	1	(2.9%)
5. Drown of mangroves due to the rapid SLR	31	(7.8%)	8	(15.4%)	11	(19.3%)	2	(3.3%)	0	(0.0%)	0	(0.0%)	0	(0.0%)	0	(0.0%)	10	(18.2%)	0	(0.0%)
6. Reduction of utilizable beach area	11	(2.8%)	2	(3.8%)	0	(0.0%)	6	(10.0%)	1	(2.6%)	1	(3.1%)	0	(0.0%)	0	(0.0%)	1	(1.8%)	0	(0.0%)
7. Negative impacts for coastal tourism area	21	(5.3%)	1	(1.9%)	8	(14.0%)	4	(6.7%)	1	(2.6%)	2	(6.3%)	0	(0.0%)	0	(0.0%)	5	(9.1%)	0	(0.0%)
8. Know all of them	213	(53.8%)	19	(36.5%)	22	(38.6%)	10	(16.7%)	26	(66.7%)	23	(71.9%)	31	(96.9%)	30	(93.8%)	20	(36.4%)	32	(91.4%)
9. Know none of them	10	(2.5%)	4	(7.7%)	0	(0.0%)	3	(5.0%)	1	(2.6%)	0	(0.0%)	1	(3.1%)	0	(0.0%)	0	(0.0%)	0	(0.0%)
10. Know other impacts	2	(0.5%)	0	(0.0%)	0	(0.0%)	0	(0.0%)	1	(2.6%)	0	(0.0%)	0	(0.0%)	0	(0.0%)	1	(1.8%)	0	(0.0%)
Total	396	(100.0%)	52	(100.0%)	57	(100.0%)	60	(100.0%)	39	(100.0%)	32	(100.0%)	32	(100.0%)	32	(100.0%)	55	(100.0%)	35	(100.0%)

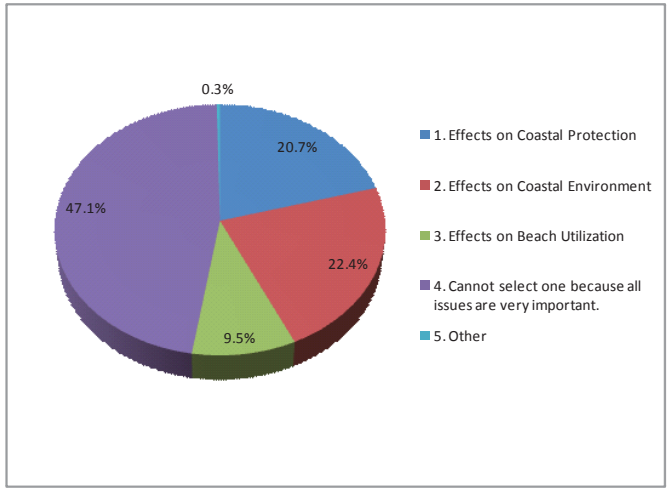


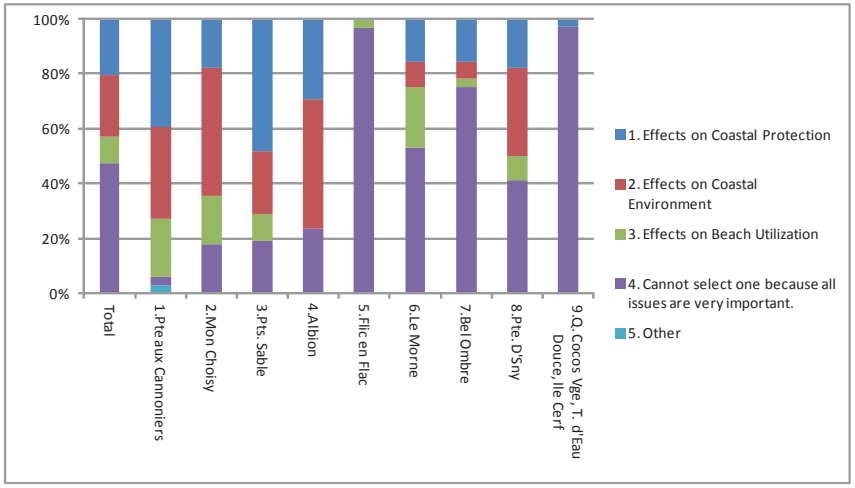


Q.3 Among the effects in Q1, which effect do you think most serious for coastal zone and why do you think so?

Most serious effects, especially considering your own situation:

	Total		1.Pte aux Cannoniers		2.Mon Choisy		3.Pts. Sable		4.Albion		5.Flic en Flac		6.Le Morne		7.Bel Ombre		8.Pte. D'Sny		9.Q. Cocos Vge, T. d'Eau Douce, Ile Cerf	
1. Effects on Coastal Protection	61	(20.7%)	13	(39.4%)	6	(17.6%)	15	(48.4%)	10	(29.4%)	0	(0.0%)	5	(15.6%)	5	(15.6%)	6	(17.6%)	1	(2.9%)
2. Effects on Coastal Environment	66	(22.4%)	11	(33.3%)	16	(47.1%)	7	(22.6%)	16	(47.1%)	0	(0.0%)	3	(9.4%)	2	(6.3%)	11	(32.4%)	0	(0.0%)
3. Effects on Beach Utilization	28	(9.5%)	7	(21.2%)	6	(17.6%)	3	(9.7%)	0	(0.0%)	1	(3.2%)	7	(21.9%)	1	(3.1%)	3	(8.8%)	0	(0.0%)
4. Cannot select one because all issues are very important.	139	(47.1%)	1	(3.0%)	6	(17.6%)	6	(19.4%)	8	(23.5%)	30	(96.8%)	17	(53.1%)	24	(75.0%)	14	(41.2%)	33	(97.1%)
5. Other	1	(0.3%)	1	(3.0%)	0	(0.0%)	0	(0.0%)	0	(0.0%)	0	(0.0%)	0	(0.0%)	0	(0.0%)	0	(0.0%)	0	(0.0%)
Total	295	(100.0%)	33	(100.0%)	34	(100.0%)	31	(100.0%)	34	(100.0%)	31	(100.0%)	32	(100.0%)	32	(100.0%)	34	(100.0%)	34	(100.0%)

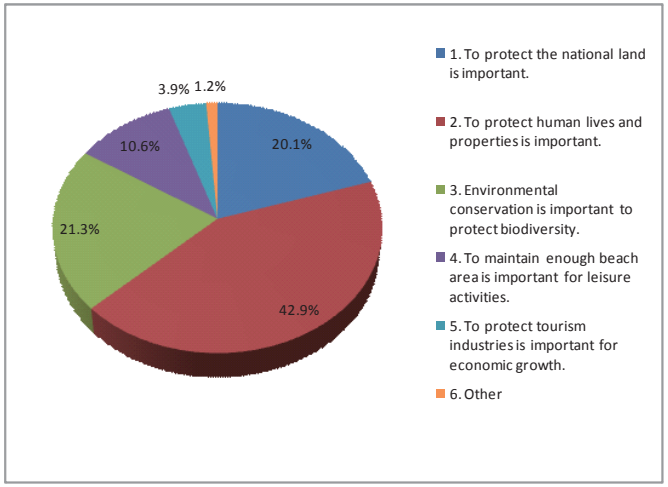


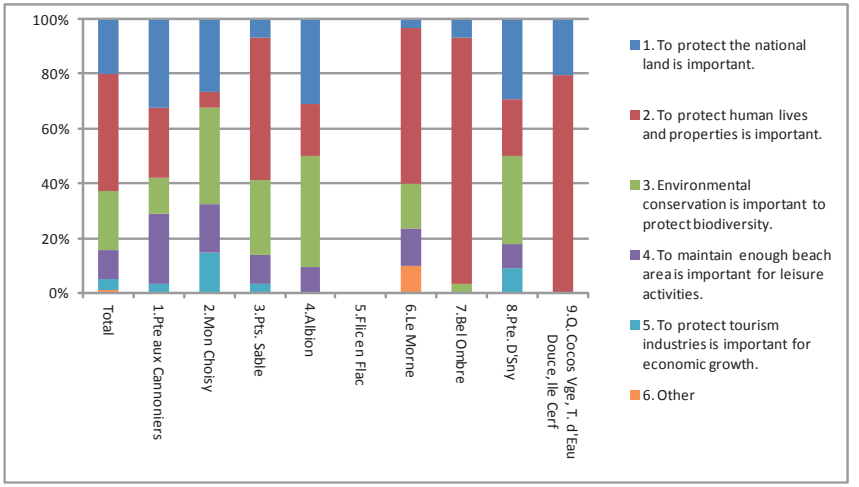


Q.3 Among the effects in Q1, which effect do you think most serious for coastal zone and why do you think so?

Reason

	Total		1.Pte aux Cannoniers		2.Mon Choisy		3.Pts. Sable		4.Albion		5.Flic en Flac		6.Le Morne		7.Bel Ombre		8.Pte. D'Sny		9.Q. Cocos Vge, T. d'Eau Douce, Ile Cerf	
1. To protect the national land is important.	51	(20.1%)	10	(32.3%)	9	(26.5%)	2	(6.9%)	10	(31.3%)	0	–	1	(3.3%)	2	(6.7%)	10	(29.4%)	7	(20.6%)
2. To protect human lives and properties is important.	109	(42.9%)	8	(25.8%)	2	(5.9%)	15	(51.7%)	6	(18.8%)	0	–	17	(56.7%)	27	(90.0%)	7	(20.6%)	27	(79.4%)
3. Environmental conservation is important to protect biodiversity.	54	(21.3%)	4	(12.9%)	12	(35.3%)	8	(27.6%)	13	(40.6%)	0	–	5	(16.7%)	1	(3.3%)	11	(32.4%)	0	(0.0%)
4. To maintain enough beach area is important for leisure activities.	27	(10.6%)	8	(25.8%)	6	(17.6%)	3	(10.3%)	3	(9.4%)	0	–	4	(13.3%)	0	(0.0%)	3	(8.8%)	0	(0.0%)
5. To protect tourism industries is important for economic growth.	10	(3.9%)	1	(3.2%)	5	(14.7%)	1	(3.4%)	0	(0.0%)	0	–	0	(0.0%)	0	(0.0%)	3	(8.8%)	0	(0.0%)
6. Other	3	(1.2%)	0	(0.0%)	0	(0.0%)	0	(0.0%)	0	(0.0%)	0	–	3	(10.0%)	0	(0.0%)	0	(0.0%)	0	(0.0%)
Total	254	(100.0%)	31	(100.0%)	34	(100.0%)	29	(100.0%)	32	(100.0%)	0	–	30	(100.0%)	30	(100.0%)	34	(100.0%)	34	(100.0%)

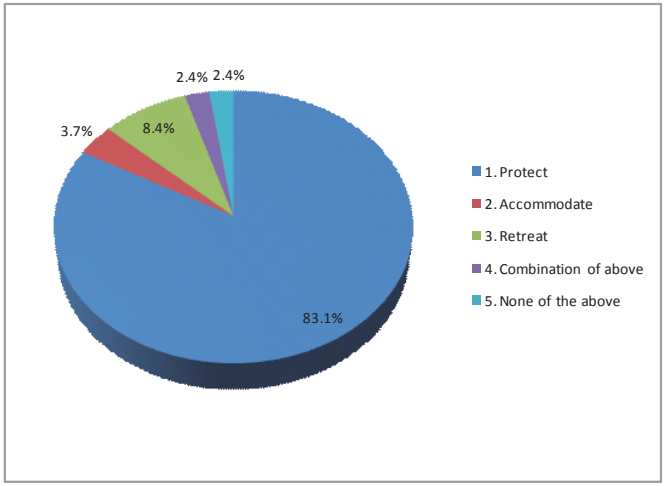


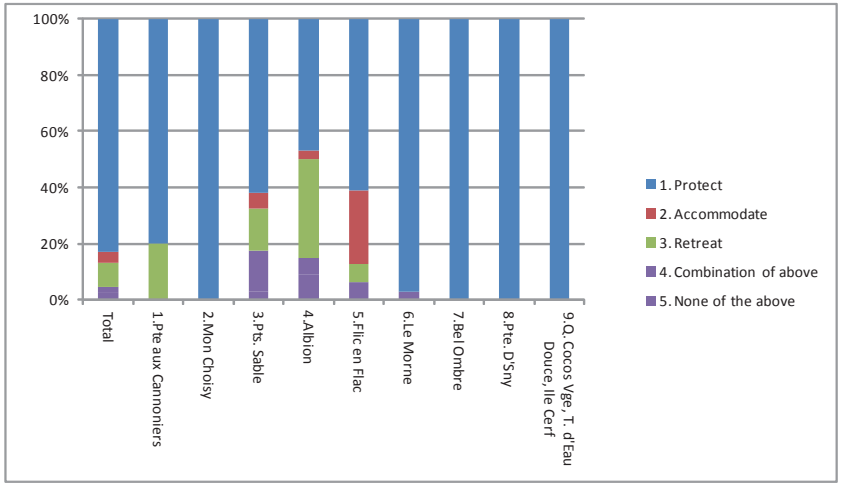


4. Desirable adaptation to the beach erosion and SLR

Q.1 Among above, which methods do you think most desirable as adaptations?

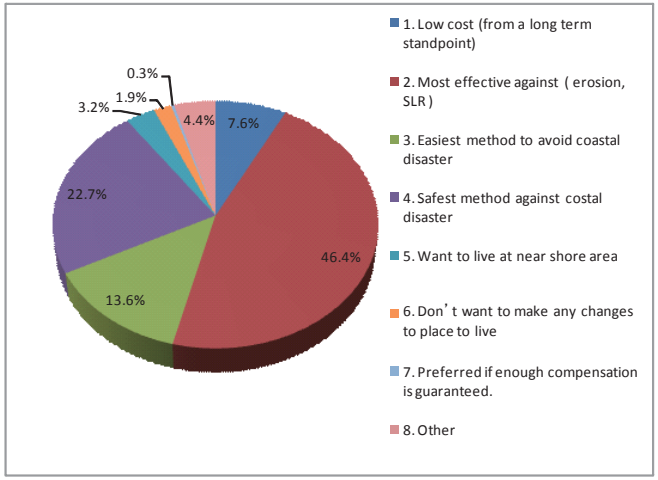
	Total		1.Pte aux Cannoniers		2.Mon Choisy		3.Pts. Sable		4.Albion		5.Flic en Flac		6.Le Morne		7.Bel Ombre		8.Pte. D'Sny		9.Q. Cocos Vge, T. d'Eau Douce, Ile Cerf	
1. Protect	246	(83.1%)	24	(80.0%)	34	(100.0%)	21	(61.8%)	16	(47.1%)	19	(61.3%)	32	(97.0%)	32	(100.0%)	34	(100.0%)	34	(100.0%)
2. Accommodate	11	(3.7%)	0	(0.0%)	0	(0.0%)	2	(5.9%)	1	(2.9%)	8	(25.8%)	0	(0.0%)	0	(0.0%)	0	(0.0%)	0	(0.0%)
3. Retreat	25	(8.4%)	6	(20.0%)	0	(0.0%)	5	(14.7%)	12	(35.3%)	2	(6.5%)	0	(0.0%)	0	(0.0%)	0	(0.0%)	0	(0.0%)
4. Combination of above	7	(2.4%)	0	(0.0%)	0	(0.0%)	5	(14.7%)	2	(5.9%)	0	(0.0%)	0	(0.0%)	0	(0.0%)	0	(0.0%)	0	(0.0%)
5. None of the above	7	(2.4%)	0	(0.0%)	0	(0.0%)	1	(2.9%)	3	(8.8%)	2	(6.5%)	1	(3.0%)	0	(0.0%)	0	(0.0%)	0	(0.0%)
Total	296	(100.0%)	30	(100.0%)	34	(100.0%)	34	(100.0%)	34	(100.0%)	31	(100.0%)	33	(100.0%)	32	(100.0%)	34	(100.0%)	34	(100.0%)

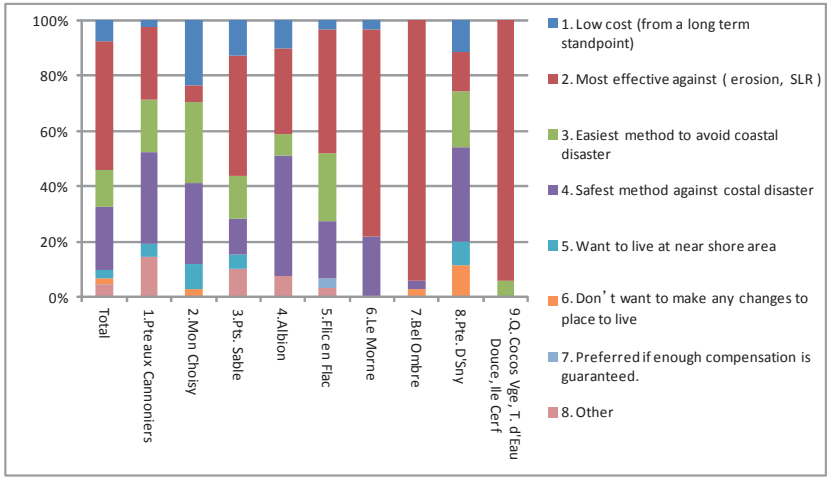




Q.2 Why do you prefer the method in Q.1.? (multiple choices)

	Total		1.Pte aux Cannoniers		2.Mon Choisy		3.Pts. Sable		4.Albion		5.Flic en Flac		6.Le Morne		7.Bel Ombre		8.Pte. D'Sny		9.Q. Cocos Vge, T. d'Eau Douce, Ile Cerf	
1. Low cost (from a long term standpoint)	24	(7.6%)	1	(2.4%)	8	(23.5%)	5	(12.8%)	4	(10.3%)	1	(3.4%)	1	(3.1%)	0	(0.0%)	4	(11.4%)	0	(0.0%)
2. Most effective against (erosion, SLR)	147	(46.4%)	11	(26.2%)	2	(5.9%)	17	(43.6%)	12	(30.8%)	13	(44.8%)	24	(75.0%)	31	(93.9%)	5	(14.3%)	32	(94.1%)
3. Easiest method to avoid coastal disaster	43	(13.6%)	8	(19.0%)	10	(29.4%)	6	(15.4%)	3	(7.7%)	7	(24.1%)	0	(0.0%)	0	(0.0%)	7	(20.0%)	2	(5.9%)
4. Safest method against costal disaster	72	(22.7%)	14	(33.3%)	10	(29.4%)	5	(12.8%)	17	(43.6%)	6	(20.7%)	7	(21.9%)	1	(3.0%)	12	(34.3%)	0	(0.0%)
5. Want to live at near shore area	10	(3.2%)	2	(4.8%)	3	(8.8%)	2	(5.1%)	0	(0.0%)	0	(0.0%)	0	(0.0%)	0	(0.0%)	3	(8.6%)	0	(0.0%)
6. Don't want to make any changes to place to live	6	(1.9%)	0	(0.0%)	1	(2.9%)	0	(0.0%)	0	(0.0%)	0	(0.0%)	0	(0.0%)	1	(3.0%)	4	(11.4%)	0	(0.0%)
7. Preferred if enough compensation is guaranteed.	1	(0.3%)	0	(0.0%)	0	(0.0%)	0	(0.0%)	0	(0.0%)	1	(3.4%)	0	(0.0%)	0	(0.0%)	0	(0.0%)	0	(0.0%)
8. Other	14	(4.4%)	6	(14.3%)	0	(0.0%)	4	(10.3%)	3	(7.7%)	1	(3.4%)	0	(0.0%)	0	(0.0%)	0	(0.0%)	0	(0.0%)
Total	317	(100.0%)	42	(100.0%)	34	(100.0%)	39	(100.0%)	39	(100.0%)	29	(100.0%)	32	(100.0%)	33	(100.0%)	35	(100.0%)	34	(100.0%)

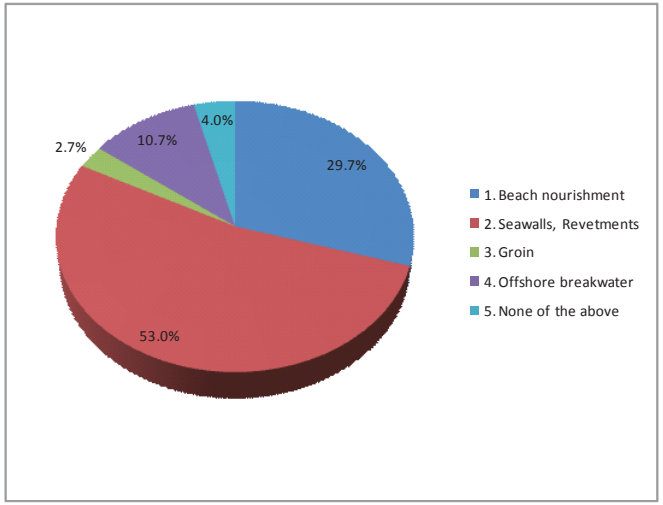


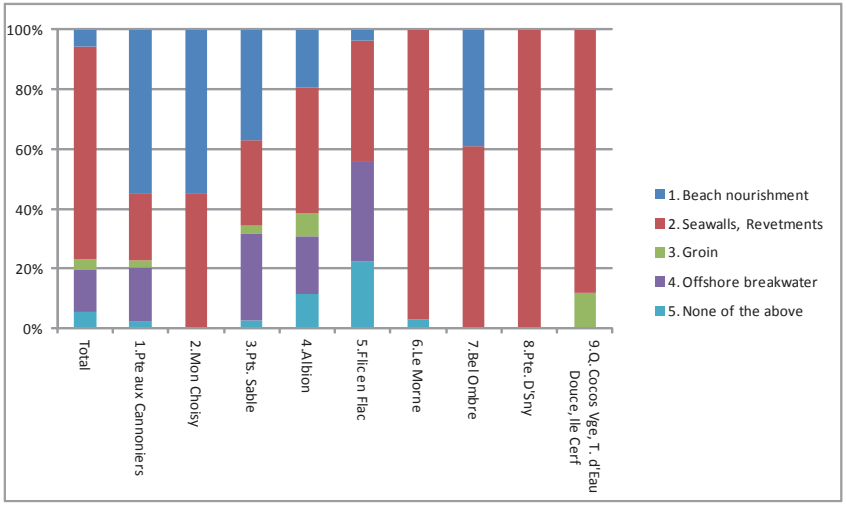


5. WTP(Willingness to Pay) for the Coastal Conservation Project

Q.1 Which measures do you think most desirable as coastal protection?

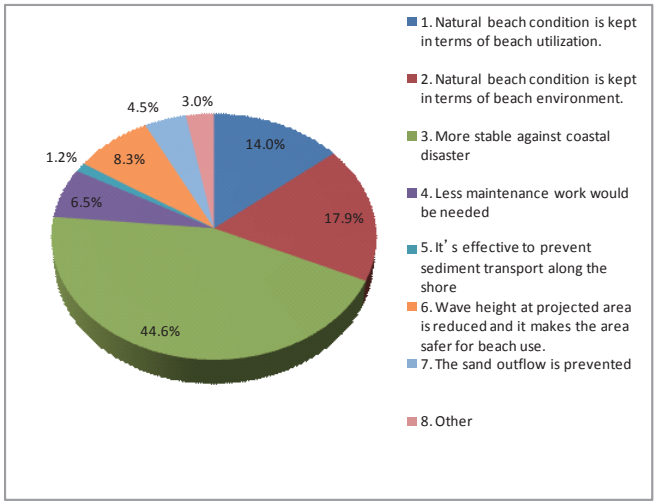
	Total		1.Pte aux Cannoniers		2.Mon Choisy		3.Pts. Sable		4.Albion		5.Flic en Flac		6.Le Morne		7.Bel Ombre		8.Pte. D'Sny		9.Q. Cocos Vge, T. d'Eau Douce, Ile Cerf	
1. Beach nourishment	89	(29.7%)	13	(39.4%)	24	(70.6%)	12	(35.3%)	13	(38.2%)	5	(16.1%)	1	(3.0%)	0	(0.0%)	21	(61.8%)	0	(0.0%)
2. Seawalls, Revetments	159	(53.0%)	10	(30.3%)	10	(29.4%)	10	(29.4%)	11	(32.4%)	11	(35.5%)	31	(93.9%)	33	(100.0%)	13	(38.2%)	30	(88.2%)
3. Groin	8	(2.7%)	1	(3.0%)	0	(0.0%)	1	(2.9%)	2	(5.9%)	0	(0.0%)	0	(0.0%)	0	(0.0%)	0	(0.0%)	4	(11.8%)
4. Offshore breakwater	32	(10.7%)	8	(24.2%)	0	(0.0%)	10	(29.4%)	5	(14.7%)	9	(29.0%)	0	(0.0%)	0	(0.0%)	0	(0.0%)	0	(0.0%)
5. None of the above	12	(4.0%)	1	(3.0%)	0	(0.0%)	1	(2.9%)	3	(8.8%)	6	(19.4%)	1	(3.0%)	0	(0.0%)	0	(0.0%)	0	(0.0%)
Total	300	(100.0%)	33	(100.0%)	34	(100.0%)	34	(100.0%)	34	(100.0%)	31	(100.0%)	33	(100.0%)	33	(100.0%)	34	(100.0%)	34	(100.0%)

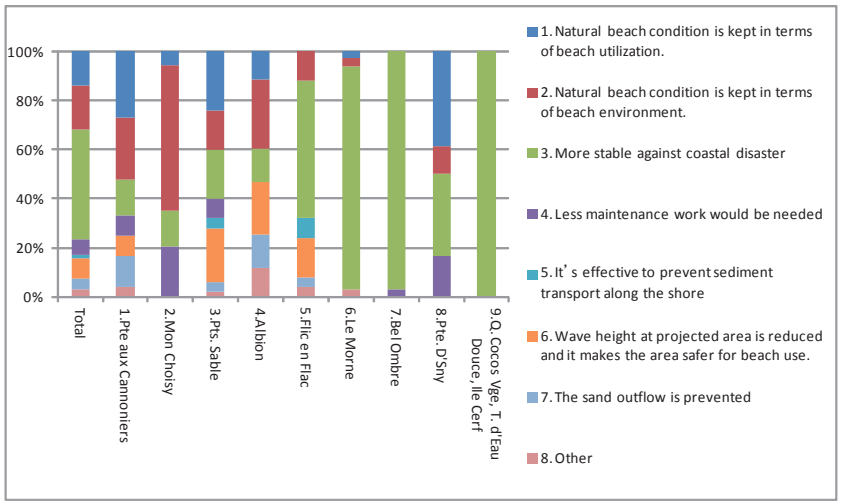




Q.2 Why do you prefer the method in Q.1.? (multiple choices)

	Total		1.Pte aux Cannoniers		2.Mon Choisy		3.Pts. Sable		4.Albion		5.Flic en Flac		6.Le Morne		7.Bel Ombre		8.Pte. D'Sny		9.Q. Cocos Vge, T. d'Eau Douce, Ile Cerf	
1. Natural beach condition is kept in terms of beach utilization.	47	(14.0%)	13	(27.1%)	2	(5.9%)	12	(24.0%)	5	(11.6%)	0	(0.0%)	1	(3.0%)	0	(0.0%)	14	(38.9%)	0	(0.0%)
2. Natural beach condition is kept in terms of beach environment.	60	(17.9%)	12	(25.0%)	20	(58.8%)	8	(16.0%)	12	(27.9%)	3	(12.0%)	1	(3.0%)	0	(0.0%)	4	(11.1%)	0	(0.0%)
3. More stable against coastal disaster	150	(44.6%)	7	(14.6%)	5	(14.7%)	10	(20.0%)	6	(14.0%)	14	(56.0%)	30	(90.9%)	32	(97.0%)	12	(33.3%)	34	(100.0%)
4. Less maintenance work would be needed	22	(6.5%)	4	(8.3%)	7	(20.6%)	4	(8.0%)	0	(0.0%)	0	(0.0%)	0	(0.0%)	1	(3.0%)	6	(16.7%)	0	(0.0%)
5. It' s effective to prevent sediment transport along the shore	4	(1.2%)	0	(0.0%)	0	(0.0%)	2	(4.0%)	0	(0.0%)	2	(8.0%)	0	(0.0%)	0	(0.0%)	0	(0.0%)	0	(0.0%)
6. Wave height at projected area is reduced and it makes the area safer for beach use.	28	(8.3%)	4	(8.3%)	0	(0.0%)	11	(22.0%)	9	(20.9%)	4	(16.0%)	0	(0.0%)	0	(0.0%)	0	(0.0%)	0	(0.0%)
7. The sand outflow is prevented	15	(4.5%)	6	(12.5%)	0	(0.0%)	2	(4.0%)	6	(14.0%)	1	(4.0%)	0	(0.0%)	0	(0.0%)	0	(0.0%)	0	(0.0%)
8. Other	10	(3.0%)	2	(4.2%)	0	(0.0%)	1	(2.0%)	5	(11.6%)	1	(4.0%)	1	(3.0%)	0	(0.0%)	0	(0.0%)	0	(0.0%)
Total	336	(100.0%)	48	(100.0%)	34	(100.0%)	50	(100.0%)	43	(100.0%)	25	(100.0%)	33	(100.0%)	33	(100.0%)	36	(100.0%)	34	(100.0%)

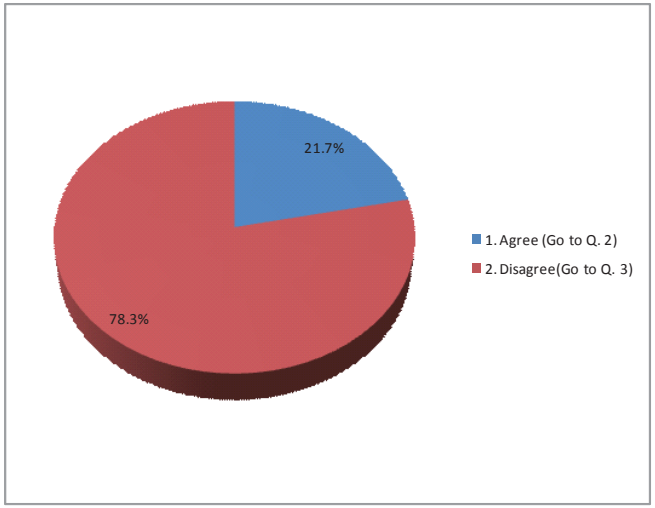


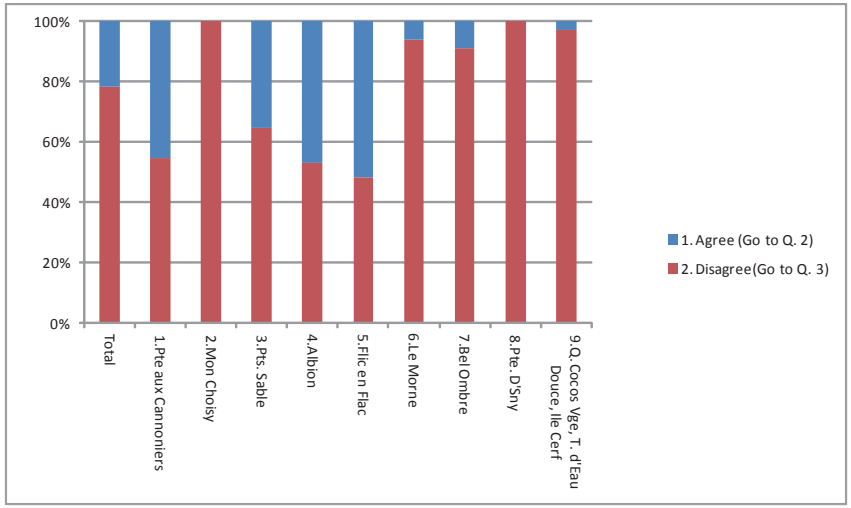


5.WTP (Willingness to Pay) for the Coastal Conservation Project

Q.3 If your household was asked to pay a monthly donation to support the plan, would you agree or disagree to donate Rs 100 / month?

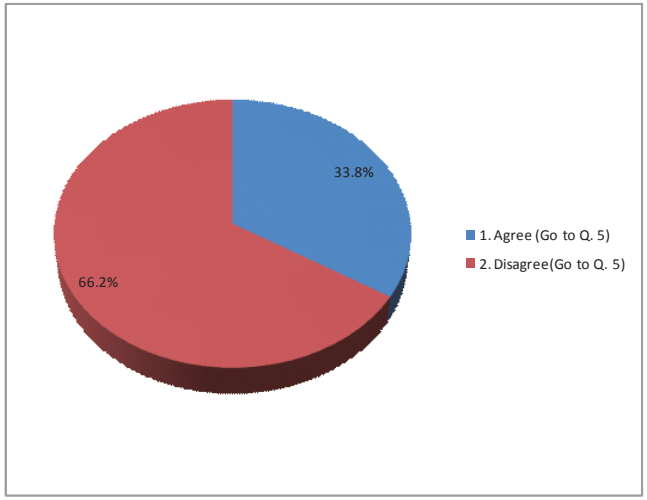
	Total		1.Pte aux Cannoniers		2.Mon Choisy		3.Pts. Sable		4.Albion		5.Flic en Flac		6.Le Morne		7.Bel Ombre		8.Pte. D'Sny		9.Q. Cocos Vge, T. d'Eau Douce, Ile Cerf	
1. Agree (Go to Q. 2)	65	(21.7%)	15	(45.5%)	0	(0.0%)	12	(35.3%)	16	(47.1%)	16	(51.6%)	2	(6.1%)	3	(9.1%)	0	(0.0%)	1	(2.9%)
2. Disagree(Go to Q. 3)	235	(78.3%)	18	(54.5%)	34	(100.0%)	22	(64.7%)	18	(52.9%)	15	(48.4%)	31	(93.9%)	30	(90.9%)	34	(100.0%)	33	(97.1%)
Total	300	(100.0%)	33	(100.0%)	34	(100.0%)	34	(100.0%)	34	(100.0%)	31	(100.0%)	33	(100.0%)	33	(100.0%)	34	(100.0%)	34	(100.0%)

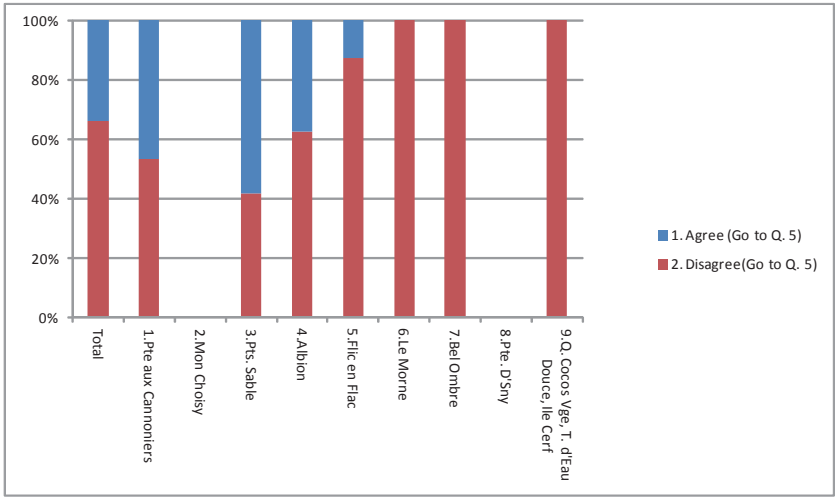




Q.4 If your household was asked to pay a monthly donation to support the plan, would you agree or disagree to donate Rs 200 / month?

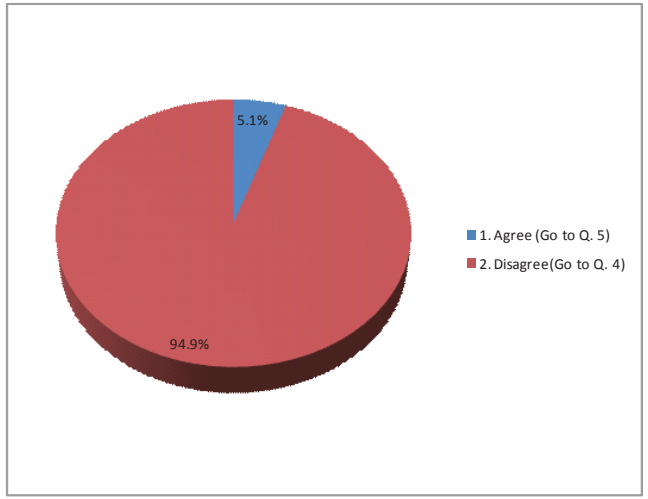
	Total		1.Pte aux Cannoniers		2.Mon Choisy		3.Pts. Sable		4.Albion		5.Flic en Flac		6.Le Morne		7.Bel Ombre		8.Pte. D'Sny		9.Q. Cocos Vge, T. d'Eau Douce, Ile Cerf	
1. Agree (Go to Q. 5)	22	(33.8%)	7	(46.7%)	0	–	7	(58.3%)	6	(37.5%)	2	(12.5%)	0	(0.0%)	0	(0.0%)	0	–	0	(0.0%)
2. Disagree(Go to Q. 5)	43	(66.2%)	8	(53.3%)	0	–	5	(41.7%)	10	(62.5%)	14	(87.5%)	2	(100.0%)	3	(100.0%)	0	–	1	(100.0%)
Total	65	(100.0%)	15	(100.0%)	0	–	12	(100.0%)	16	(100.0%)	16	(100.0%)	2	(100.0%)	3	(100.0%)	0	–	1	(100.0%)

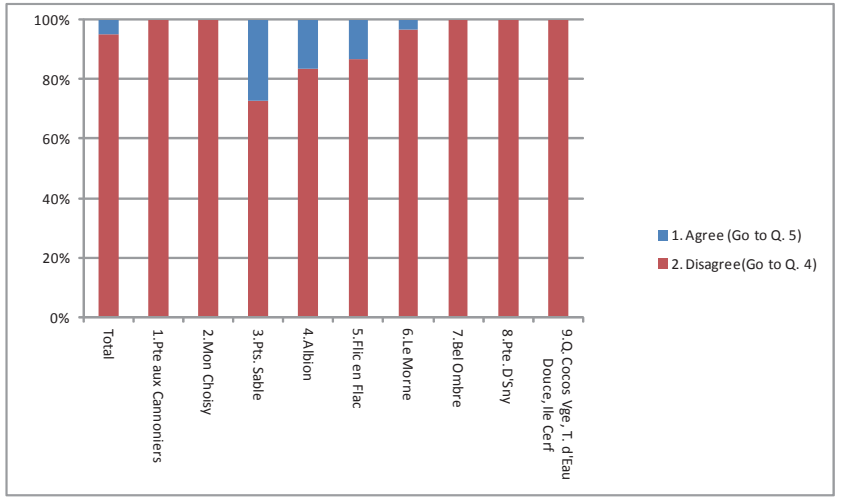




Q.5 If your household was asked to pay a monthly donation to support the plan, would you agree or disagree to donate Rs 50 /month?

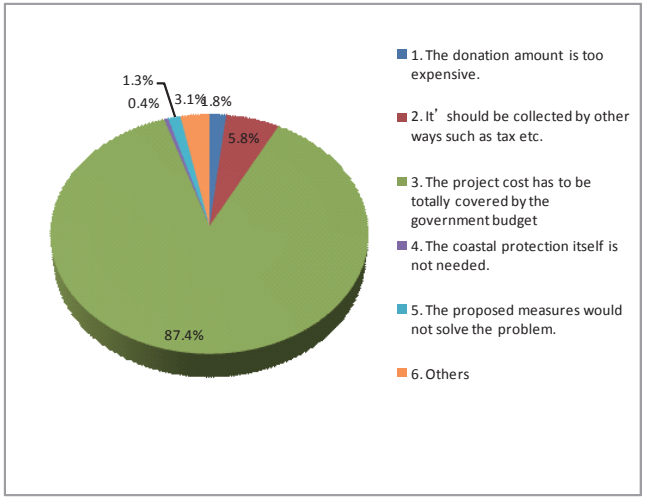
	Total		1.Pte aux Cannoniers		2.Mon Choisy		3.Pts. Sable		4.Albion		5.Flic en Flac		6.Le Morne		7.Bel Ombre		8.Pte. D'Sny		9.Q. Cocos Vge, T. d'Eau Douce, Ile Cerf	
1. Agree (Go to Q. 5)	12	(5.1%)	0	(0.0%)	0	(0.0%)	6	(27.3%)	3	(16.7%)	2	(13.3%)	1	(3.2%)	0	(0.0%)	0	(0.0%)	0	(0.0%)
2. Disagree(Go to Q. 4)	222	(94.9%)	17	(100.0%)	34	(100.0%)	16	(72.7%)	15	(83.3%)	13	(86.7%)	30	(96.8%)	30	(100.0%)	34	(100.0%)	33	(100.0%)
Total	234	(100.0%)	17	(100.0%)	34	(100.0%)	22	(100.0%)	18	(100.0%)	15	(100.0%)	31	(100.0%)	30	(100.0%)	34	(100.0%)	33	(100.0%)

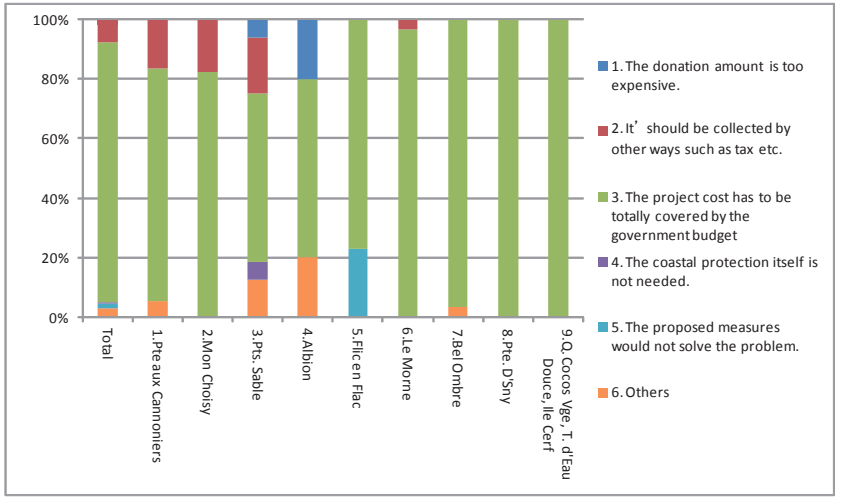




Q.6 (For those who disagree with Q. 5), why would you disagree for the donation?

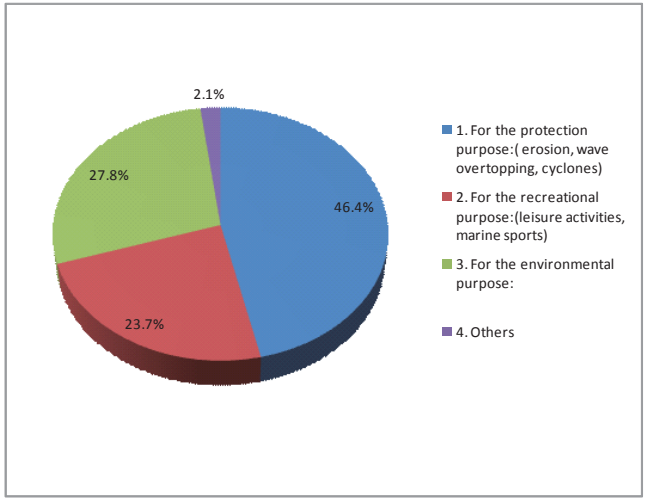
	Total		1.Pte aux Cannoniers		2.Mon Choisy		3.Pts. Sable		4.Albion		5.Flic en Flac		6.Le Morne		7.Bel Ombre		8.Pte. D'Sny		9.Q. Cocos Vge, T. d'Eau Douce, Ile Cerf	
1. The donation amount is too expensive.	4	(1.8%)	0	(0.0%)	0	(0.0%)	1	(6.3%)	3	(20.0%)	0	(0.0%)	0	(0.0%)	0	(0.0%)	0	(0.0%)	0	(0.0%)
2. It' should be collected by other ways such as tax etc.	13	(5.8%)	3	(16.7%)	6	(17.6%)	3	(18.8%)	0	(0.0%)	0	(0.0%)	1	(3.3%)	0	(0.0%)	0	(0.0%)	0	(0.0%)
3. The project cost has to be totally covered by the government budget	195	(87.4%)	14	(77.8%)	28	(82.4%)	9	(56.3%)	9	(60.0%)	10	(76.9%)	29	(96.7%)	29	(96.7%)	34	(100.0%)	33	(100.0%)
4. The coastal protection itself is not needed.	1	(0.4%)	0	(0.0%)	0	(0.0%)	1	(6.3%)	0	(0.0%)	0	(0.0%)	0	(0.0%)	0	(0.0%)	0	(0.0%)	0	(0.0%)
5. The proposed measures would not solve the problem.	3	(1.3%)	0	(0.0%)	0	(0.0%)	0	(0.0%)	0	(0.0%)	3	(23.1%)	0	(0.0%)	0	(0.0%)	0	(0.0%)	0	(0.0%)
6. Others	7	(3.1%)	1	(5.6%)	0	(0.0%)	2	(12.5%)	3	(20.0%)	0	(0.0%)	0	(0.0%)	1	(3.3%)	0	(0.0%)	0	(0.0%)
Total	223	(100.0%)	18	(100.0%)	34	(100.0%)	16	(100.0%)	15	(100.0%)	13	(100.0%)	30	(100.0%)	30	(100.0%)	34	(100.0%)	33	(100.0%)

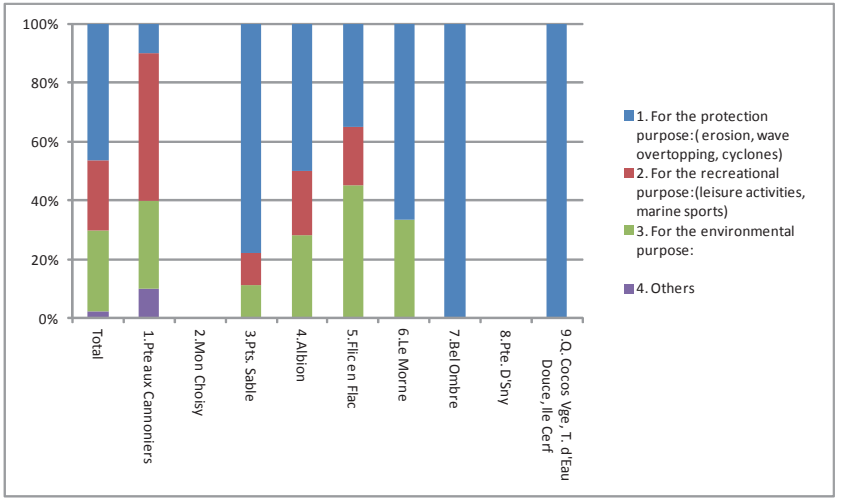




Q.7 (For those who agree with Q3-5 at least one time), why would you agree for the donation?

	Total		1.Pte aux Cannoniers		2.Mon Choisy		3.Pts. Sable		4.Albion		5.Flic en Flac		6.Le Morne		7.Bel Ombre		8.Pte. D'Sny		9.Q. Cocos Vge, T. d'Eau Douce, Ile Cerf	
1. For the protection purpose:(erosion, wave overtopping, cyclones)	45	(46.4%)	2	(10.0%)	0	–	14	(77.8%)	16	(50.0%)	7	(35.0%)	2	(66.7%)	3	(100.0%)	0	–	1	(100.0%)
2. For the recreational purpose:(leisure activities, marine sports)	23	(23.7%)	10	(50.0%)	0	–	2	(11.1%)	7	(21.9%)	4	(20.0%)	0	(0.0%)	0	(0.0%)	0	–	0	(0.0%)
3. For the environmental purpose:	27	(27.8%)	6	(30.0%)	0	–	2	(11.1%)	9	(28.1%)	9	(45.0%)	1	(33.3%)	0	(0.0%)	0	–	0	(0.0%)
4. Others	2	(2.1%)	2	(10.0%)	0	–	0	(0.0%)	0	(0.0%)	0	(0.0%)	0	(0.0%)	0	(0.0%)	0	–	0	(0.0%)
Total	97	(100.0%)	20	(100.0%)	0	–	18	(100.0%)	32	(100.0%)	20	(100.0%)	3	(100.0%)	3	(100.0%)	0	–	1	(100.0%)

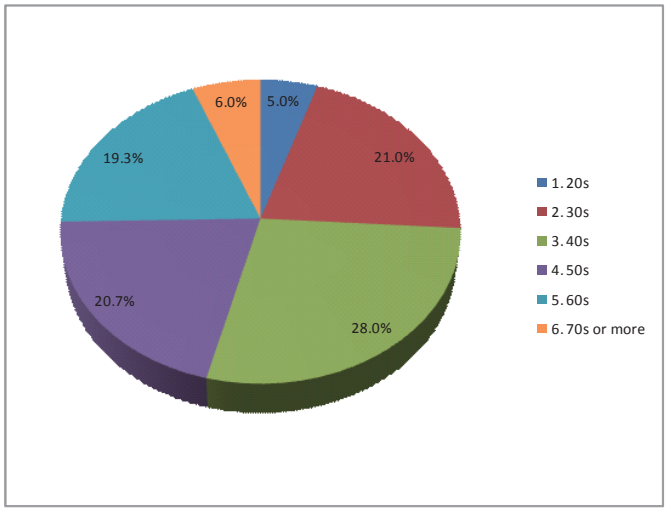


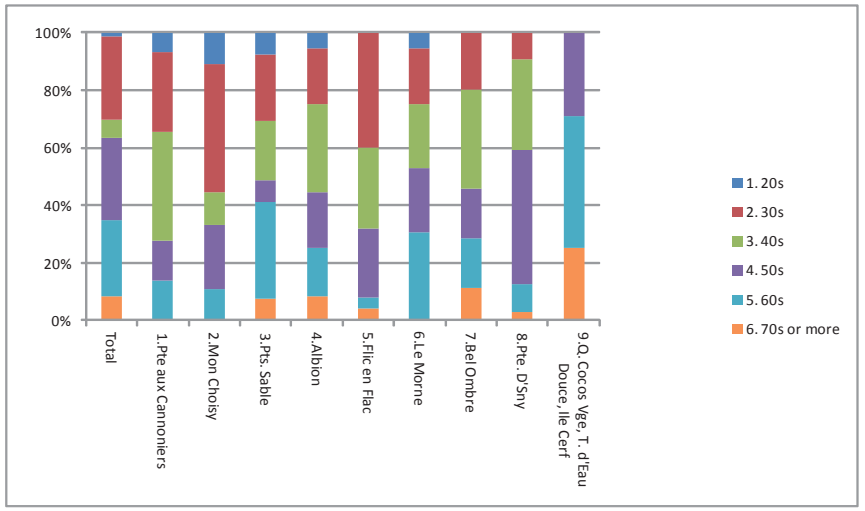


5. (Socio -Economic Characteristics)

Q1.Age

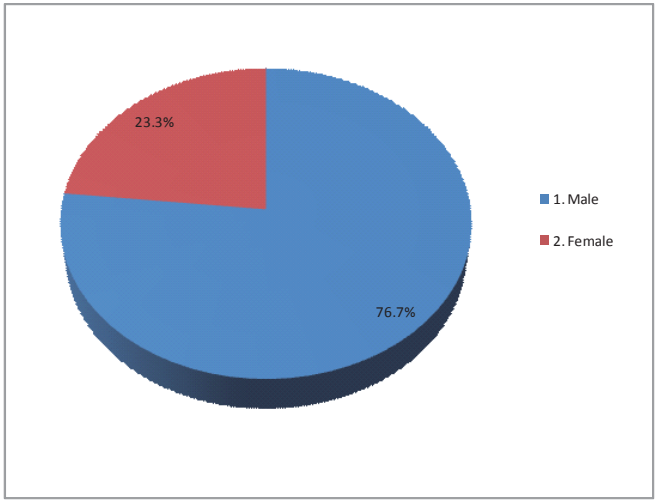
	Total		1.Pte aux Cannoniers		2.Mon Choisy		3.Pts. Sable		4.Albion		5.Flic en Flac		6.Le Morne		7.Bel Ombre		8.Pte. D'Sny		9.Q. Cocos Vge, T. d'Eau Douce, Ile Cerf	
1. 20s	15	(5.0%)	3	(9.1%)	2	(5.9%)	3	(8.8%)	3	(8.8%)	2	(6.5%)	0	(0.0%)	2	(6.1%)	0	(0.0%)	0	(0.0%)
2. 30s	63	(21.0%)	8	(24.2%)	12	(35.3%)	9	(26.5%)	7	(20.6%)	10	(32.3%)	7	(21.2%)	7	(21.2%)	3	(8.8%)	0	(0.0%)
3. 40s	84	(28.0%)	14	(42.4%)	11	(32.4%)	3	(8.8%)	8	(23.5%)	11	(35.5%)	7	(21.2%)	8	(24.2%)	12	(35.3%)	10	(29.4%)
4. 50s	62	(20.7%)	4	(12.1%)	6	(17.6%)	3	(8.8%)	7	(20.6%)	6	(19.4%)	8	(24.2%)	6	(18.2%)	15	(44.1%)	7	(20.6%)
5. 60s	58	(19.3%)	4	(12.1%)	3	(8.8%)	13	(38.2%)	6	(17.6%)	1	(3.2%)	11	(33.3%)	6	(18.2%)	3	(8.8%)	11	(32.4%)
6. 70s or more	18	(6.0%)	0	(0.0%)	0	(0.0%)	3	(8.8%)	3	(8.8%)	1	(3.2%)	0	(0.0%)	4	(12.1%)	1	(2.9%)	6	(17.6%)
Total	300	(100.0%)	33	(100.0%)	34	(100.0%)	34	(100.0%)	34	(100.0%)	31	(100.0%)	33	(100.0%)	33	(100.0%)	34	(100.0%)	34	(100.0%)

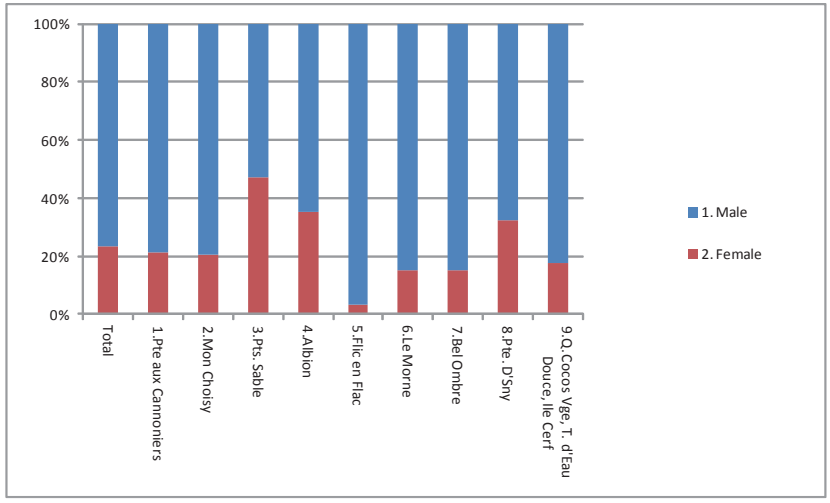




Q2. Sex

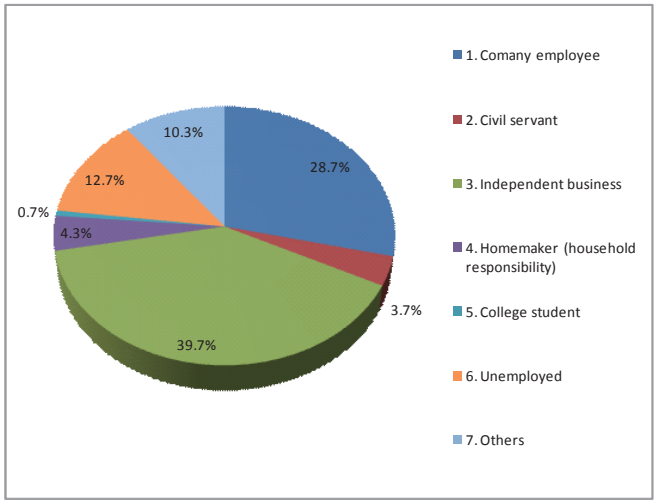
	Total		1.Pte aux Cannoniers		2.Mon Choisy		3.Pts. Sable		4.Albion		5.Flic en Flac		6.Le Morne		7.Bel Ombre		8.Pte. D'Sny		9.Q. Cocos Vge, T. d'Eau Douce, Ile Cerf	
1. Male	230	(76.7%)	26	(78.8%)	27	(79.4%)	18	(52.9%)	22	(64.7%)	30	(96.8%)	28	(84.8%)	28	(84.8%)	23	(67.6%)	28	(82.4%)
2. Female	70	(23.3%)	7	(21.2%)	7	(20.6%)	16	(47.1%)	12	(35.3%)	1	(3.2%)	5	(15.2%)	5	(15.2%)	11	(32.4%)	6	(17.6%)
Total	300	(100.0%)	33	(100.0%)	34	(100.0%)	34	(100.0%)	34	(100.0%)	31	(100.0%)	33	(100.0%)	33	(100.0%)	34	(100.0%)	34	(100.0%)

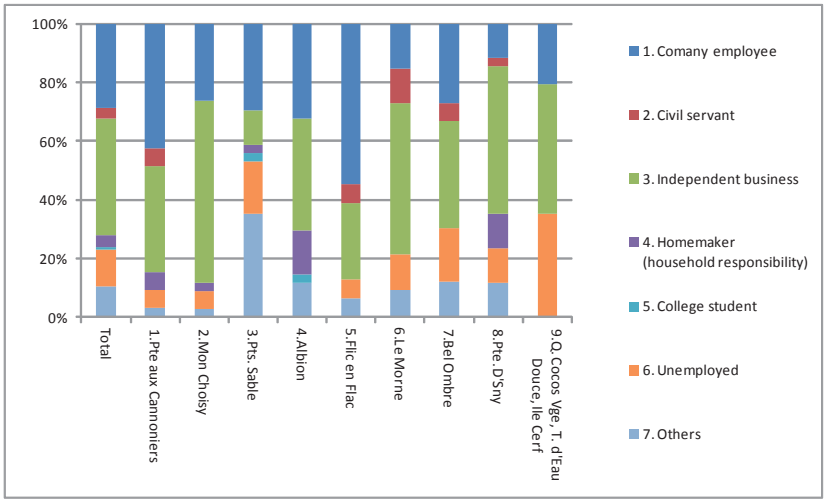




Q3. Occupation

	Total		1.Pte aux Cannoniers		2.Mon Choisy		3.Pts. Sable		4.Albion		5.Flic en Flac		6.Le Morne		7.Bel Ombre		8.Pte. D'Sny		9.Q. Cocos Vge, T. d'Eau Douce, Ile Cerf	
1. Comany employee	86	(28.7%)	14	(42.4%)	9	(26.5%)	10	(29.4%)	11	(32.4%)	17	(54.8%)	5	(15.2%)	9	(27.3%)	4	(11.8%)	7	(20.6%)
2. Civil servant	11	(3.7%)	2	(6.1%)	0	(0.0%)	0	(0.0%)	0	(0.0%)	2	(6.5%)	4	(12.1%)	2	(6.1%)	1	(2.9%)	0	(0.0%)
3. Independent business	119	(39.7%)	12	(36.4%)	21	(61.8%)	4	(11.8%)	13	(38.2%)	8	(25.8%)	17	(51.5%)	12	(36.4%)	17	(50.0%)	15	(44.1%)
4. Homemaker (household responsibility)	13	(4.3%)	2	(6.1%)	1	(2.9%)	1	(2.9%)	5	(14.7%)	0	(0.0%)	0	(0.0%)	0	(0.0%)	4	(11.8%)	0	(0.0%)
5. College student	2	(0.7%)	0	(0.0%)	0	(0.0%)	1	(2.9%)	1	(2.9%)	0	(0.0%)	0	(0.0%)	0	(0.0%)	0	(0.0%)	0	(0.0%)
6. Unemployed	38	(12.7%)	2	(6.1%)	2	(5.9%)	6	(17.6%)	0	(0.0%)	2	(6.5%)	4	(12.1%)	6	(18.2%)	4	(11.8%)	12	(35.3%)
7. Others	31	(10.3%)	1	(3.0%)	1	(2.9%)	12	(35.3%)	4	(11.8%)	2	(6.5%)	3	(9.1%)	4	(12.1%)	4	(11.8%)	0	(0.0%)
Total	300	(100.0%)	33	(100.0%)	34	(100.0%)	34	(100.0%)	34	(100.0%)	31	(100.0%)	33	(100.0%)	33	(100.0%)	34	(100.0%)	34	(100.0%)





Q5. Household income per month (total amount in household)

	Total		1.Pte aux Cannoniers		2.Mon Choisy		3.Pts. Sable		4.Albion		5.Flic en Flac		6.Le Morne		7.Bel Ombre		8.Pte. D'Sny		9.Q. Cocos Vge, T. d'Eau Douce, Ile Cerf	
1. Less than Rs 10,000	170	(58.6%)	14	(43.8%)	20	(58.8%)	6	(20.0%)	14	(48.3%)	23	(74.2%)	21	(63.6%)	20	(60.6%)	24	(70.6%)	28	(82.4%)
2. Rs 10,000_Rs 20,000	92	(31.7%)	13	(40.6%)	14	(41.2%)	15	(50.0%)	9	(31.0%)	8	(25.8%)	8	(24.2%)	12	(36.4%)	10	(29.4%)	3	(8.8%)
3. Rs 20,000_Rs 30,000	5	(1.7%)	1	(3.1%)	0	(0.0%)	2	(6.7%)	0	(0.0%)	0	(0.0%)	1	(3.0%)	1	(3.0%)	0	(0.0%)	0	(0.0%)
4. Rs 30,000_Rs 40,000	7	(2.4%)	2	(6.3%)	0	(0.0%)	1	(3.3%)	3	(10.3%)	0	(0.0%)	0	(0.0%)	0	(0.0%)	0	(0.0%)	1	(2.9%)
5. Rs 40,000_Rs 50,000	6	(2.1%)	1	(3.1%)	0	(0.0%)	1	(3.3%)	1	(3.4%)	0	(0.0%)	1	(3.0%)	0	(0.0%)	0	(0.0%)	2	(5.9%)
6. Rs 50,000_Rs 60,000	6	(2.1%)	0	(0.0%)	0	(0.0%)	4	(13.3%)	1	(3.4%)	0	(0.0%)	1	(3.0%)	0	(0.0%)	0	(0.0%)	0	(0.0%)
7. Rs 60,000_Rs 70,000	1	(0.3%)	0	(0.0%)	0	(0.0%)	0	(0.0%)	1	(3.4%)	0	(0.0%)	0	(0.0%)	0	(0.0%)	0	(0.0%)	0	(0.0%)
8. Rs 70,000_Rs 80,000	3	(1.0%)	1	(3.1%)	0	(0.0%)	1	(3.3%)	0	(0.0%)	0	(0.0%)	1	(3.0%)	0	(0.0%)	0	(0.0%)	0	(0.0%)
9. Rs 80,000_Rs 120,000	0	(0.0%)	0	(0.0%)	0	(0.0%)	0	(0.0%)	0	(0.0%)	0	(0.0%)	0	(0.0%)	0	(0.0%)	0	(0.0%)	0	(0.0%)
10. More than 120,000	0	(0.0%)	0	(0.0%)	0	(0.0%)	0	(0.0%)	0	(0.0%)	0	(0.0%)	0	(0.0%)	0	(0.0%)	0	(0.0%)	0	(0.0%)
Total	290	(100.0%)	32	(100.0%)	34	(100.0%)	30	(100.0%)	29	(100.0%)	31	(100.0%)	33	(100.0%)	33	(100.0%)	34	(100.0%)	34	(100.0%)