USAID, Sri Lanka Tsunami Reconstruction Program (TRP)

Initial Environmental Examination (IEE) Report

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USAID SRI LANKA

FACESHEET

INITIAL ENVIRONMENTAL EXAMINATION (IEE)

PROGRAM/ACTIVITY DATA:

Program/Activity Number: (386-05-016)

Country/Region: Sri Lanka/Asia Near East Bureau

Program/Activity Title: Sri Lanka Tsunami Reconstruction Program (TRP)

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IEE Prepared By: Dr. Ananda Mallawatantri, Mission Environment Officer
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IEE Amendment (Y/N): N If "yes", Filename & date of original IEE _____

ENVIRONMENTAL ACTION RECOMMENDED:
Categorical Exclusion: ( )
Negative Determination: ( )
Positive Determination: (X)

SUMMARY OF FINDINGS:

The Government of the United States of America intends to provide assistance in Sri Lanka for the reconstruction of damaged infrastructure as a part of its response to the damage caused by the December 26, 2004 Tsunami. The tsunami caused extensive damage to life and property in coastal districts along the eastern, southern and western coasts of Sri Lanka. It is the worst human disaster in Sri Lanka's recorded history.

This Initial Environmental Examination (IEE) was conducted to review the foreseeable effects on the environment as a result of the US Government assisted infrastructure reconstruction and signature projects in Sri Lanka. The IEE covers three types of broadly different assistance activities, namely, the Arugam Bay bridge, roads and area development in eastern Sri Lanka; improvements to three tsunami damaged fishery harbors and related area developments in southern Sri Lanka; and repair, relocation and new construction of vocational technical educational institutions in several locations in southern and eastern Sri Lanka.

Field visits, stakeholder discussions and literature reviews indicated that all three key activities pass the threshold environment decision for positive determination pursuant to CFR 216 and require separate Environmental Assessments (EA's).

Although the primary USG assistance is to design and construct infrastructure, the projects are designed to include extensive involvement of the communities and stakeholders. The objective of the stakeholder involvement is to integrate and ensure the long term sustainability of the benefits that the infrastructure

brings into the community. The process proposed will combine the infrastructure construction with land use planning, livelihood development and energy and environmental conservation. In addition to the long-term economic, social and environmental sustainability, the projects are expected to contribute positively towards the peace process and ethnic harmony.

The community consultations, capacity building, education and increased participation of ethnic and disadvantage groups in the project activities are recommended for Categorical Exclusion under CFR 216.2 (C) 2(i).

APPROVAL OF ENVIRONMENTAL ACTION RECOMMENDED:

CLEARANCE:

Mission Director: Kimberly Finan, Senior Advisor for Director Date: June 1, 2005
Dr. Carol R. Becker

Regional Engineer: Cleared via e-mail Date: June 1, 2005

Michael Gould, USAID/Cairo

CONCURRENCE:

ANE Bureau Environmental
Officer: _____ Date: _____
Dr. John O. Wilson

Approved: _____

Disapproved: _____

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Summary of Terms

ADB	Asian Development Bank
asl	above sea level
BOD	Biological Oxygen Demand
CBO	Community-Based Organization
CCA	Coast Conservation Act (of 1997)
CCD	Coast Conservation Department
CEA	Central Environmental Authority
CZMP	Coastal Zone Management Plan
DO	Dissolved Oxygen
EA	Environment Assessment
EIA	Environmental Impact Assessment
ha	hectare(s)
IEE	Initial Environmental Examination
IUCN	International Union for the Conservation of Nature /World Conservation Union
LEEDS	Leader in Environment and Energy Design Standards by US Green Business Council
mg/l	milligrams per liter
msl	mean sea level
NARA	National Aquatic Resources Agency
NGO	Non-Governmental Organization
ppm	parts per million
SL Rs	Sri Lanka Rupees
SS	Suspended Solids
TA	Technical Assistance
UDA	Urban Development Authority
UNDP	United Nations Development Fund
UNESCO	United Nations Education Science and Cultural Organization
USACE	United State Army Corps of Engineers
USAID	United States Agency for International Development
USG	The United States Government
WWF	World Wildlife Fund

1. BACKGROUND AND ACTIVITY DESCRIPTION

1.1 Background

On December 26, 2004, a 9.0 magnitude earthquake struck off the west coast of Sumatra, triggering a massive tsunami that killed more than 250,000 people and displaced thousands in countries around the Indian Ocean. The tsunami caused extensive damage to life and property in all coastal districts along the East, South and West coasts in Sri Lanka.

In Sri Lanka the tsunami left behind widespread destruction; killing over 39,000 people, destroying over 100,000 homes, and damaging natural ecosystems and coastal infrastructure. Although Sri Lanka is 1,600 kilometers (994 miles) away from the epicenter of the earthquake, waves as high as 6 meters (20 ft) crashed into coastal villages, sweeping away people, cars and even a train with 1,700 passengers. It was the worst human disaster in Sri Lanka's history. The percentage of the coastal population affected ranges from about 20% in the southern districts of Galle, Matara, and Hambantota to 80% in the eastern districts of Mullativu and Ampara.

Table 1: Estimates of Livelihoods and Structural Damages in the Coastal Belt of Sri Lanka

Sector	Losses (million $)	
	Assets	Outputs
Housing	290-325	-
Roads	80	-
Water /Sanitation	40	-
Railways	14	-
Education	21	-
Health	57	-
Agriculture	3	-
Fisheries	120	155
Tourism	250	65-130
Power	9	-
Environment	10	-
Total in $ million	**900-930**	**220-290**
Percent of GDP	**4-4.5**	**1-1.5**

Source ADB, JBIC, JAICA and WB

Overall damage is estimated to be between $900 - $930 million with major losses concentrated in the housing, tourism, fisheries, and transport sectors (Table 1). Total losses across all sectors are estimated to be about 5% of the GDP of Sri Lanka. The largest share of output losses appear in the fisheries and tourism sectors due to lost income and production. Many coastal fishermen and small scale farmers' livelihoods were impacted by the tsunami causing greater vulnerability to poverty. In addition, many people working in the informal sector who service the fisheries, tourism sectors and the coastal communities have lost their homes and livelihoods.

The United States Government provided immediate relief assistance, and through USAID, intends to extend the assistance to include post – tsunami infrastructure rehabilitation and development with the objective of "building better."

1.2 Description of Activities

The infrastructure to be built includes a replacement of a 500 meter bridge in Arugam Bay, approach roads to the bridge and water sanitation in the Arugam Bay area (Pottuvil, Ulla and Panama); reconstruction and improvement to three fishery harbors at Hikkaduwa, Mirissa and Puranawella (Dondra); and reconstruction and improvements of up to 14 damaged vocational training institutions including two new centers in the East and South.

Into this process, USAID-Sri Lanka proposes to include community consultations, coastal management programs and capacity building for local authorities and communities in the areas where the infrastructure will be built. The purpose of linking infrastructure assistance to community capacity building, livelihood and environmental management is to ensure the long-term economic, social and environmental sustainability and ethnic and social harmony in the areas. During the process, the projects will introduce and implement educational and training aspects, measures to improve economic gains by fisherman,

tourism operators and others by providing quality value added products and services and improved service delivery on water, wastewater, sanitation and waste disposal. The buildings and the land use plans developed will include environment and energy best practices such as water and energy saving, erosion control, improved water storage, rainwater harvesting etc.

1.3 Purpose and Scope of IEE

The purpose of this IEE is to review the reasonably foreseeable effects on the environment of a proposed action and identify the mitigation and monitoring actions needed. An IIE is a streamlined version of a full environmental assessment (EA). As per Title 22, code of federal regulations part 216 (22 CFR 216), also known as REG216, the purpose of the Environmental Assessment is to provide *USAID and host country decision-makers* with a full discussion of significant environmental effects of a proposed action. It includes alternatives which would avoid or minimize adverse effects or enhance the quality of the environment so that the expected benefits of development objectives can be weighed against any adverse impacts upon the human environment or any irreversible or irretrievable commitment of resources.

The selected project management company for the overall contract will explore the environmental issues identified during this IEE in much greater depth through the recommended Environmental Assessments.

The EA process has to be conducted prior to the commencement of the physical work and must include a strong public/stakeholder consultative process. The EA may bring to light other issues (not identified by this IEE), and the contractor will need to develop mitigation measures for clearance by USAID at different stages of construction.

The participatory coastal zone management (PCZM) component programmed into the work may help to identify and implement some of the mitigation measures identified.

This IEE intends to review the foreseeable effects on the environment as a result of the US Government-financed Tsunami Reconstruction Program. The key activity areas covered include 1) Arugam Bay bridge construction and area development, 3) rehabilitation of three fishery harbors in the south (Hikkaduwa, Mirissa and Puranawella) and associated area developments and 3) reconstruction and new construction related to vocational and technical educational centers as well as curriculum/course enhancement in the coastal areas impacted by the tsunami.

Due to the wide variety of projects involved, this IEE was designed as a programmatic IEE and each major activity is dealt with separately. Literature collected from multiple sources (Government of Sri Lanka Agencies at national and local levels, regional bodies and NGOs), field visits and discussions in Arugam Bay and fishery harbor locations provided the information for this IEE. More discussions with the communities and stakeholders are expected during the project formulation and during the Environmental Assessment (EA) process.

We would like to acknowledge the contributions of the staff of the Government of Sri Lanka offices of the Central Environmental Authority (CEA), the Ceylon Fishery Harbor Corporation (CFHC), the Coast Conservation Department (CCD), the National Aquatic Resources Agency (NARA), the Road Development Authority (RDA), Urban Development Authority (UDA) and Vocational Training Authority (VTA); Consulting companies ARCADIS Euroconsult and EML Consultants; non-governmental organizations Arthacharya Foundation, Environmental Protection Foundation, HELP-O, Mercy Corps and Rebuild Sri Lanka Trust; the USAID staff in Egypt, India, Sri Lanka and Washington DC; and the US Army Corps of Engineers based in Hawaii, Korea, Japan and Washington D.C, for their valuable contributions by way of providing information, concepts, ideas and encouragement.

2. COUNTRY AND ENVIRONMENTAL INFORMATION

Land and climate:
Sri Lanka is an island the size of West Virginia located between latitudes 6 to 10 degrees north and longitudes 79 and 82 degrees east off the southern tip of the Indian subcontinent. Its total terrestrial area is approximately 65,610 square kilometers (25,332 sq. miles), of which 64,740 sq. km (98.7%) is land and 870 sq. km (1.3%) is water. About 13.9% of Sri Lanka consists of arable land, with 15.7% in permanent crops and 70.4% in other uses (2001). Irrigated land area is about 6,510 sq. km (2,514 sq mi) in 1998. Sri Lanka has 1,340 km (833 mi) of coastline. The extent of the territorial sea and the Exclusive Economic Zone (EEZ) is 21,500 sq. km and 517,000 sq. km, respectively; the EEZ amounts to 7.8 times the total land area of the country.

Sri Lanka is richly endowed with water resources that are replenished mainly by rainfall. The mountain massif of the central highlands contains peaks of up to 2,500 meters in elevation. All the major rivers start in the central highlands and flow into the ocean creating 103 river basins. The climate is moist tropical/subtropical, with monsoon rains falling during May-September (South-West) and November-February (North-East). Average annual rainfall ranges from 1,500mm to 2,500mm. Mean annual temperature ranges from 27°C in the lowlands to 15°C in the central highlands, with little seasonal variation. Frost occurs occasionally in some parts of the central highlands. The generalized water balance includes 130 billion cubic meters of water received as rainfall (100%) with 65% infiltration and 35% remaining as surface water. Out of the 65% infiltrated 25 billion cubic meters (20%) recharges soil and groundwater while 60 billion cubic meters (45%) is lost through evaporation and transpiration. Twenty billion cubic meters (about 15%) of water returns to the sea. The primary uses of water are for irrigation, power generation and water supply (Ministry of Environment and Natural Resources, 2002).

Demographic and socio- economic status:
Sri Lanka's population had reached 19.3 million in 2003, with an annual growth rate of 1.3%. Per capita annual income is estimated at US$ 935 (2003). Birth rates (2.1 per woman) and infant mortality rates (15 per 1000 births) are relatively low by associated developing country standards. Approximately 22% of the population lives in urban areas and 34% in coastal areas. Ethnic breakdown of the population is Sinhalese (74.0%), Sri Lankan Tamils (12.6%), Indian Tamils (upcountry) (5.5%), Muslims (7.1%) and others (0.8%). In 2003, the GDP consisted of Agriculture (19%), Industry (26.5%) and Services (54.5%).

Biodiversity:
Sri Lanka is ranked by IUCN, UNESCO, WWF, Conservation International and other conservation entities as a biodiversity "hot-spot" of major global importance due to the presence of important tropical forests and coral reef habitats, and a high proportion of endemic species of plants and animals within these habitats. More than 50% of Sri Lanka's reptiles and amphibians, 25% of its plants, and 17% of its mammals are endemic. Most of the endemic animal and plant species inhabit the rain forests of the wet zone that includes the coastal areas affected by the December 26, 2004 tsunami.

Table 2: Endemic, Threatened and Endangered Species in Sri Lanka

Category	Total number of known species	Endemic species	Threatened& endangered
Plants	3,414	890	431
Birds	251	25	11
Reptiles	144	77	8
Amphibians	39	20	(no data)
Freshwater Fish	65	17	8
Mammals	88	5	14

Source: IUCN

Sri Lanka's coastal region contains highly productive marine ecosystems, including coral reefs, mangroves, salt marshes, lagoons, estuaries, barrier beaches, and dunes. An estimated 2-3% of the coastline has fringing reefs. The reef ecosystem has a rich diversity of both fauna and flora including 183

species of hard corals, more than 300 fish species, turtles, dolphins and numerous invertebrates. However, the health of the coral reefs have been declining due to a variety of threats. According to the most recent report from the Global Coral Reef Monitoring Network, an estimated 35% of reefs are now classified as "dead" and 45% are "threatened".

Coastal zone and coastal ecosystems:
Out of the 25 administrative districts in Sri Lanka, 14 districts (74 Divisional Secretariat Divisions) have maritime boundaries. Based on the administrative districts the coastal areas consist of 24% of the total land area with 25% of the total population, 62% of the industries (Min. of Industrial Development Information, 2002), 70% of the tourist hotels (Ceylon Tourist Board Information, 2002). It also encompasses 285 sq. km (1.6 %) of municipal and urban lands. Sri Lanka has several hundred miles of coral reefs; 120,000 ha of brackish water lagoons, estuaries, and mangrove swamps; and about 140,000 ha of freshwater tanks and reservoirs that provide the basis for productive marine and inshore fisheries.

Coastal and marine environments are intrinsically linked with the country's society and economy. Coastal fishery accounts about 64% of the marine fishery, about 91% of the total fish projection in Sri Lanka (Coast Conservation Department, 2002 data). The vast majority of the fish catch (85%) comes from marine sources and is estimated to be about 183,000 tons annually. Although fishing contributes only 2.6% of GDP, fish is the major source (over 60%) of animal protein in the Sri Lankan diet and fishing supports about 500,000 people. In addition to the food value of the fish, many reef fish species are much sought after in the ornamental fish trade.

From scenic sandy beaches to mangrove forested estuarine areas, these often fragile ecosystems provide the basis for the marine fisheries industry, coastal tourism and a host of other related economic and social benefits. For example, the coastal reefs especially in the southwest of the island play a vital role in mitigating the impacts of the waves and reducing coastal erosion. The coastal environment is being seriously degraded by various forms of pollution, silt deposition, erosion compounded by sand and coral mining, conversion to tourist facilities, and the loss of mangroves.

Population growth, expanding tourism, industry, urban settlements, migration of people towards the coast, and widespread poverty, continue to contribute to the depletion of coastal resources and the degradation of coastal environments. The key environmental issues in the coastal zones are; loss of habitats and nursery grounds; overexploitation of coastal resources including food fish, ornamental fish, sand, and coral limestone; destructive fishing practices, timber felling and mangrove clearing, the use of dynamite; and marine pollution. Pollution in the marine environment is causing reduced growth in coral reefs and other living organisms, health hazards for recreational users, and reduced fish production. Causes of degradation/destruction and the pressures on mangrove and estuaries, coral reefs and the fish stocks were reported in detail in a number of studies (Ekaratne, 1997; Ministry of Forestry and Environment, 1999; Rajasuriya and White 1995; and Coast Conservation Department unpublished communications, 2005).

The December 26, 2004 tsunami severely affected coastal ecosystems in Sri Lanka and impacted more than 70% of the coastal belt extending from Jaffna in north all around the east and south coasts to Negombo in the west.

Human induced pollution:
Controlling coastal water pollution is a major issue and the main pollution sources have been identified as sewage, domestic waste and waste water, and land based activities including agriculture, industry and urban development. Coastal waters receive heavy pollution loads containing, sediments, fertilizer nutrients, agrochemicals, industrial waste water and waste oils. Both ground and surface water quality in the coastal areas are highly threatened. There is little treatment of municipal and industrial wastewater, and therefore the receiving waters are considerably polluted. The Kelani River which provides drinking

water to the City of Colombo and many other areas, receives untreated effluent from more than 20 industries and untreated sewage that eventually finds its way to the marine environments.

Although Sri Lanka is trying to address the waste problems and related water pollution and health issues, lack of understanding of the relationship between health and pollution, the pressure to develop the economy without much attention to the long-term consequences, the quantities of waste etc., are impediments to the efforts. These issues are expected to increase in the future.

Environmental management after the tsunami - new dimensions and opportunities:
Additional environmental concerns have been raised as a result of the December 26th, 2004, tsunami. There is an urgent need to rehabilitate communities and to develop infrastructure without paying much attention to resource utilization, optimum methods to provide services such as water, electricity and waste disposal etc. Post tsunami environmental concerns include;

- Land pressures and issues arising in relation to the coastal no build zones
- Land clearing to create new access roads and to meet the increased demand for timber and settlements
- Limited community consultations on their needs and how they want to configure their future
- Lack of knowledge of the effects of harmful or hazardous materials on coastal ecosystems and reefs
- Associated problems with invasive species
- Accumulation of debris, waste and sediments
- Extensive mining of sand, corals and excavation of clay needed to supply the increased demand for building materials
- Illegal and unsustainable use of mangroves, wetlands and state lands - often under forest cover
- Attempts to supply large quantities of ground water for construction and resettlements that may have long-term negative impacts such as poor supply and salt water intrusion
- Low priority given to waste management despite expanded activities
- Limited knowledge and mechanisms to deal with oils and chemical spills on soils
- Ideas of new land use planning emerging such as planning for multi-hazards and installation of early warning systems etc, but with no prior or well implemented example to build on

However, despite concerns that these environmental issues will be aggravated, if handled properly, the tsunami related reconstruction and rehabilitation assistance could be turned into an opportunity to make a positive contribute toward the development and social/economic improvement of the tsunami impacted populations and the country. Successful development and rehabilitation programs may bring communities, authorities and other stakeholders together, increase enforcement of regulations, and build capacities in local authorities and communities to understand and buy into the need for economic growth while protecting the environment.

The set of proposed USAID sponsored activities in this project carry the theme ‘building better” indicating the potential to design good programs and link infrastructure assistance to increase local capacity.

2.1 Locations Affected

Figure 1: Arugam Bay Site location

2.1.1 Pottuvil – Arugam Bay Area

Climate:

Arugam Bay in the eastern coast is located within the hot, humid, tropical dry zone of Sri Lanka. The mean annual temperature is 27.4ºC ranging from 18ºC on cooler nights during the rainy seasons, to a 38ºC day time peak in the summer months. The average daily maximum and minimum are 30.6ºC and 24.3ºC respectively. The eastern province where Arugam Bay is located receives an annual average rainfall of about 700-1700 mm with 60% during the northeast monsoons (October to February). Winds during the monsoon originating in the ocean bring relatively little precipitation while the inter-monsoonal convectional rains account for the majority of rainfall with some rain during the southwest monsoon. Rainfall distribution, therefore, is important in determining the climatic conditions in the area. Most of the province has a dry spell of three months with fairly dry conditions prevailing between May - September. Winds are generally moderate, ranging from 7–15 km per hour with stronger winds during the evening.

Immediate damage from Tsunami

According to the post-tsunami assessment by "Arcadis Euroconsult", the tsunami damage and direct effects on beaches and dunes were immediately visible and large amounts of debris were scattered along the high water mark. This included organic matter (varying from branches to whole, uprooted trees), dislodged coral boulders and marine rocks, rubble from destroyed buildings, and large amounts of household waste. There has been significant erosion in some areas, and dune vegetation has suffered some damage, although this is limited to the most exposed (a belt of 10-15 meters) or eroded areas.

Damage to vegetation:

Lagoon mangroves suffered limited impact while mangroves located directly near the seaward part of the lagoons were affected more. At the mouth of the Pottuvil lagoon mangrove trees had been dislodged or snapped off at the base, or entirely stripped of branches. At the "Surfing Point" in Arugam Bay, at least 10 meters of dune was lost on the exposed side. A band of woody vegetation of about 15 meters on the bay side was destroyed. Both coconut and Palmyra trees have remained upright and have not been uprooted. However, the palmyra palms (*Borassus flabellifer*) have been killed due to salt water intrusion into the freshwater stored in the soil. In contrast many of the Coconut palms have survived as these can withstand saline conditions.

Changes in the lagoon environment

The tsunami has also changed the lagoon environment in Arugam Bay. The addition of a large amount of decomposing organic matter in the lagoon may lower oxygen levels, but there was no visible evidence of fish kills attributable to this phenomenon. The Arcadis Euroconsult team who worked on the ground in Arugam Bay reported that the decomposition was causing some disagreeable odours around some lagoons, which is a nuisance to local communities, but not considered a health hazard. The reason that anoxic conditions have not led to fish kills is attributable to the fact that the tsunami has opened up direct links with the sea in many of the lagoons. This brings in oxygen-saturated waters that may have reduced the anaerobic decomposition that caused the odor. In some instances the link has been temporary, with a sand bar quickly forming again near the mouth (e.g. Arugam Lagoon). The influx of seawater has

increased the salinity in many lagoons, but this could be temporary. The rains that followed shortly after the tsunami would have contributed to diluting the system.

Impact on transportation, water and electricity supply

Roads have been heavily hit by the tsunami, with many road sections washed away, or undermined by deep scouring, usually on the landward side of (elevated) roads. A large section of the bridge at Arugam Bay was destroyed, and only recently (9th March 2005) re-opened after Bailey bridge sections were installed by the Indian army. Until that time, crossing was possible by boat service across the lagoon, driving on the sand spit at the mouth of the lagoon or taking the emergency jungle road (a detour of 11km) that was cleared to increase access and facilitate the relief operations in the area.

Wells in the affected areas are generally still brackish, although much pumping has occurred and is still ongoing. Usually, if wells have been overtopped by seawater, a 'bubble' of brackish water is formed at the base, and this simply needs to be pumped out. In affected areas in Pottuvil and Arugam Bay the problem seems much more serious as most attempts at desalinisation have failed. It appears that seawater has intruded into the groundwater system, and a coastal freshwater 'wedge' has been displaced, at least momentarily. Large polyester or corrugated iron tanks have been installed throughout affected areas (mainly by NGOs and the private sector), and these are being serviced by tankers. Power and telephone lines were knocked out by the tsunami, but were soon repaired and are now restored in most areas serviced before the tsunami.

Local government services in drainage and waste management

At best, drainage networks in towns and villages were modest before the tsunami and have not been restored, as this is not yet a priority. Solid waste disposal was also not adequate with only 20-25% being collected in Pottuvil town before the tsunami. Sanitary dumping sites are also non-existent in the area. Post tsunami, the waste issue has been greatly amplified and a solution in needed.

Disposal of solid waste by the Local Authorities occurs at a number of sites around Pottuvil. There is no prior sorting of waste, and all the waste is transported by tractor-trailer to the dump sites and deposited on the surface. The waste is regularly burnt to prevent build-up. Prior to the tsunami, two sites were in use, while a third had been discontinued due to complaints from a nearby police station. Both sites still being used are located in small clearings in forested areas – one immediately adjacent Lahugala National Park – and this attracts wildlife, judging from the presence of animal dung around the site (especially elephant).

There is no sewerage system in the area, and most have either soak pits or septic tanks, or (in the case of migrant fishermen, for example) simply make use of the cover of coastal scrub.

Cultural sites

Pottuvil's most noteworthy archaeological site is the 2000 year old Magul Maha Viharaya temple, which was apparently discovered only 60 years ago, although it lies just on the outskirts of Pottuvil (UTM: 0592719/0759235), at the base of the Pottuvil dunes. The site consists of the temple platform, several pillars, and three large statues. The site has not been affected by the tsunami, as it was shielded by the tall dunes.

2.1.2 Fisheries Harbor Areas at Hikkaduwa, Mirissa and Puranawella (Dondra)

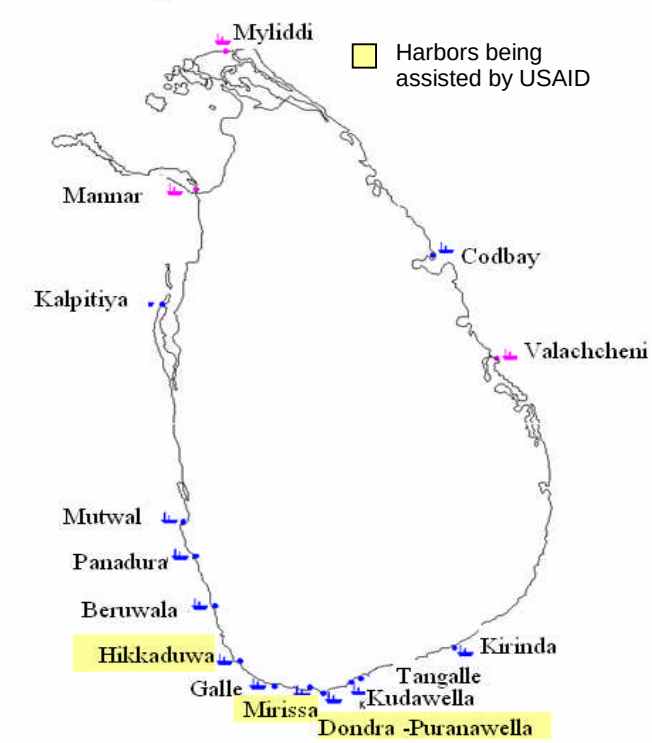
The tsunami affected the infrastructure of fishery harbors, landing points and the reefs in the south west, south, east and north-east. A number of donors and Sri Lankan entities came forward to rebuild and improve these harbors and to provide fishing gear. The United States Government has agreed to improve the conditions in three harbors, namely, Hikkaduwa, Mirissa and Puranawella (also referred to as Dondra).

Table 3: Number and Types of Fishing Boats registered at Hikkaduwa, Mirissa and Puranawella (Dondra) Fisheries Harbors

Size class	Dondra	Hikkaduwa	Mirissa
No Engine	50	11	-
On board motor	12	-	-
18”	-	-	-
28”-30”	25	28	64
31”-35”	129	17	48
36”-40”	94	4	41
41”-45”	17	1	10
>45”	-	-	-
Total	327	61	163

Source: Ceylon Fisheries Harbor Corporation

Figure 2: Fisheries Harbors in Sri Lanka



Hikkaduwa Fishery Harbor

Hikkaduwa harbor is located 100 km southwest of Colombo and the Fishery Harbor is in the heart of the city. Hikkaduwa is a very attractive tourist center due to the presence of submerged coral in the near shore area. A large number of fishing boats in this harbor were moored in an area that is a Marine Sanctuary. They have shifted into the Hikkaduwa harbor that was built in 2001. The administrative district is Galle and the divisional secretariat division is Hikkaduwa. The harbor presently has a capacity for 350 boats with a land area of about 0.54 ha and a basin area of 6.9 ha.

Hikkaduwa town covers about 325 ha in eleven Grama Niladari divisions (smallest administrative unit) with an average population of about 3,000 people. The number of hotel rooms in Hikkaduwa is about 1,170 with about 70% and 30% occupancy in high and off seasons, respectively. The average amount of garbage residents generate is about 0.35 kg/day, while a tourist generates about 2.44 kg/day. City of Hikkaduwa will be getting a new waste water system in 2006 and the plan for the new sanitary landfill site is drawn but stalled due to public opposition and lack of funding.

The near shore area of Hikkaduwa consists of patches of sand (fine sand with mean diameter about 0.1 mm) interspersed with coral rocks. Past studies (1991, 1996) show removal or loss of sediment between the reef and the shoreline (Lanka Hydraulics Ltd, 1996) at the average rate of about 5,000 cubic meters per year. The observation made was that either the sand is being trapped in the river (confluence north of

harbor) or transported north of the town of "Seenigama." Somewhat uniform special distribution of the calcium content and the high percentage (15% - 25%) indicates a reduced discharge of river sediment to the sea. However it is also observed that during dry spells the river acts as a sink of sediments and after rains it discharges sediments to the reef and some sand is transported north by the currents.

Before the harbor construction (breakwater) the waves traveling south reached the shore about 250 meters south of the harbor (presently a marine sanctuary with protected revetments). Immediately after the harbor breakwater construction some of the wave action on the south side of the breakwater was observed to create reflected waves traveling in the south-easterly direction. However further investigation on this aspect is recommended. The breakwater provides a larger basin area by sheltering the northern basin. It also prevents sediment flow from the river mouth into the harbor basin.

Mirissa Fishery Harbor

Mirissa harbor is located about 154 km from Colombo west of Matara town in Matara Bay. The administrative district is Matara and the Divisional Secretariat area is Weligama. The harbor was commissioned in 1966 and it has a land area of 1.54 ha and a basin area of approximately 7 ha. The main breakwater is about 450 meters long and the depth of the harbor varies between 2.5 – 3.0 meters. Berthing capacity at present is for 250 vessels with 3.5 to 5.0 ton capacity. The harbor is over crowded and many delays occur due to the lack of berthing capacity. As a result, only about 170 boats are registered in the harbor. The proposed harbor master plans may need to investigate the reason for the overcrowding when only 170 boats occupy a harbor designed for 250 vessels.

Opportunities for private sector involvement at the Mirissa Fishery Harbor lie in the boat repair facilities. The nearest slipway is in Tangalle 40 Km away and therefore there is justification for a slipway at this harbor due to its size, supported by several small workshops. The location of Mirissa may provide opportunities for developing a "Marina" for yachts as a future development plan.

The tsunami damages and the need for harbor expansion provide USAID an opportunity to assist in the rebuilding of the Mirissa harbor. Some of the facilities at the Mirissa Fishery Harbor are very old, the workshop and winch were commissioned about 30 years ago.

Dondra (Puranawella) Fishery Harbor

Dondra harbor is located 165 km south of Colombo on the west side of the "Dondra Point" the southern most tip of Sri Lanka at the eastern end of the Matara Bay (latitude 5° 56'N and longitude 80° 35' E). The Nilwala Ganga, one of the major rivers, flows out to the sea nearly 5 km to the west of the harbor. The administrative district is Matara and the district secretariat division is Devinuwara.

The construction of the harbor started in 1982 and was expected to provide facilities to 450 boats if the full area of the harbor could have been used. However the shallowness (dead coral mixed with sandstone) does not allow the full use of the harbor area. According to Ministry of Fisheries and Aquatic Resources (1995), about 650 boats with in-board engines, a large number of out-board engines and non-mechanized crafts operate from the coastal stretch of 30 km between Dondra and Tangalle. Tangalle harbor accommodates about 100 boats; therefore, the expansion of the Dondra harbor is justifiable but also must take into consideration plans in Tangalle.

2.1.3: Vocational and Technical Education Centers

USAID together with Vocational Training Authorities of Sri Lanka will rehabilitate and reconstruct up to 14 facilities. The project will also review and improve the curriculum and provide necessary equipment as replacements and enhancements.

Table 4: Indicative list of the vocational and technical training centers

	Facility	Location	Scope
1	Training Center	Urawatta, Ambalangoda	Repair
2	Printing Center	Pettigalwatte, Galle	3 Story
3	Relocation	Galle	2 Bldgs
4	New Site	Galle	3 Bldgs
5	Weligama Center	Weligama	3 Bldgs
6	Ahangama	Imoduwa	3 Bldgs
7	Matara Relocation	Talalla	9 Bldgs
8	Nintavar Expansion	Nintavar	2 - 3 Story

Source: Vocational Training Authority, Sri Lanka

In order to add value to the two new centers, the aim is to incorporate "Green Design Concepts" generally characterized by the Leadership in Environment and Energy Design (LEEDS) by US Green Business Council (2001) into the rehabilitation or construction of the Vocational Training Centers. The buildings will then have an educational role for the community and the students benefiting from the facility. Some may have residential facilities and therefore the liquid and solid waste generation could be significant.

2.2 National Environmental Policies and Procedures

Some of the relevant regulations and acts include: the National Environment Act No 47 of 1980 (NEA) and its 1988 amendments that is the national charter for protection and management of the Environment; the Coast Conservation Act No 57 of 1981; and, the standard Environment Impact Assessment (EIA) procedure. The EIA procedures applicable today are based on the Gazette (Extra – ordinary) No: 772/22 dated June 24th, 1993; No 859/14 dated February 23rd, 1995; No 1104/22 dated November 6th, 1999; No 1108/1 dated November 29th, 1999 and No 1159/22 dated November 22nd, 2000 of the Democratic Socialist Republic of Sri Lanka.

Coast Conservation Act 1981 (No. 57 of 1981) has 42 sections that covers: Administration (I); Coastal Zone Management (II); Permit Procedure (III); General (IV); Amendment and Modification of Certain Written Laws (V).

A Coast Conservation Advisory Council has to be established along with an appointed Director of Coast Conservation (secs. 2-10) who will submit to the Council a comprehensive Coastal Zone Management Plan.

Section 16 provides for environmental impact assessment to be provided by applicants for permits to engage in development activities in the Coastal Zone other than prescribed development activities.

Coastal Zone is defined as *"the area lying within a limit of three hundred meters landwards of the mean high water line and two kilometers seawards of the mean low water line and in the case of rivers, streams, lagoons, or any other body of water connected to the sea either permanently or periodically, the landward boundary shall extend to a limit of two kilometers measured perpendicular to the straight baseline drawn between the natural entrance points thereof and shall include the waters of such rivers, streams and lagoons or any other body of water so connected to the sea*" (sec. 2).

Source: Coast Conservation Act

The objective of conducting an IEE and the EIA in Sri Lanka under the Sri Lanka National Environment ACT (NEA) is similar to the objective of the USAID REG 216 process.

However, in Sri Lanka after scoping a two stage process is adopted. The first level is the IEE that identifies the potential environmental impacts of the proposed project with a view to determine whether the impacts are significant or not. The second level is the Environmental Impact Assessment (EIA) which is a more comprehensive document where alternatives to the project and mitigation measures are identified. The IEE is USAID's way to identify an approach to be taken; therefore, conducting a scoping and IEE together is always preferred. If the IEE recommends a detailed analysis or an Environmental Assessment, then USAID requires an EA or EIA.

The EIA process in Sri Lanka is managed and monitored by the Central Environmental Authority (CEA) and implemented through a number of State Agencies designated by CEA as Project Approving Agencies (PAA). Following approval, a project monitoring committee is formed to monitor the project implementation.

The IEE/EIA process in coastal areas is covered by the Coast Conservation Act (CCA) of 1981. CCA does not specify when an EIA is required for a particular project, but generally the Coast Conservation Department (the regulatory agency for the CCA) interprets this provision as that "an EIA is required when the impacts are likely to be significant". An exception is made for 'environmentally sensitive areas' (ESA) in the coastal zone; projects in ESAs are subject to regulations as determined by the National Environmental Act No. 56 of 1988. Projects outside the coastal zone and in ESAs are to be cleared according to procedures determined by the NEA (1988) where the Ministry of Environment in 1993 had determined that IEE/EIA are to be conducted only for a prescribed list of 31 (types of) projects. IEE/EIAs are to be cleared by Project Approving Agencies (PAAs), of which 14 are designated in an order published by the Ministry of Environment in 1993.

IEEs/EIAs are compulsory for solid waste disposal facilities that have a capacity exceeding 100 tons per day. None of the project sites covered in this IEE collects more than 100 tons of municipal solid waste per day. However we recommend evaluation of the waste management in the project areas considering the potential growth due to improved facilities, increased economic activities and life style changes.

The first comprehensive National Action Plan in Sri Lanka came into effect in 1992. Among the documents that provide a good environmental and regulatory overview are the present National Environmental Policy document named "Caring for the environment 2003-07" and the "State of the Environment - 2002" by the Ministry of Environment and Natural Resources.

After the December 26th 2004, tsunami, several environment-related agencies, with the objective of helping the post tsunami rehabilitation and reconstruction efforts, published a number of documents summarizing the legal aspects of land use (Environmental Foundation Ltd., 2005) and a set of guidelines for environment-related best practices for reconstruction activities (IUCN, 2005)

3. EVALUATION OF ACTIVITY/PROGRAM ISSUES WITH RESPECT TO ENVIRONMENTAL IMPACT POTENTIAL

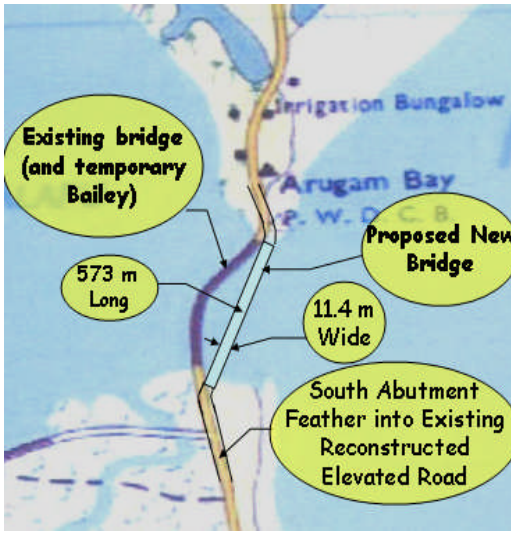
3.1 The Arugam Bay Bridge and Related Structural and Participatory Coastal Management Components in the Area

3.1.1. Brief Description of the Arugam Bay Bridge

The existing Arugam Bay bridge is located approximately one mile south of Pottuvil about 400km from Colombo. The existing bridge is a steel truss bridge with a total length of 152 meters consisting of four equal spans, each 38 meters long. The bridge cross-section consists of 6.7 meter clear carriageway and 0.4 meter wide sidewalk on either side. The bridge was also connected to a 550 meter long causeway and a separate single span concrete bridge on the south side. The tsunami completely washed off the causeway on the south side leaving a gap of about 500 meters. The tsunami also changed the width of the bay at the bridge. The width of the bay at the bridge was approximately 150 meters, but after the tsunami, the width of the bay has increased to more than 260 meters. A temporary 4 span Bailey Bridge was constructed to span over the additional 110 meter of waterway caused by the tsunami. The temporary bridge over Arugam bay now consists of four spans existing steel truss bridge connected to a four span bailey bridge for a total bridge length of 262.8 meters.

Proposed Arugam Bay Bridge:
Design and construct a replacement bridge on a new alignment and on the east side of the existing Arugam Bay Bridge. The total length of the new bridge will be about 686 meters long. The total width will be 11.4m to provide 7.4m carriageway for two lanes of traffic with 2.0m wide foot walks on either sides. The foundation will be either large diameter bored piles or large diameter caissons taken to bedrock. The same free board shall be used as the existing bridge. The same vertical clearance shall be maintained between the soffit of the superstructure and to the waterway below. The vertical profile of the approaching roads and bridge will require adjustment to accommodate the depth of the new superstructure. The new bridge will be of concrete construction. The existing bridge will be used as a detour until the new bridge is constructed. The existing bridge will be removed and the existing causeway demolished after the new bridge is operational.

Figure 3: Location of the Present and Proposed Bridges at Arugam Bay



The Superstructure will consist of five 1.8m deep post-tensioned concrete girders, spaced at 2.4m center to center spacing.

The bridge will consist of twenty one 32.7m long spans. The deck will either be 200mm thick cast in place concrete crowned at the center with 2% slope, or 100mm thick pre cast deck with 100mm thick cast in place concrete topping crowned at the center with 2% slope. A 7.5 meter long approach slab should be provided at each approach of bridge to give a smooth riding surface at the road/bridge transition.

The substructure consists of twenty intermediate CIP (cast in place) bents and two CIP abutments at the ends of the bridge. The piers will utilize two 1.2 m diameter bored piles and 1.5m by 1.5m bent caps

spanning between the bored piles to support the superstructure. The 1.2 m bored piles should be socketed 4 meters minimum into bedrock. The elevation of the bedrock varies between 27.4 m to 33.4 m below the Ordinary Water Level (OWL). The abutments will consist of reinforced concrete retaining wall supported on a pile cap utilizing 0.6m diameter bored piles. To resist a combination of forces (overturning, vertical and lateral forces), the piles at the abutment will either be staggered spacing or double row. Reinforced concrete wing walls will be required to retain the fill behind the abutments. The wing walls will also be concrete retaining wall supported on a pile cap utilizing 0.6 m diameter bored piles.

The new bridge will eliminate the need for a causeway on the south side which restricted the lagoon water flow and could not resist the intensity of waves and water flow at turbulent weather. The new bridge will have a more direct alignment with the existing roads on the north and south approaches and will be 3.8 meters wider than the existing steel truss bridge to accommodate future widening of the approaching roads. The new bridge will require minimal maintenance since it will be constructed with concrete as opposed to the steel bridge that lacks durability in the salt water environment. Restoration of the wetlands as a result of eliminating the causeway is a direct environmental benefit.

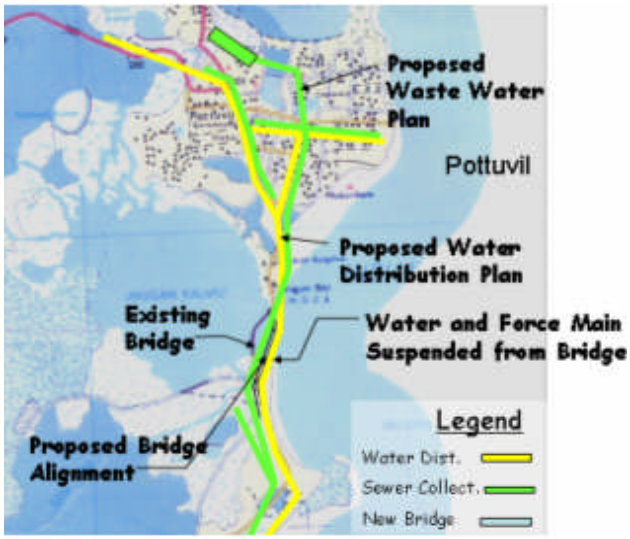
3.1.2 Bridge Approach Roads

Arugam Bay bridge roadway approach may involve the design and construction of about 500 meters of approach roadway at both ends of the new Arugam Bay Bridge. These approach roads may pass through stretches of wetlands and environmentally sensitive areas and mitigating impacts at construction and operational phases have to be addressed.

3.1.3 Water and Sanitation Development and Land-use Planning in Arugam Bay area

Arugam Bay area already reports problems with water availability and quality. Socio economic growth, improved quality of life of the citizens in the area and the growth of key areas such as tourism development rely heavily on the management of water and sanitation in the area. The proposed water supply project will generate water for Pottuvil, Ulla and Panama area covering a projected population of about 50,000 people. One water treatment facility is expected to provide water from Pottuvil to Panama.

Figure 4: Arugam Bay area water supply lines and the proposed bridge locations



The source of water is identified as the Rattakulam reservoir which is used for irrigation purposes, presently. National Water Supply and Drainage Board (NWSDB) that has a regional office at Ampara will be the local counterpart office and the project needs to be developed from ground up. The initial scoping conducted in February by USACE indicated the possibilities of conducting a ground water exploration, but the NWSDB is of the view that the surface water from Rattakulam reservoir is sufficient for the purpose.

3.1.4 Integration of infrastructure development with Sustainable Socio - Economic Development

In order to bring the maximum benefit of the infrastructure projects proposed for the Arugam Bay area to the larger society, community consultations and development of an integrated area management plan related to water, wastewater and coastal management (as they relate to the expansion of the tourism industry) is proposed. It will include elements of Participatory Coastal Zone Management (PCZM) and capacity building of the citizens as well as the local authorities, businessmen, government officials involved in Arugam Bay area development. Community consultations are the key to identifying the needs of the people. With the new tsunami related development, a number of large scale development ideas were proposed that include extensive land development. However the sustainability of the proposed projects needs to be evaluated. The USAID sponsored infrastructure needs to be designed and implemented to complement an agreed sustainable development strategy to enhance the socio-economic wellbeing of the citizens of the area.

3.1.5. Implementation Plan: Arugam Bay Infrastructure and Area Development

The Arugam Bay area infrastructure development (bridge, roads and water sanitation) is envisaged as a portion of a larger rehabilitation and growth strategy in the area. The objective is to incorporate community consultations and introduce sustainable coastal and environmental management practices while providing the necessary infrastructure. The prospective management company is expected to start communications with the community as soon as possible and we anticipate that the EA process could be one way to start the dialogue. The following timeline is proposed for organizational purposes. The projected time frame is between October 2005 and March 2008.

Activity / Phase	Year 1				Year 2				Year 3			
	FY 2006				FY 2007				FY 2008			
Community consultations/building linkages												
EA's for GSL and USAID Approvals developed												
Official Inauguration of the project												
Geotechnical Investigations/ Surveys												
Designing of the Bridge and Water Sanitation												
Designing of roads												
Bridge and roads constructions												
Water Sanitation construction												
Local authority/ community capacity build.												
Environmental monitoring												
Project monitoring and evaluations												

3.1.6 Evaluation of Environmental Impact Potential and Recommended Mitigation Actions in Arugam Bay

This section contains the details of the physical activities in the Arugam Bay area (Pottuvil, Ulla and Panama), potential issues (identified during this IEE) that need to be addressed along with potential mitigation measures that can be adopted. It is expected that the EA process may bring out more issues and mitigation measures that have to be addressed. Various issues need to be addressed at different stages of the project.

	Component	Environmental concerns	Potential Mitigation
1	Integration of the community in the infrastructure design process	• Community lacks awareness of the impacts and potential benefits of proposed developments. • Possible lack of community support for the project due to ethnic composition and different interests (three ethnic groups at varying degree of education).	Conduct a number of consultations with the community, local authorities and stakeholders on potential changes and adjustments and contributions needed to make the development useful, suited to their needs and sustainable. Involve the community at the outset of planning and designing. Create ownership for the infrastructure and use infrastructure as a way to promote sustainable economic, social, governance and environmental best practices.
2	Capacity building of the stakeholders in project design, identification of needs and improved monitoring and accountability	• Poor capacity of the local authorities, area businessmen, government agencies to engage the community and implement participatory development. • Underestimation of the value of monitoring and evaluation of the changes (social, economic and environmental) as a result of the project.	A dynamic well thought capacity building plan is necessary to overcome the barriers in this area. Participatory coastal zone management programs may help and some plans are available. Include monitoring concerns in the design and planning. Build the capacity of the local authorities and stakeholders to carry out these activities. Provide technical assistance mainly using local expertise. Proper understanding of the benefits of the project and the communities increased ability to pay for services (for sustainability) could change the dynamics of the local authorities, citizens and businessmen in the area.
3	Providing facilities for building workers during the construction	• Water and sanitation issues by camping on-site close to wetlands (for bridge, roads and water supply projects).	Plan for off-site accommodation and to construct water and sanitation facilities for the workers considering the sensitive sandy soils and potential to pollute ground water in the area. Design and implement solid waste management systems.

	Component	Environmental concerns	Potential Mitigation
4	Designing the bridge, roads and water sanitation.	• Displacement of the people. • New setback requirements • Obstruction to natural water flow patterns and impacts on biota. • Water flow path modifications due to excavations on the ground and in wetlands and both wind and water erosion could be significant. • Extensive needs of water for construction work and need for water conservation and to reduce seawater intrusion if ground water was pumped.	Work with local authorities and planners to reduce displacement as far as possible. Open dialogue with communities to come to a consensus. New setback guidelines will need to be followed Drainage flow paths should not be disturbed. Adequate planning is needed at the design stage to avoid siltation of wetlands and water bodies. Accumulation of water may lead to diseases. Avoid storage of loose soil near flow paths Design surface cover methods such as landscaping and compaction to minimize erosion related transport of soils into wetlands and water bodies. Prepare adequate drainage and storm water systems. Adopt methods to increase infiltration into soils such as planting cover with the help of coir materials or compost that can be produced in the area. Adopt water conservation and water monitoring capabilities in the design.
5	Construction of the bridge and roads	• Potential damages by excavations. Runoff of excavated materials into wetlands and unwanted locations can be a serious issue in Arugam Bay. • Noise and dust. • Destruction of plants, animals and habitats. • Use of building materials such as sand from sand dunes in the beach. • Potential water scarcity and ground water depletion. • Demolition of old bridge and disposal of material.	List out the potential damage and take precautions. Excavated areas can be dangerous to inhabitants in the area. Take necessary safety precautions. Manage the excavated loose soil to minimize wind and water erosion. Minimize by staggering the noise generation and wet the ground to minimize dust of the road construction Ensure minimum disturbance to the ecosystem. Remove plants that can be saved and integrate the construction work with other area land use development work to find mechanisms to use soil, plant material and other removed material. Ensure the environmentally sound supplies of sand, timber and other construction materials. Plan for water supplies for construction. Already the groundwater system is challenged by sea water intrusion. Adopt appropriate precautions for removing the old bridge without damaging the surrounding environment by following environmentally sound disposal mechanisms.

	Component	Environmental concerns	Potential Mitigation
6	Use of heavy machinery	• Hydraulic and motor oil and other chemical leaks from machines. • Noise and dust.	Take precautions and minimize potential spills and accidents. Recycle motor oil and dispose other oils properly. Introduction of a good disposal system in the project could be a pilot project by itself that can be transferred to the community. Arugam Bay is a very calm place with tourism as one of the key industries. Adopt techniques to minimize noise.
7	Design and construction of water supply to Arugam Bay, Pottuvil and the vicinity.	• Adequate water in quantity and quality to cover the supply project area. • Changes to surface water bodies.	Conduct a detailed feasibility to evaluate the potential sources of water (ground and surface or a combination). Introduce water conservation measures in the design and educate the stakeholders about water efficiency and related energy efficiency. With the new infrastructure and area development the water consumption is expected to increase. Introduce rainwater harvesting designs and best practices to increase recharge through the awareness and development programs. Partitioning of lakes for water treatment needs extensive environmental assessments that include expansion to water retention area in lakes.
8	Implementation of waste management practices and awareness	• Pollution due to plastic and solid waste such as dumping debris into sea and lagoons, wetlands etc. • Solid waste could be potential breeding grounds for disease causing organisms • Disposal of hazardous, poisonous and flammable waste	Waste needs to be collected, sorted, processed and disposed properly. Design and introduce sorting, recycling and strategies to manage solid waste in the area (i.e: microfinance scheme similar to Galle). Work with local authorities and the community to introduce integrated waste management through the project. Consider public – private partnership to establish a system (Dutch donors are already working on this in Arugam Bay).
9	Monitoring and evaluation	• Lack of capacity and recognition of the need to monitor and evaluate long-term changes to the environment as a result of development projects and human activities. • Development of an institutional mechanism to take the responsibility of monitoring and networking with other institutions.	Design and conduct a consultative process to convince the community and stakeholders of the need to monitor and understand the changes on the landscape and water. Establish a monitoring system inclusive of indicators that involves the local community, government, academics and local authorities. Establish a sustainable system to support the long-term monitoring and link data systems with national, provincial and local authorities for regulatory and policy work.

3.2 Fisheries Infrastructure and Participatory Coastal Management Components

Design and construct a mix of repair, replacement, and new structures and facilities impacted by the tsunami. The projects sites are located at Hikkaduwa, Mirissa, and Puranawella (Dondra). The work will consist of repair and improvement of breakwaters, wharfs, docks and pavements. The work may include shoreline work, dredging, and blasting. New developments may include fish flash freezing facilities, waste and wastewater processing facilities, fuel supply facilities, security improvements, and other improvements to commercial fisheries related structures.

The increased berthing area within the harbor basin, improved facilities for fish unloading and improvements to other off shore activities (fish auction, net mending, weighing and data collection of fish catch etc) will boost the fishing industry. Present wastage in the fish industry due to poor handling and weaknesses in the storage is estimated at 30% - 40%. Adopting higher standards will enable the fishing industry to sell the products at a higher value to the export market, reduce their loan burden and bring positive impacts to social and economic conditions of the community.

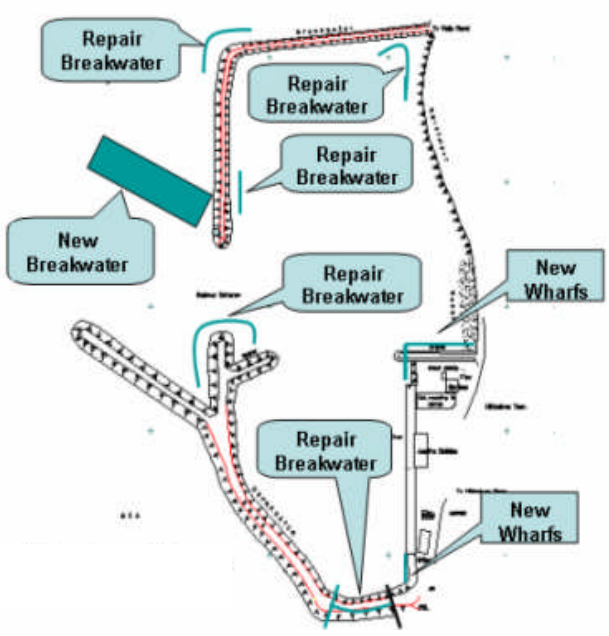
Community participation in activities, sustainable fishing activities, and other activities that benefit the greater population of the area are to be built in wherever possible and as identified by the community and local partners.

Hikkaduwa Fishery Harbor:

Before the harbor construction the Lanka Hydraulics Institute, a leading research group associated with the University of Moratuwa, Sri Lanka conducted a modeling exercise and the model and the data are still available for any further modeling work related to rehabilitation or construction. The model uses a wave basin of 35m x 25m covering an area with 0.7km x 1.0km from the Hikkaduwa harbor to the river.

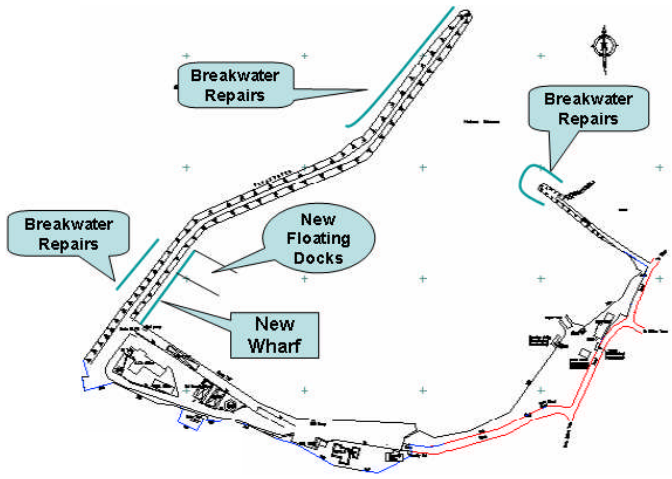
During the discussions with the Ceylon Fishery Harbor Corporation an extension to the present breakwater was requested. However, the Lanka Hydraulics Institute model conclusions do not support the idea. In March 2005, the Army Corps of engineers proposed a breakwater in the north side of the entrance, but in April 2005, they reassessed their position and suggested that an extension of the current pier may work. Further studies are needed to evaluate the sand movements, modification to the flow paths and erosion of the reef.

Figure 5: Hikkaduwa Harbor and Associated Construction work



The construction of a proposed breakwater would alter the hydrodynamic conditions within and in the vicinity of the harbor. The north bound current would be restricted and new eddy current patterns would be formed. Proposed changes to the entry will also change the flow pathways.

Figure 6: Mirissa Harbor and Associated Construction work



Mirissa fishery harbor

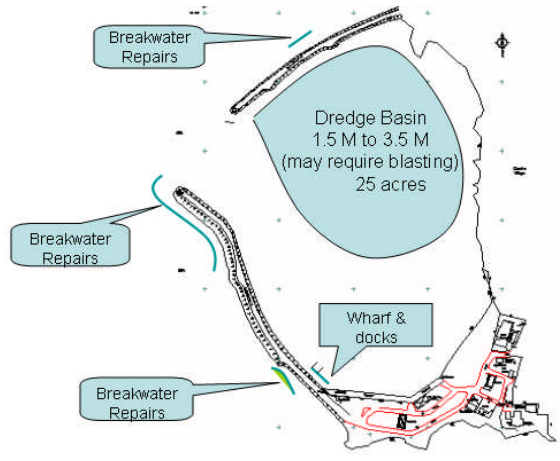
Mirissa harbor is designed to support the anchorage, supply and trade of the catch of 300 boats. More efficient use of space and increasing docking areas, with separate space for boat repairs is needed. Community engagement is also needed here to look for ways in which neighboring fisher communities, not sufficiently served by this harbor, (due to space restrictions) can also benefit.

Dondra (Puranawella) fishery harbor

One of the sensitive activities is the dredging of the harbor to deepen the bay to about 3 to 3.5 meters. This is another area that needs further study but should the idea gain traction, the mechanism for dredging and the mode of disposal are the primary concerns. The geology of the material to be dredged is inert and three options can be considered, namely, 1) the transport and disposal of the material in sea at selected locations avoiding fish breeding grounds and coral reefs; 2) use a cutter-suction dredger and pumping it out to nourish depleted beaches north of the harbor, and 3) separate limestone from the other material, sell lime and use the remainder as filling material for roads etc. Whatever process is undertaken it must be conducted with tight supervision and after ensuring that the material is free of contaminants. Some material can be used for the filling work done at the harbor itself. The previous dredged spoil site is 8 km out to the sea and the same site is used by the Beruwala fishery harbor dredging works.

The layout of the present breakwaters is finalized through a mathematical modeling work by the Lanka Hydraulic Institute Ltd. (LHI) in 1994. According to the findings of a master plan study of coastal erosion (DANIDA, 1986) the coastline changes resulting from the implementation of the breakwater construction is minimal. Also it was noted that the establishment of the breakwater minimized the progressive erosion in the Matara Bay that threatened the coastal lands and the Matara – Kataragama road.

Figure 7: Puranawella Harbor and associated construction work



3.2.1 Implementation Plan for Harbor Rehabilitation and Area Development

As in the case of Arugam Bay area development, harbor rehabilitation also includes a strong community participation component. We anticipate a significantly larger program in Hikkaduwa than in Dondra and Mirissa. Program development and consultation may include researchers, local government, NGO's and businessmen in addition to the fishery population and the community. The objective is to identify the equipment, technologies and the systems needed for harbors and surroundings to integrate the economic

benefits as a result of the infrastructure rehabilitation into sustainable development. The anticipated project duration is between October 2005 and March 2008.

Activity / Phase	Year 1				Year 2				Year 3			
	FY 2006				FY 2007				FY 2008			
EA's Govt of SL and USAID approvals and start of stakeholder consultations												
Inauguration of harbor projects												
Train harbor, local govt. and fishermen												
Identification of Monitoring Teams												
Designing of infrastructure projects												
Stakeholders design environ. projects												
Continuing stakeholder consultations												
Implementation of Infrastructure projects												
Environmental monitoring												
Project monitoring and evaluations												

3.2.2 Evaluation of Environmental Impact Potential and Recommended Mitigation Actions for the Harbors

Section 3.2.2. identifies the key interventions expected during the fishery harbor rehabilitation, technology enhancements and introduction of best practices to the fishermen, employees of the harbor and the community. This IEE highlights several potential environmental concerns and potential mitigation measures. The activities in the harbors and the suggested improvements will certainly impact the socio – economic status of the surrounding community and the conservation projects located nearby. For example, in Hikkaduwa the Special Area Management Site (SAM) managed by the Coast Conservation Department is located south of the Harbor. This site also has a national park and is the same area used for nature tourism. We anticipate that the EA process will identify more issues and mitigation/ monitoring needs. All three harbor sites are surrounded by coral reefs that have been impacted by the tsunami, any additional stress may further reduce regeneration capabilities.

It is expected that the suggested stakeholder consultations will be broad enough that the area needs will be captured during the discussions. The process is expected to build the capacity of the local government authorities, NGO's and other stakeholders in identifying the niches they need to improve and mechanisms to work together to serve the harbor communities and maximize the economic improvements created by the harbor improvements. The harbor component of the project, especially in Hikkaduwa, has the potential to develop into a multi faceted project with a range of partnerships. Already several donors (AusAid, USAID and EU) and a number of strong NGO's are working in the harbor areas.

	Description	Environmental Issues	Mitigation
	Replacement of breakwater Dondra (D): 750 feet Hikkaduwa (H): 500 feet Mirissa (M): 650 feet Construct/improve sea and channel entrances D: Repair channel revetment and provide additional 1000 ft H: New 350 ft channel entrance M: Repair channel revetment and provide additional 300 ft Breakwater repairs D: Approximately 1,700 feet of 12 feet wide H: 250 ft of breakwater and 1,500 ft of 12 ft wide pavement on top of the breakwater. M: Repair approximately 1,500 ft of 12 ft wide pavement on the breakwater Repair/extension of wharfs D: Repair & addition of 300 ft H: Repair & addition of 400 ft M: Repair & addition of 450 ft Floating docks in and slipway/dry docks D: Two floating docks, a new 80 ton slipway/dry dock and replacement of 20' x 50' boat ramp. H: New 80 ton dry dock M: 200 ft of floating docs and 80 ton capacity dry dock	• New breakwater additions, if done, will impact the flow patterns, erosion and depositional behaviors on the reefs. (This issue seems to be most prevalent or of concern in in Hikkaduwa where breakwater modification is suggested.) • Water quality (turbidity) deterioration due to construction and related problems such as impact to corals and tourism industry. • Discharges (loads of pollutants) from multiple sources (urban, erosion tourism related and industries etc.) that includes the harbor activities such as disposal of solid and liquid waste and oils. • Expansion of sea entrances may require blasting or other heavy duty equipment (noise and impacts). • Raw materials for revetments may contain impurities that may dissolve in water later or be taken from illegal sources (timber, metal and sand). • Timely, UDA, CEA, Local Authority and CCD approvals.	There are ongoing or past studies conducted by the Universities, IUCN and NARA. Take advantage of these studies and the laboratory simulations conducted by the Lanka Hydraulic Inc. (LHI) for Hikkaduwa and Dondra in the design stage to better understand the fluid dynamics and erosion/depositions in and around the harbors. Use methods that minimize the disturbance and remove the disturbed material efficiently. Design and implement a monitoring program to track the changes of the physical, chemical and biological parameters (EC, BOD, DO, pathogens, nutrients etc.). Bench mark before the construction, monitor during and after the construction. Build the community into the monitoring to ensure the sustainability. Minimize the noise and vibration impact using covers and other techniques. Alert the community of the potential noise. Take safety precautions and remove and dispose of the debris with minimum damage to the ecosystem. Monitor the quality. Construction materials for the repair and new breakwater will be rubble mound structures. Boulders and quarry material used to be granite. Sizes of the material may vary and be obtained from the local quarry sites. There are incidents of sand mined at illegal locations and granite taken out from conservation sites etc. therefore, sources need to be verified. Work with the Ceylon Fishery Harbor Corporation to get the environmental clearances. Keep relevant sources informed of activities and steps taken.

	Description	Environmental Issues	Mitigation
2	<u>Dredging of the harbor</u> Only for Dondra: About 25 acres of harbor area needs to be deepened from 1 meter to about 3 meters (this task is an optional).	• Water quality (turbidity) deterioration due to dredging. • Disposal of dredged material. • Noise and vibrations associated with dredging and construction	Take precautions to alert community, plan the work so that fishing activities will not disturb environmental preservation or vice a versa. Consider cleaning the coral structures after the operation (suction tubes). Investigate the best possible mechanism of disposal (sea, sorting, selling and filling or other options. IUCN (2005) indicates the disposal sites identified in each district by the CEA. Make the fishermen and residents and local authorities aware and take precautions to minimize the impact of under water vibrations.
3	<u>New boat motor repair shops</u> facilities at each location with 20' x 70' <u>Fishing net repair, fish auction and other buildings</u> D: Add 40' to 27' x 80' fish auction facility, expand 20' x 60' to 80' for net mending and repair the pavements H: New 80 ' x 30' fish auction facility, new administration buildings and net mending building repaired M: 40' addition to 27' x 80' fish auction building. New 20' x 60' net mending building and pavement repairs <u>Improvements to fuel storage facility</u> Two 8000 gallon facilities to be added and station improvements at all three harbors	• Lack of understanding of the amounts and types of waste generated. • Need for mechanisms to collect and dispose of used oil and combustion oils. • Corrosion effects on the tanks and leak tests. • Water quality issues in the vicinity due to disposal of fish waste • Erosion of sediments into harbor • Options to use nets in a productive manner.	Study the waste generating pattern and the compositions. Introduce technologies (oil water separation, skimming etc) to minimize the contamination of water by used motor oil. Increase the awareness on the harmful aspects of used oil in water (oxygen barrier). Adopt a recycling system for oils. Design and implement a mechanism to maintain boats to minimize major repairs and to save fuel. Most oil leaks are due to poor maintenance. Corrosion controls for fuel and oil storage. Frequent checks on stocks of fuel and oils to monitor leaks and evaporation losses. Plan to introduce erosion control techniques to minimize sediment loads to harbor. Investigate alternate uses for discarded fish nets.

	Description	Environmental Issues	Mitigation
4	Ice- plant & flash freeze facilities added (capacities to be determined and economic benefits to be evaluated).	• Adoption of new technology. The purpose is to reduce the post harvest loss of fish catch. Balancing the provision of ice and the extent of flash freeze technology use may need to be evaluated.	Study the pros and cons of flash freeze, issuance of ice and any other technical intervention to cut down the waste. Once identified, create a program to educate stakeholders to get the maximum benefits. Use this as an opportunity to collect data on the volume of catch and the composition of the catch and to improve the quality of fish and the market price.
6	Water, waste water and solid waste disposal. Systems to be designed and constructed at each harbor location for water treatment, waste water and solid waste management.	• Arriving at the optimum capacity of water treatment systems needed considering present or planned facilities in the area and the expanded activities in the harbor. Identification of the right technology and maintenance/operational mechanism for waste water treatment. • Water scarcity in the harbor areas and plans to use ground water • Integration of solid waste disposal with the local authority system • Increase use of water as a result of expansion.	Study the needs and options considering the activities in the area and types of waste water. Consider recycling of and introduce water and energy efficiency programs. Co-ordinate with local authorities on waste water and possibility of developing a partnership with other donors and the utilities. In Hikkaduwa the potential exists to integrate harbor waste water treatment with the upcoming waste water project by the city (funded by AusAID). In other areas the harbor staff can get involved in the area waste water planning. Negotiate with the local authorities to optimize the solid waste disposal mechanisms. Introduce water conservation techniques and systems to reuse water after treatment. Adopt rainwater harvesting to complement water supply by design.
8	Processing of fish waste to marketable products Facility to recycle up to 6 tons per day fish waste and an integrated solid waste management system at each location	• New adaptation of a technology to convert fish waste to useable products (fertilizer and a nitrogen source.)	Evaluate the potential technologies and ensure the economics of scale for the Fishery Harbor Corporation. The system may include the fish waste in the community by devising a system to obtain fish waste discarded at landing points outside the harbors.

	Description	Environmental Issues	Mitigation
9	Multipurpose community facilities Each harbor will have a newly designed facility that will include a visitor center, sales outlet and a canteen. Sizes and the scope are to be determined and Hikkaduwa center will be the most sophisticated one with green designs etc (US Green Business Council, 2001).	• Potential to demonstrate waste management (solid and liquid) systems using the community facility. • Ensuring the full use of the community center after the investment. • Ability to use the center as an educational / tourism promotion location, especially in Hikkaduwa.	Use education and financial benefits to promote sustainable waste management. Introduce techniques to dispose waste and generate energy (biogas, composting etc.) and develop harbor as a model to encourage communities to do the same. Design and implement a program that will be appreciated by the community and the fishermen. Proper use of the community facility can have a number of benefits and provide an enabling environment for stakeholders to get together.
10	Monitoring and evaluation	• Lack of data on weight of the catch and composition. • Mechanisms to ensure financial stability of the harbor operation and convince the need for such change to improve the service/performance of the fishery harbors. • Lack of systems for continuous monitoring of the impacts of the projects. • Impact of the tsunami by way of bringing debris, chemicals, saline water and invasive species etc.	Establish a data collection system and convince the stakeholders of the value of doing so. A mechanism to collect data from other landing sites needed (GSL is going to expand the field staff). Discuss and develop a system to improve the income of fisher community using the infrastructure and technical assistance provided and convert harbors as separate cost centers. Donated infrastructure should boost the profits and help to fetch a high price for good quality fish. Need to identify a community, regulatory and scientific team and provide facilities to implement a designed monitoring protocol to benchmark the present situation, changes over time and project impacts including the results of environmental best practices. The variables to monitor need to be evaluated and agreed upon. The designed system should be self sustaining and continue after the project. There is potential to involve school children and diver communities in the monitoring.

3.3 Rehabilitation of Vocational Training Facilities and New Construction

The exact detail of the extent of rehabilitation needed and the proposed improved designs to buildings, curricula and management have yet to be developed. The Vocational Educational Section of the RFP (Attachment J-8) provides more detail regarding the type of enhancements anticipated. It is agreed to adopt the green designs (LEED Standards) where ever possible and to create a community and stakeholder interaction around each project site, especially on the proposed state–of–the–art facilities that are to be designed and built as new projects.

3.3.1. Implementation Plan for Rehabilitation and Construction of Vocational and Technical Training Centers.

Section 3.3.1 provides the timeline for the rehabilitation of vocational and technical educational centers. The project duration will be from October, 2005 to March 2008. This work has the opportunity to get the students and staff of the institutions oriented toward improved environmental management through the stakeholder dialogue. Community and the local authorities need to be included in the EA consultative process. New zoning related guidelines will apply to these projects and new sites may have extensive environmental mitigation measures. Visitor Centers and residential facilities have been proposed in certain locations and a number of environmental best practices can be incorporated into the designs.

Activity / Phase	Year 1				Year 2				Year 3			
	FY 2006				FY 2007				FY 2008			
Identification of actual sites, start of consultations on curricula and building designs												
EA's Govt of SL and USAID approvals												
Ground Breaking												
Stakeholder and community involvement												
Repair of damaged buildings												
Const. of new state of the art facilities												
Curricula development for new facilities												
Equipping damaged and new facilities												
Implementation of waste and energy management and awareness												
Evaluation												
Independent monitoring												

3.3.2. Evaluation of Environmental Impact and Potential and Recommended Mitigation Actions for Vocational Technical Training Centers

Environmental concerns in the vocational and technical education center rehabilitation activity will face most of the same concerns that are being faced by the new housing construction, that include adhering to the government established setbacks. This project may become a good model for housing projects or building constructions, especially on connecting services, adopting water and energy efficiency and disposal of waste materials. Landscaping, surface modifications and the use of building materials are other areas that may provide demonstration effects.

Supply of raw materials (sand, timber, lime, metal etc) for building construction is a serious issue due to the high volume of construction taking place. Therefore the management plans should include precautions to verify the sources of supplies to avoid using the building materials from illegal and environmentally unfriendly channels. The weather in the coastal belt project area can be extreme. High heat, intense rains during monsoons can severely impact the progress and pose environmental issues.

	Component	Environmental concerns	Mitigation
1	Site identification to relocate damaged buildings and for new sites for new facilities	• Need to move people or site is near a sensitive area. • Need to disrupt the environment to improve access to services • Environmental concerns related to site characteristics (slopes, forests, roads and wetlands etc.)	Understand the site characteristics. Work with local authorities to minimize the environmental impact and to get the services configured. It is better to avoid displacement of families, if possible.
2	Debris removal and site preparation	• Demolition of structures and disposal of material • Hazardous materials and chemicals spilled as a result of the tsunami • Dumping waste in low lands and lagoons. • Exposing the bare soil can cause erosion of sediments and disturbance to the ecosystem. High intensity rainfall in the coastal area can induce severe erosion on loosely exposed soils	Adopt appropriate precautions to minimize harmful effects of dust, asbestos and metal and recycle as much material as possible. See the guidelines developed by IUCN (2005) for post tsunami reconstruction. Use cover methods and compaction and plant cover crops or landscape. Landscaping with coir material to provide initial cover is one solution. Include erosion controls in the designs and avoid piling loose soils near water flow pathways.
3	Planning for design and maintenance of environmentally friendly facilities.	• Facility management may not have funds to maintain the systems. • Need for capacity building of the managers to ensure the new systems designed are used properly. • Community access to the facilities to learn the models is limited. • Ability to use projects as demonstrated models for waste and energy management techniques	Involve the managers in the designing stage to highlight the advantages of green designs and provide training for proper maintenance of the installed systems. Waste management coupled with energy generation (biogas) and rainwater harvesting should be used whenever possible. Improved air-conditioning and lighting will help to reduce the working capital needs of the management. Work with the community and local authorities to promote the concepts and designs established

	Component	Environmental concerns	Mitigation
4	Construction of buildings, access roads and connecting services	• Excavations can cause erosion, siltation, and changes in natural water flow and damage ecosystems when excavated soil is piled inappropriately. • Access roads may remove vegetation • Water supplies using ground water and saline intrusion.	Take precautions to protect the erosion of freshly dug soils, cover and reuse as quickly as possible. Be aware of drainage water flow pathways in the site and the water bodies nearby to prevent contamination. Adopt landscaping best practices and minimize the creation of impermeable surfaces that reduce water infiltration and induce runoff. Construction work needs extensive amount of water and if ground water wells are to be used, extreme care should be taken to protect from seawater intrusion. Recycling of water to be promoted.
5	Solid waste and waste water management	• Lack of systems for solid waste and waste water management. • Potential to introduce recycling and waste management techniques that are self sustaining.	Introduce integrated waste management combined with conservation and energy generation techniques. Involve the vocational educational community to manage the systems. Transfer similar successful practices (eg: The Energy Research Institute (TERI), India) and encourage students to improve and develop new systems. Promote the established system in the community.
6	Monitoring and evaluation	• Variations to the ground and surface water status due to the project • Effectiveness of adopting the improved designs and best practices • Potential to involve community and students to disseminate the findings.	Decide on the potential parameters to be monitored depending on the interests of the stakeholders. Develop a participatory monitoring program that has a significant educational component. Develop mechanisms that are sustainable to disseminate the findings and the impacts of the best practices. The same system can be used to monitor the environmental impacts due to the project.

4. SUMMARY OF FINDINGS AND ENVIORNMENTAL DETERMINATIONS

Project Area	Threshold Determination	Remarks
Arugam Bay area infrastructure and area development • New bridge and access road • Arugam Bay and Pottuvil water supply and sanitation • Arugam Bay and vicinity participatory area development including coastal management	Positive determination for the first two actions and categorical exclusion for the last action	The construction activities require the conduct of an Environmental Assessment (EA) to assess the environmental impact and identify the steps to mitigate the impacts pursuant to CFR 216 regulations.
Rehabilitation and improved harbor and area environmental management of fishery harbors • Dondra (Puranawella) harbor • Hikkaduwa harbor • Mirissa harbor • Capacity building and improved environmental management	Positive determination for the first three actions and categorical exclusion for the last action	The harbor improvement activity requires the conduct of an Environmental Assessment (EA) to access the environmental impact and identify the steps to mitigate the impacts pursuant to CFR 216 regulations.
Rehabilitation and improvements to vocational and educational centers • Repair or relocate tsunami damaged facilities and provide equipment • Design and construction of two to three new state – of – the art vocational educational centers • Make modifications to curricula and providing equipment • Adoption of best environment and energy management practices	Positive determination for the first two actions and the categorical exclusion for the last two actions	Detailed site specific information for this activity is not available. However the type of activity indicates the need for an Environmental Assessment (EA), at least for selected sites. Some sites may not have a sufficient footprint or impacts to conduct an EA.

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