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Guyana: Preliminary Damage and Needs Assessment Following the Intense Flooding of January 2005

Executive Summary

Beginning in late December 2004, unusually heavy rainfall in Guyana resulted in severe flooding within the coastal administrative regions of West Demerara / Essequibo Islands, Demerara / Mahaica, and Mahaica / West Berbice. These areas comprise 75 percent of Guyana's population and include the capital city, Georgetown. Flooding was insidious in onset and resulted from saturation of upper watershed soils and the poor performance of the drainage systems distributed within the coastal irrigation districts. Serious flooding began on January 15 reaching its peak around January 17, corresponding with the January spring (lunar high) tide. Rains continued until the first week of February 2005, causing flood waters to reach a height of four to five feet in villages near the East Demerara conservancy. As of January 25, the Government of Guyana's Joint Operations Center (GOG/JOC) reported close to 200,000 residents directly affected by the floods.

At the time of this report, floodwaters were receding at a slow pace and damage to low lying infrastructure, agriculture production and livelihood were only just becoming apparent. Sanitary conditions and public health concerns are a major priority as flood waters have overwhelmed drinking and wastewater management systems. Livestock and other animals killed by rising waters coupled with flooding of latrines (outhouses) and septic systems have contributed to generally unsanitary conditions and contaminated floodwaters. Epidemic disease such as *Leptospirosis*, (also known as swineherd's disease, swamp fever, or mud fever) are present and is being tracked. The disease can be fatal and, to date, 16 persons are believed to have died from *Leptospirosis*. As waters recede, incidence of vector borne disease such as Dengue Fever is likely to increase. Contaminated waters are also likely to provide sources for Hepatitis outbreaks, particularly Hepatitis A.

The current floods have also brought to light the extreme urgency for rehabilitating protective drainage structures and strengthening of the Demerara conservancy dam system. This is of particular concern if one considers that the upcoming rainy season of June/July is typically heavier than the rain period occurring during December and January. The present assessment suggests that the main conservancy dam, retaining some 100 billion gallons of water, has suffered such stress from this last event that it is at serious risk of failure, should similar high water levels occur again. Protective drainage outlets have been neglected and are in need of immediate rehabilitation. Seawall outlets have also fallen into disrepair and require major work. Rehabilitation of protective drainage structures could extend the life of the conservancy dam allowing the time necessary to accomplish the needed dam rehabilitation works. Without intervention, the weakened dam structure continues to place some 450,000 regional inhabitants at risk from catastrophic flooding.

Acknowledgement

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Introduction

The damage survey team, consisting of Francis Ghesquiere (Team Leader); Marc Forni (Economist); and Gerald Meier (Environment Specialist); visited Guyana between January 29 and February 9, 2005. Lucia Hanmer, World Bank Resident Representative, Patricia Lopez (Water Sector Specialist) and Bill Peacock (technical expert, external consultant from Halcrow Ltd.) also contributed to the report. Team activities were coordinated with support from the staff of the Resident Mission.

Initial meetings were held with the Office of the President, United Nations, PAHO, Guyana Water Incorporated, Joint Operations Command (JOC), the Citizens Initiative and Donor Representatives. Field visits began on February 2, and an over-flight of the area was made February 3 with the JOC. Boat expeditions into the conservancy and drainage structures followed. The team also benefited from the assistance of staff of the Region 4 Conservancy Dam who provided the necessary logistics to inspect the Demerara Conservancy Dam and canal network.

A short briefing was provided to the Office of the president and to representative of the donors upon closing of the mission on February 9, 2005.

Scope of the Report

The objective of this report is to provide a preliminary assessment of the damage incurred with a special focus on reconstruction needs likely to emerge once the relief phase is over. Its aim is to provide donors with an initial assessment of possible intervention needs within six months to a year following the emergency created by the floods.

As such, the report does not address the need for emergency relief and is issued after the UN launched a flash appeal for immediate assistance needed for the relief operation currently ongoing. This appeal would cover urgent needs in Health; Education; Water and Sanitation; Food; Agriculture; Economic Recovery and Infrastructure; and Co-ordination and support services.

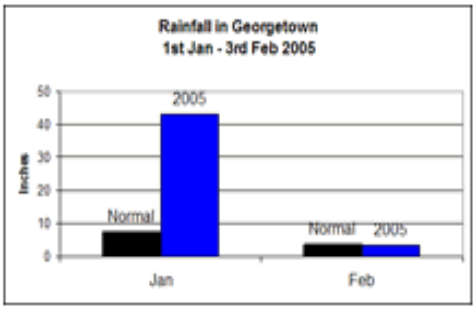
The report does not provide a cost estimate of damage incurred. An ECLAC Assessment Team is scheduled to arrive in Guyana on February 28, 2005 to carry out a detailed damage assessment. At the time of this report, ECLAC was conducting training in Guyana aimed at preparing personnel in the collection of relevant data for the compilation a comprehensive assessment report on the impacts of the flood.

Background

Guyana is situated in the northern Amazon Basin and experiences two rainy seasons annually. The strongest of these occurs between the months of June and July with the lesser rainy season occurring between December and January. This semi-annual rainy pattern provides the Guyanese with two planting seasons, allowing for two annual harvests of two of their key export crops, sugar cane and rice. Combined, these crops are responsible for approximately 27 percent of the nation's GDP. In an increasingly competitive international market, Guyana maintains a firm market position in cane and rice due to these annual weather cycles, particularly in relation to its regional competitors who lack such favorable climate conditions.

Of the 750,000 citizens inhabiting Guyana, over 500,000 live near or below sea-level in a 25 kilometer wide band along the coast. To compensate for high levels of rainfall and the low elevation of the populated regions, the colonial powers (England and Holland) developed an intricate drainage system requiring constant care and maintenance. Over the past three decades, this network of dams, canals and sluices has fallen into disrepair, straining the system during heavy rain periods.

Guyana has been experiencing higher than usual rainfall. Over the six week period from December 24, 2004 to February 3, 2005, 60.6 inches of rain fell. Under normal conditions the average rainfall in the month of January totals 7.3 inches, a mere 12 percent of what actually fell. The 53.3 inches of additional rain created the flood conditions leading to the present disaster. The timing of the rains, which coincided with the lunar high tide, further contributed to the development of the disaster.



When 25 inches of torrential rains fell between January 14 and 18, the saturated drainage system was unable to properly purge the water. As a result, the East Demerara Conservancy Dam, Crown Dam, and canals making up the irrigation network became overwhelmed and water overtopped the barriers. Overtopping of the dam, coupled with the lack local drainage, caused the flooding of inhabited areas (nearly 200,000 persons affected) and farmlands between the capital Georgetown and the Mahaica River. As waters rose some 50 inches above normal level in some areas, power and drinking water systems become inoperable. Latrines were flooded and crops and livestock were inundated. In many cases people who were unable to wade through the flood-waters and remained trapped on their second-story floors. While the water level was receding at the time of this report, most flooded areas were still affected.

Organization of the response

In response to the flood, the President of Guyana set up five task forces. These included Health, Infrastructure Rehabilitation, Management of Shelter Support, Food Security, and Potable Water Delivery. A government minister headed each task force and members of the largest opposition party, the PNC-R were invited to nominate members to the various task forces. Task force activities were coordinated directly through the Office of the President.

Initially a Joint Operations Command (JOC) was also created and placed under the command of Colonel J. Lewis, Guyana Defense Force (GDF). The JOC consolidated and managed activities for the GDF, police, coast guard, fire and related agencies, while working as the initial disaster management organization for the flood emergency. The Government then reconstituted the Civil Defense Commission (CDC), which was placed under the leadership of Colonel J. Ramsaroop. As the CDC was activated, the JOC began the transfer of emergency management responsibilities to the CDC. At this writing, the JOC has transferred all operational responsibilities to the CDC, which is now in charge of managing the disaster response.

JOC/CDC have held daily coordination and briefing meetings. The briefings covered weather, infrastructure (the state of the conservancy dams and maintenance carried out), shelter status, food supplies, potable water distribution, as well as health and security issues. All donor agencies and a representative of the Citizen's Initiative were invited to attend.

In a response to a request from GoG, a United Nations Disaster Assessment and Coordination Team arrived in Guyana on January 23rd, 2005. This team remained in country to assist the government with co-ordination of the relief effort until February 7th, 2005. On February 8, the UN launched a flash appeal for approximately US$ 3 million to cover basic assistance in Health, Education, Water and Sanitation, Food, Agriculture, Economic Recovery and Infrastructure, and Co-ordination and support services. Organizational contributions, by sector are presented in table 1.

Table 1 - Flash Appeal, February 8, 2005

Agencies	Sector	Amount /USD
PAHO, UNICEF, UNFPA	Health	$480,000
UNICEF	Education	$350,000
PAHO UNICEF	Water and Sanitation	$325,000
WFP	Food	$400,000
UNDP	Agriculture	$250,000
UNDP	Economic Recovery and Infrastructure	$150,000
UNDP	Co-ordination and support services	$150,000

An ECLAC Assessment Team is scheduled to arrive in Guyana on February 28, 2005 to carry out a detailed damage assessment. At the time of this report, ECLAC had already conducted training in Guyana to develop local capacity for the collection of damage assessment data in preparation for the compilation of a comprehensive damage assessment report on the impacts of the floods to be issued in mid March.

Sector Assessment and Needs

Drainage

Background

The Guyana coast comprises the river delta regions of the principal rivers of Guyana including the Berbice, Mahaica, Demerara and Essequibo rivers. The proximity of the rivers and the volume of sediment deposited annually has created a low coast, often below sea level, which is constantly expanding northward due to the deposition of riverine sediments. The rich fertile lands of the delta region, compared with the thin soils of the tropical jungle to the south, presented a strong incentive for the colonial powers to settle the coastal region and invest in drainage works to access its agricultural potential. With savannah water, rich in organics, contained in a conservancy system, a network of drainage canals for both conservancy maintenance and agricultural irrigation was constructed leading to the present intricate system of dams and canals. Human habitation grew around the agricultural lands and associated transportation centers concentrating much of the development in a 25 Km band along the Guyanese coast. The lack of the malaria mosquito *Anopheles sp* vector, added to the appeal of coastal living.

As designed, the water management system was completely gravity dependent. It allows water to pass from the conservancy to outlets along the sea and bounding rivers and water can only drain during the low tide period. Due to the low and sometimes below sea level elevations of the protected areas, drainage is highly dependent on the tidal state to create the gravity gradient necessary to assure proper water flow.

<u>Tidal Movement</u>

Guyana has a semi-diurnal tide (4 tides a day), which represents a fluctuation of 9.5 feet between Mean Low Water and Mean High Water. In terms of Mean Sea Level (MSL), this represents elevations of –4.75 feet below MSL and +4.75 feet above MSL. Lowlands between the conservancy dam and the coast lie at between –5 and 5 feet MSL, with the majority of populated and cultivated lands lie between +1 and +3 feet above Mean Sea Level. As a result, during high tide, many coastal areas are still approximately 1 foot below sea water levels.

Exacerbating this situation is the spring or lunar maximum tide cycle. This is the monthly tidal maximum changing with the gravity associated with the phases of the moon. Also affecting tide is a seasonal variation resulting from a shift to northerly winds. This increases the mean high tide by driving water in from the north pushing water up river along the coast. A combination of lunar high tide, coupled with wind effect, creates a maximum high tide that may greatly exceed the average tide. This occurred in mid January during the present flood situation

The tidal effects operate in two ways: (i) high tide events back up water river systems to the point where water control structures cannot effectively release impounded fresh water; and (ii) due to the porosity of the soil, the high tide actually raises ground water levels, resulting in a backup of fresh water behind sea wall structures. The net effect is that the system only has a window of four to six hours daily, depending on lunar cycle, to drain during the available low tide period.

Dam Structure

There are two water conservancies, divided by the Demerara River. The Region 4 Conservancy lies on the eastern side, while the Region 3 Conservancy borders the western side of the river. The combined water storage capacity of the two conservancies is approximately 250 square miles by roughly 12 feet deep.

The East Demerara Conservancy Dam, located in Region 4, lies between the Demerara and Mahaica rivers. The total capacity of the conservancy is estimated at roughly 100 billion gallons and was originally built by Dutch colonists using slave labor in 1818. Drainage from the dam flows north into the coastal lowlands; along the coast from the village of Mahaicony to Georgetown. Drainage also passes into either the Demerara River on the west side of the conservancy or the Mahaica river along the eastern side of the conservancy.

The Crown dam is located at a distance of between 0.5 and 3.0 kilometers in front of the conservancy dam and serves to provide irrigation water to the agricultural sector. While the dam in generally regarded as failsafe system in the event of a breach in the conservancy dam, coverage is not continuous and there are numerous breaches in the Crown dam to promote local irrigation. The Crown dam is not likely to provide any significant margin of safety in the event of a Conservancy dam breach and was not originally designed to serve that purpose.

Drainage and efficiencies

There are two basic drainage systems operating together that make up the system of dykes and polders along the Guyanan coast. The two drainage types are irrigation and system management. Irrigation drains serve only to water agricultural fields during dry periods, while the management drainage system serves to protect the conservancy by providing water relief conduits during high water periods.

The drainage system designed in the early to mid nineteenth century is gravity based. Over the past several decades, the system has fallen into disrepair due to neglect. Causes of the general deterioration of the system are many and the result has been an increased vulnerability to flooding of inhabited areas north of the Conservancy and Crown dams. Contributing factors include poor maintenance, damaged water control structures, back-filling of canals, uncontrolled development and filling, and backfilling of the conservancy water storage areas due to sedimentation and accumulation of vegetation. These activities have changed the water management

regime. Moreover, illegal interventions in the Crown dam by farmers to secure irrigation water for their personal use has weakened this structure and diminished its effectiveness both as a source of irrigation water and as a safety feature of the Conservancy dam system.

In Region 4, the conservancy dam has four operational water control structures which allow for the management of water levels behind the Conservancy dam. Three of these structures release water to the Mahaica River and one releases water to the Demerara River to the east. Other canals exist but have fallen into disrepair and cannot be used. These include the Shanks and Nebaccarus canals that release to the sea and the Cuna, Coffee, and Diamond canals that release to the Demerara River.

Conservancy Water Management Issues

At the present time, water management in the conservancy area is handled through the use of the Mahaica River and the Demerara River on the east and west side of the conservancy respectively. The difficulty is that when structures draining to the Mahaica River are opened, the towns along the Mahaica river are usually flooded. Originally, these water control structures were designed to take water from the Mahaica River to replenish the conservancy during low water periods rather than relieve high water along the Conservancy dam. This leaves the single water control structure at the town of Land of Canaan which drains to the Demerara River. Known as 5 Gates, this water control structure is approximately 15 meters wide and the only operational structure on the western side of the conservancy.

Poor maintenance of the remaining key drainage canals from the conservancy have limited the ability to manage conservancy water levels. While the system was designed to use at least 6 drainage canals to eliminate water from the conservancy into the ocean, currently only 4 discharges (one into the Demerara and three into the Mahaica) are operational. This leaves no flexibility for the management of conservancy water levels and has contributed greatly to the inability to successfully relieve pressure on the conservancy dam during this latest emergency.

Evidence of past stresses on the conservancy dam is seen in the general profile of the dam. The inability to effectively manage conservancy water levels during high water emergencies has contributed to a weakening of the dam structure in several locations as evidenced by the undulating ribbon like appearance, known as creep, of the dam in repaired locations.

Relative to the function of the dam, water levels in the conservancy are measured in terms of feet above GD. GD is the Guyanan horizontal datum which corresponds to the elevation at the base of the light house in Georgetown. This is 1.8 feet above Mean Sea Level. Conservancy dam management calls for the following parameters; the water level must be maintained above 50 feet GD to avoid decomposition of the

dam but should not go higher than 57 feet. The nominal elevation of the dam is 60 GD or 61.8 feet MSL.

Structural attributes

Dam construction is generally of clay/sand mixtures. Where repairs have been made made, or where the dam has been fortified to prevent overtopping, a local material referred to as pegas has bee used as well. Pegas is a vegetation rich mix of organic muds and clays from the conservancy bottom, which is porous and highly vulnerable to oxidation when exposed to the air. When exposed to air, pegas has been known to spontaneously ignite from energy released by its rapid oxidation in air.

Local dam stabilization techniques include the promotion of tree growth, which is believed to inhibit structural erosion. However, root penetration into deep dam structures has had the effect of weakening the system. It is also highly likely that the accumulation of sediments and plant debris has changed the fundamental characteristics of the conservancy by raising the elevation of the conservancy bottom, resulting in higher peak water levels with respect to the conservancy dam.

Safety and Improvements

The torrential rains experienced during the past month resulted in major stresses to an already damaged structure. This is the third time heavy pressure has been exerted onto the structure in the past 20 or so years. While the dam structures have luckily held up to this point with no breaches, the general stressed condition of the Region 4 Conservancy Dam structure suggest that without major attention to rehabilitation, the structure will ultimately fail. The slow drainage rate, caused by the lack of open canals has saturated the entire system and overtopping has historically occurred. To protect the dam from collapse and to halt overtopping, immediate repairs must be realized to open inoperable drainage canals.

The improved capacity to manage water levels through an enhanced drainage system will prolong the serviceability of the current structure and will probably help to provide sufficient service life in order to complete the necessary structural improvements to the dam. Conservative estimates indicate these improvements should be completed over the coming 5 to 7 years.

Current Status

Repairs to drainage systems have already begun but are limited in scope and budget. Most of the drainage improvements are directed at draining flooded communities rather than the longer-term problem of the survival of the Conservancy dam.

Sector Needs

Study to map drainage flows

Before serious material interventions can be realized to repair the depleted drainage system, a flow study would need to be completed. By studying the drainage capacity of primary as well as secondary canals based on water flows, width and depth, an engineer would be able to target specific canals that would be effective in purging excess water. The study could be expanded to include tertiary drainage canals to promote more effective system management within the communities.

Reducing water pressure through improved Drainage management (medium and long-term)

Rehabilitate Main drainage canals (short and medium-term) - The estimated cost to rehabilitate the old canals by dredging and reinforcing embankments is approximately US$25,000 per canal mile. At this writing an estimated 30- 40 miles of canals could be worked on quickly at a cost of approximately US$750,000 – US$1 million. This figure will become more precise as more accurate maps are completed and field data are analyzed.

Develop contingency and emergency management plans (monitoring, interventions on the dam, Disaster Management Plan and Evacuation plan).

Together with the needed engineering interventions, the present disaster clearly points to the need for capacity building and emergency response planning. Clear objectives concerning the management of conservancy water levels, action thresholds, disaster management plans and evacuation guidelines need to be developed. As the condition of the dam is known and threshold water levels can be pre-determined based on the drainage regime and dam condition, action plans must be developed and exercised to avert a possible disaster. Together with improvements to drainage and physical structure, this will assist in averting civilian losses in the event of a structural failure prior to the completion of the required structural improvements to the system.

Structural strengthening of the main dam

It is unlikely that the Conservancy Dam would be able to sustain another crisis. While there are no precise assessment at this writing, the dam has been significantly weakened. The treatment of the entire 60 km structure is likely to exceed the Government capacity as preliminary estimates range between US$200 and US$350 million to reconstruct a new dam. From a pragmatic standpoint, studies could be commissioned to find alternative, lower cost measures which could prove equally effective.

Possible Donor Intervention

With an overall portfolio totaling US$180 million, the Inter-American Development Bank (IDB) is the major donor in the country. -. The IDB has identified $16.7M from its existing portfolio which could be made available to fund flood reconstruction work in different sectors. The European Union has about Euro 20 million earmarked for strengthening of the sea defenses in the 9th European Development Fund; these funds would not be available for about 2 years. The United States has $3M available under the PL480 program for Sea Defense Drainage and Irrigation which could be used for work that may be required in the aftermath of the flood.

The primary recommendation for donor intervention would be first to complete a flow study. At the same time, opening and refurbishing the principal (4) blocked drainage canals. Doing so will relieve the pressure currently on the system by allowing for more timely and effective water management. Upon completion of this first phase, a well targeted and creative intervention would help prolonging the life of the dam structure allowing breathing space to realize the necessary major repairs.

Drinking Water

Background

Guyana Water Inc. (GWI) is the utility company responsible for water supply and sewerage services nationwide[1]. The majority of the Guyana's water is derived from deep water aquifers, however, Georgetown receives about 40% of its water supply from the Conservancy reservoir. In its present state, the water system suffers from severe leakage, 80 percent of which is due to poor service connections and 20 percent to bandit links. The system suffers from a lack of quality and standardization, and as a result, GWI has made replacing these connections their key priority.

The January flooding along the coast, between the Demerara and Mahaica rivers, has seriously inhibited GWI's ability to supply potable water (approximately 164,000 people affected) and to dispose of sewage in the affected areas. The principal water treatment plant in Georgetown, is operational. Yet the plant is not run at full efficiency because two key processes are missing relating to sediment removal; flocculation and sedimentation.

Current Status

The impact of the flood water has been minimized thanks to the efficient response of GWI. Emergency arrangements to provide drinking water to the affected population have been well managed and effective. In coordination with the military, drinking

[1] GWI is currently run by Severn Trent Water International under a management contract.

water in bags has been effectively distributed to affected areas including those only accessible by boat. Tanks with safe water have been set up in places accessible by road and GWI teams have been dispatched to the affected areas to monitor the distribution of water and to assist the community. Oxfam UK contributed to the financing of bottles and bags of drinking water, and has committed to maintain its support until the situation returns to normal.

The flood situation has caused some damage to the water distribution infrastructure in the affected areas on the East Coast, in particular to service connections, of which hundreds are in need of replacement. The floods have also damaged the sewage pumping stations that are required to enable GWI to provide sewage disposal service to 35,000 customers in Georgetown. At present 15 of the 24 sewage stations are in operation. However, it should be noted that immediately following the main flooding event, only one of the 24 stations remained operational and emergency repairs using spare parts from stores have been undertaken to rectify this situation.

The flooding has exposed GWI's vulnerabilities to respond to emergency situations. Although in this occasion GWI's response has been effective and well managed, they have had to rely upon the borrowing of tanks and equipment from other public entities and the private sector.

Sector Needs

Some of the water treatment plants, pumping stations (water and sewage), and distribution systems have been damaged and are in need of rehabilitation to recover to normal operation status. There is also a need to strengthen GWI's capacity to respond if the agency is to be as effective in future emergency events. Preliminary needs assessment prepared totals US$ 546,000. A detailed assessment of needs is provided in Appendix 2.

Health

Current Status

While damaged, the existing health network appears largely intact. Eighteen health centers and clinics (at this count) have been physically damaged by flood waters. Repairs include walls and floors and replacement of lost equipment. Damage is primarily to floors and walls of clinic buildings. Lost equipment includes beds, stretchers, diagnostic tools and similar items. While significant, these losses are not of a catastrophic nature.

With the exception of Georgetown, there is little community based management of sanitary waste. Latrines and septic systems are common and in the flood affected areas have been completely overwhelmed. This has resulted in a generally unsanitary condition. As waters recede, bacterial and chemical contaminant

concentrations are likely to rise due to the concentration of waste in reduced volumes of stagnant water.

Fungal infection, in particular skin rashes caused by ringworm are common, probably resulting from increased contaminant exposure and nutritional deficiencies. While diarrheal disease, leptospriosis, and hepatitis are of the greatest concerns, vector born diseases (mosquito) particularly dengue, are also being monitored.

Vulnerable segments of the population are likely to be unusually affected. Children under 5 are particularly susceptible to the affects of diarrheal disease, which in that age group is life threatening. Immuno depressed persons (HIV) are more likely to suffer higher rates of infection, which can also be life threatening. Elderly and pregnant women are also likely to be disproportionately affected.

Sector Needs

The 18 health centers are in need of minor rehabilitation works such as the replacement of floors, tiles and damaged walls. Equipment loss was kept at a minimum since medical employees had sufficient time in most cases to protect vulnerable supplies.

The current fear is an outbreak of leptospirosis (16 deaths at the time of this writing) and many agencies including PAHO, OCHA, the Red Cross and other health focused international aid groups are responding with vigilance to bring in the necessary medication.

When water levels recede and contamination levels increase, vector borne diseases will become high risk. To mitigate these risks, 30,000 mosquito nets have been brought into the country, although a need exists to import an additional 150,000.

Possible Donor Intervention

The Pan American Health Organization (PAHO) has taken the lead in the health sector and is working closely with the government to develop a comprehensive short term recovery project, primarily focused on monitoring water quality, executing a public awareness campaign and preparing to respond to possible epidemics. Donor intervention could help address the minor rehabilitation works of the affected health centers and medication needs. The current situation has also demonstrated the need for improved emergency response capacity in the public health system. This would include replenishing emergency supplies, rehabilitating hospital wards to increase capacity and the development of contingency planning in the case of disasters.

Solid Waste

Background

While not unexpected, the accumulation of trash and organic waste is likely to compound the declining sanitation situation. Waste includes floating plastic material, animal carcasses and other refuse, which has been distributed over a wide area by flood waters. The privatized waste collection company and the government have stepped up efforts to remove refuse.

Current Status

Georgetown's waste disposal site, the Mandela Avenue Landfill, is already above capacity. Since the beginning of the floods, the site has had to accommodate an enormous increase of waste due to the floods in Georgetown. Compounding the issue, the landfill is now having to take in additional waste from areas typically outside of its usual mandate.

Possible Donor Intervention

In 2004, the IDB approved a US$9.5 million Georgetown Solid Waste Project aimed at relieving the stress on the Mandela Avenue Landfill by opening a new sanitary landfill at Eccles, close the Mandela Landfill. The events of the last two months have increased the visibility and importance of this project to maintain sanitary conditions in the Georgetown area.

Agriculture

Farm to Market

Much of Guyana's food supply is produced locally by small farmers who sell their goods at open markets and approximately 40 percent of all farm to market produce is grown in the flood affected region. Most has been destroyed. Root crops have been completely lost where waters covered the fields and fruits and other vegetables are at risk.

Subsistence farmers will be disproportionately affected as these crops represent their primary food source. Because much to the local produce represents either primary or supplemental farm income, many of the affected farmers will see serious reductions in cash flow over the coming months. This will not only affect the near term quality of life but hamper the recovery of other flood damaged assets.

Livestock

Indications are that the livestock has been severely affected, with the poultry population suffering losses of over 80% losses in some areas. There is also a risk that much of the livestock will be lost within the next months as alternative sources

of food have been lost. In many post flood situations, livestock that survive are often placed on the market or killed for consumption, depleting the ability to rebuild reduced herds. While no indications of livestock disease (hoof and mouth and screwworm) have surfaced, the emergence of such diseases would also be devastating.

Main Export Crops – Sugar, Rice and Shrimp

Guyana's economy remains heavily dependant on agricultural production, which accounts for over a third of the country's GDP. Unlike many countries in the region, Guyana has managed to remain competitive in both sugar and rice production thanks to its intricate system of irrigation and drainage that allows two planting seasons per year. Sugar alone accounts for 20 percent of the country's GDP, 25 percent of foreign exchange earnings, and directly or indirectly affects the livelihoods of over 10 percent of the population. Rice represents approximately 7 percent of Guyana's GDP, contributing 9 percent of export revenues. A third sub-sector, shrimp and fish production, constitutes approximately 8 percent of the country's GDP and 11 percent of the foreign exchange earnings.

While the production of sugar and rice is likely to be affected by the flooding, it is hard at this time to assess the extent of the loss as much will depend on whether or not produces can be harvested on time (the next harvest for both crops is scheduled to start in a few weeks). While sugar and rice are likely to suffer some losses, shrimp is likely to benefit due to the increased food supply resulting from the flood waters.

GUYSUCO, the national sugar company has indicated that it would start this year's cutting season in the coming days. Roughly 25 percent of the cane to be harvested has been affected by the flooding. While this portion of the crop has not been physically swept away and production facilities have not been damaged, it is expected that the sugar content of the cane will be lower than usual. High water levels late in the development of the cane causes sugar levels to decrease thus affecting the overall value of the harvest..

The present rice crop is reaching maturity and depending on the rate of flood recession, may suffer significant damage. Some 80 percent of rice is produced in the lesser affected Region 5, which lies to the east of the heavily affected lands, yet still remains under water in many areas. While water is now receding in most areas, the extent of the loss will depend on whether farmers can access their field on time for the harvest.

Possible Donor Intervention

FAO, IICA and IDB have historically been active in the agriculture sector. Depending on the severity of the damage to the rice crop and local farm to market production, a program of seed (and possibly livestock) distribution may prove

necessary to help farmers recover. While not heavily publicized, the livelihoods of those in the farm to market sub-sector will need important short term assistance to help recovery from the effects of the flooding. Should the rice not be available for harvest and sugar levels of the cane be low, export revenue will be limited, which would directly effect the tax revenue the government has available for the short and medium term recovery effort.. If any outbreak in livestock disease presents itself, the country will likely require assistance in reestablishing livestock production, particularly in poultry and cattle.

Education

Background

The education system in Guyana provides comprehensive access to school. Nursery education is offered to 85 percent of children in some 412 centers. About 105,000 students attend 431 public primary schools, representing a net enrollment of 95%. Secondary education is offered in 69 General Secondary Schools (GSS), 35 community high schools, and 310 secondary departments of primary "all age" schools and is attended by roughly 60 percent of Guyana's eligible students.

Current Status

Damage to school infrastructure immediately imputable to the floods is likely to be limited, requiring thorough clean-up with in some cases repairs to floors and doors. However, the poor condition of many buildings will have been exacerbated by the floods and it may be appropriate at this stage to reassess the state of the schools to target buildings in need to replacement. Books, supplies and furniture on the first floors of affected schools have been damaged by the waters and will need to be replaced.

Table 2 presents an estimate of the total number of schools and children affected by the floods.

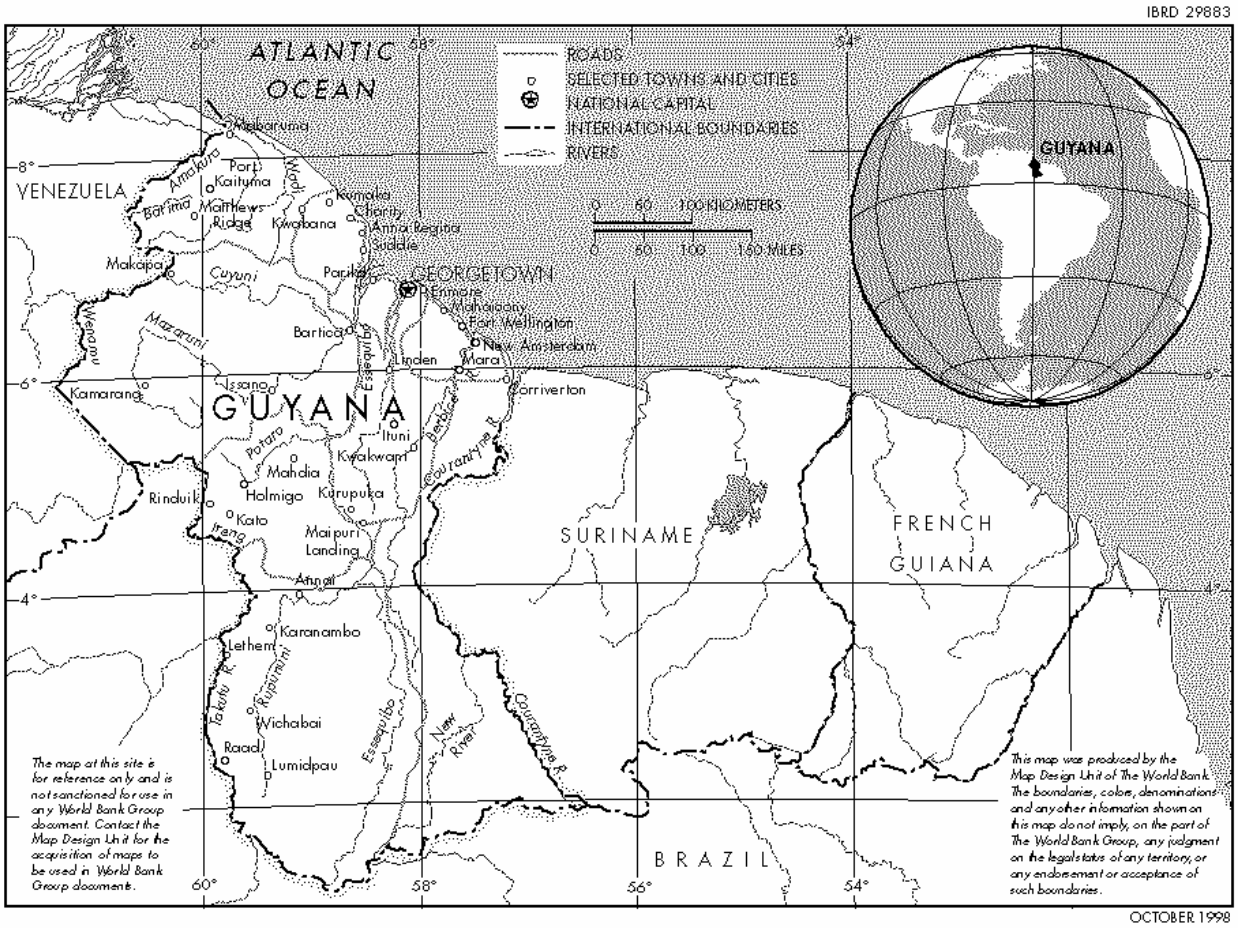
Table 2 - Schools and Children Affected by the floods by Education Region/District and School Level

Education District/Region	Schools Levels and children						Total	
	Nursery		Primary		Secondary			
	Schs.	Child	Schs.	Child	Schs	Child	Schs.	Child
Region 3	21	2,293	35	13,725	16	6,592	63	22,610
Georgetown	37	5,907	32	21,843	39	18,735	108	46,485
Region 4	48	3,858	32	4,881	10	5,340	90	14,079
TOTAL	106	12,058	99	40,449	65	30,667	261	83,174

Possible Donor Intervention

UNICEF is assisting the government to carry out cleaning and sanitizing operations. The UN Flash appeal is requesting $350,000 for rehabilitation and creation of a safe learning environment for children and adolescents in flood effected areas. It is likely the needs will increase as a full assessment of all supplies and materials lost to the floods have been taken.

Appendix 1 – Map of Guyana



Appendix 2 – Detailed Needs Assessment for the Water Sector

The information below is extracted from a detailed needs assessment prepared by GWI in collaboration with the World Bank Water Sector Team present in Guyana at the time of this report. The report provides cost estimates for rehabilitation of water treatment plants, pumping stations (water and sewage), and distribution systems that have been damaged by the floods. The report also underlines the need to strengthen GWI's capacity to respond if the agency is to be as effective in future emergency events. Preliminary needs assessment prepared totals US$ 546,000. The table below summarizes these cost estimates. More details on the investment needed is provided in the sections that follows.

Description of Works	Amount - $G	Amount US$
1. Treatment Plants	20,614,180	103,071
2. Pumping stations	1,735,000	8,675
3. Spare parts	41,057,440	205,287
4. Establishment of Emergency Response Capacibility	31,000,000	155,000
5. Provisional sum for cost of airfreight	5,513,950	27,570
6. Overall price contingency (10%)	9,440,662	47,203
Grand Total	**109,361,232**	**546,806**

Treatment Plants

All of the affected treatment plants, with the exception of Friendship, are back in operation, but three are still in need of repair work as a result of the floods. These are described below:

- *Friendship Water Treatment Plant:* Status – Out of Operation

  This treatment plant is located at Friendship on the East Coast of Demerara approximately 16 km east of Georgetown and less than 200 m from the Atlantic Ocean. The villages of Annandale, Buxton, Friendship, Strathspey and Vigilance with a total population of 14,000 are served from this source. An assessment of the current situation revealed that the main power company (GPL) transformer, the booster pumps, the control room, the chlorine room and the wellhead are all submersed in approximately one metre of flood waters.

- *Better Hope Water Treatment Plant:* Status – Operating at a reduce capacity

  The Better Hope treatment plant, which was recently rehabilitated, also suffered from the recent floods. This plant is situated approximately 6 km east of Georgetown and serves approximately 10,000 customers residing the communities of Vryheid Lust, Better Hope, Atlantic Gardens, Ogle, Courida Park and Plaisance. A recent assessment of the Treatment Plant revealed that flood waters had damaged the soft starter and contactor of the change over switch.

- *Covent Garden Water Treatment:* Status–Operating at a reduced capacity

  The Covent Garden treatment plant, which was recently rehabilitated, has also suffered flood damage. This plant is situated approximately 6 km south east of Georgetown and serves approximately 11,000 customers residing the communities of Mocha Herstelling, Covent Garden, Little Diamond and Prospect. A recent assessment of the treatment plant revealed that heavy rains coupled with the floods water damaged the soft starter for the well pump.

Pumping Stations

The water supply systems in the flood affected areas in the East Coast of the Demerara River include a total of 19 water source works (pumping stations) of which not all involve treatment. Four of the pumping stations within the affected systems along the East Coast are in need of repair. The assessed cost of rehabilitation needs totals around US$ 8,500.

Spare Parts

The need to respond to the emergency situation has drawn down GWI's inventory of spare parts to a critical level. Should there be a need for spare parts due to failing equipment, there would be no replacement available to keep the systems operational. Rehabilitation needs include obtaining additional submersible borehole pumpsets, pipes, valves, temporary standpipes and materials for service connections.

Emergency Response Equipment

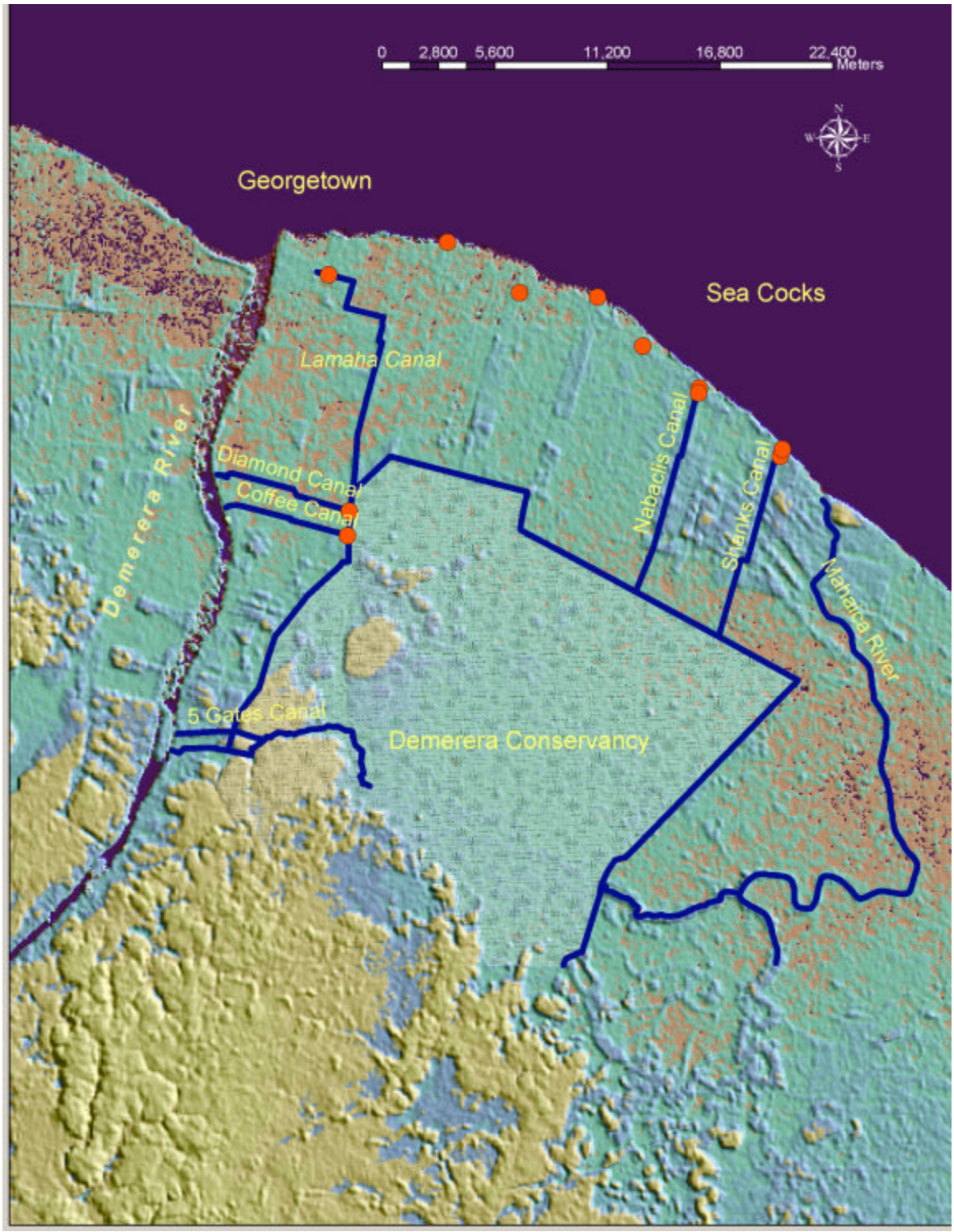
In order to be able to better respond to emergency situations in the future, GWI would need to establish in-house emergency response capability. The main two needs are as follows:

- *Mobile chlorination units:* It is crucial to address water quality deterioration and GWI has targeted mobile chlorination units as their top priority. In fact, this equipment is not only needed in this and other cases of emergency, but can also be used in everyday operations to respond to incidents of

contamination being identified in the distribution systems, by enabling the disinfection of water directly into the mains. Whilst GWI is able to establish most of this requirement locally, they would need to import the dosing pumps – which are unavailable in Guyana - and procure tanks and pipework locally. They estimate their needs to be 10 mobile chlorination stations and the equipment for this would total approximately US$ 20,000 to be fully operational within three months.

- *Water bowsers:* There is a need to procure 2 water bowsers for temporary supply of safe water to areas where the distribution systems may be out of service. These have been included in the needs assessment (approx. US$ 135,000).

Appendix 3 - Principle Drainage Canals in the East Demerara Conservancy



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