THE IMPACT OF
THE MONTSERRAT VOLCANIC ERUPTION
ON WATER AND SANITATION

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THE IMPACT OF THE MONTSERRAT VOLCANIC ERUPTION
ON WATER AND SANITATION 1995 . 1997,
AND LESSONS LEARNED

ABSTRACT

The eruption of the Soufriere Hills volcano in 1995 on the 39 square mile island of Montserrat, with 10,000 inhabitants, caused major disruption to a country that had made great strides in its social, economic and health infrastructure. The situation overwhelmed the authorities:

(a) the volcanic activity impacted its only town, urban areas, and industrial areas;

(b) this new phenomenon found the authorities without a disaster plan to deal with such an emergency

(c) lack of experience to deal with a volcanic threat of such magnitude in the region was minimal or non-existent, which further compounded the problem.

Within a two-year period, two-thirds of the population were relocated and settled in 14 square miles of land at the north of Montserrat, seriously affecting water and sanitation services.

With a newly-formed Emergency Operations Centre, plans were developed using local and external expertise to respond to a crisis that was swirling out of control. Within a two-year period, rehabilitation and reconstruction efforts restored potable water coverage to 99% of the population, with minor disruptions. At least five new types of sewage disposal technologies were introduced.

After a two-year period, water and sanitation were improved sufficiently to provide relief to the people.
INTRODUCTION

Prior to July 1995, the island of Montserrat, located in the Northern Leeward Islands, had achieved significant growth in its economic, social and health sectors. This level of growth heightened the quality of life and health status of the indigenous population and visitors alike.

Water and sanitation were priority areas for Government at that time, and were recognized as integral parts of the development process, vital for ensuring the maintenance of the health and well-being of the population.

The eruption of the Soufriere Hills Volcano in July 1995 suddenly created a climate of chaos and uncertainty for the previously viable, well-organised and health-oriented society of Montserrat, and re-ordered its major goal into one of survival.

The capital of Plymouth and its surrounding areas, the center of activity for Government and the private sector, were destroyed by pyroclastic flows. As a result of volcanic activity, two-thirds of the population had been relocated to the northern safe zone of the island, an area of around 14.5 square miles. Lack of adequate infrastructure and services hindered rapid settlement of the population and a return to normalcy. This resulted in major environmental and health problems, which challenged the resilience and creativity of the populace.

This major disaster of unprecedented magnitude in the Caribbean region, initially overwhelmed the authorities and brought about panic and fear to the population. There
existed at the time no volcano disaster preparedness or management plans.

To cope with the large number of displaced residents, most of the schools and church buildings were turned into emergency shelters. There was considerable overcrowding in the early period of the emergency, increasing the health risks. During the time under review, the number of persons in shelters was as high as 1,400. However, environmental health measures were put in place to improve and manage liquid waste facilities and

1 A pyroclastic flow is a ground-hugging avalanche of hot ash, pumice, rock fragments, and volcanic gas that rushes down the side of a volcano as fast as 100 km/hour or more, destroying everything in its path. The temperature within a pyroclastic flow may be greater than 500° C, sufficient to burn and carbonize wood. Once deposited, the ash, pumice, and rock fragments may deform (flatten) and weld together because of the intense heat and the weight of the overlying material.

4 disposal, provide adequate potable water, ensure food safety, and monitor communicable disease outbreaks.

Within two years of the start of volcanic activity, water and sanitation services were restored to levels that allowed the population to return to a life of normalcy, and an improved state of health and well-being.

**POTABLE WATER**

Prior to 1995, approximately 85% of domestic water supply came from springs, and 15% from wells. Approximately 50% of springs and all wells were lost in the area impacted by volcanic activity, including some reservoirs and distribution lines. This created intermittent water shortages for most communities. A number of strategies were employed to relieve the population of the burden experienced at that time.

Large containers were procured and installed at strategic locations, including the temporary hospital and theatre, district health clinics, and shelters (these included schools, churches and camp sites). Water was supplied to containers by direct connections or by the water truck.
The health authorities noted an increase in gastro-intestinal illnesses with children and elderly worse affected. There was no confirmation that these were caused by the water supply. The bi-weekly water reports showed that the bacteriological, chemical and physical parameters tested were in compliance with World Health Organisation guidelines. The local health authorities in collaboration with the Water Authority further promoted safety measures, including methods of disinfecting water for drinking purposes.

It was also the consensus at that time that illnesses may have been attributed to a multiplicity of conditions that existed at the time: poor personal hygiene, inadequate sewage disposal and poor housekeeping and insufficient water for household and individual use.

Other health-related challenges arose as a result of the practice of storing water, often in poorly covered containers. There was a significant increase in the mosquito population, and in particular, *Aedes aegypti*, the mosquito which carries the dengue fever virus.

A multi-sectoral approach was taken to address the water problem resulting in a number of activities. A water development project was undertaken, with the main objectives to:

- increase yields at the springs;
- protect springs;
- increase storage capacity of potable water;
- increase coverage to new development sites, particularly those being developed for residential housing.

In addition, a programme to replace old water mains was initiated and new main lines were laid to service newly developed areas. Major work was undertaken on the catchment area of springs, in an effort to harness all available water produced at the
springs. Two new reservoirs were constructed. Laboratory facilities were re-established to perform basic bacteriological, chemical and physical analyses of water.

To safeguard the quality of water at the springs, the Forestry, Wildlife and Protected Areas Act was passed. This act restricted activity in the area of the springs, protecting the watershed areas, and in so doing, maintaining the quality of the water supply at the source.

**SEWAGE DISPOSAL**

Traditionally, waste water disposal took place via on-site systems. Around 75% of households used septic tanks with soakways, and 13% used pit latrines.

The mass relocation of the population to the northern safe zone created major sewage disposal challenges for the Ministries responsible for Health and Housing. A large percentage of sewage disposal systems at residential households and all emergency shelters malfunctioned, because the designed capacities could not cope with the large volumes of waste generated by the increased levels of occupancy. For example, two-bedroomed houses, designed to accommodate a maximum of four adults were, in most cases, now housing anywhere from six to fifteen persons! Soak pits backed up with alarming regularity, flooding buildings, entire premises, and even streets. Inadequate drainage of waste water from kitchens and washing facilities only exacerbated the problem.

To reduce the potential public health risks, five new methods of waste disposal were introduced:

- sewage treatment plants were installed at two major housing projects;
- holding tanks were located at small housing/business locations;
- portable toilets were placed close to areas of high public activity;
- sub-surface sewage disposal systems were constructed at the temporary hospital site (tile fields);
pit holes were dug for the final disposal of sewage.

Expert advice was sought from external agencies with expertise in sanitation methods, including the Caribbean Environmental Health Institute.

6 Apart from safely disposing waste water generated on site, a strategy to provide housing for displaced residents eased the burden placed on the disposal systems and allowed the soak pits to recover.

The Ministry of Health held the responsibility for sewage disposal. However, the introduction of Sewage Treatment Plants changed the onus of responsibility, and this was reluctantly shouldered by the Montserrat Water Authority, which formerly had only been responsible for potable water. Staff from the Water Authority had to be specially trained to manage and maintain the operations at the sewage treatment plant.

LESSONS LEARNED

There are many lessons learned from the Montserrat Volcanic experience, and of necessity, only those related to the topic of this paper will be mentioned.

1. Governments should undertake thorough assessments of possible threats from natural disasters which face the country. Studies and risk assessment documents should be made accessible to relevant authorities so as to promote awareness of contents, and increase the possibility that they will be integrated at all levels in the decision-making and planning processes.

Despite the availability of the 1988 Wadge Report, no consideration was given to the relocation of major infrastructure after the ravages of Hurricane Hugo. Had weight been given to the Wadge Report, which accurately predicted the areas of high risk from volcanic activity, it is likely that some of the new buildings and infrastructure work undertaken and developed after Hurricane Hugo might have been located in the Northern area of the island, to which the population were relocated at the onset of volcanic activity.

In 1994, a major exercise to assess and draw up action plans for dealing with all the possible threats to the island from natural disaster, gave only a cursory nod to the likelihood of volcanic activity. No action plans were drawn up to
deal with any aspect of such activity. No reference was made to the Wadge Report referred to earlier. Had a thorough assessment been made, using all the information available, then major planning decisions may have catered for such an eventuality.

2 A volcanic hazard mapping and risk assessment was prepared by a British team of scientists. Wadge and Isaacs - as part of the United Nations Decade of Risk Reduction from Natural Disaster. The report concluded that there was a 1% chance per century of a full eruption and predicted, with a great degree of accuracy, the areas of Montserrat what would be at greatest risk from an eruption. It does not appear that the authorities took this report into consideration in the disaster preparedness planning.

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2. Preparation of strong contingency plans, and training for dealing with hazards.

There were plans for dealing with some natural disasters such as hurricanes, but no plans for dealing with volcanic activity. It was not until after the first threat of volcanic activity that a team was quickly put together to develop action and contingency plans. These plans must include clear lines of communication and decision-making, and must be tested. In the Montserrat case, simulation exercises were carried out on a number of occasions to test the emergency response mechanisms outlined in the contingency plans. There were mistakes made, and the plans were revised in light of the lessons learned.

Planners should undertake public consultation. This is essential not only to reduce panic and fear among the population in the face of tremendous adversity from natural disasters, but also to increase public confidence in the national contingency and action plans. Public consultation on matters of disaster planning may also provide a useful source of pertinent information to the planners and administrators, which may enhance the suitability and adequacy of the national contingency plan.

3. Establishment of National Disaster Management Agencies to develop strategies and co-ordinate responses to disasters.

Montserrat is no stranger to natural disasters, and as recently as 1989, the island had been devastated by Hurricane Hugo. However, it was not until January 1995 that an Emergency Operations Centre was established. When volcanic activity began on 18 July 1995, the EOC was activated. This center became the focal point of all response efforts, including the local, regional
and international media.

4. **Environmental Health Management is important and should be given priority in pre-and post-disaster planning and activities.**

The need to relocate two-thirds of the population to the northern .safe. zone of Montserrat, created a strain on the sanitation and water services. The geology of the north of Montserrat rendered the traditional sewerage disposal systems inadequate, and the lack of natural springs and reservoir capacity adversely impacted the provision of potable water to serve the entire population. Lack of planning for such a crisis compounded the difficulties, and so delayed the implementation of new disposal technologies as well as additional water storage capacity.

Major lessons have been learned from this, and a Health Disaster Co-ordination unit has been established, in recognition of the particular impact of disasters on public health, and the importance of thorough contingency planning for safeguarding the health of the nation.

5. **Timely Communication of Information is vital for national planning and disaster mitigation.**

During the early days of volcanic activity, there was a dire need for the public to be informed about the events taking place and how their lives would be impacted. Initially, this was provided only by the Governor and Chief Minister. However, the public wanted to hear from the scientists, and they were added to the voices on the daily broadcasts, to the great relief of the public. This was especially important, because of the perceived threat to human life, and the necessity to make rapid decisions based on the daily broadcasts.

Public education is critical in any disaster, and must be factored into any contingency plan. This is vital to keep public confidence, maintain law and order, to protect lives and reduce damage to property, where possible. The information provided should be clear, concise and timely. The importance of having personnel with communication skills cannot be underestimated. One careless phrase or inappropriate comment can undermine years of disaster planning and the best efforts at co-ordination.

Building public knowledge about disasters is also essential and very useful. The Montserratian public became very knowledgeable about the volcano and the types and levels of volcanic activity, and as a result, followed official and scientific advice more readily.
Communication equipment also proved vital in saving lives. It is essential that all the key response players are able to communicate with each other by means of radio and mobile phones, to avoid delays and reduce mistakes. In the Montserrat case, front-line personnel such as administrators, scientists, police, military and search and rescue officers were equipped with a variety of communication devices. This was essential given the terrain and ashy conditions in which these personnel had to operate, and the need for speedy transmission of information, advice, and warnings.

6. **Management of External Assistance**

Montserrat benefited from a great deal of external assistance during the volcanic crisis. from regional and international governments, donor agencies and charitable institutions. However the aid received did not always provide the relief hoped for, for example,

- the provision of second-hand vehicles and equipment which broke down and for which spare parts were difficult to obtain;
- the use of building materials which were unsuitable for the Montserrat situation; emergency rations which were out-of-date.

There was great reluctance on the part of some donor agencies to make use of local knowledge and expertise. As a result, some of the solutions provided were far more costly less effective than they might otherwise have been.

In addition, the insistence of some donor agencies on using supplies and materials manufactured in the international arena, created additional costs for shipping which could have been saved if materials, suitable for the Caribbean situation, had been obtained regionally.

One of the important lessons learned was that in preparing short-term solutions, decision-makers should keep a long-term vision in sight, in order to maximize slim resources.

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Trevor Howe is currently the Principal Environmental Health Officer in the Ministry of Health, Montserrat, a position which he has held for five years. He has over twenty-six years experience in the field of public health. He is a graduate of the University of Technology, Jamaica, with a BSc degree in Environmental Health Management. He also serves as Health Disaster Co-ordinator and is actively involved in public education campaigns on Environmental Health and Disaster Preparedness.