A brief outline of the sewage infrastructure and public health risks in the Gaza Strip for the World Health Organisation

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Introduction

The siege and recent violent military invasion of the Gaza Strip by Israel has put additional pressure on the long standing undeveloped sewage infrastructure of the Gaza Strip. A simple visible manifestation of this is the significant volume of raw and partially treated sewage discharging into the environment (e.g. Wadi Gaza in Middle Zone, and the Stormwater Reservoir in Khan Yunis) and the Mediterranean Sea at multiple points along the coast line of the Gaza Strip (about 80,000 m^3/day, *refer to* the Figures below). There is considerable world literature about the risk of cholera outbreaks from contaminated and warm seawater (Lipp et al 2003; Madico et al 1996; Munro & Colwell 1996; Tauxe et al 1995). Microbiologically contaminated seawater has been found along the Gaza Strip coast (WHO 2009a), and there is evidence of sanitation-related infections in the Gaza Strip (Halileh & Gordon 2005; Issa et al 2005; Kuhail & Tulaib 2005; Abu Mourad 2004; Astal 2004; Yassin et al 2001).

Recent reports by the WHO have identified the main factors affecting the overall health of the population in the Gaza Strip, including sanitation (WHO 2009b,c). Whilst cholera has not been reported in the Gaza Strip since 1992, the

> '..risk of outbreaks of waterborne and foodborne diseases is currently high and will increase if water, sanitation and food control services are not restored, or are allowed to deteriorate further.' (WHO 2009b:4).

Moreover, WHO further point out that a

> '..functioning communicable disease surveillance system was in operation prior to June 2006. This has since deteriorated and ceased functioning as of 27 December 2008' (WHO 2009b:5).

UNRWA (United Nations Relief and Works Agency) has a long standing syndromic and clinical surveillance system in the Gaza Strip with 23 infectious diseases under surveillance through 20 reporting units at Health Centre level (UNRWA 2009). However, WHO report there are 129 comprehensive Primary Health Care centres in the Gaza Strip (WHO 2009c:6), so the surveillance and monitoring coverage in the Gaza Strip appears less than ideal in terms of sensitivity.

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Outline of sewage infrastructure in the Gaza Strip

Methodology

Two of us (FA, GH) undertook a tour of all 5 governorates in the Gaza Strip on Thursday 26th March 2009 to view the major sewage plants and wastewater problems in the Gaza Strip. All authors contributed in significant ways to this report based on previous work and knowledge, and institutional support to the preparation of the report.

Observations

Figure 1 shows a map of the Gaza Strip prepared by one of us (BA) showing important locations relevant to sewage issues.

Rafah Governorate

The City of Rafah, with a population of about 184,000 people, has a water supply through the CMWU water supply system. However, only 65% of Rafah City is connected to the existing wastewater system, with 35% using septic tanks (ICRC 2008). There are 4 pumping stations, and the treatment facility consists of one treatment lagoon, and an effluent pumping station connected to 3 kilometres of force main of diameter 25cms, discharging directly to the sea. The problems and difficulties of the existing waste water treatment plant include: inadequate treatment (effluent characteristics are BOD 300ppm, COD 550ppm, and TSS 250ppm) so that virtually untreated sewage is being discharged to the sea (*refer to* Figure 2); overload of the system – the current flow is up to 8,500 m^3/day, with a design flow of 2000m^3/day; and inadequate discharge capacity – the existing pressure line has a maximum discharging capacity of 7,500 m^3/day (ICRC 2008). An upgrade is currently in progress with key support and cooperation between the ICRC and CMWU (*refer to* Figures 3-4), with the aim of : increasing treatment capacity to 20,000 m^3/day; the possibility of more house connections in Rafah; discontinuing the current pollution of the sea and groundwater; and recharging the aquifer by infiltration of good quality post-treated water (ICRC 2008). This plant was not damaged during the recent Israeli invasion.

Khan Yunis Governorate

The population of Khan Unis is about 250,000, and receives a water supply through the CMWU water supply system. However, only 25% of Khan Unis City is connected to a waste water system, with 75% of the population using septic tanks (ICRC 2008). There are 2 pumping stations, with the collected wastewater discharged to the existing storm water pond at El Amal area (*refer to* Figure 5) and a temporary partly completed wastewater treatment plant with anaerobic, aerobic, and settling ponds (*refer to* Figures 6-7). The current flow rate is about 5,000 m^3/day, and there is currently no discharge to the sea. A new project (expected to be completed in 2 months time) will pump the partially treated wastewater to the sea. These facilities were not damaged in the recent Israeli invasion

Middle Zone Governorate

The population of Middle Zone is about 190,000, and receives a water supply through the CMWU water supply system.

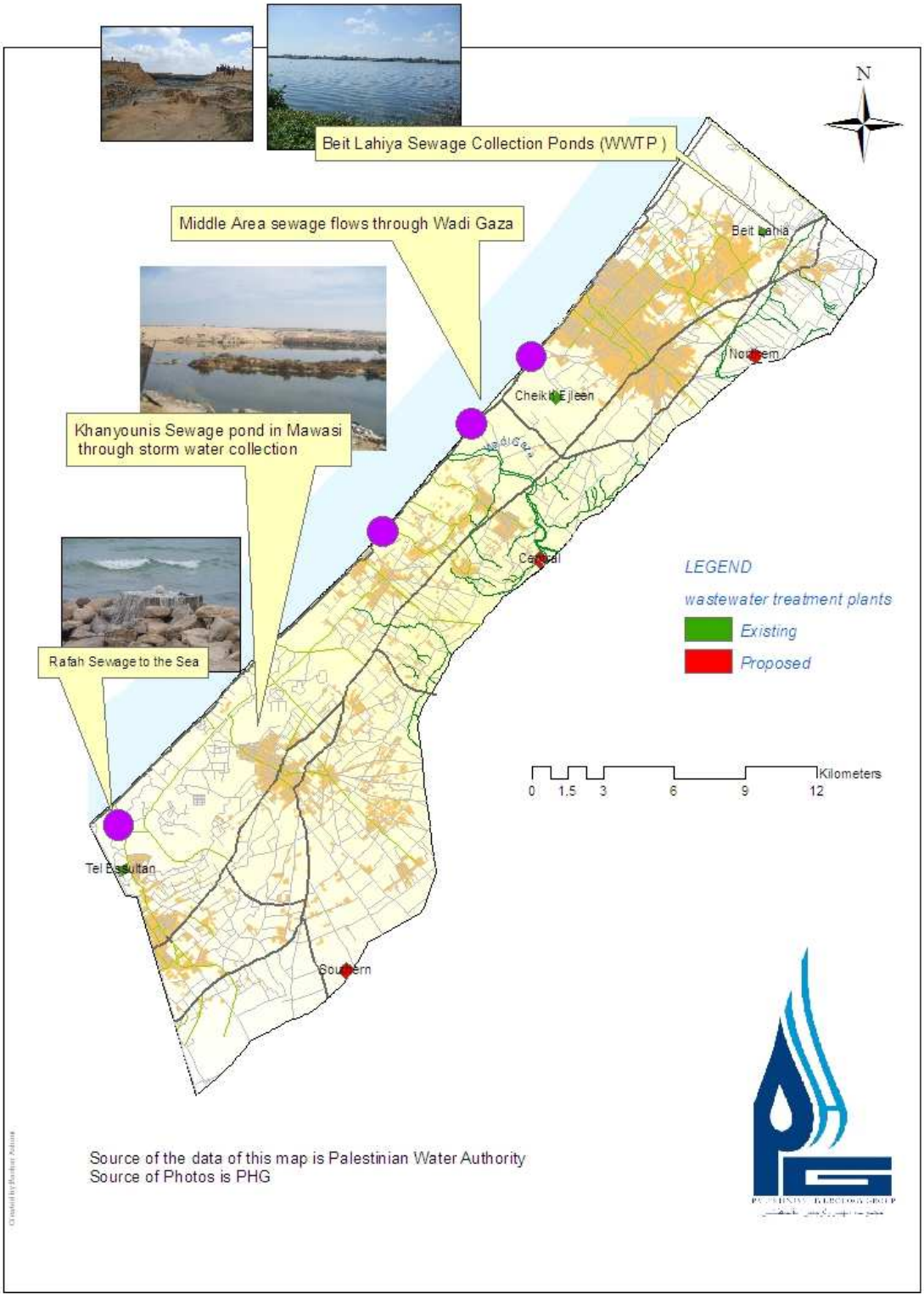

Figure 1 The Gaza Strip: An outline of important sewage-related locations

Figure 2 **Discharge of virtually untreated wastewater into the sea near the Egyptian border from the existing Rafah Wastewater Treatment Plant, March 2009** (Photograph by Najla Shawa)

Figure 3 **Current upgrade of the Rafah Wastewater Treatment Plant, March 2009** (Photograph by Graham Henderson)

Figure 4 **Current upgrade of the Rafah Wastewater Treatment Plant, March 2009** (Photograph by Graham Henderson)

Figure 5 **Stormwater pond at El Amal Area in Khan Unis, March 2009** (Photograph by Graham Henderson)

Figure 6 **Anaerobic pond in Khan Unis Treatment Plant, 2009**
(Photograph by Fareed Ashour)

Figure 7 **Anaerobic ponds in Khan Unis Treatment Plant, 2009**
(Photograph by Fareed Ashour)

Figure 8 **Heavily polluted Wadi Gaza, Middle Zone Governorate, view east, March 2009** (Photograph by Graham Henderson)

Figure 9 **Heavily polluted Wadi Gaza, Middle Zone Governorate, view west, March 2009** (Photograph by Graham Henderson)

Figure 10 Untreated wastewater from Wadi Gaza entering the Mediterranean Sea, March 2009 (Photograph by Graham Henderson)

Middle Zone Governorate (continued)

There is currently no wastewater treatment plant in this Governorate. Most raw sewage is collected in a concrete pipe through Salah Aldeen Road and slopes to the wadi, and enters directly into Wadi Gaza at two locations (*refer to* Figures 8-9) and then flows to the sea (*refer to* Figure 10). The flow rate of untreated sewage into the sea is about 10,000 m^3/day.

Gaza Governorate

The population of Gaza is about 470,000, and receives a water supply through the CMWU water supply system. The Gaza Wastewater Treatment Plant (GWWTP) is the largest in the Gaza Strip. This plant has anaerobic and aerobic ponds and 2 large (9 metre high) bio-towers, one settling pond and polishing pond, and a complete sludge management system (*refer to* Figures 11-13). The plant was damaged during the recent Israeli invasion when the anaerobic pond embankment was destroyed causing the flooding of more than 100,000 m^3 of waste water and sludge onto agricultural areas (*refer to* Figure 14). GWWTP discharges about 50,000 m^3/day of treated wastewater directly into the sea (*refer to* Figure 15). About 10,000 m^3/day of untreated wastewater is currently discharging directly into the sea at 3 locations near Beach Camp in Gaza City and North Gaza (*refer to* Figures 16-18). The discharge shown in Figure 18a,b is from a ruptured wastewater pipe caused by the recent Israeli invasion.

Figure 11 **Anaerobic pond in Gaza Wastewater Treatment Plant, 2009**
(Photograph by Fareed Ashour)

Figure 12 **Bio-towers in Gaza Wastewater Treatment Plant, 2009**
(Photograph by Fareed Ashour)

Figure 13 **Aerobic pond in Gaza Wastewater Treatment Plant, 2009** (Photograph by Fareed Ashour)

Figure 14 **Damage to an anaerobic pond in Gaza Wastewater Treatment Plant caused by the recent Israeli invasion, 2009** (Photograph by Fareed Ashour)

Figure 15 **Treated wastewater from the Gaza Wastewater Treatment Plant discharging into the Mediterranean Sea, March 2009** (Photograph by Graham Henderson)

Figure 16 **Untreated wastewater from the Gaza City wastewater network discharging into the Mediterranean Sea near Beach Camp, view south, March 2009** (Photograph by Graham Henderson)

Figure 17 **Untreated wastewater from the Gaza City wastewater network discharging into the Mediterranean Sea near Beach Camp, view north, March 2009** (Photograph by Graham Henderson)

Figure 18a **Untreated wastewater from the North Gaza wastewater network discharging into the Mediterranean Sea north of Beach Camp, March 2009** (Photograph by Graham Henderson)

Figure 18b **Untreated wastewater from the North Gaza wastewater network discharging into the Mediterranean Sea north of Beach Camp, March 2009** (Photograph by Graham Henderson)

North Gaza Governorate

The population of North Gaza is about 255,000, and 190,000 people from Jabalaya, Beit Lahia, Beit Hanoun and Um Al Nasser are served by the Beit Lahia Wastewater Treatment Plant (BLWTP). Current inflows to the plant are greater than 17,000 m^3/day, beyond plant capacity (CMWU & InfraMan 2007). The plant consists of anaerobic, aerobic, polishing, and infiltration ponds of 400,000 m^2 area that contains more than 2.5 million m^3 in the middle of Beit Lahia city (*refer to* Figures 19-23). This plant was not damaged in the recent Israeli invasion, and no wastewater is discharging directly into the sea in this governorate.

Figure 19 **Large polishing pond, Beit Lahia Wastewater Treatment Plant, March 2009** (Photograph by Graham Henderson)

Figure 20 **Anaerobic pond and new pumping station, Beit Lahiya Wastewater Treatment Plant, March 2009** (Photograph by Graham Henderson)

Figure 21 **Anaerobic and aerobic ponds, Beit Lahiya Wastewater Treatment Plant, March 2009** (Photograph by Graham Henderson)

Figure 22 **An overall view of ponds, Beit Lahia Wastewater Treatment Plant (with Israeli power station in background), March 2009** (Photograph by Graham Henderson)

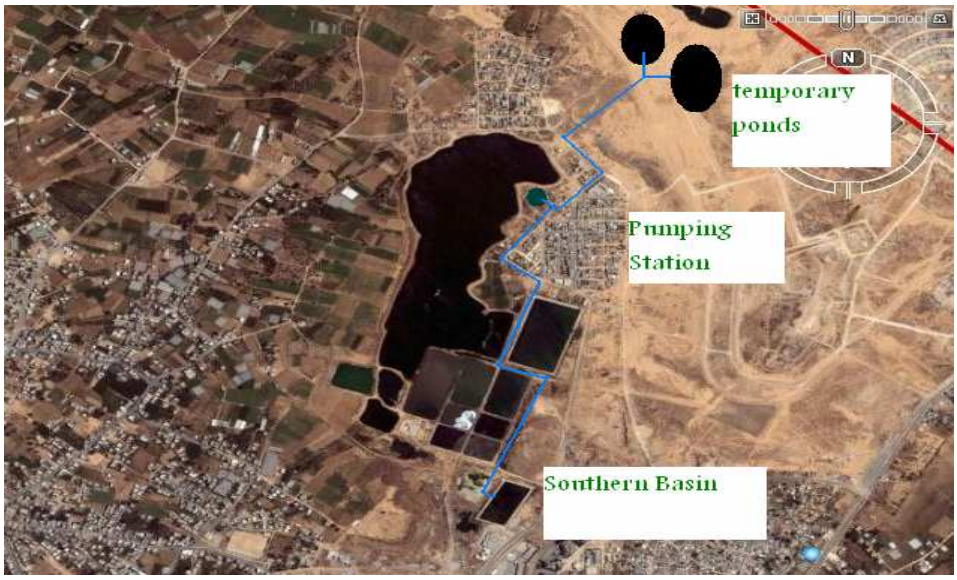

Figure 23 **Aerial view of Beit Lahia Wastewater Treatment Plant** (CMWU and InfraMan 2007:8)

Conclusion

The safe disposal of human excreta is critical to prevent the transmission of faecal-oral diseases. Large population centres such as exist in the Gaza Strip (Rafah, Khan Unis, Gaza City, Jabalya), are at particular public health risk if wastewater networks fail, are poorly maintained, or are damaged by conflict. The longstanding restrictions, siege and recent violent invasion of the Gaza Strip by Israel have resulted in great underinvestment in the water and sanitation infrastructure of the Gaza Strip, and serious difficulty implementing essential repairs and maintenance to existing systems. The entry of essential materials such as cement, pipes, pumps and other equipment has been blocked completely or restricted.

Whilst the existing wastewater infrastructure was not greatly damaged by the invasion, many buildings (including schools) and other structures throughout the Gaza Strip were destroyed completely or partially. Many of these buildings and structures were connected to the wastewater networks. The flow of untreated wastewater into the sea shown in Figure 18 resulted from such destruction.

A symptom of the major longer-term impediments to upgrading the existing inadequate wastewater infrastructure is the large volume (about 80,000 m^3/day) of untreated and partially treated wastewater discharging into the Mediterranean Sea at 6 main points along the Gaza Strip coast. Studies in 2008 by the WHO and Ministry of Health in Gaza found polluted seawater (5,000 to >10,000 faecal coliform colonies per 100 litres of seawater, and/or >2,000 faecal streptococcus colonies per 100 litres of seawater) at a number of specific locations along the Gaza Strip coastline (WHO 2009a). This pollution of the sea represents a daily health hazard to fisherman, a health risk to the Gaza Strip population through potentially contaminated seafood (greatly exacerbated by the Israeli

military restriction on Palestinian fisherman going beyond 1-2 kilometre to sea), and a health risk to Palestinian people during recreation activities in the sea. This is not to mention the loss of potentially recyclable water for aquifers, and the pollution damage to the environment. The environmental damage to Wadi Gaza and the public health risks to people living in this area are serious.

We strongly urge Israel and the international community which supports Israel to stop the blockade and allow major infrastructure works to complete repairs, maintenance, and upgrades of existing wastewater infrastructure, and enable the proposed wastewater plants along the eastern border of the Gaza Strip to be completed. The fact that no major outbreaks of faecal-oral disease has occurred in recent times reflects the dedicated work of many local public health professionals and their organisations, and the resilience of the Palestinian people. We also consider there is an urgent need to strengthen the surveillance and monitoring system of water quality and diseases throughout the Gaza Strip.

A recent (27th March 2009) wastewater emergency in the Beit Lahiya Wastewater Treatment Plant in North Gaza Governorate when 40-50,000 m^3 of partially treated wastewater escaped from temporary disposal ponds (combined capacity of 250,000 m^3) close to the border with Israel and flowed near to the Bedouin Um ALNasser Village highlights the urgency of the public health issues described above (WASH Cluster Gaza 2009).

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