Methodology

In order to illustrate the occasions when rainfall events that continue for days, the daily rainfall data at HKO's Tai Po Wong Shiu Chi Secondary School Automatic Weather Station in the past 21 years has been reviewed. The 2016 rainfall data, which is of the highest total annual rainfall, has been adopted as a reference case for the assessment purpose. The objective of the analysis of consecutive days of rainfall is to illustrate the benefit brought by the drainage system under stress but not to quantify the upper/lower limits of the system. As such, the total annual rainfall is considered to be a typical factor in identifying extreme/stress conditions and thus is considered sufficient for the analysis.

First, the volume of daily runoff (m^3) is calculated as follow:

Daily average rainfall (mm) × Effective catchment area within Project area (m^2)

where:

Effective catchment area is the area weighted by runoff coefficient. Details are discussed in **Section 2**.

According to **Section 2,** the average daily consumption of water during the operational phase for irrigation would be approximately 1,800m^3/day. Then, the volume of water in the storage tanks is estimated as follow:

Residual water in the storage tanks in the previous day (m^3) + Runoff by today's rainfall (m^3) – Daily water consumption (m^3)

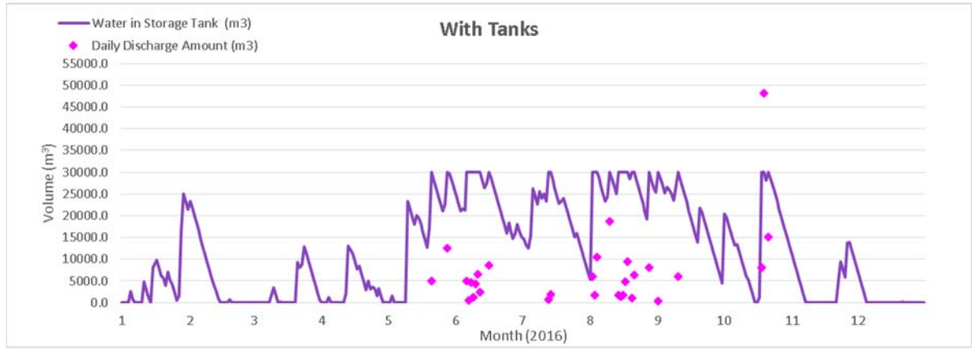
The bypass would occur when the amount of stored water reaches 30,000m^3 (total capacity of the water storage tanks) and any additional water would be bypass the water storage tanks. Also, if the residual water in the storage tanks plus the runoff of the day is not enough for the daily water consumption, the water in the storage tanks will first be consumed and the rest will be supplemented by other water sources.

Results

Based on the methodology and assumptions above, two scenarios – one is with water storage tanks and the other is without water storage tanks – will be formulate with a view to assess the benefit brought by the proposed water storage tanks. **Figure 1** and

Figure 2 show the water profile and daily bypass events under the with- and without-water storage tanks scenarios. **Table 1** summarizes the number of days with bypass events and the causes under the two scenarios.

Figure 1 Water profile of water storage tanks and daily bypass events under the With Water Storage Tanks Scenario



Notes:

[1] The bypass events are caused by extreme weather (70%) and prolonged rainfall (30%)

Figure 2 Water profile of water storage tanks and daily bypass events under the Without Water Storage Tanks Scenario

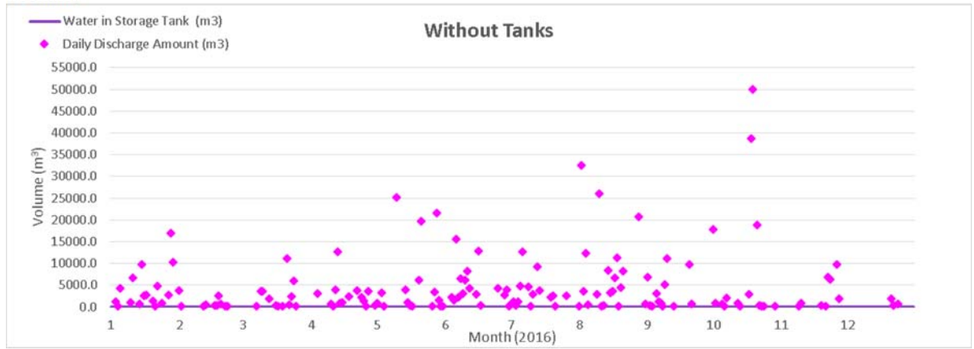


Table 1 Rainfall in Project Site and bypass from water storage tanks in 2016

Scenarios	Number of Days with Bypass Events [% over the year] [1]	Causes of Bypass Events
With Water Storage Tanks	29 [8%]	Tropical cyclone or red/black rainstorm events (about 70% or 20 days out of 29 days) [2] Prolonged rainfall events (about 30% or 9 days out of 29 days) [3]
Without Water Storage Tanks	156 [43%]	Rainfall events

Notes:

[1] It should be noted that the percentage of bypass would change from year to year and is especially sensitive to rainfall intensity, duration, etc. which would vary as a result of weather variation and climate change.

[2] In 2016, there were 4 tropical cyclones, 2 red rainstorms and 1 black rainstorm which brought heavy rainfall to Hong Kong and thus will directly cause the bypass of water storage tanks.

[3] There were a total of 5 prolonged rainfalls in 2016 which lasted for 3 days on average with an average rainfall of 28mm.

[4] Some shown figures may have been rounded for easy reference.

It should be noted that, among other things, all these bypass events would not contain agrochemicals with levels exceeding any criteria according to the water quality assessment in **Section 6**. Thereofre, no adverse water quality impact is anticipated from these bypass events. The purpose of this paper is to illustrate the benefit brought by the water storage tanks under the episode of 2016 rainfall data only.

As shown in **Table 1** there are 8 % or 29 days with bypass events in 2016 when the tanks are in place, much reduced as compared to the 43% or 156 days in 2016 when the tanks are not in place. The days with bypass events are significantly reduced by the proposed water storage tanks. In other words, the site characteristics, design of the drainage system and stormwater control practice can effectively reduce the number of days with bypass events by 127 days.

Among these 29 days with bypass events with the water storage tanks in place, about 70% (out of the 29 days) or 20 days of those would occur around the time when tropical cyclone warning signals and/or red or black rainstorm warning signals were issued. The rest occurred when there was less intense but prolonged rainfall.

In addition to the stormwater analysis of the proposed tank size, a review of the feasibility to allocate a sufficient large water storage tanks to prevent the chances of full capacity is conducted. To construct a water storage tank that could retain all surface run-off, the size of water storage tanks could be more than 232,000 m^3 based on a sensitivity test, which is more than 7 times larger than the currently proposed tank. **Figure 3** shows the water profile of water storage tanks under the full retention scenario.

Figure 3 Water profile of water storage tanks under the full retention scenario