FIRST FLUSH AND WATER MANAGEMENT SYSTEMS: GUIDE AND PRINCIPLES

CEMENT CONCRETE
& AGGREGATES AUSTRALIA

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1 CEMENT CONCRETE & AGGREGATES AUSTRALIA

Cement Concrete & Aggregates Australia (CCAA) is the peak industry body for the heavy construction materials industry in Australia, including the extractive, cement and pre-mixed concrete industries. The industry produces some 150 million tonnes of aggregates, 9 million tonnes of cement and 25 million cubic metres of pre-mixed concrete per year. The industry is committed to ensuring that these operations are sustainable and environmentally responsible.

2 OBJECTIVE

Australia has approximately 1,250 operational concrete batch plants that, in accordance with relevant environmental protection legislation, must ensure that their activities do not pollute waterways.

All concrete batch plants should have a water management system, which in addition to filling an operational need to supply water of adequate volume and quality for the batching of concrete must also be designed and operated to protect the environment from discharges of polluted water.

This document has been prepared to provide guidance for CCAA members in the design of water management systems for concrete batch plants. It does not attempt to be prescriptive, but rather provides the overarching principles for achieving sound environmental and operational outcomes. The desired final outcome is to ensure that any discharged water from a concrete batching plant is clean and uncontaminated.

3 DEFINITIONS

Clean Water Area: areas of the concrete batch plant where stormwater runoff is unlikely to become contaminated with concrete related pollutants, such as sand, cement, admixtures and wash water. Clean water areas normally include sealed car parks, roofs, offices and other areas where concrete batching does not take place.

Dirty Water Area: areas of the plant where stormwater runoff is likely to become polluted with sand and materials, such as aggregate storage bins. Dirty water areas should be drained via properly designed settling pits.

Contaminated Water Area: areas of the concrete batch plant where stormwater runoff is likely to become contaminated with pollutants, such as admixtures, cementitious materials, which can result in high pH levels, hydrocarbons and / or high sediment load wastewater. Contaminated water areas normally include cement and Secondary Cementitious Material (SCM) silo filling areas, loading bays, slump stands, truck washout areas and wastewater collection areas.

4 FIRST FLUSH SYSTEM

A First Flush system is an integral component of a concrete batch plant's water management system and it needs to be designed so that in a rainfall event contaminated water is flushed into a holding pit. Once the holding pit is full, clean stormwater runoff cannot enter the holding pit, but is discharged from the site via a properly designed high-level by-pass. The First Flush system should contain all the contaminated water and ensures that all water discharged from the plant is clean.

For a First Flush system to operate effectively, it is essential to have properly designed pits or tanks with an effective high-level bypass system. The bypass system should also be located up stream of all water drainage systems.

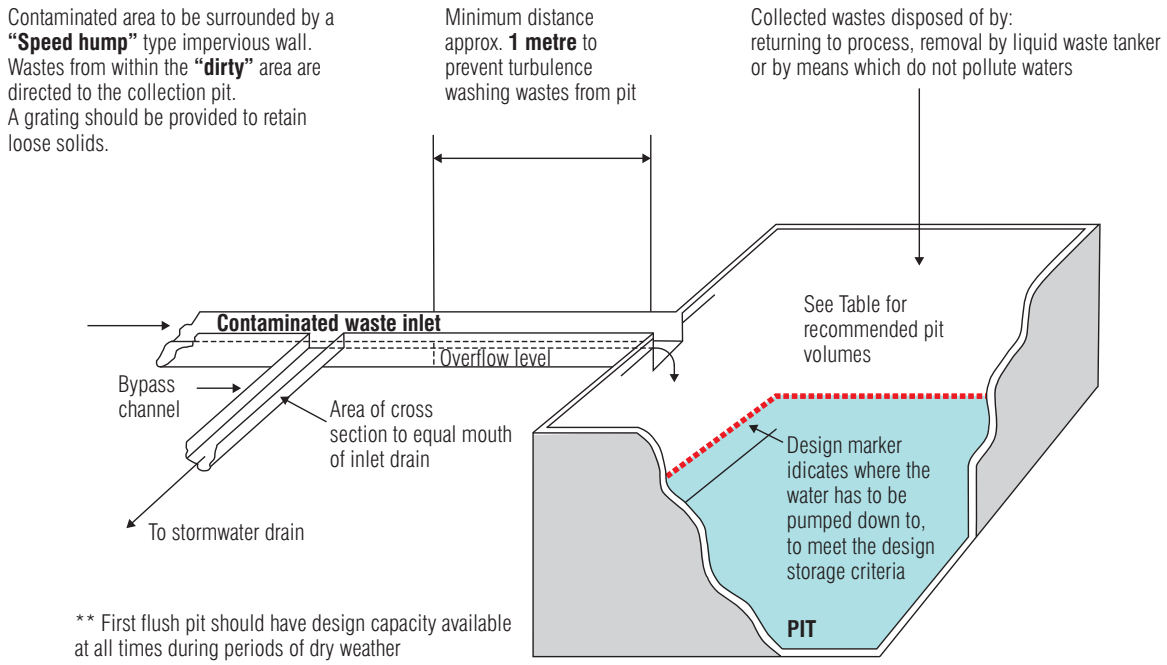
When developing any First Flush system the plant design, plant area and local rainfall patterns need to be considered so as to ensure that when a rainfall event occurs, enough contaminated water is contained so that only clean, uncontaminated water leaves the site. Water from the First Flush system should be the first used in the production process so as to maintain the system's capacity.

4.1 First Flush System Example Diagram

A typical First Flush system and the design criteria are illustrated in the diagram below:

Design criteria for first flush containment systems.
Note: high-level bypass channel needs to be upstream of wedge pits and sources of high pH to avoid contamination sources of polluting water as it is being diverted and discharged.

Typical First Flush Collection Pit



This diagram is for illustrative purposes only and each First Flush system should be specifically designed to meet all applicable State regulations, site requirements and weather conditions.

Table 1: Design criteria for first flush containment systems

Pollutants	Catchment surface	Examples of industries	Rainfall level to be contained
Substances easily mobilised, such as soluble materials, fine dusts and silts	Impervious: concrete, cement, bitumen	Concrete batching plants	10 mm
Substances that are more difficult to mobilise, such as oil, grease and other non-volatile hydrocarbons	Impervious: concrete, cement, bitumen	Petrochemical plants, motor vehicle courtyards, chemical manufacturers, hot mix bitumen emulsion plants, roadways	15 mm
All types of pollutant	Pervious surfaces (including natural ground surface) that are not as easily cleansed of deposited pollutants	Market gardens, nurseries	20 mm

4.2 10 first flush design principles

1 When setting up the operational areas at the plant all contaminated and dirty water areas should be identified and minimised. Once this is done, it is possible to calculate the size of all three types of water areas, which makes it possible to determine how much water needs to be captured by the First Flush system, to ensure that any water discharged at the plant is clean.

2 The First Flush system should have enough capacity to capture as a minimum the first 10 mm of rainwater. Please note, this amount is dependent on the concrete batch plant's layout and on local rainfall patterns and therefore some First Flush systems may need to capture a greater amount of water in a rainfall event. Be sure to check minimum requirements with your State regulator.

Note For example, a catchment area of 60m x 50m that is required to capture 10mm of rainfall requires a first flush capacity of 30,000 Litres. 60m x 50m x 0.01L $=30m^3$. $30m^3 = 30,000$ Litres

3 The different water areas may be delineated through the use of bunding and speed bumps, which can be used to direct water flows to the correct areas, such as holding ponds and tanks.

4 Wastewater from washout bays and slump stands should be collected in a closed system and pumped to the wastewater containment system

5 The water management system should be designed so that no wastewater drains into the First Flush system during wet weather.

6 Contaminated water needs to be captured and recycled into the concrete batching process, or disposed of correctly, as it is highly alkaline. Dirty water needs to be captured and allowed to settle in a pit or tank before reuse.

7 Tanks can provide the First Flush system with extra capacity, but they should not be used for long-term water storage. A common misconception is that an empty tank is a waste. This can result in tanks being filled with contaminated and dirty water, which may not allow enough capacity for the first flush runoff and may require bunding.

8 A properly maintained and managed First Flush system will ensure only clean uncontaminated water leaves the site via a well-designed high-level bypass that is located upstream of the First Flush system.

9 Ponds and tanks should have a guide-stick, a painted line or a float valve to indicate how much free capacity is required at all times in the pond or tank in order to ensure that there is sufficient spare capacity to capture the required volume of contaminated or dirty water for each rainfall event.

10 It is essential to develop a work procedure where the first flush water is the first water used in the concrete batching process, as this will ensure that the system has sufficient capacity should there be a rainfall event.

5 WATER MANAGEMENT

Effective water management relies on the concrete batch plant manager, and other relevant personnel, having a good understanding of the operation of the site's water management system.

Good water management occurs when both contaminated and dirty water are captured and recycled back into the concrete batching process. This should occur in preference to the use of mains water, assuming that production water quality requirements are maintained. In this manner the concrete batch plant will improve its sustainability credentials and cost effectiveness by reducing the amount of mains water consumed.

5.1 10 Key Work Practices

When managing water at a concrete batch plant, it is a good idea to instigate the following work practices:

1 If required, any stormwater leaving the site discharge point of the concrete batching plant should be monitored to ensure that its pH is between 6.5 and 8.5 and total suspended solids are less than 50 mg/L.

2 It may be advisable to monitor and record the pH of storage pits and tanks, as this provides an understanding of the site's water quality. This can also provide the regulator with verification of the site's water management work practices.

3 Water catchment areas should be segregated into clean, dirty and contaminated water areas, as these three areas need to be treated differently. This can be achieved through changes in the fall of pavements and through the installation of drainage, bunding and through speed bump diversions.

4 These areas should be documented in a map of the yard to highlight the clean, dirty and contaminated areas. As well as mapping the clean, dirty and contaminated areas on site, it is advisable to mark these areas so as to visually delineate the site. This can be done by applying markings to the ground surface. This also assists with training staff in water management on site, as well as serving as a day-to-day reminder of the location of these areas.

5 The water management system should be designed so as to automatically select recycled water for use before it selects mains water. Any water captured in the site's First Flush system should be used, in the concrete batching process, in preference to other stored or mains water.

6 One of the main purposes of the water management system is to minimise the amount of contaminated water that is generated at the site. This can be achieved through closed loop washout systems, recycling contaminated water into the concrete batching process and slumping with contaminated water.

7 Contaminated and dirty water areas can also be covered or segregated so that no stormwater runoff is able to enter or leave the area. Achieving this can reduce the capacity of the First Flush system or completely remove the requirement for a First Flush system.

8 A good work practice is to ensure that at the end of each day the site's First Flush system has sufficient spare capacity to capture at least the first 10 mm, or greater, of stormwater runoff should there be a rainfall event.

9 The capacity of the First Flush systems should be maintained at all times, even during dry weather.

10 Keeping the site well maintained and clean, through work activities such as regular sweeping, can prevent the extent of contaminated run-off.

5.2 Staff Training

Training staff about water management issues will assist in avoiding the pollution of waterways. Ensuring that the following misconceptions are rectified can help improve water management at concrete batching plants:

- There is an assumption that clear water is not contaminated. There is often only concern about visibly dirty water. All staff should be trained so that they understand that water can be perfectly clear and still be contaminated. For example, water with high pH from cementitious material can look like normal uncontaminated mains water.
- There is an assumption that a concrete batch plant's water storage facilitates must be kept full. Water storage ponds or tanks, that are part of the First Flush system, must have sufficient spare capacity to contain at least 10 mm of contaminated and dirty water in order to prevent it from leaving the site. Sustainability and environmental benefits are achieved when as much water as possible that is harvested from a rainfall event is used in the concrete batching process.
- It is a common practice for some concrete batch plants to keep all their ponds and tanks full, or nearly full of contaminated water, while still batching and slumping with mains water, thereby generating even more dirty and contaminated water. Concrete batch plants should aim to use and recycle all stored water, as soon as possible.

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