

# NRMCA Practical Water Recycling and Treatment in a Ready mixed Concrete Plant



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***NRMCA***  
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7. Truck Wash Out Set Up for Medium Size Ready-mixed Plant.
8. Drum Washout Procedure



# Water Recycling - General Points to Ready mix operators

- ▶ Water is a scarce resource and therefore all ready mix operators have a duty to recycle as much water as possible.
- ▶ Discharging water contaminated by cementitious material or other pollutants at concentrations above the limits prescribed in the Malaysian Environmental Quality (Industrial Effluent) Regulations is obviously irresponsible and also *illegal* in Malaysia.
- ▶ The Environmental Quality (Industrial Effluent) Regulations 2009 Fifth Schedule define the limits and concentrations that are allowed in water intended to be discharged.
- ▶ ***As responsible ready mix operators we have a duty to the community and to our industry to recycle contaminated water or treat prior to discharge.***



# Areas Where Water is Produced

- ▶ Areas where water runoff is “made” or “produced” in a ready mixed concrete Plant and hence has to be treated or stored and reused.
  - ▶ Controlling air emissions thru water sprays in batch bay.
  - ▶ Washing the bowl and slumping of the concrete at the slump stand area after the concrete is batched.
  - ▶ Washing out the concrete mixer after the load has been delivered.
  - ▶ Cleaning the concrete pavements/roads through hosing or dumping a load of water via a mixer truck.
  - ▶ And of course in Malaysia *RAIN* events (a major issue given the large downpours often encountered in Malaysia).





# Definitions

## ▶ Clean Areas

- ▶ Clean areas include roadways, carparks etc...
- ▶ Run-off contains no significant sediment load or contaminants.
- ▶ Can usually be discharged off-site without treatment or stored for used in plant operations depending on government regulations.

## ▶ Dirty Areas

- ▶ Dirty areas include raw material stockpile areas and unpaved areas.
- ▶ Run-off contains an elevated sediment load but no significant cementitious or chemical contamination.
- ▶ This run-off must be treated to reduce the concentration of suspended solids.
- ▶ Permissible levels apply before discharge from site.



# Definitions

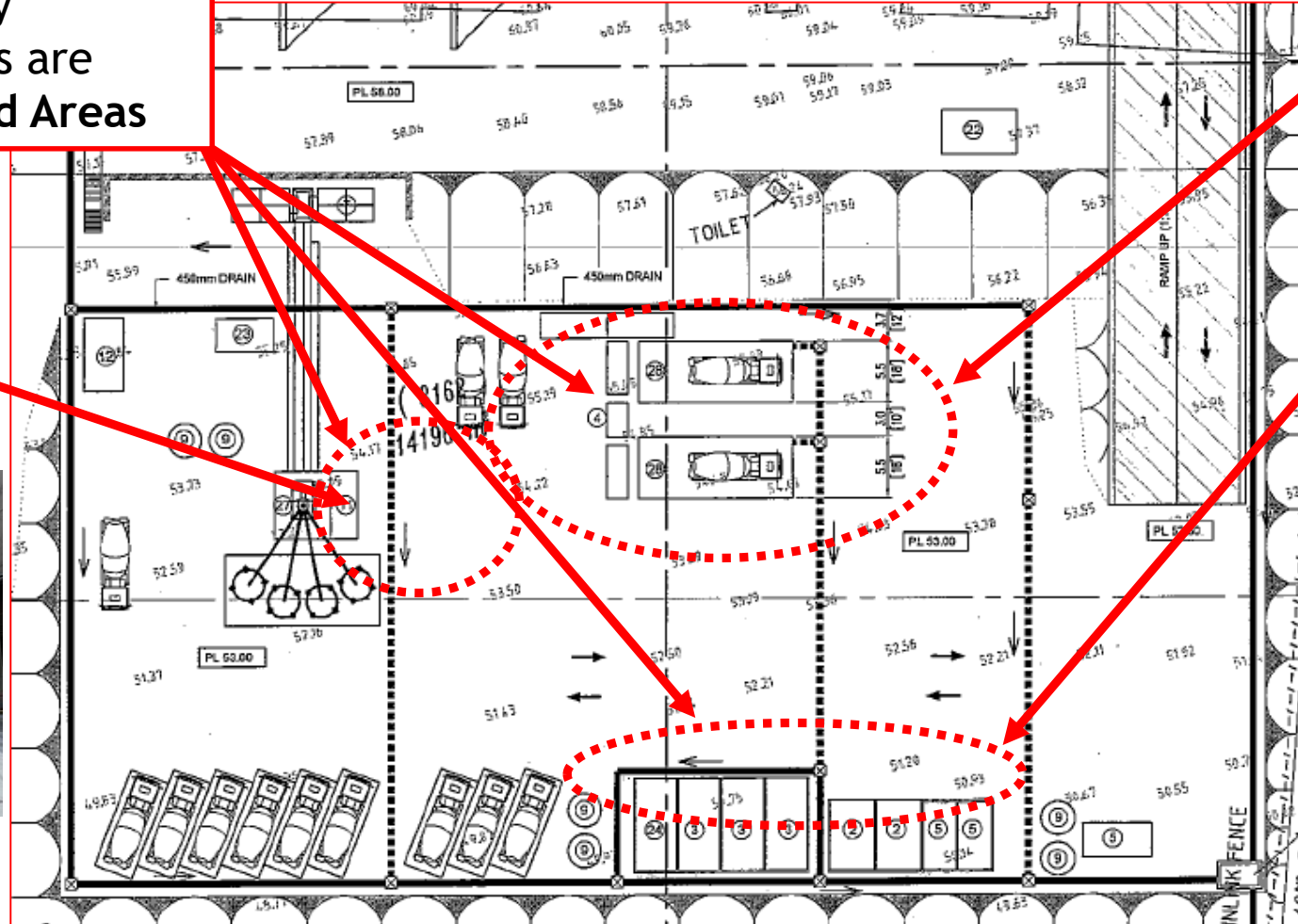
- ▶ Contaminated areas can be split into two basic types:
- ▶ **Cement Contaminate Areas**
  - ▶ Cement contaminated areas include the concrete truck loading bay area, slump stand area, truck washing area, and the truck wash-out facility.
  - ▶ Run-off is highly alkaline and may have a high suspended solids content.
  - ▶ This run-off must be contained and recycled, treated to comply with discharge criteria and discharged, or disposed of off-site in a legal manner.
  - ▶ Under no circumstances should this run-off/water be discharged from the site untreated.
- ▶ **Other Contaminated Areas**
  - ▶ Other sources of contaminants are admixtures, fuel and oil, detergents and acids.
  - ▶ Run-off may contain hydro-carbons and other chemical contaminants.
  - ▶ This run-off must be contained and removed from site for disposal in a legal manner.
  - ▶ This is not discussed in detail in this presentation.



# Types of Pavement Areas in Terms of Water Recycling

Areas contaminated by cementitious materials are **Cement Contaminated Areas**

**Concrete batching bay**



**Truck slumping Area**

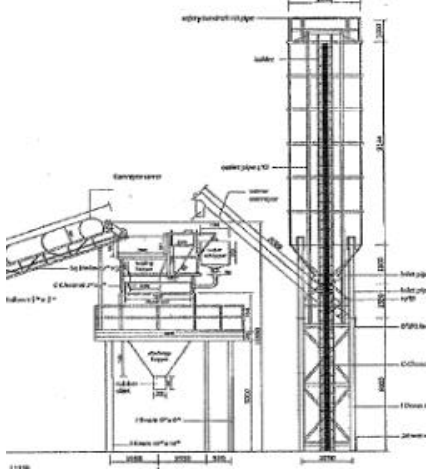
**Truck wash out area**





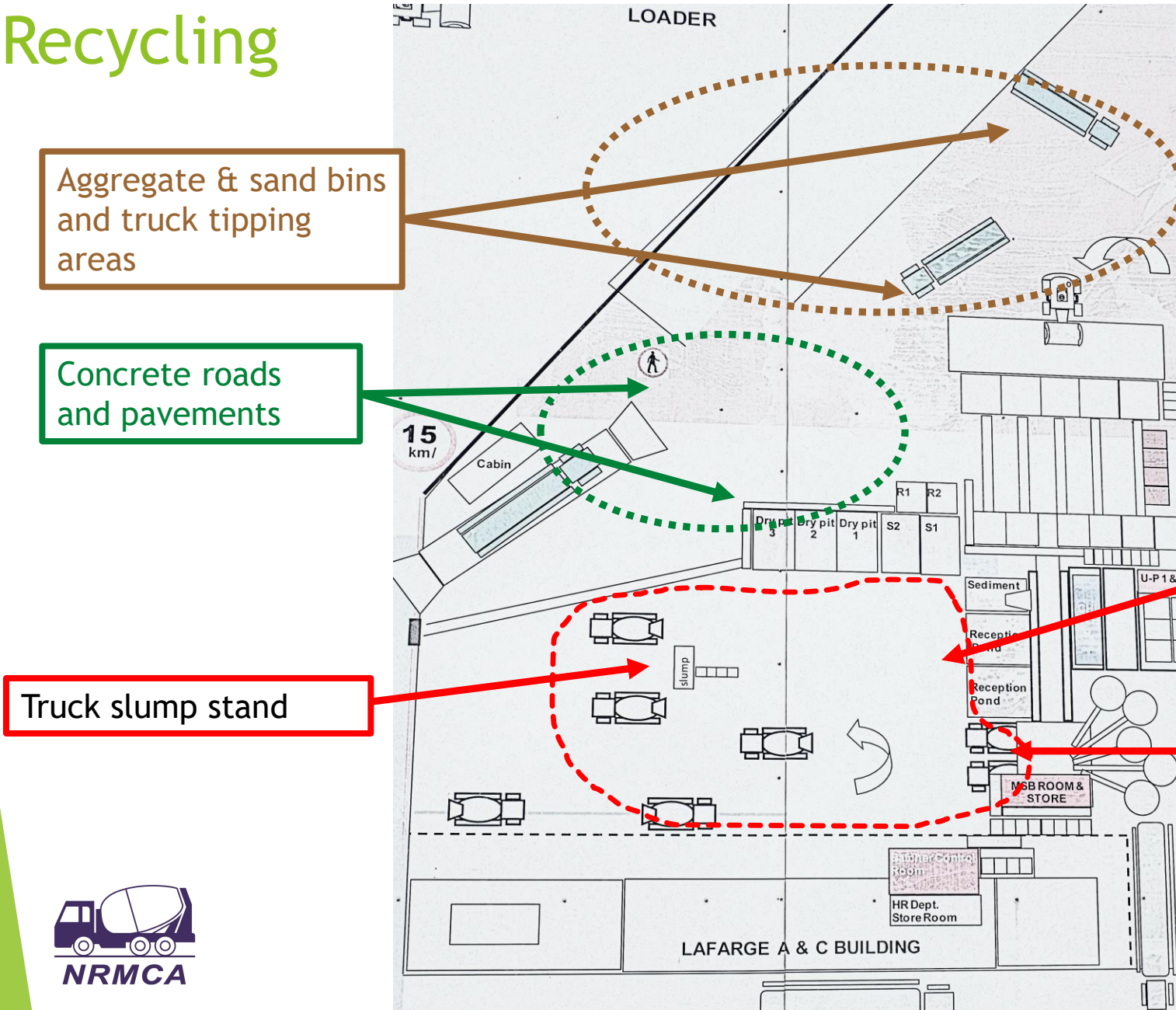
# Types of Pavement Areas in Terms of Water Recycling

## Cement Contaminated Areas - Examples





# Types of Pavement Areas in Terms of Water Recycling



Aggregate & sand bins and truck tipping areas

Concrete roads and pavements

Truck slump stand

Areas not contaminated by Cementitious Materials are Classed as “Dirty” Areas & “Clean” Areas. Dirty areas have been contaminated by silt from the aggregates and sand etc.. Clean areas are simply concrete or asphalt sealed pavements

Truck wash out area

Concrete batching Bay



# Design Considerations for Different Pavement Types in Terms of Efficient Water Treatment

## ► Cement Contaminated Areas

- Cement contaminated water is highly alkaline and generally has a pH value of between 6 and 9 depending on the suspended solids concentration.
- In most countries this water must be captured, the cementitious material removed and the pH and turbidity (suspended solids content) tested to confirm that the water confirms to the local regulations prior to discharge as storm water.
- Cement contaminated water is therefore very expensive to dispose of and using fresh tap water for batch water is also very expensive. As a result, it is best to settle out some of the suspended solids and recycle this cement contaminated water as batch water.
- In a rain event, the rain runoff from these areas also becomes contaminated, needs to be treated and therefore the total area needs to be defined and minimized.
- As a general rule and in a lot of countries, the first 20mm of a rain event needs to be captured and treated, this called the **“First Flush”**.
- After this **“First Flush”** water is captured, generally the rain runoff can be discharged into the storm water however this depends on the local regulations and needs to be confirmed through testing .



# Design Considerations for Different Pavement Types in Terms of Efficient Water Treatment

## ▶ Cement Contaminated Areas

- ▶ In order to reuse as batch water, treatment areas require large areas for the installation of either wedge pits, settling pits, concrete recycling equipment or filter presses to reduce the amount of cementitious slurry suspended in the water.
- ▶ Suspended cementitious solids decrease concrete performance at high concentrations and can lead to **Flush Setting** on the concrete.
- ▶ There is a high cost to construct these areas as they require wedge pits, cleanable drains, sludge pumps, pits etc. etc. and have high maintenance and operating costs to remove cement sludge and replace pumps and pipes.
- ▶ When rain/precipitation occurs (which is obviously a big issue in Malaysia), a proportion on the rain should be captured or the “*First Flush*” of rain water with the aim to catch the first part of the cementitious contaminated water and treat it.
- ▶ Capturing the First Flush volume (depending on the treatment you have in place) should ensure the discharged water complies with the Environmental Quality (Industrial Effluent) Regulations 2009 Fifth Schedule however this needs to be confirmed by testing.





# Design Considerations for Different Pavement Types in Terms of Efficient Water Treatment

## ► Cement Contaminated Areas

- Generally the regulating authority will specify the First Flush to be contained either by specifying a rainfall event (e.g. a one in two year storm) or by stating the volume per unit area (e.g. L/m<sup>2</sup> or as mm of rainfall 20mm for example) however in Malaysia there is no such specification.
- In the absence of regulation (as per Malaysia) a standard may be adopted in a geographic region based on past experience. This is a common method; the standard adopted can be checked for adequacy by direct measurement of discharge pH during rainfall.
- As a result one of the primary design goals when designing a concrete plant should be;
  - Minimize these areas where possible.
  - Settle out or remove as much cementitious as possible and reuse as batch water in the concrete.



# Design Considerations for Different Pavement Types in Terms of Efficient Water Treatment

## ▶ Dirty Areas

- ▶ Run-off contains an elevated sediment or suspended solids load but no significant cementitious or chemical contamination.
- ▶ This run-off must be treated to reduce the concentration of suspended solids and the permissible levels (Suspended Solids (max of 50 or 100 mg/L).
- ▶ A simple control pit is usually all that is required to discharge this water into the storm water and off site if the water complies with the Environmental Quality (Industrial Effluent) Regulations 2009 Fifth Schedule.

## ▶ Clean Areas

- ▶ Clean areas include roadways, carparks etc...
- ▶ Run-off contains no significant sediment load or contaminants.
- ▶ Generally can be discharged straight off-site without treatment or stored for used in plant operations if the water complies with the Environmental Quality (Industrial Effluent) Regulations 2009 Fifth Schedule.



Control Pit designed to capture the water and settle out the suspended solids from **Clean area pavements**

# Standards and Requirements in Malaysia for Water Discharge and Treatment

## ► Environmental Quality (Industrial Effluent) Regulations 2009 Fifth Schedule.

- There are (2) Standards A & B with A being the stricter standard.
- Which standard applied to your operations depends on your approval conditions.
- The (2) key parameters for ready mix players are;
  - A pH value between
    - 6.0 - 9.0 for Standard A
    - 5.5 - 9.0 for Standard B
  - Suspended solids max
    - 50 mg/L for Standard A
    - 100 mg/L for Standard B.



### FIFTH SCHEDULE

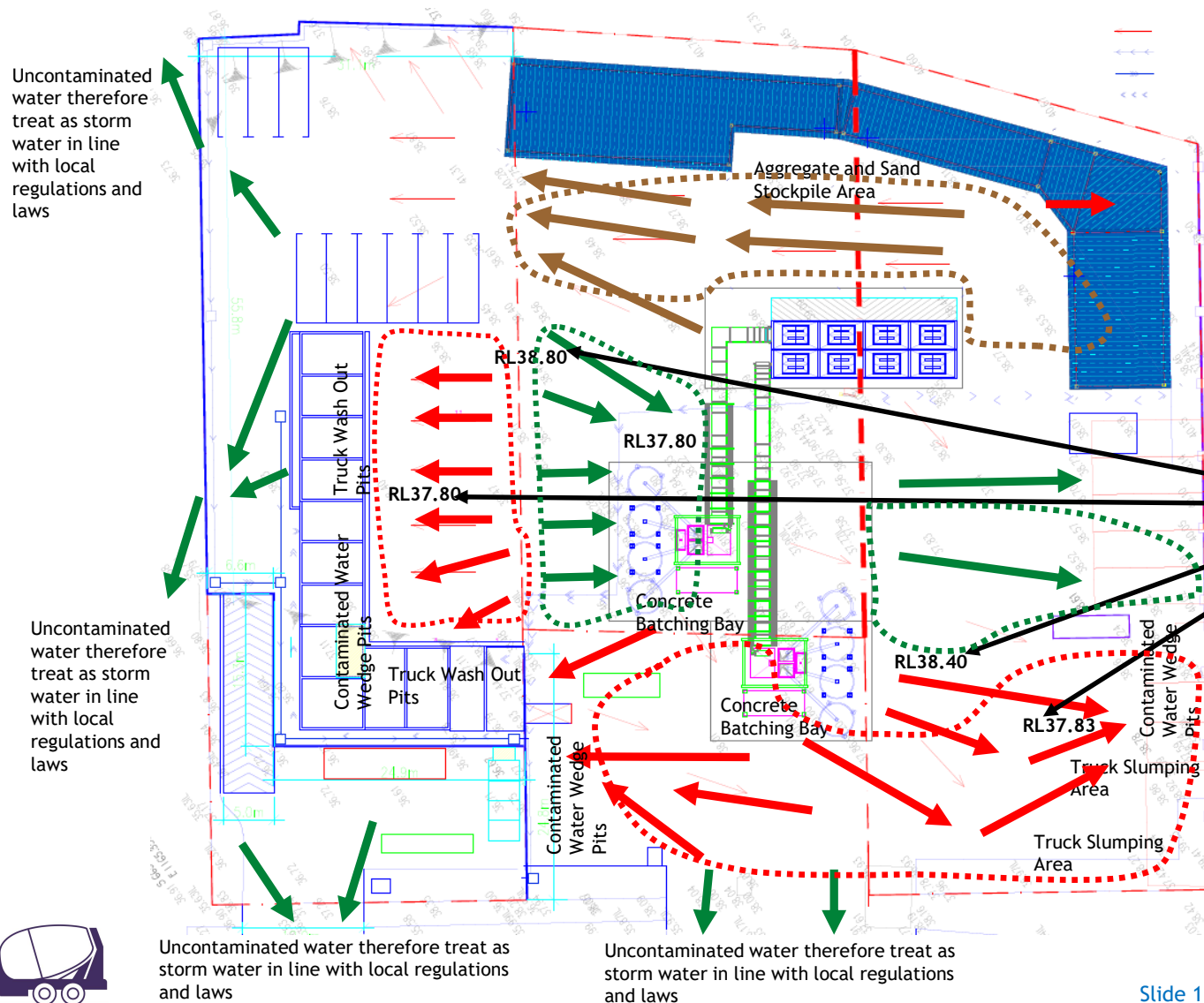
[Subregulations 11(1), 11(2), 11(3)]




#### ACCEPTABLE CONDITIONS FOR DISCHARGE OF INDUSTRIAL EFFLUENT OR MIXED EFFLUENT OF STANDARDS A AND B

| Parameter                      | Unit | Standard |         |
|--------------------------------|------|----------|---------|
|                                |      | A        | B       |
| (1)                            | (2)  | (3)      | (4)     |
| (i) Temperature                | °C   | 40       | 40      |
| (ii) pH Value                  | —    | 6.0-9.0  | 5.5-9.0 |
| (iii) BOD <sub>5</sub> at 20°C | mg/L | 20       | 50      |
| (iv) Suspended Solids          | mg/L | 50       | 100     |
| (v) Mercury                    | mg/L | 0.005    | 0.05    |
| (vi) Cadmium                   | mg/L | 0.01     | 0.02    |
| (vii) Chromium, Hexavalent     | mg/L | 0.05     | 0.05    |
| (viii) Chromium, Trivalent     | mg/L | 0.20     | 1.0     |
| (ix) Arsenic                   | mg/L | 0.05     | 0.10    |
| (x) Cyanide                    | mg/L | 0.05     | 0.10    |
| (xi) Lead                      | mg/L | 0.10     | 0.5     |
| (xii) Copper                   | mg/L | 0.20     | 1.0     |
| (xiii) Manganese               | mg/L | 0.20     | 1.0     |
| (xiv) Nickel                   | mg/L | 0.20     | 1.0     |
| (xv) Tin                       | mg/L | 0.20     | 1.0     |
| (xvi) Zinc                     | mg/L | 2.0      | 2.0     |
| (xvii) Boron                   | mg/L | 1.0      | 4.0     |
| (xviii) Iron (Fe)              | mg/L | 1.0      | 5.0     |



# How to Define and Isolate Different Pavements to Ensure No Cross Contamination of water



 Indicate the water flow for **Clean** water  
 Indicates the water flow for **Dirty** water  
 Indicates the water flow for **Contaminated** water

Water Flow is controlled by designing, specifying and constructing the final levels of the concrete pavements to achieve the desired water runoff through changing the pavement levels when laying the concrete.

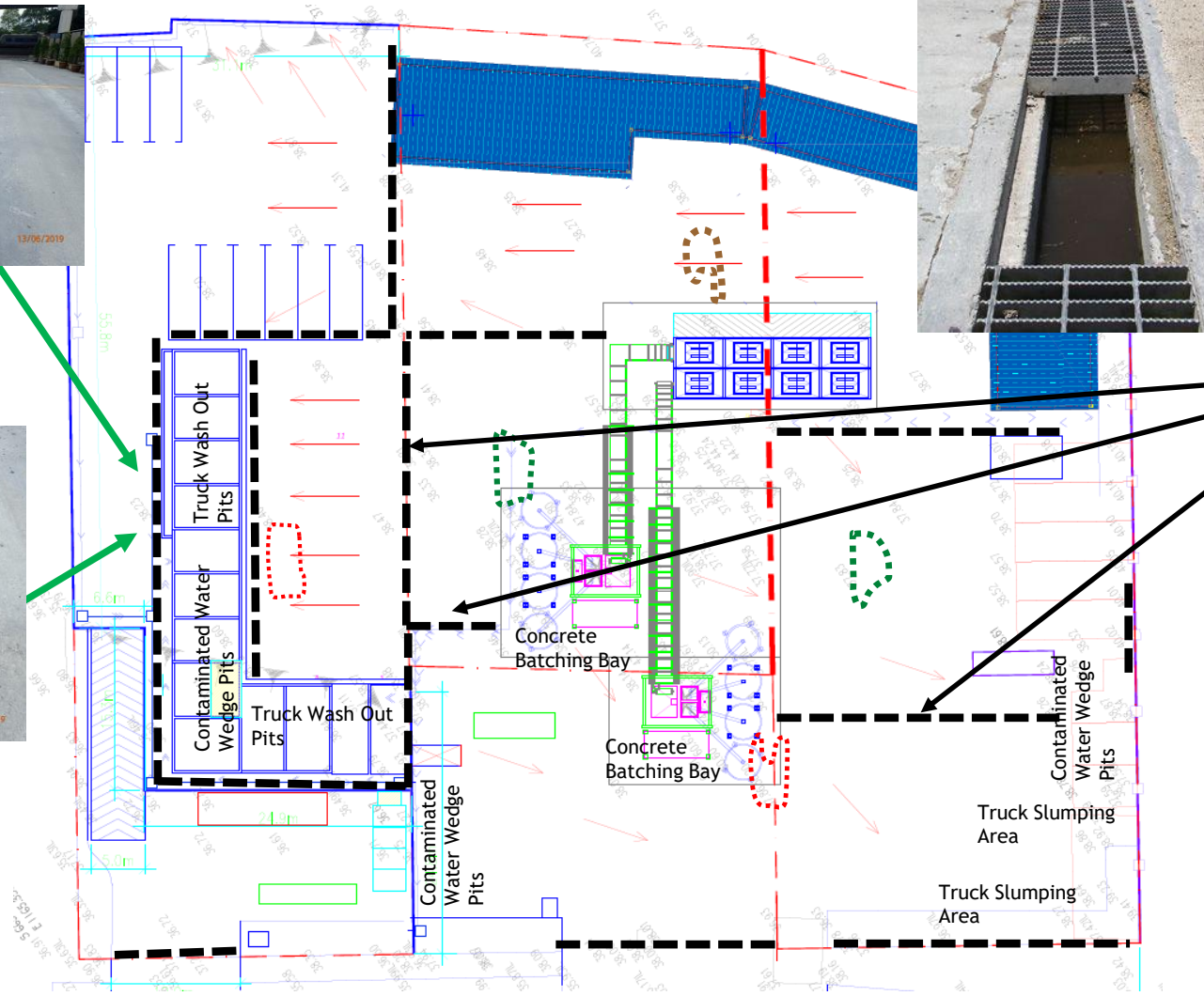
As a guide;

For **Contaminated** areas  
1:100 to 1:200 (max) design falls.

For **Dirty** or **Clean** areas  
1:200 design falls.



# How to Define and Isolate Different Pavements to Ensure No Cross Contamination



Indicates drains used to  
--- catch the water and define the different areas

Water Flow is controlled by installing drains (spoon or in ground) to define the boundaries of the different areas, catch the water and direct it to the wedge pits, storm water drains or wash out pits.



These drains are also used to run the water pipes to improve ease of maintenance and for water pipe replacement.



# Truck Wash Out Set Up for Medium Size Ready-mixed Plant

Overhead pipes using recycled water from the settlement ponds



Wedge pit 2

Wedge pit 1

Dry Pit to store waste slurry

Washout pit 3

Washout pit 2

Washout pit 1

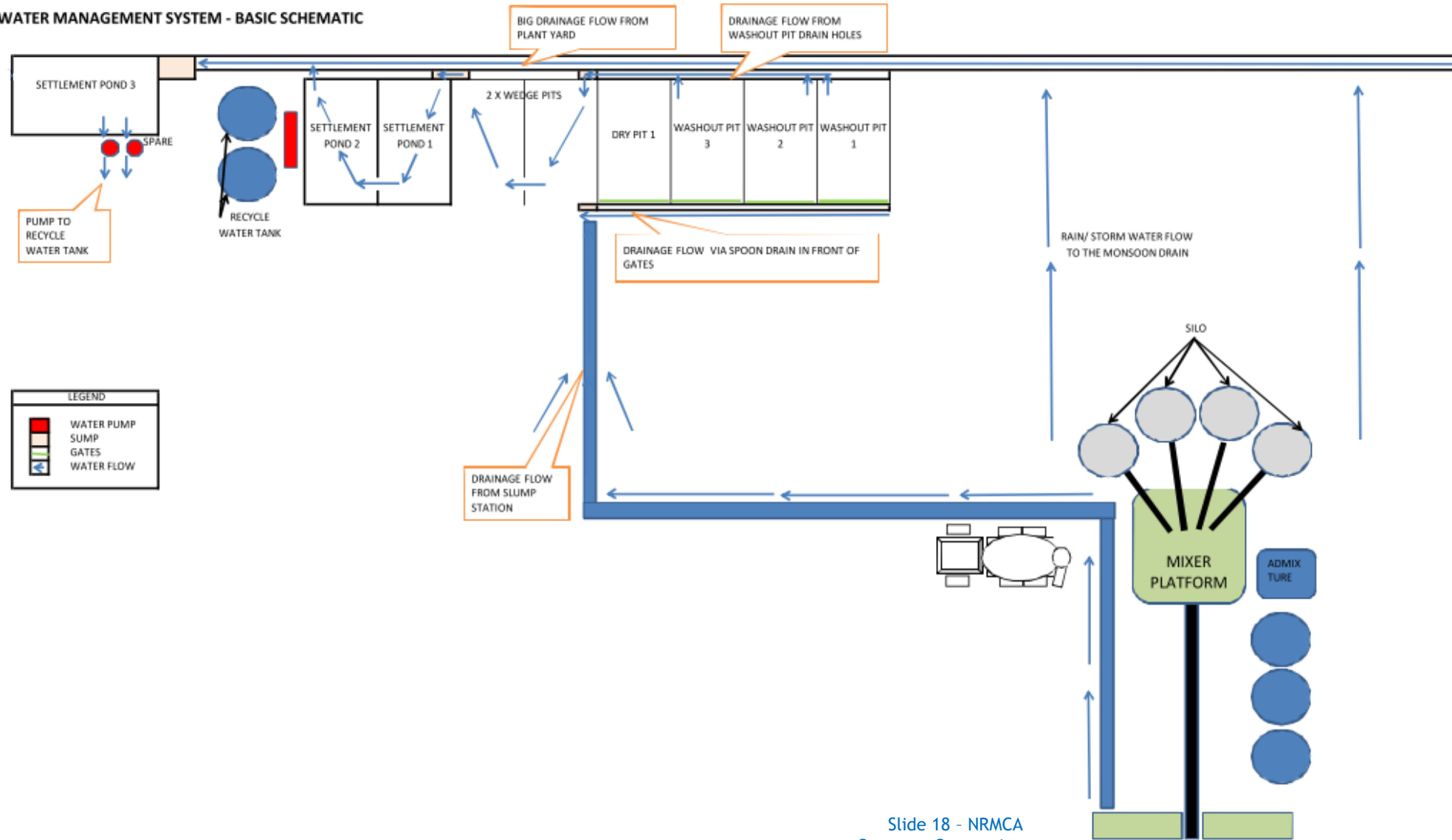
- Suitable for a plant that produces around 3,000 - 10,000m<sup>3</sup>/month.
- Requires maintenance and daily work by the plant staff and FEL operator.
- At least 2-4 hours per day depending on the volume of returned concrete.
- **Will be a failure if the plant staff don't maintain the system EVERY DAY!!!!!!**





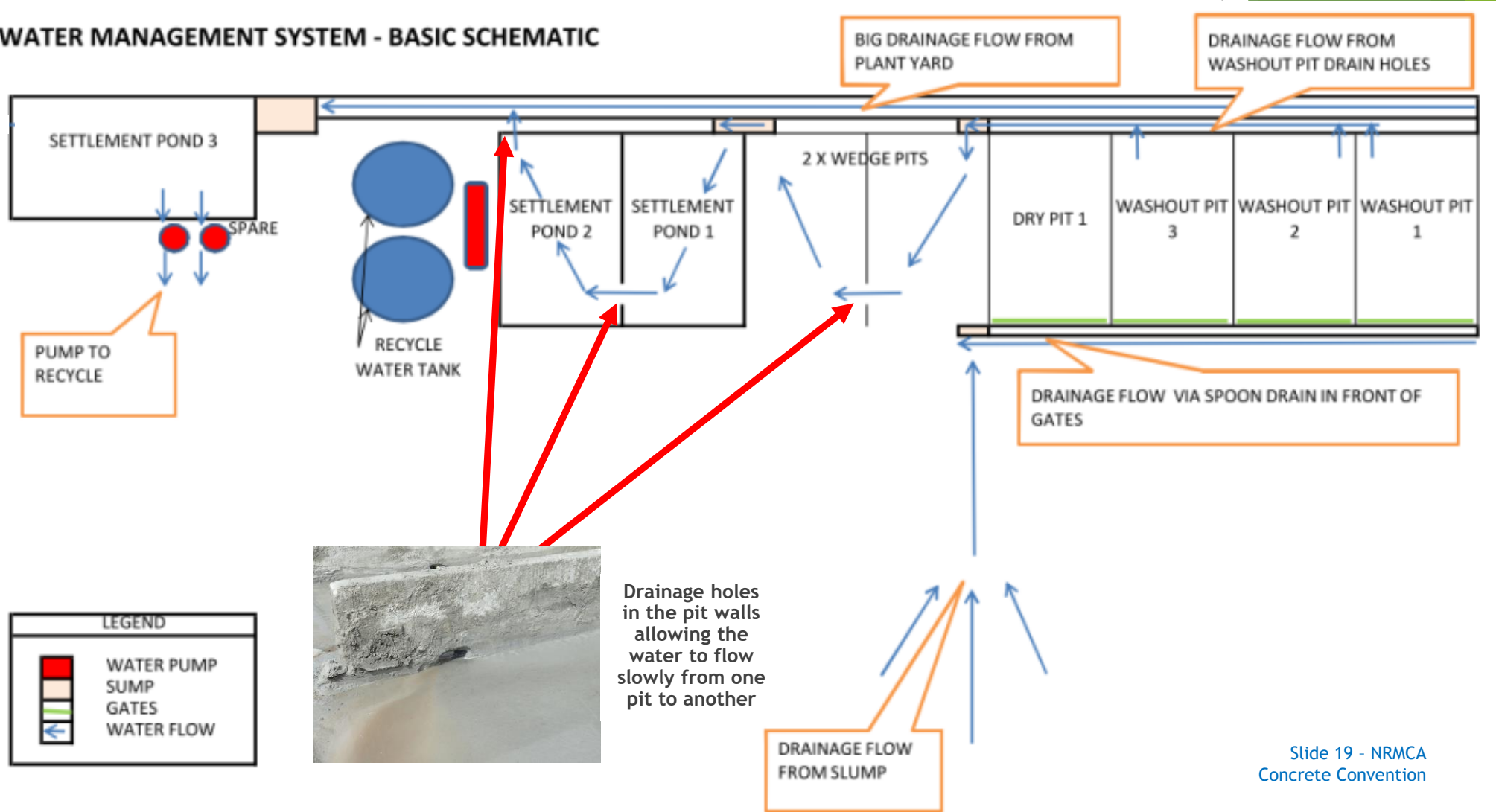
# Water Management System Schematic Truck Wash Out Set Up for Medium Size Ready-mixed Plant

WATER MANAGEMENT SYSTEM - BASIC SCHEMATIC



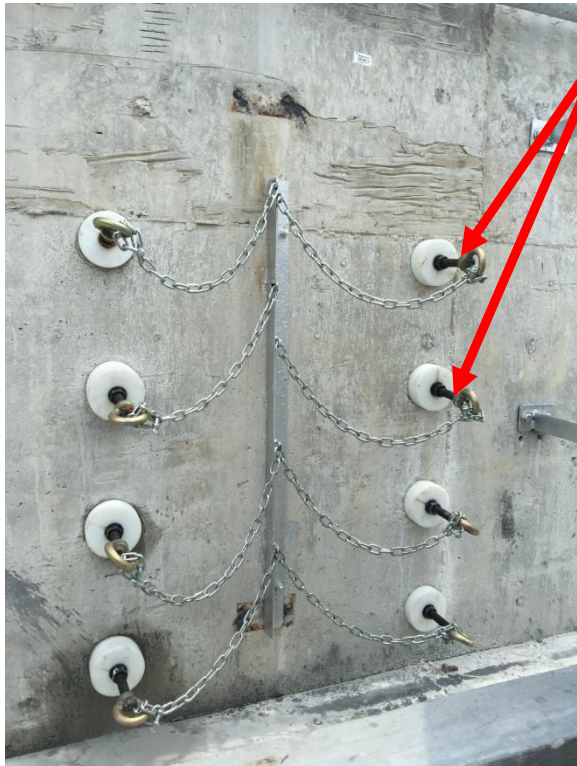
# Water Management System Schematic Truck Wash Out Set Up for Medium Size Ready-mixed Plant

## WATER MANAGEMENT SYSTEM - BASIC SCHEMATIC



# Bungs to the rear of the Wash Out Pits

Bungs - acts as a stopper that allows the contaminated water to settle before discharge out. The bungs do need to be cleaned out to keep them free of slurry build up.



Bungs



Splash Plate - directs the water from the holes to the drain behind the wall.



# Washout Pit Gate Designs



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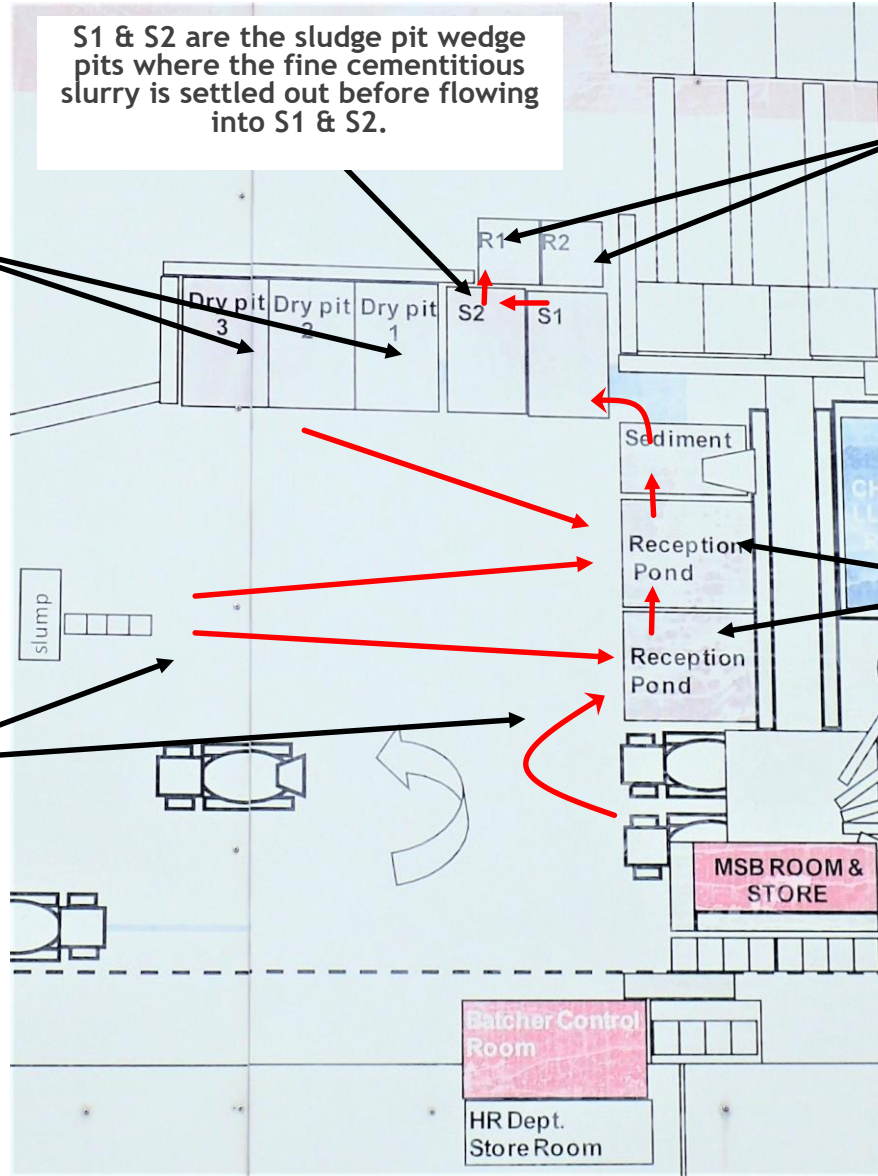


# Water Management System Schematic Truck Wash Out Set Up for Larger Size Ready-mixed Plant



Material Drying pits where the sludge from the reception ponds, sediment ponds and S1 & S2 are removed by the front end loader and placed to dry out before being transported away by truck.

The concrete pavements are sloped to ensure all of the water from the slump stand and batching bay are directed toward the Reception Ponds.



R1 & R2 are the recycled water pits where the water is stored before being pumped and recycled to be used as batch water in the concrete.



The reception ponds are where the trucks wash their bowls out and discharge the water and waste into these wedge pits. The front end loader operator frequently cleans these pits and dumps the material into the Material Drying Pits.





# Concrete Recyclers and Reclaimers

- ▶ Very effective in reclaiming the coarse aggregate and fine aggregate portions of concrete returned to the batch plant.
- ▶ The challenges;
  - ▶ Still require large footprint for the water storage and water processing pits as the cementitious content in the water used in these plants must be lowered before it can be used in batch water or in the reclaimer.
  - ▶ Often installed with stirrer pits that agitate the cementitious solids in the water being recycled. this often leads to strength and setting time issues when this water is used as batch water.
  - ▶ Capacity issues when large amounts of concrete are returned as typically these plants only process small volumes per hour.
  - ▶ Operational issues with the truck drivers incorrectly using this type of equipment and discharging the concrete into them too quickly.
  - ▶ Expensive to maintain and frequent maintenance required.
  - ▶ Need to have a backup when the reclaimer is down or being serviced or repaired.





# Operational Considerations for Effective Water Recycling & Treatment

- ▶ Your staff need to be trained on how to use the system effectively.
- ▶ Your staff need to maintain the water treatment system, empty the wedge pits, empty the dry pits, remove the slurry and clean the system when ever it is required ***consistently***.
- ▶ This usually is **at least once per day**.
- ▶ If this does not happen, the system will fail and the water will;
  - ▶ have too much cementitious suspended which will effect the compressive strengths of your concrete or
  - ▶ If discharged, the water will be detrimental to the environment and outside the legal limits.

**HARD  
WORK  
PAYS  
OFF**



# Clear and Easily Understood Procedures - Example

## Drum Washout Procedure

This procedure is carried out if there is balance concrete or during end of production day.

- ▶ **STEP 1:** Fill the mixer drum with recycle water from the Overhead Pipe.
- ▶ **STEP 2:** Spin the drum (in mixing rotation) to get a thorough cleaning.
- ▶ **STEP 3:** Reverse the drum rotation and the washout waste is discharged directly into one of the Washout Pits.
- ▶ **IMPORTANT:** Washout out operation must be carried out at active pit, where all bungs at back of the wall are closed.





# Thank You

Hanson - Sungai Besi Plant



Lafarge - Petaling Jaya Plant



Megamix - Chan Sow Lin Plant



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