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SUBJECT: Surf PD Water Treatment Strategy

## 1. INTRODUCTION

Turbid Water Solutions was asked to provide a strategy for the treatment of water on the proposed Surf PD development in Port Douglas Queensland. Identified water sources include the stormwater runoff from the catchment during rainfall events that will lead into a proposed reservoir and the other being from the extraction of water from a proposed bore and/or spring.

The stormwater treatment is to ensure any discharges from site will have minimal impact on the receiving Mowbray River system and provide potential re-use options on site for water sustainability outcomes.

The bore/spring water will be utilised to supply the aquatic facilities proposed with the development. A treatment system will be required to treat this water to a standard ensuring minimal health risks to users of the facilities.

The following memorandum will look at the two sources separately and provide a strategy to deal with each.

## 2. Stormwater Treatment

The stormwater treatment will be integrated between the construction phase and the operational phase of the development to give the greatest chance of minimising impacts on the receiving environment.

Turbid Water Solutions has pioneered the use of High Efficiency Sediment (HES) basins in Australia. These types of sediment basins have been stipulated as best practice with the International Erosion Control Association (IECA) sediment control guidelines and seen as a solution by many councils and the Department of Environment and Science (DES) alike to comply with the QLD State Planning Policy (SPP) and satisfy the “general environmental duty” condition under the Environmental Protection Act to manage construction phase sediment loading.

We propose that the HES basin will be part of a permanent integrated system to manage both sediment and nutrients to satisfy both the construction and operational phases of the developments water quality objectives.

## Construction phase:

The HES basin will act as the primary system for water treatment during the construction phase of the development. All run off will be directed to a single inflow point of the HES basin for automated dosing of water treatment products. Indicative location of the HES basin is given below in Figure 1. Actual location will be determined as part of the Erosion and Sediment Control plan developed later.

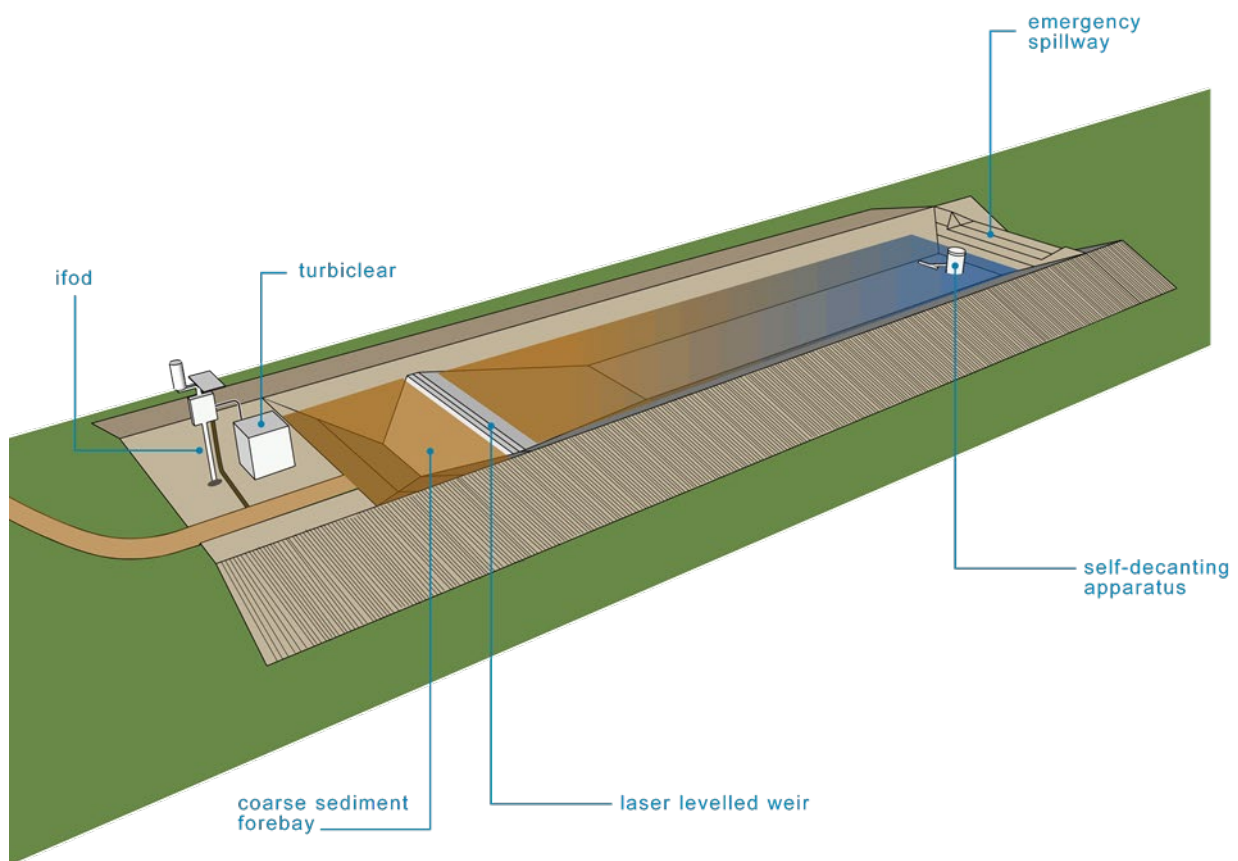


**Figure 1 indicative location of the HES basin**

Typical layout of a HES basin is given below in Figure 2. The HES basin will be sized to ensure a minimum of 80% of the annual runoff will be discharged with no greater than 50mg/L in Total Suspended Solids (TSS) and pH in the range of 6.5 to 8.5 to coincide with the water quality objectives of the QLD SPP.

An automated dosing unit will be sized in accordance with the designed inflow rates and dose rates of the treatment product required. Jar testing of various treatment products will be carried out to determine the effective product and dose rate to effectively settle the solids out within the timeframe required.

Automated dosing the appropriate treatment product will result in significant sediment removal and deposition in the forebay section of the HES basin. With this sediment removal, there will be significant nutrient removal as well- particulate Nitrogen and Phosphorous in particular. It is proposed that the captured sediment in the HES basin be recycled back into the topsoil being utilised for landscaping purposes on site.



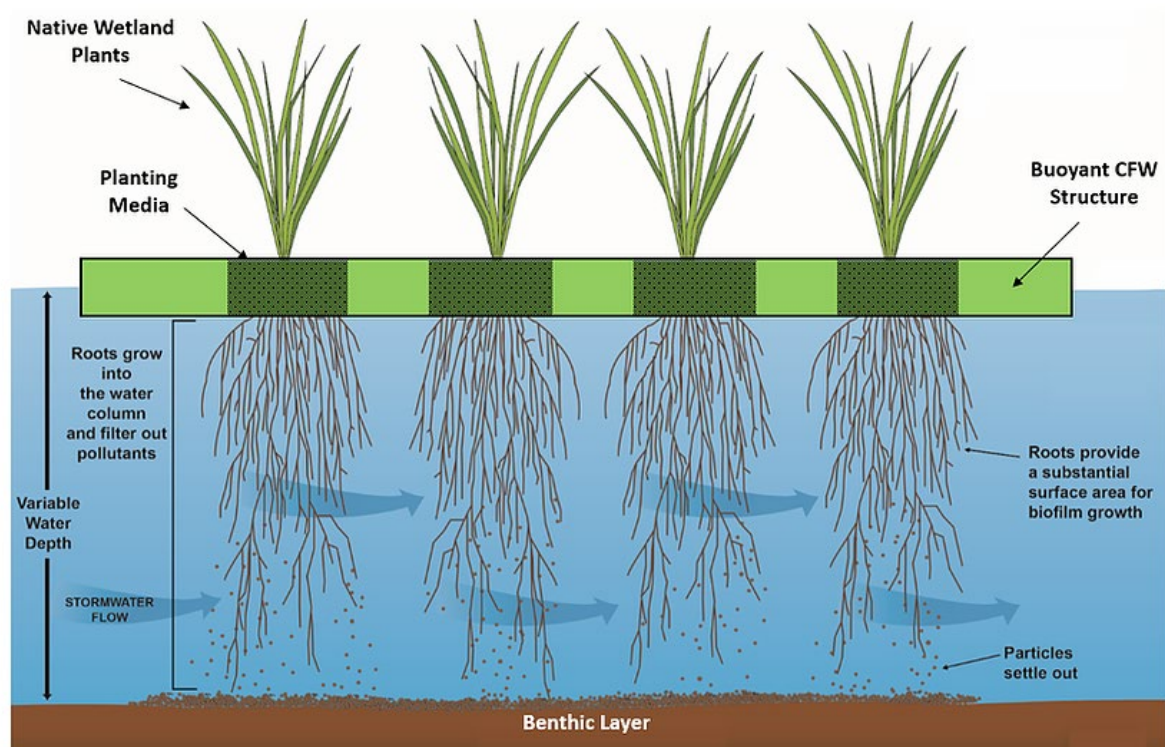
**Figure 2 Typical HES basin layout**

## Operational phase

Once construction phase impacts are negated (sediment loads are minimal) the HES basin will be augmented to cater for predominantly nutrient removal. The automated dosing unit will be utilised only at times necessary for extensive sediment removal of any stormwater runoff.

We propose to install Constructed Floating Wetlands (CFWs) as the primary nutrient control during the operational phase of this development. The CFW technology has been proven to be successful at removing high loads of nutrients as well as lower loads of sediment.

CFWs are an innovative water treatment device that uses biomimicry to remove pollution from water. They function like hydroponic systems where the plant roots grow down into the water to access nutrients. The exposed plant roots create an effective filter for suspended solids and also provide a very large surface area for growth of microbial biofilm as can be seen in Figure 3 below.



Constructed Floating Wetland Schematic

Figure 3 CFW schematic

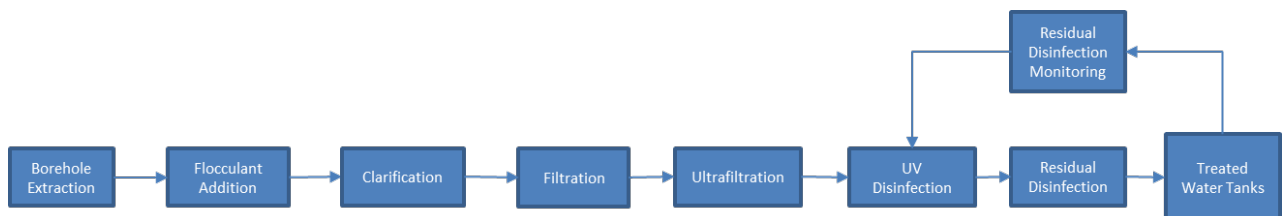
As well as providing high water treatment performance, CFWs can also:

- Reduce algae growth
- Provide habitat for a variety of animals- birds and fish
- Provide a food source for microorganisms, fish and other aquatic biota
- Enhance visual amenity of water bodies
- Reduce water temperatures under the modules
- Inhibit wind and wave energy, protecting shorelines from erosion

See proposed CFW system in Appendix A.

### 3. Bore/Spring Water Treatment

The operational and makeup water for this facility will be a mixture of council supplied potable water and bore/spring water as available. The overview of the process to treat the bore/spring water to an acceptable standard for use on site is provided in Figure 4.



**Figure 4 Preliminary Process Block Diagram - Borehole Treatment**

The water quality from the bore/spring has not currently been quantified therefore the process adopted has the capacity to remove sediment, metals, and micro-organisms.

The preliminary process has the following units included in the design.

#### **Borehole Extraction**

Water will be extracted from the bore with an appropriately sized pump based on borehole extraction performance testing and site facility requirements. This water will be transferred to a buffer tank directly before the treatment system.

#### **Flocculant Addition**

Dependant on the contaminants and the water chemistry, the water will be treated with a flocculant to assist in the removal of any particles. The requirement for and selection of the appropriate flocculant will be dependant on water testing, however, it is envisaged if required aluminium chlorohydrate will be utilised.

#### **Clarification & Filtration**

A series of clarification and filtration modules will be used within the design dependant on particle size distributions and settling rates. The requirement will be to ensure that the turbidity is no greater than 5NTU to ensure effective UV treatment.

#### **UV Disinfection**

The first stage of disinfection will be using UV treatment with a log reduction of 4 for cryptosporidium and 3 for bacteria. The UV units will be the first stage to ensure the tubes are not coated with oxidised material from the addition of chlorine. The disinfection with UV is particularly effective with protozoa as demonstrated in Figure 5. The requirement for inclusion of the UV treatment process will be determined against the WSA Health Based Targets for Drinking Water Safety.

Log Inactivation	Fluence required (mW.s/cm <sup>2</sup> )		
	<i>Giardia</i>	Viruses	<i>Cryptosporidium</i>
1	2.1	58	2.5
2	5.2	100	5.8
3	11	143	12
4	NA	186	NA

**Figure 5 UPEPA Fluence Values for Inactivation with UV Light**

## Residual Disinfection

As the disinfection with UV provides no residual protection, the use of a chlorine product will be required. Additionally, the use of a chlorine product is much more effective against viruses and bacteria than UV treatment as shown in Figure 6. The chlorine dosing will either be undertaken with sodium hypochlorite or chlorine gas, depending on capacity required of the dosing system.

Log Inactivation	Required <i>Ct</i> (mg.min/L)					
	Temperature (°C)			Temperature (°C)		
	5	15	25	5	15	25
<i>Giardia</i> <sup>a</sup>	pH ≤ 6			pH 8		
1	39	19	10	72	41	20
2	77	39	19	144	81	41
3	116	58	29	216	122	61
Viruses	6 < pH < 9			pH 10		
2	4	2	1	30	15	7
3	6	3	1	44	22	11
4	8	4	2	60	30	15

<sup>a</sup> Required *Ct* values for disinfection of *Giardia* by chlorine depend on the chlorine concentration; the values shown are for 2 mg/L as Cl<sub>2</sub>. The values for 1 mg/L as Cl<sub>2</sub> are approximately 10% less than those shown.

**Figure 6 USEPA Disinfection Requirement by Free Chlorine**

## Treated Water Tanks and Residual Monitoring

After the treatment process the water will be stored in tanks of sufficient capacity to ensure adequate residence time for the effectiveness of the disinfection with chlorine. If these tanks are used for additional storage capacity, a residual chlorine monitoring system will be used to recirculate the water back through the disinfection system as required. This operation will be to ensure the continued removal of micro-organisms in the water.

## APPENDIX A

### CONSTRUCTED FLOATING WETLAND



Brazeau County has utilized the Clarity Aquatic floating wetland system in its novel Violet Grove floating wetland project. We have been very happy with the durability of the product, as well as its ability to provide a stable and safe working platform for maintenance personnel. The native wetland plants have flourished in the floating wetland modules and the innovative design allows us to track plant growth and health with ease. We have just gone through our second severe winter with the Clarity Aquatic floating modules and the system is as good as new. We're able to walk on the modules safely in order to work on the plants without any problems. The design of these modules has been tested in subzero temperatures and I can say with confidence the modules are very safe for operation."

Mr Zimran Khokar, Project Manager - Public Works, Brazeau County

Discover the possibilities Clarity Aquatic offers for your project.  
Email [info@clarityaquatic.com](mailto:info@clarityaquatic.com) today.

FEATURES	SPECIFICATIONS	
Ease of Installation	Unique interlocking module design and planting baskets allow rapid, trouble-free installation. Modules are quickly connected with a simple key arrangement.	✓ Yes
Durability	10 Year Written Structural Warranty	✓ Yes
UV Stability	Made from 100% UV-resistant LDPE with an expected lifespan > 20 years	✓ Yes
Recyclability	All CFW components are fully recyclable and do not need to go to land-fill	✓ Yes
Strength	Modules have pull-apart strength > 4500kg (commercially tested)	✓ Yes
Stable Buoyancy	Modules have additional reserve buoyancy of over 300 kg which can be regulated by introducing ballast water into the module.	✓ Yes
Maintainability	Plants can be easily removed from the granular media if required without risk of damage to the baskets or modules.	✓ Yes
Accessibility	Modules have built-in walkways to ensure safe and easy movement through wetland for maintenance and access	✓ Yes
Flexibility	Modules can be arranged to produce nearly any desired shape, and can also be quickly and easily reconfigured, if required.	✓ Yes
Fauna Protection	Unique key design allows for temporary connection of custom frames for bird and turtle netting if required	✓ Yes
Safety	Specially designed brackets allow installation of handrails to AS1657 regulations if required	✓ Yes
Australian Made	CFW modules designed and manufactured in Australia providing local jobs	✓ Yes

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*A New Standard in  
Constructed Floating Wetlands  
Environmentally Engineered for Stormwater Treatment*



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## Strength and Flexibility

The interlocking module design is the strongest system on the market and allows the CFW to be expanded, reconfigured or even ultimately relocated in the future.



## Superior Performance

The system allows for plant roots to be suspended in the water. Most of the nutrient uptake occurs on the biofilm covering the roots, which has a very large surface area. Trials using Baumea spp show the highest ever recorded nitrogen and phosphorous uptake for a CFW.



## Environmentally Sustainable

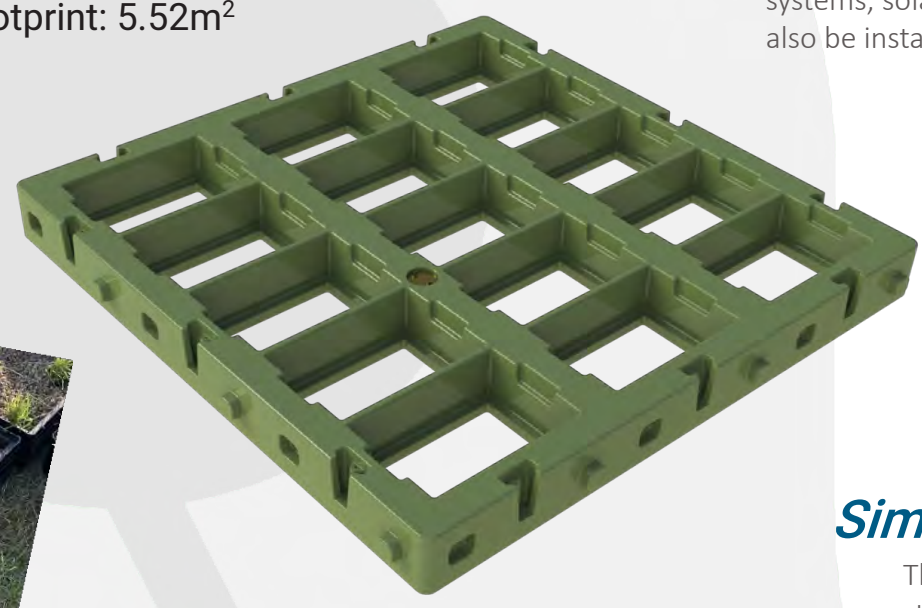
Manufactured from UV stabilised and recyclable low-density polyethylene (LDPE), with no risk of degradation or release of unwanted materials into the environment. Clarity Aquatic CFW modules come with a 10-year structural warranty and are fully recyclable at the end of their lifespan.



## Constructed Floating Wetland (CFW) Module

Footprint: 5.52m<sup>2</sup>

## Planting Boxes



*...the native plants have flourished in the floating wetland modules...*

## Easy to Access and Maintain

Plants are grown in purposely designed baskets allowing them to be individually harvested or replaced as required. Weed species can be easily removed without the need for herbicides.

# The Natural Approach to Stormwater Treatment

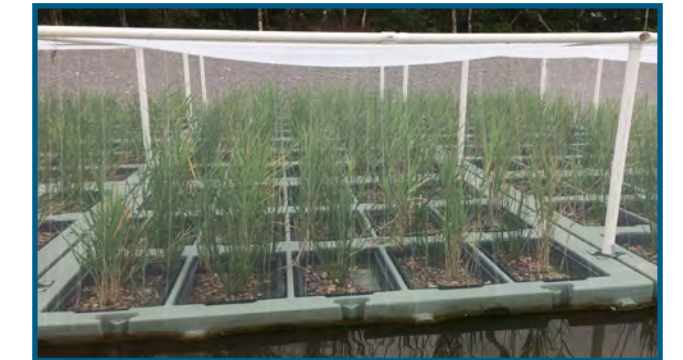
Constructed Floating Wetlands (CFWs) offer a range of advantages over traditional water treatment approaches. In combination with detention strategies, CFWs can substantially reduce the need for drainage infrastructure, can increase lot yield, require smaller footprints, and often reduce maintenance burdens.

## Engineered by Experts

Clarity Aquatic floating wetlands are designed to be the most adaptable product on the market. They are stable to walk on, easy to install and maintain, long lasting, and fully recyclable at the end of their design life.

## Modular and Adaptable System

Our system can incorporate key safety features, like handrails, walkways and working platforms. We can also build in water quality monitoring systems, solar panels, and aeration systems. Bird and turtle netting can also be installed to protect young plants if required.



## Simple and Fast Installation

The modules have adjustable buoyancy to allow for different stages of plant growth, different plant species, and various other weather conditions.

