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Surface Water Management Plan – Summary Document

Twynyrodyn, Merthyr Tydfil

Revision A – February 2024

SWMP Summary Document

- **This document should be read in conjunction with Frog Environmental Report FR3120_SWMP**
- **A copy of the Surface Water Management layout for the site is included in Appendix A. The maximum discharge from the site will be 2267 m^3/day. This is based on the average rainfall intensity for 6 hour 100 year event (+30% climate change) falling across the whole site and no reduction. Therefore a worst case scenario.**
  - ***Q= 2.73 x A x I = 2.73 x 2.04ha x 18.3mm/hr = 2267m^3***
- **The two permanent basins on site have been split into a settlement pond (Basin B) and attenuation basin (Basin A) during the construction phase. Both basins will be lined with an impermeable membrane. As per CIRIA Guidance Document C532 all calculations for temporary works are based on the 5 year event.**
- **The retention time required for full settlement particles can be determined as follows:**
  - ***T_r = n x d/V_s* where**
  - ***n is trap efficiency (assumed to be 70%), d is depth of flow (assumed to be 1m) and V_s is settling velocity (assumed to 0.018mm/s for a coarse silt)***
- **Total retention time to achieve 70% would be c. 13 hrs**

SWMP Summary Document

- Assuming a storage volume of 300m^3 in each section of Basin B for settlement, it is anticipated that the volume would turn over in c. 2 hours for each section. This is based on rainfall intensity of 6.92 mm/hr and a flow rate of 38 l/s. This is not sufficient for 70% trap efficiency hence the need for chemical treatment.
- Treatment following the attenuation/settlement in Basin B should be introduced via a pipe reactor containing Water Lynx blocks (WL494 | WL360) and across a Silt Capture Channel, into Basin A prior to discharge via overflow pipe. Full details of the treatment system are in Appendix B and Chemical Data Sheets are in Appendix C
- Settlement testing has shown the turbidity of the samples drops by 50% within a 2 hour period. The addition of flocculant results in a further 25% of the original reading being removed. A report of the test is included in Appendix D.
- Shorter duration events will have less retention time but less volume to process through the reactor. Longer duration events will have greater retention time but higher volumes. The 6 hour event is a median value to base calculations on.
- Whilst temporary works are designed for 5 year events, it should be noted that events in excess of the 10 year event can wholly be accommodated within Basin A. Anticipated volumes for run off into each basin for 1, 5 and 10 year events are in Appendix E. Further settlement will take place in this basin given that water will be held prior to discharge at Q Bar for the development (43 l/s)

SWMP Summary Document

- **To ensure that the mitigation and treatment process is working correctly, monitoring will utilise the standard monitoring record form in Appendix F, measure and record the following parameters:**

Parameter	Measurement	Range	Method
Weather	Visual	**Sun | Rain**	Observation
Discharge from site	Visual	**Yes | No**	Observation
Water Clarity	Visual	**Clear | Cloudy | Silty**	Observation
Turbidity	NTU	**0-150**	Palintest Turbidity Meter
TSS	Mg/l	**0-100**	Palintest Turbidity Meter
pH	pH	**6.5-8.5**	pH meter
Hydrocarbons	Visual	**sheen**	Observation

- **It is anticipated that the TSS value at the discharge will not exceed 40mg/l**
- **Should an Environmental Incident occur, it will be recorded and reported in accordance with Persimmon Homes Group Guidance, which is included in Appendix G. Whilst this is standard Persimmon guidance, for this development any potential to breach the permit limit, or discharge water in a way not permitted, will be immediately reported to NRW. This report will include measures that are being taken to resolve the issue and return to compliance**

SWMP Summary Document

- **Appendix H also contains Persimmon Homes Group Guidance on the treatment and disposal of concrete washout on development sites.**
- **In accordance with Persimmon Homes standards, there will be several points of contact for development in terms of Environmental Management – these are outlined below and will be kept up to date in the Project Environmental Plan held on site.**

Point of contact	
Person(s) acting as normal contact with the Regulator about this plan	Name: Anthony Harris Tel: 07721 260989 Email: anthony.harris@persimmonhomes.com
Person(s) acting as 24-hour contact with the Regulator in case of emergency (i.e. if there is an imminent risk of pollution or where pollution is occurring)	Name: Anthony Harris Tel: 07721 260989 Email: anthony.harris@persimmonhomes.com
Person(s) acting as the environmental lead with the Regulator about this plan	Name: Caroline North Tel: 07548 218673 Email: caroline.north@persimmonhomes.com
Person(s) acting on behalf of the operator as a contracted environmental support	Name: Natalia Perez del Postigo (Frog Environmental) Tel: 07827 765 850 Email: natalia@frogenvironmental.co.uk

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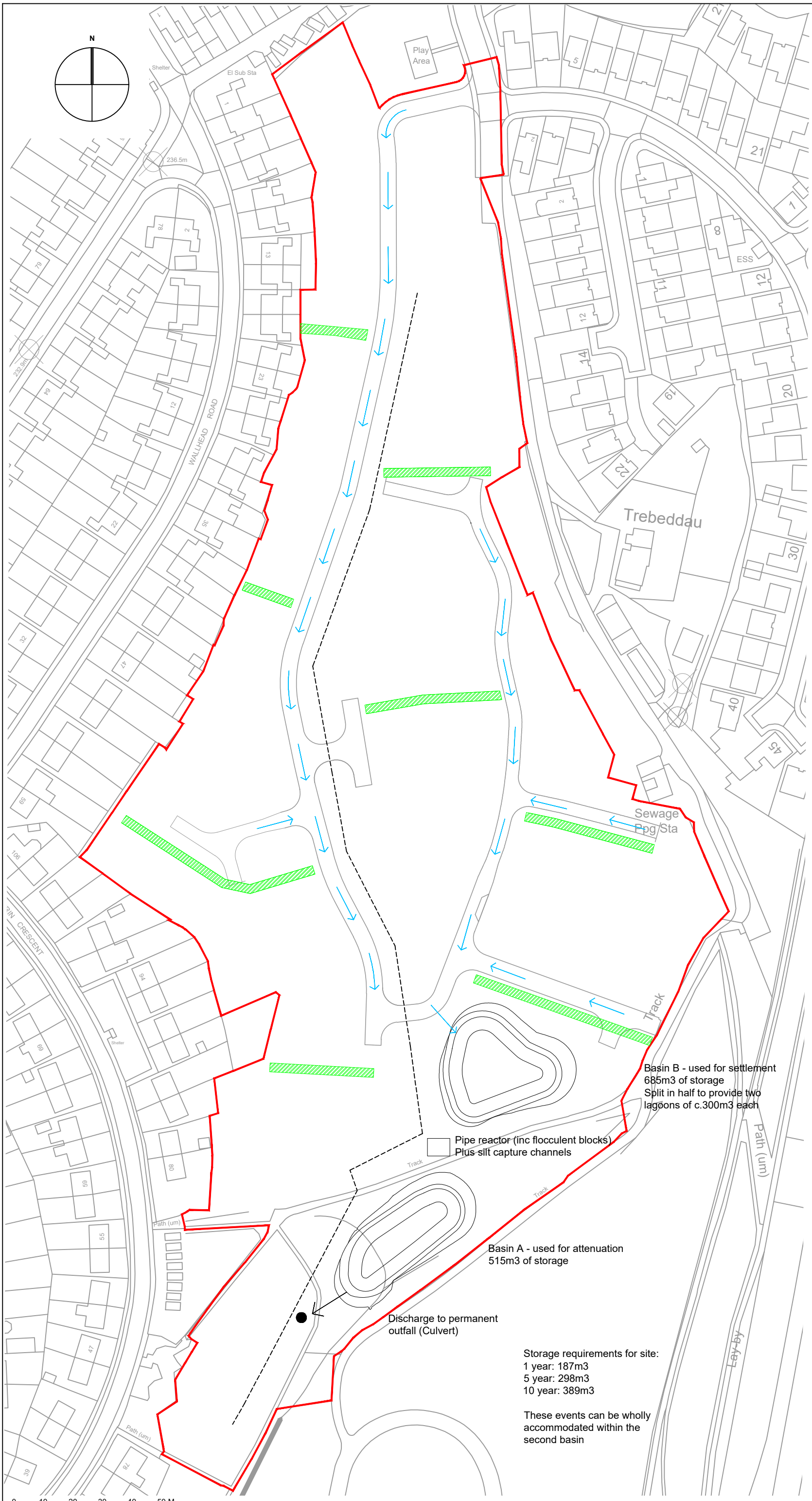
Appendix A – Site Plan

A



Site Legend

- Application Site
- Diverted Culvert
- Basins used as settlement ponds
- Pipe reactor system
- Discharge and monitoring location (Manual)
- Utilise proposed surface water infrastructure to convey flows
- Capture channels installed as required on site, utilising existing channels wherever possible

Rev A - Basin storage requirements and capture channels shown — 06.10.23

Twynyrodyn
Merthyr Tydfil

Drawing Title: Surface Water Permit Plan

Drawing No	Drawing by:
SW-03_A	RJ
Scale	Checked by:
1:1250 @ A3	Technical
Date	Status:
02.08.23	Planning

Persimmon Homes
East Wales

Persimmon House
Llantrisant Business Park
Llantrisant
Rhondda Cynon Taf
CF72 8YP
Tel : 01443 223 653

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Appendix B – Treatment System

B

Settlement Pond Design Guidance Note

GN-08v1

Settlement Ponds

Settlement ponds and lagoons offer valuable silt control during temporary works, providing necessary water capture and retention to enable surface water management.

Settlement ponds allow physical settlement and containment of silt whilst providing the opportunity to introduce flocculant through the placement of gel blocks in the inflow promoting further separation and settlement of solids.

Temporary settlement ponds can be positioned within the footprint of the permanent pond design, making a few simple adaptations to improve their function in silt control

Attenuation ponds, or settlement lagoons that are used for storing excess surface water runoff can be made more effective for managing muddy water encountered during the construction phase of a project and improved settlement of silts, with a few simple measures.

Early Planning

- Determine the potential surface water volumes during a storm event, considering catchment size and rainfall intensity.
- Ensure that there is sufficient capacity to hold water during a storm event.
- Ensure that the ponds are watertight.

Improving the performance of settlement ponds for silt control during construction

- Early construction, creating slope roughness and stabilisation with the establishment of vegetation on the bed and banks of the basin will reduce the potential for erosion.
- Avoid installing the permanent outfall whilst the asset is being used for silt control, the headwall can be undermined causing uncontrolled egress of water. Instead create a spillway to manage the flow pathway of excess water. Consider forming this as a series of steps in the spillway to slow the flow rather than a steep channel.
- If it is necessary to install the permanent outfall, then incorporate a penstock or flap valve to allow prevent and control the release of water from site. Pipe stoppers and bungs are less reliable and bring risk of failure.
- Prevent scour and erosion as water enters the pond, consider lining the bank with a membrane, rock mattress, or concrete canvass.
- Slow the flow as water enters the lagoon, introduce baffles to reduce energy and disperse water.

October 2021

- Create a forebay or primary cell to contain the bulk of the settled solids.
- Prevent short cutting or channelisation between the income and overflow to maximise settlement in the pond. Achieved simply by utilising an impermeable barrier such as a silt curtain.
- Release water from the surface of the pond, whether this is via a spillway or pump to ensure that only the cleanest water is transferred through the system.
- Should a subsurface discharge have to be used, form a permeable bund around the outfall to prevent mud from being drawn from the bed through the outfall.
- Release water as adequate quality is achieved to ensure capacity for storm waters.



In instances where clay soils are encountered, even large attenuation ponds with a big surface area will struggle to achieve clean water through gravity settlement alone and the introduction of a flocculant needs to be considered. A flocculant such as the Water Lynx gel blocks supports the aggregation of the fine clay and silt particles into larger heavier clumps known as ‘flocs’ that will more easily fall out of suspension.

Additional Silt Control Using Flocculant

- Water Lynx gel flocculant blocks can be installed under gravity into the drains and interceptor ditches that fed the lagoon, on the spillways and within pipes between ponds.
- Water may be pumped to the settlement pond via a pipe reactor containing gel flocculant blocks.
- Floc Nets can be incorporated into the pond design, permeable to water they serve to polish the water prior to the outfall.
- Polishing water in the outfall channel using a series of Floc Mats and Silt Mats.
- In a closed pond water may be pumped via pipe reactor and silt capture channel to provide the final silt control before release from site.

Monitoring

- Monitor the surface water being released into the stream at the point of discharge.
- Please refer to the frog environmental turbidity monitoring guidance note for further information.
- Silt management is iterative, taking any of these steps will help to maximise the effectiveness of a settlement pond.

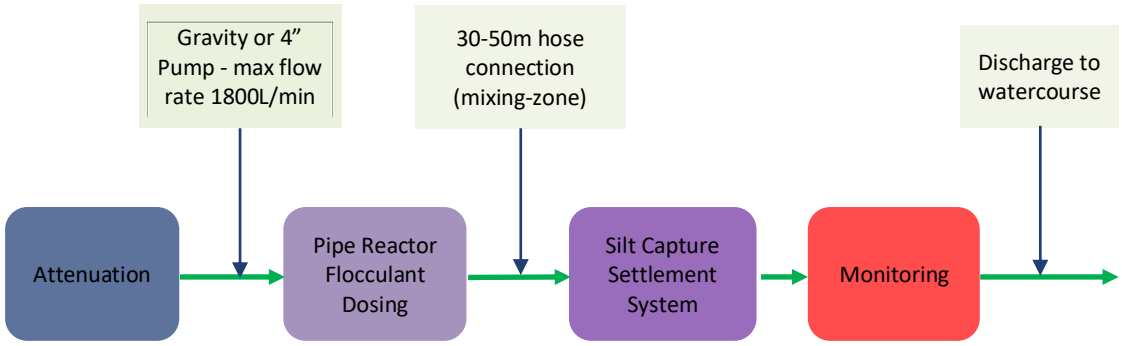
Pipe Reactor Mobile Water Treatment System Guidance Note

GN-10v1

The Pipe Reactor is designed to optimise flocculant mixing so that when water is passed through the barrel and a mixing-zone, fine silts and clays bind together. Smaller particles then become easier to trap through settlement or in a Silt Capture Channel.

Water may be pumped or moved under gravity through the Pipe Reactor, connected inline to rigid or layflat hose using a 4" Bauer coupling.

The correct deployment of the Pipe Reactor is vital to ensure the suitable mixing and binding of the flocculant, as well as the capture of silt to complete the water treatment process.



Overview of Treatment Process

Principles

- Ensure the water treatment system is easily accessible from site to enable regular maintenance.
- If a pump is used, specify a 4" model with a flow restrictor, the flow restrictor may be a separate element.
- The pump rate will be an important aspect of treatment and may need to be altered to achieve the water quality goals. The maximum flow will be 1800L/min (30L/sec).
- A mixing zone of 30-50m should immediately follow the Pipe Reactor, transferring water to the silt capture. Lay flat hose is a popular option but solid pipes may also be configured.
- The pH of water entering the treatment should be 6-9 to ensure maximum treatment efficacy.
- An NTU of over 3000 will blind the blocks and prevent the system from working effectively.

October 2021

Pipe Reactor Mobile Water Treatment System Guidance Note
GN-10v1

- Minimise the transfer of heavy silts when transferring water. Do not allow the pump hose or strainer to settle on or draw silts from the ground, instead use a sump, stone pad or float the head. If operating under gravity protect the intake. The pumping from excavations guidance note provides more detail good practice.
- Constantly treat and release water to maximise capacity within attenuation ponds

Capturing Flocculated Silt

Appropriate capture methods include the use of a settlement lagoon, settlement tank and / or a silt capture channel. This aspect should be carefully considered prior to the start-up of the Pipe Reactor.

The capture system needs to be suitably sized to physically settle and filter the 'flocs', the flow may need to be split across two tanks or silt capture channels in parallel to each other to ensure they are not inundated. Silts will need to be removed from the system at regular intervals to retain capacity and treatment efficiency.

Settlement Pond

- A settlement pond can physically settle the 'flocs' effectively separating the silt from the water.
- Ensure no muddy flows are being received by the pond, bypassing the treatment.
- Reference the settlement pond guidance note and adopt good design principles to maximise settlement.
- Prevent silts from becoming entrained in the clean water by releasing water from the surface of the settlement pond to final discharge point via a polishing channel.

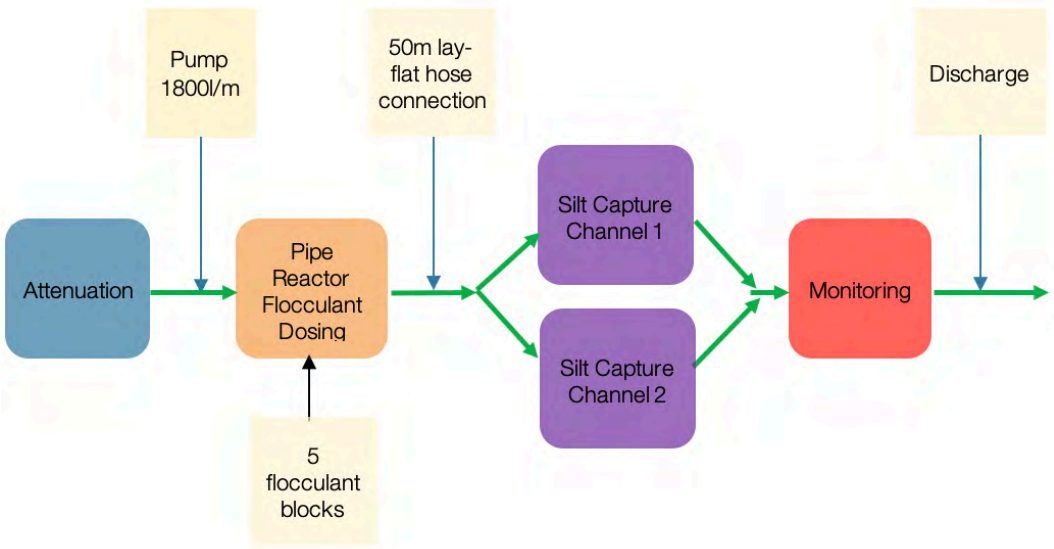
Settlement Tank

- Several tank-based systems are available on the market, each having different properties. Utilise the largest volume tank you can obtain, this must have baffles with coalescent media and/or lamella plates. A skip such as a roll on roll off or container may be adapted for this purpose.
- The flow rate will depend on the volume and effectiveness of the internal media, it will be necessary to check the final effluent and alter the flow velocity to attain the water quality required.

- It is suggested that 900L/min (30L/sec) is likely to be the maximum rate of a standard XXL settlement tank.
- Tanks may be placed parallel to each other, and water split between them to increase treatment efficiency.
- Water must be transferred from the tank to the discharge point without the possibility of new silts becoming entrained in the clean water. A polishing channel may be used before releasing water from site.

Silt Capture Channel

- The Silt Capture Channel is designed to capture silt, separating the solid fraction from water with a maximum flow rate of 900L/min.
- A typical channel is 4m wide and 20m long, lined with an impermeable membrane.
- Silt Capture Channels can be placed parallel to each other, and water split between them to increase treatment rates and efficiency.
- Reference the Silt Capture Channel Installation Method Statement.
- Water must be transferred from the end of the channel to the discharge point without entraining silts in the clean water, this may be an extension of the channel of piped outfall.



Example set up of Pipe Reactor and x 2 Silt Capture Channels

Maintenance and Monitoring

- Monitor the surface water leaving site at the discharge point.
- Ensure that there is a regime of inspection and maintenance of the silt control measures for their continued integrity, remove excess silts from the system, clean settlement media and replace the materials such as Floc Mats, Silt Mats and Water Lynx Blocks.
- Stop all water movement and connection to the discharge point whilst maintenance activities take place to ensure that there is no risk to the wider environment i.e., by a road sweeper suctioning out material and that the excess material can be moved to appropriate storage location.
- Plan where any excess captured silts will be stored and/or used on site to prevent their re-entry into the surface water system.

End notes

- Ensure you have agreement for the use of flocculants from the regulator and the MSDS is available.
- No requirement for storage of liquid coagulants, flocculants or buffering agents is required on site when using Water Lynx gel flocculant blocks.
- There is no possibility of operator error regarding over-dosing or incorrect dosing with the gel flocculant blocks.
- Floc Mats and Silt Mats are comprised entirely of natural biodegradable materials (coir and jute) and so may be reused on site following their function as a silt capture vessel, such as ground stabilisation and seeding
- The flocculants do not change waste classification (EWC code) of the material for waste disposal and reuse on site
- Early engagement regarding site set up affords opportunities to rely on gravity for some parts of the treatment. This reduces reliance on pumps and can significantly reduce carbon footprint and costs, see case study: https://www.frogenvironmental.co.uk/case-study/zero-carbon-water-lynx/

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Appendix C – Chemical Data Sheets

C

SAFETY DATA SHEET

Gel Flocculant 360

SECTION 1: IDENTIFICATION OF MIXTURE AND COMPANY

1.1 Product identifier

Gel Flocculant 360

CHEMICAL FAMILY: Polyacrylamide/polyacrylate polymer

CAS NUMBER: none identified

CHEMICAL NAME: none identified

1.2 Relevant Identified Uses

Water treatment

1.3 Supplier

Frog Environmental Ltd

Business Contact

The Byre

0345 057 4040

Blackenhall Park

Emergency Contact

Bar Lane

Staffordshire DE13 8AJ

0345 057 4040 (not 24 hours)

24 Hour Emergency Contact

UK National Poisons Information Service: 0344 892 0111

SECTION 2: HAZARDS IDENTIFICATION

2.1. Classification

Not classified according to EU regulation 1272/2008 as implemented in The Chemicals (Health and Safety) and Genetically Modified Organisms (Contained Use) (Amendment etc.) (EU Exit) Regulations 2019.

2.2 Label elements

No labeling required

2.3. Other hazards

No component meets the criteria of a PBT or vPvB substance according to EU regulation 1907/2006 as implemented in The REACH etc. (Amendment etc.) (EU Exit) Regulations 2019 (as amended)

SECTION 3: COMPOSITION/INFORMATION ON INGREDIENTS

There are no components present, within the current knowledge of the supplier that are classified as hazardous to health or the environment and present at concentrations that require reporting in this section.

SECTION 4: FIRST AID MEASURES

4.1. Description of first aid measures

General

Take proper precautions to ensure your own health and safety before attempting rescue and providing first aid.

Skin

Wash skin with soap and water. Remove contaminated clothing. Launder contaminated clothing before reuse. If irritation occurs get medical attention.

Inhalation

Remove exposed person to fresh air. Seek medical attention if the patient feels unwell.

Eye

Flush eyes with large amounts of water for at least 15 minutes, lifting eyelids to insure complete flushing of surface. Seek medical attention if irritation persists.

Ingestion

Keep at rest. Never give anything by mouth to an unconscious person. Do not induce vomiting. If vomiting occurs, the head should be kept low so that vomit does not enter the lungs. Keep airway clear. Seek medical attention.

4.2. Most important symptoms and effects, both acute and delayed.

Signs and Symptoms of Acute Exposure

Inhalation: vapours, mists or dusts of the product may be irritating to the respiratory system. May irritate mouth, nose, and throat.

Ingestion: May cause irritation of the lining of the stomach.

Skin: Mild to moderate irritation can occur.

Eyes: Can cause mild to moderate irritation.

Chronic Health Effects

Prolonged or repeated contact may cause defatting and drying of the skin. Prolonged or repeated contact may cause discomfort and local redness. No known other chronic effects.

4.3 Indication of any immediate medical attention and special treatment needed.

Treat symptomatically.

SECTION 5: FIRE FIGHTING MEASURES

5.1. Extinguishing Media

Suitable: Use extinguishing media suitable for the surrounding fire.

Unsuitable: None.

5.2. Special hazards arising from the mixture

Hazardous Combustion Products: Carbon and Nitrogen Oxides (CO, CO2, NOx)

5.3. Advice for Firefighters

Protective Equipment/Clothing: Wear full protective clothing including positive pressure self-contained breathing apparatus.

Fire Fighting Guidance: Fight large fires from maximum distance or use unmanned hose handlers or monitor nozzles. Move containers from fire area if you can do it without risk. Cool containers with flooding quantities of water until after fire is out.

SECTION 6: ACCIDENTAL RELEASE MEASURES

6.1 Personal precautions, protective equipment and emergency procedures

Wear appropriate protective equipment (see section 8). Wet product and aqueous solutions of product are very slippery. Trace amounts of product on smooth surfaces can become extremely slippery when wet.

6.2 Environmental precautions

Prevent entry of concentrated solutions into waterways or sewers.

6.3. Methods and materials for containment and clear up

Sweep or scoop dry material and place in appropriate container. Absorb aqueous solutions with a dry inert material, such as clay, and place in an appropriate waste disposal container. After most of the material has been recovered, clean the area with warm, soapy water.

SECTION 7: HANDLING AND STORAGE

7.1. Precautions for Safe Handling

Normal precautions common to good manufacturing practice should be followed in handling and storage. Open and handle container with care. Keep the containers closed when not in use. Avoid physical damage to blocks. Use appropriate personnel protective equipment (See section 8).. Avoid contact with eyes, skin, and clothing. Do not ingest. After handling, wash hands thoroughly with soap and water.

7.2. Conditions for safe storage, including any incompatibilities.

Store in a cool, dry area. Store in accordance with good industrial practices. Keep away from direct sunlight. Protect against physical damage.

SECTION 8: EXPOSURE CONTROLS AND PERSONAL PROTECTION

8.1. Control parameters

None identified.

8.2. Exposure controls

8.2.1. Engineering Controls

No specific measures required.

8.2.2. Individual Personal Protection

Eye Safety glasses are required as a minimum. Use splash goggles or a face shield when eye contact due to splashing is possible.

Skin: Wear nitrile, butyl or Viton® gloves. The specification of glove depends on the work being undertaken; consult manufacturer's recommendations. Breakthrough times >480 mins (thickness ≥0.1 mm). When skin contact is possible for other than the hands, protective clothing including gloves, apron, sleeves, boots, head and face protection should be worn. Protective clothing must be cleaned thoroughly after each use.

Respiratory: No specific measures required.

Thermal: No hazard

Additional Remarks: Selection of appropriate personal protective equipment should be based on an evaluation of the performance characteristics of the protective equipment relative to the task(s) to be performed, conditions present, duration of use, and the hazards and/or potential hazards that may be encountered during use. Emergency eye wash fountains and safety showers should be available in the immediate vicinity of any potential exposure. Use good personal hygiene practices. Wash hands before eating, drinking, smoking, or using toilet facilities. Promptly remove soiled clothing and wash thoroughly before reuse. Use care in walking on spilled material. Material spilled on hard surfaces can be a serious slipping/falling hazard.

8.2.3. Environmental exposure controls

No specific measures identified for normal handling and use.

SECTION 9: PHYSICAL AND CHEMICAL PROPERTIES

Physical state: Solid.

Colour: Green to white or off-white

Odor: Slight vinegar odour.

Melting Point: > 100 °C

Boiling Point: > 100 °C

Flammability: not flammable

Lower/Upper Flammable Limit: Not applicable

Flash Point: No Data Available

Auto-Ignition temperature: No data available

Decomposition temperature: No data available.

pH: 7 (concentration dependent)

Viscosity: Not applicable.

Solubility (Water): Soluble in water but dissolves very slowly.

Partition Coeffecient (KOW): No Data Available.

Vapor Pressure: No data available

Relative density: ~1.1

Vapour density: No data available

Particle characteristics: Not applicable, bulk form

Other information : No relevant data identified

SECTION 10: STABILITY AND REACTIVITY

10.1: Reactivity

No hazardous reactions identified. Does not react with air, water or other common materials.

10.2. Chemical Stability

This product is stable.

10.3. Possibility of hazardous reactions

None identified. Hazardous polymerization will not occur.

10.4. Conditions to Avoid

High temperatures.

10.5. Incompatible materials

Oxidising agents. Strong bases may cause the release of ammonia.

10.6. Hazardous Decomposition Products

Carbon and nitrogen oxides (CO, CO_2 NO_x)

SECTION 11: TOXICOLOGICAL INFORMATION

11.1. Information on hazard classes

Acute Toxicity: This product is of a low order of acute toxicity. Oral LD50 (Rat) >5000 mg/kg

Skin Irritation: Mild to moderate irritation can occur. Prolonged or repeated contact may cause defatting and drying of the skin

Eye irritation: Transient mild to moderate irritation can occur.

Respiratory of skin sensitization: No known effects.

Germ cell mutagenicity: No known effects

Carcinogenicity: No known effects

Reproductive toxicity: No known effects

Specific target organ toxicity – single exposure: No known effects

Specific target organ toxicity – repeated exposure: No known effects

Aspiration hazard: not applicable for solids

11.2. Other information

The substance is not expected to have endocrine disrupting properties. No other relevant information identified.

SECTION 12: ECOLOGICAL INFORMATION

12.1. Ecotoxicity

Fish (Oncorhynchus mykiss): 96 hr LC_{50}: 140- 150 mg/L.

Invertebrates (Daphnia magna): 48 hr EC_{50}: ≥ 125 mg/L.

12.2. Persistence and Degradability

Not readily biodegradable but complete mineralization is expected under environmental exposure. Degradation initialization and rate are dependent on UV levels.

12.3. Bioaccumulation potential

The product is not expected to bioaccumulate.

12.4. Mobility in soil

The product is designed to bind to sediment and soil, so it is not expected to suffer from leaching or mobility.

12.5. Results of the PBT assessment

This product does not meet the criteria of a PBT or vPvB substance.

12.6 Endocrine disrupting properties

The substance is not expected to have endocrine disrupting properties

12.7 Other adverse effects

None identified

SECTION 13: DISPOSAL CONSIDERATIONS

13.1 Waste treatment methods: Dispose of all waste must be in accordance with all applicable national and local health and environmental regulations. Empty containers should be recycled or disposed of through an approved waste management facility.

SECTION 14: TRANSPORT INFORMATION

14.1: UN number: Not applicable. The products is not classified as dangerous for transport.

14.2: UN proper shipping name: The products is not classified as dangerous for transport.

14.3: Transport hazard classes: Not applicable. The products is not classified as dangerous for transport

14.4: Packing group: Not applicable. The products is not classified as dangerous for transport

14.5: Environmental hazards: None identified.

14.6: Special precautions for users: None identified.

14.7. Maritime transport in bulk: Not applicable. The products is not classified as dangerous for transport

SECTION 15: REGULATORY INFORMATION

15.1. Safety, health and environmental regulations/ legislation specific for the product

EU REACH: All components of this product have been registered with the European Chemicals Agency or are exempt from registration.

U.S. TSCA Inventory Status: All components of this product are either on the Toxic Substances Control Act (TSCA) Inventory List or exempt.

Canadian DSL Inventory Status: All components of this product are either on the Domestic Substances List (DSL), the Non-Domestic Substances List (NDSL) or exempt.

15.2. Chemical Safety Assessment

A chemical safety assessment has not been carried out for this product.

SECTION 16: OTHER INFORMATION

DATE: December 2022: First issue:

DISCLAIMER OF RESPONSIBILITY

Information contained in this publication, while accurate to the best knowledge and belief of Frog Environmental Ltd (FEL) is not intended and should not be construed as a warranty or representation for which FEL assumes any legal responsibility.

Any information or advice obtained from FEL otherwise than by means of this publication is also given in good faith. However, it remains at all times the responsibility of the customer to ensure that the product is suitable for the particular purpose intended. Conditions of use are beyond our control, and therefore users are responsible for verifying the data under their own operating conditions to determine whether the product is suitable for their particular purposes and they assume all risks of their use, handling, and disposal of the product.

FEL accepts no liability whatsoever (except as otherwise expressly provided by law) arising out of the use of information supplied, the application, adaptation or processing of the products described herein, the use of other materials in lieu of FEL materials or the use of FEL materials in conjunction with such other materials. The information in this safety data sheet relates only to the product designated herein, and does not relate to its use in combination with any other material.

SAFETY DATA SHEET

Gel Flocculant 494

SECTION 1: IDENTIFICATION OF MIXTURE AND COMPANY

1.1 Product identifier

Gel Flocculant 494

CHEMICAL FAMILY: Polyacrylamide polymer

CAS NUMBER: none identified

CHEMICAL NAME: none identified

1.2 Relevant Identified Uses

Water treatment

1.3 Supplier

Frog Environmental Ltd

Business Contact

The Byre

0345 057 4040

Blackenhall Park

Emergency Contact

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24 Hour Emergency Contact

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Remove exposed person to fresh air. Seek medical attention if the patient feels unwell.

Eye

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Ingestion

Keep at rest. Never give anything by mouth to an unconscious person. Do not induce vomiting. If vomiting occurs, the head should be kept low so that vomit does not enter the lungs. Keep airway clear. Seek medical attention.

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Unsuitable: None.

5.2. Special hazards arising from the mixture

Hazardous Combustion Products: Carbon and Nitrogen Oxides (CO, CO_2, NO_x)

5.3. Advice for Firefighters

Protective Equipment/Clothing: Wear full protective clothing including positive pressure self-contained breathing apparatus.

Fire Fighting Guidance: Fight large fires from maximum distance or use unmanned hose handlers or monitor nozzles. Move containers from fire area if you can do it without risk. Cool containers with flooding quantities of water until after fire is out.

SECTION 6: ACCIDENTAL RELEASE MEASURES

6.1 Personal precautions, protective equipment and emergency procedures

Wear appropriate protective equipment (see section 8). Wet product and aqueous solutions of product are very slippery. Trace amounts of product on smooth surfaces can become extremely slippery when wet.

6.2 Environmental precautions

Prevent entry of concentrated solutions into waterways or sewers.

6.3. Methods and materials for containment and clear up

Sweep or scoop dry material and place in appropriate container. Absorb aqueous solutions with a dry inert material, such as clay, and place in an appropriate waste disposal container. After most of the material has been recovered, clean the area with warm, soapy water.

SECTION 7: HANDLING AND STORAGE

7.1. Precautions for Safe Handling

Normal precautions common to good manufacturing practice should be followed in handling and storage. Open and handle container with care. Keep the containers closed when not in use. Avoid physical damage to blocks. Use appropriate personnel protective equipment (See section 8).. Avoid contact with eyes, skin, and clothing. Do not ingest. After handling, wash hands thoroughly with soap and water.

7.2. Conditions for safe storage, including any incompatibilities.

Store in a cool, dry area. Store in accordance with good industrial practices. Keep away from direct sunlight. Protect against physical damage.

SECTION 8: EXPOSURE CONTROLS AND PERSONAL PROTECTION

8.1. Control parameters

None identified.

8.2. Exposure controls

8.2.1. Engineering Controls

No specific measures required

8.2.2. Individual Personal Protection

Eye Safety: glasses are required as a minimum. Use splash goggles or a face shield when eye contact due to splashing is possible.

Skin: Wear nitrile, butyl or Viton® gloves. The specification of glove depends on the work being undertaken; consult manufacturer's recommendations. Breakthrough times >480 mins (thickness ≥0.1 mm). When skin contact is possible for other than the hands, protective clothing including gloves, apron, sleeves, boots, head and face protection should be worn. Protective clothing must be cleaned thoroughly after each use.

Respiratory: No specific measures required.

Thermal: No hazard

Additional Remarks: Selection of appropriate personal protective equipment should be based on an evaluation of the performance characteristics of the protective equipment relative to the task(s) to be performed, conditions present, duration of use, and the hazards and/or potential hazards that may be encountered during use. Emergency eye wash fountains and safety showers should be available in the immediate vicinity of any potential exposure. Use good personal hygiene practices. Wash hands before eating, drinking, smoking, or using toilet facilities. Promptly remove soiled clothing and wash thoroughly before reuse. Use care in walking on spilled material. Material spilled on hard surfaces can be a serious slipping/falling hazard.

8.2.3. Environmental exposure controls

No specific measures identified for normal handling and use.

SECTION 9: PHYSICAL AND CHEMICAL PROPERTIES

Physical state: Solid

Colour: Yellow to white or off-white

Odor: Slight vinegar odour

Melting Point: > 100 °C

Boiling Point: > 100 °C

Flammability: not flammable

Lower/Upper Flammable Limit: Not applicable

Flash Point: No data available

Auto-Ignition temperature: No data available

Decomposition temperature: No data available

pH: 5-7.5 (concentration dependent)

Viscosity: Not applicable

Solubility (Water): Soluble in water but dissolves very slowly

Partition Coeffecient (KOW): No data available

Vapor Pressure: No data available

Relative density: ~1.1

Vapour density: No data available

Particle characteristics: Not applicable, bulk form

Other information : No relevant data identified

SECTION 10: STABILITY AND REACTIVITY

10.1: Reactivity

No hazardous reactions identified. Does not react with air, water or other common materials

10.2. Chemical Stability

This product is stable

10.3. Possibility of hazardous reactions

None identified. Hazardous polymerization will not occur

10.4. Conditions to Avoid

High temperatures

10.5. Incompatible materials

Oxidising agents. Strong bases may cause the release of ammonia

10.6. Hazardous Decomposition Products

Carbon and nitrogen oxides (CO, CO_2 NO_x)

SECTION 11: TOXICOLOGICAL INFORMATION

11.1. Information on hazard classes

Acute Toxicity: This product is of a low order of acute toxicity. Oral LD50 (Rat) >5000 mg/kg

Skin Irritation: Mild to moderate irritation can occur. Prolonged or repeated contact may cause defatting and drying of the skin

Eye irritation: Transient mild to moderate irritation can occur

Respiratory of skin sensitization: No known effects

Germ cell mutagenicity: No known effects

Carcinogenicity: No known effects

Reproductive toxicity: No known effects

Specific target organ toxicity – single exposure: No known effects

Specific target organ toxicity – repeated exposure: No known effects

Aspiration hazard: not applicable for solids

11.2. Other information

The substance is not expected to have endocrine disrupting properties. No other relevant information identified

SECTION 12: ECOLOGICAL INFORMATION

12.1. Ecotoxicity

Fish (Oncorhynchus mykiss): 96 hr LC_{50}: > 2500 mg/L.

Invertebrates (Daphnia magna): 48 hr EC_{50}: immobility 705 mg/L.

12.2. Persistence and Degradability

Not readily biodegradable but complete mineralization is expected under environmental exposure. Degradation initialization and rate are dependent on UV levels.

12.3. Bioaccumulation potential

The product is not expected to bioaccumulate.

12.4. Mobility in soil

The product is designed to bind to sediment and soil, so it is not expected to suffer from leaching or mobility.

12.5. Results of the PBT assessment

This product does not meet the criteria of a PBT or vPvB substance.

12.6 Endocrine disrupting properties

The substance is not expected to have endocrine disrupting properties

12.7 Other adverse effects

None identified

SECTION 13: DISPOSAL CONSIDERATIONS

13.1 Waste treatment methods: Dispose of all waste must be in accordance with all applicable national and local health and environmental regulations. Empty containers should be recycled or disposed of through an approved waste management facility.

SECTION 14: TRANSPORT INFORMATION

14.1: UN number: Not applicable. The products is not classified as dangerous for transport.

14.2: UN proper shipping name: The products is not classified as dangerous for transport.

14.3: Transport hazard classes: Not applicable. The products is not classified as dangerous for transport

14.4: Packing group: Not applicable. The products is not classified as dangerous for transport

14.5: Environmental hazards: None identified.

14.6: Special precautions for users: None identified.

14.7. Maritime transport in bulk: Not applicable. The products is not classified as dangerous for transport

SECTION 15: REGULATORY INFORMATION

15.1. Safety, health and environmental regulations/ legislation specific for the product

EU REACH: All components of this product have been registered with the European Chemicals Agency or are exempt from registration.

U.S. TSCA Inventory Status: All components of this product are either on the Toxic Substances Control Act (TSCA) Inventory List or exempt.

Canadian DSL Inventory Status: All components of this product are either on the Domestic Substances List (DSL), the Non-Domestic Substances List (NDSL) or exempt.

15.2. Chemical Safety Assessment

A chemical safety assessment has not been carried out for this product.

SECTION 16: OTHER INFORMATION

DATE: December 2022: First issue:

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Any information or advice obtained from FEL otherwise than by means of this publication is also given in good faith. However, it remains at all times the responsibility of the customer to ensure that the product is suitable for the particular purpose intended. Conditions of use are beyond our control, and therefore users are responsible for verifying the data under their own operating conditions to determine whether the product is suitable for their particular purposes and they assume all risks of their use, handling, and disposal of the product.

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Appendix D – Settlement Test

D

Settlement Test and Gel Flocculant Validation Report
CT-02v5

Frog reference	FR3120
Customer	Persimmon Homes
Site	Twyn y Rodyn
Sample	Collected by Natalia Perez del Postigo (frog environmental)
Date	31.07.2023
Lead Author	Natalia Perez del Postigo natalia@frogenvironmental.co.uk

Table of Contents

Introduction

Testing has been undertaken on a soil & water sample from the above-mentioned site. The testing process examines the rate of natural separation of solid fraction from water and helps inform the type of silt pollution control measures that may be required during Temporary Works.

frog environmental has a protocol in place that we will first examine the possibilities for treating water without the deployment of flocculants. Only when this avenue has been exhausted through testing and site investigation will frog suggest the use of a flocculant. For more information about the use of flocculants on construction sites, please follow the link: https://www.frogenvironmental.co.uk/pollution-avoidance-and-mitigation/flocculant-use-on-a-construction-site/

If test result show that a flocculant is required, there is a preference for working with the customer to develop gravity fed treatment systems. Gravity fed systems have several distinct advantages over pumped system:

- Reduced energy and carbon footprint
- Reduced fuel costs
- Reduced pump hire costs
- Reduced risk associated with refueling

A limitation of gravity fed treatment systems can be the effective mixing of flocculant with effluent. In these circumstances, forced mixing using a pumped flow of water can improve reaction times and settlement rates. Gravity fed systems are therefore not appropriate for every site.

About Gel Flocculant

Gel Flocculant is an active silt control product applied in slow-release solid gel blocks. It is designed to separate liquid from solid. Gel Flocculant is stored in dehydrated state and only activates on contact with water. There are several different blends of Gel Flocculant frequently used in the UK and settlement testing establishes the most effective blend for the site in question. In some circumstances a combination of 2 different blends of Gel Flocculant may provide the most effective solid separation.

Gel Flocculant products applied in the UK are synthetic anionic polyacrylamides that also have a coagulating function.

For peer reviewed information regarding the safety of Gel Flocculant and its fate in the environment, a literature review is available from frog environmental upon request.

Management calculations to demonstrate the carry-over concentrations of three key substances; Acrylamide, Polyacrylamide Polyelectrolyte (PP) and Aluminium contained in Gel Flocculant are completed for every project to ensure compliance with relevant Environmental Quality Standards (EQS) for drinking water. These calculations are intentionally conservative and do not account for the factor of the dilution within the receiving waterbody nor any binding to the sediments. It is anticipated that any residual concentrations are present in very small concentrations.

Should there be specific environmental sensitivities, testing for acrylamide and aluminum concentrations in effluent can be undertaken as part of a management system to ensure thresholds are not breached. However, there are no UK laboratory tests available for polyelectrolytes.

Test Process

The aim of testing is to record the natural separation of the solid fraction from water in controlled conditions. The control is tested against different Gel Flocculant blends with reaction times and type of floc produced noted. Where a control shows promise for effective natural settlement this will be recorded in the report and the customer advised of passive silt management interventions.

Once all Gel Flocculant blends have been tested, the most effective blend is photographed and included in the report, with the results of testing from other less effective blends omitted. The control is also photographed for comparison purposes.

Repeated agitation of the same sample gives a good indication for the reaction time required to settle solids from suspension. In each case an NTU reading is taken and shown in the key alongside a photographic record of the test. The level of agitation required for reaction helps to inform a deployment plan.

In some cases, Gel Flocculant will not be effective. Whilst cationic flocculants and liquid products are available, frog environmental do not supply these products for use in ‘open’ applications, such as surface water drainage from construction sites due to the associated environmental risks.

Where products tested by frog environmental are not effective this will be openly discussed with the client and support provided in objectively reviewing alternative pollution control interventions.

Disclaimer

The use of flocculants on site requires permission from the local regulatory authority. Proceeding with deployment of gel flocculant without regulatory permission is not advised.

Whilst frog environmental provide advice on product specification and deployment, frog environmental is not in control of the construction site or any portion of the construction site at any time. frog environmental do not take responsibility for the quality of water discharging from site at any time and do not accept design liability for the efficacy of any water treatment systems that are developed as part of this report. Please refer to our full terms and conditions prior to procurement, as these will form part of any contract for supply of silt control products and services.

Any product specifications, technical drawings, sketches and site plans provided by frog environmental ltd in relation to this report are proposals and should be reviewed and approved by the Permanent Works Designer. All proposals are based on the best available data at the time of quotation.

Testing results are indicative and are reliant on the representative nature of samples. Most silt control systems require an element of fine tuning once installed to operate at optimal levels.

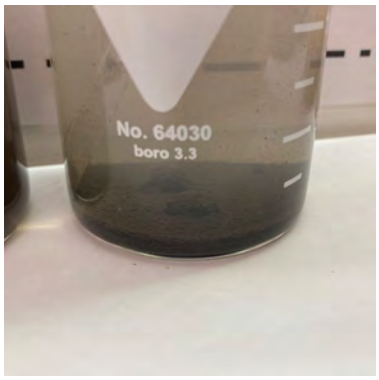
Results

Water Temperature (°C)	**17.4**	**pH**	**7.89**

A. Control vs 30 min Settlement

B. Control vs 12h Settlement

Turbidity 256 NTU to 172 NTU	Turbidity 172 NTU to 81 NTU

 A. Test 1 Control vs WL 494 / 398 (15 seconds agitation plus 30 seconds settlement)	 B. Test 2 Control vs WL 494 / 398 (further 15 second agitation from Test 1 plus 60 seconds settlement)
Turbidity 256 NTU to 287 NTU	Turbidity 287 NTU to 153 NTU
 C. Test 3 Control vs WL 494 / 398 (further 15 second agitation from Test 2 plus 60 second settlement)	
Turbidity 153 NTU to 64 NTU	Test 3 Close Up

Summary of Results

Natural settlement at Twyn y Rodyn reduced from 256 NTU to 239 NTU over a period of 10 mins. Settlement for 30 min decreased the NTU from 239 NTU to 172 NTU, with visible change. After 2 hours, turbidity decreased to 130 NTU. A further 12-hour settlement provided a further reduction in turbidity to 81 NTU.

Testing showed the most effective Gel Flocculant to be WL494 in combination with WL398. The first stage of testing did not show a quick reaction nor a visible solid-separation, with the turbidity reading showing an increase from 256 NTU to 287 NTU. The second stage of mixing resulted in a fast reaction with visible sediment deposition, reducing the rabidity to 153 NTU. The third and last stage reduced the turbidity to 64 NTU, resulting in a clear sample with noticeable deposition and a fine flocculated sediment.

Conclusions and next Steps

Physical settlement is extremely likely to achieve clear water at Twyn Y Rodyn if correct attenuation and silt management is implemented. The addition of flocculant will enhance and speed up the sediment deposition when the volumes on site hinder longer attenuation times. Settlement Testing is a key factor when it comes to assessing the risk of a construction site causing a silt pollution event. However, there are other important factors to consider:

Factor	Why is it important?
Settlement characteristics of particle (defined by Settlement Test)	Defines how the silt particles behaves when in suspension with and without the application of Gel Flocculant
Water Attenuation areas and attenuation design	Attenuation areas slow the flow of water and allow time for silt or floc particles to settle out of suspension. If this can be done without use of flocculant, it should be.
Permitted Total Suspended Solids (TSS) value expressed in mg/l	Notes the quality of water acceptable for discharge.
The flow rate of effluent that requires treatment	Treatment solutions have differing effective treatment rates. Knowing the flow rate helps to come up with the most cost-effective approach.
Proximity and connectivity to watercourse(s)	Where does surface water from your site drain to? It is illegal to cause silt pollution or erosion at the point of discharge.
Knowledge and Experience on site	Skills and knowledge on site can help prevent a silt pollution incident or react quickly to mitigate one
Management Systems	Named roles and responsibilities on site helps a company to respond effectively to an incident.

There are 5 key components to a treatment system using Gel Flocculant:

1. **Mixing:** the mixing of effluent with Gel Flocculant, through passive or forced measures.
2. **Capturing:** trapping flocculated particles, either in attenuation features, Silt Capture Channels or a combination of measures.
3. **Maintenance:** removing accreted silt from attenuation features or Silt Capture Channels
4. **Monitorin**g: testing effluent quality to ensure compliance
5. **Optimise:** refine the system, scaling treatment up or down depending on the season or the risk associated with a specific construction phase

More information on the deployment of Gel Flocculant is available from frog environmental.

To discuss next steps, contact: Natalia Perez del Postigo (natalia@frogenvironmental.co.uk)

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Appendix E – Basin Volumes

E

Summary of Results for 1 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	216.393	0.993	35.0	21.8	O K
30 min Summer	216.509	1.109	35.1	28.1	O K
60 min Summer	216.550	1.150	35.1	30.6	O K
120 min Summer	216.529	1.129	35.1	29.3	O K
180 min Summer	216.456	1.056	35.1	25.1	O K
240 min Summer	216.365	0.965	35.1	20.4	O K
360 min Summer	216.070	0.670	35.1	9.3	O K
480 min Summer	215.774	0.374	35.1	3.0	O K
600 min Summer	215.604	0.204	33.8	1.1	O K
720 min Summer	215.575	0.175	31.1	0.9	O K
960 min Summer	215.546	0.146	26.7	0.7	O K
1440 min Summer	215.517	0.117	21.4	0.5	O K
2160 min Summer	215.493	0.093	17.1	0.4	O K
2880 min Summer	215.480	0.080	14.7	0.3	O K
4320 min Summer	215.461	0.061	11.4	0.2	O K
5760 min Summer	215.449	0.049	9.5	0.2	O K
7200 min Summer	215.441	0.041	8.2	0.2	O K
8640 min Summer	215.435	0.035	7.4	0.1	O K
10080 min Summer	215.430	0.030	6.7	0.1	O K
15 min Winter	216.480	1.080	35.1	26.4	O K
30 min Winter	216.590	1.190	35.2	33.2	O K
60 min Winter	216.600	1.200	35.4	33.8	O K
120 min Winter	216.496	1.096	35.1	27.3	O K
180 min Winter	216.320	0.920	35.1	18.3	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	25.220	0.0	54.1	20
30 min Summer	17.563	0.0	75.3	28
60 min Summer	12.231	0.0	105.6	44
120 min Summer	8.518	0.0	145.9	78
180 min Summer	6.893	0.0	177.1	110
240 min Summer	5.932	0.0	203.2	142
360 min Summer	4.800	0.0	246.7	200
480 min Summer	4.131	0.0	283.1	254
600 min Summer	3.677	0.0	314.9	308
720 min Summer	3.343	0.0	343.6	366
960 min Summer	2.855	0.0	391.3	486
1440 min Summer	2.287	0.0	470.0	726
2160 min Summer	1.831	0.0	564.5	1076
2880 min Summer	1.564	0.0	642.9	1440
4320 min Summer	1.209	0.0	745.4	2164
5760 min Summer	1.007	0.0	828.0	2856
7200 min Summer	0.874	0.0	898.1	3544
8640 min Summer	0.778	0.0	960.1	4304
10080 min Summer	0.706	0.0	1015.4	5072
15 min Winter	25.220	0.0	60.6	20
30 min Winter	17.563	0.0	84.2	30
60 min Winter	12.231	0.0	118.1	48
120 min Winter	8.518	0.0	163.4	82
180 min Winter	6.893	0.0	198.4	116

Summary of Results for 1 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
240 min Winter	215.961	0.561	35.1	6.5	O K
360 min Winter	215.583	0.183	32.2	1.0	O K
480 min Winter	215.553	0.153	27.8	0.7	O K
600 min Winter	215.535	0.135	24.8	0.6	O K
720 min Winter	215.523	0.123	22.6	0.6	O K
960 min Winter	215.505	0.105	19.3	0.5	O K
1440 min Winter	215.484	0.084	15.5	0.3	O K
2160 min Winter	215.467	0.067	12.4	0.3	O K
2880 min Winter	215.456	0.056	10.6	0.2	O K
4320 min Winter	215.441	0.041	8.2	0.1	O K
5760 min Winter	215.431	0.031	6.9	0.1	O K
7200 min Winter	215.425	0.025	6.0	0.1	O K
8640 min Winter	215.420	0.020	5.4	0.1	O K
10080 min Winter	215.416	0.016	4.9	0.1	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
240 min Winter	5.932	0.0	227.6	142
360 min Winter	4.800	0.0	276.3	188
480 min Winter	4.131	0.0	317.0	246
600 min Winter	3.677	0.0	352.7	306
720 min Winter	3.343	0.0	384.8	362
960 min Winter	2.855	0.0	438.3	484
1440 min Winter	2.287	0.0	526.4	730
2160 min Winter	1.831	0.0	632.3	1088
2880 min Winter	1.564	0.0	720.1	1428
4320 min Winter	1.209	0.0	835.0	2184
5760 min Winter	1.007	0.0	927.3	2912
7200 min Winter	0.874	0.0	1006.1	3632
8640 min Winter	0.778	0.0	1075.3	4328
10080 min Winter	0.706	0.0	1137.3	5056

Model Details

Storage is Online Cover Level (m) 216.900

Tank or Pond Structure

Invert Level (m) 215.400

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	3.2	1.200	66.7

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0250-3510-1240-3510
Design Head (m)	1.240
Design Flow (l/s)	35.1
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	250
Invert Level (m)	215.340
Minimum Outlet Pipe Diameter (mm)	300
Suggested Manhole Diameter (mm)	1800

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.240	35.1	Kick-Flo®	0.892	30.0
Flush-Flo™	0.426	35.1	Mean Flow over Head Range	-	29.5

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	8.1	0.800	32.4	2.000	44.2	4.000	61.7	7.000	81.0
0.200	25.6	1.000	31.7	2.200	46.2	4.500	65.4	7.500	83.8
0.300	34.4	1.200	34.5	2.400	48.2	5.000	68.8	8.000	86.5
0.400	35.1	1.400	37.2	2.600	50.1	5.500	72.1	8.500	89.1
0.500	34.9	1.600	39.7	3.000	53.7	6.000	75.2	9.000	91.6
0.600	34.4	1.800	42.0	3.500	57.9	6.500	78.2	9.500	94.0

Summary of Results for 5 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	216.300	0.900	35.1	54.8	O K
30 min Summer	216.424	1.024	35.1	68.3	O K
60 min Summer	216.483	1.083	35.1	75.3	O K
120 min Summer	216.501	1.101	35.1	77.5	O K
180 min Summer	216.476	1.076	35.1	74.5	O K
240 min Summer	216.435	1.035	35.1	69.5	O K
360 min Summer	216.327	0.927	35.1	57.6	O K
480 min Summer	216.168	0.768	35.1	42.4	O K
600 min Summer	216.004	0.604	35.1	29.2	O K
720 min Summer	215.861	0.461	35.1	19.8	O K
960 min Summer	215.657	0.257	34.6	9.2	O K
1440 min Summer	215.561	0.161	29.1	5.3	O K
2160 min Summer	215.525	0.125	22.9	4.0	O K
2880 min Summer	215.506	0.106	19.4	3.3	O K
4320 min Summer	215.480	0.080	14.7	2.4	O K
5760 min Summer	215.465	0.065	12.1	1.9	O K
7200 min Summer	215.455	0.055	10.4	1.6	O K
8640 min Summer	215.447	0.047	9.2	1.4	O K
10080 min Summer	215.441	0.041	8.3	1.2	O K
15 min Winter	216.385	0.985	35.1	63.9	O K
30 min Winter	216.519	1.119	35.1	79.8	O K
60 min Winter	216.573	1.173	35.1	86.7	O K
120 min Winter	216.556	1.156	35.1	84.5	O K
180 min Winter	216.488	1.088	35.1	75.9	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	41.338	0.0	88.4	21
30 min Summer	27.991	0.0	119.9	31
60 min Summer	18.953	0.0	162.5	48
120 min Summer	12.834	0.0	219.7	82
180 min Summer	10.217	0.0	262.4	116
240 min Summer	8.690	0.0	297.8	150
360 min Summer	6.918	0.0	355.5	216
480 min Summer	5.884	0.0	403.2	278
600 min Summer	5.190	0.0	444.5	332
720 min Summer	4.684	0.0	481.5	388
960 min Summer	3.955	0.0	541.9	498
1440 min Summer	3.115	0.0	640.4	732
2160 min Summer	2.454	0.0	756.6	1100
2880 min Summer	2.072	0.0	851.7	1440
4320 min Summer	1.575	0.0	971.5	2164
5760 min Summer	1.297	0.0	1066.6	2936
7200 min Summer	1.116	0.0	1146.6	3552
8640 min Summer	0.986	0.0	1216.5	4264
10080 min Summer	0.889	0.0	1278.9	5128
15 min Winter	41.338	0.0	99.0	21
30 min Winter	27.991	0.0	134.3	32
60 min Winter	18.953	0.0	181.7	52
120 min Winter	12.834	0.0	246.2	88
180 min Winter	10.217	0.0	294.2	126

Summary of Results for 5 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
240 min Winter	216.399	0.999	35.1	65.4	O K
360 min Winter	216.114	0.714	35.1	37.7	O K
480 min Winter	215.804	0.404	35.1	16.5	O K
600 min Winter	215.621	0.221	34.1	7.7	O K
720 min Winter	215.578	0.178	31.5	5.9	O K
960 min Winter	215.546	0.146	26.7	4.7	O K
1440 min Winter	215.515	0.115	21.0	3.6	O K
2160 min Winter	215.490	0.090	16.5	2.8	O K
2880 min Winter	215.476	0.076	14.0	2.3	O K
4320 min Winter	215.456	0.056	10.6	1.7	O K
5760 min Winter	215.444	0.044	8.8	1.3	O K
7200 min Winter	215.436	0.036	7.6	1.1	O K
8640 min Winter	215.430	0.030	6.7	0.9	O K
10080 min Winter	215.425	0.025	6.0	0.7	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
240 min Winter	8.690	0.0	333.5	160
360 min Winter	6.918	0.0	398.2	224
480 min Winter	5.884	0.0	451.6	272
600 min Winter	5.190	0.0	497.9	318
720 min Winter	4.684	0.0	539.2	370
960 min Winter	3.955	0.0	607.0	490
1440 min Winter	3.115	0.0	717.2	730
2160 min Winter	2.454	0.0	847.4	1072
2880 min Winter	2.072	0.0	953.9	1452
4320 min Winter	1.575	0.0	1088.1	2164
5760 min Winter	1.297	0.0	1194.6	2872
7200 min Winter	1.116	0.0	1284.3	3584
8640 min Winter	0.986	0.0	1362.5	4272
10080 min Winter	0.889	0.0	1432.4	5112

Model Details

Storage is Online Cover Level (m) 216.900

Tank or Pond Structure

Invert Level (m) 215.400

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	28.0	1.200	136.2

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0250-3510-1240-3510
Design Head (m)	1.240
Design Flow (l/s)	35.1
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	250
Invert Level (m)	215.340
Minimum Outlet Pipe Diameter (mm)	300
Suggested Manhole Diameter (mm)	1800

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.240	35.1	Kick-Flo®	0.892	30.0
Flush-Flo™	0.426	35.1	Mean Flow over Head Range	-	29.5

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	8.1	0.800	32.4	2.000	44.2	4.000	61.7	7.000	81.0
0.200	25.6	1.000	31.7	2.200	46.2	4.500	65.4	7.500	83.8
0.300	34.4	1.200	34.5	2.400	48.2	5.000	68.8	8.000	86.5
0.400	35.1	1.400	37.2	2.600	50.1	5.500	72.1	8.500	89.1
0.500	34.9	1.600	39.7	3.000	53.7	6.000	75.2	9.000	91.6
0.600	34.4	1.800	42.0	3.500	57.9	6.500	78.2	9.500	94.0

Summary of Results for 10 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	216.266	0.866	35.1	78.8	O K
30 min Summer	216.398	0.998	35.1	98.2	O K
60 min Summer	216.468	1.068	35.1	109.2	O K
120 min Summer	216.498	1.098	35.1	114.3	O K
180 min Summer	216.489	1.089	35.1	112.8	O K
240 min Summer	216.463	1.063	35.1	108.5	O K
360 min Summer	216.388	0.988	35.1	96.6	O K
480 min Summer	216.295	0.895	35.1	82.8	O K
600 min Summer	216.164	0.764	35.1	65.4	O K
720 min Summer	216.037	0.637	35.1	50.3	O K
960 min Summer	215.813	0.413	35.1	28.2	O K
1440 min Summer	215.594	0.194	33.6	11.4	O K
2160 min Summer	215.545	0.145	26.5	8.2	O K
2880 min Summer	215.522	0.122	22.3	6.8	O K
4320 min Summer	215.492	0.092	16.8	5.0	O K
5760 min Summer	215.475	0.075	13.8	4.0	O K
7200 min Summer	215.463	0.063	11.8	3.4	O K
8640 min Summer	215.455	0.055	10.4	2.9	O K
10080 min Summer	215.448	0.048	9.3	2.5	O K
15 min Winter	216.353	0.953	35.1	91.3	O K
30 min Winter	216.495	1.095	35.1	113.8	O K
60 min Winter	216.570	1.170	35.1	126.8	O K
120 min Winter	216.581	1.181	35.1	128.7	O K
180 min Winter	216.541	1.141	35.1	121.6	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	52.931	0.0	113.3	21
30 min Summer	35.341	0.0	151.4	32
60 min Summer	23.597	0.0	202.3	50
120 min Summer	15.755	0.0	269.9	86
180 min Summer	12.440	0.0	319.6	120
240 min Summer	10.519	0.0	360.3	154
360 min Summer	8.306	0.0	427.0	222
480 min Summer	7.024	0.0	481.3	288
600 min Summer	6.167	0.0	528.1	348
720 min Summer	5.546	0.0	570.0	404
960 min Summer	4.655	0.0	637.8	514
1440 min Summer	3.637	0.0	747.5	736
2160 min Summer	2.841	0.0	876.0	1100
2880 min Summer	2.385	0.0	980.4	1464
4320 min Summer	1.799	0.0	1109.1	2200
5760 min Summer	1.472	0.0	1210.5	2936
7200 min Summer	1.261	0.0	1295.6	3584
8640 min Summer	1.110	0.0	1369.5	4296
10080 min Summer	0.997	0.0	1435.2	5136
15 min Winter	52.931	0.0	127.0	22
30 min Winter	35.341	0.0	169.5	33
60 min Winter	23.597	0.0	226.2	54
120 min Winter	15.755	0.0	302.2	92
180 min Winter	12.440	0.0	358.1	130

Summary of Results for 10 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
240 min Winter	216.482	1.082	35.1	111.5	O K
360 min Winter	216.329	0.929	35.1	87.7	O K
480 min Winter	216.086	0.686	35.1	56.0	O K
600 min Winter	215.857	0.457	35.1	32.2	O K
720 min Winter	215.690	0.290	34.8	18.2	O K
960 min Winter	215.576	0.176	31.3	10.2	O K
1440 min Winter	215.534	0.134	24.5	7.5	O K
2160 min Winter	215.505	0.105	19.2	5.8	O K
2880 min Winter	215.488	0.088	16.1	4.8	O K
4320 min Winter	215.465	0.065	12.1	3.5	O K
5760 min Winter	215.452	0.052	9.9	2.8	O K
7200 min Winter	215.443	0.043	8.5	2.2	O K
8640 min Winter	215.436	0.036	7.5	1.9	O K
10080 min Winter	215.430	0.030	6.7	1.6	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
240 min Winter	10.519	0.0	403.8	166
360 min Winter	8.306	0.0	478.1	236
480 min Winter	7.024	0.0	539.0	296
600 min Winter	6.167	0.0	591.6	348
720 min Winter	5.546	0.0	638.4	394
960 min Winter	4.655	0.0	714.4	492
1440 min Winter	3.637	0.0	837.2	728
2160 min Winter	2.841	0.0	981.1	1100
2880 min Winter	2.385	0.0	1098.0	1452
4320 min Winter	1.799	0.0	1242.2	2152
5760 min Winter	1.472	0.0	1355.8	2856
7200 min Winter	1.261	0.0	1451.0	3616
8640 min Winter	1.110	0.0	1533.8	4280
10080 min Winter	0.997	0.0	1607.4	4984

Model Details

Storage is Online Cover Level (m) 216.900

Tank or Pond Structure

Invert Level (m) 215.400

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	51.0	1.200	182.9

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0250-3510-1240-3510
Design Head (m)	1.240
Design Flow (l/s)	35.1
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	250
Invert Level (m)	215.340
Minimum Outlet Pipe Diameter (mm)	300
Suggested Manhole Diameter (mm)	1800

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.240	35.1	Kick-Flo®	0.892	30.0
Flush-Flo™	0.426	35.1	Mean Flow over Head Range	-	29.5

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	8.1	0.800	32.4	2.000	44.2	4.000	61.7	7.000	81.0
0.200	25.6	1.000	31.7	2.200	46.2	4.500	65.4	7.500	83.8
0.300	34.4	1.200	34.5	2.400	48.2	5.000	68.8	8.000	86.5
0.400	35.1	1.400	37.2	2.600	50.1	5.500	72.1	8.500	89.1
0.500	34.9	1.600	39.7	3.000	53.7	6.000	75.2	9.000	91.6
0.600	34.4	1.800	42.0	3.500	57.9	6.500	78.2	9.500	94.0

Summary of Results for 1 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	221.929	0.629	8.0	32.7	O K
30 min Summer	222.067	0.767	8.0	44.4	O K
60 min Summer	222.187	0.887	8.0	56.1	O K
120 min Summer	222.278	0.978	8.0	66.1	O K
180 min Summer	222.329	1.029	8.0	72.0	O K
240 min Summer	222.363	1.063	8.0	76.1	O K
360 min Summer	222.401	1.101	8.0	81.0	O K
480 min Summer	222.420	1.120	8.0	83.3	O K
600 min Summer	222.427	1.127	8.0	84.3	O K
720 min Summer	222.426	1.126	8.0	84.2	O K
960 min Summer	222.403	1.103	8.0	81.1	O K
1440 min Summer	222.331	1.031	8.0	72.2	O K
2160 min Summer	222.198	0.898	8.0	57.3	O K
2880 min Summer	222.034	0.734	8.0	41.4	O K
4320 min Summer	221.519	0.219	8.0	8.1	O K
5760 min Summer	221.336	0.036	7.4	1.1	O K
7200 min Summer	221.300	0.000	6.4	0.0	O K
8640 min Summer	221.300	0.000	5.7	0.0	O K
10080 min Summer	221.300	0.000	5.2	0.0	O K
15 min Winter	221.992	0.692	8.0	37.9	O K
30 min Winter	222.140	0.840	8.0	51.4	O K
60 min Winter	222.277	0.977	8.0	65.8	O K
120 min Winter	222.381	1.081	8.0	78.3	O K
180 min Winter	222.429	1.129	8.0	84.6	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	25.220	0.0	42.5	23
30 min Summer	17.563	0.0	59.5	36
60 min Summer	12.231	0.0	82.4	62
120 min Summer	8.518	0.0	114.8	102
180 min Summer	6.893	0.0	139.6	138
240 min Summer	5.932	0.0	160.6	174
360 min Summer	4.800	0.0	194.5	244
480 min Summer	4.131	0.0	223.6	316
600 min Summer	3.677	0.0	248.6	386
720 min Summer	3.343	0.0	271.4	456
960 min Summer	2.855	0.0	308.8	592
1440 min Summer	2.287	0.0	370.8	858
2160 min Summer	1.831	0.0	445.3	1252
2880 min Summer	1.564	0.0	507.6	1644
4320 min Summer	1.209	0.0	588.2	2248
5760 min Summer	1.007	0.0	653.6	2936
7200 min Summer	0.874	0.0	709.0	0
8640 min Summer	0.778	0.0	757.8	0
10080 min Summer	0.706	0.0	801.6	0
15 min Winter	25.220	0.0	47.5	23
30 min Winter	17.563	0.0	66.6	36
60 min Winter	12.231	0.0	92.2	62
120 min Winter	8.518	0.0	128.6	114
180 min Winter	6.893	0.0	156.2	146

Summary of Results for 1 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
240 min Winter	222.460	1.160	8.0	88.8	O K
360 min Winter	222.489	1.189	8.0	92.6	O K
480 min Winter	222.493	1.193	8.0	93.2	O K
600 min Winter	222.484	1.184	8.0	92.0	O K
720 min Winter	222.467	1.167	8.0	89.6	O K
960 min Winter	222.407	1.107	8.0	81.7	O K
1440 min Winter	222.258	0.958	8.0	63.8	O K
2160 min Winter	221.846	0.546	8.0	26.6	O K
2880 min Winter	221.466	0.166	7.9	5.8	O K
4320 min Winter	221.300	0.000	6.4	0.0	O K
5760 min Winter	221.300	0.000	5.4	0.0	O K
7200 min Winter	221.300	0.000	4.6	0.0	O K
8640 min Winter	221.300	0.000	4.1	0.0	O K
10080 min Winter	221.300	0.000	3.8	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
240 min Winter	5.932	0.0	179.7	186
360 min Winter	4.800	0.0	218.4	266
480 min Winter	4.131	0.0	250.5	342
600 min Winter	3.677	0.0	278.3	418
720 min Winter	3.343	0.0	303.7	492
960 min Winter	2.855	0.0	346.3	636
1440 min Winter	2.287	0.0	415.2	914
2160 min Winter	1.831	0.0	498.7	1280
2880 min Winter	1.564	0.0	568.3	1532
4320 min Winter	1.209	0.0	659.0	0
5760 min Winter	1.007	0.0	732.0	0
7200 min Winter	0.874	0.0	794.1	0
8640 min Winter	0.778	0.0	848.7	0
10080 min Winter	0.706	0.0	897.8	0

Model Details

Storage is Online Cover Level (m) 222.800

Tank or Pond Structure

Invert Level (m) 221.300

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	30.0	1.200	140.6

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0126-8000-1360-8000
Design Head (m)	1.360
Design Flow (l/s)	8.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	126
Invert Level (m)	221.140
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.360	8.0	Kick-Flo®	0.849	6.4
Flush-Flo™	0.400	8.0	Mean Flow over Head Range	-	7.0

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	4.5	0.800	6.9	2.000	9.6	4.000	13.3	7.000	17.4
0.200	7.4	1.000	6.9	2.200	10.0	4.500	14.1	7.500	18.0
0.300	7.9	1.200	7.5	2.400	10.4	5.000	14.8	8.000	18.5
0.400	8.0	1.400	8.1	2.600	10.8	5.500	15.5	8.500	19.1
0.500	7.9	1.600	8.6	3.000	11.6	6.000	16.2	9.000	19.6
0.600	7.8	1.800	9.1	3.500	12.5	6.500	16.8	9.500	20.1

Summary of Results for 5 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	221.853	0.553	8.0	59.0	O K
30 min Summer	221.984	0.684	8.0	78.4	O K
60 min Summer	222.117	0.817	8.0	100.1	O K
120 min Summer	222.229	0.929	8.0	120.5	O K
180 min Summer	222.276	0.976	8.0	129.6	O K
240 min Summer	222.308	1.008	8.0	135.9	O K
360 min Summer	222.350	1.050	8.0	144.7	O K
480 min Summer	222.377	1.077	8.0	150.2	O K
600 min Summer	222.393	1.093	8.0	153.6	O K
720 min Summer	222.402	1.102	8.0	155.6	O K
960 min Summer	222.398	1.098	8.0	154.7	O K
1440 min Summer	222.363	1.063	8.0	147.4	O K
2160 min Summer	222.283	0.983	8.0	131.0	O K
2880 min Summer	222.187	0.887	8.0	112.8	O K
4320 min Summer	221.817	0.517	8.0	54.2	O K
5760 min Summer	221.537	0.237	8.0	21.2	O K
7200 min Summer	221.391	0.091	7.7	7.5	O K
8640 min Summer	221.318	0.018	7.2	1.4	O K
10080 min Summer	221.300	0.000	6.5	0.0	O K
15 min Winter	221.912	0.612	8.0	67.5	O K
30 min Winter	222.057	0.757	8.0	90.0	O K
60 min Winter	222.203	0.903	8.0	115.7	O K
120 min Winter	222.337	1.037	8.0	141.8	O K
180 min Winter	222.397	1.097	8.0	154.5	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	41.338	0.0	69.9	24
30 min Summer	27.991	0.0	94.4	38
60 min Summer	18.953	0.0	128.4	66
120 min Summer	12.834	0.0	173.6	122
180 min Summer	10.217	0.0	207.1	164
240 min Summer	8.690	0.0	235.0	198
360 min Summer	6.918	0.0	280.8	268
480 min Summer	5.884	0.0	317.9	338
600 min Summer	5.190	0.0	350.5	410
720 min Summer	4.684	0.0	380.0	480
960 min Summer	3.955	0.0	427.6	622
1440 min Summer	3.115	0.0	505.6	898
2160 min Summer	2.454	0.0	596.4	1304
2880 min Summer	2.072	0.0	672.0	1704
4320 min Summer	1.575	0.0	766.1	2384
5760 min Summer	1.297	0.0	841.2	3016
7200 min Summer	1.116	0.0	904.7	3680
8640 min Summer	0.986	0.0	959.9	4408
10080 min Summer	0.889	0.0	1009.1	0
15 min Winter	41.338	0.0	78.1	24
30 min Winter	27.991	0.0	106.0	38
60 min Winter	18.953	0.0	143.6	66
120 min Winter	12.834	0.0	194.2	120
180 min Winter	10.217	0.0	232.3	176

Summary of Results for 5 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
240 min Winter	222.428	1.128	8.0	161.2	O K
360 min Winter	222.466	1.166	8.0	169.8	O K
480 min Winter	222.489	1.189	8.0	175.0	O K
600 min Winter	222.498	1.198	8.0	177.1	O K
720 min Winter	222.499	1.199	8.0	177.2	O K
960 min Winter	222.474	1.174	8.0	171.4	O K
1440 min Winter	222.393	1.093	8.0	153.6	O K
2160 min Winter	222.236	0.936	8.0	121.8	O K
2880 min Winter	222.026	0.726	8.0	85.0	O K
4320 min Winter	221.441	0.141	7.9	11.9	O K
5760 min Winter	221.300	0.000	6.9	0.0	O K
7200 min Winter	221.300	0.000	5.9	0.0	O K
8640 min Winter	221.300	0.000	5.2	0.0	O K
10080 min Winter	221.300	0.000	4.7	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
240 min Winter	8.690	0.0	263.0	224
360 min Winter	6.918	0.0	313.7	284
480 min Winter	5.884	0.0	356.6	364
600 min Winter	5.190	0.0	393.2	444
720 min Winter	4.684	0.0	425.8	522
960 min Winter	3.955	0.0	479.2	674
1440 min Winter	3.115	0.0	565.6	968
2160 min Winter	2.454	0.0	668.4	1392
2880 min Winter	2.072	0.0	752.2	1824
4320 min Winter	1.575	0.0	858.5	2332
5760 min Winter	1.297	0.0	942.5	0
7200 min Winter	1.116	0.0	1013.2	0
8640 min Winter	0.986	0.0	1075.0	0
10080 min Winter	0.889	0.0	1130.1	0

Model Details

Storage is Online Cover Level (m) 222.800

Tank or Pond Structure

Invert Level (m) 221.300

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	78.0	1.200	231.4

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0126-8000-1360-8000
Design Head (m)	1.360
Design Flow (l/s)	8.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	126
Invert Level (m)	221.140
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.360	8.0	Kick-Flo®	0.849	6.4
Flush-Flo™	0.400	8.0	Mean Flow over Head Range	-	7.0

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	4.5	0.800	6.9	2.000	9.6	4.000	13.3	7.000	17.4
0.200	7.4	1.000	6.9	2.200	10.0	4.500	14.1	7.500	18.0
0.300	7.9	1.200	7.5	2.400	10.4	5.000	14.8	8.000	18.5
0.400	8.0	1.400	8.1	2.600	10.8	5.500	15.5	8.500	19.1
0.500	7.9	1.600	8.6	3.000	11.6	6.000	16.2	9.000	19.6
0.600	7.8	1.800	9.1	3.500	12.5	6.500	16.8	9.500	20.1

Summary of Results for 10 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	221.823	0.523	8.0	78.3	O K
30 min Summer	221.948	0.648	8.0	102.6	O K
60 min Summer	222.081	0.781	8.0	131.0	O K
120 min Summer	222.202	0.902	8.0	159.3	O K
180 min Summer	222.257	0.957	8.0	173.0	O K
240 min Summer	222.286	0.986	8.0	180.3	O K
360 min Summer	222.325	1.025	8.0	190.5	O K
480 min Summer	222.351	1.051	8.0	197.4	O K
600 min Summer	222.368	1.068	8.0	202.2	O K
720 min Summer	222.380	1.080	8.0	205.3	O K
960 min Summer	222.381	1.081	8.0	205.7	O K
1440 min Summer	222.360	1.060	8.0	199.9	O K
2160 min Summer	222.299	0.999	8.0	183.6	O K
2880 min Summer	222.222	0.922	8.0	164.3	O K
4320 min Summer	221.940	0.640	8.0	101.0	O K
5760 min Summer	221.655	0.355	8.0	49.2	O K
7200 min Summer	221.478	0.178	8.0	22.7	O K
8640 min Summer	221.377	0.077	7.6	9.3	O K
10080 min Summer	221.321	0.021	7.2	2.4	O K
15 min Winter	221.881	0.581	8.0	89.2	O K
30 min Winter	222.019	0.719	8.0	117.4	O K
60 min Winter	222.165	0.865	8.0	150.4	O K
120 min Winter	222.306	1.006	8.0	185.5	O K
180 min Winter	222.376	1.076	8.0	204.2	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	52.931	0.0	89.4	25
30 min Summer	35.341	0.0	119.5	38
60 min Summer	23.597	0.0	159.4	66
120 min Summer	15.755	0.0	212.7	124
180 min Summer	12.440	0.0	251.8	180
240 min Summer	10.519	0.0	284.6	220
360 min Summer	8.306	0.0	336.5	288
480 min Summer	7.024	0.0	380.1	356
600 min Summer	6.167	0.0	417.1	426
720 min Summer	5.546	0.0	450.1	498
960 min Summer	4.655	0.0	503.4	640
1440 min Summer	3.637	0.0	589.4	918
2160 min Summer	2.841	0.0	691.6	1328
2880 min Summer	2.385	0.0	773.8	1736
4320 min Summer	1.799	0.0	875.0	2508
5760 min Summer	1.472	0.0	954.6	3120
7200 min Summer	1.261	0.0	1021.9	3752
8640 min Summer	1.110	0.0	1080.6	4416
10080 min Summer	0.997	0.0	1132.5	5144
15 min Winter	52.931	0.0	100.0	25
30 min Winter	35.341	0.0	133.6	39
60 min Winter	23.597	0.0	178.4	66
120 min Winter	15.755	0.0	238.2	122
180 min Winter	12.440	0.0	282.6	178

Summary of Results for 10 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
240 min Winter	222.415	1.115	8.0	214.9	O K
360 min Winter	222.450	1.150	8.0	225.0	O K
480 min Winter	222.473	1.173	8.0	231.7	O K
600 min Winter	222.488	1.188	8.0	236.0	O K
720 min Winter	222.495	1.195	8.0	237.9	O K
960 min Winter	222.482	1.182	8.0	234.1	O K
1440 min Winter	222.424	1.124	8.0	217.6	O K
2160 min Winter	222.304	1.004	8.0	184.9	O K
2880 min Winter	222.159	0.859	8.0	149.0	O K
4320 min Winter	221.619	0.319	8.0	43.5	O K
5760 min Winter	221.364	0.064	7.6	7.7	O K
7200 min Winter	221.300	0.000	6.7	0.0	O K
8640 min Winter	221.300	0.000	5.9	0.0	O K
10080 min Winter	221.300	0.000	5.3	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
240 min Winter	10.519	0.0	318.3	232
360 min Winter	8.306	0.0	376.8	306
480 min Winter	7.024	0.0	425.3	378
600 min Winter	6.167	0.0	466.5	458
720 min Winter	5.546	0.0	503.4	536
960 min Winter	4.655	0.0	563.6	692
1440 min Winter	3.637	0.0	660.4	996
2160 min Winter	2.841	0.0	774.2	1432
2880 min Winter	2.385	0.0	866.1	1856
4320 min Winter	1.799	0.0	979.9	2468
5760 min Winter	1.472	0.0	1069.8	3048
7200 min Winter	1.261	0.0	1144.9	0
8640 min Winter	1.110	0.0	1210.2	0
10080 min Winter	0.997	0.0	1268.3	0

Model Details

Storage is Online Cover Level (m) 222.800

Tank or Pond Structure

Invert Level (m) 221.300

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	117.0	1.200	295.8

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0126-8000-1360-8000
Design Head (m)	1.360
Design Flow (l/s)	8.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	126
Invert Level (m)	221.140
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.360	8.0	Kick-Flo®	0.849	6.4
Flush-Flo™	0.400	8.0	Mean Flow over Head Range	-	7.0

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	4.5	0.800	6.9	2.000	9.6	4.000	13.3	7.000	17.4
0.200	7.4	1.000	6.9	2.200	10.0	4.500	14.1	7.500	18.0
0.300	7.9	1.200	7.5	2.400	10.4	5.000	14.8	8.000	18.5
0.400	8.0	1.400	8.1	2.600	10.8	5.500	15.5	8.500	19.1
0.500	7.9	1.600	8.6	3.000	11.6	6.000	16.2	9.000	19.6
0.600	7.8	1.800	9.1	3.500	12.5	6.500	16.8	9.500	20.1

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Appendix F – Monitoring

F

Suspended Solids | Turbidity Monitoring Guide

Suspended sediment, also referred to as suspended solids is muddy water, a mixture of inorganic particles (clays and silts) and organic particles (carbon and algae) that has been entrained into the flow of water.

On a construction site, silts are commonly mobilised, creating dirty water, by rain falling onto areas of exposed soils, pumping excavations, the movement of vehicles along haul roads and erosion in ditches. Should this dirty water enter a river or stream then it would cause a pollution; the murky water restricts light penetration that limits plant growth and alters fish behaviour, whilst the accumulation of sediments damages habitats for invertebrates and fish, causing a decline in the ecosystem health.

The regulators use the measurement of suspended solids to determine water quality. The limit is specified in the site permit and the value may vary from site to site as it depends on the sensitivity of the receiving water.

Suspended Solids vs Turbidity

Suspended solids (TSS) are measured in milligrams per litre (mg/l), this relates to the dry weight of solids in a litre of water. This test is conducted in a laboratory, as it requires the sediment to be filtered, dried and weighed. This can take 3-10 working days to receive the results.

Turbidity (NTU) is measured in Nephelometric Turbidity Units (NTU), this relates to the transparency or clarity of the water. This test can be conducted in a few minutes in the field using meters or as a visual check.

The regulators will express the desired water quality limit for suspended solids in mg/l.

There is not a direct correlation between TSS and NTU so, it is important to establish the relationship using an 18-point calibration curve. This will strengthen confidence in using an NTU value to equate to the TSS expressed in the site permit to be able to undertake on-site monitoring however, it is important to note that it is not an absolute value.

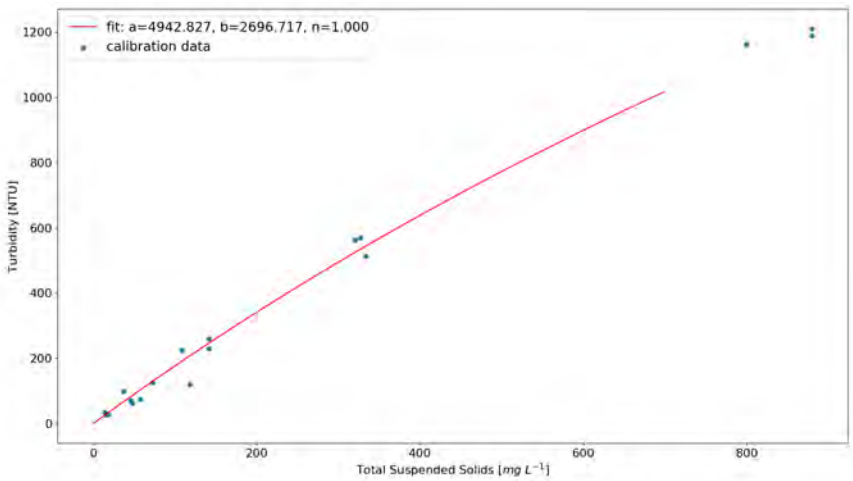

Figure 1: An 18-point calibration curve

Monitoring Plan

Monitoring requires some commitment to sample collection and record keeping. It will be these records that will evidence a proactive approach to pollution control and water management to any regulatory inquiry.

Establish your monitoring points:

- Upstream of the construction site, to determine current or background levels of silt within the water
- The discharge point, to determine the quality of water leaving site
- Downstream of discharge point, to determine whether there has been any change in quality

Frequency:

- Daily during periods of rainfall or when water is leaving site

How to collect samples:

- Using a clean sampling beaker or just a cup, collect a representative sample of the water-sediment mixture
- Take this from within the flow of water or water column
- Do not disturb the bed of the channel as this will resuspend settled sediments

Action to take if turbidity is exceeded:

- Develop a reporting method to ensure the discharge is stopped immediately, that further inspections and corrective actions are taken.

Overview of monitoring techniques

Select and implement the most appropriate monitoring technique for your site requirements. Even more simple approaches can be used to promote an increased site awareness of silt pollution issues and a company's responsibility to avoid pollution and litigation risk.

Visual Bottle Sampling

Monitoring can be as simple as filling a bottle and visually assessing the clarity of the water contained.

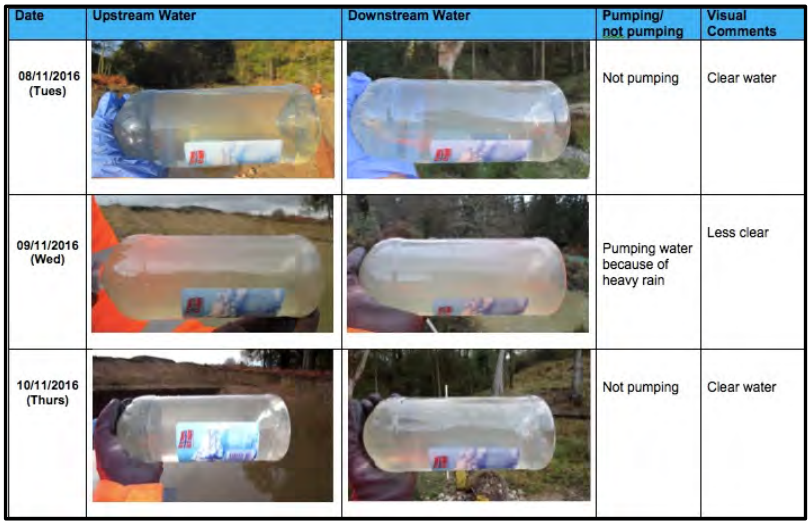

Figure 2: An example of a visual bottle sampling approach.

This offers an immediate but crude gauge as to the water quality.

- Visually comparing the water leaving site to the baseline (i.e. upstream of the discharge point)

- To estimate turbidity, place the bottle in front of your hand. If you can't see the fingers on your hand then the turbidity roughly equates to >100 NTU, if you are able to identify fingers <60NTU and the lines on your hands and fingers <30NTU.

As with all monitoring approaches, documentation is important. A simple table displaying the photos from each day's monitoring will show a positive aptitude, enabling the team to respond to murky water that could be a result of activities on site and demonstrating conformance for the purposes of a water discharge permit, if this approach is agreed as being adequate by the regulator.

Turbidity Tube

A turbidity tube is a simple and effective way to assess water clarity. The tube is filled and/or emptied of water until the mark in the bottom of the tube can no longer be observed when looking down the tube. At this depth of water, the graduated scale on the side of the turbidity tube can be read and a value for the clarity, in the units of NTU, can be determined.

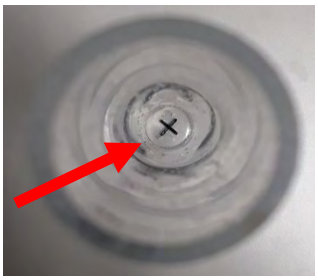

Figure 3: X Symbol

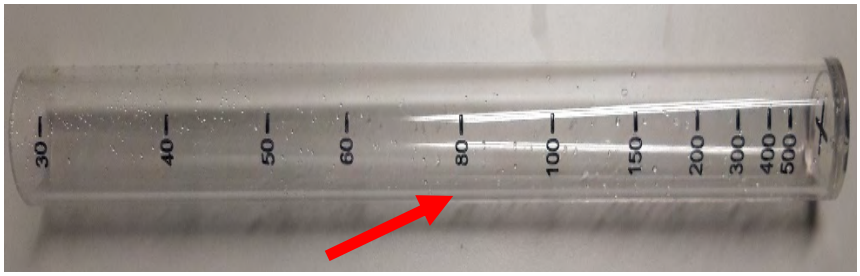

Figure 4: Turbidity Tube Measurements

Portable Turbidity Meter

A more scientific approach to monitoring uses a turbidity meter. Essentially these measure the quantity of white light penetrating the sample or being scattered by the material in the sample. These units cost a few hundred pounds.

The water sample is transferred into a vial and placed into the tester and a test button is pressed to obtain an NTU value. The equipment needs to be rinsed and dried before storing.

Figure 5: Turbidity meter

Multiparameter Water Quality Meter

A turbidity sonde can be connected to a multiparameter water quality meter. The sonde must be submerged to collect the data and therefore may not be suitable to very shallow locations with muddy bottoms. The portable meter may be used to take individual measurements or left in situ to log real-time data. Data can be manually downloaded from the meter to the computer. These units can cost 2-3 thousand pounds depending on specification.

Figure 6: Multiparameter Water Quality Meters

Remote Data Logger

An in-situ device that logs NTU at set intervals with the capability of storing the data for manual download or sharing the data by a telemetry connection such as WIFI or SMS. Data collection can be continuous or at prescribed intervals such as 2-hourly. A device will require a power source such as battery, solar or electrical connection. Alerts of exceedances can be communicated directly to site management to allow investigation.

Figure 7: In-situ turbidity measuring device used by frog environmental.

Other Water Quality Parameters

A number of other water quality parameters may be prescribed by the regulator. These typically involve determining the pH, and the presence of oils. pH strips and meters are readily available, or a sonde may be added to the multiparameter water quality meter. Oil can be checked with an oil detection strip, but visual presence is often sufficient.

Record Keeping

Water quality records should be kept. This is not only best environmental practice but will demonstrate compliance with permit conditions where they apply. Records will assist with any regulatory query or site visit, clearly showing where action has been taken to respond to and manage the site activities to prevent deterioration of water quality.

A standard monitoring form will help to guide the collection of data and prompt any subsequent actions.

MONITORING LOCATION 1 Grid Reference: Description:							
Parameter	**Monday**	**Tuesday**	**Wednesday**	**Thursday**	**Friday**	**Saturday**	**Sunday**
Weather							
Releasing Water	Yes No	Yes No	Yes No	Yes No	Yes No	Yes No	Yes No
Oil Film	None Minor Major	None Minor Major	None Minor Major	None Minor Major	None Minor Major	None Minor Major	None Minor Major
Water Clarity	Clear Cloudy Coloured	Clear Cloudy Coloured	Clear Cloudy Coloured	Clear Cloudy Coloured	Clear Cloudy Coloured	Clear Cloudy Coloured	Clear Cloudy Coloured
Turbidity (NTU) threshold <60							
pH acceptable range 7-9							
Comment on colour, smell or sediment							
Distressed fish?	Yes No	Yes No	Yes No	Yes No	Yes No	Yes No	Yes No
Photo	Yes No	Yes No	Yes No	Yes No	Yes No	Yes No	Yes No
RECORD THE POLLUTION (OIL/TURBIDITY/PH) INCIDENT INFORMATION AND DEFINE ANY CORRECTIVE ACTION(S) REQUIRED							
Action Number(s)							

Figure 8: An example of a typical monitoring table

frog environmental have prepared a separate monitoring form that can be downloaded from the website.

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Appendix G – Reporting

G

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Health, Safety
& Environment
Department

Environmental Incident Reporting Standards

Contents

1. Introduction

The purpose of the environmental incident reporting standards is to ensure action is taken following an environmental incident and that the circumstances are appropriately investigated. Also, where required reported to the relevant regulatory body (Environment Agency (England), Natural Resources Wales (Wales) or Scottish Environment Protection Agency (SEPA).

Observations and minor incidents are important learning opportunities, and all reporting will help us continually improve. Lessons learnt from incidents are shared across the organisation and relevant third parties.

It is the responsibility of the construction team to report environmental incidents and observations.

2. Definitions

Harmful substance:
A substance either prohibited from being emitted /discharged to a receiving medium (atmosphere, ground or water) or a substance released in sufficient quantities to cause environmental pollution or damage.

Environmental incident:
The release, either accidental or malicious, of a harmful substance, for example:

- Chemical or fuel / oil spillage;
- Uncontrolled release of a harmful substance to the atmosphere (e.g. asbestos fibres), dust;
- Uncontrolled release of a harmful substance to the sewerage system (e.g. high pH liquid, silt);
- Uncontrolled release of a harmful substance to the water environment (e.g. silt into watercourse / waterbody); and
- Uncontrolled release of a harmful substance to land (e.g. silt, adblue).

Level 4 - Environmental observation:
Inadequate storage/ disposal arrangements for hazardous substances

Level 3 - Minor:
A small release (less than 5 litres or less than 1 metre in diameter) that has been contained

Level 2 - Significant:
Where a significant (greater than 5 litres or greater than 1 meter in diameter) or a large (greater than 25 litres) release occurs that has the potential to cause significant environmental damage

Level 1 - Major incident:
An incident requiring the involvement of a regulatory authority due to the volume or toxicity of the harmful substance released

Refer to observations and incidents flowchart at section 8

3. Reporting procedure

All environmental incidents must be reported, even if minor in nature. This would be to the Site Manager (construction) and Shift Supervisor (manufacturing).

The Site Manager/ Shift Supervisor must take immediate steps to prevent the harmful substance from causing further environmental pollution or damage.

The Site Manager/ Shift Supervisor must undertake an initial investigation to categorise the incident as major, significant or minor. The Group Health, Safety & Environment Advisor should to be contacted for advice if deemed necessary.

The Site Manager/ Shift Supervisor must complete an environmental incident report and email a copy to the local Group Health, Safety & Environment Advisor within 24 hours of the incident. Where witnesses to the incident, details must be provided on the form and where appropriate photographs taken. In the case of an incident that has been categorised as a major or significant incident appropriate management must be contacted via phone immediately.

Refer to EMS form 007 – Environmental Incident Report

All environmental incident reports must be kept in a secure place so that they can only be accessed by authorised personnel and must be kept for a minimum of three years.

4. Investigation

The appropriate level of time and resource must be allocated to the investigation of environmental incidents. The local Group Health, Safety and Environment Advisor will carry out the investigation with input from senior members of the HS&E Department where necessary.

If a significant or major incident the local Group Health, Safety & Environment Advisor must undertake a review meeting with the Managing Director within 10 days of the incident and agree actions to prevent recurrence. This must be recorded in the actions section on the environmental incident report.

Refer to EMS form 007b – Incident Review Report

5. Notifying the regulator of an environmental incident

If a significant or major environmental incident occurs this will be reported to the relevant regulator under the direction of the Group Environment Manager. Site management and local HS&E Advisors must not contact the regulator without prior authority of the Group Environment Manager.

6. Contacted by an environmental regulator

If an environmental regulator makes contact about any environmental incident or issue this must be reported without delay to the local Group HS&E Advisor, who must also be provided with a completed regulatory authority contact form. For the purpose of environmental matters, the regulator could be the environmental/ planning department of the Local Authority, Environment Agency, Natural Resources Wales or the Scottish Environment Protection Agency.

Refer to EMS form 006 – Regulatory Authority Contact

If as a result of the contact an enforcement notice is issued by the regulator the local Group HS&E Advisor or Group Environment Management will complete enforcement notice review report, aiming to undertake a review meeting with the Managing Director within 10 days after receiving the notice.

Refer to EMS form 006a – Enforcement Notice Review Report

7. Reporting

The HS&E Department will record all environmental incidents, to monitor for trends. Where incident trends are identified, Group level corrective actions will be implemented.

All relevant environmental incident data is included in relevant management and performance reports.

8. Observations & incident response flowchart

See table below which gives examples of different types of observations and incidents and actions required. Note: the lists are not exhaustive as other types of incidents may occur. Contract the local Group Health, Safety and Environment Advisor for advice when required.

LEVEL 4 - OBSERVATION:	LEVEL 3 – MINOR classified as:	LEVEL 2 – SIGNIFICANT classified as:	LEVEL 1 – MAJOR classified as:
	Site incident or emergency which is contained on site and can be managed by onsite personnel and resources. This could also be any minor incident or equipment failure	Site incident or emergency which requires assistance from off-site third parties and resources to manage or contain the situation, e.g. Oil spill response contractors, EA / EHO, Fire Service, etc. Including any near miss / any fire / any breach of Environmental Permit	Worksite Incident or Emergency which requires assistance from off-site third parties e.g. As per Level 2 plus: Police, Local Authority / Environment Agency
Example Environmental Incidents	Example Environmental Incidents	Example Environmental Incidents	Example Environmental Incidents
• Inadequate storage/ disposal arrangements for hazardous substances. • Poor waste segregation • Failure to manage concrete / cementitious washout • Poor management of fuel storage areas • Failure to prepare / plan for nesting birds/bats • Minor drips of oils onto ground • Poor housekeeping • Wildlife found on site – left undisturbed and allowed to leave of own accord (bats, fox, badger, birds) • Failure to issue relevant permits	• Oil or other hazardous substance spills of less than 10 litres AND / OR requiring use of spill kit • Failure of equipment – e.g. poorly lined concrete washout skip / road sweeper pit • Minor disturbance to wildlife – birds nesting but not affecting works • Unauthorised work in a Tree Protection Zone – no damage • Breach of Planning Conditions • Discovery or damage to archaeological artefacts • Discovery of unknown contaminated land on site • Nuisance - noise, vibration, dust and odour issue.	• Breach of Environmental Permit condition (e.g. water quality) • Contaminated run-off / water leaving site (e.g. silty water, high pH etc.) – no visual impact/wildlife unaffected • Unauthorised discharge to sewer / environment about to occur or already occurring • Any instance of asbestos fibre release • Fire or Flood - dependent on severity, e.g. skip fire • Oil or other hazardous substances spills which have or may leave the site, over, underground or in pipes (of more than 10 litres) • Disturbance to wildlife – birds nesting and affecting works / schedule • Damage to tree or hedge branches or roots • Waste has or is about to leave site but not fully documented (e.g. no permit, exemption, waste carriers licence provided) • Repeated / ongoing nuisance complaints / s60 notice	• Breach of Environmental Permit condition leading directly to pollution event • Contaminated run-off / water leaving site (e.g. silty water, high pH etc.) leading directly to pollution event • Fishkill • Fire or Flood - dependent on severity • Oil or other hazardous substances spills which has left the site or contaminated shallow groundwater (of more than 100 litres) OR loss of control of the incident • Serious damage to wildlife e.g. protected species / habitats • Contamination that may or has caused damage to the environment and/or public health • Waste illegally dumped – disposed at location other than documented or expected • Wildlife fatality or nest/hive/den destroyed

8. Observations & incident response flowchart cont.

LEVEL 4 - OBSERVATION:	LEVEL 3 – MINOR classified as:	LEVEL 2 – SIGNIFICANT classified as:	LEVEL 1 – MAJOR classified as:
CONTACTS (In order of Priority) ➢ Site Management Team ➢ Contract Manager	CONTACTS (In order of Priority) ➢ Site Management Team ➢ Contract Manager ➢ Group Health, Safety & Environment Advisor	CONTACTS (In order of Priority) ➢ Site Management Team ➢ Contract Manager ➢ Group Health, Safety & Environment Advisor ➢ Managing Director ➢ Construction Director ➢ Technical Director (if relevant to issue) ➢ Group Environment Manager ➢ Group Health, Safety & Environment Director Group Environment Manager to determine requirement to contact the appropriate Regulator and / or Specialist Contractors etc. HS&E Director to determine requirement to contact the following: ➢ Insurers ➢ Specialist Legal Advisor	CONTACTS (In order of Priority) ➢ Site Management Team ➢ Contract Manager ➢ Group Health, Safety & Environment Advisor ➢ Managing Director ➢ Construction Director ➢ Technical Director (if relevant to issue) ➢ Group Environment Manager ➢ Group Health, Safety & Environment Director ➢ Regional Chairman (Senior GHSE Advisor to notify) Group Environment Manager to determine requirement to contact the appropriate Regulator and / or Specialist Contractors etc. HS&E Director to determine requirement to contact the following: ➢ Insurers ➢ Specialist Legal Advisor

8. Observations & incident response flowchart cont.

LEVEL 4 - OBSERVATION:	LEVEL 3 – MINOR classified as:	LEVEL 2 – SIGNIFICANT classified as:	LEVEL 1 – MAJOR classified as:
ACTION: Site team / supply chain partners to complete Toolbox Talks relevant to observation to raise awareness. Monitor performance. POTENTIAL TO PROGRESS TO LEVEL 3	ACTION: Site team to complete EMS Form 007 – Environmental Incident Report POTENTIAL TO PROGRESS TO LEVEL 2	ACTION: immediately contact Group HS&E Advisor Site team to complete EMS Form 007 – Environmental Incident Report HS&E Dept to complete "Environmental Alert" and "Lessons Learnt" investigation and communicate across Region and/ or Group. POTENTIAL TO PROGRESS TO LEVEL 1	ACTION: immediately contact Group HS&E Advisor Site team to complete EMS Form 007 – Environmental Incident Report HSE Dept to complete "Environmental Alert" and "Lessons Learnt" investigation and communicate across Region and/ or Group.

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Appendix H – Concrete Washout

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Concrete Washout

Concrete wagon wash-out contains suspended solids and has a high pH (is highly alkaline), therefore has the potential to pollute watercourses and groundwater. The substances in concrete wash-out water are far more mobile than when concrete is placed in the ground and therefore wash-out water can cause significant environmental impact. Concrete wash-out water must therefore be controlled to prevent pollution.

Planning

If concrete pours are expected, suitable measures for preventing or dealing with concrete wash-out water must be identified and agreed with subcontractors or suppliers prior to concreting activities starting.

The **hierarchy of control** in relation to concrete wash-out is:

1. Avoid concrete wash-out on site (e.g. use of ConcreteSock)
2. Use concrete wagons with integrated wash-out collection tanks
3. Contain & treat on site and;
    a. Use waters for damping down haul roads (see EA RPS 235 for rules which must be followed) – ***not in Scotland***
    b. Discharge waters to foul sewer under a temporary Trade Effluent Consent
    c. Tanker waters off site and dispose of at a permitted water treatment facility as a waste
    d. Discharge waters to surface water in accordance with an Environmental Permit (no silts, pH between 6-9)

Evaporation is not an efficient solution for dealing with concrete wash-out water and should be avoided

Commercial team

When placing orders for deliveries of concrete / cement the Commercial team should request that no washing down of chutes takes place on site.

Below are examples of concrete socks, which means washing down can be avoided on site. Note – this is only an option if the development site is not too far from the batching plant.

Integrated wash-out units

If washing down cannot be avoided then the Commercial team should request that delivery wagons have integrated wash-out collection tanks, and that they only wash down chutes into these.

If none of the above options are possible then adequate provision must be made on site to provide suitable wash down facilities.

A proprietary system such as a Siltbuster (Concrete Washout System), Mudtech BlueRinse system, Kelly Tank must be provided or suitably lined skips.

Mudtech BlueRinse system

Siltbuster system

The volume of concrete wash water should be kept to a minimum by efficient use of water during wash out, use of brushes etc. Hoses and sprays must not be left unattended. Where concrete pumps are used, washout will be necessary and must be controlled. Concrete wash waters will have a high pH and must be treated to lower the pH to safe levels (pH 6-9).

Various treatment options are available, such as pH blue (additive) or CO2 treatment which will lower the pH to safe levels. One of these options must be used to lower the pH of the

water.

On-site treatment of concrete wash water

Solids- the units above work by filtering out solids through geotextile bags, which will require emptying dependent on the number of wash-downs.

Water – after the solids have been separated from the washout water the water will have a high pH. The water require treatment to lower the pH (between 6-9).

Various options are available, such as geotextile bags impregnated with a pH reducer, pH reducer dosing liquids or carbon dioxide (available in gas bottles).

Note: the Mudtech BlueRinse system is an integrated system which means water is re-used until such time as the equipment is no longer needed.

Lined skips

If using skips to contain concrete wash waters then skips must be suitably lined with an impermeable liner. The liner must over hang the sides of the skip and be fixed onto the side of the skip with clips or similar, to prevent the liner falling into the skip.

Regular inspections must be carried out to ensure the liner is containing all water / solids and is free from damage / holes etc.

Solids which set into the skips can be broken out and used on site for various applications. However, the water must be contained, owing to high pH. High pH waters will need to be moved to another lined skip or IBC ready for disposal and or treatment (see options below).

Treated water (whether by manual or automated methods) can be:

- ✓ Used for dust suppression in specific circumstances (see EA RPS 235 for rules which must be followed) – ***not in Scotland***

- ✓ Discharged to foul sewer under a temporary trade effluent (TTE) consent. The consent must be obtained from the local water company prior to any discharge. The consent will include conditions in relation to suspended solids, pH, flow rate etc. Any discharges must be monitored in accordance with the consent and records must be kept to demonstrate compliance

Any discharges to surface water drains and watercourses will require an Environmental Permit / Licence from the Environment Agency / NRW / SEPA.

Under no circumstances should concrete wash water be discharged to ground or surface waters. Furthermore, any treatment methods must be setup >10m away from any drains, ditches, gullies, watercourses etc.

Residual concrete

Hardened residual concrete left over from the process of dewatering can be used for construction purposes where suitable. If not, this must be disposed of in the inert/masonry skip prior to removal from site.

Procurement

All of the above options involve a cost, whether for treatment of the wash-water prior to discharge, or for off-site disposal. These costs should be identified, and requirements communicated to subcontractors for inclusion in pricing. The chosen solution for dealing with concrete wash-out water must be recorded and any associated plant or equipment must be identified and included in subcontractor packages or procurement schedules (including concrete socks, settlement tanks, pH dosing kit, details of monitoring records etc.).

Contractors involved in concrete wash out activities must work to approved method statements including implementation of relevant control measures. If the effluent is to be removed from site, details of the waste carrier and disposal point must be recorded.

Competence / Training

Persons operating proprietary washout units must be given a set-up briefing by the supplier when the unit is delivered. Only persons who attend the briefing should operate the unit.

Documentation

If manual treatment of high pH water is being undertaken, records of the dosing, pH measurement and suspended solids must be recorded. A record must be produced prior to each discharge (in accordance with any temporary trade effluent consent).

Refer to EMS standard – Waste Management.