

## **Appendix M7**

### **Surface Water Drainage Systems at Tunnelling Compounds**

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# 1 INTRODUCTION

## 1.1 GENERAL

This report describes the preliminary design for the surface water drainage systems in the following areas:

- (1) Aghoos Tunnelling Compound [i.e. Compound Area (Phase I) and Stringing Area / Stockpiling Area (Phase II)]; and
- (2) Glengad Tunnelling Compound.

This report also includes an outline of the rainwater harvesting system proposed for use at Aghoos during tunnelling in order to minimise the volume of imported water to the area.

The surface water drainage system is described for two stages:

- (1) Initial Construction Stage, during which the compound is set up for the tunnelling works; and
- (2) Tunnelling Stage, during which the tunnelling operation and the subsequent gas pipeline and associated services installation take place.

## 2 INITIAL CONSTRUCTION STAGE AT AGHOOS TUNNELLING COMPOUND

### 2.1 GENERAL

The Initial Construction Stage is the period during which the tunnelling compound is constructed, prior to the start of the installation of pipelines by tunnelling.

In the drainage system design, the surface water runoff is divided into two different categories, namely 'clean' and 'dirty'. The 'clean' surface water runoff comes from the surrounding undisturbed ground area, while the 'dirty' surface water runoff is from rainwater falling on the compound and stringing areas, where stripping of peat and stone road construction will be carried out to set up the tunnelling compound.

The construction of the compound and the stringing area will be carried out using the stone road construction method. In areas of shallow peat, the stone road will be constructed using the 'excavate and replace' method, whereas in areas of deeper peat, the 'progressive displacement' method will be used. Chapter 5 of the EIS describes each of these methods.

The design principles for the surface water drainage network for the Initial Construction Stage are:

- (1) to prevent the 'clean' surface water runoff from entering into the proposed compound area and stringing area, where the runoff may be contaminated by construction activities, including the setting up of the compound, through the combined use of the existing ditches and their temporary diversions; and
- (2) to collect all 'dirty' surface water runoff for appropriate treatment prior to re-use in the tunnelling operation or discharge to the proposed outfall.

Surface water runoff management during the Initial Construction Stage is also detailed in the report, *Peatland Hydrology Impact Assessment* included as Appendix M6 of this EIS.

### 2.2 DESIGN ASSUMPTIONS

The design assumptions for the surface water runoff collection system in the compound at Aghoos are as follows:

- (1) Design return period is 20 years, in reference to the general guidance of *CIRIA – Use of SUDS Linear Trench Projects (Publication C648 and C649)*.
- (2) The Rational Method for rainfall runoff is used to determine the design flow (reference *CIRIA Report No. R124 – Scope of Control for Urban Runoff Volume 3: Guidelines*.)
- (3) Treatment and attenuation volumes are determined using the design tool for the Initial Assessment of the Surface Water Storage Volume Requirements for a Site (<http://www.irishsuds.com>).

### 2.3 SURFACE WATER COLLECTION SYSTEM

#### **(A) 'Clean' Surface Water Runoff**

For 'clean' surface water runoff, the major component of the surface water collection system is the intercepting ditches, which will be a combination of existing ditches and the proposed temporary diversions at the perimeter of the compound and stringing area. These intercepting ditches will intercept all 'clean' surface water runoff, preventing it from entering the compound and the stringing area. This will avoid potential contamination of 'clean' runoff by the construction activities.

Since there is no re-distribution of catchment area drainage to the existing ditches, no upgrade work will be required. Information about the catchment associated with the area in which the tunnelling compound will be located is detailed in Appendix M5 of this EIS (i.e. *Hydrological Impact Assessment and Stormwater Management during Construction*).

Existing ditches that will run beneath the compound and/or the stringing area will be culverted. The culverts will be adequately sized and designed to avoid flooding during the site construction phase.

'Clean' surface water runoff will be discharged directly to Sruwaddacon Bay, as it was prior to start of construction.

### **(B) 'Dirty' Surface Water Runoff**

Within the compound and stringing areas, settlement lagoons will be provided from the beginning of site set-up in order to collect 'dirty' surface water runoff (i.e. the surface water runoff within the compound area and the stringing area). In light of the topography and the geological condition of the site, these settlement lagoons (one for the compound area and one for the stringing area) may be built using mild steel sheet piles lined with polyethylene (PE) sheeting. The sizing of the settlement lagoons is detailed in **Section 3.3 (B)** of this report.

Appropriate treatment facilities will also be provided upstream of the settlement lagoon in order to ensure that the runoff discharged to Sruwaddacon Bay at the proposed outfall satisfies quality requirements for discharging into a cSAC. For instance, measures to remove hydrocarbons from the surface water runoff, in the very unlikely event of a hydrocarbon spill, will be provided. Measures will be put in place to facilitate the settlement process if required.

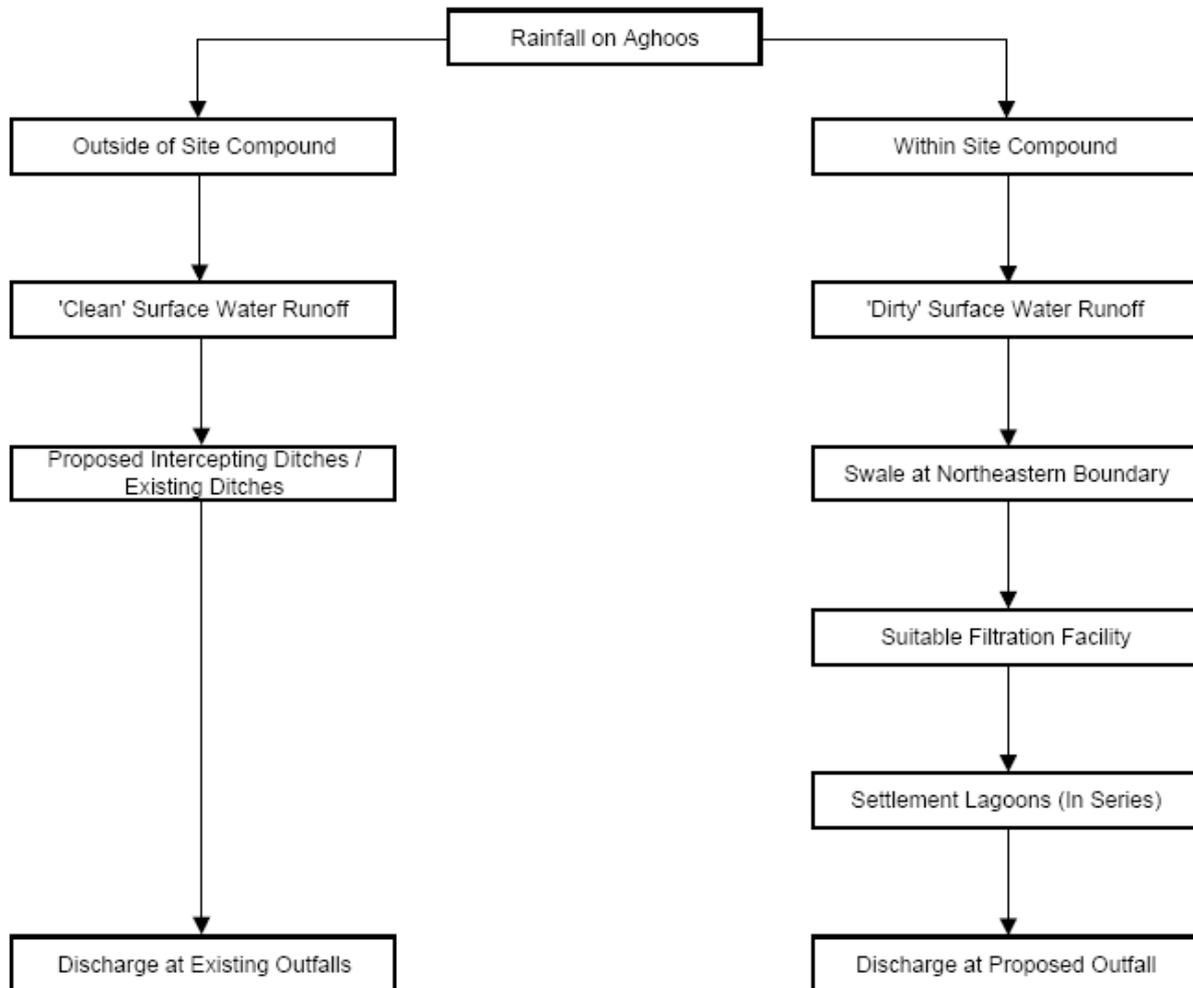
An oversized swale will be installed along the north-eastern boundary of the compound to receive all 'dirty' surface water runoff from the compound area (and the stringing area) during peat stripping and construction of the compound. The swale will drain the runoff to the proposed treatment facilities and the settlement lagoon. Further details are provided in the report, *Peatland Hydrology Impact Assessment*, included in Appendix M6 of this EIS

Peat will be excavated in a manner such that the entire excavation area will drain towards the swale and all 'dirty' surface water runoff will be properly treated prior to discharge to Sruwaddacon Bay.

A sump pump will be installed in the tunnelling pit to keep it relatively dry prior to and during construction activities. Pumped water will be treated using a suitable filtration facility to remove suspended materials that may enter the water from the mineral layer below the peat prior to discharging to the proposed outfall.

The drainage network within the compound for the Tunnelling Stage, which will consist of intercepting open channels and a kerb and drainage system (for details refer to **Section 3** of this report), which will be installed at the same time as construction of the stone road.

An illustrative design flow chart for the above is shown in **Figure 2.1**.



**Figure 2.1 – Illustrative Design Flow Chart for Surface Water Collection System in Initial Compound Construction Stage**

In general all surface water runoff collected by the Tunnelling Compound Collection System (i.e. runoff within the site compound other than the Tunnelling Arisings Storage Area) will be re-cycled and re-used in the tunnelling. Only when the water storage tanks, which are to store the water for the use of tunnelling (i.e. re-cycling water and imported water, if necessary), are full and can take no more re-cycling water, will the treated rainwater be discharged to the existing watercourse at the proposed outfall.

### 3 TUNNELLING STAGE AT AGHOOS TUNNELLING COMPOUND

#### 3.1 GENERAL

The Tunnelling Stage is the construction stage during which the tunnel will be drilled and the pipeline and services will be installed.

The design principle is similar to that for the Initial Construction Stage, as described in **Section 2.1** of this report.

#### 3.2 DESIGN ASSUMPTIONS

The design assumptions for the surface water runoff collection system in the compound at Aghoos are listed in **Section 2.2** of this report. The final surface of the compound will be tarmacadam, with a resulting discharge coefficient of 1.0. The area of the tunnelling compound is approximately 24,000m<sup>2</sup>.

#### 3.3 SURFACE WATER COLLECTION AND TREATMENT SYSTEMS

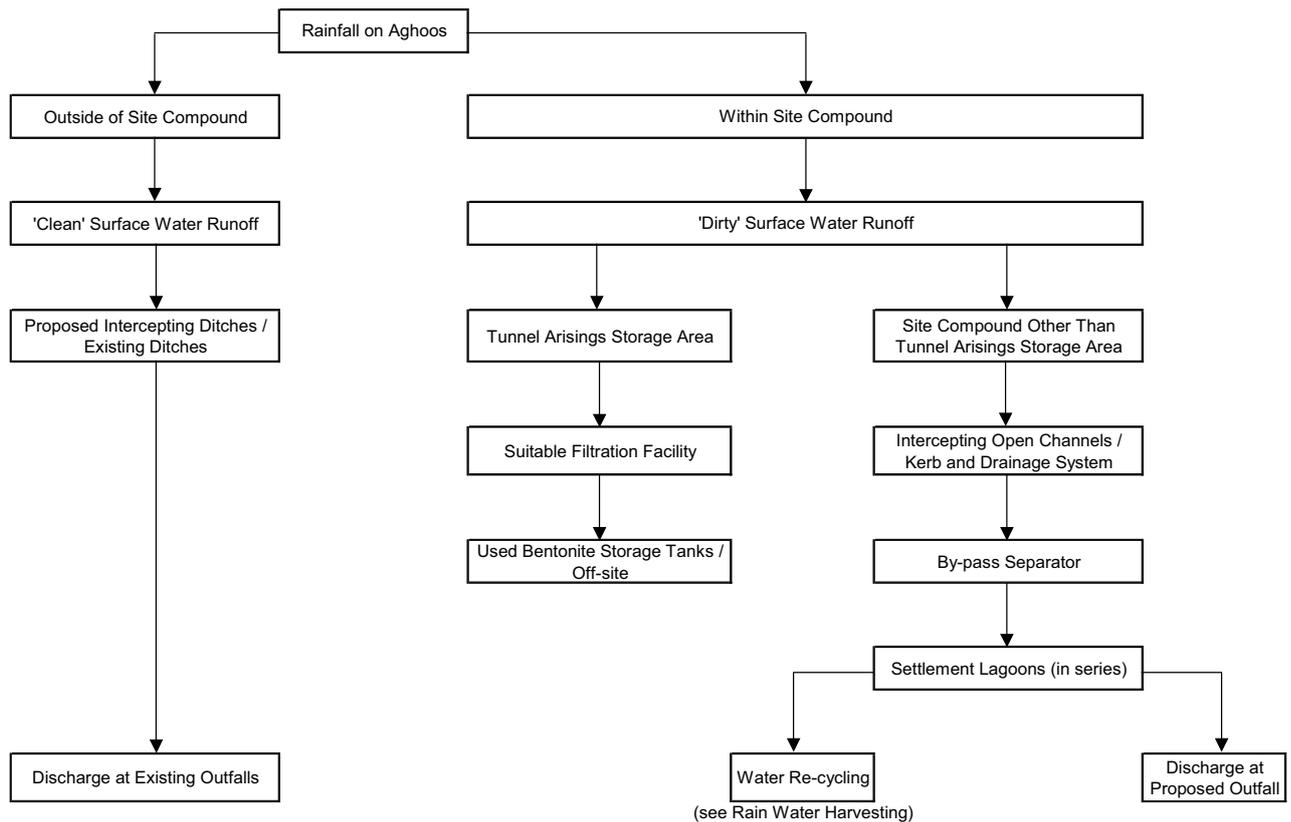
##### (A) 'Clean' Surface Water Runoff

The intercepting ditches at the perimeter will continue to collect 'clean' surface water runoff from the undisturbed ground outside the compound, preventing it from entering the compound and stringing areas. This will avoid potential contamination of 'clean' runoff by the construction activities. 'Clean' surface water runoff will discharge directly to Sruwaddacon Bay.

##### (B) 'Dirty' Surface Water Runoff

With the exception of the Tunnel Arisings Storage Area (3,000m<sup>2</sup> approx.), 'dirty' surface water runoff will drain to a surface water collection system before undergoing various stages of treatment and attenuation prior to discharge to either the rainwater harvesting re-cycling system or an existing ditch. Most of the harvested rainwater will be used for the tunnelling process. Treated rainwater will only be discharged into a ditch during extreme rainfall events.

An illustrative diagram of the surface water design is shown in **Figure 3.1** and described in further detail below.



**Figure 3.1 – Illustrative Design Flow Chart for Surface Water Collection System in Tunnelling Stage**

#### Tunnel Arisings Storage Area Collection System

Bentonite slurry will be used in the tunnelling process; therefore, the excavated material (from tunnelling) may contain some bentonite. These tunnel arisings will be stockpiled in the Tunnel Arisings Storage Area. Surface water runoff from this area will not discharge directly to Sruwaddacon Bay. A bunded micro-drainage system will be installed in order to isolate surface water runoff from this storage area from the main site surface water drainage system.

All runoff from the Tunnel Arisings Storage Area will be collected in a sump and will be dealt with by one of the following options, or a combination of these options:

- Runoff will be pumped into the used bentonite storage tank for re-use as drilling fluid in the tunnelling process,
- Runoff will be collected in a tanker and removed off site,
- Runoff will be passed through a suitable filtration facility and discharged to the settlement lagoon or will be reused in the tunnelling process.

#### Peat Storage Area Collection System

The swale which will be built at the north-eastern boundary of the compound to collect 'dirty' surface water runoff during the setting up of the compound will remain in place in order to collect runoff from the peat storage area and convey it to the settlement lagoon via a suitable filtration facility as described in **Section 2.3 (B)** of this report.

### Compound (Phase I) Collection System

During the Tunnelling Stage, within the compound (Phase I) area, the main collection system will be a combined kerb and drainage system. Regularly spaced silt traps will also be provided in the combined kerb and drainage system, which will be inspected and cleaned at regular intervals.

An example of a combined kerb and drainage system is shown in **Figure 3.2**.



**Figure 3.2 – An Example of a Combined Kerb and Drainage System**

Intercepting open channels will be provided with gratings in the facility areas, (i.e. tunnelling area, separation equipment area and storage areas, except the Tunnel Arisings Storage Area), to collect the over-land flow and drain it to the settlement lagoon via the combined kerb and drainage system.

Overland flows from the ramp and tunnel access area will be pumped from the base of the tunnel shaft to the used bentonite storage tank.

### Compound (Phase I) Settlement Lagoon and Outfall

Within the compound (Phase I) area, the settlement lagoon, which will be built in the Initial Construction Stage (for details refer to **Section 2** of this report), will remain in place to attenuate and treat collected surface water and to provide a source of water for use in the tunnelling process (the details of rainwater harvesting are described in **Section 3.3** of this report).

Prior to entering the settlement lagoons, any hydrocarbons in the surface water runoff will be removed using a by-pass separator, in the unlikely event that hydrocarbons would be present.

The settlement lagoons will be sized in accordance with the guidelines and tools of the *irishsuds.com* website. It is estimated that the treatment storage requirement for Aghoos is 288m<sup>3</sup> based on an approximate site area of 24,000m<sup>2</sup>. This volume is the minimum permanent volume provided below the lagoon inlet and outlet levels.

Since the settlement lagoon will be non-permanent and will be provided only for the purpose of construction, a 20 year return period storm has been used to determine floodwater attenuation storage, in accordance with the general guidance of *CIRIA – Use of SUDS Linear Trench Projects*. In *CIRIA C648*, a minimum return period 10 year is recommended.

The approximate attenuation and treatment storage volumes for the compound area at Aghoos, which are estimated according to the results given by the design tools for the Initial Assessment of the Surface Water Storage Volume Requirements for a Site [see **Section 2.2** Design Principle (3)] for a 20 year return period storm, are shown in **Table 3.1**.

Compound Area (excluding Stringing Area) at	Approximate Attenuation and Interception Volume (m <sup>3</sup> )	Treatment Storage (m <sup>3</sup> )	Total (m <sup>3</sup> )
Aghoos	700	288	<b>988</b>

**Table 3.1 – Compound Phase I Attenuation, Interception and Treatment Storage Volumes**

Excess treated rainwater, i.e. rainwater not used in the rainwater harvesting process, will be discharged to the existing watercourse at the proposed outfall when the water storage tanks are full.

#### Stringing Area (Phase II) Drainage System

The surface water collection system in the stringing area will be similar to the one in the compound (Phase I) area as described above and will include silt traps and open-channel grating systems. All flows will be discharged to a settlement lagoon via a by-pass separator. The sizing of the settlement lagoon will be based on the same methodology outlined for the compound (Phase I) area.

It may be necessary to use a section of the Stringing Area as a temporary stockpiling area for tunnel arisings. A micro-drainage system will be installed in this area, which will be separate from the main Stringing Area drainage system as described above.

All runoff collected from this stockpiling area will be collected in a sump and either pumped into the used bentonite storage tank for re-use as drilling fluid in the tunnelling process or removed off site or passed through a suitable filtration facility and discharged to the settlement lagoon or reused in the tunnelling process.

The final cell of the settlement lagoon will be connected to water storage tanks within the compound (Phase I) via pumped mains. Excess flows, i.e. those flows not required by the rainwater harvesting system, will discharge to an existing drainage ditch from the settlement lagoon.

## 4 RAINWATER HARVESTING AT AGHOOS TUNNELLING COMPOUND

### 4.1 GENERAL

Rainwater will be harvested for use in the tunnelling process in order to minimise the requirement for use of imported water during tunnelling.

The primary objective of this Section is to estimate the amount of rainwater that could be harvested and recycled for use during tunnelling and to establish the required water storage tank volume based on the analysis of the results.

The rainwater harvesting system will be in place only during the Tunnelling Stage following set-up of the compound area. No specific rainwater harvesting system will be provided in the Initial Construction Stage.

Only the rainwater harvesting system in the Compound (Phase I) area is presented in the following sections as a conservative scenario. The design for that in the Stringing Area (Phase II) will be similar.

### 4.2 DESIGN ASSUMPTIONS

The design assumptions for the rainwater harvesting system are as follows:

- (1) The rainfall record from the Met Éireann Belmullet Station was used as the data from this station is the most detailed available. The data was downloaded from the Met Éireann website on 12<sup>th</sup> March 2010. The Annual Totals for 2009 are the totals of 365 daily values, while the Means are for the period 1961 to 1990 (30 years). The Greatest Value is from the same 30 year period.
- (2) The final surface of the compound will be tarmacadam.
- (3) All surface water runoff (excluding that from the tunnel arisings storage area), after removal of hydrocarbons, can be recycled for use in tunnelling.
- (4) Recycling of water will begin with the commencement of tunnelling.
- (5) The monthly water consumption for tunnelling for the compound at Aghoos is conservatively estimated to be 5,248m<sup>3</sup>. This equates to a daily water consumption of about 175m<sup>3</sup>. It is expected that the actual quantity of water to be used for tunnelling will be 150m<sup>3</sup> per day. However, the sizing of the tanks is conservatively based on a usage of 175m<sup>3</sup> per day which includes a contingency of 16%.
- (6) Tunnelling will be carried out 365 days a year.
- (7) Losses may be due to (a) depression storage\* and (b) evaporation.
- (8) A typical value of 0.5mm, as recommended by *David Butler and John W. Davies Urban Drainage (2004)* for sloping impervious ground, is used to take depression storage into account.
- (9) Rainfall of less than 0.2mm is not considered as a rain event and is deducted from the mean monthly rainfall.
- (10) A coefficient of runoff of 0.95 is used to take loss of water in the pipework and system into account.

(11) Average daily rainfall = Mean Monthly Rainfall / No. of Days in the Month.

\* Depression storage accounts for rainwater that has become trapped in small depressions on the catchment surface, preventing the water from running off. This rainwater will not enter into the drainage system.

### 4.3 DESIGN PRINCIPLES

The design principles for the rainwater harvesting system in the compound (Phase I) at Aghoos are illustrated in the following design flow chart (Figure 4.1) and the illustration of the proposed operation (Figure 4.2).

The calculations are detailed in Annex 2.

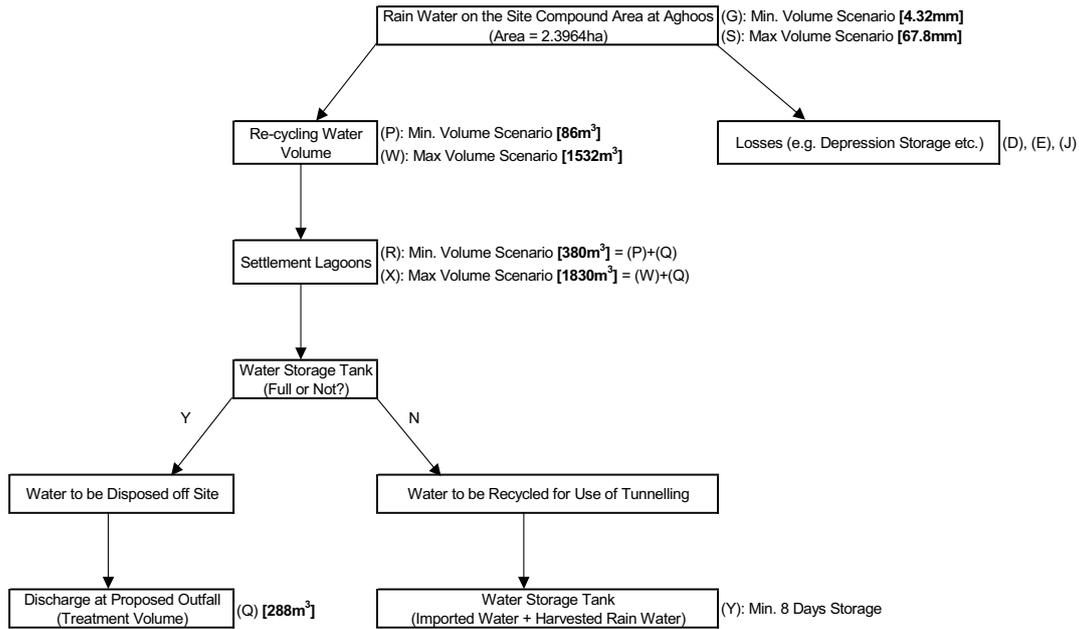


Figure 4.1 – Illustrative Design Flow Chart for the Compound Phase I at Aghoos (see Annex 1 and Annex 2)

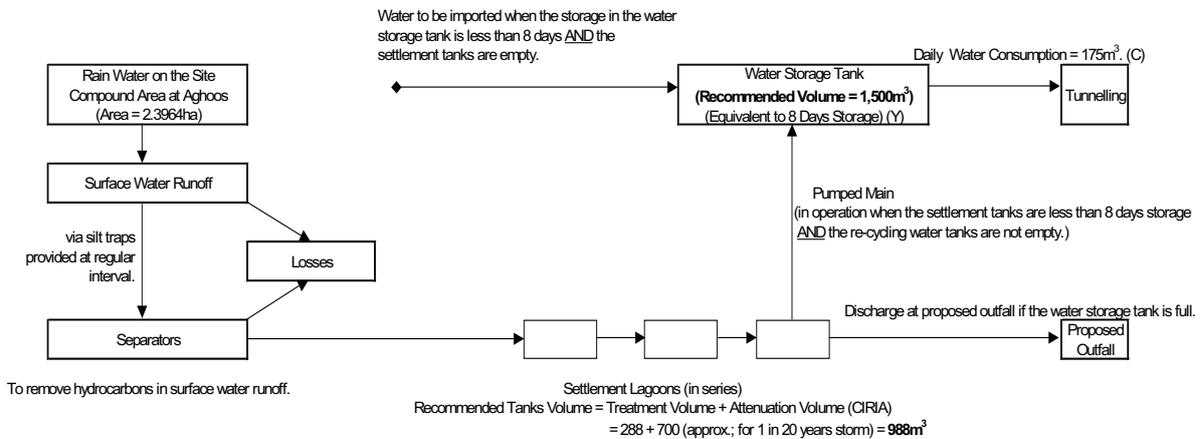


Figure 4.2 – Proposed Operation of Rainwater Harvesting System at Aghoos (see Annex 1)

As shown in the preceding flow chart and illustration, it is proposed to provide two types of tanks within the compound. The settlement lagoons, which are in series, will be provided to attenuate surface water runoff and treat it by settlement, hence providing a source of harvested rainwater for recycling, while the water storage tanks will be used to store rainwater delivered from the settlement lagoons and/or imported water from outside the site - for use in the tunnelling process.

In order to reduce the necessity for imported water, and hence the number of trips made by water tankers, harvested rainwater will be used in the tunnelling process as much as possible. The harvested rainwater will be pumped to the water storage tanks from the final phase of the settlement lagoons. Imported water will be brought into the compound only when the volume of water in the settlement lagoons is insufficient for use in tunnelling. This is further detailed in **Section 4.5 – Operation of the Harvested Rainwater System**.

For the purpose of estimating tank sizes, the following two scenarios were considered:

- (a) Minimum Harvested Rainwater Volume; and
- (b) Maximum Harvested Rainwater Volume.

In the Minimum Harvested Rainwater Volume scenario, the mean monthly rainfall as measured at Belmullet was used to estimate the minimum volume of water that could be harvested from the compound area.

In the Maximum Harvested Rainwater Volume scenario, the historical (1961-1990; 30 years) greatest daily rainfall for each month was used to estimate the maximum volume of rainwater that could be harvested from the compound area.

The calculations are detailed in **Annex 1** and the results are summarised in **Table 4.1**.

Compound Area (excluding Stringing Area) at	Volume of Harvested Rainwater (m <sup>3</sup> )	
	Minimum	Maximum
Aghoos	86	1,532

**Table 4.1 – Volume of Harvested Rainwater**

Including consideration of the treatment storage volume (i.e. 288m<sup>3</sup> as detailed in **Section 3.3** of this report), the minimum and maximum possible volume of the settlement lagoons is shown in **Table 4.2**.

Compound Area (excluding Stringing Area) at	Possible Volume of Settlement Lagoon (m <sup>3</sup> )	
	Minimum	Maximum
Aghoos	380	1,830

**Table 4.2 – Possible Volume of Settlement Lagoons**

It should be noted that, from this preliminary analysis and as detailed in **Annex 2**, the water required for tunnelling cannot be solely met by harvested rainwater. Based on the historical rainfall data from Met Éireann, the average daily rainfall (i.e. mean monthly rainfall / no. of days in a month) for the 12 months of a year is never higher than the daily water consumption [see Assumption 5 in **Section 4.2** of this report] in the compound (i.e. 175m<sup>3</sup> for Aghoos).

#### 4.4 VOLUME OF SETTLEMENT LAGOONS

As detailed in **Section 3.3 (B)** of this report, the approximate attenuation storage and interception storage for the compound area at Aghoos are provided in **Table 4.3**.

Compound Area (excluding Stringing Area) at	Approximate Attenuation and Interception Volume (m <sup>3</sup> )	Treatment Storage (m <sup>3</sup> )	Total (m <sup>3</sup> )
Aghoos	700	288	<b>988</b>

**Table 4.3 – Attenuation Volume, Interception Volume and Treatment Storage**

The total volume is within the range determined in **Table 4.2**.

#### 4.5 OPERATION OF THE HARVESTED RAINWATER SYSTEM

The settlement lagoons, the water storage tanks, the pumps and the pumped mains are the main components in the system to use harvested rainwater for tunnelling in the compound at Aghoos.

It is proposed that the water storage tanks be sized to provide a minimum 8 days storage (i.e.  $8 \times 175\text{m}^3 = 1,400\text{m}^3$ ; say **1,500m<sup>3</sup>**) for use in tunnelling. This is considered to be a reasonable size for the storage tanks having regard to local weather patterns, the size of the tunnelling compound and other factors (for instance, visual impact).

The harvested rainwater in the settlement lagoons will be pumped to the water storage tanks for use in the tunnelling process when the volume of water stored in the water storage tanks is less than 1,500m<sup>3</sup> provided the settlement lagoons are not empty. Environmental issues, such as noise, will also be taken into consideration in determining the pumping regime.

When the volume of water stored in the water storage tanks is less than 1,500m<sup>3</sup> and the settlement lagoons are empty, a notification signal will be sent to the operators. Measures may then be put in place to import water via tankers.

Should the settlement lagoons and water storage tanks be full, then the treated rainwater will be discharged at the proposed outfalls from the settlement lagoons.

**Table 4.4** summarises the proposed capacities of the Settlement Lagoons and Water Storage Tanks for the tunnelling compound.

Compound Area (excluding Stringing Area) at	Proposed Volume of Settlement Lagoons (m <sup>3</sup> )	Proposed Volume of Water Storage Tanks (m <sup>3</sup> )
Aghoos	988	1,500

**Table 4.4 – Proposed Sizes of Settlement Lagoons and Water Storage Tanks**

## 5 SURFACE WATER DRAINAGE SYSTEM AT GLENGAD TUNNELLING COMPOUND

### 5.1 GENERAL

The design principle for the surface water drainage network at the Glengad Tunnelling Reception Pit Compound is similar to that for Aghoos.

In the design, the surface water runoff is divided into two different categories, namely 'clean' and 'dirty'. The 'clean' surface water runoff comes from the surrounding undisturbed ground, while the 'dirty' surface water runoff is from rainwater falling on the compound area.

### 5.2 DESIGN ASSUMPTIONS

The design assumptions for the surface water runoff collection system in the compound at Glengad are as follows:

- (1) Design return period is 20 years, in reference to the general guidance of *CIRIA – Use of SUDS Linear Trench Projects (Publication C648 and C649)*.
- (2) The Rational rainfall runoff method is used to determine the design flow (reference *CIRIA Report No. R124 – Scope of Control for Urban Runoff Volume 3: Guidelines*.)
- (3) The final surface of the compound will be blinded stone, and for conservative reasons the discharge coefficient is taken as 1.0.
- (4) Treatment and attenuation volumes are determined using the design tool for the Initial Assessment of the Surface Water Storage Volume Requirements for a Site (<http://www.irishsuds.com>).

### 5.3 SURFACE WATER TREATMENT AND COLLECTION SYSTEM

#### (A) Collection System

The surface water collection system in the reception pit compound at Glengad will be similar to that in Aghoos.

The existing streams at the eastern and western boundary of the compound will remain in place to receive 'clean' surface water runoff and discharge to the watercourse at the existing outfalls.

Silt fences will be installed along the site boundary to stop 'dirty' surface water runoff from entering into the existing ditches without any treatment.

At the southern site boundary, two intercepting ditches (one will discharge to the eastern stream and the other will discharge to the western stream) will be provided to intercept all 'clean' surface water runoff, thereby preventing it from entering the compound area where the runoff may be contaminated by the construction activities. These two intercepting ditches will be appropriately sized to collect potential overland flows generated by seasonal springs in the vicinity.

Within the compound area, the surface water collection system will be similar to the one in the stringing area (Phase II) at Aghoos, as described in **Section 3.3** of this report, and will include silt traps and open-channel grating systems. All flows collected in the channels will be drained to settlement lagoons via by-pass separators (to remove any hydrocarbons in the unlikely event of a spill) prior to discharging to the existing ditches at the eastern and western site boundary.

The settlement lagoons and the by-pass separators will be provided in the beginning of the compound setting up so that the 'dirty' surface water runoff in the Initial Construction Stage will be treated properly before discharging to the existing ditches.

A sump pump will be installed to pump out all water in the tunnelling pit. The pumped water will be properly treated for suspended minerals prior to discharge to the network of intercepting open channels in the Tunnelling Stage. During the arrival of the TBM at the Reception Pit the water in the pit will be pumped into a tank for collection and removal off site to an authorised treatment facility.

### **(B) Settlement Lagoons**

The combined system of a settlement lagoon and a by-pass separator will be provided at the outfall to each of the existing streams at the boundary of the compound.

The settlement lagoon will be sized in accordance with the guidelines and tools of the *irishsuds.com* website. It is estimated that the total treatment storage requirements for the entire compound at Glengad is 42m<sup>3</sup> based on an approximate site area of 3,500m<sup>2</sup>. This volume represents the minimum permanent volume provided below the lagoon inlet and outlet levels.

As with the compound in Aghoos, the settlement lagoon will be non-permanent and will be provided only for the purpose of construction; therefore, a 20 year return period storm has been used to determine floodwater attenuation storage, in accordance with the general guidance of *CIRIA – Use of SUDS Linear Trench Projects*.

The approximate attenuation and treatment storage volumes for the compound area at Glengad, which are estimated according to *irishsuds.com* for a storm of 20 year return period, are provided in **Table 5.1**.

Compound Area at	Approximate Attenuation and Interception Volume (m <sup>3</sup> )	Treatment Storage (m <sup>3</sup> )	Total (m <sup>3</sup> )
Glengad	60	42	<b>102</b>

**Table 5.1 – Attenuation, Interception and Treatment Storage Volumes at Glengad Compound**

In light of the general existing topography, the size of each settlement lagoon at the Glengad compound will be a minimum of 51m<sup>3</sup> i.e. half of the treated surface water runoff will be discharged to the existing eastern stream and the other half to the existing western stream.

## 6 SUMMARY

### 6.1 GENERAL

The purpose of this report is to summarise the preliminary design for the surface water drainage systems in the compounds at Aghoos and Glengad during the Initial Construction Stage and the subsequent Tunnelling Stage.

### 6.2 AGHOOS TUNNELLING COMPOUND

#### (A) Surface Water Collection System

##### Compound (Phase I)

The surface water drainage system in the compound area (Phase I) at Aghoos is designed as follows:-

- (1) To collect the 'clean' surface water runoff from the undisturbed area (i.e. area outside of the compound and stringing area) using existing ditches and interceptor ditches and to discharge directly to the existing outfalls during both the Initial Construction Stage and the Tunnelling Stage;
- (2) To provide a settlement lagoon with appropriate treatment facilities (e.g. silt trap and by-pass separators) to treat 'dirty' surface water runoff prior to discharge to the existing ditch in the Initial Construction Stage
- (3) To provide a swale at the north-eastern boundary to collect 'dirty' surface water runoff and draining to the proposed outfall after treatment (e.g. removal of hydrocarbons and settlement lagoons and other suitable filtration facility, etc.) in the Initial Construction Stage;
- (4) To collect and treat surface water and re-use it during the tunnelling phase, or, during heavy rainfall, discharge the treated water into an existing ditch.
- (5) To provide a combined kerb and drainage system and a network of intercepting open channels to collect 'dirty' surface water runoff and drain to the settlement lagoons via by-pass separators in the Tunnelling Stage;
- (6) To provide a sump pump to pump out all water in the tunnelling pit. The pumped water will be properly treated for suspended solids prior to discharging to the swale in the Initial Construction Stage or the used bentonite storage tank in the Tunnelling Stage;
- (7) To provide a swale (same as Item 3) to collect 'dirty' surface water runoff from the peat storage area and drain to the settlement lagoon via a suitable filtration facility, if required, in the Tunnelling Stage; and
- (8) To provide a separate drainage system for the tunnel arisings storage area in the Tunnelling Stage which does not connect to the compound drainage system and settlement lagoons in order to ensure that bentonite traces or other fines from the cuttings will not discharge into the bay.

##### Stringing Area (Phase II)

The system in the stringing area (Phase II) will be similar to that in the compound area (Phase I). The following will be provided for collection and treatment of 'dirty' surface water runoff in the area:

- (1) Open-channel grating system;
- (2) Appropriate treatment facilities (e.g. silt traps and by-pass separators);

- (3) Settlement lagoons; and
- (4) A separate drainage system for the tunnel arisings stockpiling area (if required) in the Tunnelling Stage, which does not connect directly to the Stringing Area drainage system and settlement lagoons described above in Items (1) to (3) but instead is treated separately and re-used within the tunnelling process or removed from site.

### **(B) Rainwater Harvesting System**

#### Compound (Phase I)

In order to harvest rainwater on the compound area (Phase I), the following are proposed:

- (1) Settlement lagoons will be provided at the downstream end of the combined kerb and drainage system to provide treatment storage and storage of harvested rainwater;
- (2) A sump pump will be installed to pump the harvested water stored in the settlement lagoons to the water storage tanks, which will be provided to store water for use during tunnelling.

#### Stringing Area (Phase II)

The rainwater harvesting regime in the Stringing Area (Phase II) will be similar to that in the compound area (Phase I) with a connection from the settlement lagoon to the water storage tanks.

## **6.3 GLENGAD TUNNELLING COMPOUND**

The surface water drainage system in the Glengad Tunnelling Compound will be designed as follows:

- (1) To collect 'clean' surface water runoff from the undisturbed existing area (i.e. the area outside of the compound) through proposed interceptor ditches and discharge to the existing streams in both the Initial Construction Stage and the Tunnelling Stage;
- (2) To provide settlement lagoons with appropriate treatment facilities (e.g. silt trap and by-pass separators) to treat potentially 'dirty' surface water runoff prior to discharging to the existing streams in the Initial Construction Stage and the Tunnelling Stage;
- (3) To provide a network of intercepting open channels to collect the potentially 'dirty' surface water runoff and drain to the settlement lagoons via by-pass separators in the Tunnelling Stage; and
- (4) To provide a sump pump to pump out all water in the tunnelling pit. The pumped water will be properly treated for suspended minerals prior to discharge to the network of intercepting open channels in the Tunnelling Stage. During the arrival of the TBM at the Reception Pit the water in the pit will be pumped into a tank for collection and removal off site to an authorised treatment facility.

## **ANNEX 1**

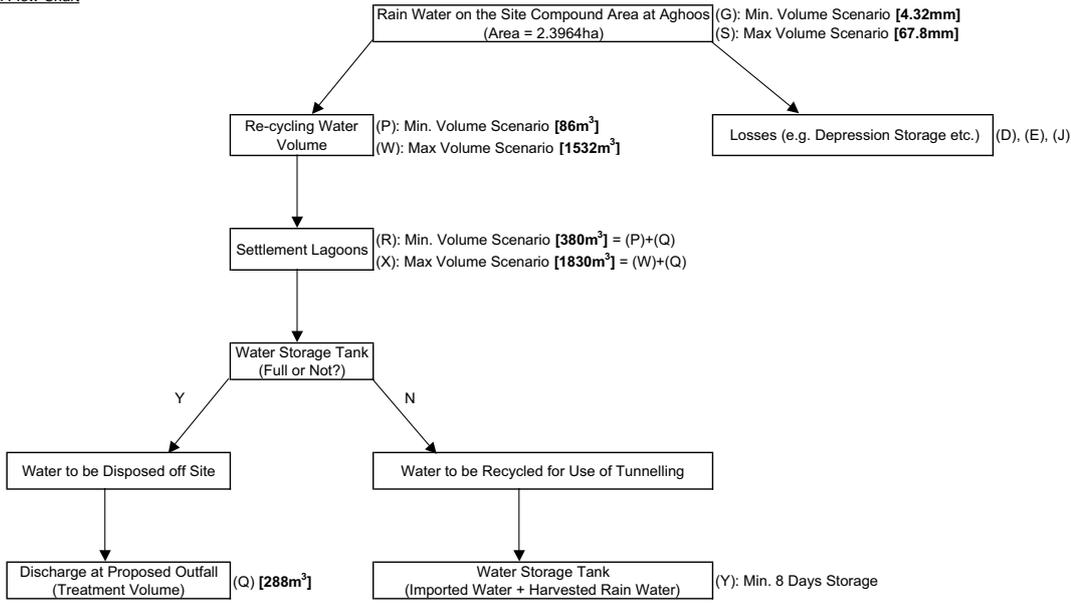
### **Design Principle for Rainwater Harvesting at Aghoos Tunnelling Compound**

Corrib Onshore Pipeline  
Preliminary Analysis of Rain Water Attenuation and Harvesting at Tunnelling Compounds

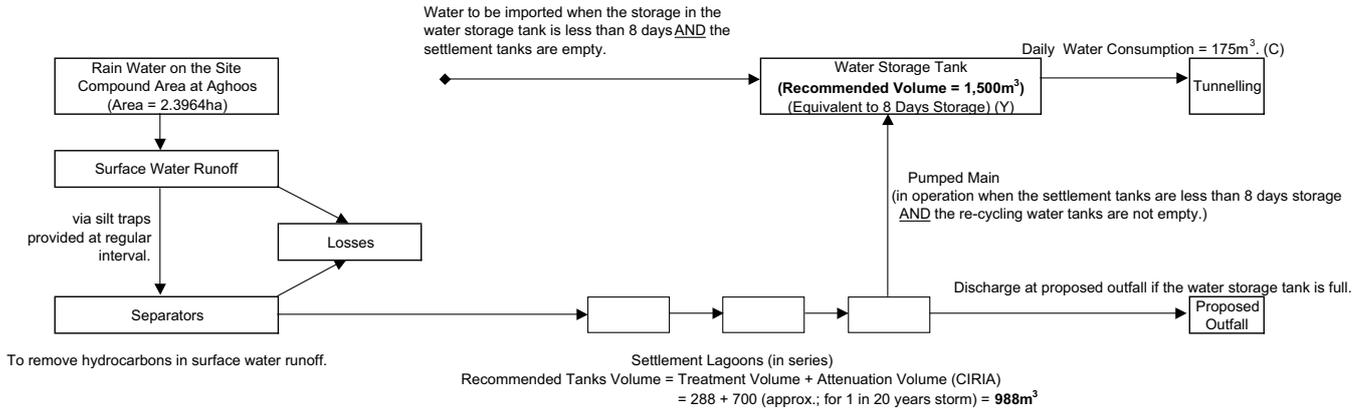
(A) Design Principles:

(1) Site Compound at Aghoos

(a) Design Flow Chart



(b) Proposed Operation Illustrations



## **ANNEX 2**

### **Preliminary Analysis for Rainwater Harvesting at Aghoos Tunnelling Compound**

**Corrib Onshore Pipeline  
Preliminary Analysis of Rain Water Attenuation and Harvesting at Tunnelling Compounds**

**(B) Preliminary Analysis:**

**(1) Site Compound at Aghoos**

Site area: 23964 m<sup>2</sup>. (A)  
(based on Drawing No. DG0405 Rev. R03)  
ie. 2.3964 ha

**(a) Minimum Re-cycling Water Volume Scenario**

Assumptions:

1. All rain water can be recycled for the use of tunnelling.
2. Re-cycling of water starts with the tunnelling.
3. Monthly water consumption for tunnelling = 5248 m<sup>3</sup>. (B) - figure provided by Contractor.
4. Daily demand for water for tunnelling = 174.93 m<sup>3</sup>. (C) = (B) / no. of days in a month (30 used here)
5. The tunnelling to be carried out in 365 days in a year.
6. Construction starts in January.
7. Mean monthly rainfall data and greatest rainfall data are from Met Eireann (1961-1990).
8. Daily rainfall < 0.2mm is considered as no rainfall.
9. Dry days (daily rainfall <0.2mm, as in Note 8) occur consecutively in a month.
10. Depression storage = 0.5 mm (typical value for sloping impervious ground). (D)
11. Coefficient of runoff = 0.95 ; to take loss of water throughout the system into account. (E)
12. Average daily rainfall = mean monthly total / no. of days in the month.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	
Mean Monthly Rainfall (mm)	123.7	80.4	96.3	56.9	67.9	67.2	67.5	93.5	108.6	133.8	127.4	119.3	123.7	F (Met Eireann Data)
Average Daily Rainfall (mm)	3.99	2.87	3.11	1.90	2.19	2.24	2.18	3.02	3.62	4.32	4.25	3.85	3.99	G = F / no. of days in a month
Mean No. of Days with Rainfall >= 0.2mm	23	19	23	19	18	18	19	20	21	24	23	24	23	H (Met Eireann Data)
Mean No. of Days with Rainfall < 0.2mm	8	9	8	11	13	12	12	11	9	7	7	7	8	J = No. of days in a month - H
Adjusted Average Daily Rainfall (mm)	3.44	2.04	2.55	1.26	1.61	1.59	1.60	2.45	2.95	3.77	3.56	3.30	3.44	K = (F - J x 0.2) / no. of days in a month - D
Exp Average Daily Water Harvested (m <sup>3</sup> )	82	49	61	30	38	38	38	59	71	90	85	79	82	L = A x K
Adjusted Average Daily Water Harvested (m <sup>3</sup> )	78	46	58	29	37	36	36	56	67	86	81	75	78	M = L x E
Exp Volume of Water to be Imported (m <sup>3</sup> )	91	141	111	146	133	139	133	114	108	83	94	94	91	N = C - M

From the above table, to minimise the average daily volume of water to be imported,

Min. volume of re-cycling rain water = 86 m<sup>3</sup>; (P) = Maximum (M)  
(maximum adjusted average daily water storage)

In case there is an excess of rain water (ie. M' > Total Water Storage on Site = Rain Water Storage + Volume of Imported Water), it should be discharged to the proposed outfalls after treatment (e.g. settlement tank).

From the website of Irish SuDS: Guidance and Tools [<http://geo.hrwallingford.co.uk:8080/wmc/savedapps/suds>],

Estimated treatment storage = 288 m<sup>3</sup>. (Q)

Min. volume of settlement tanks = 374 m<sup>3</sup>. (R) = (P) + (Q)  
Say **380** m<sup>3</sup>.

**(b) Maximum Re-cycling Water Volume Scenario**

Assumptions:

1. Similar to those for Minimum Re-cycling Water Scenario.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	
Greatest Daily Rainfall (mm)	32.2	23.6	25.9	20.4	26.5	35.2	44.9	57.3	56.1	67.8	56.4	40.5	32.2	S (Met Eireann Data)
Adjusted Greatest Daily Rainfall (mm)	31.7	23.1	25.4	19.9	26	34.7	44.4	56.8	55.6	67.3	55.9	40	31.7	T = S - D
Exp Greatest Daily Water Harvested (m <sup>3</sup> )	760	554	609	477	623	832	1064	1361	1332	1613	1340	959	760	U = A x T
Adjusted Greatest Daily Water Harvested (m <sup>3</sup> )	722	526	578	453	592	790	1011	1293	1266	1532	1273	911	722	V = U x E

From the above table, to ensure all historical rainfall is re-cycled,

Max. volume of re-cycling rain water = 1532 m<sup>3</sup>; (W) = Maximum (V)

As in Scenario 1, the estimated treatment storage = 288 m<sup>3</sup>. (Q)

Max. volume of settlement tanks = 1820 m<sup>3</sup>. (X) = (W) + (Q)  
Say **1830** m<sup>3</sup>.