RPS



**Title:** Drainage Design Philosophy

**Project:** NK016501 - Buckinghams - Southend Airport Terminal
**Prepared for:** Anna Tsartsari, RPS Planning & Development
**Written by:** Wayne Llewellyn
**Checked by:** Anna Tsartsari
**Date:** 16 September 2011
**Revision:** C
**Date:** 3 September 2012

RPS

Contents



| Revision | Date | Summary |
|---|---|---|
| A | 26/03/2012 | De-icing section 6.0 added to clarify site operations. |
| B | 29/03/2012 | Further clarification to de-icing section 6.0 |
| C | 03/09/2012 | Further clarification to de-icing section 6.0 |

## 1.0 Introduction

RPS (Newark office), was commissioned to undertake the drainage design associated with the construction of a new airport terminal for Stobart Developments and London Southend Aiport at Aviation Way, Southend-on-Sea – O.S. grid ref: TQ883856

The project involves the development of the existing airport. Works which have been completed and form part of the overall new drainage design include the following -

- New taxiways Alpha and Charlie
- Aircraft apron stands
- New Terminal and baggage handling building
- Service yard constructed in reinforced concrete.

The new terminal drainage has effectively been split into two separate networks upstream of the connections on the existing spine drain dissecting the site. The Northern Network picks up taxiway Alpha and the widening strip, with the Southern Network accommodating the terminal building and associated hardstanding areas, apron stands 6, 7 & 8 (part of) and a section of taxiway Charlie.

Anglian Water have confirmed that they will only accept a total attenuated flow of 133l/s from the whole airport development, including the rail terminal and car park, into their existing 750mm diameter sewer discharging into Prittle Brook – please refer to Appendix 1.

The maximum discharge rate for new terminal, taxiway Alpha and apron stands has been limited to 79.0l/s for any given 1:100yr storm, including climate change enhancement as confirmed on Stobart/Fairhurst drawing 79831/221K – refer to Appendix 2. This figure has been split by calculating the flow rate for each network – North & South – by contributing area. The original allowable discharge figures were 23.0l/s for the northern network and 17.0l/s for the southern. However, the allowable discharge rate for the northern network was later increased to 62.0l/s as instructed by Stobart Development Ltd due to the phase 2 car park area being fully discharged through soakaways. We therefore have been able to utilise this allowance (39.0l/s), for the northern network.

In addition to the new contributing areas, apron stands 8 (part of), 9 & 10 located on the existing pavement are drained through an existing 525Ø sewer. As the contributing area has not been modified, additional flow controls have not been added.

## 2.0 Surface Water Drainage

### Northern Network – Taxiway Alpha, including widening strip – 62.0l/s discharge

This network comprises a series of filter drains, a large diameter piped attenuation vessel and a flow control device.

The filter drains have been installed to convey the surface water run-off to the head of the solid carrier pipe at manhole S64. All filter drains have been wrapped in an impermeable membrane to avoid leaching de-icing contaminants into the underlying aquifer as instructed by The Environment Agency.

During high intensity and longer duration storms, surface water is stored within the 1.4m diameter perforated spiral wound galvanised steel pipes and specified no-fines surround providing further storage. The pipe structure and surround is also wrapped with an impermeable membrane for the reason mentioned above.

Down-stream of the attenuation, a hydrOslide unit has been installed to limit discharge to 62.0l/s for any given storm prior to the final connection which utilises an existing 375mm diameter spur.

### Southern Network – Taxiway Charlie (part), terminal & service yard – 17.0l/s discharge

This network comprises a series of slot drains, separators, pollution tank, roof drainage including a rainwater harvesting tank, carrier pipes, a large diameter piped attenuation vessel and a flow control device.

The slot drains have been installed to convey the surface water run-off to the head of the each solid carrier pipe. Apron stand drainage collection manhole S16/17 contains two penstocks installed to provide suitable flow diversion through the main drainage network, or into a remote pollution tank required to collect surface run-off during de-icing operations – refer to Section 6.0 De-icing for further information.

Service yard run-off is collected by smaller slot drain units, combining with the apron drainage run-off downstream prior to the separators – see statement regarding separator compliance below. A connection for sprinkler tests within the pump house has also been provided.

Roof drainage has been collected by a series of underground carrier pipes, with a 38,000ltr rainwater harvesting tank (see Appendix 10 for details) sized in accordance with Wat 5 - Water Recycling of the Bespoke BREEAM assessment completed by the assessor.

During high intensity and longer duration storms, surface water is stored within the 1.8m diameter perforated spiral wound galvanised steel pipes and specified no-fines surround providing further storage. The pipe structure and surround is wrapped with an impermeable membrane for the reason mentioned above.

Within a chamber on the piped attenuation, a submersible pump unit has been installed with a maximum discharge rate of 17.0l/s. A rising main lifts the surface water and discharges into a gravity chamber directly upstream of the connection to the existing spine drain, utilising an existing 300mm diameter spur.

### Attenuation

All attenuation volumes have been designed to accommodate a worst case 1:30 year storm, with no overland flooding. All surface water drainage passes through the storage structures (see Appendix 8 for tank details), with flow controls limiting discharge to figures stated above for any 1:30 year return period storm, before connecting into the existing sewer.

Phase 1 drainage includes an allowance made for terminal extension (of 150%), but does not include future phase 2 aircraft stand run-off – refer to drawings 16501/A0/0302Q, 0303E & 0304- contained with Appendix 3.

Phase 2 drainage includes all areas shown on drawings 16501/A0/1302B & 1303B contained within Appendix 5.

The site drainage has allowed for controlled flooding of the apron stand during some storms beyond 1:30 year return periods. The difference between the 30 year and the 100 year post development critical storms has been accommodated within the site. No flooding detrimental to buildings shall occur during any storm event. No surface water run-off from paved or other impermeable surfaces shall be permitted to escape onto the surface of adjacent sites.

The site drainage system has been checked against following storm intensities and durations:

- 2 year return period -15mins to 1440mins storm duration
- 30 year return period -15mins to 1440mins storm duration
- 100 year return period -15mins to 1440mins storm duration

The network has been be designed to accommodate climate change. All rainfall intensities are subject to an increase of 20% allowing significant future proofing against climate change in accordance with EA/Planning guidelines.

In accordance with Pollution Prevention Guideline document PPG3 '*Use and design of Oil Separators in Surface Water Drainage Systems*', all surface water run-off from aircraft stands and airport vehicle movement areas (except taxiways), pass through a Class 1 Full Retention Separator, with alarm. The separators comply with BS EN 858-1:2002 in full.

Roof Water does not pass through any separator.

**Aircraft De-icing**

This operation occurs on all stands and the design therefore has to accommodate the total contributing area when sizing the pollution tanks.

Initially, both the southern and northern network tanks were sized on a flat 25mm wash-down across the total stand area. When considering the southern networks (contributing stands 6-10), this figure would only be achieved during a bowser wash-down and not a rainfall first flush as the catchment area across the existing pavement went beyond the aprons stands due to the existing contours. It was later agreed following advice from Stobart Development and their engineers at Capita Symonds that the wash-down figure could be reduced to a minimum of 15mm. Consequently, the southern pollution tank (see Appendix 8 for tank details) was sized to this revised specification. Refer to Section 6.0 for further information.

RPS

## 3.0 SURFACE WATER DRAINAGE - HYDRAULIC DESIGN PARAMETERS

- Drainage calculations have been completed on Micro–Drainage Windes software.
- Parameters based on "Modified Rational Data" for simulation.
- Design using Modified Rational design check by 30 year – Rainfall profile simulations.

### GLOBAL VARIABLES

**Rainfall:** Storm intensities based on the new FEH methodology instead of using the Flood Studies Report approach.

**Design Return Period**: 2, 30 and 100 years.
**M5-60:** 20.0mm
**"r" Ratio:** 0.40
**Volumetric Runoff coefficient:** 0.75 (summer); 0.84 (winter)
**Global time of entry:** 4mins to impermeable areas; 30mins to embankments
**Infiltration:** Ignore for peak flow design
**Backdrops :** Allow in design
**Depth:** 0.9m cover typ', with 1.2m cover to pipes under taxiway and aircraft stands
**Surcharge:** no surcharging of pipes during 1:2 year event, where practicably possible

## 4.0 Surface Water Drainage Calculations

### MicroDrainage

This section provides a summary of the calculations produced in the full detailed network design in accordance with the design parameters noted in section 3.0. The drainage system has been modelled for the storms up to and including a 1:100 year event including climate change enhancement.

The maximum discharge from site has been modelled as 79.0l/s (17+62) for any return period in accordance with Fairhurst's drawing 79831/221K.

The calculation sheets indicate the worst case 'water level' or 'outflow' for each particular node for each particular return period selected. The total output can be summarised as follows:

### Northern Network – Phase 1

1:2 year
The model indicates some surcharging of pipes due to the attenuation tank level invert connection. This option was progressed to omit the need for an additional pump and the potential for ongoing maintenance issues. However, following a check of 1:30 year storms, it was found that upsizing of these pipes was not efficient and provided little benefit.

1:30 year
No flooding occurs.

1:100 year
The most onerous storm duration modelled as required by the EA indicates the extent of temporary flooding to be minimal, with no detrimental areas shown.

### Southern Network – Phase 1

1:2 year
The model indicates some surcharging of pipes. However, following a check of 1:30 year storms, it was found that upsizing of these pipes was not efficient and provided little benefit.

1:30 year
In accordance with the design parameters, some minor temporary flooding occurs. The duration of flooding and water depths, again are minimal.

1:100 year
The most onerous storm duration modelled as required by the EA indicates the extent of temporary flooding to be minimal, with no detrimental areas shown.

For details of phase 1 Microdrainage model calculations, refer to Appendix 4.

RPS

**Northern Network – Phase 2**

1:2 year
The model indicates some surcharging of pipes. However, following a check of 1:30 year storms, it was found that upsizing of these pipes was not efficient and provided little benefit.

1:30 year
No flooding occurs.

1:100 year
The most onerous storm duration modelled as required by the EA indicates the extent of temporary flooding to be minimal, with no detrimental areas shown.

For details of phase 2 Microdrainage model calculations, refer to Appendix 6.

## 5.0 Foul Water Drainage

The foul water drainage system has also been designed in accordance with BS EN 752-4: 1997. The network accommodates foul water discharge from all sanitaryware facilities, retail outlets, a waste/recycling area and an aircraft discharge chamber where aircraft waste is disposed from tankers. The foul water shall be discharged via an underground package pumping station (see Appendix 11 for details) located adjacent to GL'D/15', with 24hr emergency storage based on water usage.

The foul water aircraft chamber has been designed with a Gatic 1500x700 cover with integral 400x300 hinged hydrant lid to aid day-to-day operations. The discharge has been rated at 2520ltrs/day/3.0l/s for 1 hour per day during night time whilst the airport is quiet. This therefore ensures the foul system is not temporarily backed up during the aircraft waste discharge period, as far as is practicably possible. The aircraft waste chamber has therefore been sized to accommodate 24hrs of foul waste – i.e. 2.52m$^3$.

Appendix 7 includes the sanitaryware discharge unit calculation and Microdrainage model output.

## 6.0 De-icing

Part of airport operations require aircraft to be 'de-iced' during periods of cold weather. During this operation, potassium sulphate and/or glycol is used and this operation can occur on any one, or all, of stands 1-10 and the adjoining section of taxiway Alpha. The drainage system has been designed to facilitate these operations without polluting the downstream public sewer.

Prior to de-icing operations occurring, specific penstock flow diversion controls (see Appendix 9 for details) are manually closed to contain contaminants on site. The location of these penstocks (S16, S104 & S224) has been shown on drawings 0302, 0304 and 1302 together with the two pollutant holding tanks. Penstock chamber S16 serves stands 6-8, chamber S104 serves stands 8-10 on the existing pavement (and is ultimately controlled downstream at chamber S16), whilst penstock chamber S224 serves stands 1-5. Flow diversion chamber S104 has been installed to direct flow into the downstream drainage system installed within the new pavement area by means of Gatic SlotDrains. When de-icing operations occur on stands 8-10, penstocks at S104 and S16 are to be controlled to divert flows into the pollution tank.

Before applying de-icer to aircraft on stands 1-10 or the section of taxiway Alpha up to the end of stand 1, the relevant penstock(s) are to be closed manually by airport operatives. This will direct the dirty water to the polluted water holding tank and stop any water with de-icer from entering the surface water system. The tank has been sized to accommodate the first flush i.e. first 15mm minimum depth of rainfall that falls across the contributing apron area. The water can then be collected from the tank by tanker and disposed of in the appropriate way including the option of it being recycled.

It is probably also worth noting that the water level in the tank is monitored/alarmed by means of an automated level indicator linking back to the BMS. The alarm levels have been set at approximately 50, 75 & 100% full. De-icing operation must stop once the tanks have reached their capacity.

As the rate of filling of the tanks is dependent on a number of variables such as, frequency of freezing weather, number of flights and turnaround time for emptying the tanks, it is possible that it would take the airport until the first freezing winter before devising a robust and efficient emptying regime. Until such time, we would suggest that the tanks are emptied as soon as they have reached their 50% capacity.

## 7.0 Maintenance

| Element | Access Method including specific access equipment | Method of Maintenance | Frequency Required |
|---|---|---|---|
| Roof Gutters | Scaffolding / Cherry pickers to be used where required. | General cleaning of gutters. Jet cleaning where required. | Periodic inspection of gutters to ensure rainwater outlets do not become blocked. Periodic renewal of gutter coatings to prevent corrosion. |
| Oil / Petrol Interceptors | In accordance with health and safety regulations. | Refer to manufacturers guidance. | Bi-annual inspection and emptying. |
| Channel drains | In accordance with health and safety regulations. | Monitored to ensure no blockages develop. Jet cleaning. | Bi-annual jet cleaning of channel drains |
| Silt-traps and Gullies | In accordance with health and safety regulations. | Monitored to ensure no blockages develop. | Bi-annual inspection and clearance of all silt traps and gullies |

# Appendix 1

Appendix 1.zip

RPS

Appendix 2

Appendix 2.zip

RPS

# Appendix 3

Appendix 3.zip

RPS

# Appendix 4

Appendix 4.zip

RPS

# Appendix 5

Appendix 5.zip

RPS

Appendix 6

Appendix 6.zip

RPS

Appendix 7

Appendix 7.zip

RPS

# Appendix 8

Appendix 8.zip

RPS

Appendix 9

Appendix 9.zip

RPS

# Appendix 10

Appendix 10.zip

RPS

# Appendix 11

Appendix 11.zip