



DROVE LANE, YAPTON

Attenuation Basins - Design Calculation for mitigation measures against buoyancy force acting on waterproof liner

RSK Reference 133981-R01 (00)

DECEMBER 2021





RSK GENERAL NOTES

Project No.: 1343981

Document: 133981 -R01 (Rev:0)

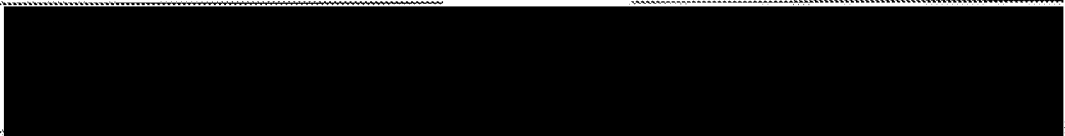
Title: Attenuation Basins - Design Calculation for mitigation measures against buoyancy force acting on waterproof liner

Client: Barratt David Wilson, Southern Counties

Date: December 2021

Office: Hemel Hempstead

Status: Environmental Agency Issue

Designer	Sabesan Siva	Technical reviewer	Vasi Vaseekaran
Signature			
Date:	05.12.2021	Date:	05.12.2021

RSK Land & Development Engineering Ltd. (RSK) has prepared these calculations for the sole use of the client, showing reasonable skill and care, for the intended purposes as stated in the agreement under which this work was completed. The calculations may not be relied upon by any other party without the express agreement of the client and RSK.

This work has been undertaken in accordance with the quality management system of RSK Land & Development Engineering Ltd.

Drove Lane, Yapton
Attenuation Basins - Design Calculation Report
133981-R01 (Rev 0)

1. INTRODUCTION

It is required to provide several attenuation basins at the above site as part of the surface water drainage system. The minimum invert level of the attenuation basins is proposed for various basins to suit the drainage design. Based on the site investigation works, a worst-case ground water level is obtained at each of these attenuation basin locations. When the worst-case ground water level is higher than the proposed basin level, there is a potential for buoyant force to act on the waterproofing liner which will be provided at a depth below the basin. The design calculation provided herewith is to determine the minimum depth surcharge required on top of the waterproof layer to achieve a minimum factor of safety of 1.3 against potential buoyancy forces.

Job No.:

133921

Date:

01/12/2021

Author/Calc by:

SS

Checked by:

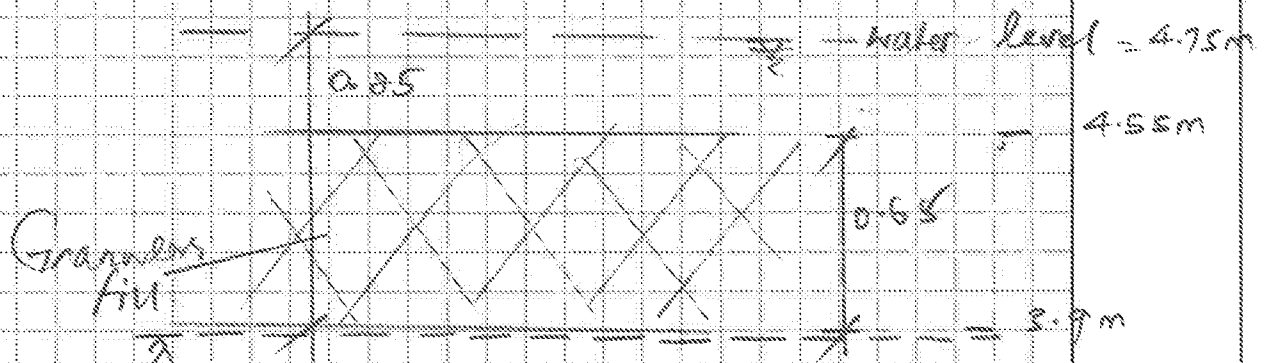
PROJECT NAME:

Drove Lane, Yaphon.

SUBJECT:

Check for flotation of Road - 2

Check Flotation if Road 2 at Critical location.


Impermeable
geotextile wrap
Terram-11000 or
Similar approved.

mass of water displaced = 0.85×1000
per m² Area = 850kg

mass of Soil resisting flotation =
 0.65×2000
= 1300 kg

F.O.S. = $\frac{1300}{850} = 1.53 > 1.2$ OK!

Job No.: 133 981

Date: 01/12/2021

Author/Calc by: SS

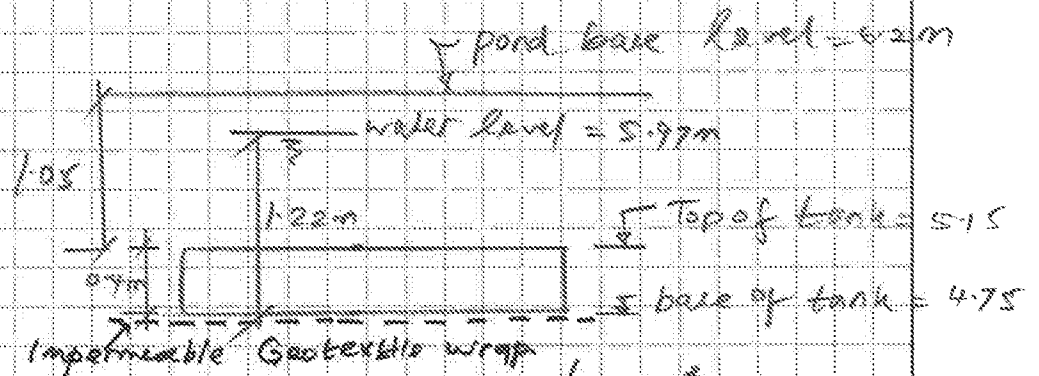
Checked by:

PROJECT NAME: Provo Lane, Yapton.

SUBJECT:

Check Flotation for pond-3

Flotation critical at attenuation tank location.



$$\text{mass of water displaced / Pond Area} = 1.22 \times 1000 = 1220 \text{ kg}$$

$$\text{mass of soil resisting Flotation} = 1.05 \times 2000 \text{ kg} = 2100 \text{ kg}$$

$$F.O.S. = \frac{2100}{1220} = 1.72 > 1.3 \text{ OK!}$$

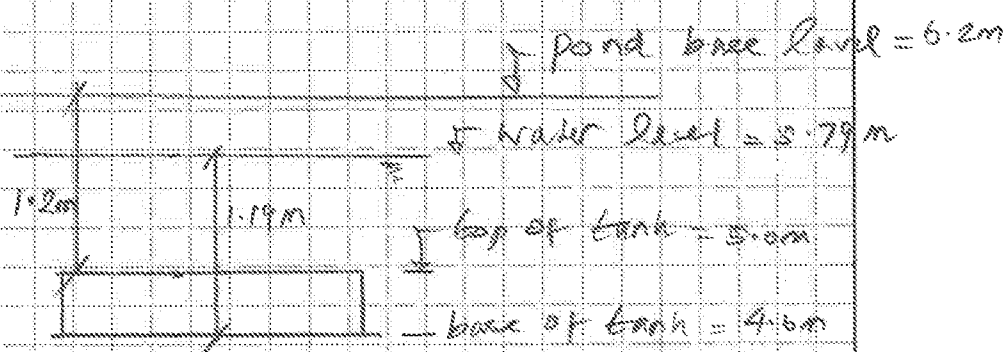
Job No.: 133981
 Date: 01/12/2021
 Author/Calc by: SS
 Checked by:

PROJECT NAME: Drain Lane, Yaphan.

SUBJECT:

Check flotation for pond-4

Flotation critical at attenuation tank location.



$$\text{Mass of water displaced / per m}^2 \text{ area} = 1.19 \times 2000 = 1190 \text{ kg}$$

Mass of granular fill retaining

$$\text{Flotation} = 1.2 \times 2000 = 2400$$

$$F.O.S = \frac{2400}{1190} = 2.01 > 1.5$$

OK!

Job No.: 133981

Date: 01/12/2001

Author/Calc by: SS

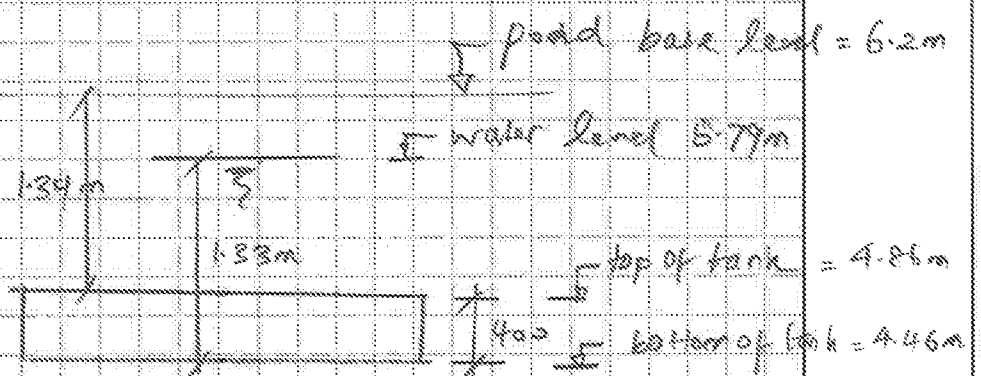
Checked by:

PROJECT NAME: Drive Lane, Yapton.

SUBJECT:

Check flotation for Pond 5

Flotation critical at attenuation tank location.



Mass of water displaced = $1.33 \times 1000 = 1330 \text{ kg}$
/ per m² area

Mass of soil resisting flotation = $1.34 \times 2000 \text{ kg}$
= 2680 kg

$$F.O.S = \frac{2680}{1330} = 2.01 > 1.3$$

OK!

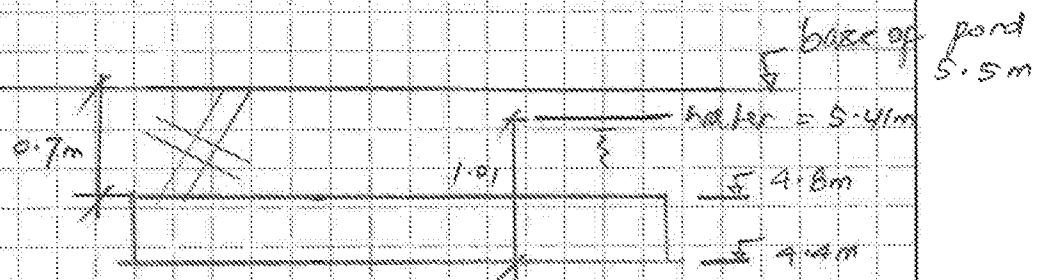
Job No.: 133981
 Date: 01/12/2021
 Author/Calc by: SS
 Checked by:

PROJECT NAME: Drove Lane, Yapton.

SUBJECT:

Check flotation of pond - 6

Flotation critical at attenuation tank location.



$$\text{Mass of water displaced / per m}^2 \text{ area} = 1.01 \times 1000 \text{ kg} = 1010 \text{ kg}$$

$$\text{Mass of soil resisting flotation} = 0.7 \times 2000 \text{ kg} = 1400 \text{ kg}$$

$$F.O.S = \frac{1400}{1010} = 1.38 > 1.3 \text{ ok}$$

Check for Floating of storage Tanks below Southern Swale

Ground Level

water level

Top Level

Bott Level

STORAGE TANK ST16

Mass of water displaced (per m² area)

1050 kg

Mass of saturated fill above Tank (per m² area)

1570 kg

F.O.S against Floating

1.50 > 1.3

OKAY

Check for Floating of storage Tanks below Southern Swale

Ground Level

water level

Top Level

Bott Level

STORAGE TANK ST17

Mass of water displaced (per m² area)

900 kg

Mass of saturated fill above Tank (per m² area)

1570 kg

F.O.S against Floating

1.74 > 1.3

OKAY

Check for Floating of storage Tanks below Southern Swale

Ground Level 5.185

water level 5.03

Top Level 4.85

Bott Level 4.45

STORAGE TANK ST18

Mass of water displaced (per m² area)

580 kg

Mass of saturated fill above Tank (per m² area)

670 kg

F.O.S against Floating

1.16 < 1.3

NOT OKAY

Check for Floating of storage Tanks below Southern Swale

Ground Level 5.185

water level 5.03

Top Level 4.85

Bott Level 4.45

Blanket thk 0.3

STORAGE TANK ST18

Mass of water displaced (per m² area)

880 kg

Mass of saturated fill above Tank (per m² area)

1270 kg

F.O.S against Floating

1.44 > 1.3

OKAY

Check for Floating of storage Tanks below Southern Swale

Ground Level

water level

Top Level

Bott Level

STORAGE TANK ST19a

Mass of water displaced (per m² area)

950 kg

Mass of saturated fill above Tank (per m² area)

610 kg

F.O.S against Floating

0.64 < 1.3

NOT OKAY

Check for Floating of storage Tanks below Southern Swale

Ground Level

water level

Top Level

Bott Level

Blanket thk

0.9

STORAGE TANK ST19a

Mass of water displaced (per m² area)

1850 kg

Mass of saturated fill above Tank (per m² area)

2410 kg

F.O.S against Floating

1.303 > 1.3

OKAY

Check for Floating of storage Tanks below Southern Swale

Ground Level	5.21
water level	4.9
Top Level	4.88
Bott Level	4.08

STORAGE TANK ST19b

Mass of water displaced (per m ² area)	820 kg
Mass of saturated fill above Tank (per m ² area)	660 kg
F.O.S against Floating	0.80 < 1.3
	NOT OKAY

Check for Floating of storage Tanks below Southern Swale

Ground Level	5.21
water level	4.9
Top Level	4.88
Bott Level	4.08
Blanket thk	0.6

STORAGE TANK ST19b

Mass of water displaced (per m ² area)	1420 kg
Mass of saturated fill above Tank (per m ² area)	1860 kg
F.O.S against Floating	1.310 > 1.3
	OKAY

Check for Floating of storage Tanks below Southern Swale

Ground Level

water level

Top Level

Bott Level

STORAGE TANK ST20

Mass of water displaced (per m² area)

630 kg

Mass of saturated fill above Tank (per m² area)

990 kg

F.O.S against Floating

1.57 > 1.3

OKAY

Check for Floating of storage Tanks below Southern Swale

Ground Level

water level

Top Level

Bott Level

Blanket thk

STORAGE TANK ST21

Mass of water displaced (per m² area)

1140 kg

Mass of saturated fill above Tank (per m² area)

1500 kg

F.O.S against Floating

1.316 > 1.3

OKAY

Check for Floating of storage Tanks ST26 beneath Pond 7

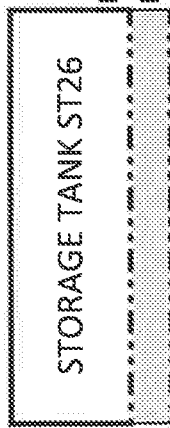
Ground Level

water level

Top Level

Bott Level

Blanket thk



STORAGE TANK ST26

Mass of water displaced (per m² area)

1015 kg

Mass of saturated fill above Tank (per m² area)

1370 kg

F.O.S against Floating

1.350 > 1.3

OKAY

Check for Floating of storage Tanks ST26a beneath Pond 7a

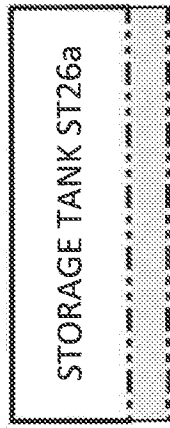
Ground Level

water level

Top Level

Bott Level

Blanket thk



STORAGE TANK ST26a

Mass of water displaced (per m² area)

935 kg

Mass of saturated fill above Tank (per m² area)

1230 kg

F.O.S against Floating

1.316 > 1.3

OKAY

Check for Floating of Isolated storage Tanks

Ground Level 5.76

water level 5.76

Top Level 5.25

Bott Level 4.85

Blanket thk 0.3

1210 kg

1620 kg

1.339 > 1.3

OKAY

STORAGE TANK ST15

Mass of water displaced (per m² area)

Mass of saturated fill above Tank (per m² area)

F.O.S against Floating

Check for Floating of Isolated storage Tanks

Ground Level 5.7

water level 5.24

Top Level 4.92

Bott Level 4.12

1120 kg

1560 kg

1.393 > 1.3

OKAY

STORAGE TANK ST14

Mass of water displaced (per m² area)

Mass of saturated fill above Tank (per m² area)

F.O.S against Floating

Check for Floating of isolated storage Tanks

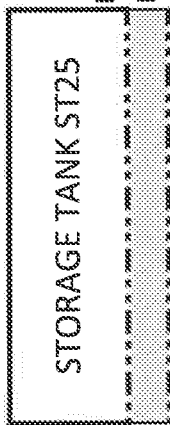
Ground Level

water level

Top Level

Bott Level

Blanket thk



Mass of water displaced (per m² area) 1870 kg
 Mass of saturated fill above Tank (per m² area) 2440 kg
 F.O.S against Floating 1.305 > 1.3 OKAY

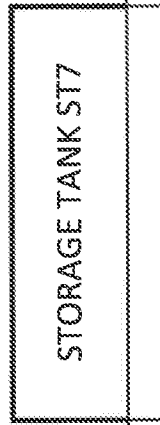
Check for Floating of isolated storage Tanks

Ground Level

water level

Top Level

Bott Level



Mass of water displaced (per m² area) 1055 kg
 Mass of saturated fill above Tank (per m² area) 2270 kg
 F.O.S against Floating 2.152 > 1.3 OKAY

Check for Floating of isolated storage Tanks

Ground Level 5.389

water level 5.3

Top Level 4.65

Bott Level 4.25

STORAGE TANK ST22

Mass of water displaced (per m² area)

1050 kg

Mass of saturated fill above Tank (per m² area)

1478 kg

F.O.S against Floating

1.408 > 1.3

OKAY

Check for Floating of isolated Enhanced Swale - SW4

Ground Level 5

water level 4.7

Top Level 4.9

Bott Level 4.1

Granular Blanket

Mass of water displaced (per m² area)

600 kg

Mass of saturated fill above Tank (per m² area)

1800 kg

F.O.S against Floating

3.000 > 1.3

OKAY

Check for Floating of isolated Enhanced Swale - SW5 (Start)

Ground Level

water level

Top Level

Bott Level

Granular Blanket

Mass of water displaced (per m² area) 980 kg
Mass of saturated fill above Tank (per m² area) 3330 kg
F.O.S against Floating 3.398 > 1.3 OKAY

Check for Floating of isolated Enhanced Swale - SW3

Ground Level

water level

Top Level

Bott Level

Granular Blanket

Mass of water displaced (per m² area) 30 kg
Mass of saturated fill above Tank (per m² area) 1670 kg
F.O.S against Floating 55.667 > 1.3 OKAY

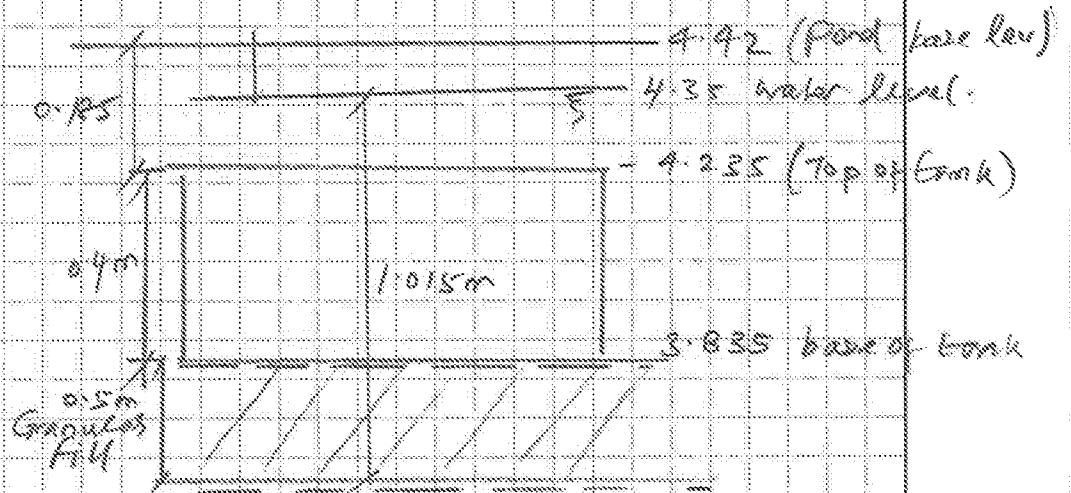
Job No.: 133 981
 Date: 01/12/21
 Author/Calc by: SS
 Checked by:

PROJECT NAME: Drove Lane, Yaphon

SUBJECT:

Check for flotation of pond-7

check for flotation of pond-7 at critical location.



Mass of water displaced / per m² area

$$= 1.015 \times 1000 = 1015 \text{ kg}$$

Mass of soil resisting Flotation = 0.185×2000

$$= 1370 \text{ kg}$$

$$F.O.S = \frac{1370}{1015} = 1.35 > 1.3 \text{ OK!}$$

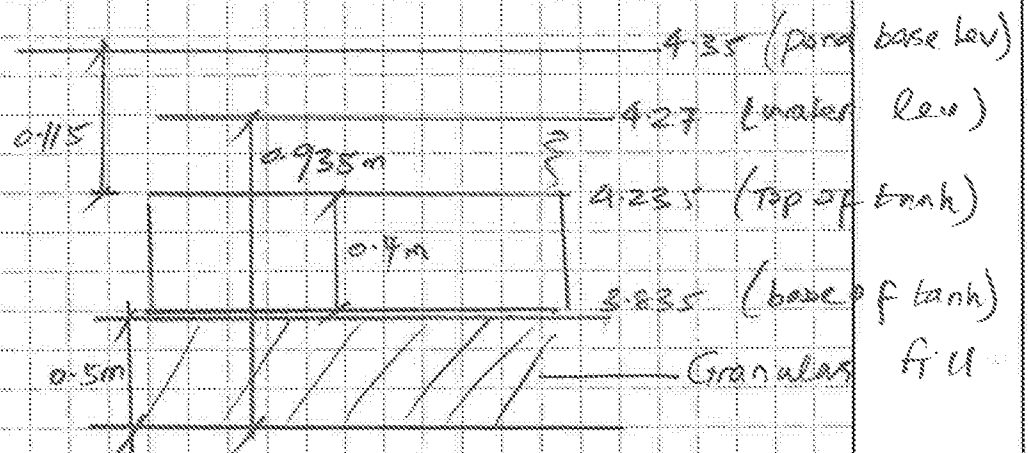
Job No.: 132921
 Date: 01/12/21
 Author/Calc by: SS
 Checked by:

PROJECT NAME: Drove Lane, Yapton.

SUBJECT:

Check for flotation of pond 7a.

Check for flotation of pond 7a at its critical location.



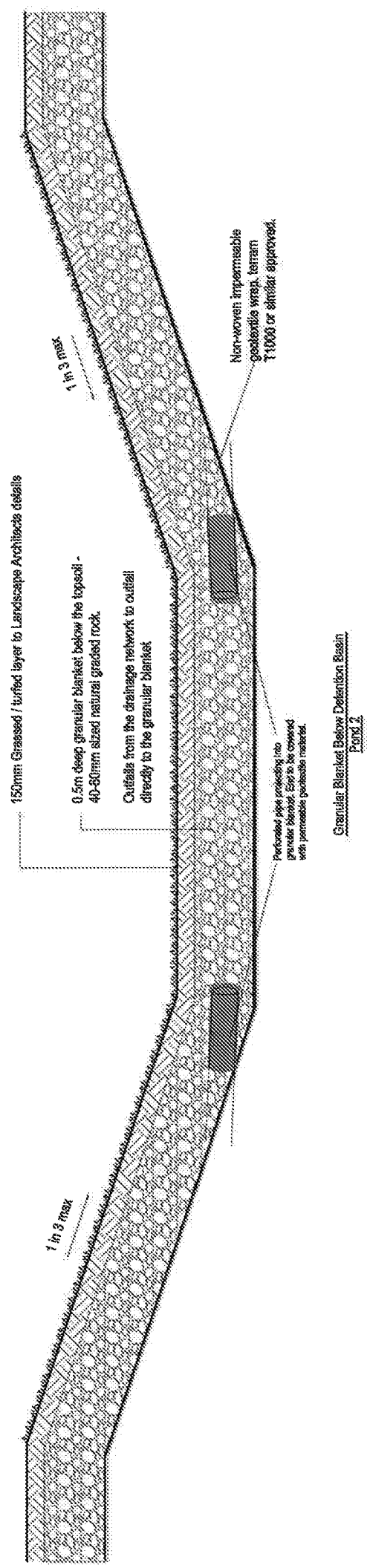
Mass of water displaced / m² area

$$= 0.935 \times 1000 = 935 \text{ kg}$$

Mass of Soil resisting flotation = 0.615 x 2000

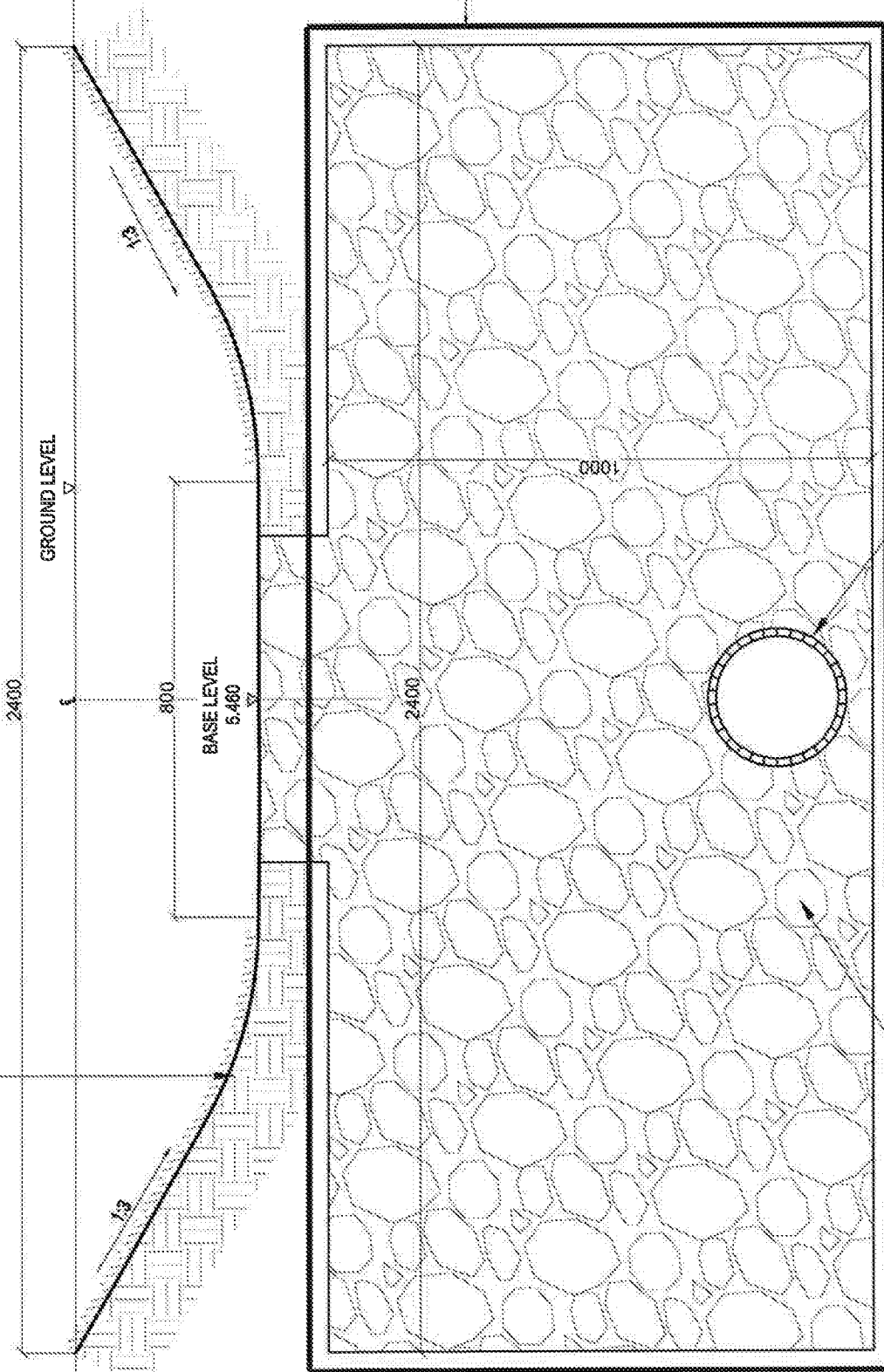
$$= 1230 \text{ kg}$$

$$F.O.S = \frac{1230}{935} = 1.32 > 1.3 \text{ OK!}$$



TYPICAL SECTION THROUGH PONDS

Finish to dry swale to landscape architects details.



Permeable geotextile or impermeable membrane to completely surround geocellular units. Protective fleece to be placed over the geotextile wrap prior to backfilling and surrounding with granular material. Refer to table for details on which SuDS features will be wrapped with impermeable membrane instead of permeable geotextile.

225mm Ø
perforated pipe.

Type B
(SFHW)
granular fill.

Enhanced Swale 3
Scale 1:10

TYPICAL SECTION THROUGH ENHANCED SWALE

14

TOP SOIL TO BE SUITABLY
FERTILE, POROUS AND OF
SUFFICIENT DEPTH TO ENSURE
HEALTHY VEGETATION AND
GROWTH.

MINIMUM 0.4m COVER
TO TOP OF CELLS

CELLS WRAPPED
IN GEOTEXTILE

GROUND LEVEL

BASE LEVEL
4.120

2no. CELLS DEEP (800mm) TO BE
AGRIACELL CORE OR SIMILAR

SECTION THROUGH STORAGE TANK 14

10:1

TYPICAL SECTION THROUGH STORAGE TANKS