Galway Harbour Extension

Report on Civil Works
Planning Stage

Nov 2013

TOBIN CONSULTING ENGINEERS

TOBIN
Patrick J. Tobin & Co. Ltd.

Report on Civil Works Planning Stage

PROJECT: **GALWAY HARBOUR EXTENSION**

CLIENT: **GALWAY HARBOUR COMPANY**

COMPANY: **TOBIN Consulting Engineers**
Fairgreen House
Fairgreen
Galway

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DOCUMENT AMENDMENT RECORD

Client:	GALWAY HARBOUR COMPANY
Project:	GALWAY HARBOUR EXTENSION
Title:	REPORT ON PROPOSED CIVIL WORKS

PROJECT NUMBER: 2165				**DOCUMENT REF:** 2139/04/01			
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TOBIN Consulting Engineers							

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1 INTRODUCTION

This report has been prepared to detail the Civil Works Planning submission element for the Galway Harbour Extension (GHE) Development in Galway. It should be read in conjunction with the foul, storm and watermain design drawings as outlined and noted herein. Consultation was undertaken with the Water Services Department of Galway City Council and the Storm, Foul and Watermain design was agreed in principle.

1.1 Foul Drainage System Overview

The foul drainage system has been designed to cater for the port related buildings proposed as part of this planning application (e.g. Harbour Office, Passenger Terminal, Marina Management Building) and also any building development which may occur in the future (e.g. Marina Village Buildings, Nautical Centre). It is proposed that the foul drainage will fall by gravity to a proposed pumping station. From here the effluent will be pumped to a rising main which currently exists at Galway Harbour Enterprise Park (GHEP). The existing GHEP is serviced by a twin rising main consisting of an 80mm and 100mm main. The 80mm rising main services the GHEP whilst the 100 mm rising main was constructed as a reserve main to facilitate future development. Therefore the GHE rising main will connect to the reserve 100mm GHEP rising main.

Details of the development's foul drainage network are shown on Drawing Nos. 2139-2207-A – 2139-2210-A.

1.2 Storm Drainage System Overview

The drainage system has been designed using Micro Drainage's Windes Drainage Design Software which is based on the Wallingford Procedure. Windes incorporates the 'Sewers for Adoption – 6th Edition into the design and satisfies recommendations for sustainable drainage systems as set out in the Greater Dublin Strategic Drainage Study. The storm water drainage design for the development has been designed to cater for all surface water generated from all hard surfaces within the proposed development including roadways, footpaths, buildings, yards and quays. The storm drainage has been broken down into 4 different networks (Networks A, B, C & D) each with their own outfall location. Networks A, B & C cater for all the road, yard and building areas. Network D caters for the quay areas. Each network outfalls to sea through a tideflex type non-return valve. Petrol Interceptors are incorporated into each network design. The existing storm outfall from GHEP has been diverted and outfalls at the same location as Network A.
Details of the storm drainage system are shown in Drg. Nos. 2139-2214-A – 2139-2218-A.

Details of the storm drainage for the proposed road realignment under Lough Atalia bridge are shown in Drg. No. 2139-2169-A.

2 FOUL WATER DRAINAGE DESIGN

2.1 Introduction

The foul drainage system has also been designed using Micro Drainage's Windes Drainage Design Software. The pipework to the drainage system has been designed to provide for six times the dry weather flow (DWF) in accordance with the recommendations of the Greater Dublin Strategic Drainage Study. The design calculations are displayed in Appendix A. The input reference no., manhole upstream, manhole downstream, length of pipe, population equivalent, size, invert upstream (A), invert downstream (B), resulting gradient, flow rate and capacity of each foul sewer pipe within the network are tabulated. As noted in Section 1.1 the foul drainage will fall by gravity to a proposed pumping station. From here the effluent will be pumped to a rising main which currently exists in Galway Harbour Enterprise Park. The existing GHEP is serviced by a twin rising main consisting of an 80mm and 100mm main. The 80mm rising main services the GHEP whilst the 100mm rising main was constructed as a reserve main to facilitate future development. Therefore the GHE rising main will connect to the reserve 100mm GHEP rising main.

Details of the development's foul drainage network are shown on Drawing Nos. 2139-2207-A – 2139-2210-A. Windes generated longitudinal sections of the proposed drainage network are detailed in Drg. Nos. 2139-2211-A – 2139-2212-A.

2.2 Occupancy Figures & Wastewater Flow Rates

The occupancy figures for the proposed development are detailed Table 2.1 below. Details of the discharge wastewater flow rates as generated by Windes can be seen attached in Appendix B. A peak discharge flow of 4.3 litres/sec will be created by the proposed development.

The Hydraulic and BOD loading for the proposed development are also detailed in Table 2.1 below in accordance with the recommendations obtained from the EPA Wastewater Treatment Manual.

	Floor Area (m^2)	Occupancy Load Factor	Total No. of Persons	Litres per Person per day	BOD per person per day	Total Hydraulic Loading (Litres/Day)	Total Organic Loading (Grams/Day)
Harbour Office							
Office	207	7	30	60	30	1800	900
Meeting Room	105	1	105	40	20	4200	2100
Day Bed			1	222	60	222	60
						6222	**3060**
Passenger Terminal							
Queuing & Waiting Area	356	0.7	509	20	10	10180	5090
Staff	356	50	8	60	30	480	240
Office	47	7	7	60	30	420	210
						11080	**5540**
Marina Mgmt Building							
Office/Reception	55	7	8	60	30	480	240
Visitors	62	10	7	10	10	70	70
						550	**310**
Harbour Warehouse & Management Building							
Storage	900	30	30	30	20	900	600
Office	35	7	5	60	30	300	150
						1200	**750**
Control Houses							
Staff			6	60	30	**360**	**180**
Shipping							
Crew of typical 25,00 tonne tanker			25	60	30	**1500**	**750**
Marina							
216 No. Berths			216	60	30	**12960**	**6480**
Future Marina Village Buildings							
Office	2148	7	307	60	30	**18420**	**9210**
Future Harbour Warehousing							
Storage	1800	30	60	30	20	**1800**	**1200**
Future Nautical Centre							
Storage	325	30	11	30	20	330	220
Training	130	1	130	20	10	2600	1300
Office / reception	85	7	13	60	30	780	390
						3710	**1910**

Future Oil Offices							
Office	40	7	6	60	30	**360**	**180**
Development Total (incl future proofing)						**58162**	**29570**

** Occupancy Load Factors for Retail Units as per Building Regulations Technical Guidance Document B – Fire Safety Section 1.0.10*
** Staff based on standard retail employment to floor space ratio of 1No. job per 50sqm (gross)*
** Occupancy Load Factors for Library per Appendix A of the Code of Practice for the Management of Fire Safety in Places of Assembly*

From this data, the PE for the proposed development is calculated using the Total Organic Loading, or BOD, figure of 29,570 grams/day and dividing it by 60 grams per day per population equivalent, to get a **PE figure of 493**.

2.3 Pumping Station and Rising Main Design

2.3.1 Introduction

As outlined above, it is proposed to outfall the foul effluent by gravity to a pumping station. The location of the pumping station is shown in Drg. No. 2139-2207-A and the details of the pumping station are shown in Drg. No. 2139-2213-A. The pumping station has been designed to cater for 24-hour storage of the effluent produced by the proposed development and any future development which may arise. Designing the pumping station to cater for 24-hour storage gives a storage capacity requirement of **58,162 litres**. We are therefore proposing to provide a Precast or RC pumping station with pump sump and overflow tank having a combined capacity of **59m^3**, as detailed in Drg. No. 2139-2213-A.

A proposed 100mm rising main will facilitate the pumping of effluent from the proposed pumping station to the existing 100mm rising main in GHEP. This proposed 100mm rising main location is shown in Drg. No. 2139-2007-A. The proposed 100mm Rising Main is approximately 533m long and is designed to cater for the DWF of 58,162 litres litres/day as described above. Based on a pumping rate of 15 times DWF the proposed arrangement will cater for flow of 10 l/s pumped through the 100mm Rising Main. The resulting velocity is 1.29 m/sec. Please see Appendix C for preliminary rising main calculations. The proposed pumping station pumping cycle will be synced with the existing GHEP pumping station to ensure that the only one pumping station will be pumping at any one time. This will ensure that no overloading issues will arise at the existing rising main outfall location to the Galway Main Drainage.

Any risk of septicity will be eliminated by the installation of the proprietary “Sca” Sewage Conditioner system.

3 STORM WATER DRAINAGE DESIGN

3.1 Introduction

As noted above, the storm drainage for the entire development has been designed using the Micro Drainage’s Windes Drainage Design Software. The storm water drainage design has been designed to cater for surface water from public hard surfaces in the proposed development. The pipe ref. no., manhole no. upstream, manhole no. downstream, length of pipe, ground level at manhole upstream, ground level at manhole downstream, impermeable area for each pipe section, invert level upstream, invert level downstream, gradient, capacity and rate of flow for each pipe section are detailed. Windes generated longitudinal sections of the proposed drainage network are detailed in Drg. Nos. 2139-2219-A – 2139-2223-A.

Details of the storm drainage for the proposed road realignment under Lough Atalia bridge are shown in Drg. No. 2139-2169-A.

3.2 Network

As noted in Section 1.2, the storm drainage has been broken down into 4 different networks (Networks A, B, C & D) each with their own outfall location. Networks A, B & C cater for hard surfaces such as road, yard and building areas. The existing storm outfall from GHEP has been diverted and is proposed to outfall at the same location as Network A. Network D caters for the quay areas. The quay areas will be bunded and graded to a drainage channel as detailed in Drg. No. 2139-2219-A. Each network outfalls to sea through a tideflex type non-return valve. Details of the proposed outfall layout are presented in Drg. No. 2139-2225-A.

For Networks A & B all hydrocarbon pollutants will be removed using a Class 1 CNSB135 Bypass Seperator or similar prior to outfall to sea at each location. For Networks C all hydrocarbon pollutants will be removed using a Class 1 CNSB110 Bypass Seperator or similar. Drg. No. 2139-2224-A presents details of the separators. The separator will also remove silt and sedimentation from the storm water.

The storm outfall from the existing GHEP will be diverted as shown on Drg. No. 2139-2215-A at the same outfall location as Network A. The separators which exist at the current GHEP outfall locations will be retained to ensure that the diverted storm will be exclusive of hydrocarbons and

silt. All full retention separators have an automatic closure device (ACD) fitted as standard to prevent accumulated pollutants flowing through the unit when maximum storage level is reached.

For Network D, all hydrocarbon pollutants will be removed using a NSFP200 Full Retention Seperator or similar prior to outfall to sea. Details of the full retention separator are shown on Drg. No. 2139-2224-A. The separator will also remove silt and sedimentation from the storm

The storm drainage for the proposed road realignment under Lough Atalia Bridge flows to a pumping station and storage tank and is then pumped via a 100mm diameter rising main to the existing GHEP stormwater drainage network. The storage tank has been sized to cater for a 6 hour 100 year storm event.

4 WATER MAIN

4.1 General over view

The Water main has been designed in accordance with the Recommendations for Site Development Works for Housing Areas published by the Department of the Environment and Local Government. Consultation was undertaken with the Water Services Department of Galway City Council in relation to the proposed watermain layout and the design was agreed in principle.

A 300mm diameter watermain exists along the main road of the GHEP as detailed in Drg. No. 2139-2201-A. It is proposed to construct PVC-U watermain to service the as shown in Drg. No. 2139-2201-A. In accordance with Local authority standards Water meter and Logging Device (Larson Type) are proposed at the connections into the proposed sites. The proposed development will be metered and fire hydrants will be located as shown on Drg. Nos. 2139-2202-A – 2139-2205-A. All watermain will be commissioned and pressure tested to Galway County Council Standards. The typical construction details and the meter details are shown in Drg. No. 2139-2206-A. Static Storage will be provided for each proposed building in the GHE to the requirements of Galway City Council.

5 CONCLUSION

The Report should be read in conjunction with the associated Drawings, layouts and specifications. This report has been prepared as part of the new planning submission in accordance with the relevant standards. We trust that adequate detail has been provided for Wastewater, Storm water drainage and water main layout.

APPENDIX A

Foul Drainage Design Calculations

Fairgreen House
Fairgreen Road
Galway

Date 27 July 2013 11:46
File Foul Sewer Design.fws
Micro Drainage

Designed By James O'Malley
Checked By
System1 W.11.2

SPREADSHEET REPORT - FOUL NETWORK

PN	Length (m)	Dia (mm)	Slope (1:X)	USMH	USCL (m)	USIL (m)	DSMH	DSCL (m)	DSIL (m)	Vel (m/s)	Flow (l/s)	Cap (l/s)
1.000	82.00	150	136.0	1	4.700	3.750	2	4.700	3.147	0.75	0.9	13.3
1.001	68.00	150	134.9	2	4.700	3.147	3	4.800	2.643	0.75	2.1	13.3
1.002	75.00	150	134.9	3	4.800	2.643	4	4.800	2.087	0.75	2.5	13.3
1.003	84.00	150	135.0	4	4.800	2.087	5	4.800	1.465	0.75	2.8	13.3
1.004	81.00	150	130.2	5	4.800	1.465	16	4.800	0.843	0.77	3.0	13.6
2.000	90.00	150	134.9	6	4.700	3.550	8	4.800	2.883	0.75	0.0	13.3
3.000	90.00	150	134.9	7	4.800	3.650	8	4.800	2.983	0.75	0.1	13.3
2.001	81.00	150	135.0	8	4.800	2.883	13	4.800	2.283	0.75	0.3	13.3
4.000	83.00	150	135.0	9	4.700	3.550	10	4.700	2.935	0.75	0.3	13.3
4.001	80.00	150	134.9	10	4.700	2.935	13	4.800	2.342	0.75	0.3	13.3
5.000	90.00	150	134.9	11	4.800	3.650	12	4.800	2.983	0.75	0.1	13.3
5.001	90.00	150	128.6	12	4.800	2.983	13	4.800	2.283	0.77	0.1	13.6
2.002	45.00	150	135.3	13	4.800	2.283	14	4.700	1.950	0.75	0.8	13.3
2.003	56.00	150	135.3	14	4.700	1.950	15	4.800	1.537	0.75	0.8	13.3
2.004	70.00	150	100.9	15	4.800	1.537	16	4.800	0.843	0.87	1.0	15.4
1.005	19.00	150	134.8	16	4.800	0.843	Pumping Station	4.700	0.702	0.75	4.3	13.3

APPENDIX B

Storm Drainage Design Calculations

i) Galway Harbour Extension
ii) Lough Atalia Road Realignment

i) Galway Harbour Extension Calculations

Fairgreen House
Fairgreen Road
Galway

Date 17/08/2013 15:22
File network a.mdx
Designed By James O'Malley
Checked By
Micro Drainage
Network W.12.4

Spreadsheet Report - STORM NETWORK A

PN	Length (m)	Dia (mm)	Slope (1:X)	Area (ha)	USMH	USCL (m)	USIL (m)	DSMH	DSCL (m)	DSIL (m)	Pro Vel (m/s)	Cap (l/s)	Flow (l/s)
S1.000	56.000	225	99.3	0.126	S1	4.700	3.404	S3	4.800	2.840	1.22	52.2	19.3
S2.000	32.000	300	241.6	0.419	S2	4.800	3.300	S3	4.800	3.168	1.14	71.2	64.9
S1.001	65.000	375	321.4	0.028	S3	4.800	2.690	S4	4.800	2.488	1.09	111.0	81.5
S1.002	76.000	525	491.3	0.860	S4	4.800	2.338	S5	4.800	2.183	1.12	217.3	189.0
S3.000	51.000	300	241.9	0.344	S6	4.800	3.300	S5	4.800	3.089	1.10	71.1	52.1
S1.003	88.000	600	500.0	0.344	S5	4.800	2.108	S11	4.700	1.932	1.21	306.0	260.1
S4.000	47.000	450	235.0	1.230	S7	4.900	3.250	S8	4.700	3.050	1.49	210.2	189.7
S4.001	60.000	675	500.0	0.960	S8	4.700	2.825	S9	4.800	2.705	1.28	417.0	318.5
S4.002	60.000	675	500.0	0.400	S9	4.800	2.705	S10	4.800	2.585	1.30	417.0	356.8
S4.003	61.000	675	500.0	0.300	S10	4.800	2.585	S11	4.700	2.463	1.31	417.0	378.4
S1.004	46.000	825	500.0	0.116	S11	4.700	1.707	S12	4.900	1.615	1.48	706.1	610.6
S1.005	90.000	825	500.0	0.896	S12	4.900	1.615	S13	4.700	1.435	1.49	706.1	680.0
S1.006	42.000	825	500.0	0.040	S13	4.700	1.435	S20	4.800	1.351	1.49	706.1	680.0
S5.000	86.000	150	99.0	0.110	S14	4.900	3.550	S15	4.900	2.682	1.14	17.8	16.0
S5.001	90.000	225	137.3	0.093	S15	4.900	2.607	S20	4.800	1.951	1.17	44.3	27.2
S6.000	46.000	150	92.0	0.090	S16	4.200	3.050	S17	3.500	2.550	1.15	18.5	13.7
S6.001	44.000	300	244.4	0.167	S17	3.500	1.750	S18	4.800	1.570	1.01	70.8	37.3
S6.002	90.000	300	240.0	0.091	S18	4.800	1.570	S19	4.900	1.195	1.07	71.4	46.2
S6.003	64.000	300	245.2	0.090	S19	4.900	1.195	S20	4.800	0.934	1.10	70.7	54.8
S1.007	10.000	900	666.7	0.000	S20	4.800	0.334	S21	4.700	0.319	1.36	767.2	734.8
S1.008	5.000	900	625.0	0.000	S21	4.700	0.319	SPetrol Interceptor	4.700	0.311	1.40	792.6	734.8
S1.009	5.000	900	625.0	0.000	SPetrol Interceptor	4.700	0.311	SNetwork A Outfall	4.700	0.303	1.40	792.6	734.8

Fairgreen House
Fairgreen Road
Galway

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File NPOG Network B.sws
Micro Drainage

Designed By James O'Malley
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System1 W.11.2

SPREADSHEET REPORT - STORM NETWORK B

PN	Length (m)	Dia (mm)	Slope (1:X)	Area (ha)	USMH	USCL (m)	USIL (m)	DSMH	DSCL (m)	DSIL (m)	Vel (m/s)	Cap (l/s)	Flow (l/s)
7.000	90.00	450	400.9	1.039	1	4.800	3.150	2	4.900	2.925	1.01	160.5	149.9
7.001	90.00	600	500.0	0.864	2	4.900	2.775	3	4.900	2.595	1.08	306.0	252.1
7.002	60.00	675	500.0	0.755	3	4.900	2.520	4	4.800	2.400	1.17	417.0	335.7
7.003	69.00	750	500.0	0.954	4	4.800	2.325	14	4.700	2.187	1.24	549.9	434.8
8.000	62.00	300	241.6	0.395	7	4.700	3.200	8	4.800	2.943	1.01	71.2	58.8
8.001	77.00	300	241.6	0.116	8	4.800	2.943	9	4.800	2.625	1.01	71.2	70.0
8.002	58.00	375	321.0	0.178	9	4.800	2.550	10	4.900	2.369	1.01	111.1	89.3
8.003	51.00	375	257.0	0.305	10	4.900	2.369	14	4.700	2.170	1.13	124.3	123.6
9.000	90.00	375	321.0	0.600	11	4.900	3.325	12	4.800	3.045	1.01	111.1	86.5
9.001	90.00	525	491.3	0.776	12	4.800	2.895	14	4.700	2.711	1.00	217.3	181.1
7.004	9.00	900	500.0	0.317	14	4.700	1.645	15	4.700	1.627	1.39	887.1	754.2
7.005	12.00	900	500.0	0.000	15	4.700	1.627	Petrol Interceptor	4.700	1.603	1.39	887.1	754.2
7.006	4.00	900	500.0	0.000	Petrol Interceptor	4.700	1.603	Network B Outfall	0.000	1.595	1.39	887.1	754.2

Fairgreen House
Fairgreen Road
Galway

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Micro Drainage

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SPREADSHEET REPORT - STORM NETWORK C

PN	Length (m)	Dia (mm)	Slope (1:X)	Area (ha)	USMH	USCL (m)	USIL (m)	DSMH	DSCL (m)	DSIL (m)	Vel (m/s)	Cap (l/s)	Flow (l/s)
10.000	80.00	300	241.6	0.393	1	4.900	3.400	2	4.800	3.069	1.01	71.2	57.0
10.001	72.00	375	261.9	0.515	2	4.800	2.994	3	4.800	2.719	1.11	123.1	123.0
10.002	85.00	450	376.7	0.405	3	4.800	2.644	4	4.800	2.418	1.04	165.6	164.6
10.003	79.00	525	490.6	0.447	4	4.800	2.343	5	4.900	2.182	1.00	217.4	206.3
10.004	73.00	600	500.0	0.592	5	4.900	2.107	7	4.700	1.961	1.08	306.0	261.6
11.000	90.00	300	241.9	0.352	6	4.700	3.200	7	4.700	2.828	1.01	71.1	50.5
10.005	55.00	600	500.0	0.048	7	4.700	1.961	8	4.700	1.851	1.08	306.0	294.9
10.006	55.00	675	500.0	0.611	8	4.700	1.776	9	4.700	1.666	1.17	417.0	348.8
10.007	55.00	750	500.0	1.135	9	4.700	1.591	10	4.700	1.481	1.24	549.9	453.0
10.008	53.00	750	500.0	0.568	10	4.700	1.481	11	4.700	1.375	1.24	549.9	496.5
10.009	3.00	825	500.0	0.568	11	4.700	1.300	Petrol Interceptor	4.700	1.294	1.32	706.1	551.4
10.010	3.00	825	500.0	0.000	Petrol Interceptor	4.700	1.294	Network C Outfall	4.700	1.288	1.32	706.1	551.4

Fairgreen House
Fairgreen Road
Galway

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File Quay Network D Rev 2.sws
Micro Drainage

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System1 W.11.2

SPREADSHEET REPORT - STORM NETWORK D

PN	Length (m)	C. Height (mm)	Slope (1:X)	Area (ha)	USMH	USCL (m)	USIL (m)	DSMH	DSCL (m)	DSIL (m)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.000	403.00	425	327.9	1.300	1	4.700	4.275	3	4.700	3.046	1.08	195.3	144.4
2.000	265.00	325	215.6	0.520	2	4.700	4.375	3	4.700	3.146	1.12	119.2	64.6
1.001	4.00	525	400.0	0.000	3	4.700	2.946	4	4.700	2.936	1.11	241.1	201.6
1.002	3.00	525	375.0	0.000	4	4.700	2.936	Petrol Interceptor	4.700	2.928	1.15	249.1	201.6
1.003	3.00	525	375.0	0.000	Petrol Interceptor	4.700	2.928	6	4.700	2.920	1.15	249.1	201.6
1.004	5.00	525	384.6	0.000	6	4.700	2.408	Network D Outfall	4.700	2.395	1.14	245.9	201.6

ii) Lough Atalia Road Realignment Calculations

SPREADSHEET REPORT - LOUGH ATLIA ROAD STORM NETWORK

PN	Length (m)	Dia (mm)	Slope (1:X)	Area (ha)	USMH	USCL (m)	USCL (m)	DSMH	DSCL (m)	DSIL (m)	Pro Vel (m/s)	Cap (l/s)	Flow (l/s)
S1.000	35.000	225	60.0	0.060	S1	3.800	3.800	S2	2.810	1.992	1.20	67.2	9.5
S1.001	15.000	225	140.0	0.080	S2	2.810	2.810	S3	2.800	1.878	1.10	43.9	21.7
S1.002	1.500	300	200.0	0.055	S3	2.800	2.800	SAttenuation Culvert	2.800	1.870	1.04	78.3	30.2
S2.000	45.000	225	26.0	0.050	S3	5.490	5.490	S5	3.780	2.534	1.54	102.4	7.9
S2.001	1.500	225	187.5	0.045	S5	3.780	3.780	SAttenuation Culvert	4.290	2.526	0.90	37.8	15.0

Project No.	2139	Client :	Galway Harbour Co.		Date:	25/11/2013
Storm Storage Design - Lough Atalia Road						
Q = Rate of run off (l/s)	$Q=A_p$x I x Cr x Cv x 2.78		Determined using Modified Rational Method			
Ap =	**0.29**	hectares	=2,900sqm/10,000	(Impermeable Area)	**2900**	m^2
Cr=	**1.3**			(Routing Coefficient)		
Cv=	**0.9**			(Impermeability Factor)		
Q=	**0.943**	**x Intensity (I)**	**(l/sec.)**	0.943	= Cr x Cv x Ap x 2.78	
		See below for Intensity (I) Calculations				
100-Year return period rainfall figures as below						
Time (mins)	**Rainfall depth for 100 yr highlighted (mm)**					
15	15.3	16.83	*Please note rainfall figures have been increased by a factor of 1.1*			
30	18.9	20.79	*for climate change*			
60	23.2	25.52				
120	28.5	31.35				
240	35	38.5				
360	**39.5**	**43.45**				
720	48.5	53.35				
1440	59.7	65.67				
2880	73	80.3				
Taking a 6-hour 100-year return period as highlighted above						
Rainfall (hours) R	**mm depth d**	**Intensity = d/R (mm / hr)**	**Q in (l/sec.)**	**Volume flow in (litres/hour)**	**Volume of Storage required (litres) - 6 hour**	
6.00	**43.45**	7.242	6.831	**24591**	**147544**	
Storage provided		**150 m3**	see Drg No 2139-2169			

APPENDIX C

Preliminary GHE Rising Main Design Calculations

RISING MAIN DESIGN

Dry Weather Flow for Proposed Development **58,162 l/d** **58.16 m³/d**

Dry Weather Flow	58.16 m³/d	2.42 m³/hr	0.67 l/sec

Proposed Pumping Arrangement - Option

		Notes
Select Pumping Arrangement such that number of pump starts per hour =	8 No.	Recommended Pump Starts of 6 to 10 per hour
Resultant duration between pump starts =	7.50 mins.	
Select Multiples of DWF to be Pumped	15 No.	
Resultant duration pumping between pump starts =	0.50 mins.	
Resultant duration idle between pump starts =	7.00 mins.	
Select number of duty pumps	1 No.	
Select number of standby pumps	1 No.	

	litre/day	**litre/hour**	**m3/hour**	**m3/s**	**l/s**
Dry Weather Flow	58162 l/day	2423.42	2.42	0.0007	0.67
Required Total Pumping Rate	872430 l/day	36351.25	36.35	0.0101	10.10
Selected Flow per pump			36.35	0.0101	10.10

Rising Main Diameter and Resultant Velocities

$Ø_{mm}$	$Ø_m$	$Q_{Max\ m^3/s}$	**C.S.A.** m^2	**Velocity** m/sec	**Notes**
80	0.08	0.0101	0.005	2.01	Velocity Adequate for Self - Cleansing
100	0.1	0.0101	0.008	1.29	Velocity Adequate for Self - Cleansing
150	0.15	0.0101	0.018	0.57	Velocity too Low for Self - Cleansing
175	0.175	0.0101	0.024	0.42	Velocity too Low for Self - Cleansing

Selected Rising Main is the 100mm Ø Rising Main with 8 No. Pump Starts per hour and 15 DWF Pumping Rate (10.1l/s)