Attachment 07_4084 3.f

Section D.2 of WWTP Waste Licence Application
Final Effluent Outfall Design

Client	**Coffey Construction Ltd**
Project No.	**1779**
Project Title	**Waterford City WWTP**
Report Title	**Final Effluent Outfall Detailed Design Statement – Final Design Report**

Rev.	Status	Author(s)	Reviewed By	Approved By	Issue Date
0	For discussion with CCL	Claire Lyons	Claire Lyons		28/08/07
1	Issue to Emp Rep	Claire Lyons	Claire Lyons	Michael Joyce	12/10/07
2	Change to Fuller valves	Claire Lyons	Claire Lyons	Michael Joyce	11/03/08

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	Part of Structure **Final Effluent Outfall to River Suir Detailed Design**			Calc Sheet No.
	Drawing Reference **3126/E, 3127/B, 3128/A**	Calculations by **CL**	Checked by **MJ**	Date **27/08/07 Rev 0** **16/10/07 Rev 1** **11/03/08 Rev 2**

Ref	Calculations	Output

General

The proposed final effluent outfall can be considered in three sections, namely;

Section A. Land based section – 227m

Defined as running from the final effluent chamber to southern side of railway crossing at MHOF2

Co-ordinates

264840.146, 112200.506

to

265012.337, 112170.705….railway crossing (north)

to

265016.294, 112118.972….railway crossing (south)

Section B. Section parallel to railway line above high water mark - 399m

Defined as running from MHOF2 to MHOF5 south of railway embankment and below HWM within "Marine Treatment Site" as defined on Tender Invitation Drawing 6268-N901-C.

Co-ordinates

265016.294, 112118.972

to

265412.095, 112141.105

Section C. Marine – 237m

Fully below the HWM from MHOF5 to end of diffuser section

Co-ordinates

265412.095, 112141.105

to

265514.519, 112042.829…….change of direction

to

265602.703, 112076.797

It should be noted at this point, that the co-ordinates of MHOF5 are not as per the foreshore licence. The proposed MHOF5 is now located south of the original co-ordinates as this is considered a more appropriate pipeline route. The alignment of the route from the submarine bend to the foreshore remains the same.

Ground Conditions

General

A number of boreholes were carried out along or close to the route prior to tender stage as follows; BH85, BH86, BH87, BH88, BH89, BH90, BH91& BH92. BH85 to BH89 refer to Section B of the pipeline route. BH89 to BH92 are in relation to Section C of the pipeline route.

Section A

The Contractor has carried out trial pits along Section A of the pipeline route. These trial pits showed similar material at invert level to that encountered over the rest of the treatment works site ie. a granular clay with sand. The excavations were all stable and it is considered that the material is capable of supporting the pipeline.

Section B

The boreholes carried out on Section B indicate a layer of silt ranging from a maximum depth of 4.5m at BH86 to a minimum depth of 2.2m below ground level at BH89. This silt layer is underlain by a sandy gravelly clay with SPT values ranging from N=15 to over 50, with the exception of BH85 where a lower SPT of N=5 was recorded. The invert level of the proposed pipeline on this section will be in the order of 4 to 5m below ground level and will therefore be founded in the sandy gravelly clay.

Section C

The boreholes carried out on Section C again indicate a layer of silt approximately 2m deep underlain by a sandy gravelly clay. The majority of the length of this section will be founded in the stronger clay stratum. As the diameter of the pipe decreases towards the end of the diffuser section, the pipeline will lie within the silt layer. In order to provide a suitable foundation for the concrete ballasts anchoring the pipe, this silt layer will have to be dredged and replaced with imported granular material in order to avoid future pipeline settlement.

Pipeline Physical Characteristics
Section A and B

A 1200mm ID PROFIX pipe is proposed from the final effluent chamber to MHOF5. Details previously supplied by Coffey Construction Ltd.

Structural calculations from the pipe manufacturer show that the pipe has the required stiffness to satisfy long term deflection requirements, that there is an adequate factor of safety for buckling and floatation analysis for the temporary and permanent condition. Bed and surround will be as per the pipe manufacturer's instructions.

Section C

A butt fusion welded SDR26 PE100 pipe is proposed for Section C, the marine section. The diffuser section will comprise polyetylene riser pipes from PE tees with a flanged Series CVF check valve as supplied by Fuller at each port. Stainless steel backing rings will be used throughout. The configuration of the diffuser section of the pipe is as follows; 33m of 1200mm OD, 35m of 900mm OD and 27m of 450mm OD. The reduction tapers along the length are required in order to achieve adequate scour velocities periodically and ensure uniform discharge from the ports.

Principle Hydraulic Design Parameters

<u>Tide Levels (all related to Malin Head OD)</u>

MHWS	1.618m OD
MLWS	-2.466m OD
HAT	2.220m OD (received from Port of Waterford)
MSL	-0.080m OD (received from Port of Waterford)

50 year tide level 2.770m OD (from Table 4.1 OPW "Report on Flood Protection at Scotch Quay Waterford" for Great Island Waterford Harbour)
Highest recorded water level 2.98m OD

Peak flow through works	$1.687m^3/sec$
Full flow to treatment (FFT)	$0.956m^3/sec$
Average Flow	$0.477m^3/sec$

Relevant Employers Requirements – Hydraulic Design

- **13.2.7**

(iii) The effluent shall be diluted with not less than 20 times its volume of ambient water at the river surface at mean low water (MLWS) spring tides, with the maximum effluent discharge and zero ambient current

At maximum treated effluent discharge of $0.956m^3/sec$, 20 times initial dilution or greater is achieved at all ports assuming ambient current velocity of 0.4m/sec or greater.

- **13.4.3**

The outfall and diffuser shall be designed to discharge all the effluent from the Works against a tidal level with a 1:50 year return period.

The design of the outfall and diffuser allows for discharge of flow up to $1.687m^3/sec$, which is the maximum flow that can enter the treatment works at the 1:50 return period. In this situation, the final effluent chamber weir will be drowned. However, there will still be free flow from the final settlement tank outlet weirs. The flowmeter on the outlet will also be surcharged in this condition – this will not affect its operation. At the maximum flow to treatment of 0.956m^3/sec, the final effluent chamber weir will not be surcharged under any tidal condition.

- **13.4.4**

As far as physically possible the outfall and diffuser shall be designed to remain full of effluent at all times.
The fitting of "Tideflex" valves manufactured by Red Valve Co of Carnegie, PA, USA or approved equivalent, to all ports shall be deemed to satisfy this requirement.
If fitted, non return valves shall be designed to resist a back pressure equal to the maximum rise in sea level that could occur in any 12 hour period.

All ports will be fitted with "Fuller" valves which are a non-return duckbill valve equivalent to "Tideflex". They are designed to resist the maximum back pressure that may occur.

- **13.4.5**

*The manifold shall be designed so that the flow through any port (in m^3/sec) is between 0.9 and 1.1 * (maximum flow rate/total number of ports) when the sea is at MEAN SEA LEVEL (MSL) with a density of 1.025 and the flow through the works is a maximum*

This requirement is satisfied in all but three of the ports. However, within the confines of standard size fittings and duckbill valves, this is the best flow distribution in the manifold that can be achieved taking all the criteria into account.

- **13.4.6**

The initial dilution shall be determined for the peak flow at MHWS, MLWS and MSL using any internationally accepted buoyant plume model.

The initial dilution has been modelled for peak flow at all of the above mentioned tidal conditions. Analysis is included in Appendix 1.

Hydraulic Design Methodology

In general, the overall length and location of the outfall and the number and spacing of the diffuser ports is determined by consideration of the initial dilution and secondary dispersion. The length and location of this particular outfall is fixed as per the Foreshore Licence co-ordinates and so the main thrust of the hydraulic design is related to the spacing, configuration and number of outfall ports required to discharge the design flows with the

Ref	Calculations	Output

available head and to achieve suitable flow distribution between diffuser ports to satisfy the assumptions used in initial dilution calculations.

A diffuser ideally will be designed to discharge equally through all ports over a wide range of total discharges. However, this can only be achieved when a diffuser is operating at high pressure, with small ports and high discharge velocities. This mode of operation would be impractical due to the high headlosses involved. As an outfall diffuser can only be designed to discharge equally over a small range of flows, a design compromise is necessary.

The hydraulic analysis procedure being used is as per the WRc "Design Guide for Marine Treatment Schemes". The hydraulic balance of the system may be expressed in a series of equations which compare the specific energy between selected points in the system. The analysis is an iterative process and involves assigning an initial discharge rate to the last port on the diffuser equal to the design flow divided by the number of ports. The value of $P/\rho g$ is computed for this port. This in turn allows the value of $P/\rho g$ to be computed for the pipeline part of the diffuser upstream of the port. Knowing $P/\rho g$ for this pipeline section, then allows the computation of the flow through the adjacent upstream riser. This process is repeated for each riser along the complete diffuser. The total flow is calculated by aggregating the flows calculated for each riser and this is then compared to the actual design flow. If this total aggregated flow is approximately equal to the design flow, then the flow distribution is taken as correct. If not, a new value of discharge for the last port is selected on a pro rata basis and the calculation repeated until the flows match. At each iteration of the calculation, the total head is computed to check that there is enough head available to drive the system.

A copy of these calculations is included on the enclosed CD. A summary of the resultant flows from each port is provided in Appendix 1. The number of ports has been determined based on initial dilution considerations. A diffuser with 16 No. ports fitted with check valves is proposed as detailed on Drawing 3127.

The initial dilution at each port has been calculated and these calculations are also provided on the CD. Firstly, the buoyant discharge regime has been determined to be either BDNF (Buoyancy Dominated Near Field) or BDFF (Buoyancy Dominated Far Field), by determining if H > or < than $5B/U_a^3$, where H = water depth from point of discharge to free surface, U_a is the ambient current velocity and B is the buoyancy flux of the effluent discharge. Then the initial dilution is calculated using either $S = C_1(B^{1/3}H^{5/3})/q_p$ or $S = C_3(U_aH^2)/q_p$ depending on the buoyancy discharge regime, where C_1 and C_3

are dilution constants and q_p is the port flow under consideration. In this case, the BDFF condition is the relevant state.

Outfall Installation

A detailed method statement is provided elsewhere by Coffey Construction Ltd. To summarise briefly, the outfall will be installed in the estuary by floating the empty pipeline into position and then filling the pipeline with water in order to sink the outfall into the prepared trench on the estuary bed. Reinforced concrete ballast weights will be attached to the empty outfall to assist in the sinking and holding of the submerged pipeline in the location as detailed in the foreshore licence conditions. The design criteria used in sizing the ballast weights are as follows;

a) the pipeline sits in the water at half bore when empty and being floated into position
b) the outfall will sink when the pipe bore is 80% full with water

Full design calculations for the ballast weights are provided in Appendix B and are detailed on Drawing No. 3128. The ballast weights will be connected using stainless steel bolts in plastic sleeves.

Accidental Damage Assessment

As a final check, the possibility of the outfall being damaged is considered. A common factor that characterises accidental damage to an outfall is that the probability of occurrence is low. Many of the factors considered are best mitigated against by choice of outfall route and it is assumed that a risk assessment was carried out at preliminary report stage and that the chosen pipeline route represents the best available option.

The following scenario's were considered when arriving at the choice of protection;

a) Direct hit by anchor dropped on the diffuser or anchor cable dragged over diffuser

The risk of this happening is considered low. Firstly, it is highly unlikely that a ship would be in such close proximity (approximately 1m) to the edge of the navigable channel. Secondly, a ship would have to lower an anchor so that it reaches the estuary bed. Thirdly, the anchor would have to move far enough across the bottom to reach the outfall. Fourthly, the anchor would have to hook port and not pass harmlessly over it. Finally, the anchor system has to apply enough force to induce damage. There is a finite probability associated with each of these steps and the aggregated risk of each of the steps happening is very

Ref	Calculations	Output

low.

As the diffuser pipe will be buried, the most vulnerable part of the structure will be the 20 No. diffuser ports. It is proposed to provide protection to the diffuser ports by the installation of 900mm diameter, 600mm high precast concrete rings around each port.

The 900mm diameter around the port should be sufficiently small that in the case where an anchor was dropped it should settle on the concrete ring. There will be a portion of the check valve protruding above the ring which is necessary for its operation. However, as set out above, it is considered that the risk of a direct hit by anchor or cable chain is low and the consequences will not be severe as the full volume of effluent can still be discharged and the check valve will be relatively easy to replace in-situ by a diver.

b) Vessel straddling over the outfall
Again, it is considered that the risk to the diffuser is extremely low. The outfall is buried and there is flexibility in the rubber risers.

c) Scour caused by wash from the propellers of vessels turning over the outfall diffuser
A scour mat will be provided along the length of the diffuser section which will consist of 100mm clean stone.

d) Overdredging/dredging
The Contractor is required by the Contract and the Foreshore Licence conditions to mark the position of the diffuser with a marker buoy. The position of the diffuser will be advised to the Commissioner of Irish Lights and the Port of Waterford.

Appendix 1

1. Diffuser Calculations Summary
(detailed calculations on CD)

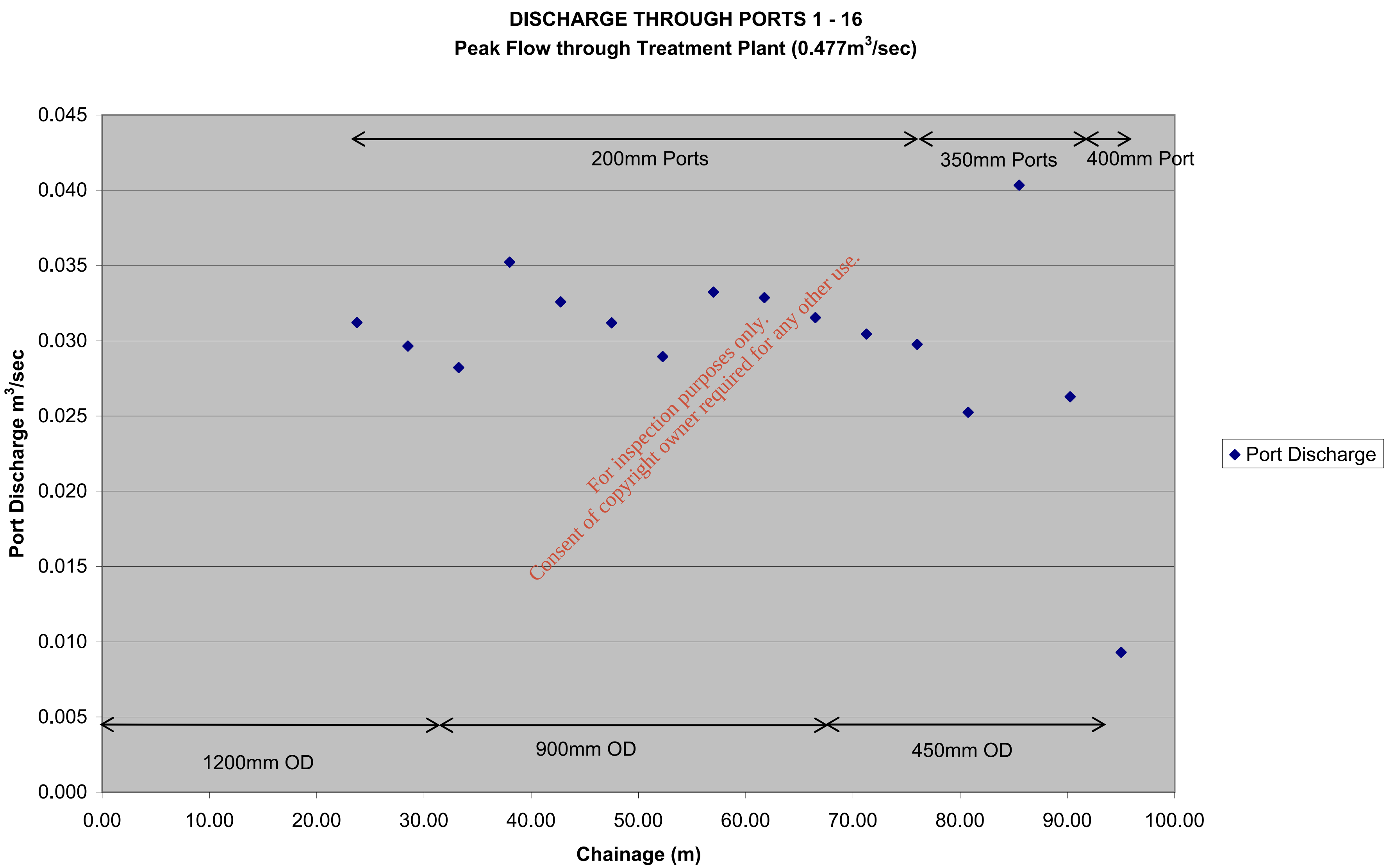
2. Initial Dilution Calculations

3. Buoyancy Calculations

4. Ballast Weight Calculations

Summary of Port Discharges for Average Flow

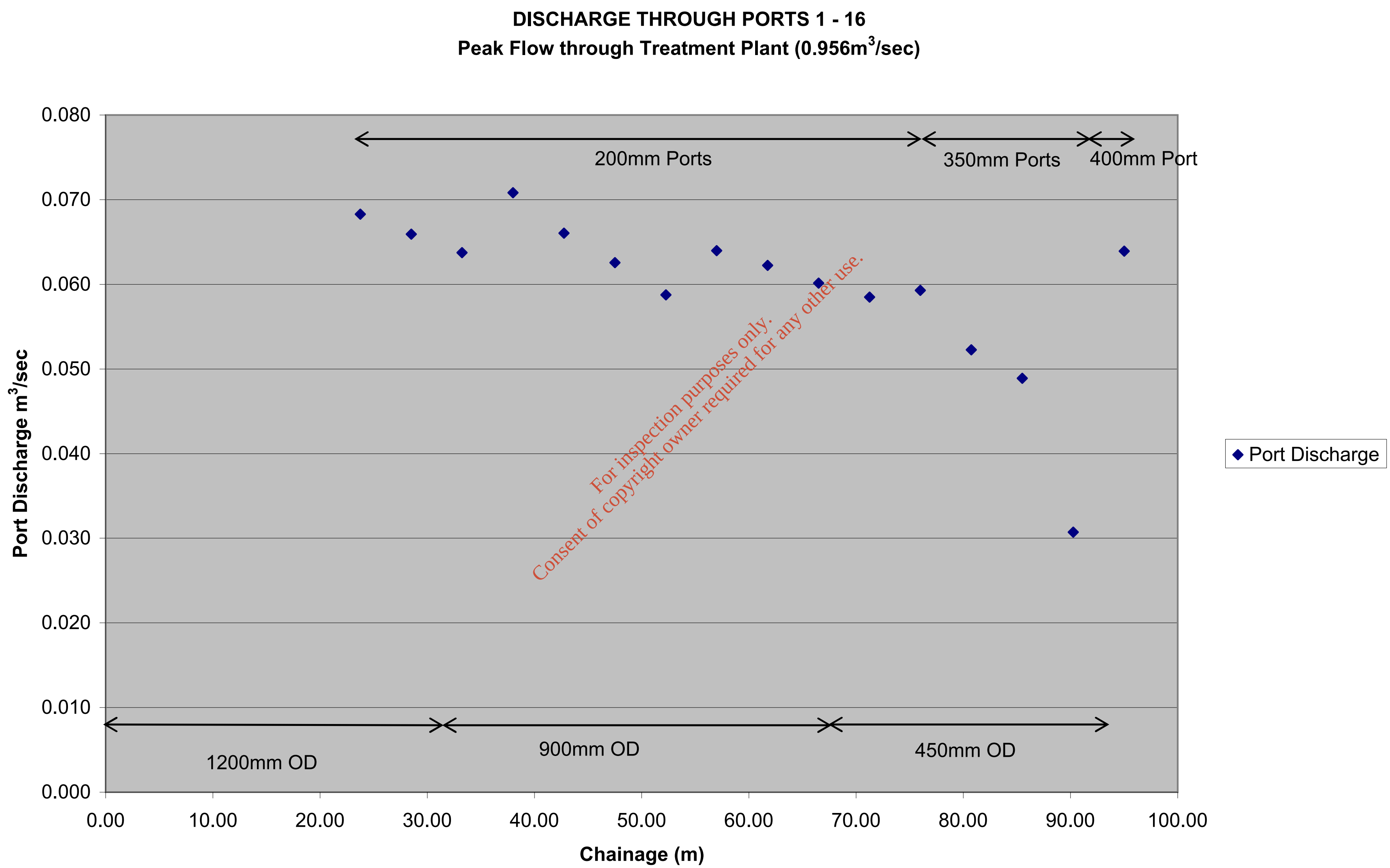
			FFT (0.477m³/sec)								
			MHWS		MLWS		MSL		HAT + delta H		
Chainage	Total Flow	m3/s	0.477		0.477		0.477		0.477		Port Size
	Water Level	m O.D.	1.618		-2.466		-0.08		2.245		
	Head at FE Chamber	m O.D.	2.204		-1.982		0.464		2.847		
95.00	q_1	m^3/s	0.009	0.3	0.009	0.3	0.009	0.3	0.009	0.3	400mm
90.25	q_2	m^3/s	0.026	0.9	0.026	0.9	0.026	0.9	0.026	0.9	350mm
85.50	q_3	m^3/s	0.040	1.4	0.040	1.4	0.040	1.4	0.040	1.4	
80.75	q_4	m^3/s	0.025	0.8	0.025	0.8	0.025	0.8	0.025	0.8	
76.00	q_5	m^3/s	0.030	1.0	0.030	1.0	0.030	1.0	0.030	1.0	200mm
71.25	q_6	m^3/s	0.030	1.0	0.030	1.0	0.030	1.0	0.030	1.0	
66.50	q_7	m^3/s	0.032	1.1	0.032	1.1	0.032	1.1	0.032	1.1	
61.75	q_8	m^3/s	0.033	1.1	0.033	1.1	0.033	1.1	0.033	1.1	
57.00	q_9	m^3/s	0.033	1.1	0.033	1.1	0.033	1.1	0.033	1.1	
52.25	q_{10}	m^3/s	0.029	1.0	0.029	1.0	0.029	1.0	0.029	1.0	
47.50	q_{11}	m^3/s	0.031	1.0	0.031	1.0	0.031	1.0	0.031	1.0	
42.75	q_{12}	m^3/s	0.033	1.1	0.033	1.1	0.033	1.1	0.033	1.1	
38.00	q_{13}	m^3/s	0.035	1.2	0.035	1.2	0.035	1.2	0.035	1.2	
33.25	q_{14}	m^3/s	0.028	0.9	0.028	0.9	0.028	0.9	0.028	0.9	
28.50	q_{15}	m^3/s	0.030	1.0	0.030	1.0	0.030	1.0	0.030	1.0	
23.75	q_{16}	m^3/s	0.031	1.0	0.031	1.0	0.031	1.0	0.031	1.0	
19.00											
14.25											
9.50											
4.75											
	Q_T	m^3/s	**0.476**		**0.476**		**0.476**		**0.476**		



DISCHARGE THROUGH PORTS 1 - 16
Peak Flow through Treatment Plant (0.477m3/sec)
Port Discharge m3/sec
Chainage (m)
0.045
0.040
0.035
0.030
0.025
0.020
0.015
0.010
0.005
0.000
0.00
10.00
20.00
30.00
40.00
50.00
60.00
70.00
80.00
90.00
100.00
200mm Ports
350mm Ports
400mm Port
1200mm OD
900mm OD
450mm OD
Port Discharge

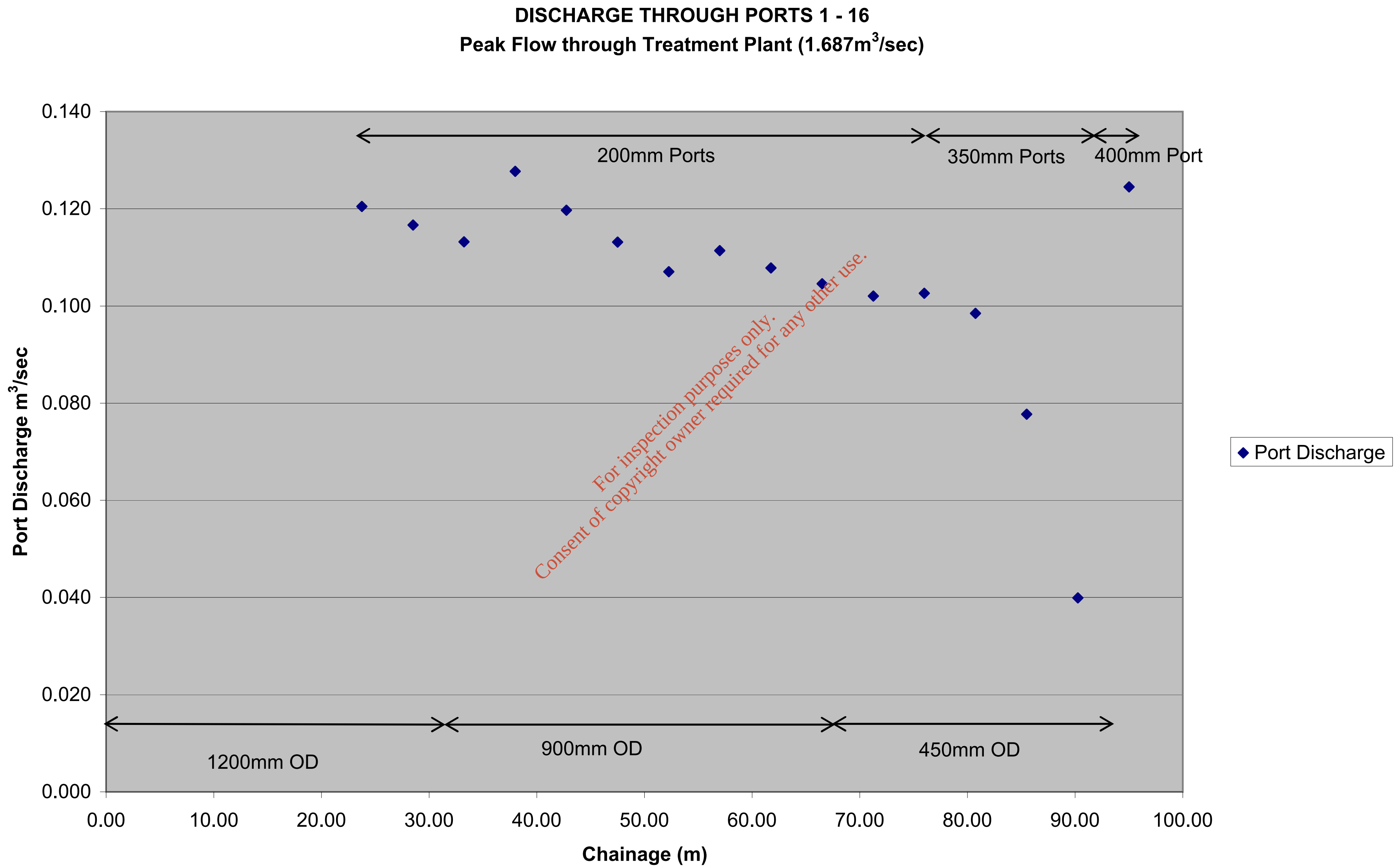
Summary of Port Discharges for Average Flow/FFT

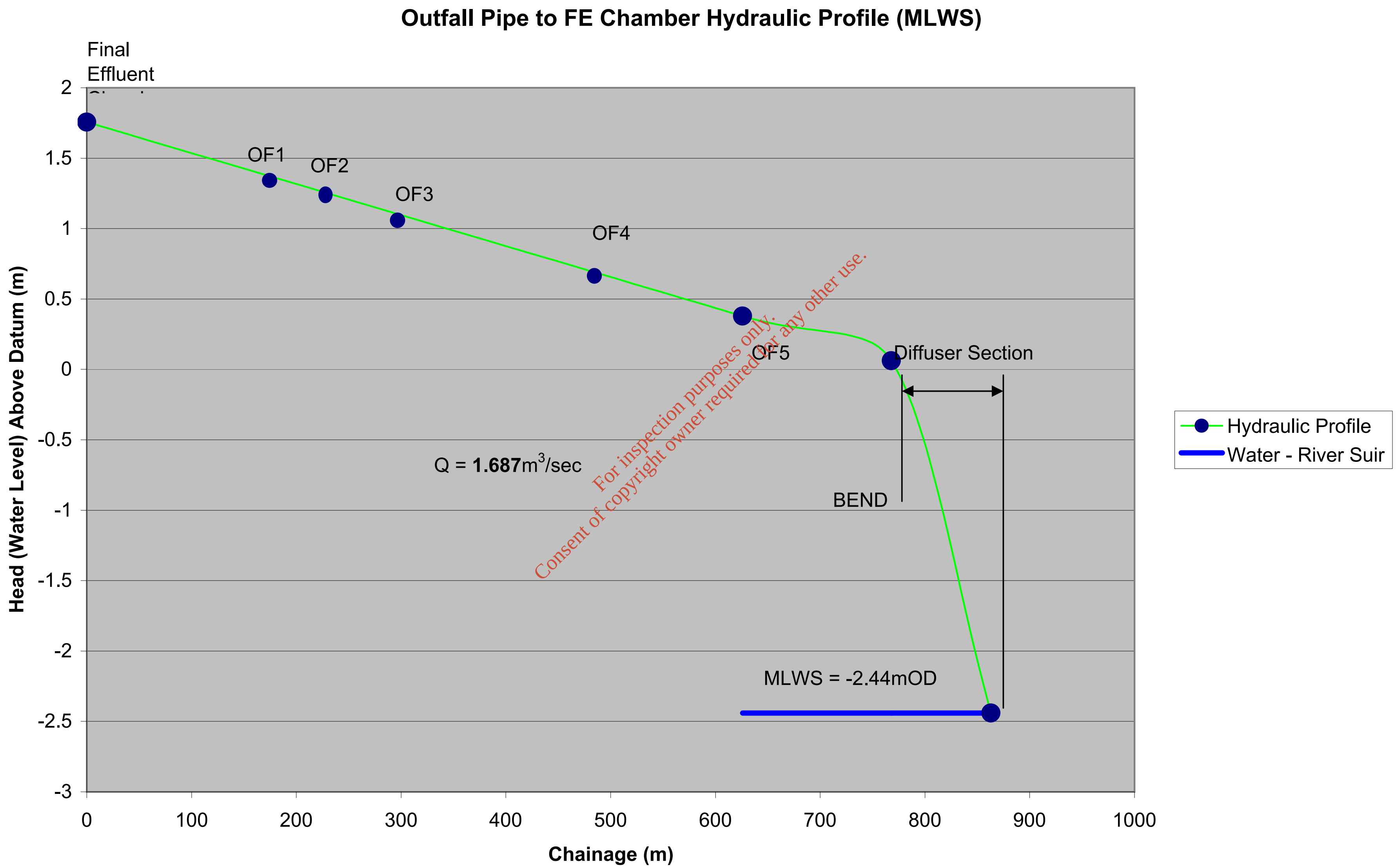
			FFT (0.956m^3/sec)								
			MHWS		MLWS		MSL		HAT + delta H		
	Total Flow	m3/s	0.956		0.956		0.956		0.956		
	Water Level	m O.D.	1.618		-2.466		-0.08		2.245		
Chainage	**Head at FE Chamber**	m O.D.	3.879		-0.307		2.139		4.522		**Port Size**
95.00	**q_1**	m^3/s	0.064	1.1	0.064	1.1	0.064	1.1	0.064	1.1	**400mm**
90.25	**q_2**	m^3/s	0.031	0.5	0.031	0.5	0.031	0.5	0.031	0.5	**350mm**
85.50	**q_3**	m^3/s	0.049	0.8	0.049	0.8	0.049	0.8	0.049	0.8	
80.75	**q_4**	m^3/s	0.052	0.9	0.052	0.9	0.052	0.9	0.052	0.9	
76.00	**q_5**	m^3/s	0.059	1.0	0.059	1.0	0.059	1.0	0.059	1.0	**200mm**
71.25	**q_6**	m^3/s	0.058	1.0	0.058	1.0	0.058	1.0	0.058	1.0	
66.50	**q_7**	m^3/s	0.060	1.0	0.060	1.0	0.060	1.0	0.060	1.0	
61.75	**q_8**	m^3/s	0.062	1.0	0.062	1.0	0.062	1.0	0.062	1.0	
57.00	**q_9**	m^3/s	0.064	1.1	0.064	1.1	0.064	1.1	0.064	1.1	
52.25	**q_{10}**	m^3/s	0.059	1.0	0.059	1.0	0.059	1.0	0.059	1.0	
47.50	**q_{11}**	m^3/s	0.063	1.0	0.063	1.0	0.063	1.0	0.063	1.0	
42.75	**q_{12}**	m^3/s	0.066	1.1	0.066	1.1	0.066	1.1	0.066	1.1	
38.00	**q_{13}**	m^3/s	0.071	1.2	0.071	1.2	0.071	1.2	0.071	1.2	
33.25	**q_{14}**	m^3/s	0.064	1.1	0.064	1.1	0.064	1.1	0.064	1.1	
28.50	**q_{15}**	m^3/s	0.066	1.1	0.066	1.1	0.066	1.1	0.066	1.1	
23.75	**q_{16}**	m^3/s	0.068	1.1	0.068	1.1	0.068	1.1	0.068	1.1	
19.00											
14.25											
9.50											
4.75											
	Q_T	**m^3/s**	**0.956**		**0.956**		**0.956**		**0.956**		


DISCHARGE THROUGH PORTS 1 - 16
Peak Flow through Treatment Plant (0.956m3/sec)
Port Discharge m3/sec
Chainage (m)
200mm Ports
350mm Ports
400mm Port
1200mm OD
900mm OD
450mm OD
Port Discharge
0.080
0.070
0.060
0.050
0.040
0.030
0.020
0.010
0.000
0.00
10.00
20.00
30.00
40.00
50.00
60.00
70.00
80.00
90.00
100.00

Summary of Port Discharges for Peak Flow

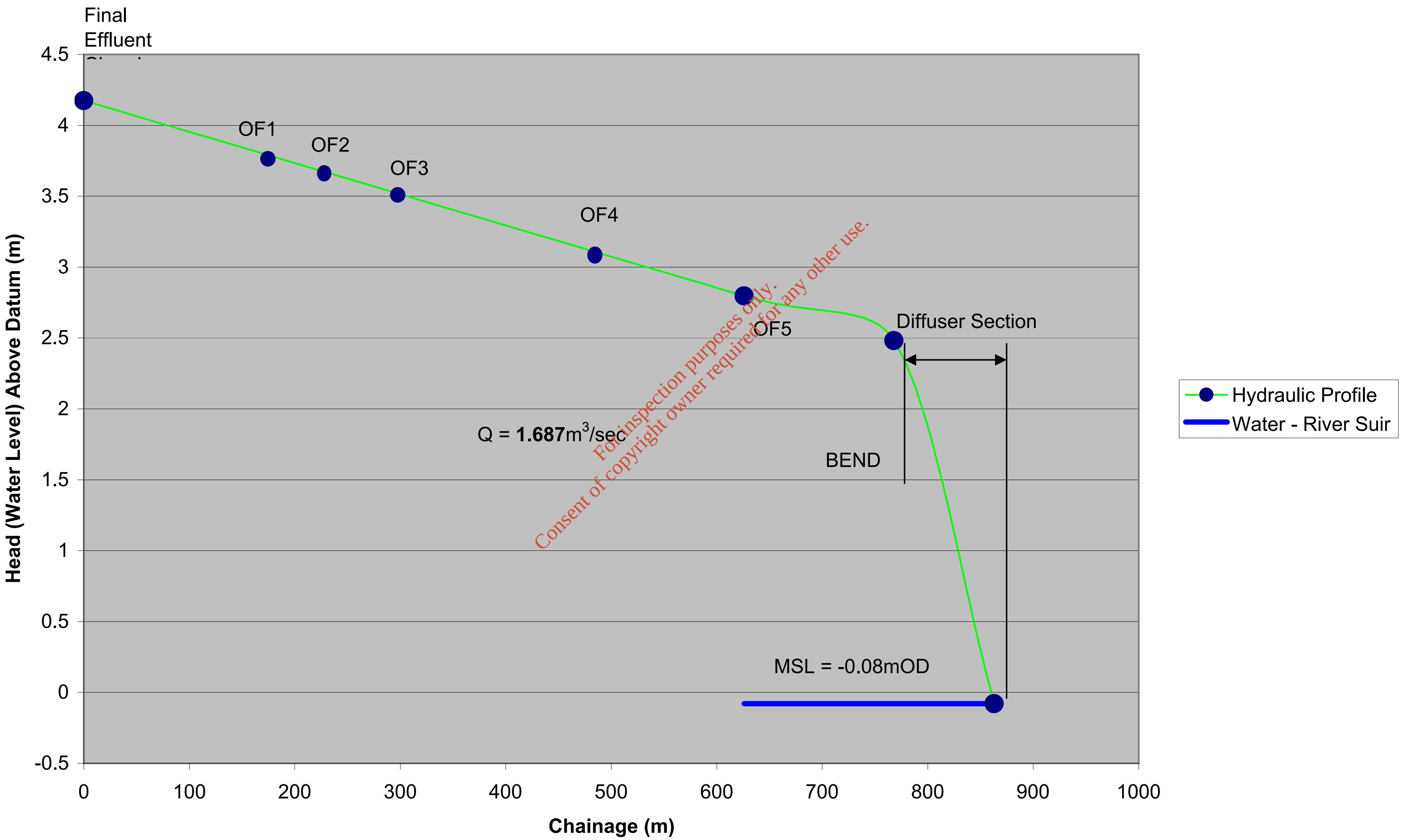
			Peak Flow (1.687m^3/sec)								
			MHWS		MLWS		MSL		HAT + delta H		
	Total Flow	m3/s	1.687		1.687		1.687		0.956		
	Water Level	m O.D.	1.618		-2.466		-0.08		2.245		
Chainage	**Head at FE Chamber**	m O.D.	5.915		1.729		4.168		6.558		**Port Size**
95.00	q_1	m^3/s	0.125	1.2	0.125	1.2	0.125	1.2	0.125	1.2	**400mm**
90.25	q_2	m^3/s	0.040	0.4	0.040	0.4	0.040	0.4	0.040	0.4	**350mm**
85.50	q_3	m^3/s	0.078	0.7	0.078	0.7	0.078	0.7	0.078	0.7	
80.75	q_4	m^3/s	0.099	0.9	0.099	0.9	0.099	0.9	0.099	0.9	
76.00	q_5	m^3/s	0.103	1.0	0.103	1.0	0.103	1.0	0.103	1.0	**200mm**
71.25	q_6	m^3/s	0.102	1.0	0.102	1.0	0.102	1.0	0.102	1.0	
66.50	q_7	m^3/s	0.105	1.0	0.105	1.0	0.105	1.0	0.105	1.0	
61.75	q_8	m^3/s	0.108	1.0	0.108	1.0	0.108	1.0	0.108	1.0	
57.00	q_9	m^3/s	0.111	1.1	0.111	1.1	0.111	1.1	0.111	1.1	
52.25	q_{10}	m^3/s	0.107	1.0	0.107	1.0	0.107	1.0	0.107	1.0	
47.50	q_{11}	m^3/s	0.113	1.1	0.113	1.1	0.113	1.1	0.113	1.1	
42.75	q_{12}	m^3/s	0.120	1.1	0.120	1.1	0.120	1.1	0.120	1.1	
38.00	q_{13}	m^3/s	0.128	1.2	0.128	1.2	0.128	1.2	0.128	1.2	
33.25	q_{14}	m^3/s	0.113	1.1	0.113	1.1	0.113	1.1	0.113	1.1	
28.50	q_{15}	m^3/s	0.117	1.1	0.117	1.1	0.117	1.1	0.117	1.1	
23.75	q_{16}	m^3/s	0.120	1.1	0.120	1.1	0.120	1.1	0.120	1.1	
19.00											
14.25											
9.50											
4.75											
	Q_T	**m^3/s**	**1.687**		**1.687**		**1.687**		**1.687**		


DISCHARGE THROUGH PORTS 1 - 16
Peak Flow through Treatment Plant (1.687m3/sec)
200mm Ports
350mm Ports
400mm Port
1200mm OD
900mm OD
450mm OD
Port Discharge m3/sec
Chainage (m)
0.140
0.120
0.100
0.080
0.060
0.040
0.020
0.000
0.00
10.00
20.00
30.00
40.00
50.00
60.00
70.00
80.00
90.00
100.00
Port Discharge

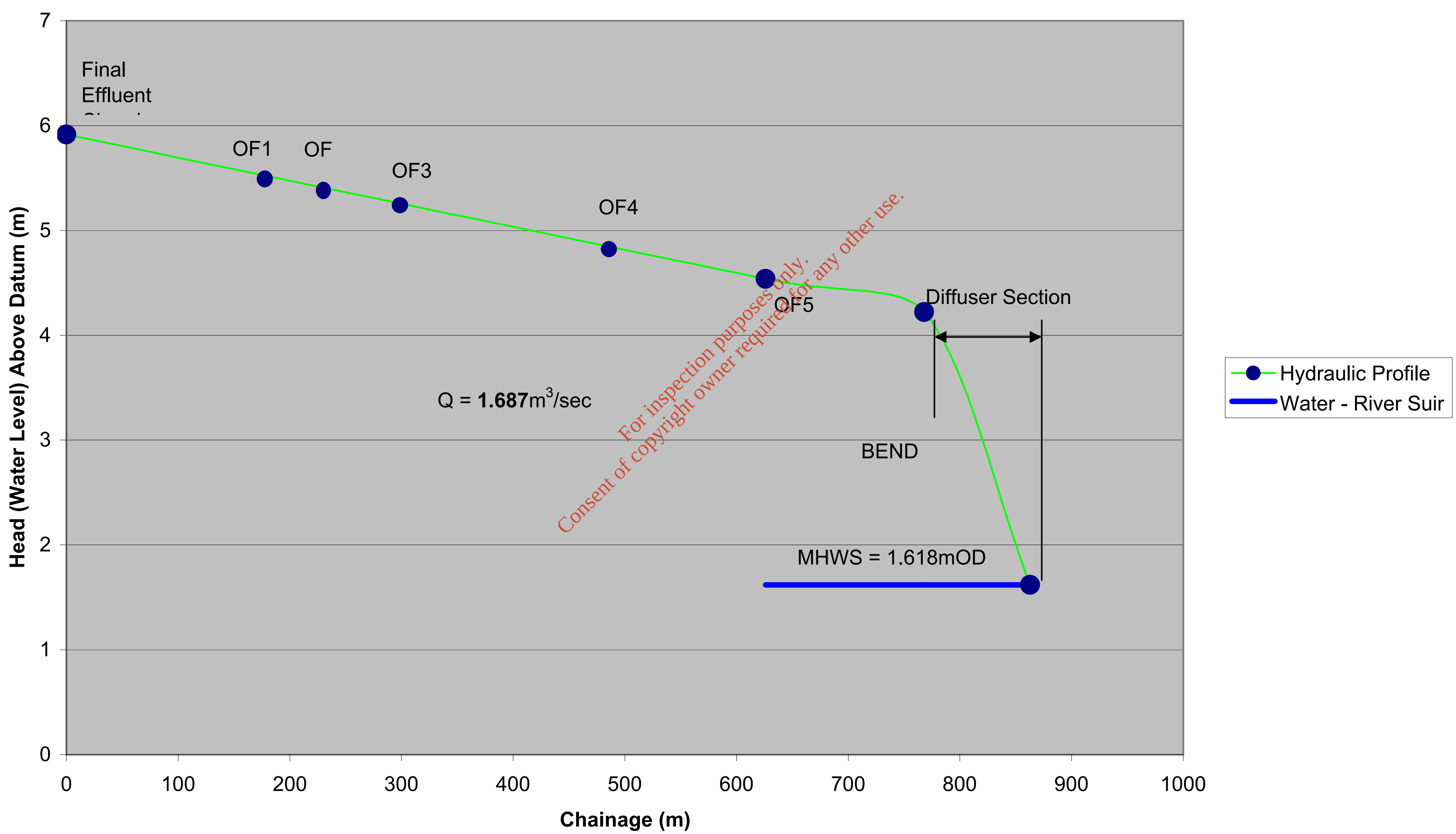


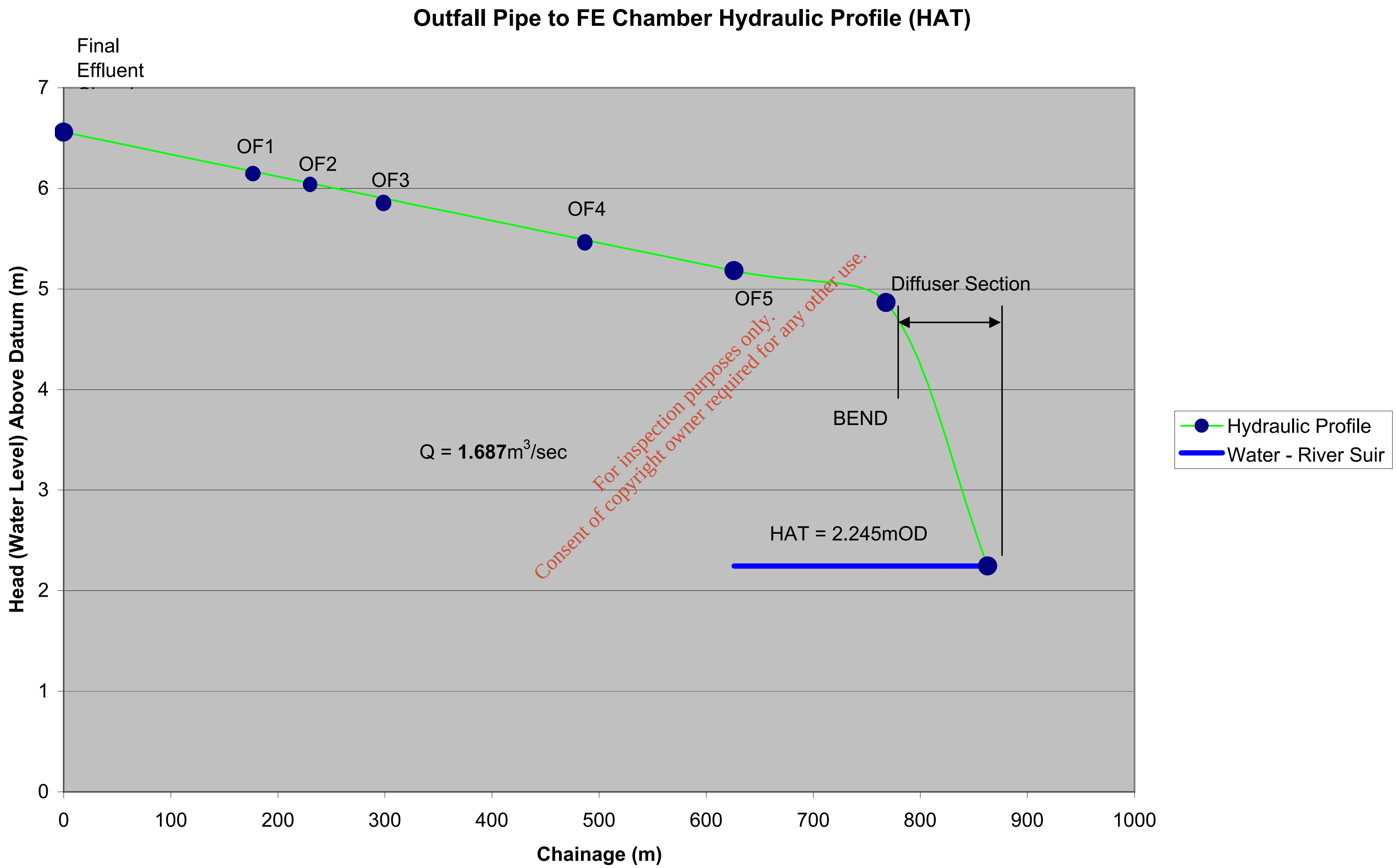
Outfall Pipe to FE Chamber Hydraulic Profile (MLWS)
Final
Effluent
Head (Water Level) Above Datum (m)
Chainage (m)
OF1
OF2
OF3
OF4
OF5
Diffuser Section
BEND
Q = 1.687m3/sec
MLWS = -2.44mOD
Hydraulic Profile
Water - River Suir
2
1.5
1
0.5
0
-0.5
-1
-1.5
-2
-2.5
-3
0
100
200
300
400
500
600
700
800
900
1000

Outfall Pipe to FE Chamber Hydraulic Profile (MSL)

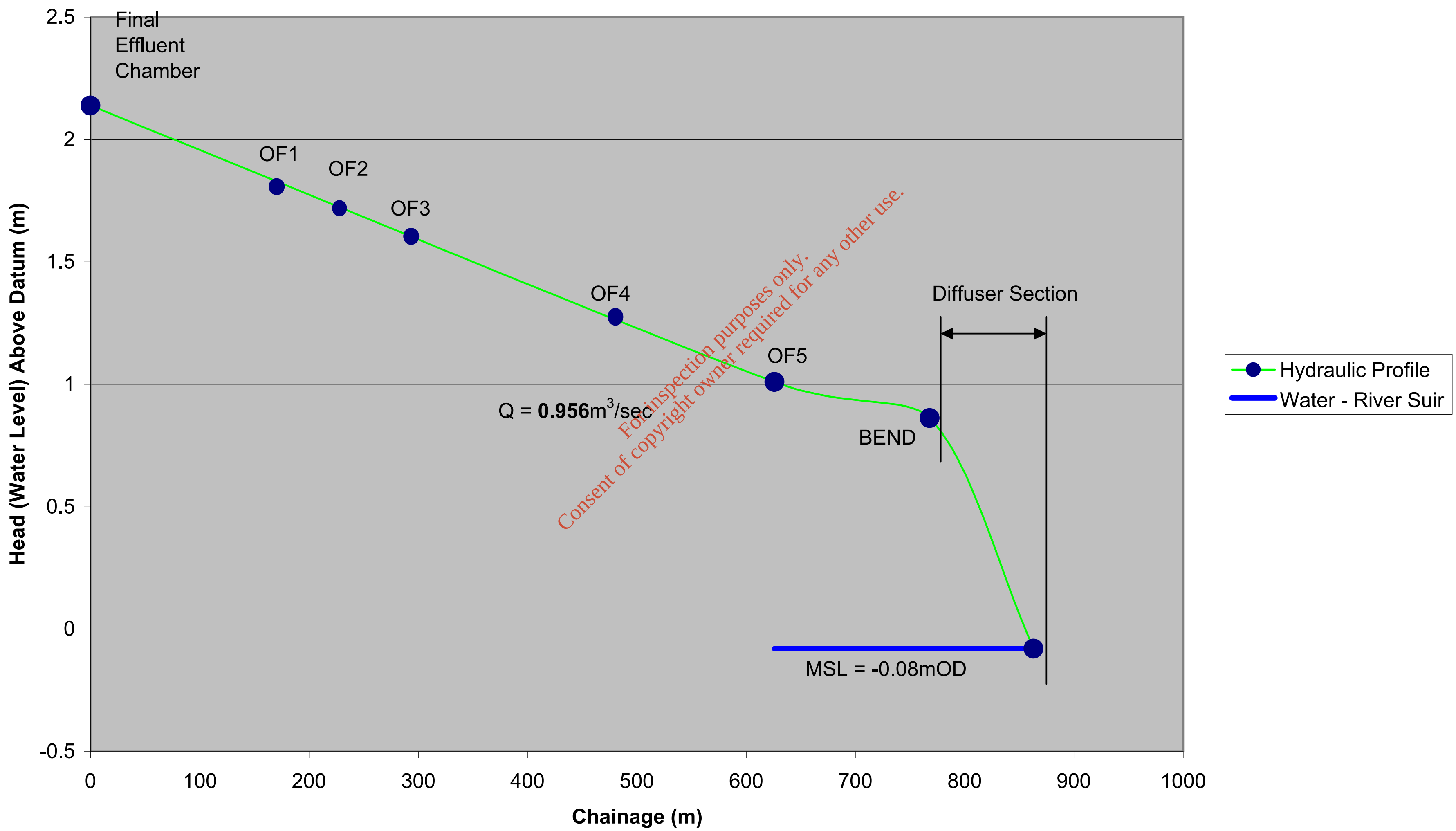


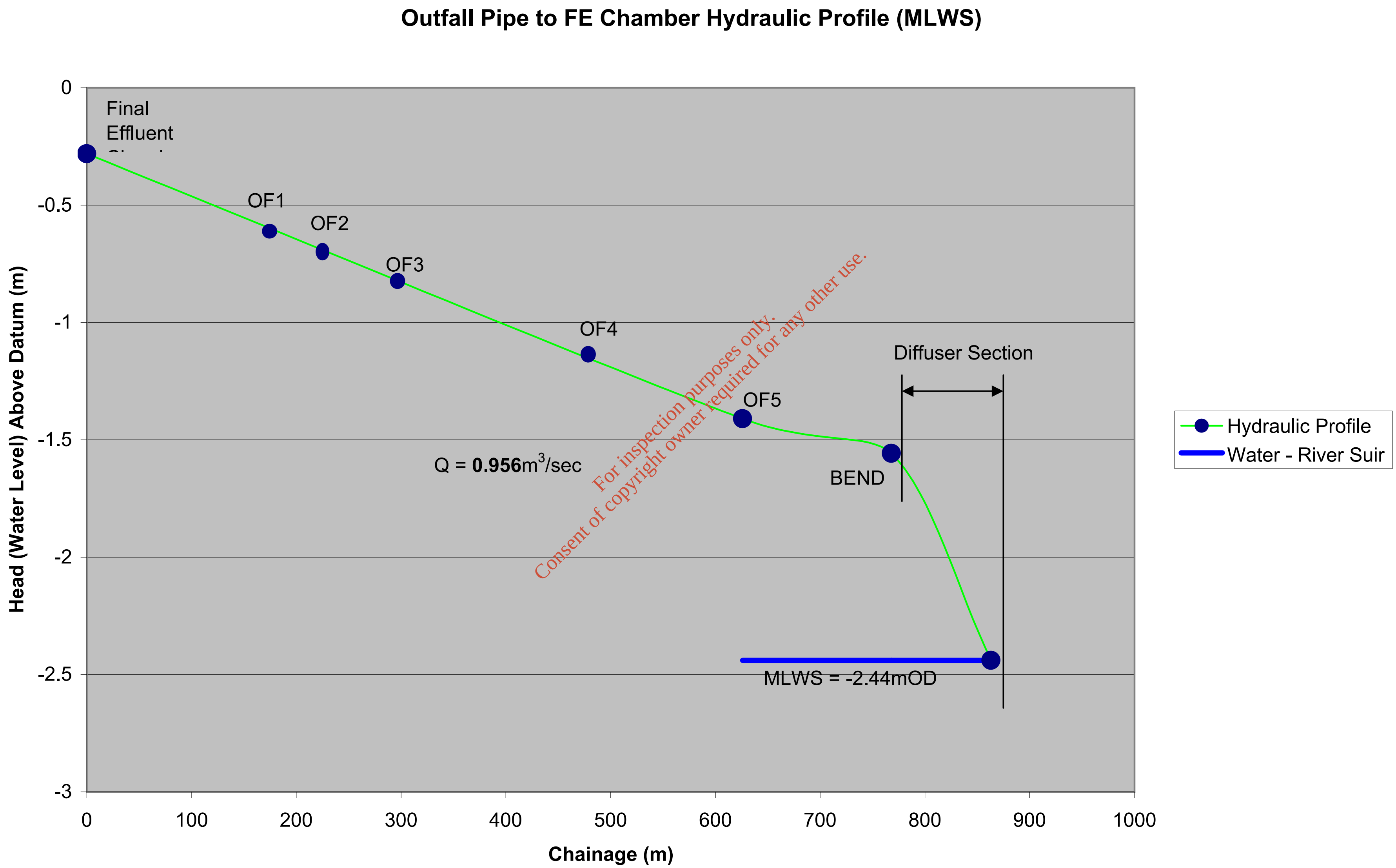
Outfall Pipe to FE Chamber Hydraulic Profile (MHWS)



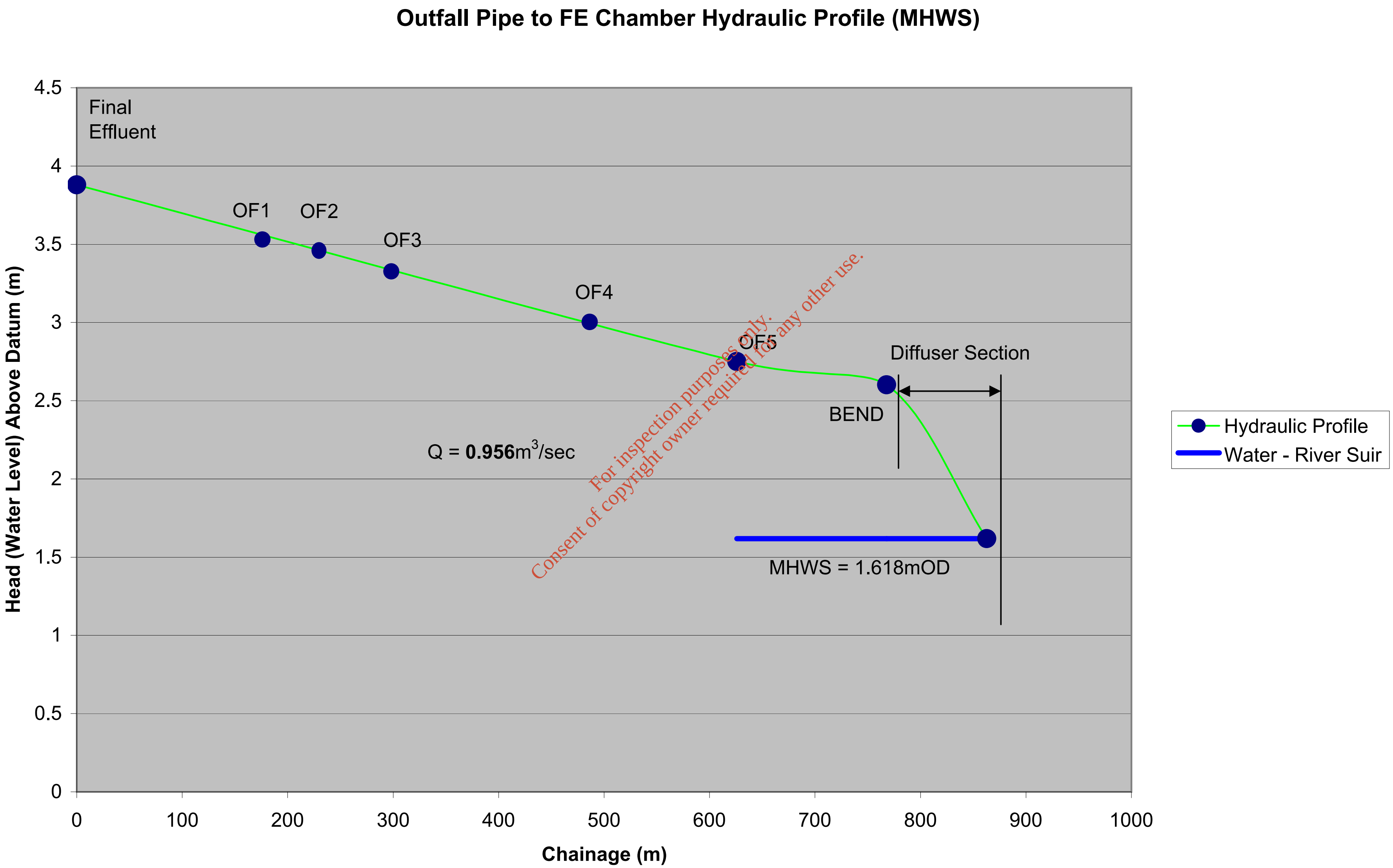

Outfall Pipe to FE Chamber Hydraulic Profile (HAT)
Final
Effluent
OF1
OF2
OF3
OF4
OF5
Diffuser Section
BEND
Q = 1.687m3/sec
HAT = 2.245mOD
Head (Water Level) Above Datum (m)
Chainage (m)
0
1
2
3
4
5
6
7
0
100
200
300
400
500
600
700
800
900
1000
Hydraulic Profile
Water - River Suir

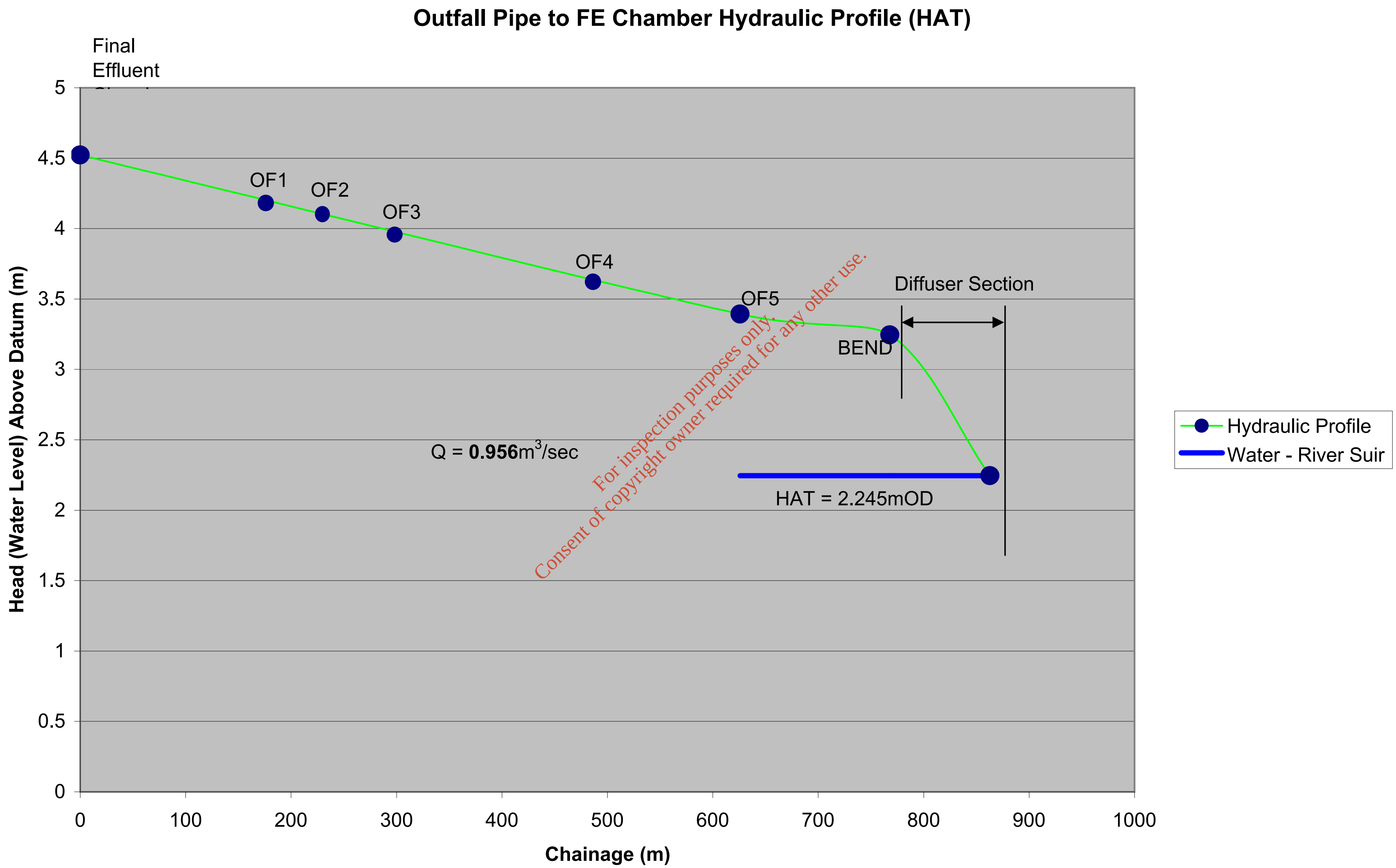
Outfall Pipe to FE Chamber Hydraulic Profile (MSL)

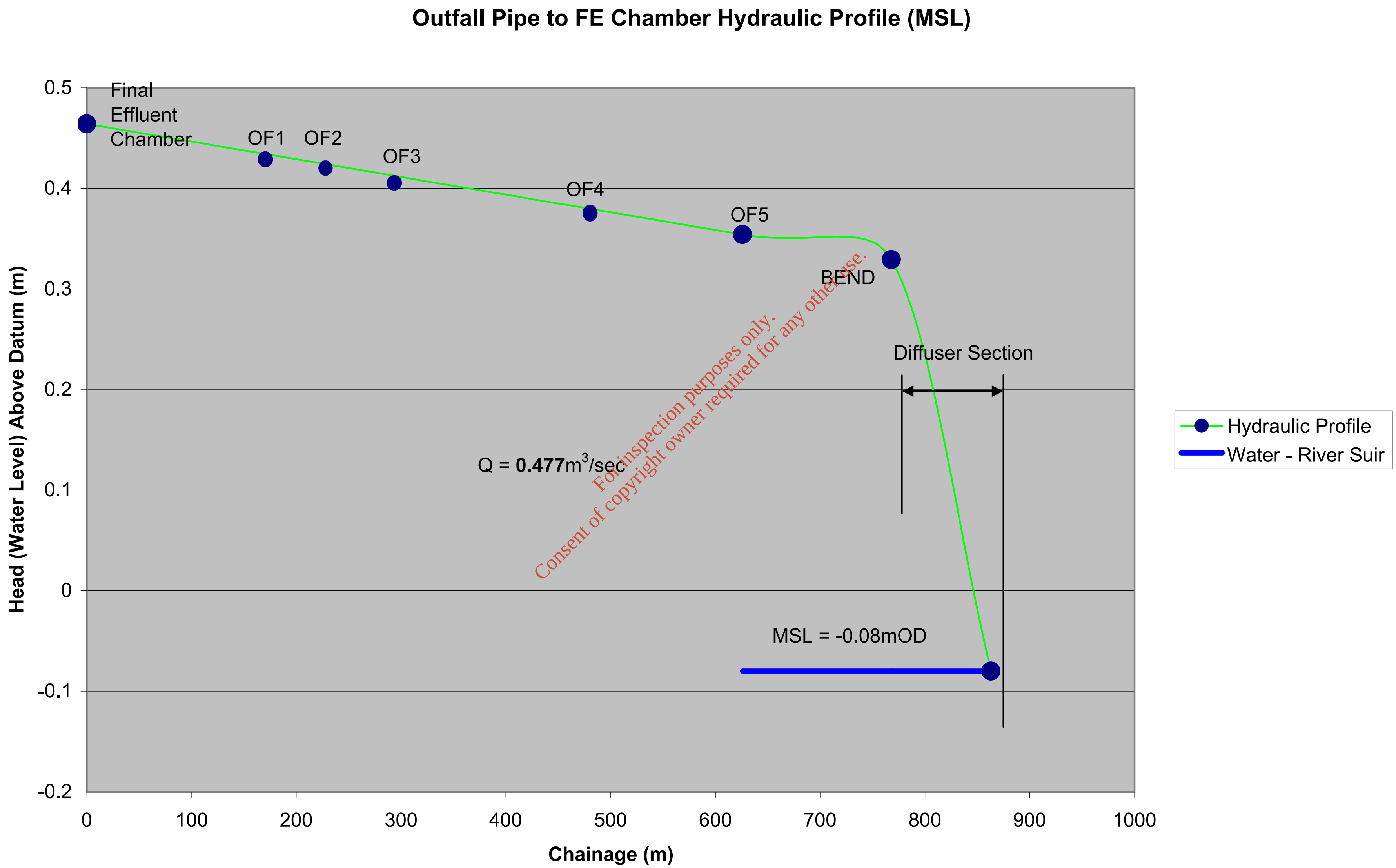




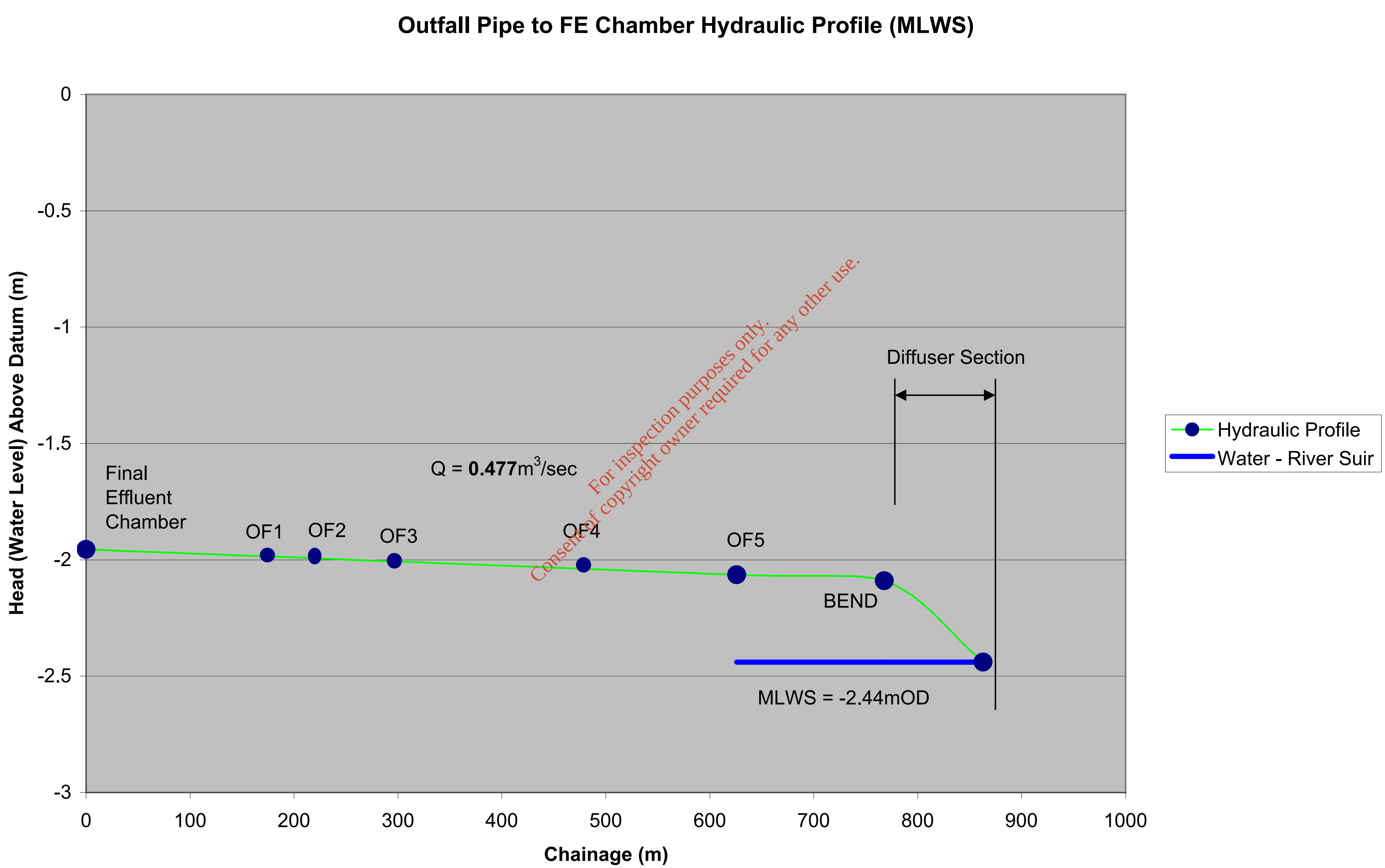
Outfall Pipe to FE Chamber Hydraulic Profile (MLWS)
Head (Water Level) Above Datum (m)
0
-0.5
-1
-1.5
-2
-2.5
-3
0
100
200
300
400
500
600
700
800
900
1000
Chainage (m)
Final
Effluent
OF1
OF2
OF3
OF4
OF5
BEND
Diffuser Section
Q = **0.956**m3/sec
MLWS = -2.44mOD
Hydraulic Profile
Water - River Suir

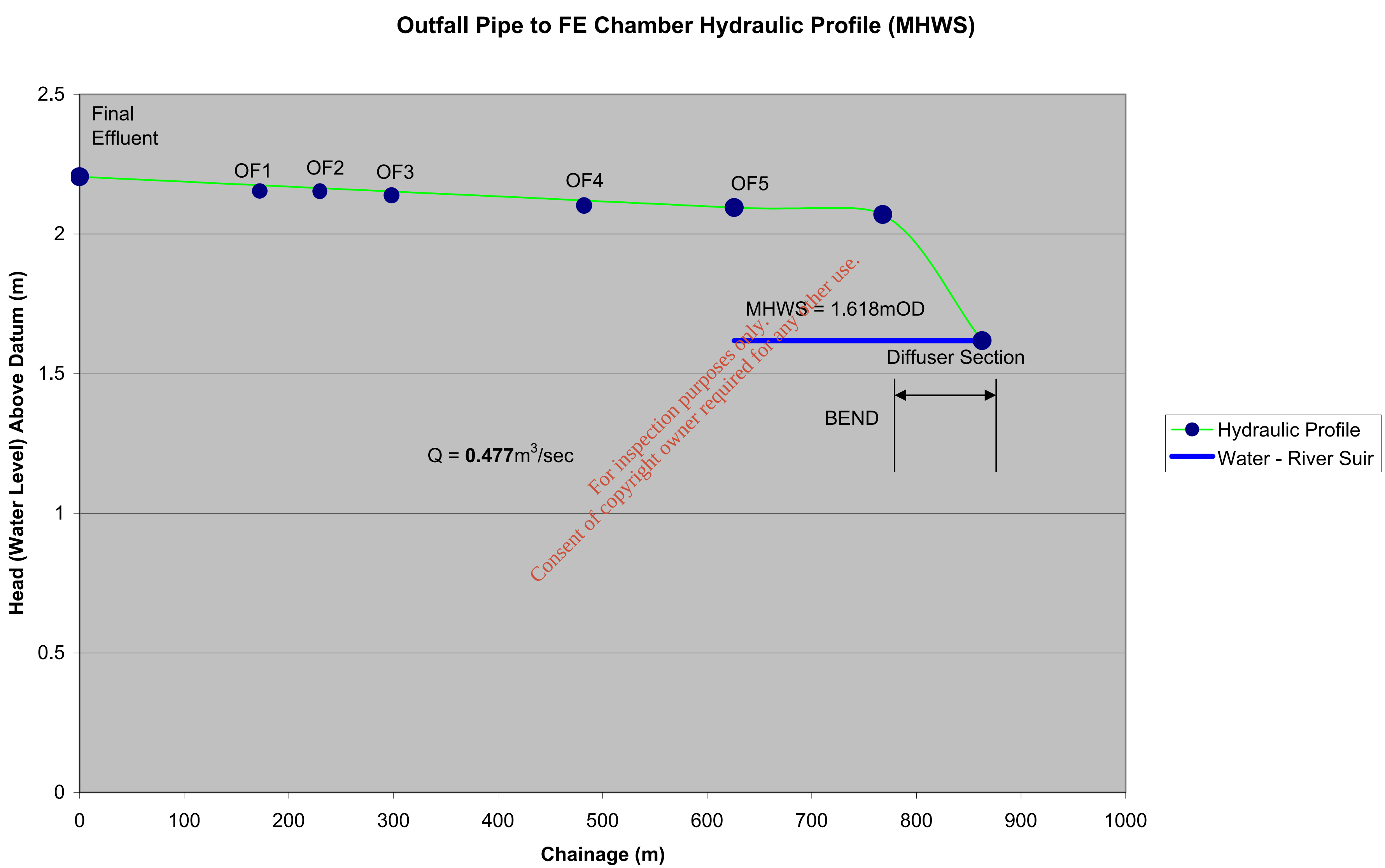

Outfall Pipe to FE Chamber Hydraulic Profile (MHWS)
Head (Water Level) Above Datum (m)
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
Final
Effluent
OF1
OF2
OF3
OF4
OF5
Diffuser Section
BEND
Q = 0.956m3/sec
MHWS = 1.618mOD
0
100
200
300
400
500
600
700
800
900
1000
Chainage (m)
Hydraulic Profile
Water - River Suir


Outfall Pipe to FE Chamber Hydraulic Profile (HAT)
Final
Effluent
Head (Water Level) Above Datum (m)
Chainage (m)
OF1
OF2
OF3
OF4
OF5
BEND
Diffuser Section
Q = 0.956m3/sec
HAT = 2.245mOD
Hydraulic Profile
Water - River Suir
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5
0
100
200
300
400
500
600
700
800
900
1000

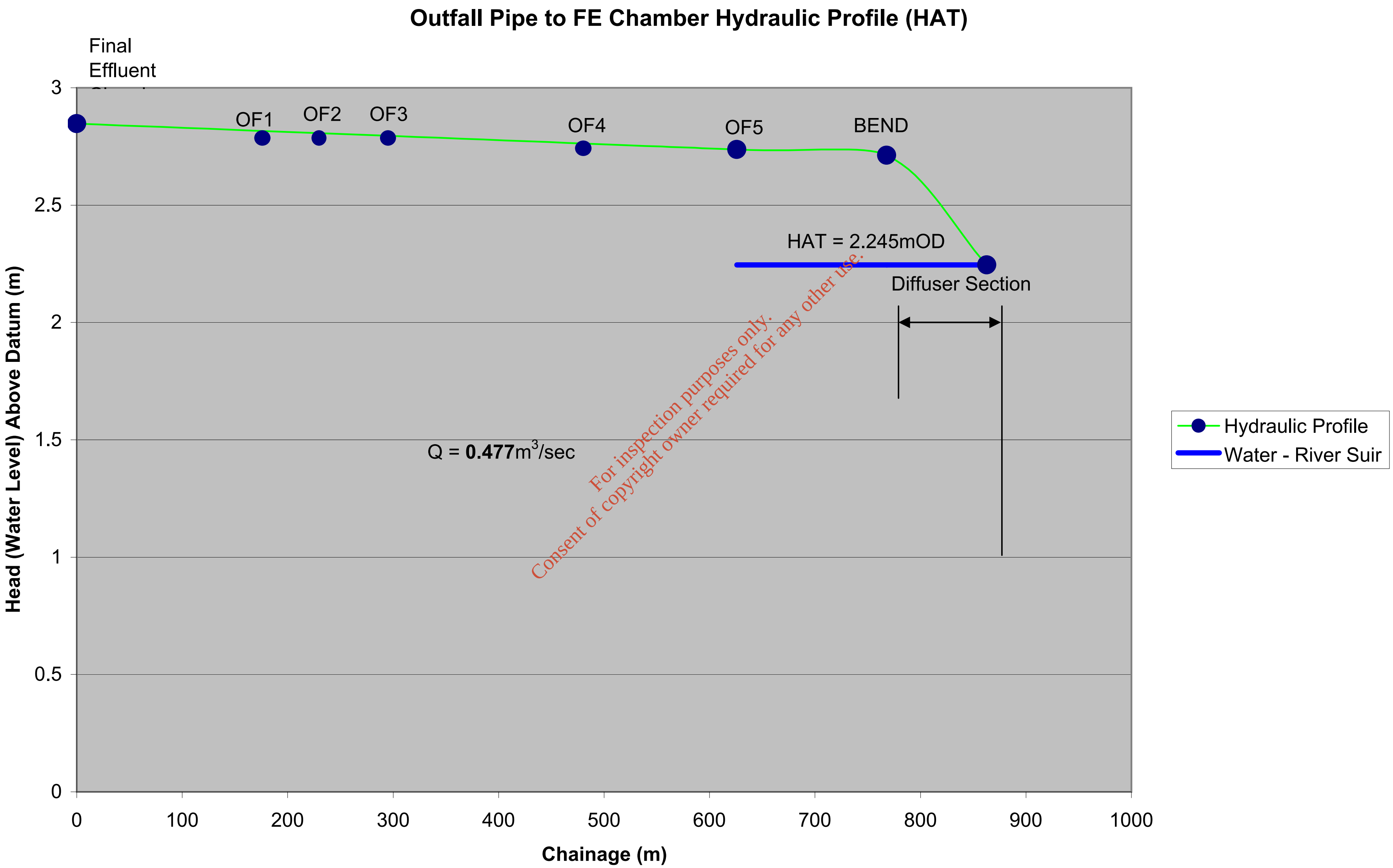


Outfall Pipe to FE Chamber Hydraulic Profile (MSL)
Final Effluent Chamber
OF1
OF2
OF3
OF4
OF5
BEND
Diffuser Section
Q = 0.477m3/sec
MSL = -0.08mOD
Head (Water Level) Above Datum (m)
Chainage (m)
0.5
0.4
0.3
0.2
0.1
0
-0.1
-0.2
0
100
200
300
400
500
600
700
800
900
1000
Hydraulic Profile
Water - River Suir

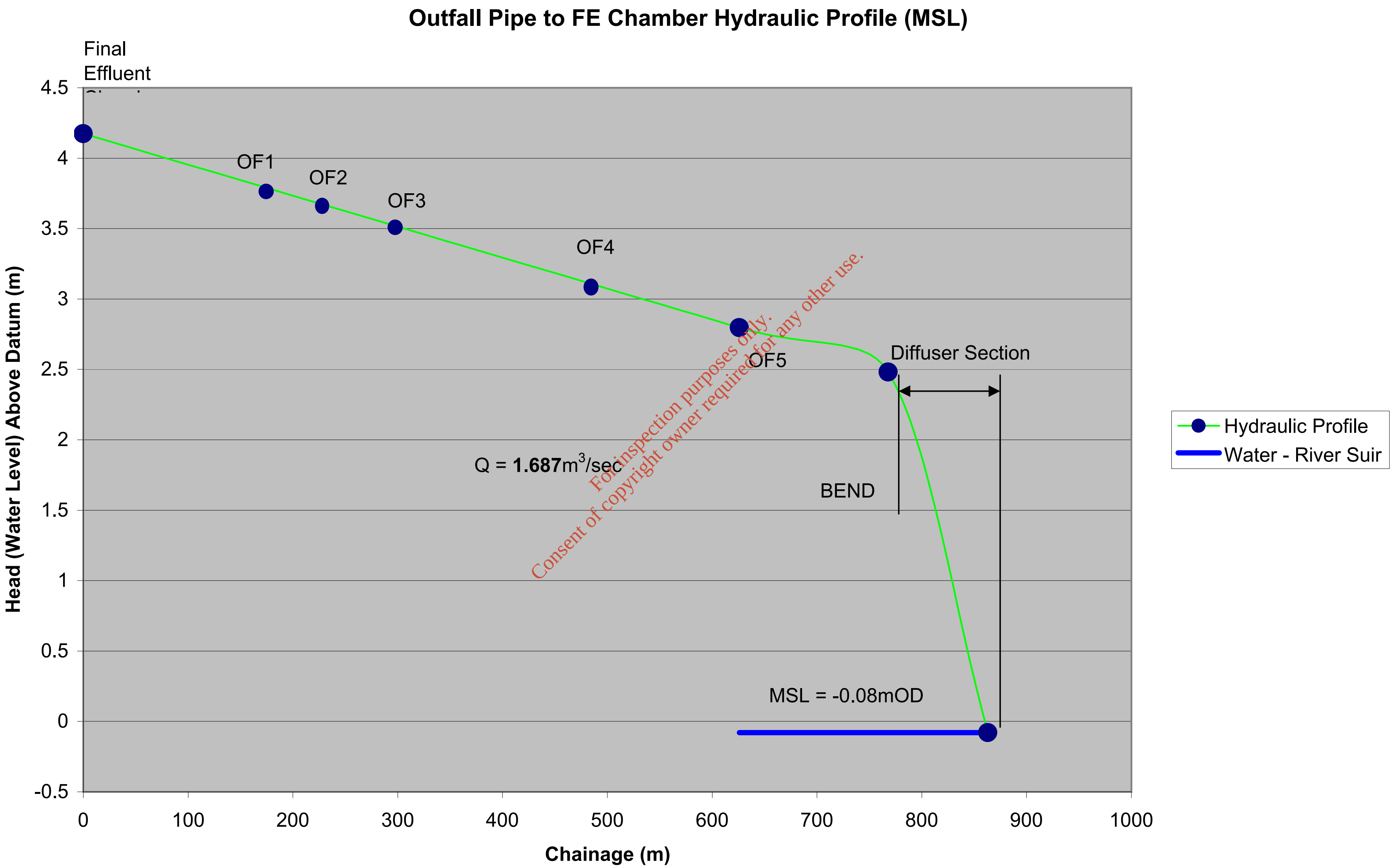

Outfall Pipe to FE Chamber Hydraulic Profile (MLWS)
Head (Water Level) Above Datum (m)
0
-0.5
-1
-1.5
-2
-2.5
-3
0
100
200
300
400
500
600
700
800
900
1000
Chainage (m)
Final Effluent Chamber
OF1
OF2
OF3
OF4
OF5
BEND
Q = 0.477m3/sec
Diffuser Section
MLWS = -2.44mOD
Hydraulic Profile
Water - River Suir



Outfall Pipe to FE Chamber Hydraulic Profile (MHWS)
Final Effluent
OF1
OF2
OF3
OF4
OF5
MHWS = 1.618mOD
Diffuser Section
BEND
Q = 0.477m3/sec
Head (Water Level) Above Datum (m)
Chainage (m)
2.5
2
1.5
1
0.5
0
0
100
200
300
400
500
600
700
800
900
1000
Hydraulic Profile
Water - River Suir



Outfall Pipe to FE Chamber Hydraulic Profile (HAT)
Final Effluent
OF1
OF2
OF3
OF4
OF5
BEND
HAT = 2.245mOD
Diffuser Section
Q = 0.477m3/sec
Head (Water Level) Above Datum (m)
Chainage (m)
0
0.5
1
1.5
2
2.5
3
0
100
200
300
400
500
600
700
800
900
1000
Hydraulic Profile
Water - River Suir



Outfall Pipe to FE Chamber Hydraulic Profile (MSL)
Final
Effluent
Head (Water Level) Above Datum (m)
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
-0.5
OF1
OF2
OF3
OF4
OF5
Diffuser Section
Q = 1.687m3/sec
BEND
MSL = -0.08mOD
0
100
200
300
400
500
600
700
800
900
1000
Chainage (m)
Hydraulic Profile
Water - River Suir

Summary of Initial Dilutions
Peak Flow 1.687m^3/sec

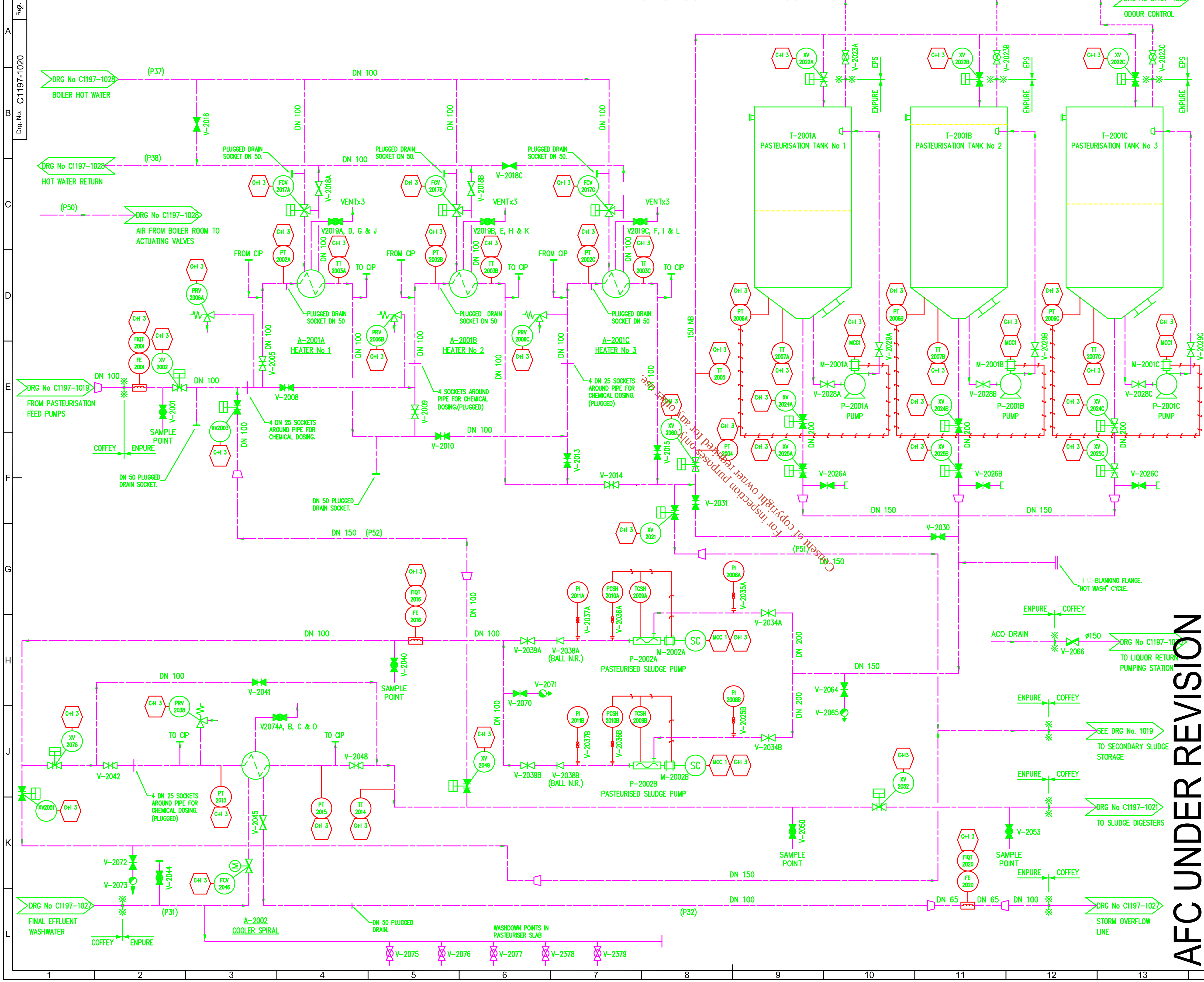
	MHWS		MLWS		MSL	
	Q_{port}	S (BDFF)	Q_{port}	S (BDFF)	Q_{port}	S (BDFF)
Port 1	0.125	68.73	0.125	13.19	0.125	20.86
Port 2	0.040	213.23	0.040	40.63	0.040	64.60
Port 3	0.078	108.89	0.078	20.60	0.078	32.93
Port 4	0.099	85.68	0.099	16.15	0.099	25.89
Port 5	0.103	81.79	0.103	15.31	0.103	24.67
Port 6	0.102	82.03	0.102	15.30	0.102	24.72
Port 7	0.105	79.59	0.105	14.73	0.105	23.95
Port 8	0.108	76.75	0.108	14.10	0.108	23.05
Port 9	0.111	74.09	0.111	13.56	0.111	22.23
Port 10	0.107	76.67	0.107	13.93	0.107	22.97
Port 11	0.113	72.14	0.113	13.01	0.113	21.57
Port 12	0.120	67.98	0.120	12.21	0.120	20.31
Port 13	0.128	63.38	0.128	11.30	0.128	18.90
Port 14	0.113	71.28	0.113	12.66	0.113	21.24
Port 15	0.117	68.77	0.117	12.12	0.117	20.46
Port 16	0.120	66.22	0.120	11.57	0.120	19.66
Total	**1.687**		**1.687**		**1.687**	
Average	**0.11**	**84.83**	**0.11**	**15.65**	**0.11**	**25.50**
Maximum	**0.13**	**213.23**	**0.13**	**40.63**	**0.13**	**64.60**
Minimum	**0.04**	**63.38**	**0.04**	**11.30**	**0.04**	**18.90**

Summary of Initial Dilutions

FFT 0.956m^3/sec

	MHWS		MLWS		MSL	
	Q_{port}	S (BDFF)	Q_{port}	S (BDFF)	Q_{port}	S (BDFF)
Port 1	0.064	51.33	0.064	13.28	0.064	32.77
Port 2	0.031	106.16	0.031	27.27	0.031	67.66
Port 3	0.049	66.34	0.049	16.92	0.049	42.21
Port 4	0.052	61.91	0.052	15.73	0.052	39.35
Port 5	0.059	54.28	0.059	13.69	0.059	34.45
Port 6	0.058	54.87	0.058	13.79	0.058	34.79
Port 7	0.060	53.06	0.060	13.24	0.060	33.59
Port 8	0.062	50.98	0.062	12.63	0.062	32.21
Port 9	0.064	49.45	0.064	12.20	0.064	31.22
Port 10	0.059	53.54	0.059	13.11	0.059	33.74
Port 11	0.063	50.02	0.063	12.16	0.063	31.47
Port 12	0.066	47.25	0.066	11.44	0.066	29.70
Port 13	0.071	43.81	0.071	10.53	0.071	27.49
Port 14	0.064	48.53	0.064	11.61	0.064	30.42
Port 15	0.066	46.66	0.066	11.08	0.066	29.20
Port 16	0.068	44.80	0.068	10.55	0.068	27.98
Total	**0.956**		**0.956**		**0.956**	
Average	**0.06**	**55.19**	**0.06**	**13.70**	**0.06**	**34.89**
Maximum	**0.07**	**106.16**	**0.07**	**27.27**	**0.07**	**67.66**
Minimum	**0.03**	**43.81**	**0.03**	**10.53**	**0.03**	**27.49**

DO NOT SCALE - IF IN DOUBT ASK



AFC UNDER REVISION

See Previous Issues For Past Revision Details

Rev.	Date	Description	Drawn
2		FLOWMETER FE2020 WAS DN100	

NOTES

1. REMOVED
2. SEE DRAWING C1197-2021 FOR DETAILS OF RODDING POINTS.
3. DN 50 BLANKED FLANGE FOR ANTI FOAM INJECTION IF REQUIRED.

LEGEND:

NEW PIPEWORK/CHANNEL BY CIVILS CONTRACTOR.

NEW PIPEWORK BY M&E CONTRACTOR.

ENPURE PIPEWORK

CHECKED			APPROVED		
	PROCESS ENG.	RJM		PROCESS TECH SPECIALIST.	DGG
	PROJECT ENG.	JMN		PROJECT MAN.	CGP
	LEAD MECH ENG.	JAM		MECH ENG MAN.	BM
	LEAD ELEC ENG.	AMT		ELEC ENG MAN.	JL

A.W.I. CONTRACT No 1002

enpure

Enpure Limited
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Birmingham Road,
Kidderminster, DY10 2SH.
Tel: +44 (0)1562 820 010
Fax: +44 (0)1562 820 008
Internet : www.enpure.co.uk

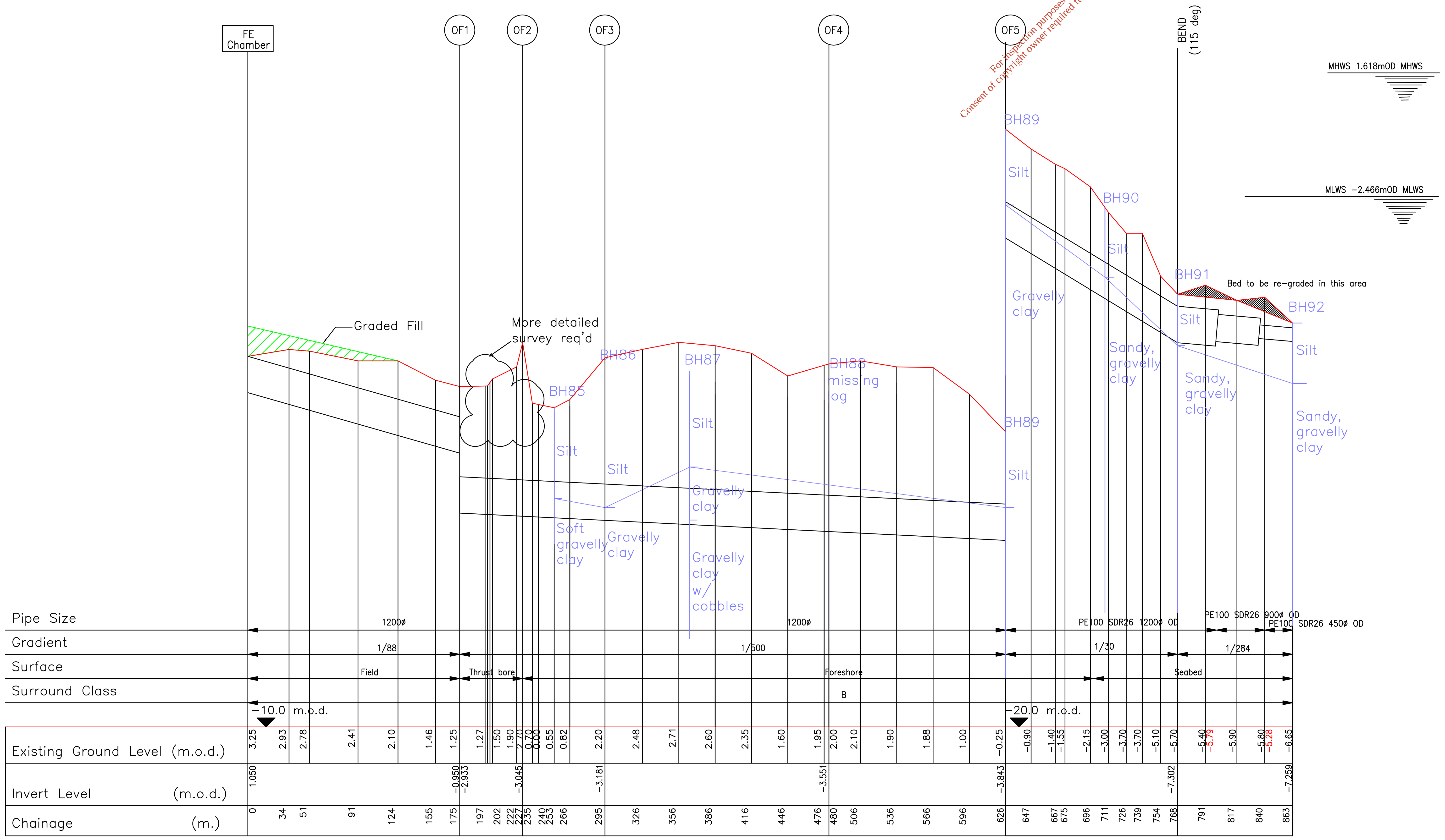
Customer: WATERFORD CITY COUNCIL

Title: SLUDGE PASTEURISATION
P & I DIAGRAM
WATERFORD WWTW

Drawn	Checked	Approved	Original Sheet Size
DJTildesley			A1
Date: 20/10/2006	Date	Date	Original Scale: NTS

Drg. No. C1197-1020 Rev 2

SCALE: 1/1000



LEGEND

Proposed Final Effluent Outfall

Proposed Manhole (OF1)

NOTES

1. Levels are in metres O.D. and refer to Malin Head datum
2. Dimensions are in millimetres unless otherwise stated, Chainages are in meters.
3. Figured dimensions only to be used. If in doubt check with the Engineer in advance of construction.

mark	by	date	revision
E	CL	02/08	Location OF3 to OF4 revised
D	SL	01/08	BAckground mapping revised
C	CL	01/08	I.L. at F.E. Chamber rasied up to 1.05m
B	CL	15/10	Issued "For Approval" Topo survey layer off
A	CL	24/08	Minor revision to route

A.W.I. CONTRACT No 1002

coffey enpure

FOR APPROVAL

client: COFFEY CONSTRUCTION LTD

project: WATERFORD CITY WASTEWATER TREATMENT PLANT

description: Final Effluent Outfall Plan & Longitudinal Section

scales: Hor. 1:2500 Ver. 1:100

drawn CL
checked CL
approved MJ

job no. 1779

set no.

date August 2007

drg.no. 3126/E

Ryan Hanley consulting engineers
Sherwood House
Sherwood Avenue
Taylor's Hill
Galway
Tel:(091)587116 Fax:(091)587110

Attachment 07_4084 3.f

Section D.2 of WWTP Waste Licence Application
Final Effluent Outfall Design

Client	**Coffey Construction Ltd**
Project No.	**1779**
Project Title	**Waterford City WWTP**
Report Title	**Final Effluent Outfall Detailed Design Statement – Final Design Report**

Rev.	Status	Author(s)	Reviewed By	Approved By	Issue Date
0	For discussion with CCL	Claire Lyons	Claire Lyons		28/08/07
1	Issue to Emp Rep	Claire Lyons	Claire Lyons	Michael Joyce	12/10/07
2	Change to Fuller valves	Claire Lyons	Claire Lyons	Michael Joyce	11/03/08

RYAN HANLEY
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Galway, Ireland
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Fax: +353 (0)91 587110
Web: www.ryanhanley.ie

Contract			Job Ref
Waterford City WWTP DBO			**1779**
Part of Structure			Calc Sheet No.
Final Effluent Outfall to River Suir Detailed Design			
Drawing Reference	Calculations by	Checked by	Date
3126/E, 3127/B, 3128/A	**CL**	**MJ**	**27/08/07 Rev 0 16/10/07 Rev 1 11/03/08 Rev 2**

Ref	Calculations	Output

General

The proposed final effluent outfall can be considered in three sections, namely;

Section A. Land based section – 227m

Defined as running from the final effluent chamber to southern side of railway crossing at MHOF2

Co-ordinates

264840.146, 112200.506
to
265012.337, 112170.705….railway crossing (north)
to
265016.294, 112118.972….railway crossing (south)

Section B. Section parallel to railway line above high water mark - 399m

Defined as running from MHOF2 to MHOF5 south of railway embankment and below HWM within "Marine Treatment Site" as defined on Tender Invitation Drawing 6268-N901-C.

Co-ordinates

265016.294, 112118.972
to
265412.095, 112141.105

Section C. Marine – 237m

Fully below the HWM from MHOF5 to end of diffuser section

Co-ordinates

265412.095, 112141.105
to
265514.519, 112042.829…….change of direction
to
265602.703, 112076.797

It should be noted at this point, that the co-ordinates of MHOF5 are not as per the foreshore licence. The proposed MHOF5 is now located south of the original co-ordinates as this is considered a more appropriate pipeline route. The alignment of the route from the submarine bend to the foreshore remains the same.

Ground Conditions

General

A number of boreholes were carried out along or close to the route prior to

Ref	Calculations	Output

tender stage as follows; BH85, BH86, BH87, BH88, BH89, BH90, BH91& BH92. BH85 to BH89 refer to Section B of the pipeline route. BH89 to BH92 are in relation to Section C of the pipeline route.

Section A

The Contractor has carried out trial pits along Section A of the pipeline route. These trial pits showed similar material at invert level to that encountered over the rest of the treatment works site ie. a granular clay with sand. The excavations were all stable and it is considered that the material is capable of supporting the pipeline.

Section B

The boreholes carried out on Section B indicate a layer of silt ranging from a maximum depth of 4.5m at BH86 to a minimum depth of 2.2m below ground level at BH89. This silt layer is underlain by a sandy gravelly clay with SPT values ranging from N=15 to over 50 with the exception of BH85 where a lower SPT of N=5 was recorded. The invert level of the proposed pipeline on this section will be in the order of 4 to 5m below ground level and will therefore be founded in the sandy gravelly clay.

Section C

The boreholes carried out on Section C again indicate a layer of silt approximately 2m deep underlain by a sandy gravelly clay. The majority of the length of this section will be founded in the stronger clay stratum. As the diameter of the pipe decreases towards the end of the diffuser section, the pipeline will lie within the silt layer. In order to provide a suitable foundation for the concrete ballasts anchoring the pipe, this silt layer will have to be dredged and replaced with imported granular material in order to avoid future pipeline settlement.

Pipeline Physical Characteristics
Section A and B

A 1200mm ID PROFIX pipe is proposed from the final effluent chamber to MHOF5. Details previously supplied by Coffey Construction Ltd.

Structural calculations from the pipe manufacturer show that the pipe has the required stiffness to satisfy long term deflection requirements, that there is an adequate factor of safety for buckling and floatation analysis for the temporary and permanent condition. Bed and surround will be as per the pipe manufacturer's instructions.

Section C

A butt fusion welded SDR26 PE100 pipe is proposed for Section C, the

Ref	Calculations	Output

marine section. The diffuser section will comprise polyetylene riser pipes from PE tees with a flanged Series CVF check valve as supplied by Fuller at each port. Stainless steel backing rings will be used throughout. The configuration of the diffuser section of the pipe is as follows; 33m of 1200mm OD, 35m of 900mm OD and 27m of 450mm OD. The reduction tapers along the length are required in order to achieve adequate scour velocities periodically and ensure uniform discharge from the ports.

Principle Hydraulic Design Parameters

Tide Levels (all related to Malin Head OD)

MHWS 1.618m OD
MLWS -2.466m OD
HAT 2.220m OD (received from Port of Waterford)
MSL -0.080m OD (received from Port of Waterford)
50 year tide level 2.770m OD (from Table 4.1 OPW "Report on Flood Protection at Scotch Quay Waterford" for Great Island Waterford Harbour)
Highest recorded water level 2.98m OD

Peak flow through works 1.687m^3/sec
Full flow to treatment (FFT) 0.956m^3/sec
Average Flow 0.477m^3/sec

Relevant Employers Requirements – Hydraulic Design

- **13.2.7**

(iii) The effluent shall be diluted with not less than 20 times its volume of ambient water at the river surface at mean low water (MLWS) spring tides, with the maximum effluent discharge and zero ambient current

At maximum treated effluent discharge of 0.956m^3/sec, 20 times initial dilution or greater is achieved at all ports assuming ambient current velocity of 0.4m/sec or greater.

- **13.4.3**

The outfall and diffuser shall be designed to discharge all the effluent from the Works against a tidal level with a 1:50 year return period.

The design of the outfall and diffuser allows for discharge of flow up to 1.687m^3/sec, which is the maximum flow that can enter the treatment works at the 1:50 return period. In this situation, the final effluent chamber weir will be drowned. However, there will still be free flow from the final settlement tank outlet weirs. The flowmeter on the outlet will also be surcharged in this condition – this will not affect its operation. At the maximum flow to treatment of 0.956m^3/sec, the final effluent chamber weir will not be surcharged under any tidal condition.

- **13.4.4**

As far as physically possible the outfall and diffuser shall be designed to remain full of effluent at all times.
The fitting of "Tideflex" valves manufactured by Red Valve Co of Carnegie, PA, USA or approved equivalent, to all ports shall be deemed to satisfy this requirement.
If fitted, non return valves shall be designed to resist a back pressure equal to the maximum rise in sea level that could occur in any 12 hour period.

All ports will be fitted with "Fuller" valves which are a non-return duckbill valve equivalent to "Tideflex". They are designed to resist the maximum back pressure that may occur.

- **13.4.5**

*The manifold shall be designed so that the flow through any port (in m^3/sec) is between 0.9 and 1.1 * (maximum flow rate/total number of ports) when the sea is at MEAN SEA LEVEL (MSL) with a density of 1.025 and the flow through the works is a maximum*

This requirement is satisfied in all but three of the ports. However, within the confines of standard size fittings and duckbill valves, this is the best flow distribution in the manifold that can be achieved taking all the criteria into account.

- **13.4.6**

The initial dilution shall be determined for the peak flow at MHWS, MLWS and MSL using any internationally accepted buoyant plume model.

The initial dilution has been modelled for peak flow at all of the above mentioned tidal conditions. Analysis is included in Appendix 1.

Hydraulic Design Methodology

In general, the overall length and location of the outfall and the number and spacing of the diffuser ports is determined by consideration of the initial dilution and secondary dispersion. The length and location of this particular outfall is fixed as per the Foreshore Licence co-ordinates and so the main thrust of the hydraulic design is related to the spacing, configuration and number of outfall ports required to discharge the design flows with the

Ref	Calculations	Output

available head and to achieve suitable flow distribution between diffuser ports to satisfy the assumptions used in initial dilution calculations.

A diffuser ideally will be designed to discharge equally through all ports over a wide range of total discharges. However, this can only be achieved when a diffuser is operating at high pressure, with small ports and high discharge velocities. This mode of operation would be impractical due to the high headlosses involved. As an outfall diffuser can only be designed to discharge equally over a small range of flows, a design compromise is necessary.

The hydraulic analysis procedure being used is as per the WRc "Design Guide for Marine Treatment Schemes". The hydraulic balance of the system may be expressed in a series of equations which compare the specific energy between selected points in the system. The analysis is an iterative process and involves assigning an initial discharge rate to the last port on the diffuser equal to the design flow divided by the number of ports. The value of $P/\rho g$ is computed for this port. This in turn allows the value of $P/\rho g$ to be computed for the pipeline part of the diffuser upstream of the port. Knowing $P/\rho g$ for this pipeline section, then allows the computation of the flow through the adjacent upstream riser. This process is repeated for each riser along the complete diffuser. The total flow is calculated by aggregating the flows calculated for each riser and this is then compared to the actual design flow. If this total aggregated flow is approximately equal to the design flow, then the flow distribution is taken as correct. If not, a new value of discharge for the last port is selected on a pro rata basis and the calculation repeated until the flows match. At each iteration of the calculation, the total head is computed to check that there is enough head available to drive the system.

A copy of these calculations is included on the enclosed CD. A summary of the resultant flows from each port is provided in Appendix 1. The number of ports has been determined based on initial dilution considerations. A diffuser with 16 No. ports fitted with check valves is proposed as detailed on Drawing 3127.

The initial dilution at each port has been calculated and these calculations are also provided on the CD. Firstly, the buoyant discharge regime has been determined to be either BDNF (Buoyancy Dominated Near Field) or BDFF (Buoyancy Dominated Far Field), by determining if H > or < than $5B/U_a^3$, where H = water depth from point of discharge to free surface, U_a is the ambient current velocity and B is the buoyancy flux of the effluent discharge. Then the initial dilution is calculated using either $S = C_1(B^{1/3}H^{5/3})/q_p$ or $S = C_3(U_aH^2)/q_p$ depending on the buoyancy discharge regime, where C_1 and C_3

are dilution constants and q_p is the port flow under consideration. In this case, the BDFF condition is the relevant state.

Outfall Installation

A detailed method statement is provided elsewhere by Coffey Construction Ltd. To summarise briefly, the outfall will be installed in the estuary by floating the empty pipeline into position and then filling the pipeline with water in order to sink the outfall into the prepared trench on the estuary bed. Reinforced concrete ballast weights will be attached to the empty outfall to assist in the sinking and holding of the submerged pipeline in the location as detailed in the foreshore licence conditions. The design criteria used in sizing the ballast weights are as follows;

a) the pipeline sits in the water at half bore when empty and being floated into position
b) the outfall will sink when the pipe bore is 80% full with water

Full design calculations for the ballast weights are provided in Appendix B and are detailed on Drawing No. 3128. The ballast weights will be connected using stainless steel bolts in plastic sleeves.

Accidental Damage Assessment

As a final check, the possibility of the outfall being damaged is considered. A common factor that characterises accidental damage to an outfall is that the probability of occurrence is low. Many of the factors considered are best mitigated against by choice of outfall route and it is assumed that a risk assessment was carried out at preliminary report stage and that the chosen pipeline route represents the best available option.

The following scenario's were considered when arriving at the choice of protection;

a) Direct hit by anchor dropped on the diffuser or anchor cable dragged over diffuser

The risk of this happening is considered low. Firstly, it is highly unlikely that a ship would be in such close proximity (approximately 1m) to the edge of the navigable channel. Secondly, a ship would have to lower an anchor so that it reaches the estuary bed. Thirdly, the anchor would have to move far enough across the bottom to reach the outfall. Fourthly, the anchor would have to hook port and not pass harmlessly over it. Finally, the anchor system has to apply enough force to induce damage. There is a finite probability associated with each of these steps and the aggregated risk of each of the steps happening is very low.

As the diffuser pipe will be buried, the most vulnerable part of the structure will be the 20 No. diffuser ports. It is proposed to provide protection to the diffuser ports by the installation of 900mm diameter, 600mm high precast concrete rings around each port.

The 900mm diameter around the port should be sufficiently small that in the case where an anchor was dropped it should settle on the concrete ring. There will be a portion of the check valve protruding above the ring which is necessary for its operation. However, as set out above, it is considered that the risk of a direct hit by anchor or cable chain is low and the consequences will not be severe as the full volume of effluent can still be discharged and the check valve will be relatively easy to replace in-situ by a diver.

b) Vessel straddling over the outfall

Again, it is considered that the risk to the diffuser is extremely low. The outfall is buried and there is flexibility in the rubber risers.

c) Scour caused by wash from the propellers of vessels turning over the outfall diffuser

A scour mat will be provided along the length of the diffuser section which will consist of 100mm clean stone.

d) Overdredging/dredging

The Contractor is required by the Contract and the Foreshore Licence conditions to mark the position of the diffuser with a marker buoy. The position of the diffuser will be advised to the Commissioner of Irish Lights and the Port of Waterford.

Appendix 1

1. Diffuser Calculations Summary
(detailed calculations on CD)

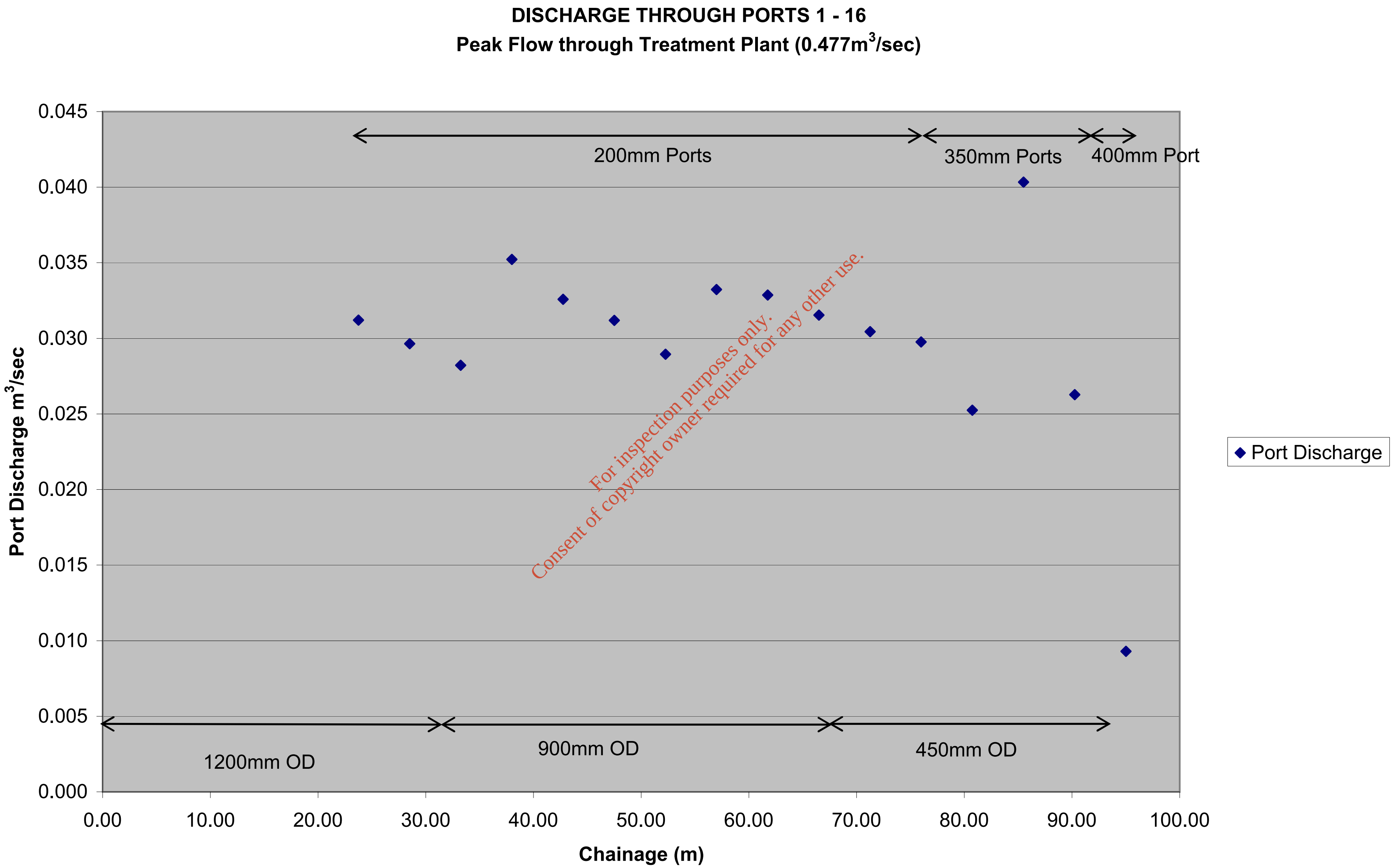
2. Initial Dilution Calculations

3. Buoyancy Calculations

4. Ballast Weight Calculations

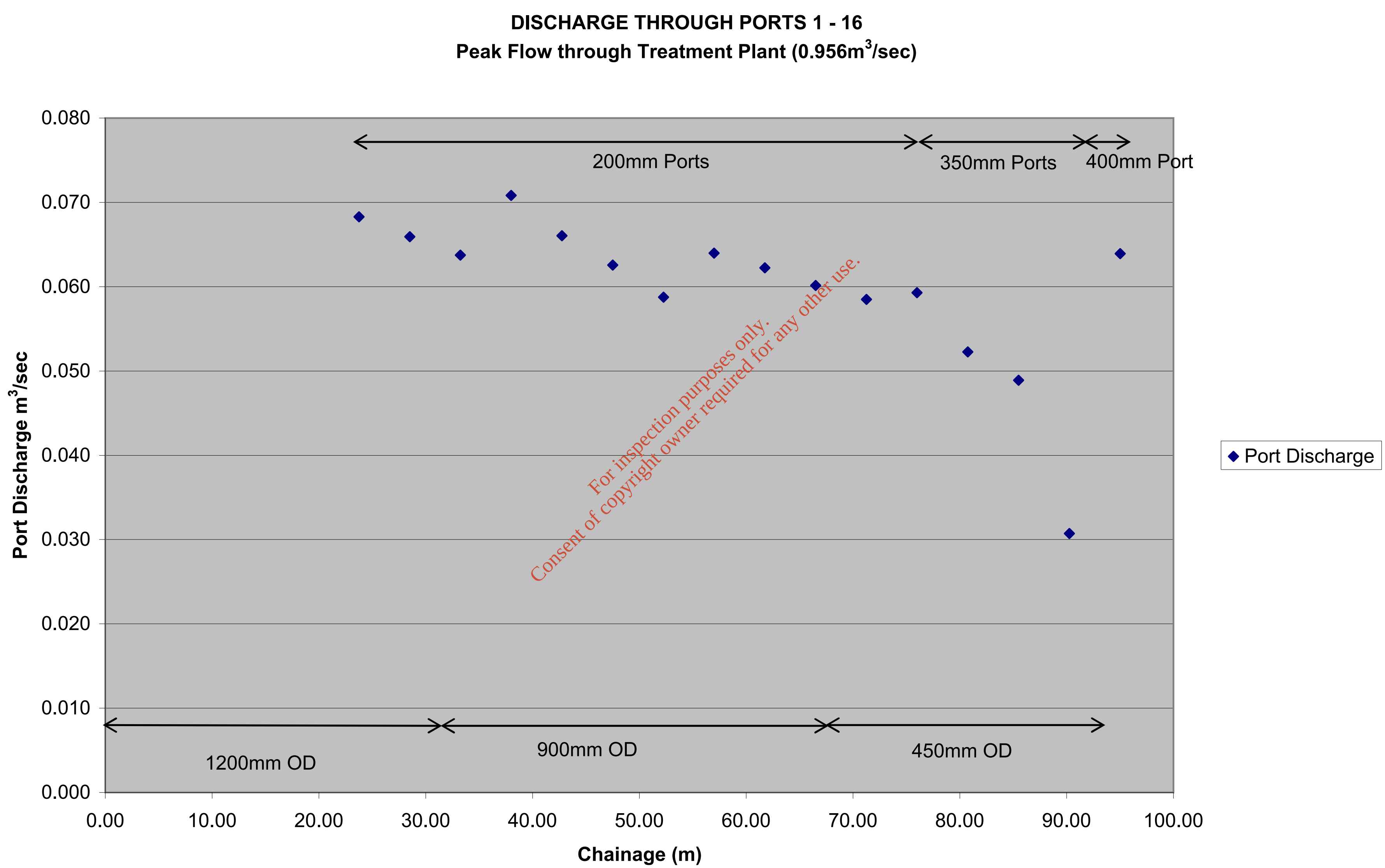
Summary of Port Discharges for Average Flow

			FFT (0.477m^3/sec)								
			MHWS		**MLWS**		**MSL**		**HAT + delta H**		
	Total Flow	m3/s	0.477		0.477		0.477		0.477		
	Water Level	m O.D.	1.618		-2.466		-0.08		2.245		
Chainage	**Head at FE Chamber**	m O.D.	2.204		-1.982		0.464		2.847		**Port Size**
95.00	q_1	m^3/s	0.009	0.3	0.009	0.3	0.009	0.3	0.009	0.3	**400mm**
90.25	q_2	m^3/s	0.026	0.9	0.026	0.9	0.026	0.9	0.026	0.9	**350mm**
85.50	q_3	m^3/s	0.040	1.4	0.040	1.4	0.040	1.4	0.040	1.4	
80.75	q_4	m^3/s	0.025	0.8	0.025	0.8	0.025	0.8	0.025	0.8	
76.00	q_5	m^3/s	0.030	1.0	0.030	1.0	0.030	1.0	0.030	1.0	**200mm**
71.25	q_6	m^3/s	0.030	1.0	0.030	1.0	0.030	1.0	0.030	1.0	
66.50	q_7	m^3/s	0.032	1.1	0.032	1.1	0.032	1.1	0.032	1.1	
61.75	q_8	m^3/s	0.033	1.1	0.033	1.1	0.033	1.1	0.033	1.1	
57.00	q_9	m^3/s	0.033	1.1	0.033	1.1	0.033	1.1	0.033	1.1	
52.25	q_{10}	m^3/s	0.029	1.0	0.029	1.0	0.029	1.0	0.029	1.0	
47.50	q_{11}	m^3/s	0.031	1.0	0.031	1.0	0.031	1.0	0.031	1.0	
42.75	q_{12}	m^3/s	0.033	1.1	0.033	1.1	0.033	1.1	0.033	1.1	
38.00	q_{13}	m^3/s	0.035	1.2	0.035	1.2	0.035	1.2	0.035	1.2	
33.25	q_{14}	m^3/s	0.028	0.9	0.028	0.9	0.028	0.9	0.028	0.9	
28.50	q_{15}	m^3/s	0.030	1.0	0.030	1.0	0.030	1.0	0.030	1.0	
23.75	q_{16}	m^3/s	0.031	1.0	0.031	1.0	0.031	1.0	0.031	1.0	
19.00											
14.25											
9.50											
4.75											
	Q_T	m^3/s	**0.476**		**0.476**		**0.476**		**0.476**		


DISCHARGE THROUGH PORTS 1 - 16
Peak Flow through Treatment Plant (0.477m3/sec)
Port Discharge m3/sec
Chainage (m)
0.045
0.040
0.035
0.030
0.025
0.020
0.015
0.010
0.005
0.000
0.00
10.00
20.00
30.00
40.00
50.00
60.00
70.00
80.00
90.00
100.00
200mm Ports
350mm Ports
400mm Port
1200mm OD
900mm OD
450mm OD
Port Discharge

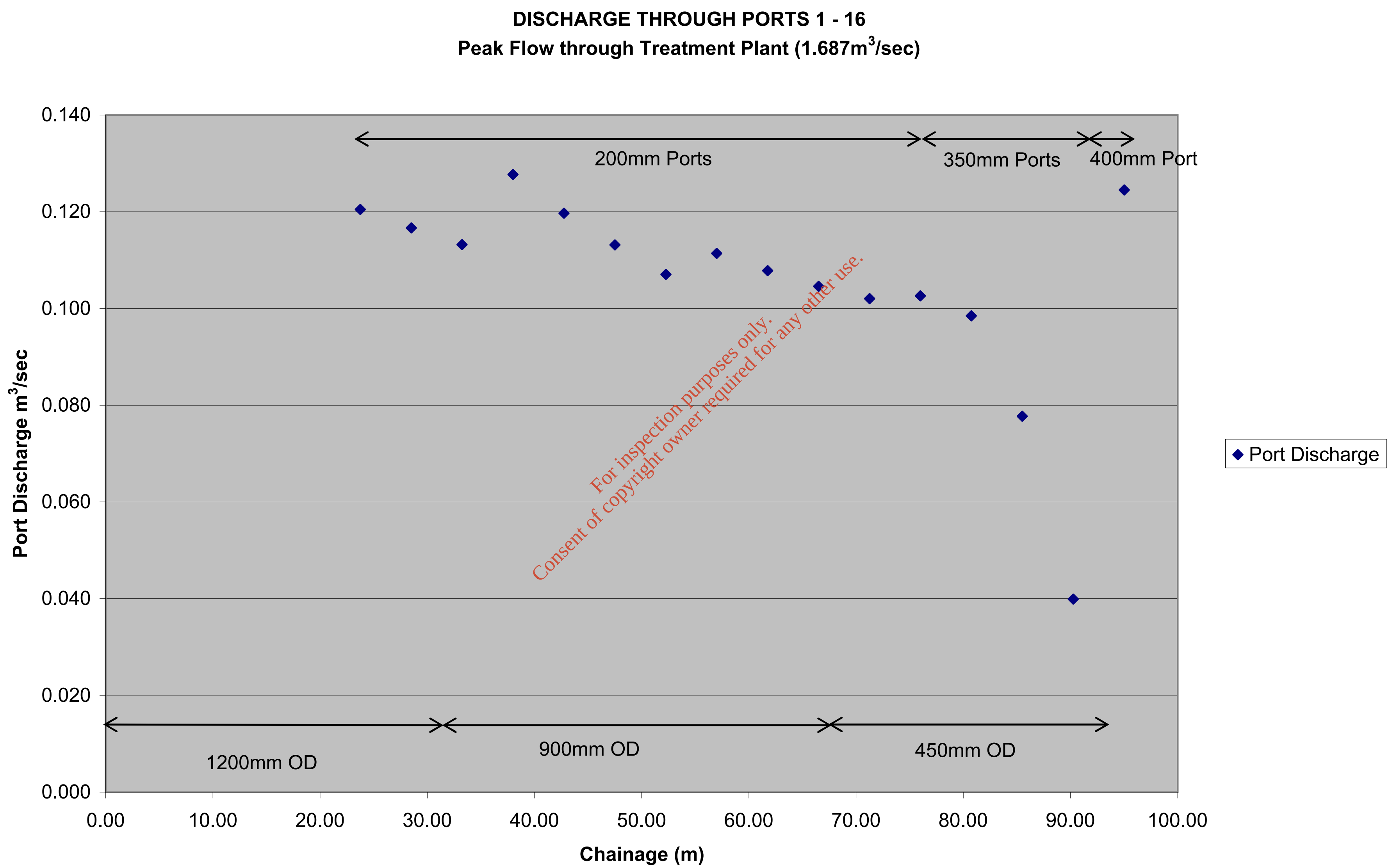
Summary of Port Discharges for Average Flow/FFT

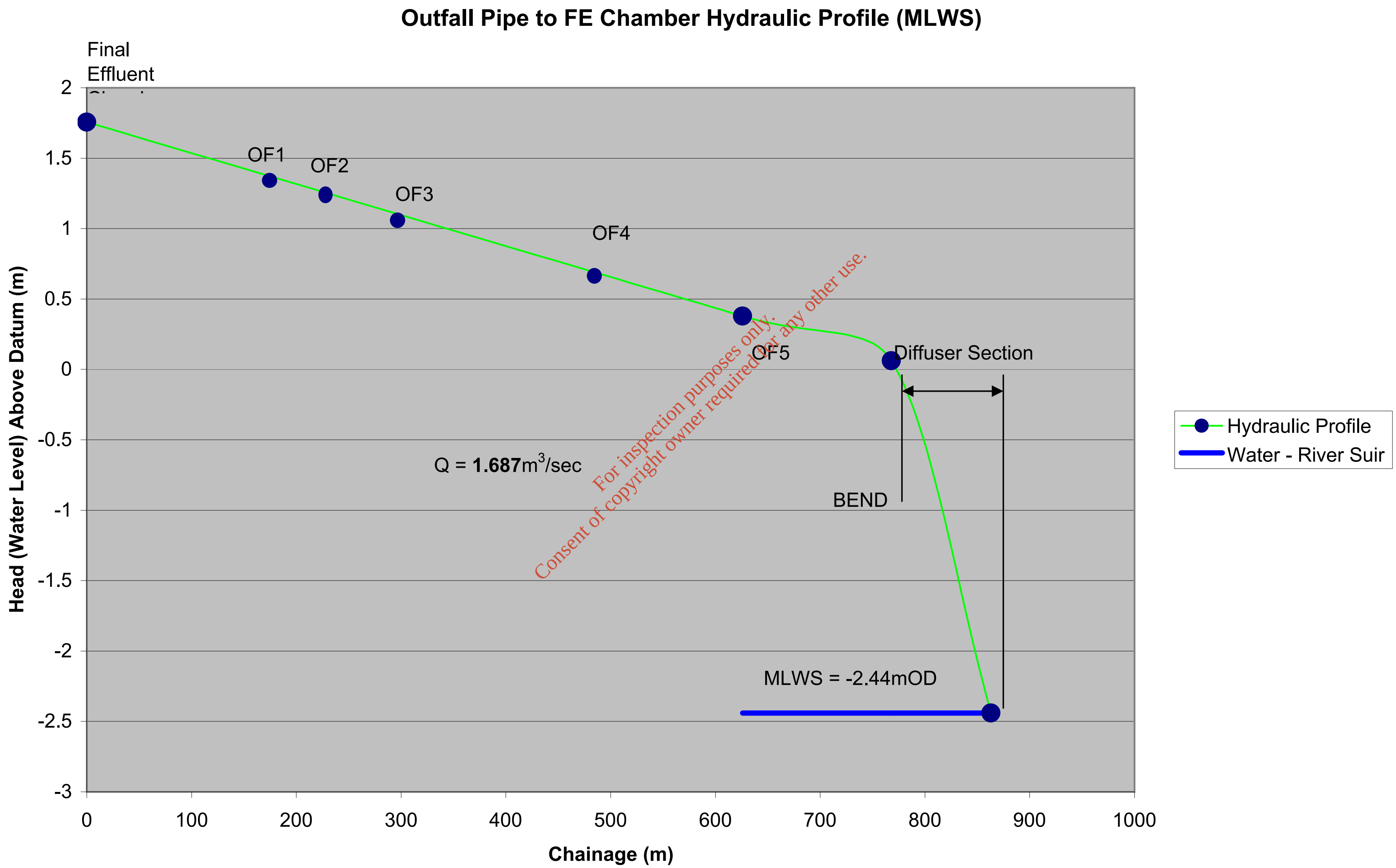
			FFT (0.956m³/sec)								
			MHWS		MLWS		MSL		HAT + delta H		
	Total Flow	m3/s	0.956		0.956		0.956		0.956		
	Water Level	m O.D.	1.618		-2.466		-0.08		2.245		
Chainage	Head at FE Chamber	m O.D.	3.879		-0.307		2.139		4.522		Port Size
95.00	q_1	m^3/s	0.064	1.1	0.064	1.1	0.064	1.1	0.064	1.1	400mm
90.25	q_2	m^3/s	0.031	0.5	0.031	0.5	0.031	0.5	0.031	0.5	350mm
85.50	q_3	m^3/s	0.049	0.8	0.049	0.8	0.049	0.8	0.049	0.8	
80.75	q_4	m^3/s	0.052	0.9	0.052	0.9	0.052	0.9	0.052	0.9	
76.00	q_5	m^3/s	0.059	1.0	0.059	1.0	0.059	1.0	0.059	1.0	200mm
71.25	q_6	m^3/s	0.058	1.0	0.058	1.0	0.058	1.0	0.058	1.0	
66.50	q_7	m^3/s	0.060	1.0	0.060	1.0	0.060	1.0	0.060	1.0	
61.75	q_8	m^3/s	0.062	1.0	0.062	1.0	0.062	1.0	0.062	1.0	
57.00	q_9	m^3/s	0.064	1.1	0.064	1.1	0.064	1.1	0.064	1.1	
52.25	q_{10}	m^3/s	0.059	1.0	0.059	1.0	0.059	1.0	0.059	1.0	
47.50	q_{11}	m^3/s	0.063	1.0	0.063	1.0	0.063	1.0	0.063	1.0	
42.75	q_{12}	m^3/s	0.066	1.1	0.066	1.1	0.066	1.1	0.066	1.1	
38.00	q_{13}	m^3/s	0.071	1.2	0.071	1.2	0.071	1.2	0.071	1.2	
33.25	q_{14}	m^3/s	0.064	1.1	0.064	1.1	0.064	1.1	0.064	1.1	
28.50	q_{15}	m^3/s	0.066	1.1	0.066	1.1	0.066	1.1	0.066	1.1	
23.75	q_{16}	m^3/s	0.068	1.1	0.068	1.1	0.068	1.1	0.068	1.1	
19.00											
14.25											
9.50											
4.75											
	Q_T	m^3/s	**0.956**		**0.956**		**0.956**		**0.956**		

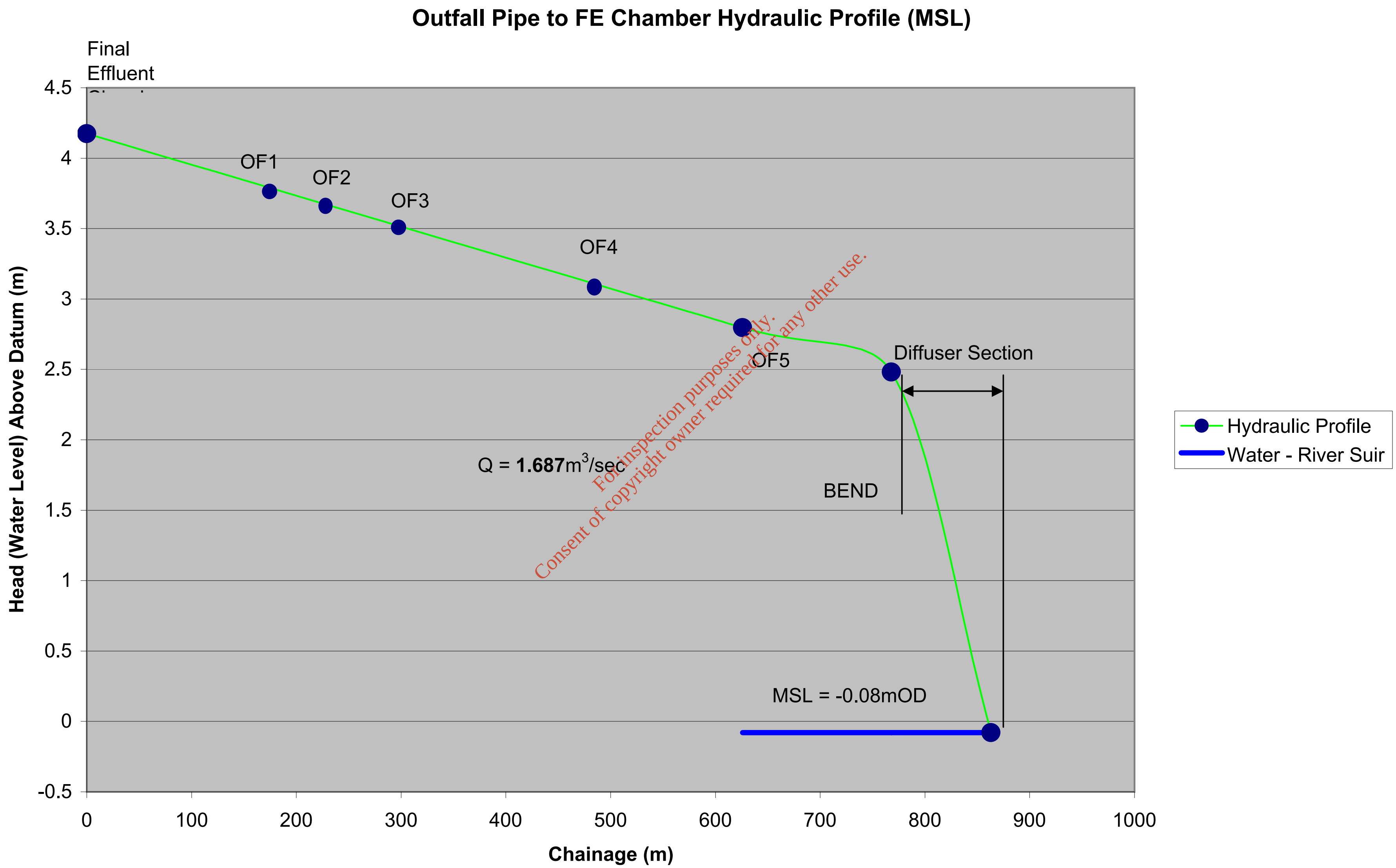

DISCHARGE THROUGH PORTS 1 - 16
Peak Flow through Treatment Plant (0.956m3/sec)
200mm Ports
350mm Ports
400mm Port
1200mm OD
900mm OD
450mm OD
Port Discharge m3/sec
Chainage (m)
Port Discharge
0.080
0.070
0.060
0.050
0.040
0.030
0.020
0.010
0.000
0.00
10.00
20.00
30.00
40.00
50.00
60.00
70.00
80.00
90.00
100.00

Summary of Port Discharges for Peak Flow

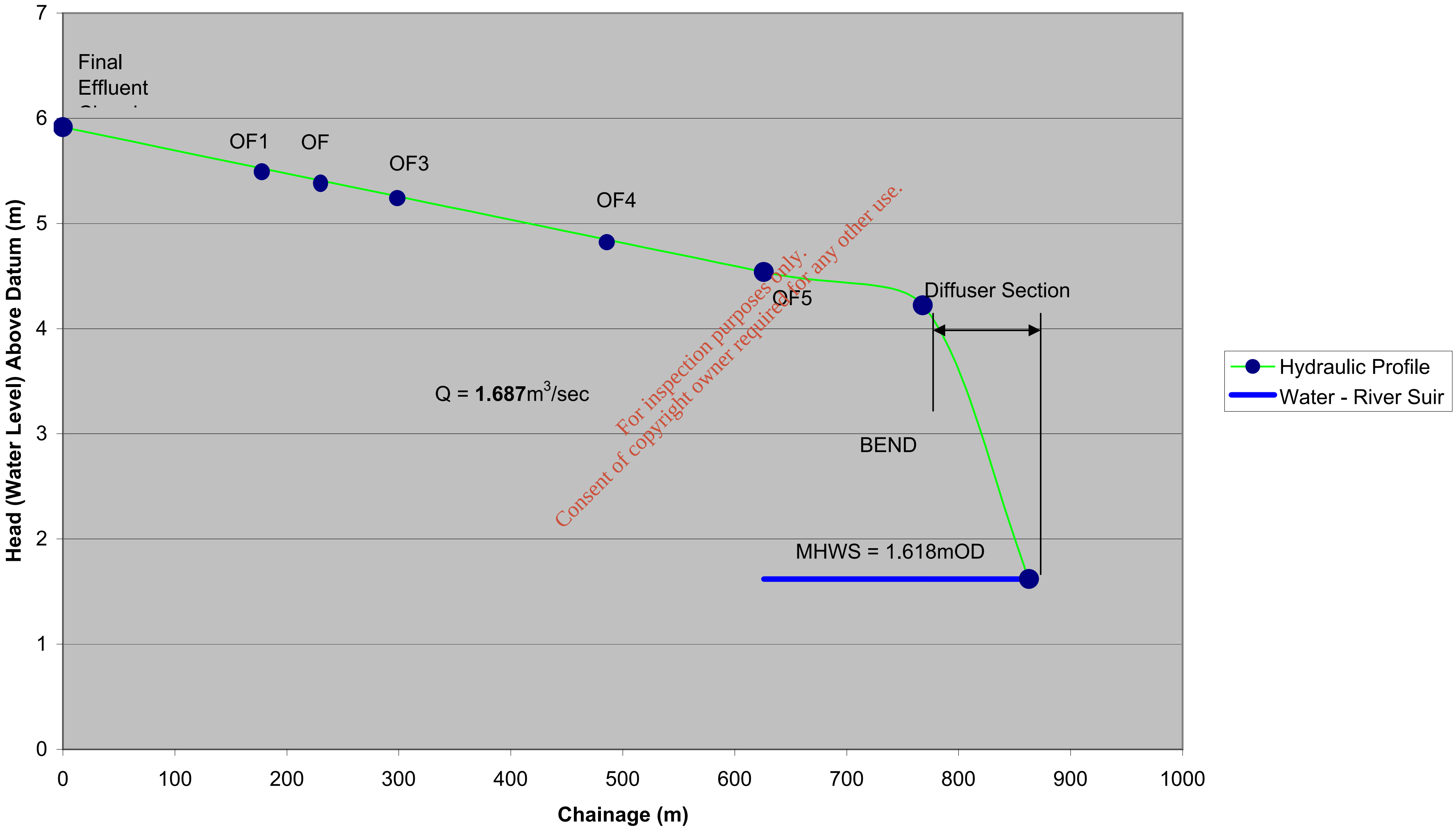
			Peak Flow (1.687m^3/sec)								
			MHWS		MLWS		MSL		HAT + delta H		
	Total Flow	m3/s	1.687		1.687		1.687		0.956		
	Water Level	m O.D.	1.618		-2.466		-0.08		2.245		
Chainage	**Head at FE Chamber**	m O.D.	5.915		1.729		4.168		6.558		**Port Size**
95.00	q_1	m^3/s	0.125	1.2	0.125	1.2	0.125	1.2	0.125	1.2	**400mm**
90.25	q_2	m^3/s	0.040	0.4	0.040	0.4	0.040	0.4	0.040	0.4	**350mm**
85.50	q_3	m^3/s	0.078	0.7	0.078	0.7	0.078	0.7	0.078	0.7	
80.75	q_4	m^3/s	0.099	0.9	0.099	0.9	0.099	0.9	0.099	0.9	
76.00	q_5	m^3/s	0.103	1.0	0.103	1.0	0.103	1.0	0.103	1.0	**200mm**
71.25	q_6	m^3/s	0.102	1.0	0.102	1.0	0.102	1.0	0.102	1.0	
66.50	q_7	m^3/s	0.105	1.0	0.105	1.0	0.105	1.0	0.105	1.0	
61.75	q_8	m^3/s	0.108	1.0	0.108	1.0	0.108	1.0	0.108	1.0	
57.00	q_9	m^3/s	0.111	1.1	0.111	1.1	0.111	1.1	0.111	1.1	
52.25	q_{10}	m^3/s	0.107	1.0	0.107	1.0	0.107	1.0	0.107	1.0	
47.50	q_{11}	m^3/s	0.113	1.1	0.113	1.1	0.113	1.1	0.113	1.1	
42.75	q_{12}	m^3/s	0.120	1.1	0.120	1.1	0.120	1.1	0.120	1.1	
38.00	q_{13}	m^3/s	0.128	1.2	0.128	1.2	0.128	1.2	0.128	1.2	
33.25	q_{14}	m^3/s	0.113	1.1	0.113	1.1	0.113	1.1	0.113	1.1	
28.50	q_{15}	m^3/s	0.117	1.1	0.117	1.1	0.117	1.1	0.117	1.1	
23.75	q_{16}	m^3/s	0.120	1.1	0.120	1.1	0.120	1.1	0.120	1.1	
19.00											
14.25											
9.50											
4.75											
	Q_T	m^3/s	**1.687**		**1.687**		**1.687**		**1.687**		

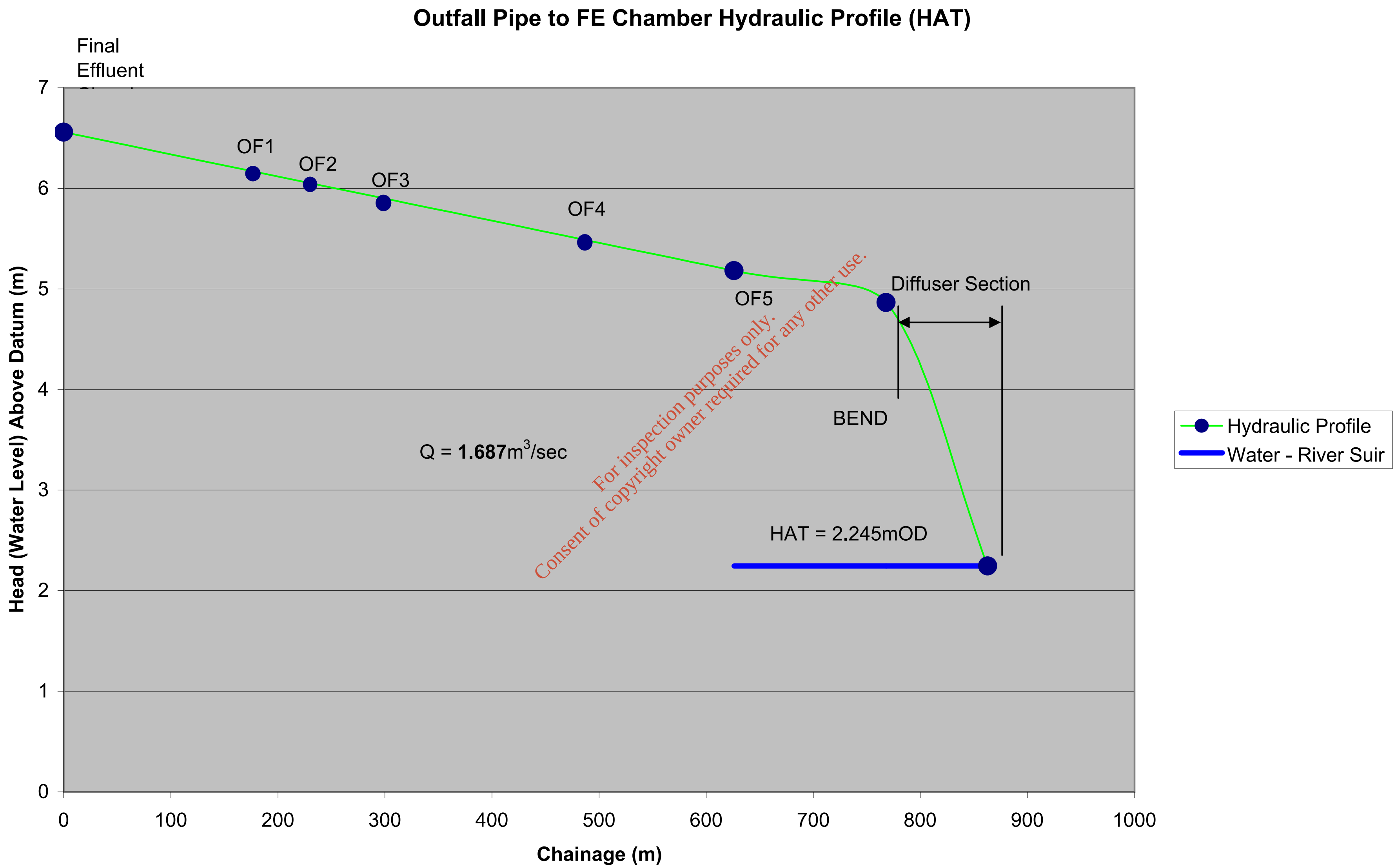

DISCHARGE THROUGH PORTS 1 - 16
Peak Flow through Treatment Plant (1.687m3/sec)
0.140
0.120
0.100
0.080
0.060
0.040
0.020
0.000
200mm Ports
350mm Ports
400mm Port
1200mm OD
900mm OD
450mm OD
0.00
10.00
20.00
30.00
40.00
50.00
60.00
70.00
80.00
90.00
100.00
Port Discharge m3/sec
Chainage (m)
Port Discharge

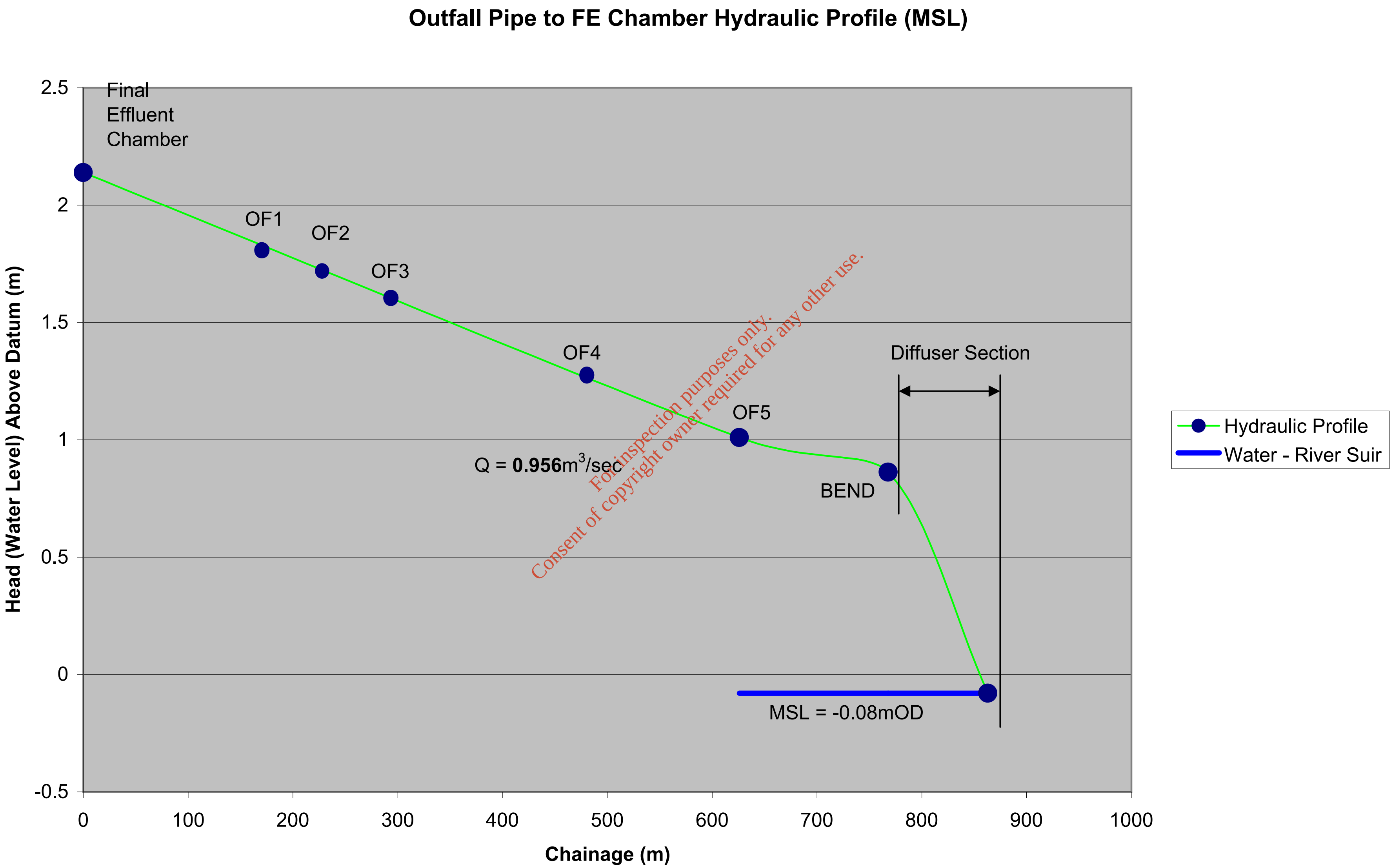

Outfall Pipe to FE Chamber Hydraulic Profile (MLWS)
Final
Effluent
OF1
OF2
OF3
OF4
OF5
Diffuser Section
BEND
Q = **1.687**m³/sec
MLWS = -2.44mOD
Head (Water Level) Above Datum (m)
Chainage (m)
2
1.5
1
0.5
0
-0.5
-1
-1.5
-2
-2.5
-3
0
100
200
300
400
500
600
700
800
900
1000
Hydraulic Profile
Water - River Suir


Outfall Pipe to FE Chamber Hydraulic Profile (MSL)
Final
Effluent
OF1
OF2
OF3
OF4
OF5
Diffuser Section
BEND
Q = 1.687m3/sec
MSL = -0.08mOD
Head (Water Level) Above Datum (m)
Chainage (m)
Hydraulic Profile
Water - River Suir
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
-0.5
0
100
200
300
400
500
600
700
800
900
1000

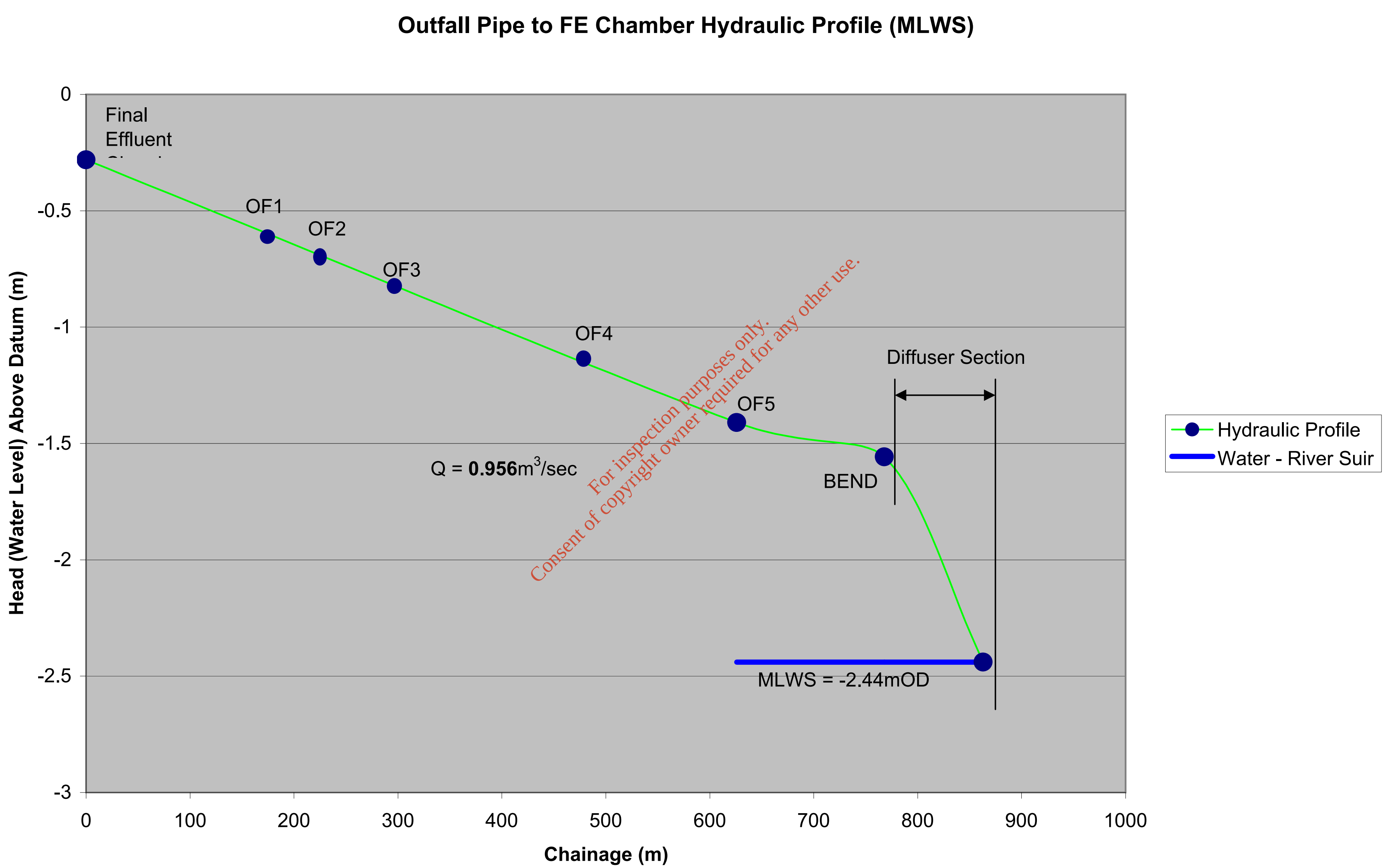
Outfall Pipe to FE Chamber Hydraulic Profile (MHWS)



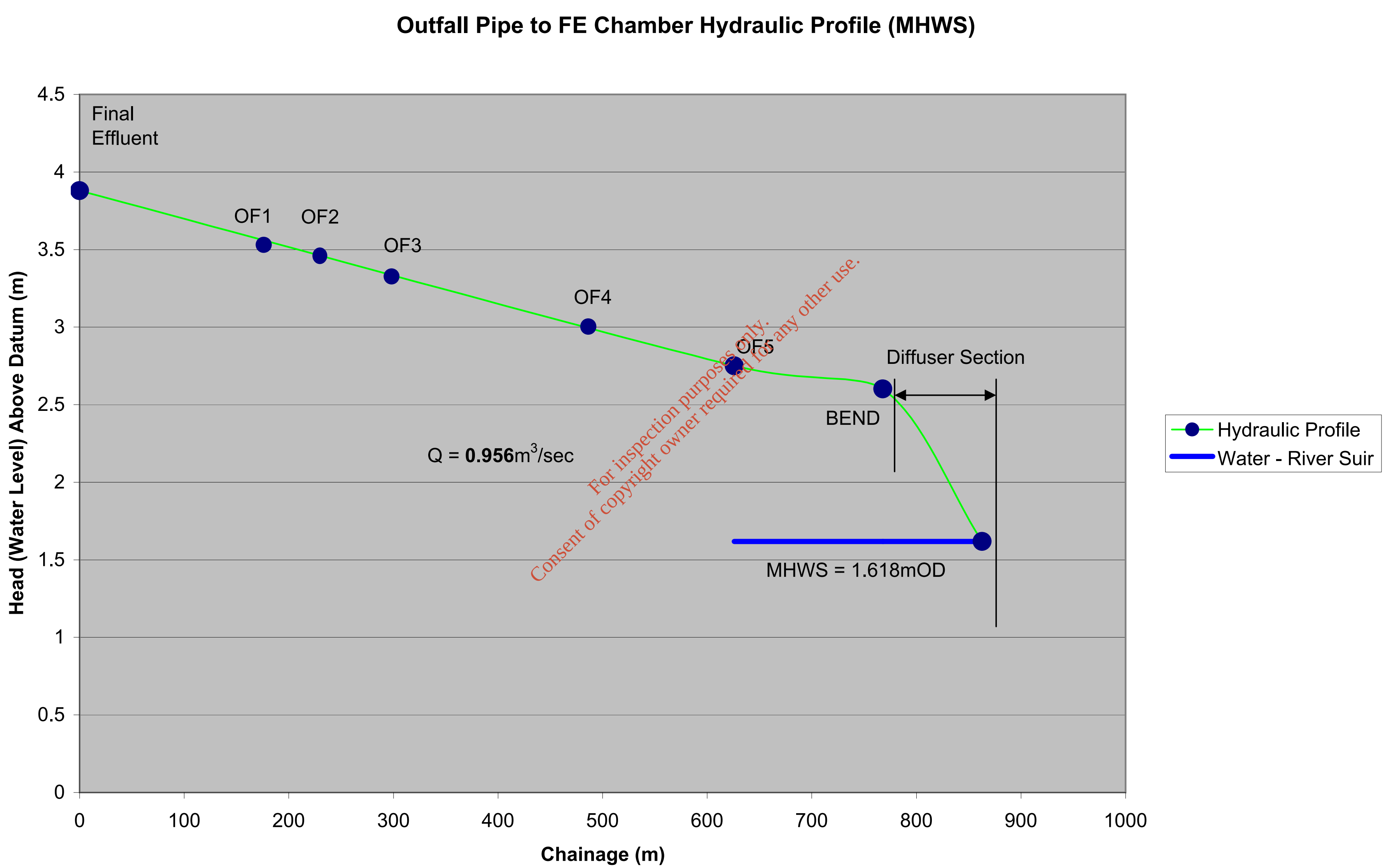

Outfall Pipe to FE Chamber Hydraulic Profile (HAT)
Final
Effluent
OF1
OF2
OF3
OF4
OF5
Diffuser Section
BEND
Q = 1.687m3/sec
HAT = 2.245mOD
Head (Water Level) Above Datum (m)
Chainage (m)
0
1
2
3
4
5
6
7
0
100
200
300
400
500
600
700
800
900
1000
Hydraulic Profile
Water - River Suir



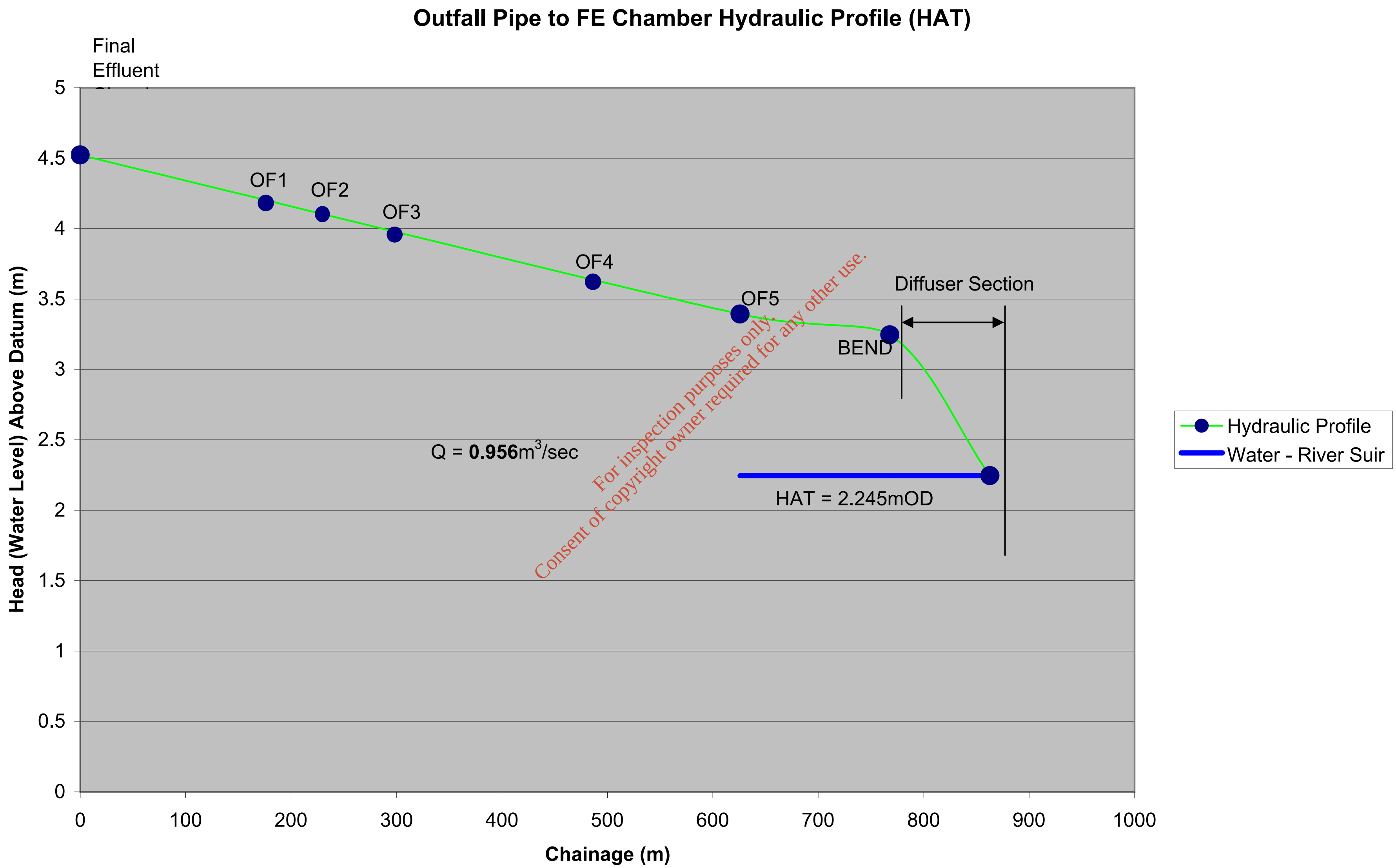
Outfall Pipe to FE Chamber Hydraulic Profile (MSL)
Head (Water Level) Above Datum (m)
2.5
2
1.5
1
0.5
0
-0.5
0
100
200
300
400
500
600
700
800
900
1000
Chainage (m)
Final Effluent Chamber
OF1
OF2
OF3
OF4
OF5
BEND
Diffuser Section
Q = 0.956m3/sec
MSL = -0.08mOD
Hydraulic Profile
Water - River Suir



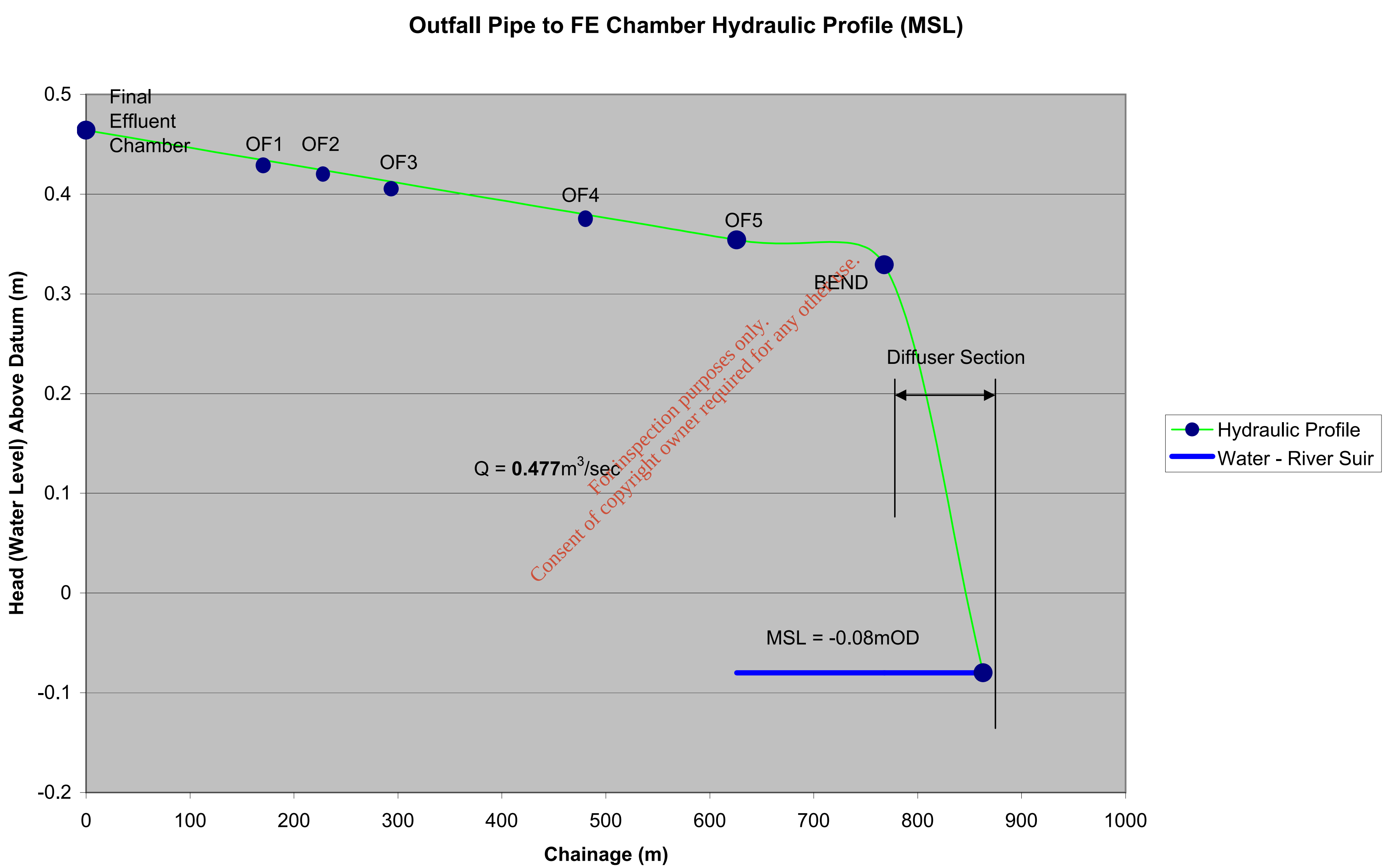
Outfall Pipe to FE Chamber Hydraulic Profile (MLWS)
Head (Water Level) Above Datum (m)
0
-0.5
-1
-1.5
-2
-2.5
-3
Chainage (m)
0
100
200
300
400
500
600
700
800
900
1000
Final Effluent
OF1
OF2
OF3
OF4
OF5
BEND
Diffuser Section
Q = **0.956**m³/sec
MLWS = -2.44mOD
Hydraulic Profile
Water - River Suir

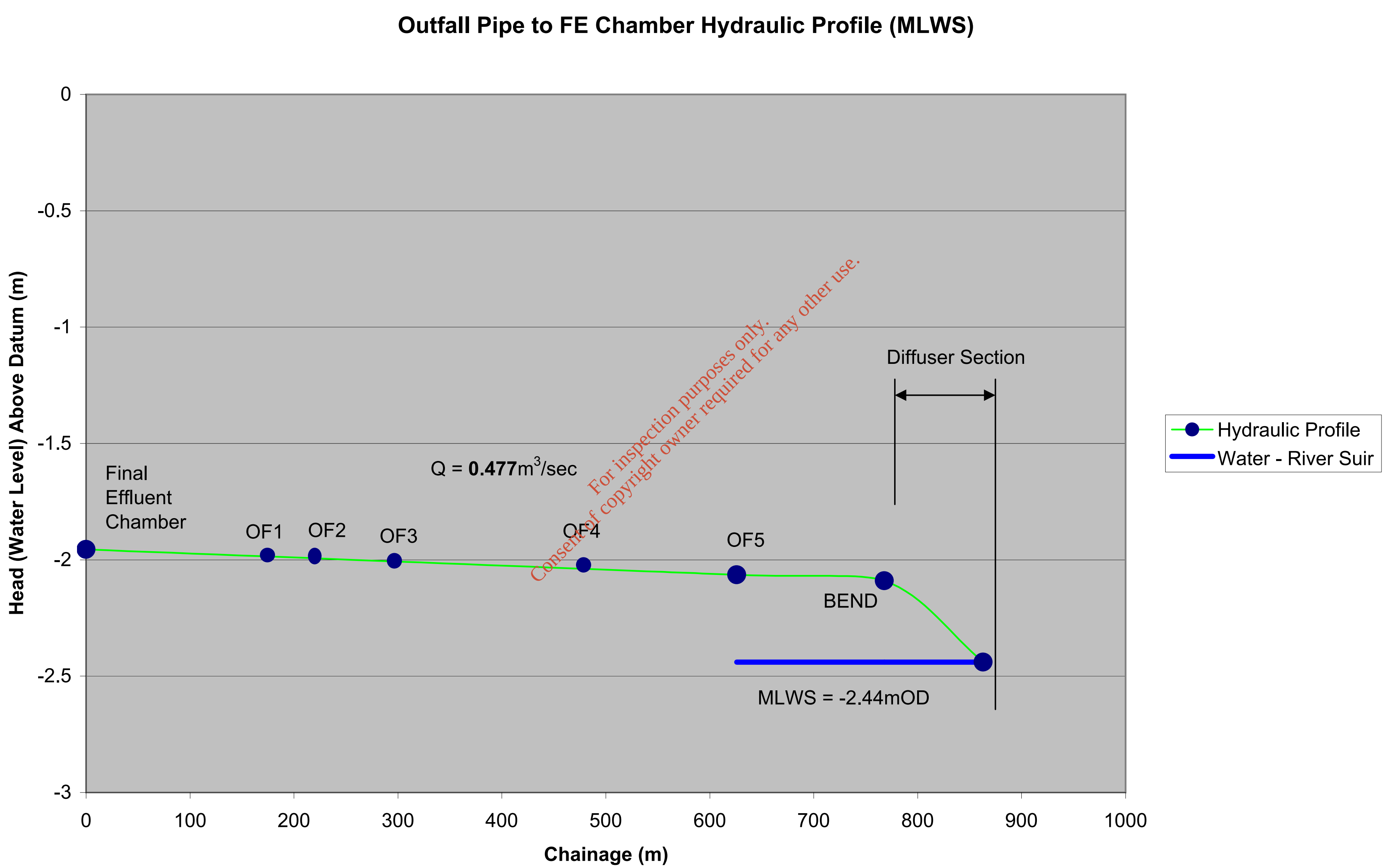


Outfall Pipe to FE Chamber Hydraulic Profile (MHWS)
Final Effluent
OF1
OF2
OF3
OF4
OF5
Diffuser Section
BEND
Q = 0.956m3/sec
MHWS = 1.618mOD
Head (Water Level) Above Datum (m)
Chainage (m)
Hydraulic Profile
Water - River Suir
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
0
100
200
300
400
500
600
700
800
900
1000

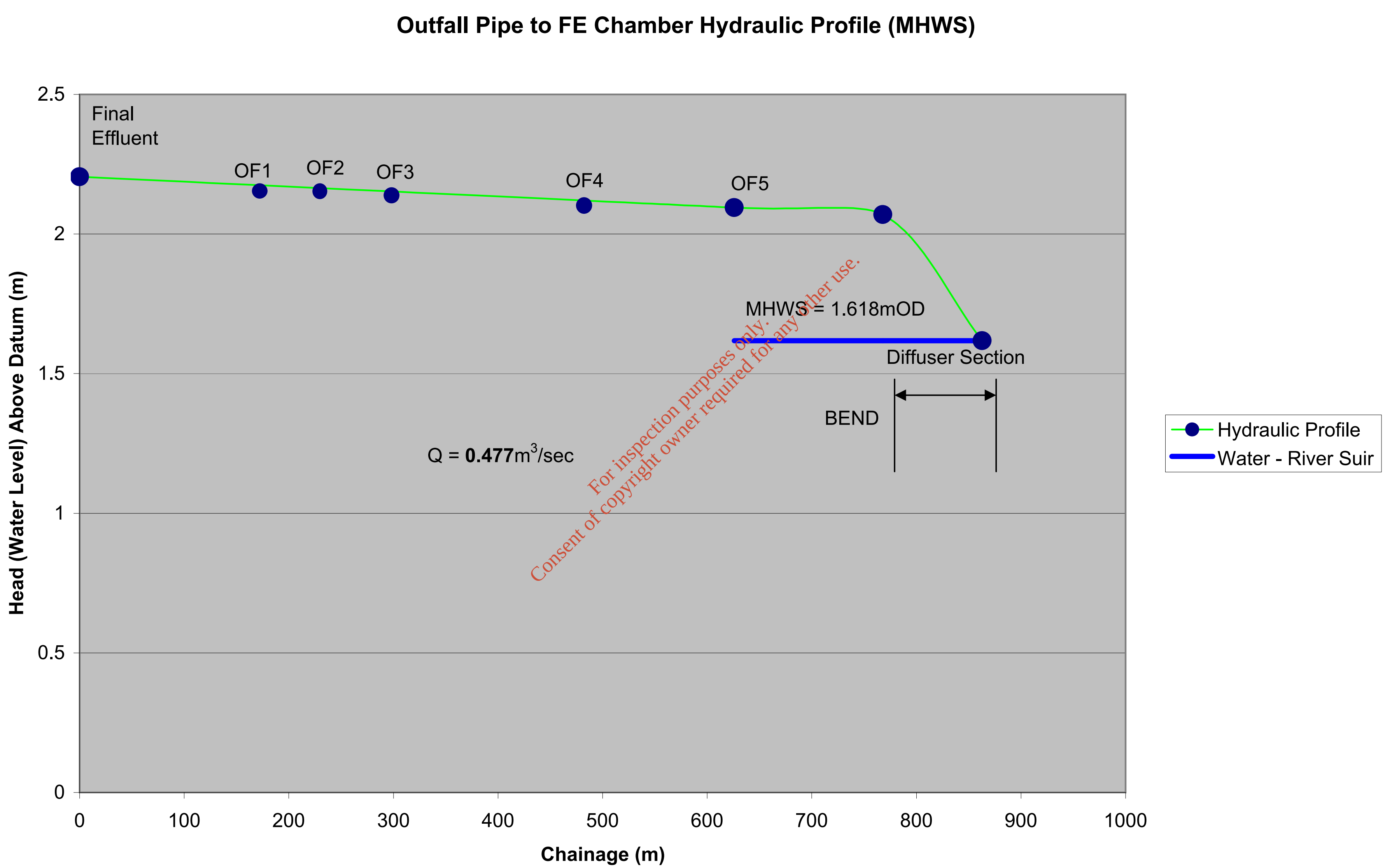


Outfall Pipe to FE Chamber Hydraulic Profile (HAT)
Final
Effluent
Head (Water Level) Above Datum (m)
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
OF1
OF2
OF3
OF4
OF5
BEND
Diffuser Section
Q = 0.956m3/sec
HAT = 2.245mOD
0
100
200
300
400
500
600
700
800
900
1000
Chainage (m)
Hydraulic Profile
Water - River Suir

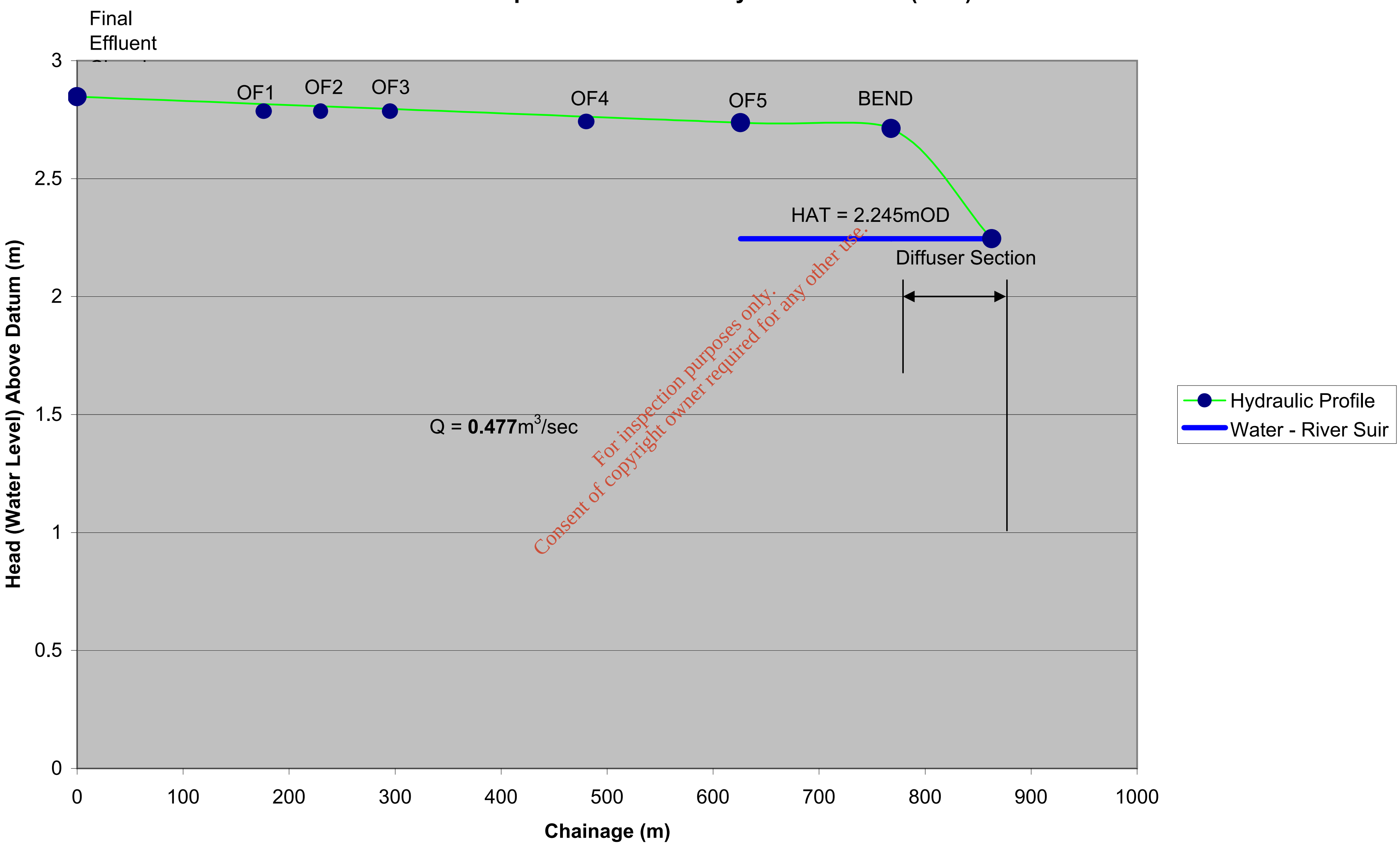

Outfall Pipe to FE Chamber Hydraulic Profile (MSL)
Head (Water Level) Above Datum (m)
Chainage (m)
Final Effluent Chamber
OF1
OF2
OF3
OF4
OF5
BEND
Diffuser Section
Q = 0.477m3/sec
MSL = -0.08mOD
Hydraulic Profile
Water - River Suir
0.5
0.4
0.3
0.2
0.1
0
-0.1
-0.2
0
100
200
300
400
500
600
700
800
900
1000

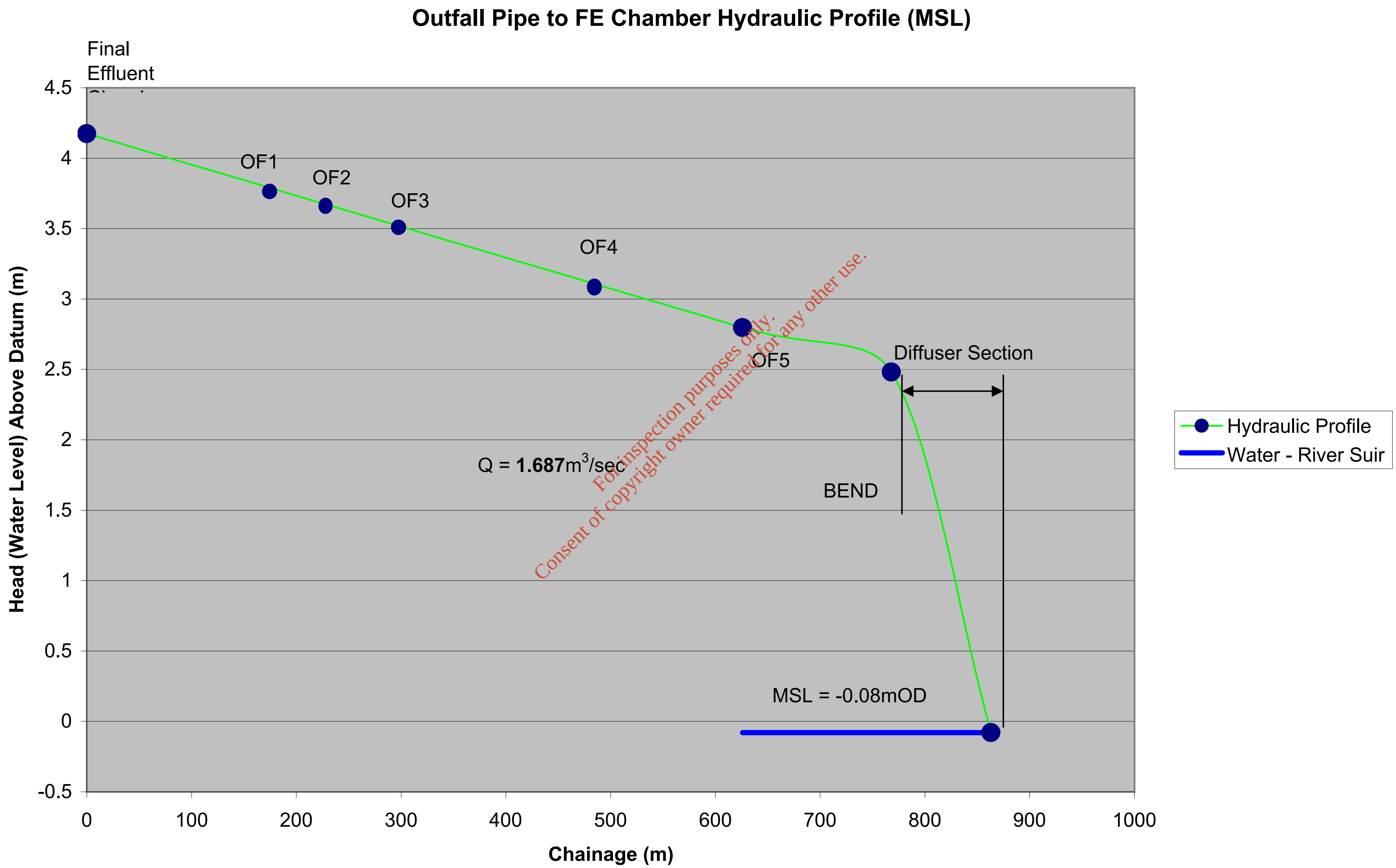


Outfall Pipe to FE Chamber Hydraulic Profile (MLWS)
Head (Water Level) Above Datum (m)
0
-0.5
-1
-1.5
-2
-2.5
-3
Chainage (m)
0
100
200
300
400
500
600
700
800
900
1000
Final
Effluent
Chamber
OF1
OF2
OF3
OF4
OF5
BEND
Q = **0.477**m³/sec
Diffuser Section
MLWS = -2.44mOD
Hydraulic Profile
Water - River Suir


Outfall Pipe to FE Chamber Hydraulic Profile (MHWS)
Final Effluent
OF1
OF2
OF3
OF4
OF5
MHWS = 1.618mOD
Diffuser Section
BEND
Q = 0.477m3/sec
Head (Water Level) Above Datum (m)
Chainage (m)
0
0.5
1
1.5
2
2.5
0
100
200
300
400
500
600
700
800
900
1000
Hydraulic Profile
Water - River Suir

Outfall Pipe to FE Chamber Hydraulic Profile (HAT)




Outfall Pipe to FE Chamber Hydraulic Profile (MSL)
Final
Effluent
Head (Water Level) Above Datum (m)
Chainage (m)
OF1
OF2
OF3
OF4
OF5
Diffuser Section
BEND
Q = 1.687m3/sec
MSL = -0.08mOD
Hydraulic Profile
Water - River Suir
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
-0.5
0
100
200
300
400
500
600
700
800
900
1000

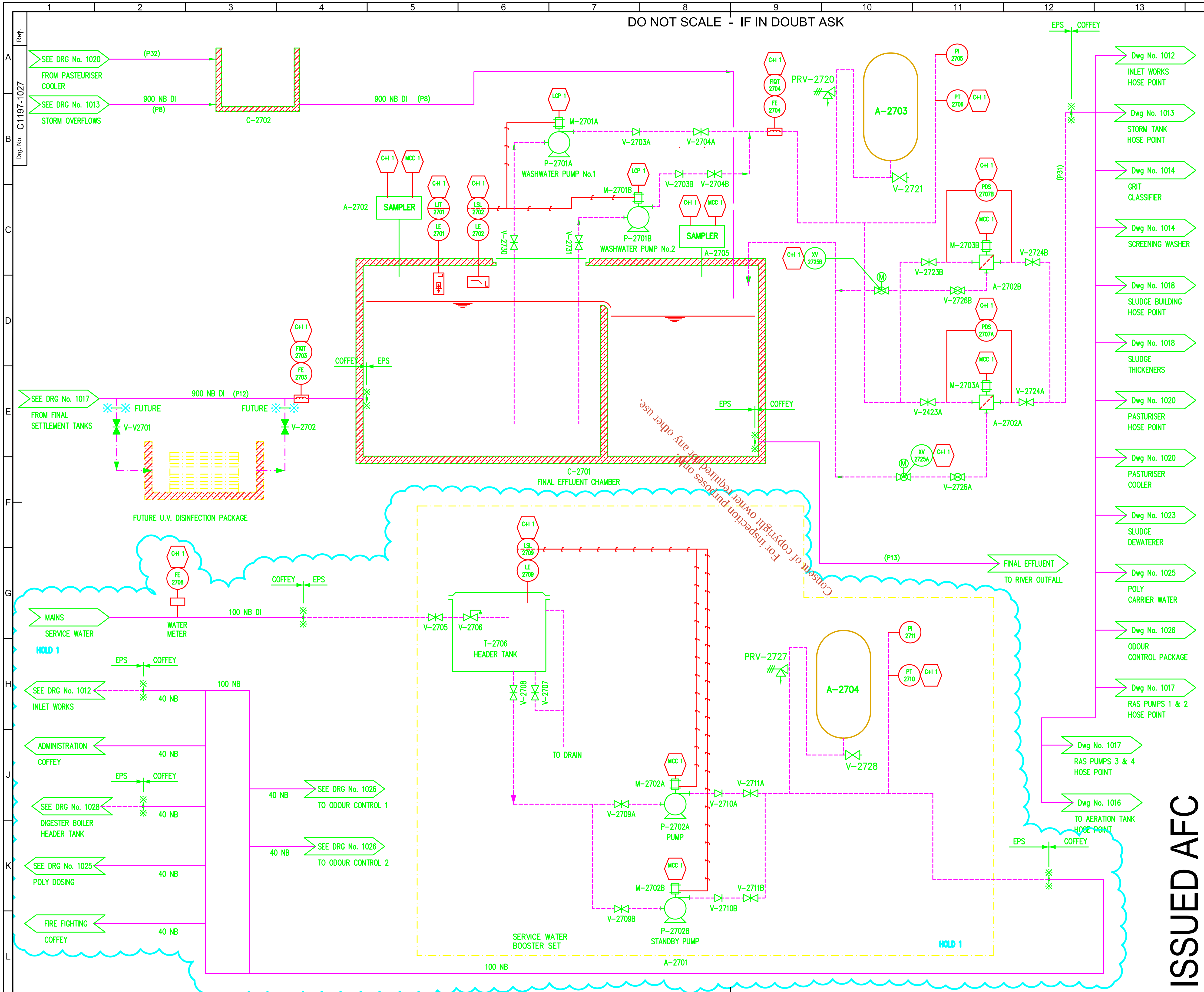
Summary of Initial Dilutions
Peak Flow 1.687m^3/sec

	MHWS		MLWS		MSL	
	Q_{port}	S (BDFF)	Q_{port}	S (BDFF)	Q_{port}	S (BDFF)
Port 1	0.125	68.73	0.125	13.19	0.125	20.86
Port 2	0.040	213.23	0.040	40.63	0.040	64.60
Port 3	0.078	108.89	0.078	20.60	0.078	32.93
Port 4	0.099	85.68	0.099	16.15	0.099	25.89
Port 5	0.103	81.79	0.103	15.31	0.103	24.67
Port 6	0.102	82.03	0.102	15.30	0.102	24.72
Port 7	0.105	79.59	0.105	14.73	0.105	23.95
Port 8	0.108	76.75	0.108	14.10	0.108	23.05
Port 9	0.111	74.09	0.111	13.56	0.111	22.23
Port 10	0.107	76.67	0.107	13.93	0.107	22.97
Port 11	0.113	72.14	0.113	13.01	0.113	21.57
Port 12	0.120	67.98	0.120	12.21	0.120	20.31
Port 13	0.128	63.38	0.128	11.30	0.128	18.90
Port 14	0.113	71.28	0.113	12.66	0.113	21.24
Port 15	0.117	68.77	0.117	12.12	0.117	20.46
Port 16	0.120	66.22	0.120	11.57	0.120	19.66
Total	**1.687**		**1.687**		**1.687**	
Average	**0.11**	**84.83**	**0.11**	**15.65**	**0.11**	**25.50**
Maximum	**0.13**	**213.23**	**0.13**	**40.63**	**0.13**	**64.60**
Minimum	**0.04**	**63.38**	**0.04**	**11.30**	**0.04**	**18.90**

Summary of Initial Dilutions
FFT 0.956m^3/sec

	MHWS		MLWS		MSL	
	Q_{port}	S (BDFF)	Q_{port}	S (BDFF)	Q_{port}	S (BDFF)
Port 1	0.064	51.33	0.064	13.28	0.064	32.77
Port 2	0.031	106.16	0.031	27.27	0.031	67.66
Port 3	0.049	66.34	0.049	16.92	0.049	42.21
Port 4	0.052	61.91	0.052	15.73	0.052	39.35
Port 5	0.059	54.28	0.059	13.69	0.059	34.45
Port 6	0.058	54.87	0.058	13.79	0.058	34.79
Port 7	0.060	53.06	0.060	13.24	0.060	33.59
Port 8	0.062	50.98	0.062	12.63	0.062	32.21
Port 9	0.064	49.45	0.064	12.20	0.064	31.22
Port 10	0.059	53.54	0.059	13.11	0.059	33.74
Port 11	0.063	50.02	0.063	12.16	0.063	31.47
Port 12	0.066	47.25	0.066	11.44	0.066	29.70
Port 13	0.071	43.81	0.071	10.53	0.071	27.49
Port 14	0.064	48.53	0.064	11.61	0.064	30.42
Port 15	0.066	46.66	0.066	11.08	0.066	29.20
Port 16	0.068	44.80	0.068	10.55	0.068	27.98
Total	**0.956**		**0.956**		**0.956**	
Average	**0.06**	**55.19**	**0.06**	**13.70**	**0.06**	**34.89**
Maximum	**0.07**	**106.16**	**0.07**	**27.27**	**0.07**	**67.66**
Minimum	**0.03**	**43.81**	**0.03**	**10.53**	**0.03**	**27.49**

DO NOT SCALE - IF IN DOUBT ASK



ISSUED AFC

See Previous Issues For Past Revision Details

Rev.	Date	Description	Drawn
1	27/06/2008	GENERAL MODS	

NOTES

1. DRAWING PREVIOUSLY E8374-1027

HOLDS

1. AWI TO CONFIRM SUPPLY SOURCE.

LEGEND:

- NEW PIPEWORK/CHANNEL BY CIVILS CONTRACTOR.
- NEW PIPEWORK BY M&E CONTRACTOR.
- FUTURE PIPEWORK.
- ENPURE PIPEWORK.

CHECKED		APPROVED	
PROCESS ENG.	DGH	PROCESS TECH SPECIALIST.	DGG
PROJECT ENG.	JMN	PROJECT MAN.	CGP
LEAD MECH ENG.	JAM	MECH ENG MAN.	BM
LEAD ELEC ENG.	AMT	ELEC ENG MAN.	JL

A.W.I. CONTRACT No 1002

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Customer
WATERFORD CITY COUNCIL

Title
WASHWATER & POTABLE WATER
P & I DIAGRAM
WATERFORD WWTW

Drawn	Checked	Approved	Original Sheet Size
DJTildesley	RJMiller	RJMeakin	A1
Date 20/10/2006	Date 26/06/2008	Date 27/06/2008	Original Scale NTS

Drg. No. C1197-1027 Rev. 1

Article 12 (Part 4)
Section E.1: Emissions to Air

(a) Provide the thermal input MW of the boilers and capacity of the generator

The process data sheet for the boilers is included as 07_4084 Appendix 4.1. The thermal input is 625 kW per boiler.

The standby generator (located within the Sludge building) is a Volvo type TWD 1643 GE machine, rated at 917kW max standby power. It is designed to provide power for the key areas of process operation essentially to keep the process alive. These loads have been determined as `base load` demands until such time as the mains power supply is restored. The main power demand is to run one blower, rated at 110Kw, to keep the activated sludge process alive in the aeration tanks. The use of the one blower will be rotated across the 4 aeration tanks, depending on how many are in service.

It is not provided to run and operate the Plant in full operational mode.

(b) Complete Table E.1(v) for the fugitive emissions from the facility

See table included at end of this section.

(c) Provide further details on potential odour sources: skips, uncovered tanks, screening and grit skips, grease removal, any other transfer operations, release valves, sumps etc

The main potential odour sources from the inlet works and sludge treatment works are detailed in the responses in Part 2 and Part 3, with the abatement controls that will be applied to these areas/items of plant.

There are a number of uncovered tanks; these are the final settlement tanks, the aeration tanks and selector tank. These tanks contain activated sludge, which would not be considered a common source of odour and are not typically covered.

Screening and grit skips, containing 95% of the screenings and grit, which will be taken out of the sewage at the inlet works stage, will be contained within skips in the inlet building. As this building is under negative pressure, which is directed to the Odour Control Unit (OCU-1), there will be no odour emissions to atmosphere from this source.

The remaining 5% (approximately) of the screenings will be stored in small skips/bins adjacent to the sludge building (See Drawing No. C1197-3014, Item 28 – Skip Holding Area). As these screenings and grit have been through the sludge treatment processes, they are relatively clean and will not produce odours that may create a nuisance.

Grease removal processes are contained in the inlet works building, again this building is under negative pressure, which is directed to the Odour Control Unit (OCU-1) and there will be no odour emissions to atmosphere from this source.

Many of the release valves and sumps are contained within the inlet works or sludge treatment building and potential odours from these will be contained and treated by the OCUs. However, there are a number that will be external to these buildings, but the potential odour emissions from these is considered to be minimal, very temporary and slight. As such, it would not be practical or feasible to apply odour abatement to these individual areas/items and it is not considered necessary.

TABLE E.1(iv): EMISSIONS TO ATMOSPHERE - Minor /Fugitive

Emission point Reference Numbers	Description	Emission details[1]				Abatement system employed
		material	mg/Nm3(2)	kg/h.	kg/year	
A-02	Waste Burner (Ground Flare Stack E264518 N112409). Vent diameter 1250 mm, Height above ground level 5.2 m	H_2S	283	Not Applicable	Not Applicable	None Required. Volumetric flow is <5 m/sec, and all H_2S is burned off

1 The maximum emission should be stated for each material emitted, the concentration should be based on the maximum 30 minute mean.
2 Concentrations should be based on Normal conditions of temperature and pressure, (i.e. 0^oC101.3kPa). Wet/dry should be clearly stated. Include reference oxygen conditions for combustion sources.

enpure

PROCESS DESIGN CALCULATION

Contract Name : Waterford **Contract No:** C1197

Document Reference: 8417 **Title :** Bolier

Revision	No. of Pages (Excluding Cover)	Date of Issue	Purpose of Issue	Originator	Checked	Approved
1	1	04/06/2007	Contract Issue	DGH	[signature]	[signature]

BOILER SIZING						
		Case 1	Case 2	Case 3	Case 4	
Total Heat Required by all Digesters	kW	253	314	744	921	Ref: 8416 Heat Exchanger Design
Number of Duty Boilers Selected		1	1	2	2	
Output Required by Each Boiler	kW	253	314	372	461	
Boiler output required to be specified to suppliers. Suppliers to select actual boiler model to meet the required output and advise actual output, efficiency and fuel input requirements. Calculation given below is for preliminary assessment purposes only.						
Boiler Output Selected (Each)	kW	500	500	500	500	
Boiler Efficiency (Assumed)	%	80	80	80	80	
Estimated Fuel Input Required (Each)	kW	625	625	625	625	
Sludge Gas Usage						
Gas Net Calorific Value	MJ/Nm^3	22.5	22.5	22.5	22.5	
Approximate Gas Flowrate (Each)	Nm^3/h	100	100	100	100	
Approximate Gas Flowrate (Total)	Nm^3/h	100	100	200	200	
Minimum Gas Yield (Total)	m^3/d	2291	2291	3776	3776	8413 Gas Production
Proportion of Minimum Gas Yield Consumed by all Boilers	%	105	105	127	127	
Standby Fuels						
Fuel Oil Net Calorific Value	MJ/m^3	36900.00	36900.00	36900.00	36900.00	
Fuel Oil Flowrate (approx)	m^3/h	0.06	0.06	0.06	0.06	
	l/h	61	61	61	61	
LPG Net Calorific Value	MJ/m^3	93.90	93.90	93.90	93.90	
LPG Flowrate (approx)	Nm^3/h	23.96	23.96	23.96	23.96	
Natural Gas Net Calorific Value	MJ/Nm^3	38.62	38.62	38.62	38.62	
Natural Gas Flowrate (approx)	Nm^3/h	58.26	58.26	58.26	58.26	

Article 12 (Part 5)
Section E.2: Surface Water

(a) Clarify receiving waters for SW-01 and location of discharge

Emission Point SW-01 enters the un-named stream at the southeast corner of the site, immediately as the stream meets the Suir Estuary, and therefore as it is the very end of the stream where it meets the Estuary, it is essentially the Suir Estuary that is the receiving waters for Emission Point SW-01. The SW-01 emission point is shown in Drawing J300-SK-007-220808.

TABLE E.2(i): EMISSIONS TO SURFACE WATERS

Emission Point: SW-01

Emission Point Ref. Nº:	SW-01
Source of Emission:	Surface Water Runoff
Location :	Southeast corner of WWTP site, at site boundary
Grid Ref. (10 digit, 5E,5N):	265022 112153
Name of receiving waters:	The Suir Estuary - at the confluence of the un-named Stream (flowing along the eastern boundary of the Site) and the Suir Estuary
Flow rate in receiving waters:	Not Determined – Tidal Regime in Suir Estuary $m^3.sec^{-1}$ Dry Weather Flow Not Determined – Tidal Regime in Suir Estuary $m^3.sec^{-1}$ 95%ile flow
Available waste assimilative capacity:	(Refer to Appendix A in Original EIS, included in Section B.3) kg/day

Emission Details:

(i) Volume to be emitted			
Normal/day	7,171.2 m^3	Maximum/day	20,995.2 m^3
Maximum rate/hour	873.2 m^3		

(ii) Period or periods during which emissions are made, or are to be made, including daily or seasonal variations (*start-up /shutdown to be included):*

Periods of Emission (avg)	60 min/hr 24 hr/day 365 day/yr

In terms of the volumes presented in Table E.2(i), the flow given is for a 1 hour storm with 6 month return period i.e. likely to occur twice per year. As the impermeable area of the site is 1.5hA, the volume of runoff is significant.

Emission Point SW-02 is the where the emission of the final treated effluent into the centre of the Suir Estuary takes place. See Table below.

TABLE E.2(i): EMISSIONS TO SURFACE WATERS

Emission Point: SW-02

Emission Point Ref. Nº:	SW-02
Source of Emission:	Final Treated Effluent
Location :	Middle of Suir Estuary, 500 m West-Southwest of WWTP Site
Grid Ref. (10 digit, 5E,5N):	265602 112078
Name of receiving waters:	Suir Estuary
Flow rate in receiving waters:	Not Determined – Tidal Regime $m^3.sec^{-1}$ Dry Weather Flow Not Determined – Tidal Regime $m^3.sec^{-1}$ 95%ile flow
Available waste assimilative capacity:	(Refer to Appendix A in Original EIS, included in SectionB.3) kg/day

Emission Details:

(i) Volume to be emitted			
Normal/day	35,704 m^3	Maximum/day	145,725 m^3
Maximum rate/hour	6071.875 m^3		

(ii) Period or periods during which emissions are made, or are to be made, including daily or seasonal variations (*start-up /shutdown to be included):*

Periods of Emission (avg)	60 min/hr 24 hr/day 365 day/yr

(b) Resubmit a completed Table E2(ii) for SW-02

TABLE E.2(ii): EMISSIONS TO SURFACE WATERS - Characteristics of the emission

Emission point reference number : SW-02

Parameter	Prior to treatment				As discharged				% Efficiency
	Max. hourly average (mg/l)	Max. daily average (mg/l)	kg/day	kg/year	Max. hourly average (mg/l)	Max. daily average (mg/l)	kg/day	kg/year	
Biological Oxygen Demand (BOD)	16.1	387.1	14,759	5,387,035	25	50	0.89	324.85	Not Applicable
Chemical Oxygen Demand	Not Available	Not Available	Not Available	Not Available	135	250	4.82	1759.3	Not Applicable
Suspended Solids	11.84	284.1	10,833	3,954,045	35	87.5	1.25	456.25	Not Applicable

Article 12 (Part 6)
Section I.5: Ground and/or Groundwater Contamination

Provide a brief development and operational history of the site

As discusses in the EIS for this facility and in the update of the EIS (included in full in Section B.3 of the Waste Licence Application), the site on which the WWTP facility is situated, was a Greenfield site prior to commencement of construction of the facility.

The site is located on the former Springfield House Estate, the ruins of which are located at the northern boundary of the site. The site itself contains part of the former garden area of Springfield House, which has been used for pasture in the past number of years. As described in Section 3.2 of the original EIS (Section B.3 of the application), to the south of the gardens, there was a meadow with hedgerows and some mature trees. Towards the Suir Estuary banks, is marshland, which was not suitable for agricultural use. No other uses other than agricultural (pasture) have been recorded for the site.

Soils groups recorded at the time of the Environmental Impact Assessment, were brown earth, loam, and mixed brown earth/brown podzolic. No soil contamination was noted at the site.

The IDA Business and Technology Park is located directly to the north of the site, i.e. north of the Springfield House ruins. The IDA has recently installed a borehole/well for the purposes of abstraction of potable water for developments within the IDA Park, until a water supply mains are extended to serve the area. No development has been carried out at the site to date, with the exception of infrastructural works.

The IDA lands in relation to the WWTP site are shown in Figure 07_4084 I.5.1. The location of the IDA Borehole is also shown on this figure.

Table I.5(i) is not applicable and therefore has not been completed.

Project

Waterford WWTP Waste Licence Application

Reference

07_4084 I.5.1

Figure 07_4084 I.5.1

Aerial Photograph showing location of the IDA lands in relation to the WWTP site

awnconsulting

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