

# Annual Environmental Report 2017

<b>Agglomeration Name:</b>	<b>Shannon</b>
<b>Licence Register No.</b>	<b>D0045-01</b>



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## Section 1. Executive Summary and Introduction to the 2017 AER

### 1.1 Summary report

This Annual Environmental Report has been prepared for D0045-01, Shannon, in County Clare in accordance with the requirements of the wastewater discharge licence for the agglomeration. No specified reports are included as appendices to the AER.

The agglomeration is served by a wastewater treatment plant with a Plant Capacity PE of 12,500 which is located in Shannon, County Clare. The Shannon WWTP and pumping stations in the sewer network serving Shannon town are operated under contract between Irish Water and a private operator, Response Engineering Ltd.

The treatment process consisted of two process streams: a domestic stream and an industrial stream. The domestic stream has a design capacity of 12,500 P.E. and treatment for this stream includes:

- Preliminary treatment including screening and grit removal
- Primary treatment
- Secondary treatment – activated sludge

The treatment process for the industrial stream is no longer operational. It used to consist of:

- A balancing tank and chemical dosing
- Sludge thickening and dewatering

However, the supernatant from the centrifuge and the leachate continues to be sent to the industrial side of the plant and also discharges into the large final effluent lagoon before discharging into the Shannon Estuary.

Treated wastewater discharges to a large final effluent lagoon before discharge to the Shannon Estuary via an outfall pipe and diffuser.

It should be noted that since 21 December 2016, both the domestic and industrial streams have been diverted into one stream at the new inlet works and is now being balanced and combined before treatment.

The final effluent from the Primary Discharge Point was non-compliant with the Emission Limit Values in 2017.

The following parameters exceeded the emission limit values in 2017:

- cBOD
- COD
- Suspended solids

431,400 Kgs sludge (as 20.1% dry solids) were removed from the wastewater treatment plant as dewatered sludge cake. Sludge was transferred to Traderee Sludge Landfill site, which is licensed separately by the EPA, Reg. No. W0037-01.

The following major capital or operational changes were undertaken in 2017:

A flow and load survey for Shannon Town Agglomeration was completed in September 2017.

Consultants were also appointed to carry out the design of improvements to the plant and also to undertake an interim upgrade design. Shannon WWTP is on the Capital Investment Plan 2017-2021.

Further details are outlined in the Annual Statement of Measures in **Appendix 7.1**.

## Section 2. Monitoring Reports Summary

### 2.1 Summary report on monthly influent monitoring

Table 2.1 - Influent Monitoring Summary

	BOD (mg/l)	COD (mg/l)	SS (mg/l)	TP (mg/l)	TN (mg/l)	Hydraulic Loading (m3/d)
Number of Samples	24	24	23	13	24	
Annual Max.	306	739	460	7.2	45.5	17,371
Annual Mean	161	385	143	4	25	6283

#### Significance of results

The annual mean hydraulic loading is less than the peak Treatment Plant Capacity as detailed further in Section 3.2.

The annual maximum hydraulic loading is greater than the peak Treatment Plant Capacity as detailed further in Section 3.2.

The annual mean organic loading is less than the Treatment Plant Capacity as detailed further in Section 3.2.

The annual maximum organic loading is greater than the Treatment Plant Capacity as detailed further in Section 3.2.

## 2.2 Discharges from the agglomeration

**Table 2.2 - Effluent Monitoring Summary**

	BOD (mg/l) <sup>2</sup>	COD (mg/l) <sup>2</sup>	TSS (mg/l) <sup>2</sup>	TON (mg/l)	NH3-N (mg/l)	pH	Comment
<b>WWDL ELV (Schedule A)</b>	25	125	35	15	35	6-9	
<b>ELV with Condition 2 Interpretation included</b>	50	250	87.5	18	42	6-9	
<b>Number of sample results</b>	24	24	23	17	23	12	
<b>Number of sample results above WWDL ELV/not achieving min % reduction<sup>1,2</sup></b>	9	5	9	0	0	0	
<b>Number of sample results above ELV with Condition 2 Interpretation included</b>	7	2	2	0	0	0	
<b>Annual Mean (for parameters where a mean ELV applies)</b>	N/A	N/A	N/A	N/A	N/A	N/A	
<b>Overall Compliance (Pass/Fail)</b>	Fail	Fail	Fail	Pass	Pass	Pass	

### Significance of results

The WWTP was non-compliant with the ELV's set in the wastewater discharge licence for BOD, COD and TSS. There were 11 samples non-compliant with the ELV's in relation to BOD (7), COD (2) and Suspended Solids (2). There is a compliance investigation and upgrade underway to manage these non-compliances. Similarly, the results do not meet the requirements of the Urban Waste Water Treatment (UWWT) Regulations 2001 – 2010. The impact on receiving waters is assessed further in Section 2.3.

## 2.3 Ambient monitoring summary

**Table 2.3 - Ambient Monitoring Report Summary**

Ambient Monitoring Point from WWDL (or as agreed with EPA)	Irish Grid Reference	EPA Feature Coding Tool code	Receiving Waters Designation(Y/N)				WFD Status
			Bathing Water	Drinking Water	FWPM	Shellfish	
Traderee Bunratty Buoy station (upstream SN310)	144527E 159156N		N	N	N	N	Poor
Carraig Bank Buoy station (downstream SN330)	138528E 159128N		N	N	N	N	Poor

**Table 2.3.2 Ambient Impact Assessment Table**

<b>Ambient Monitoring Point from WWDL (or as agreed with EPA)</b>	<b>Current WFD Status</b>	<b>cBOD</b>	<b>0-Phosphate (as P)</b>	<b>Ammonia (as N)</b>	<b>Nitrogen</b>
Traderee Bunratty Buoy station (SN310)	Poor	0.7	0.048	0.058	
Carraig Bank Buoy station (SN330)	Poor	0.6	0.048	0.054	
Difference between Upstream and Downstream		-0.1	0	-0.004	
EQS		2.6	0.075	0.140	
% of Eqs		-0.038%	0%	-0.029%	

The results for the upstream and downstream monitoring used are included as in Appendix 7.2.

The EPA's Coastal & Estuarine Dataset 2007-2013 was used to assess the receiving waters (this is the most recent dataset available for the locality). Results from the two sampling stations proximate to the WWTP (Traderee Bunratty Buoy station and Carraig Bank Buoy station) are detailed in Appendix 7.2.

#### Significance of results

- The WWTP was non-compliant with the ELV's set in the wastewater discharge licence as detailed in Section 2.2.
- The discharge from the wastewater treatment plant does not have an observable negative impact on the water quality.
- The discharge from the wastewater treatment plant may be a contributory factor on the Water Framework Directive status, which has been assigned a WFD status of Poor.

#### **2.4 Pollutant Release and Transfer Register (PRTR) - report for previous year**

A PRTR is not required in the 2017 AER as this agglomeration is under 100,000 p.e.

## Section 3 Operational Reports Summary

### 3.1 Treatment Efficiency Report

A summary presentation of the efficiency of the treatment process including information for all the parameters specified in the licence is included below:

**Table 3.1 - Treatment Efficiency Report Summary**

	cBOD (kg/yr)	COD (kg/yr)	SS (kg/yr)	Total P (kg/yr)	Total N (kg/yr)
Influent mass loading (kg/year)	157,503	377,770	131,206	3,313	24,619
Effluent mass emission (kg/year)	88,494	247,207	109,722	5,081	41,990
% Efficiency (% reduction of influent load)	44%	35%	16%	-53%	-71%

### 3.2 Treatment Capacity Report

**Table 3.2 - Treatment Capacity Report Summary**

Hydraulic Capacity – Design / As Constructed (m3/day) DWF	6,312
Hydraulic Capacity – Design / As Constructed (m3/day) Peak	13,686
Hydraulic Capacity – Current loading (m3/day)	6,283
Hydraulic Capacity – Remaining (m3/day)	7,403
Organic Capacity - Design / As Constructed (PE)	12,500
Organic Capacity - Current loading (PE)	20,809
Organic Capacity – Remaining (PE)	-8,309
Will the capacity be exceeded in the next three years? (Yes / No)	Yes



### 3.3 Extent of Agglomeration Summary Report

In this section Irish Water is required to report on the amount of urban waste water generated within the agglomeration. It does not include any waste water collected and treated in a private system and discharged to water under a Section 4 Licence issued under the Water Pollution Acts 1977 (as amended):

**Table 3.3 - Extent of Agglomeration Summary Report**

	% of p.e. load generated in the agglomeration
<b>Load generated in the agglomeration that is collected in the sewer network</b>	<b>100%</b>
<b>Load collected in the agglomeration that enters treatment plant</b>	<b>Unknown</b>
<b>Load collected in the sewer network but discharged without treatment</b>	<b>Unknown</b>

**Load generated in the agglomeration that is collected in the sewer network** is the total load generated and collected in the municipal network within the boundary of the agglomeration.

**Load collected in the agglomerations that enters treatment plant** is that portion of the previous figure which enters the waste water treatment plant

**Load collected but discharged without treatment** is that portion of the first figure which is discharged without treatment.

### 3.4 Complaints Summary

A summary of complaints of an environmental nature is included below.

**Table 3.4 - Complaints Summary Table**

<b>Number of Complaints</b>	<b>Nature of Complaint</b>	<b>Number Open Complaints</b>	<b>Number Closed Complaints</b>
<b>20</b>	<b>Sewage overflowing/blocked sewer</b>	<b>1</b>	<b>19</b>

### 3.5 Reported Incidents Summary

Table 3.5.1 - Summary of Incidents

Incident Type (e.g. Non-compliance, Emission, spillage, Emergency Overflow Activation)	Incident Description	Cause	No. of incidents	Corrective Action	Authorities Contacted <small>Note 1</small>	Reported to EPA (Yes/No)	Closed (Y/N)
Breach of ELV	ELV exceedance for parameter cBOD	WWTP overloaded	7	Upgrading of Shannon WWTP proposed	No	Yes	No CI000044 open
Breach of ELV	ELV exceedance for parameter COD	WWTP overloaded	2	Upgrading of Shannon WWTP proposed	No	Yes	No CI000044 open
Breach of ELV	ELV exceedance for parameter SS	WWTP overloaded	2	Upgrading of Shannon WWTP proposed	No	Yes	No CI000044 open
Uncontrolled release	Flooding of rear gardens.	Foul sewer blockage	1	Cleaned and unblocked.	EPA, DAFM	Yes INCI011614	Yes
Uncontrolled release	Break in Rising Main Sewer	Damaged Sewer Pipe	1	Repair works undertaken	EPA, DAFM	Yes INCI011700	Yes
Non-compliance	Flooding of Pump House 2	Heavy rainfall	1	Jet vacuum deployed reducing water levels & washdown.	EPA, DAFM	INCI012783	Yes
Uncontrolled release	Uncontrolled release occurred from Rising Main to field at Tullyglass	Faulty Air-Valve	1	Repaired.	EPA, DAFM	INCI012462	Yes
Uncontrolled release	Foul Rising Main burst	Broken Sewer Pipe	1	Rising Main repaired.	EPA, DAFM	INCI012869	Yes
Non-compliance	Shock load to plant	Shock load	1	Pump Station cleaned out.	EPA, DAFM	INCI013014	Yes

Non-compliance	Power outage in Shannon	Red alert warning in place.	Power restored.	1	EPA, DAFM	INCI013027	Yes
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Note 1: For shellfish waters notify the Marine Institute (MI) Sea Fisheries Protection Authority (SFPA) Food Safety Authority (FSAI) and An Bord Iascaigh Mhara (BIM). This should also include any other authorities that should be contacted arising from the findings of any Licence Specific Reports also e.g. Drinking Water Abstraction Impact Risk Assessment, Fresh Water Pearl Mussel Impact Assessments etc.

**Table 3.5.2 - Summary of Overall Incidents**

<b>Number of Incidents in 2017</b>	No. of 18
<b>Number of Incidents reported to the EPA via EDEN in 2017</b>	No. of 7
<b>Explanation of any discrepancies between the two numbers above</b>	All results of monitoring submitted as quarterly reports to the Agency in compliance with CI000044.

### 3.6 Sludge / Other inputs to the WWTP

'Other inputs' to the waste water treatment plant are summarised in Table 3.6 below.

**Table 3.6 - Other Inputs<sup>1,2</sup>**

Input type	m3/year	PE/year	% of load to WWTP	Included in Influent Monitoring (Y/N) <sup>3</sup>	Is there a leachate/sludge acceptance procedure for the WWTP? (Y/N)	Is there a dedicated leachate/sludge acceptance facility for the WWTP? (Y/N)
Domestic /Septic Tank Sludge	0	0	0	N/A	N/A	N/A
Industrial / Commercial Sludge	0	0	0	N/A	N/A	N/A
Landfill Leachate (delivered by tanker)	29647	42.25	1.29	N	N	N
Landfill Leachate (delivered by sewer network)	0	0	0	N/A	N/A	N/A
Other (specify)	0	0	0	N/A	N/A	N/A

Leachate volumes based on pump hours run and PE equivalent based only on an average of the 6 months that leachate was sampled.

**Notes:**

1. Other Inputs include; septic tank sludge, industrial /commercial sludge, landfill leachate and any other sludge that is collected and added to the treatment plant.
2. Sludge that is added to a dedicated sludge reception facility at a waste water treatment plant **not** included in Table 3.6. Only include sludge which is added to the waste water treatment process stream. Enter zero where there are no inputs.
3. If any inputs were introduced **prior** to influent monitoring point and therefore already reported in S.2.1 *Influent Monitoring Summary*, then clarify this to avoid duplication and over-reporting of PE.

## Section 4. Infrastructural Assessments and Programme of Improvements

### 4.1 Storm water overflow identification and inspection report

A Storm Water Overflow Identification & Inspection report was included in 2014 AER. A summary of the significance and operation is included below.

**Table 4.1.1 - SWO Identification and Inspection Summary Report**

WWDL Name / Code for Storm Water Overflow	Irish Grid Ref.	Included in Schedule A4 of the WWDL	Significance of the overflow (High / Medium / Low)	Compliance with DoEHLG Criteria	No. of times activated in 2017 (No. of events)	Total volume discharged in 2017(m3)	Total volume discharged in 2017(P.E.)	Estimated /Measured data
SW2	E143381 N159426	Yes	High	Non-compliant	Unknown	Unknown	Unknown	E

**Table 4.1.2 - SWO Identification and Inspection Summary Report**

How much sewage was discharged via SWOs in the agglomeration in the year (m3/yr)?	Unknown
How much sewage was discharged via SWOs in the agglomeration in the year (p.e.)?	Unknown
What % of the total volume of sewage generated in the agglomeration was discharged via SWOs in the agglomeration in 2017?	Unknown
Is each SWO identified as non-compliant with <u>DoEHLG Guidance</u> included in the Programme of Improvements?	Yes (SWO is at the WWTP and will be addressed as part of WWTP upgrade)
The SWO assessment includes the requirements of Schedule A3 & C3	Yes
Have the EPA been advised of any additional SWOs / changes to Schedule C3 and A4 under Condition 1.7?	No

**4.2 Report on progress made and proposals being developed to meet the improvement programme requirements.**

A programme of infrastructural improvements is noted below as specified under Schedule C of the WWDL.

**Table 4.2.1 - Specified Improvement Programme Summary**

Specified Improvement Programmes (under Schedule A and C of WWDL)	Licence Schedule (A or C)	Licence Completion Date	Date Expired? (N/NA/Y)	Status of Works ((i) Not Started; (ii) At planning stage; (iii) Work ongoing on-site; (iv) Commissioning Phase; (v) Completed; (vi) Delayed;)	% Construction Work Completed	Timeframe for Completing the Work	Comments
Refurbish the existing WWTP and upgrade it, resulting in a capacity to treat a population equivalent of 35,000	C.1	31/12/2015	Y	Contract awarded to Response Engineering in January 2016 for Phase 1 upgrade to Shannon WWTP.	25%	2020	Phase 1 Improvement Works consisted of: inlet works to separate flows, screening, grit removal, and provision of two new balancing tanks.  Flow & Load survey will inform ultimate upgrade requirements of Shannon WWTP.

A summary of the status of any improvements identified by under Condition 5.2 is included below.

**Table 4.2.2 - Improvement Programme Summary**

<b>Improvement Identifier</b>	<b>Improvement Description</b>	<b>Improvement Source</b>	<b>Progress (% completed)</b>	<b>Expected Completion Date</b>	<b>Comments</b>
D0045-01: Inlet works	Inlet works to separate flows, screening and grit removal, and the provision of two new balancing tanks.	WWTP assessment (Condition 5.2).	100%	Complete	
Rising main	PS14 Rising Main Replacement	WWTP assessment (Condition 5.2).	100%	Completed 30 November 2016	
Pumps	Installation of New Pumps at PS14	WWTP assessment (Condition 5.2).	100%	Completed June 2016	
Flows & loads	Flow and load survey for Shannon Town Agglomeration	WWTP assessment (Condition 5.2).	100%	Commenced on 31/01/2017. Completed Sept 2017.	

**Table 4.2.3 - Sewer Integrity Risk Assessment Tool Summary**

Full assessment completed as part of 2014 AER

<b>The Improvement Programme should include an assessment of the integrity of the existing wastewater works for the following:</b>	<b>Risk Assessment Rating (High, Medium, Low)</b>	<b>Risk Assessment Score</b>	<b>Comment</b>
Hydraulic Risk Assessment Score	High	130	Scores may not be a true reflection of the agglomeration due to absence of survey.
Environmental Risk Assessment Score	Low	135	
Structural Risk Assessment Score	High	150	
Operation & Maintenance Risk Assessment Score	Medium	120	
Overall Risk Score for the agglomeration	High	535	A Drainage Area Plan for Shannon started in 2015 and will take approximately 3 years to complete

A Drainage Area Plan for Shannon started in 2015 and will take approximately 3 years to complete. The DAP will encompass both Storm Water Overflow and network assessments and will therefore provide a more accurate review of Storm Water Overflow and Sewer Integrity Assessments.

## Section 5. Licence Specific Reports

**Licence Specific Reports Summary Table**

<b>Licence Specific Report</b>	<b>Required in AER or outstanding from previous AER</b>	<b>Report Included in AER</b>	<i>Reference to relevant section of AER (e.g. Appendix 2 Section4).</i>
<b>Priority Substances Assessment</b>	No	No	Submitted as part of 2011 AER.
<b>Drinking Water Abstraction Point Risk Assessment</b>	No	No	N/A
<b>Habitats Impact Assessment</b>	No	No	N/A
<b>Shellfish Impact Assessment</b>	No	No	N/A
<b>Pearl Mussel Report</b>	No	No	N/A
<b>Toxicity/Leachate Management</b>	No	No	N/A
<b>Toxicity of Final Effluent Report</b>	No	No	N/A
<b>Small Stream Risk Score Assessment</b>	No	No	N/A

### Licence Specific Reports Summary of Findings

Licence Specific Report	Recommendations in Report	Summary of Recommendations in Report
Priority Substances Assessment	Yes	No further analysis deemed necessary
Drinking Water Abstraction Point Risk Assessment	N/A	N/A
Habitats Impact Assessment	N/A	N/A
Shellfish Impact Assessment	N/A	N/A
Pearl Mussel Report	N/A	N/A
Toxicity/Leachate Management	N/A	N/A
Toxicity of Final Effluent Report	N/A	N/A
Small Stream Risk Score Assessment	N/A	N/A

#### 5.1 Priority Substances Assessment

A Priority Substances Assessment report was provided in 2011. A summary of the 2011 report is included below.

**Table 5.1 - Priority Substance Assessment Summary**

	<i>Licensee self-assessment checks to determine whether all relevant information is included in the Assessment.</i>
<b>Does the assessment use the Desk Top Study Method or Screening Analysis to determine if the discharge contains the parameters in Appendix 1 of the EPA guidance</b>	Desk Top and Screening
<b>Does the assessment include a review of Trade inputs to the works?</b>	Yes
<b>Does the assessment include a review of other inputs to the works?</b>	Yes
<b>Does the report include an assessment of the significance of the results where a listed material is present in the discharge? (e.g. impact on the relevant EQS standard for the receiving water)</b>	Yes
<b>Does the assessment identify that priority substances may be impacting the receiving water?</b>	no
<b>Does the Improvement Programme for the agglomeration include the elimination / reduction of all priority substances identified as having an impact on receiving water quality?</b>	no



## Section 6. Certification and Sign Off

Table 6.1 - Summary of AER Contents

Does the AER include an Executive Summary?	Yes
Does the AER include an assessment of the performance of the Waste Water Works (i.e. have the results of assessments been interpreted against WWDL requirements and or Environmental Quality Standards)?	Yes
Is there a need to advise the EPA for consideration of a Technical Amendment / Review of the licence?	No
List reason e.g. additional SWO identified	N/A
Is there a need to request/advise the EPA of any modifications to the existing WWDL? Refer to Condition 1.7 (changes to works/discharges) & Condition 4 (changes to monitoring location, frequency etc.)	No
List reason e.g. failure to complete specified works within dates specified in the licence, changes to monitoring requirements <i>(insert lines as required)</i>	N/A
Have these processes commenced? (i.e. Request for Technical Amendment / Licence Review / Change Request)	N/A
Are all outstanding reports and assessments from previous AERs included as an appendix to this AER?	N/A
List outstanding reports	N/A

### Declaration by Irish Water

The AER contains the following;

- Introduction and background to AER
- Monitoring reports summary.
- Operational reports summary.
- Infrastructural Assessment and Programme of Improvements.
- Certification and Sign Off
- Appendices

I certify that the information given in this Annual Environmental Report is truthful, accurate and complete:

Signed:..  ..... Date:..20/02/2018

**Michael O'Leary**  
Acting Head of Environmental Regulation

## **Section 7. Appendices**

The following appendices are attached to this AER:

Appendix 7.1 - Annual Statement of Measures

Appendix 7.2 - Ambient monitoring summary

## Appendix 7.1 Annual Statement of Measures

An upgrade to the WWTP was undertaken during 2016 and completed in January 2017 and consisted of:

- New inlet works on both industrial and domestic streams including installation of Inlet screens – No. 2 industrial; No. 2 domestic.
- Screening and grit removal: No. 1 Industrial Grit trap; No. 1 domestic Grit Trap; Common screenings compaction unit; and Common grit transfer system and classifier
- Flow monitoring and flow proportional composite sampling,
- Industrial storm/Balance tank,
- Domestic Storm/Balance tank,
- Associated site work and odour control facilities for inlet works/balance tanks.
- Cleaning of domestic aeration tanks.
- Electrical upgrade of PS14 and new pumps installed.
- 1.8km of new Rising Main was laid from PS14 (225mm diameter) to Industrial Rising Main (450mm diameter) at Illaunamanagh.

A Drainage Area Plan for Shannon started in 2015 and will take approximately 3 years to complete. The DAP will encompass both Storm Water Overflow and network assessments and will therefore provide a more accurate review of Storm Water Overflow and Sewer Integrity Assessments.

A Flow and load survey for Shannon Town Agglomeration was completed in September 2017 and will inform the ultimate upgrade requirements of the Tradaree WWT plant.

The need for measures to prevent environmental damage will be reviewed on an annual basis.

## Appendix 7.2 Ambient Monitoring Summary

Ambient monitoring data for Shannon WWTP (D0045-01) 2017 AER (Source: EPA – Coastal & Estuarine Monitoring 2007-2013)

Sample_ID	Station_No	Date_Surveyed	Time	Depth_Bed	Depth_Sample	Salinity	Temp	pH	Secchi	DO_saturation	DO_mgL	BOD	TON	NH3	PO4	chl_a	DIN	Season
116932	SN330	27/11/2013	11:42:00	8.1	0.0	9.68	8.04	8.1	0.8	97.0	10.8	0.5	0.51	0.06	30	1.0	0.57	Winter
116933	SN330	27/11/2013	11:42:00	8.1	8.0	17.18	8.67	8.0	0.8	95.1	9.9	0.5	0.38	0.06	30	1.0	0.44	Winter
117054	SN310	27/11/2013	11:59:00	6.5	0.0	3.28	7.89	8.2	0.8	96.9	11.3		0.60	0.06	30	1.0	0.66	Winter
117055	SN310	27/11/2013	11:59:00	6.5	6.4	9.84	8.08	8.1	0.8	94.6	10.5		0.50	0.08	30	1.0	0.58	Winter
117744	SN330	26/08/2013	13:55:00	6.3	0.0	20.04	17.68	7.9	0.5	84.9	7.2		0.57	0.08	50	4.0	0.65	Summer
117897	SN310	26/08/2013	14:21:00	5.1	4.8	15.39	17.62	8.0	0.3	81.8	7.1	0.5	0.82	0.10	70	4.0	0.92	Summer
117736	SN330	26/08/2013	13:53:00	6.3	6.1	24.32	17.51	7.9	0.5	86.9	7.2		0.52	0.07	40	5.0	0.59	Summer
117884	SN310	26/08/2013	14:19:00	5.1	0.0	11.05	17.78	8.0	0.3	81.9	7.3		0.86	0.09	50	6.0	0.95	Summer
118141	SN330	15/07/2013	15:05:00	6.0	5.8	23.92	20.79	8.0	0.9	96.1	7.5		0.27	0.01	40	6.0	0.28	Summer
118154	SN330	15/07/2013	15:07:00	6.0	0.3	21.74	21.29	8.0	0.9	96.8	7.6		0.28	0.01	40	6.0	0.285	Summer
118277	SN310	15/07/2013	15:35:00	4.8	2.3	13.75	22.26	8.0	0.5	94.3	7.6		0.47	0.01	50	6.0	0.475	Summer
118269	SN310	15/07/2013	15:33:00	4.8	4.6	16.72	21.97	8.0	0.5	91.7	7.3	0.8	0.40	0.01	40	7.0	0.405	Summer
118512	SN310	27/05/2013	18:17:00	6.5	0.3	10.38	13.68	8.1	0.3	96.3	9.4		0.65	0.08	90	2.0	0.73	Summer
118506	SN330	27/05/2013	17:52:00	8.5	8.0	18.77	12.95	8.0	0.3	99.4	9.3		0.47	0.05	80	3.0	0.52	Summer
118511	SN310	27/05/2013	18:15:00	6.5	6.0	11.79	13.56	8.0	0.3	95.6	9.2	0.8	0.62	0.06	50	4.0	0.68	Summer
118508	SN330	27/05/2013	17:54:00	8.5	0.3	18.42	13.00	8.0	0.3	98.4	9.2		0.49	0.05	70	8.0	0.54	Summer
109898	SN310	30/08/2012	14:08:00	4.1	0.0	0.35	16.79	8.5	0.1	92.7	9.0		1.32	0.06	50	4.0	1.38	Summer
109898	SN310	30/08/2012	14:08:00	4.1	3.9	0.35	16.76	8.5	0.1	92.3	8.9		1.32	0.06	50	4.0	1.38	Summer
109897	SN330	30/08/2012	13:56:00	6.6	0.0	5.80	16.35	8.2	0.1	93.9	8.9		1.07	0.06	60	6.0	1.13	Summer
109897	SN330	30/08/2012	13:56:00	6.6	6.5	5.65	16.35	8.2	0.1	93.6	8.9		1.07	0.06	60	6.0	1.13	Summer
109577	SN330	16/07/2012	13:20:00	5.5	0.0	4.96	16.27	8.1	0.3	95.7	9.1	0.7	0.65	0.07	40	3.0	0.72	Summer
109577	SN330	16/07/2012	13:20:00	5.5	5.3	12.12	15.94	8.1	1.3	92.1	8.4	0.7	0.65	0.07	40	3.0	0.72	Summer
109578	SN310	16/07/2012	13:52:00	5.8	0.0	0.91	16.52	8.4	0.3	94.9	9.2		0.81	0.04	30	3.0	0.85	Summer
109578	SN310	16/07/2012	13:52:00	5.8	3.5	1.41	16.44	8.4	0.3	94.7	9.2		0.81	0.04	30	3.0	0.85	Summer

Sample_ID	Station_No	Date_Surveyed	Time	Depth_Bed	Depth_Sample	Salinity	Temp	pH	Secchi	DO_saturation	DO_mgL	BOD	TON	NH3	PO4	chl_a	DIN	Season
109338	SN330	13/06/2012	13:31:00	10.1	0.0	8.34	15.63	8.1	0.5	94.1	8.9		0.59	0.08	30	1.0	0.67	Summer
109338	SN330	13/06/2012	13:31:00	10.1	10.0	19.07	14.81	8.1	0.5	88.8	8.0		0.59	0.08	30	1.0	0.67	Summer
109340	SN310	13/06/2012	13:52:00	6.4	6.3	10.64	14.97	8.1	0.6	88.0	8.3		0.68	0.11	50	8.0	0.79	Summer
109339	SN310	13/06/2012	13:52:00	6.4	0.0	1.35	16.54	8.5	0.6	97.4	9.4		0.87	0.06	30	9.0	0.93	Summer
108998	SN310	06/03/2012	14:27:00	6.1	0.0	3.77	8.27	8.2	0.3	99.9	11.5		0.94	0.05	80	2.0	0.99	Winter
108998	SN310	06/03/2012	14:27:00	6.1	6.0	6.06	8.35	8.2	0.3	98.9	11.2		0.94	0.05	80	2.0	0.99	Winter
108997	SN330	06/03/2012	14:11:00	8.2	0.0	12.02	8.51	8.1	0.3	99.4	10.7		0.74	0.04	90	4.0	0.78	Winter
108997	SN330	06/03/2012	14:11:00	8.2	8.1	13.63	8.57	8.1	0.3	98.3	10.5		0.74	0.04	90	4.0	0.78	Winter
108576	SN330	24/08/2011	13:19:00	8.0	0.0	19.92	16.65	8.1	1.2	105.8	9.1		0.23	0.02	12	1.8	0.245	Summer
108579	SN310	24/08/2011	13:36:00	8.0	7.0	21.83	16.68	8.0	0.5	90.9	7.7	1.0	0.27	0.04	19	4.1	0.311	Summer
108577	SN330	24/08/2011	13:19:00	8.0	7.0	24.94	16.58	8.0	1.2	94.5	7.9		0.22	0.02	17	4.8	0.244	Summer
108578	SN310	24/08/2011	13:36:00	8.0	0.0	11.42	16.58	8.1	0.5	100.4	9.1	2.0	0.48	0.06	16	5.8	0.535	Summer
108377	SN310	25/07/2011	14:07:00	11.5	11.0	19.28	16.53	8.1	0.6	91.6	7.9		0.33	0.04	23	5.4	0.368	Summer
108374	SN330	25/07/2011	13:49:00	8.5	0.0	19.14	17.02	8.1	0.7	100.8	8.7	1.0	0.31	0.01	20	8.6	0.324	Summer
108375	SN330	25/07/2011	13:49:00	8.5	8.0	24.15	16.29	8.1	0.7	95.2	8.1		0.21	0.02	18	9.1	0.23	Summer
108376	SN310	25/07/2011	14:07:00	11.5	0.0	14.78	17.11	8.1	0.6	99.2	8.7		0.44	0.03	23	10.1	0.469	Summer
107954	SN330	01/03/2011	13:45:00	5.0	0.0	5.63	7.95	8.1	0.5	96.6	11.0		1.10	0.06	21	1.9	1.156	Winter
107956	SN310	01/03/2011	14:20:00	6.8	0.0	0.70	7.23	8.2	0.5	96.0	11.5	1.0	1.25	0.04	17	2.1	1.289	Winter
107955	SN330	01/03/2011	13:45:00	5.0	4.0	11.91	7.70	8.0	0.5	94.7	10.4		0.90	0.05	26	2.8	0.948	Winter
107957	SN310	01/03/2011	14:20:00	6.8	6.0	1.16	7.19	8.1	0.5	95.6	11.5	1.0	1.21	0.04	19	4.4	1.254	Winter
92728	SN330	16/07/2009	10:44:00	5.2	0.0	12.80	17.62	8.1	0.6	95.9	8.5	1.0	0.40	0.04	33	8.0	0.44	Summer
92755	SN310	16/07/2009	10:23:00	6.5	0.0	7.90	17.67	8.1	0.6	91.7	8.3		0.50	0.05	29	9.4	0.55	Summer
92665	SN330	16/07/2009	10:44:00	5.2	5.2	20.50	17.58	8.1	0.6	94.4	8.0	1.0	0.20	0.04	33	9.5	0.24	Summer
92729	SN310	16/07/2009	10:23:00	6.5	6.2	13.42	17.77	8.1	0.6	90.3	7.9		0.40	0.06	38	11.6	0.46	Summer
92817	SN330	21/05/2009	14:11:00	8.0	0.0	7.79	13.38	8.2	0.2	98.9	9.8		0.80	0.05	26	4.7	0.85	Summer
92775	SN330	21/05/2009	14:11:00	8.0	7.8	14.34	12.62	8.1	0.2	96.5	9.4		0.60	0.04	32	5.3	0.64	Summer
92833	SN310	21/05/2009	14:44:00	12.0	0.0	2.48	13.13	8.2	0.2	96.9	10.0	1.0	0.90	0.06	31	12.2	0.96	Summer
92833	SN310	21/05/2009	14:44:00	12.0	10.9	4.08	12.78	8.2	0.2	95.3	9.8	1.0	0.90	0.06	31	12.2	0.96	Summer
92834	SN330	05/02/2009	12:20:00	8.0	0.0	10.85	4.70	8.0	0.8	98.6	11.8	1.0	0.90	0.04	26	0.8	0.94	Winter

Sample_ID	Station_No	Date_Surveyed	Time	Depth_Bed	Depth_Sample	Salinity	Temp	pH	Secchi	DO_saturation	DO_mgL	BOD	TON	NH3	PO4	chl_a	DIN	Season
92800	SN330	05/02/2009	12:20:00	8.0	7.5	15.10	5.40	8.0		98.2	11.2	1.0	0.70	0.03	26	1.0	0.73	Winter
92876	SN310	05/02/2009	11:44:00	7.0	6.5	6.50	4.53	8.1		98.5	12.2		1.10	0.05	24	1.5	1.15	Winter
92894	SN310	05/02/2009	11:44:00	7.0	0.0	0.54	3.83	8.2	1.1	97.7	12.8	1.0	1.20	0.05	16	2.7	1.25	Winter
94362	SN310	26/08/2008	12:10:00	6.5	5.5	0.88	16.24	8.4	0.6	95.5	9.3	1.0	0.80	0.02	14	2.9	0.82	Summer
94362	SN310	26/08/2008	12:10:00	6.5	0.0	0.44	16.27	8.4	0.6	94.4	9.2	1.0	0.80	0.02	14	2.9	0.82	Summer
94045	SN330	10/07/2008	13:11:00	8.6	0.0	13.77	16.00	8.0	0.5	95.6		1.0	0.30	0.03	22	0.2	0.33	Summer
94159	SN310	10/07/2008	13:48:00	7.0	6.0	14.30	16.12	8.1	0.3	92.5	8.3		0.40	0.04	12	0.2	0.44	Summer
94226	SN330	10/07/2008	13:11:00	8.6	8.0	13.77	16.18	8.0	0.5			1.0	0.20	0.03	11	0.2	0.23	Summer
94266	SN310	10/07/2008	13:48:00	7.0	0.0	9.53	16.34	8.1	0.3	94.8	8.8	1.0	0.50	0.04	17	0.6	0.54	Summer
94194	SN330	29/05/2008	12:39:00	5.7	0.0	24.29	14.43	8.1	0.5	98.5	8.7	1.0	0.30	0.03	19	0.2	0.33	Summer
94114	SN330	29/05/2008	13:29:00	5.7	4.0	25.88	13.97	8.1	0.5	97.3	8.5	1.0	0.40	0.04	17	0.5	0.44	Summer
94169	SN310	29/05/2008	13:15:00	6.7	6.0	21.41	14.37	8.1	0.5	98.6	8.8		0.50	0.03	22	0.5	0.53	Summer
94275	SN310	29/05/2008	13:15:00	6.7	0.0	19.88	14.66	8.1	0.5	99.7	9.0		0.60	0.02	16	1.1	0.62	Summer
94271	SN310	28/02/2008	12:18:00	7.0	0.0	0.43	7.09	8.2	0.3	86.9	10.5	1.0	1.55	0.03	7.9	0.2	1.58	Winter
94334	SN310	28/02/2008	12:18:00	7.0	6.5	10.16	7.44	8.1	0.3	91.7	10.3	1.0	1.31	0.04	25	0.2	1.35	Winter
93946	SN310	27/02/2008	13:17:00	5.8	4.9	3.02	7.06	8.2	0.1	91.7	10.9	1.0	1.18	0.03	26		1.21	Winter
93946	SN310	27/02/2008	13:17:00	5.8	0.0	0.79	7.23	8.2	0.1	87.3	10.5	1.0	1.18	0.03	26		1.21	Winter
94136	SN330	27/02/2008	12:55:00	12.0	9.2	13.77	7.57	8.1	0.1	89.7	9.8		0.97	0.03	16		1	Winter
94136	SN330	27/02/2008	12:55:00	12.0	0.0	4.30	7.46	8.1	0.1	87.2	10.2		0.97	0.03	16		1	Winter
91052	SN330	06/09/2007	12:29:00	8.0	0.0	12.08	17.50	8.1	0.4	88.2	7.8	1.0	0.15	0.01	63	2.3	0.16	Summer
91054	SN310	06/09/2007	13:07:00	6.5	0.0	10.14	17.58	8.2	0.3	87.2	7.8		0.18	0.01	90	4.7	0.19	Summer
91055	SN310	06/09/2007		6.5	6.0	18.31	17.10	8.0	0.3	90.3	7.8		0.45	0.01	100	5.6	0.46	Summer
91053	SN330	06/09/2007		8.0	7.5	22.85	16.80	8.0	0.4	91.5	7.7	1.0	0.17	0.01	48	6.9	0.18	Summer
90979	SN310	25/07/2007	12:11:00	6.0	0.0	5.77	17.60	8.2	0.9	94.7	8.7		0.85	0.05	40	0.4	0.9	Summer
90978	SN330	25/07/2007		9.0	8.0	21.49	16.03	8.1		95.7	8.3	1.0	0.44	0.07	42	1.3	0.51	Summer
90980	SN310	25/07/2007		6.0	5.5	14.54	17.27	8.1	0.9	89.2	7.8		0.56	0.08	36	1.4	0.64	Summer
90977	SN330	25/07/2007	11:36:00	9.0	0.0	8.49	17.14	8.2		96.7	8.8	1.0	0.23	0.04	25	2.3	0.27	Summer
90541	SN330	27/06/2007	10:35:00	0.8	0.0	8.50	14.66	8.2	0.3	82.9	8.0		3.79	0.03	110	1.2	3.82	Summer
90542	SN310	27/06/2007	11:06:00	3.5	0.0	2.17	15.66	8.2	0.3	88.5	8.7	1.0	4.44	0.02	49	3.6	4.46	Summer

Sample_ID	Station_No	Date_Surveyed	Time	Depth_Bed	Depth_Sample	Salinity	Temp	pH	Secchi	DO_saturation	DO_mgL	BOD	TON	NH3	PO4	chl_a	DIN	Season
90542	SN310	27/06/2007	11:06:00	3.5	3.3	4.35	15.68	8.2	0.3	87.2	8.4	1.0	4.44	0.02	49	3.6	4.46	Summer
90945	SN310	14/03/2007	13:58:00	7.5	0.0	0.59	8.15	8.0	1.3	80.9	9.5		2.36	0.01	35	0.2	2.37	Winter
90944	SN330	14/03/2007		8.2	8.0	14.92	8.03	8.3	0.8	81.7	8.8	1.0	0.45	0.02	36	0.8	0.47	Winter
90946	SN310	14/03/2007		7.5	7.0	10.45	7.87	8.3	1.3	79.6	8.8		1.56	0.02	45	0.8	1.58	Winter
90943	SN330	14/03/2007	13:25:00	8.2	0.0	1.71	8.38	7.9	0.8	84.5	9.8	1.0	1.24	0.01	24	1.6	1.25	Winter