West Offaly Power Generating Station
Continuous Monitoring
Summary Report – Period 43: June 2020

Document No.: QS-000152-01-R243-000

Date: September 2020

Engineering and Major Projects, One Dublin Airport Central, Dublin Airport, Cloghran, Co. Dublin, K67 XF72, Ireland.

Phone +353 (0)1 703 8000

www.esb.ie

File Reference:	QS-000152-01	
Client / Recipient:	ESB Generation and Wholesale Markets	
Project Title:	West Offaly Power Generating Station Continuous Monitoring	
Report Title:	Continuous Monitoring Summary Report - Period 43: June 2020	
Report No.:	QS-000152-01-R243-000	
Revision No.:	00	
Prepared by:	Tymora Freeman-Stannett	Date: 24/08/2020
Title:	Civil Engineer	
Verified by:	Dr Adrian Buckley	Date: 09/09/2020
Title:	Consultant Engineer	
Approved by:	Jim Fitzpatrick	Date: 15/09/2020
Title:	Senior Consultant	

Template Used: T-020-017-Engineering and Major Projects Report Template

Change History of Report

Date	New Revision	Author	Summary of Change

Executive Summary

In July 2016, a programme of continuous temperature monitoring commenced at a number of locations on the River Shannon in the vicinity of the cooling water discharge from the West Offaly Power Generating Station.

This report outlines the results of the forty-third period of continuous temperature monitoring from 1st June 2020 to 30th June 2020. The detailed results of this period of monitoring are contained in the Irish Hydrodata document in Appendix 1 of this report.

In all, there are seven fixed temperature monitoring points in the river, one upstream of the cooling water inlet as a baseline for the data (designated as S1) and six downstream of the cooling water discharge (designated as locations S2 to S7).

This report compares the temperature data from the downstream monitoring points with the upstream baseline monitoring point to assess the temperature differential and determine whether a thermal effect is observed at those locations. In addition, the assessment considers station load, meteorological conditions, flow conditions and water level in the River Shannon. This is to analyse whether these parameters have either a potential direct or indirect effect on the thermal plume at those locations.

The station was off-load during the forty-third monitoring period.

Conditions in the River Shannon were monitored using the data from the hydrometric gauge at Shannonbridge (Gauge No. 26028) and from Athlone Weir. The water level gauge reading at Shannonbridge was highest on the 1st June 2020 at 2.2 m and lowest on the 21st June 2020 at 1.95 m.

The estimated flow at Athlone during the period was between 7.61 m^3/s and 36.12 m^3/s. The average flow at Athlone for the period was 17.62 m^3/s and flows greater than this occur for 97 percent of the period of record for the gauge. The long-term average flow in the River Shannon at Athlone is approximately 93 m^3/s.

As the station was off-load for the entire period covered by this report, the temperature monitoring data results are not discussed with respect to IE Licence compliance.

From a review of the temperature data for Period 43, the following points of interest were noted:

- There was natural variation in water temperature in the River Shannon between the intake at S1 and each of the measuring points S2 to S7.
- Environmental conditions have a natural impact on the water temperature, causing temperature differences of over 1.5 °C in some instances.
    - At point S2, the maximum temperature increase with respect to point S1 was 2.28°C;
    - At point S3 the maximum increase with respect to point S1 was 1.83°C;
    - At point S4, the maximum increase with respect to point S1 was 2.81°C
    - At point S5, the maximum increase with respect to point S1 was 2.19°C;
    - At point S6, the maximum increase with respect to point S1 was 1.65°C

- At point S7 the max temperature increase with respect to point S1 was 1.36°C;

Contents

1 Introduction 6
2 Thermal Plumes 7
3 Continuous Monitoring 8
3.1 Monitoring Locations 8
3.2 Station Load 9
3.3 River Conditions 10
3.4 Meteorological Conditions 12
4 Conclusions 14

Appendix 1: Irish Hydrodata Ltd Report "West Offaly Power – Longterm Continuous Water Temperature Measurements – Monthly Report for June 2020"

1 Introduction

West Offaly Power Generating Station is located adjacent to the River Shannon at Shannonbridge, County Offaly. The station is a peat fired base load station i.e. continuous operation, subject to availability. The installed capacity is 150 MW and the station was commissioned in 2005. The milled peat-fired boiler generates steam which is used to drive turbines which produce electricity. The steam is then cooled to hot water and recirculated to the boiler. The steam is cooled by water abstracted from and returned to the River Shannon.

The aqueous principal discharge from the power station is cooling water discharge. The station discharges approximately 186 MWth to the River Shannon when on full load. This consists of a flow through the condenser of 5.5 m^3/s with a temperature rise of approximately 8.5°C. The flow through the condenser will vary slightly depending on the level of the River Shannon with a corresponding variation in the rise in temperature.

There has been continuous production of electricity on an adjacent site at Shannonbridge since 1965 when a 40 MW unit was commissioned. The station was extended in 1977 and again in 1982. The installed capacity in 1982 was 125 MW and this discharged a thermal load to the River Shannon of approximately 260 MWth. This consisted of a flow through the condenser of 7.7 m^3/s with an 8°C temperature rise and all units on full load. This station which was licenced by the EPA in May 2003 (P0626) was decommissioned in 2003 and the licence was surrendered in 2011.

In July 2016, a programme of continuous temperature monitoring commenced at a number of locations on the River Shannon in the vicinity of the cooling water discharge from the West Offaly Power Generating Station. The detailed results of the forty-third period of continuous monitoring from 1st June 2020 to 30th June 2020 are contained in the Irish Hydrodata (IHD) document in Appendix 1 of this report.

This report outlines the results of this forty-third period of continuous temperature monitoring. In addition, the assessment considers station load, flow conditions in the River Shannon and meteorological conditions.

2 Thermal Plumes

Thermal plumes have a complex physical structure. They are less dense than the receiving waters into which they flow because of their higher temperature. This causes the cooling water to flow over the surface of the ambient water and the increase in temperature to be confined to the surface. The depth of the thermal plume is not constant. The maximum depth of the thermal plume occurs at the discharge point and decreases with distance away from the discharge point. The gradient between the thermal plume and receiving waters is sharp in the vertical direction and sudden variations in temperature of 6°C can occur over a distance of 1-2 m below the surface. The gradients are considerably less in the horizontal direction.

The main factors which affect the thermal plume are:

- The quantity of heat discharged into the receiving waters. The maximum thermal load discharged occurs when the station is on full load.
- River conditions.
- Meteorological conditions.

It is noted for this assessment that temperature increases of less than 1.5°C are not considered part of the thermal plume.

3 Continuous Monitoring

3.1 Monitoring Locations

Continuous temperature monitoring is being undertaken at seven fixed locations in the River Shannon in the vicinity of West Offaly Power Generating Station at Shannonbridge. At each location, three temperature thermistors with loggers were deployed to measure and record temperatures at 0.3 m, 0.8 m and 1.5 m below the water surface. Figure 3-1 and Table 3-1 below show the locations of the continuous monitoring points, which are designated as points S1 to S7. See **Table 3-1** for the thermistor depths at each location.

Figure 3-1: Continuous Monitoring Points

ID	Cross-section String	Easting (m ITM)	Northing (m ITM)	Logger Depth T1 (m)	Logger Depth T2 (m)	Logger Depth T3 (m)
S1	U/s 1 (intake)	597273	724473	0.3	0.8	1.5
S2	D/s 1 West	597369	724068	0.3	0.8	1.5
S3	D/s 2 West	597467	723964	0.3	0.8	1.5
S4	D/s 2 East	597581	723903	0.3	0.8	1.5
S5	D/s 3 West	597660	723710	0.3	0.8	1.5
S6	D/s 3 East	597764	723726	0.3	0.8	1.5
S7	D/s 4 East	598123	723466	0.3	0.8	1.5

Table 3-1: Continuous Monitoring Points

One location is at the thermal cooling water intake, designated as S1, and the remaining six are downstream of the outfall, designated S2 to S7.

The instruments were installed on 8th July 2016. This report reviews the results of the monitoring for the forty-third data download, from 1st June 2020 to 30th June 2020 inclusive, designated as Period 43. As noted above, the detailed results for the forty-

third period of continuous monitoring are presented in the IHD document in Appendix 1 of this report.

3.2 Station Load

Continuous records of station load at West Offaly Power Generating Station in Megawatts (MW) for the period of monitoring were obtained from the station database, PI. The station was off load during the forty-third period of monitoring.

Figure 3-2 below shows the Station Load for West Offaly Power Generating Station and water level from the Office of Public Works (OPW) hydrometric gauge at Shannonbridge (Gauge No. 26028) for Period 43. Water levels at Shannonbridge are available from the OPW website www.waterlevel.ie. The notes and warnings concerning the source, reliability and use of the data available on this website as set out in http://waterlevel.ie/disclaimer/ are acknowledged.

Figure 3-2 below shows the Station Load for West Offaly Power Generating Station and water level at Shannonbridge gauge for Period 43.

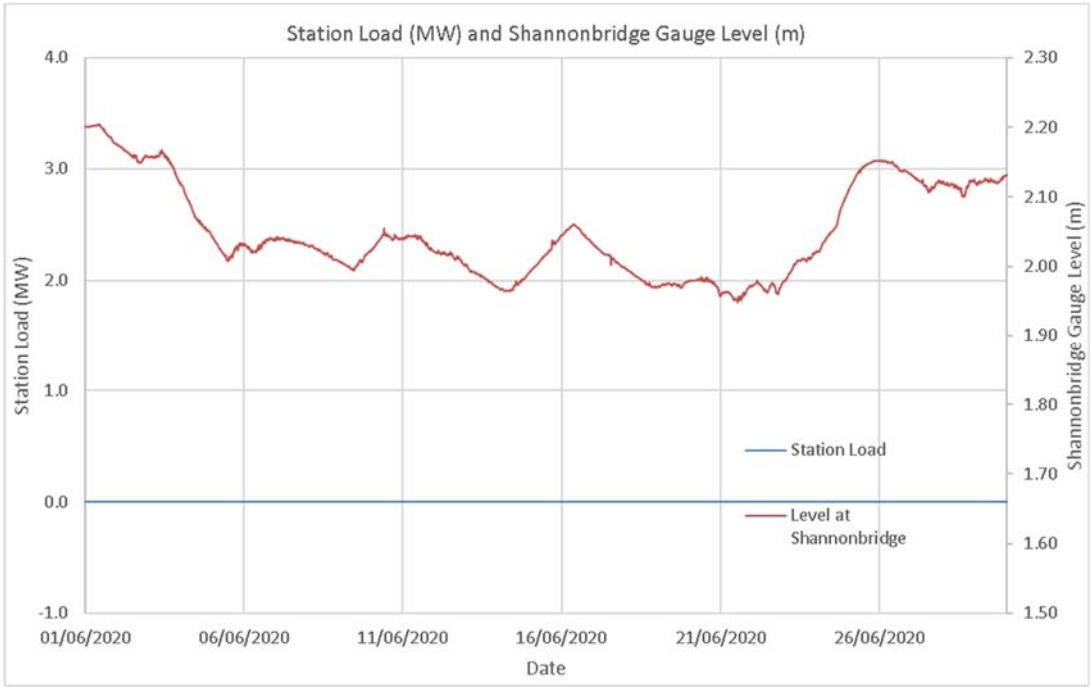


Figure 3-2: Station Load and Water Level at Shannonbridge for Period 43

3.3 River Conditions

The water level at Shannonbridge was highest on the 1st June 2020 at 2.2 m and lowest on the 21st June 2020 at 1.95 m. It is noted that the Shannon flows extend into the flood plain when the water level at the Shannonbridge gauge is above approximately 3 m. The level at Shannonbridge was not above 3 m during Period 43. The River Shannon flood plain is extensive around Shannonbridge and the currents change when the river overflows its banks.

It is not possible to determine the flow at this gauge as there is no rating curve associated with this site. The closest locations where flow in the River Shannon can be estimated are at Athlone Weir upstream of West Offaly Power Generating Station and downstream at Banagher. The estimated flow at Athlone during the period was between 7.61 m^3/s and 36.12 m^3/s. The average flow at Athlone for the period was 17.62 m^3/s and flows greater than this occur 97 percent of the period of record for the gauge. The long-term average flow in the River Shannon at Athlone is approximately 93 m^3/s.

The relative locations of West Offaly Power Generating Station, Shannonbridge gauge and Athlone Weir are shown in Figure 3-3.

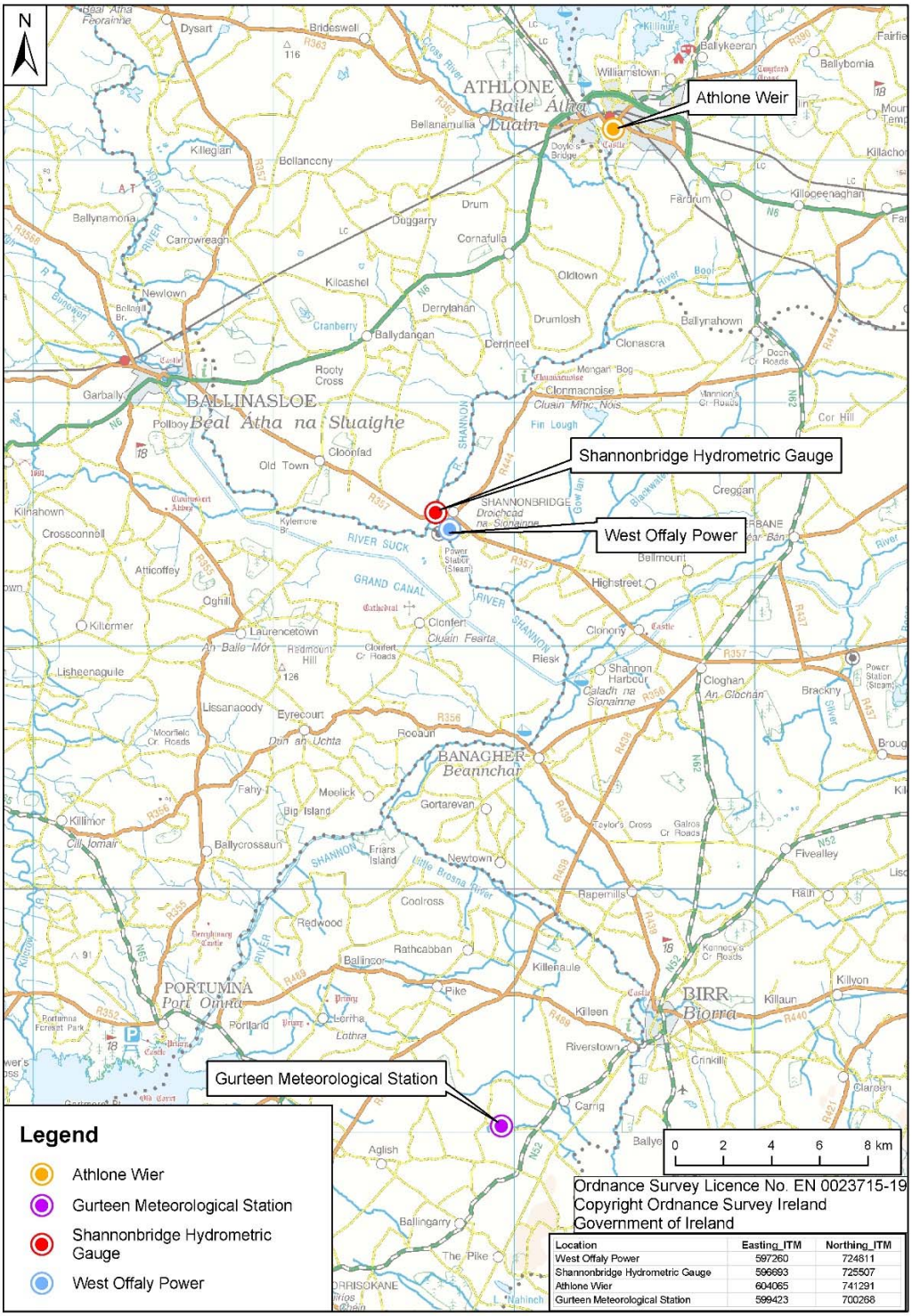


Figure 3-3: Locations of West Offaly Power, Shannonbridge Gauge and Athlone Weir

Figure 3-4 below shows the recorded levels at Shannonbridge and calculated discharge at Athlone for Period 43. The estimated discharges at Athlone were derived from the hydrometric records in the ESB hydrological database.

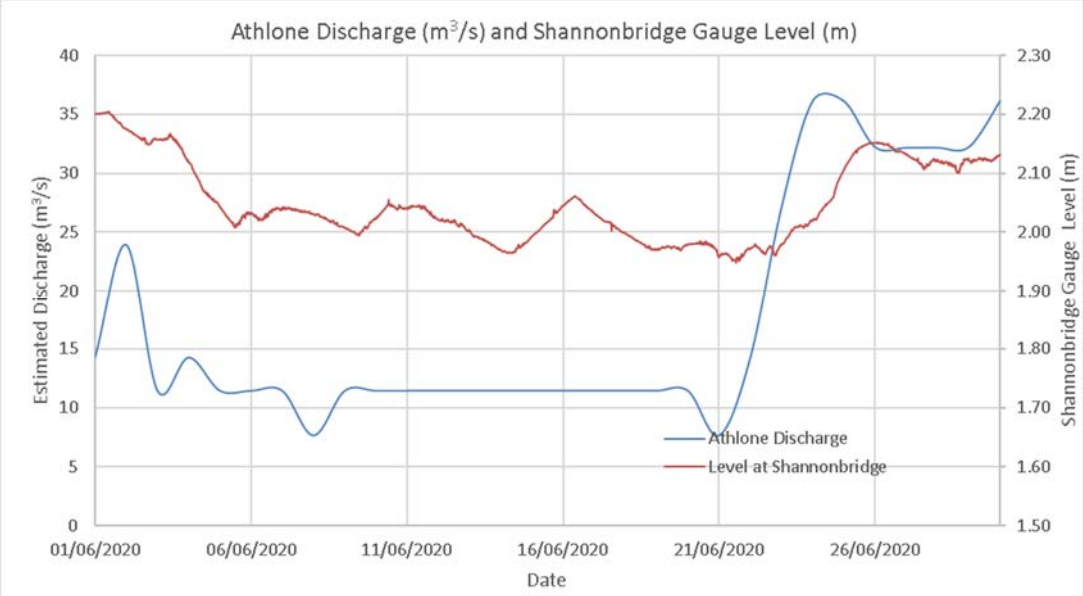


Figure 3-4: Shannonbridge Level and Calculated Discharge at Athlone for Period 43

It should be noted that the operation of the gates at Athlone Weir influences the flow and level regimes in the River Shannon during low flow conditions.

3.4 Meteorological Conditions

Meteorological conditions affect the thermal plume both directly and indirectly. Wind speed and direction can affect the size and shape of the plume by modifying the current profile in the receiving waters.

Records of wind direction and wind speed for the period of monitoring were obtained from the Met Éireann meteorological station at Gurteen, Co. Tipperary. The notes and warnings concerning the source, reliability and use of the data available on this website as set out in http://www.met.ie/copyright/default.asp are fully acknowledged.

During the period the wind was generally in a north-westerly and west-south-westerly direction shown in Figure 3-5. The wind speed ranged between 1.85 km/hr to 44.45 km/hr, shown in Figure 3-6.

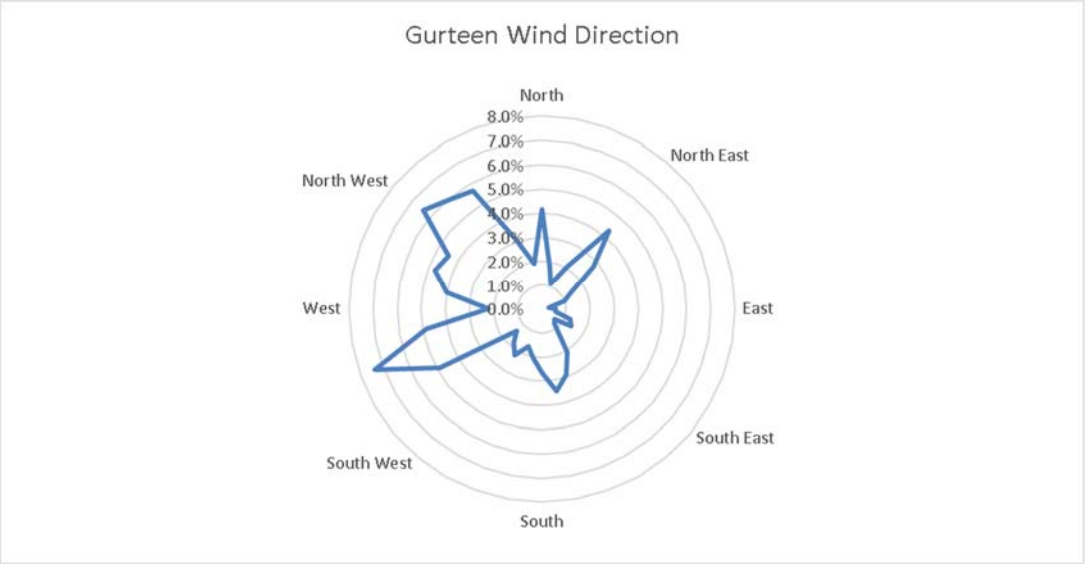


Figure 3-5: Wind Direction at Gurteen Meteorological Station for Period 43

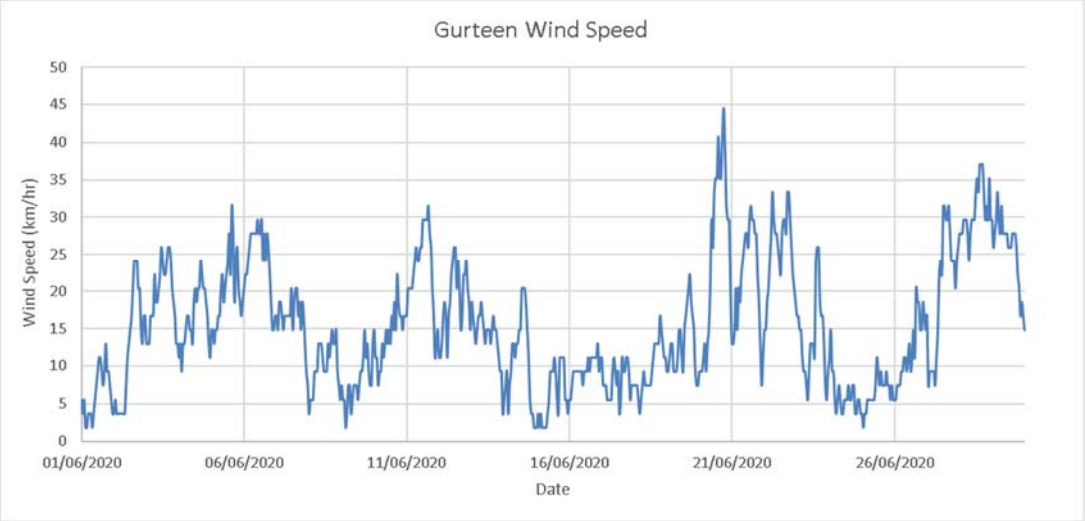


Figure 3-6: Wind Speed (km/hr) at Gurteen Meteorological Station for Period 43

4 Conclusions

From a review of the continuous temperature data and the hourly averaged data from locations S1 to S7 for Period 43 and in the light of station load, river flow and meteorological conditions, the following conclusions are drawn:

- Flows in the River Shannon were below average during the period. At Athlone the estimated minimum flow was 7.61 m^3/s, the maximum flow was 36.12 m^3/s and the average flow was 17.62 m^3/s. The long-term average flow in the River Shannon at Athlone is approximately 93 m^3/s. The corresponding gauge water levels at Shannonbridge over the period ranged between 1.95 m and 2.2 m with an average level of 2.05 m.
- The station was off load during Period 43.

The detailed results of the continuous monitoring are contained in Appendix 1. As the station was off-load for the entire period covered by this report, these results are not discussed with respect to IE Licence compliance.

From a review of the temperature data for Period 43, the following points of interest were noted:

- At times, there was natural variation in water temperature in the River Shannon between the intake at S1 and each of the measuring points S2 to S7.
- Environmental conditions have a natural impact on the water temperature, causing temperature differences of over 1.5 °C in some instances.
- With respect to the recorded values at each of the monitoring points during this period, the following was noted:
  - The temperature in the River Shannon at the cooling water intake is recorded at point S1. The recorded temperature at this point during the month varied from 14.85°C to 21.38°C with an average value of 16.98°C.
  - At point S2, which is directly adjacent to the cooling water outfall, west bank, downstream of the bridge:
    - the max temperature increase with respect to point S1 was 2.28°C;
    - the largest temperature decrease with respect to point S1 was -1.64°C and
    - the average temperature change was -0.02°C
    - See Figure 5.1 of the IHD report in Appendix 1.
  - At point S3, west bank:
    - the max temperature increase with respect to point S1 was 1.83°C;
    - the largest temperature decrease with respect to point S1 was -2.17°C and
    - the average temperature change was -0.03°C
    - See Figure 5.2 of the IHD report in Appendix 1
  - At point S4, east bank:
    - the max temperature increase with respect to point S1 was 2.81°C;
    - the largest temperature decrease with respect to point S1 was -2.28°C and
    - the average temperature change was -0.02°C

    - See Figure 5.3 of the IHD report in Appendix 1.
- At point S5, west bank:
    - the max temperature increase with respect to point S1 was 2.19°C;
    - the largest temperature decrease with respect to point S1 was -2.00°C and
    - the average temperature change was -0.02°C
    - See Figure 5.4 of the IHD report in Appendix 1
- At point S6, east bank:
    - the max temperature increase with respect to point S1 was 1.65°C;
    - the largest temperature decrease with respect to point S1 was -2.51°C and
    - the average temperature change was -0.04°C
    - See Figure 5.5 of the IHD report in Appendix 1
- At point S7, which is close to the east bank:
    - the max temperature increase with respect to point S1 was 1.36°C;
    - the largest temperature decrease with respect to point S1 was -2.09°C and
    - the average temperature change was -0.03°C
    - See Figure 5.6 of the IHD report in Appendix 1

Appendix 1

Irish Hydrodata Ltd Report

"West Offaly Power – Longterm Continuous Water Temperature Measurements

Monthly Report for June 2020"

WEST OFFALY POWER

LONGTERM CONTINUOUS WATER TEMPERATURE MEASUREMENTS

MONTHLY REPORT

FOR

JUNE 2020

Doc. Ref. 1245-16A-JUN

Prepared By:

IRISH HYDRODATA Ltd.

Oak House
Rathmacullig West
Ballygarvan
Co. Cork
T12 HD5Y

Ph. 021 4311255

admin@hydrodata.ie

www.hydrodata.ie

Prepared for:

ESB GENERATION & WHOLESALE MARKETS

Energy for generations

July 8th 2020

CONTENTS

1 Introduction ……1
2 Instrumentation ……1
3 Deployment Locations ……3
4 Data Downloads ……4
5 Data for June 2020 ……8
6 Water Levels ……15

1 Introduction

Irish Hydrodata Ltd (IHD) was contracted by ESB Generation & Wholesale Markets (ESBGWM) to deploy seven instrument strings containing a total of twenty-one temperature data loggers in the River Shannon in the vicinity of the cooling water discharge from the West Offaly Power (WOP) plant. The loggers were initially deployed on July 8th 2016 and are to remain in-situ for at least a 12-month period. Data is logged on-board the instruments and is to be downloaded on a regular basis (possibly monthly) during the course of the overall measurement period. .

The reader is referred to the following documents for further information:

"1245-16-1-MS_LRP and WOP Longterm Temperature Measurements - Method Statement - June 23rd 2016"

"1245-16A-1-DR_WOP Longterm Temperature Measurements - Deployment of July 8th 2016 – Report"

Reporting was initially done on a download-by-download basis, i.e. each report would contain the data from a single data download, irrespective of its duration. This was later modified to provide reports on a calendar monthly basis.

This report contains the data for the month of June 2020.

2 Instrumentation

For this project, Onset Hobo U22-001 Water Temp Pro V2 loggers units were chosen (Figure 2.1). These instruments are approximately 11.4cm in length and 3.0cm maximum diameter. They have off the shelf accuracies of +/-0.2°C and a resolution of 0.02°C. Instrument response time is 5 minutes. Memory capacity is 42,000 readings. There are up to 8 user-defined logging intervals and durations.

The instruments were set up to record at a 5 minute sampling interval. This is sufficient for approximately 145 days of logging before filling the available storage capacity. Battery life is of the order of 6 years, depending on operating conditions.

Figure 2.1 Hobo U22-001 Water Temp Pro V2 Logger

The instruments were calibrated by IHD prior to deployment according to the Method Statement document. Although the loggers have off the shelf accuracies of +/- 0.2°C and a resolution of 0.02°C, accuracies of about +/- 0.05°C were achieved during pre-deployment calibrations (Figure 2.2).

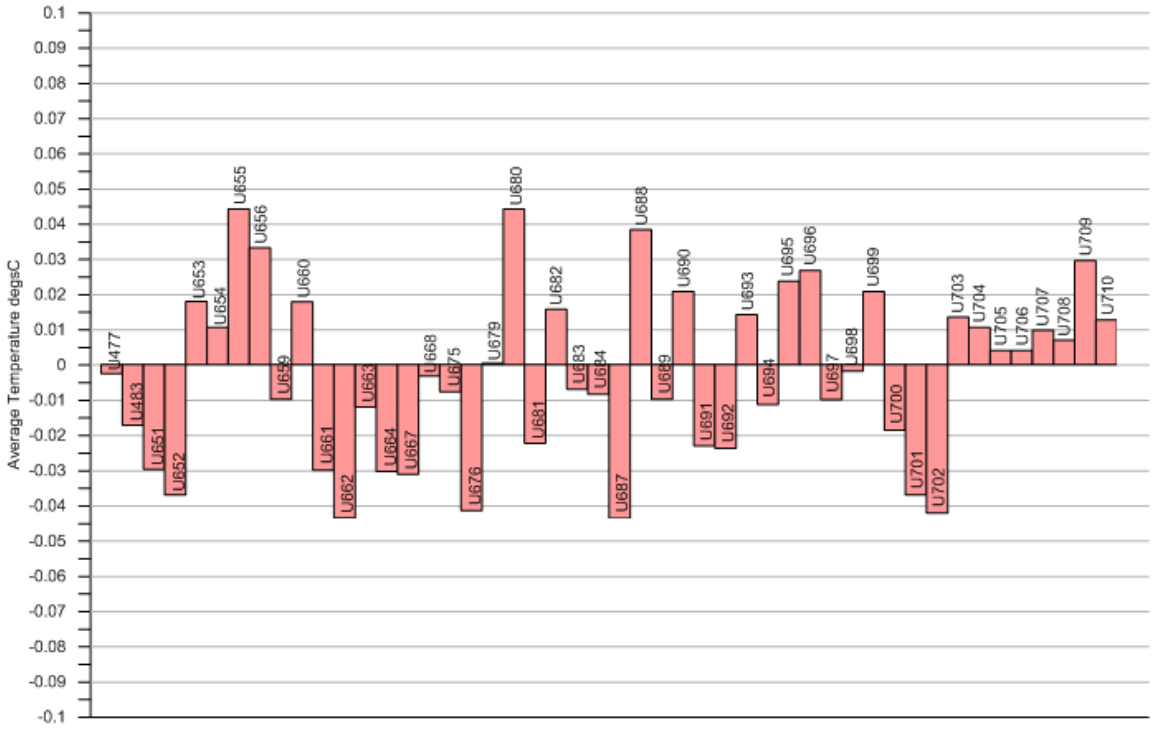


Figure 2.2 Instrument calibration

3 Deployment Locations

3.1 As-deployed locations

The as-deployed locations of the instrument strings are listed in Table 3.1 and shown in Figure 3.1. The table also shows the depth below water surface of each temperature data logger.

ID	Cross-section String	Easting (m ITM)	Northing (m ITM)	Logger Depth T1 (m)	Logger Depth T2 (m)	Logger Depth T3 (m)
S1	U/s 1 (intake)	597273	724473	0.3	0.8	1.5
S2	D/s 1 West	597369	724068	0.3	0.8	1.5
S3	D/s 2 West	597467	723964	0.3	0.8	1.5
S4	D/s 2 East	597581	723903	0.3	0.8	1.5
S5	D/s 3 West	597660	723710	0.3	0.8	1.5
S6	D/s 3 East	597764	723726	0.3	0.8	1.5
S7	D/s 4 East	598123	723466	0.3	0.8	1.5

Table 3.1 As-deployed instrument string locations

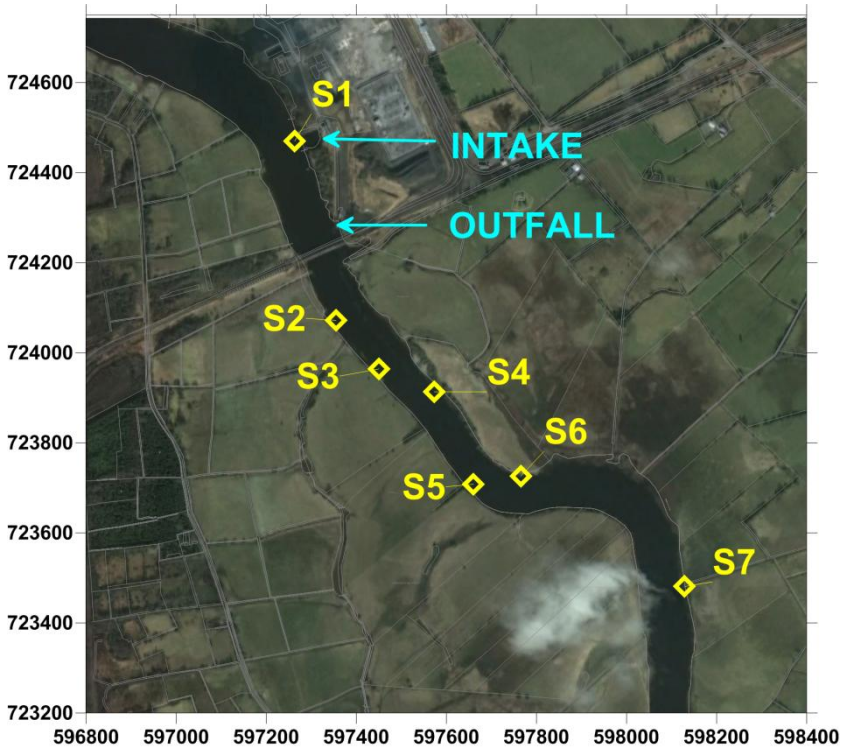


Figure 3.1 As-deployed instrument string locations

It should be noted that at low river water levels, the bottom logger and possibly the middle logger could lie on the river bed at some of the string locations.

4 Data Downloads

4.1 Previous Deployment Periods

The instruments were initially deployed on July 8th 2016. The subsequent data download and instrument redeployment information is summarised in Table 4.1 below.

Table 4.1 Deployment & Data Downloads

Deployment Number	Deployment	Data Download	Report
1	July 8th 2016	August 15th 2016	**1245-16A-DL1** Under separate cover
2	August 15th 2016	October 27th 2016	**1245-16A-DL2** Under separate cover
3	October 27th 2016	December 12th 2016	**1245-16A-DL3** Under separate cover
4	December 12th & 13th 2016	January 24th 2017	**1245-16A-DL4** Under separate cover
5	January 24th 2017	March 9th 2017	**1245-16A-DL5** Under separate cover
6	March 9th 2017	April 27th 2017	**1245-16A-DL6** Under separate cover
7	April 27th 2017	May 30th 2017	**1245-16A-DL7** Under separate cover
8	May 30th 2017	June 27th 2017	**1245-16A-DL8** Under separate cover
9	June 27th 2017	August 23rd 2017	**1245-16A-DL9** Under separate cover
10	August 23rd 2017	October 5th 2017	**1245-16A-DL10** Under separate cover. And forms part of Monthly report **1245-16A-OCT17**
11	October 6th 2017	January 12th 2018	forms part of Monthly report **1245-16A-OCT17** **1245-16A-NOV17** **1245-16A-DEC17** **1245-16A-JAN18**
12	January 12th 2018	February 9th 2018	forms part of Monthly report **1245-16A-JAN18** **1245-16A-FEB18**
13	February 9th 2018	April 5th 2018	forms part of Monthly report **1245-16A-FEB18** **1245-16A-MAR18** **1245-16A-APR18**
14	April 5th 2018	May 10th 2018	forms part of Monthly report **1245-16A-APR18** **1245-16A-MAY18**

Deployment Number	Deployment	Data Download	Report
15	May 10th 2018	June 12th 2018	forms part of Monthly report **1245-16A-MAY18** **1245-16A-JUN18**
16	June 12th 2018	July 5th 2018	forms part of Monthly report **1245-16A-JUN18** **1245-16A-JUL18**
17	July 5th 2018	August 17th 2018	forms part of Monthly report **1245-16A-JUL18** **1245-16A-AUG18**
18	August 17th 2018	September 13th 2018	forms part of Monthly report **1245-16A-AUG18** **1245-16A-SEP18**
19	September 13th 2018	October 19th 2018	forms part of Monthly report **1245-16A-SEP18** **1245-16A-OCT18**
20	October 19th 2018	November 16th 2018	forms part of Monthly report **1245-16A-OCT18** **1245-16A-NOV18**
21	November 16th 2018	December 21st 2018	forms part of Monthly report **1245-16A-NOV18** **1245-16A-DEC18**
22	December 21st 2018	February 15th 2019	forms part of Monthly report **1245-16A-DEC18** **1245-16A-JAN19** **1245-16A-FEB19**
23	February 15th 2019	March 28th 2019	forms part of Monthly report **1245-16A-FEB19** **1245-16A-MAR19**
24	March 28th 2019	April 23rd 2019	forms part of Monthly report **1245-16A-MAR19** **1245-16A-APR19**
25	April 23rd 2019	May 7th 2019	forms part of Monthly report **1245-16A-APR19** **1245-16A-MAY19**
26	May 7th 2019	June 21st 2019	forms part of Monthly report **1245-16A-MAY19** **1245-16A-JUN19**
27	June 21st 2019	July 4th 2019	forms part of Monthly report **1245-16A-JUN19** **1245-16A-JUL19**
28	July 4th 2019	July 12th 2019	forms part of Monthly report **1245-16A-JUL19**
29	July 12th 2019	July 18th 2019	forms part of Monthly report **1245-16A-JUL19**
30	July 18th 2019	July 25th 2019	forms part of Monthly report **1245-16A-JUL19**

Deployment Number	Deployment	Data Download	Report
31	July 25th 2019	August 2nd 2018	forms part of Monthly report **1245-16A-JUL19** **1245-16A-AUG19**
32	August 2nd 2018	August 8th 2018	forms part of Monthly report **1245-16A-AUG19**
33	August 8th 2018	August 15th 2018	forms part of Monthly report **1245-16A-AUG19**
34	August 15th 2018	August 29th 2018	forms part of Monthly report **1245-16A-AUG19**
35	August 29th 2018	September 5th 2019	forms part of Monthly report **1245-16A-AUG19** **1245-16A-SEP19**
36	September 5th 2019	September 12th 2019	forms part of Monthly report **1245-16A-SEP19**
37	September 12th 2019	October 7th 2019	forms part of Monthly report **1245-16A-SEP19** **1245-16A-OCT19**
38	October 7th 2019	October 15th 2019	forms part of Monthly report **1245-16A-OCT19**
39	October 15th 2019	October 31st 2019	forms part of Monthly report **1245-16A-OCT19**
40	October 31st 2019	November 15th 2019	forms part of Monthly report **1245-16A-OCT19** **1245-16A-NOV19**
41	November 15th 2019	December 13th 2019	forms part of Monthly report **1245-16A-NOV19** **1245-16A-DEC19**
42	December 13th 2019	January 31st 2020	forms part of Monthly report **1245-16A-DEC19** **1245-16A-JAN20**
43	January 31st 2020	March 5th 2020	forms part of Monthly report **1245-16A-JAN20** **1245-16A-FEB20** **1245-16A-MAR20**
44	March 5th 2020	April 23rd 2020	forms part of Monthly report **1245-16A-MAR20** **1245-16A-APR20**
45	April 23rd 2020	May 26th 2020	forms part of Monthly report **1245-16A-APR20** **1245-16A-MAY20**
46	May 26th 2020	June 9th 2020	forms part of Monthly report **1245-16A-MAY20** **1245-16A-JUN20**
47	June 9th 2020	July 1st 2020	forms part of Monthly report **1245-16A-JUN20** **1245-16A-JUL20**

Table 4.1 Deployment & Data Downloads

Note: Data downloads were rescheduled to occur on a more frequent basis starting on July 12th 2019. This coincided with the deployment of a pilot scheme of real-time telemetry systems. Data from the loggers was needed to verify the real-time system. Monthly downloads recommenced in November 2019.

4.2 Download & Redeployment Method

The instruments were recovered to the survey boat. They were cleaned and the data downloaded. All moorings were checked before the instruments were redeployed.

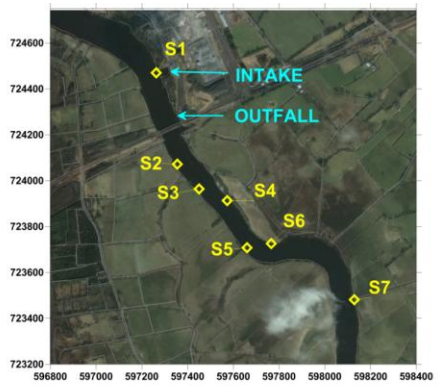
5 Data for June 2020

5.1 Data Timeseries

The calibration offsets are applied to the logged data during post-processing. The processed data is presented in the form of timeseries plots of absolute temperature. The data from S1 (close to the intake) is generally taken to be background or ambient temperature. The data from S1 is shown on all timeseries plots along with the data from each of the other six instrument strings in turn. This allows for an immediate visual comparison of the background temperature close to the intake with the temperature at the other locations. The effect of the thermal discharge, if any, can thus be clearly seen.

Figure 5.1 shows data from S1 and S2, Figure 5.2 shows data from S1 and S3.
Figure 5.3 shows data from S1 and S4, Figure 5.4 shows data from S1 and S5.
Figure 5.5 shows data from S1 and S6, Figure 5.6 shows data from S1 and S7.

Note: On occasion, the background temperatures along the western bank of the river at S2, S3 and S5 can be lower or sometimes slightly higher than those at the intake, S1. The confluence of the rivers Suck and Shannon is a short distance upstream from the cooling water discharge. The Suck joins from the west and its waters may not have completely mixed with those of the Shannon before arriving at the locations of the temperature loggers. This may explain the small difference in temperatures as outlined above.



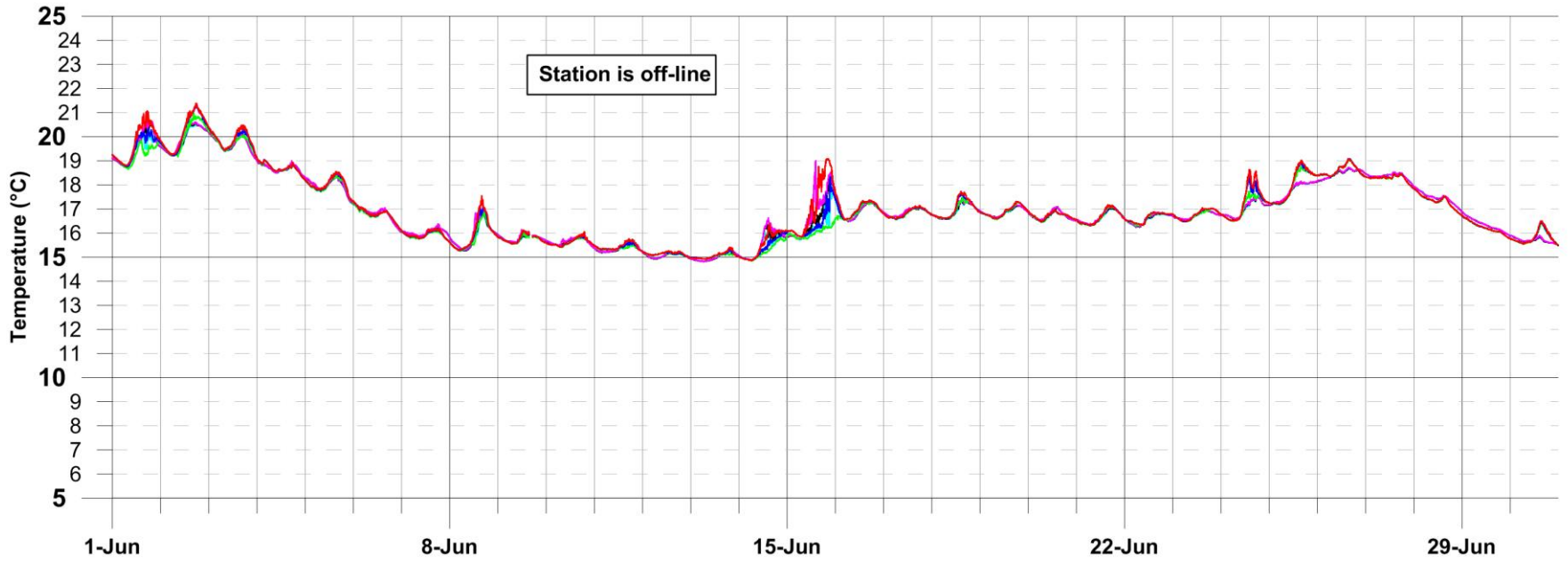
WEST OFFALY POWER
LONGTERM CONTINUOUS TEMPERATURE MEASUREMENTS

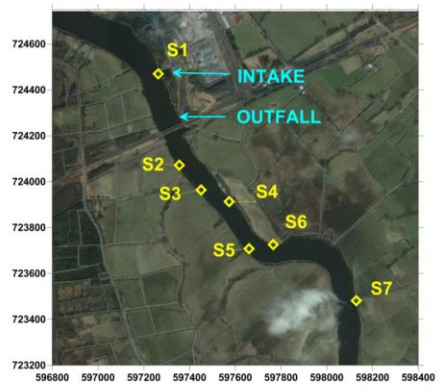
June 2020

Absolute temperatures (°C) at S1 (intake) and S2

S1-S S2-S
S1-M S2-M
S1-B S2-B

Figure 5.1





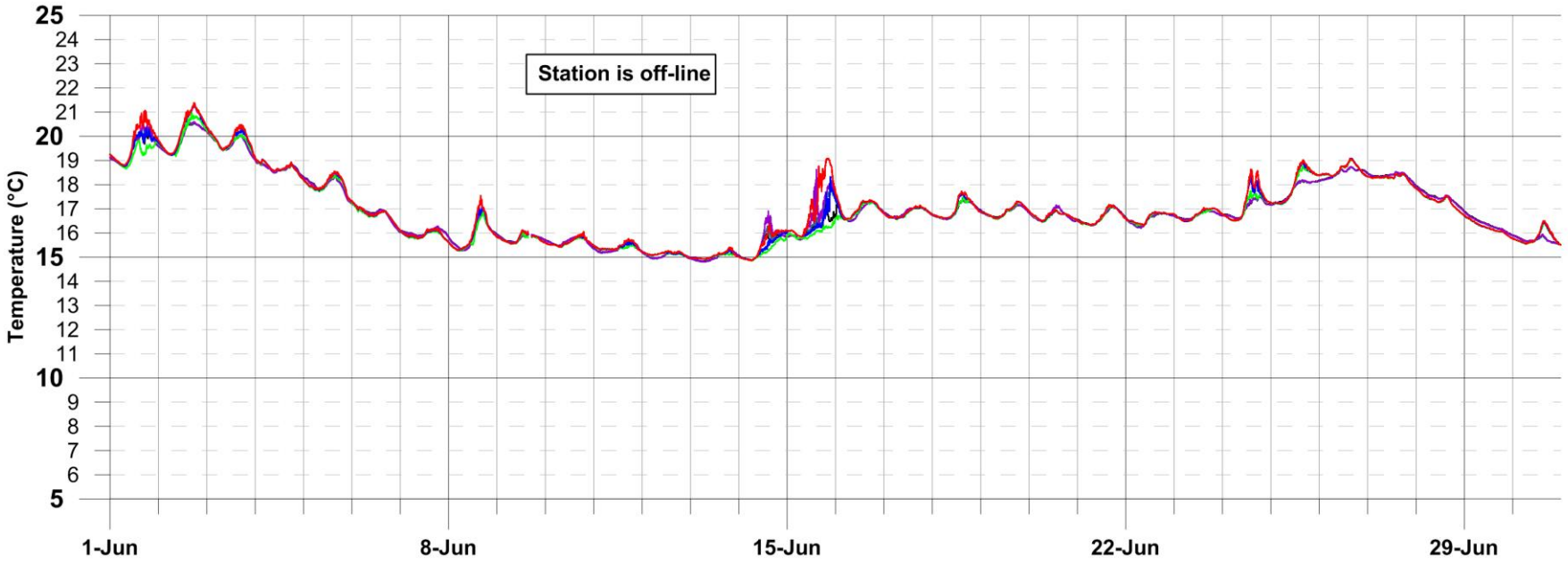
WEST OFFALY POWER
LONGTERM CONTINUOUS TEMPERATURE MEASUREMENTS

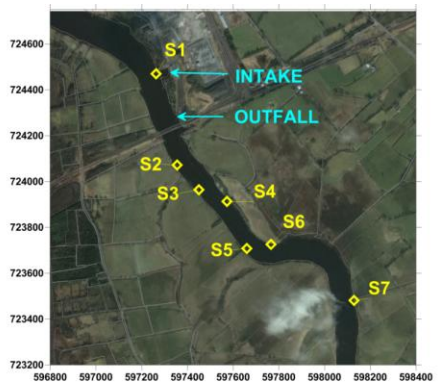
June 2020

Absolute temperatures (°C) at S1 (intake) and S3

S1-S S3-S
S1-M S3-M
S1-B S3-B

Figure 5.2





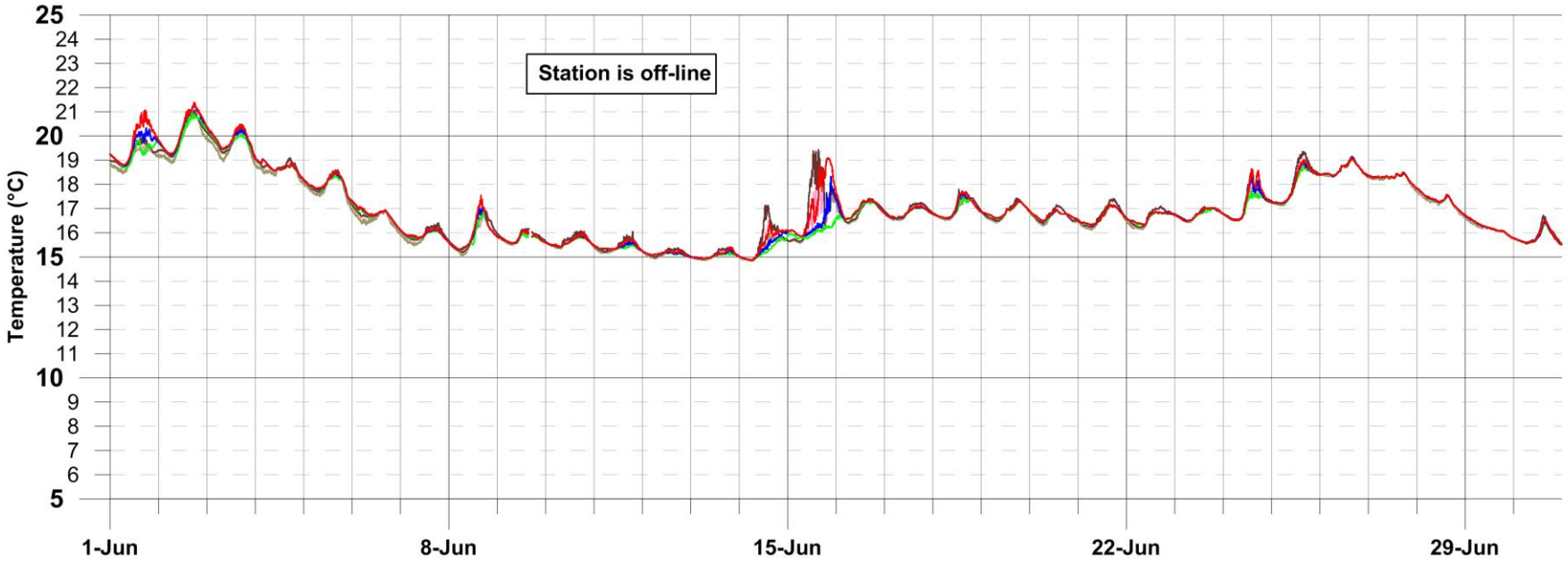
WEST OFFALY POWER
LONGTERM CONTINUOUS TEMPERATURE MEASUREMENTS

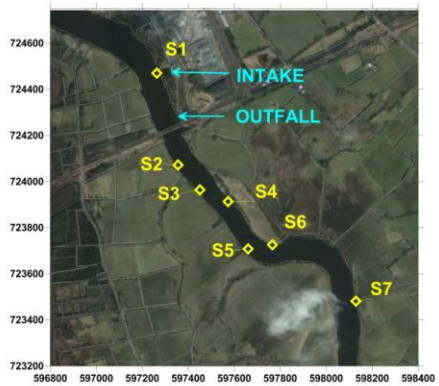
June 2020

Absolute temperatures (°C) at S1 (intake) and S4

S1-S S4-S
S1-M S4-M
S1-B S4-B

Figure 5.3





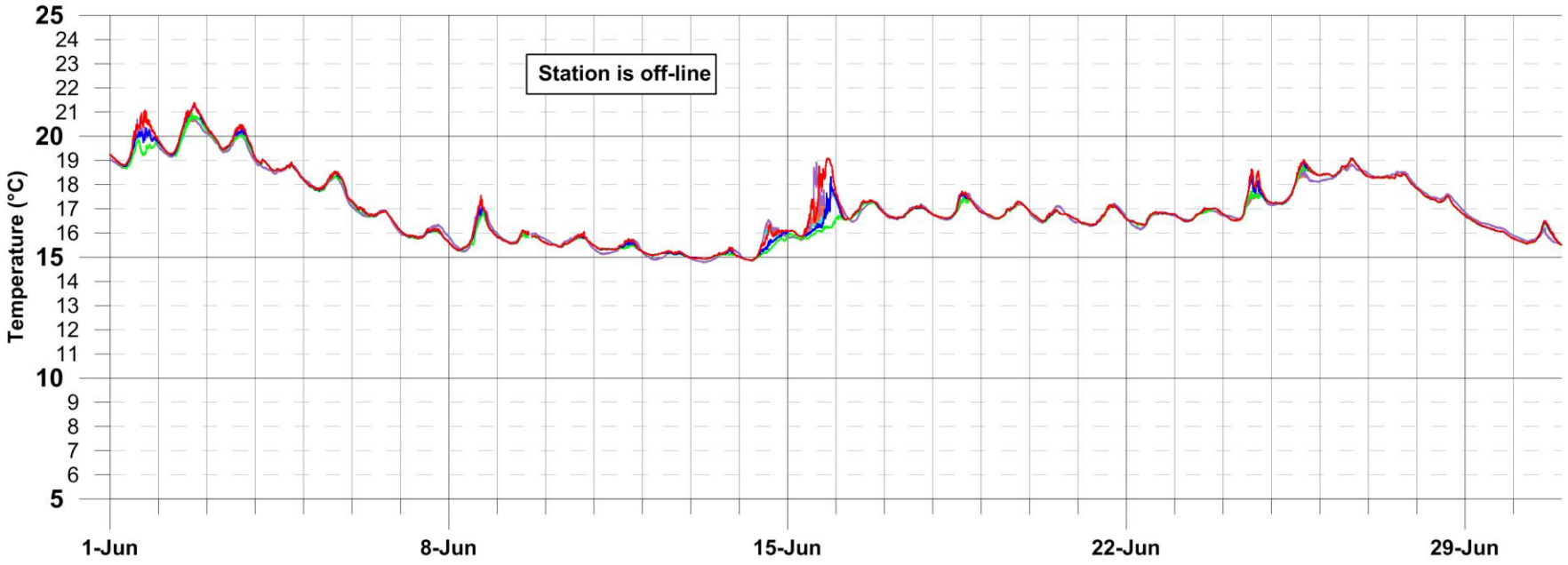
WEST OFFALY POWER
LONGTERM CONTINUOUS TEMPERATURE MEASUREMENTS

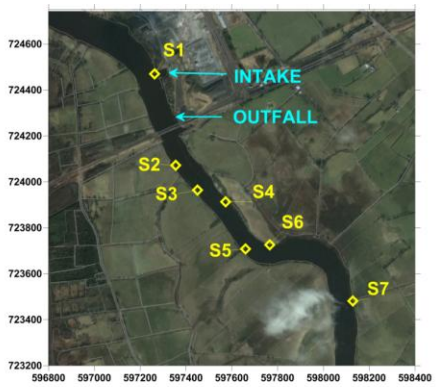
June 2020

Absolute temperatures (°C) at S1 (intake) and S5

S1-S S5-S
S1-M S5-M
S1-B S5-B

Figure 5.4





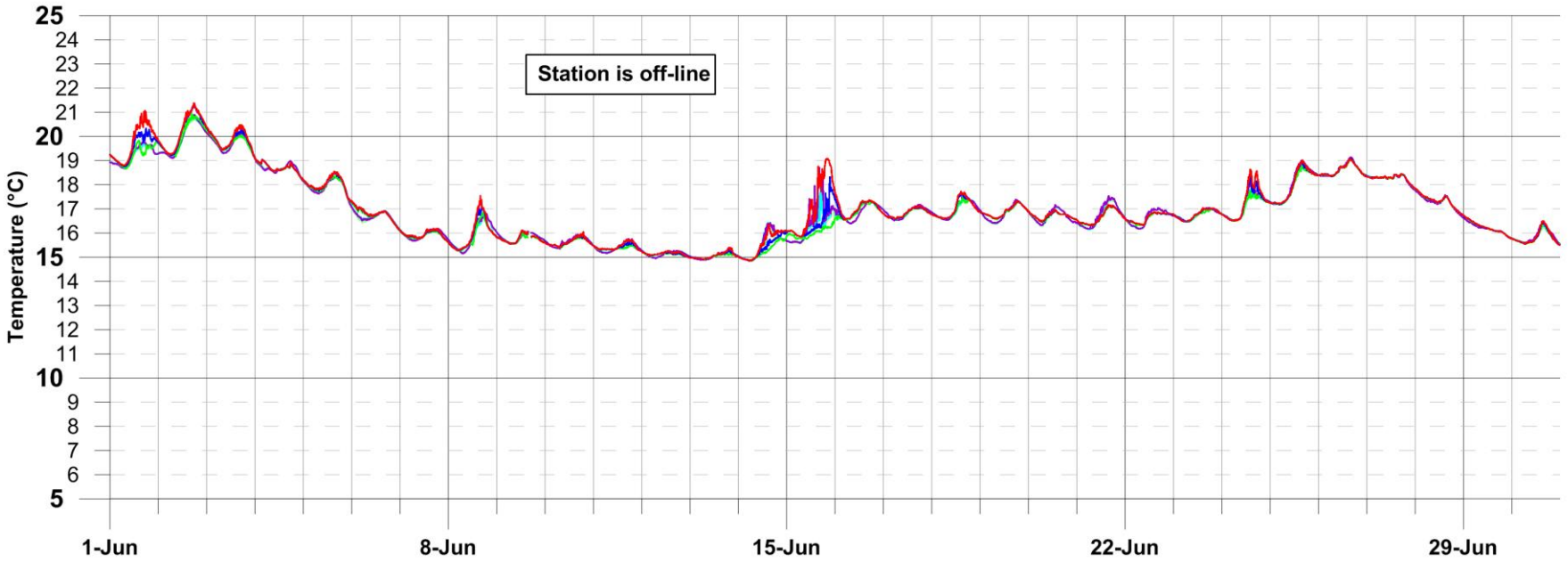
WEST OFFALY POWER
LONGTERM CONTINUOUS TEMPERATURE MEASUREMENTS

June 2020

Absolute temperatures (°C) at S1 (intake) and S6

S1-S S6-S
S1-M S6-M
S1-B S6-B

Figure 5.5



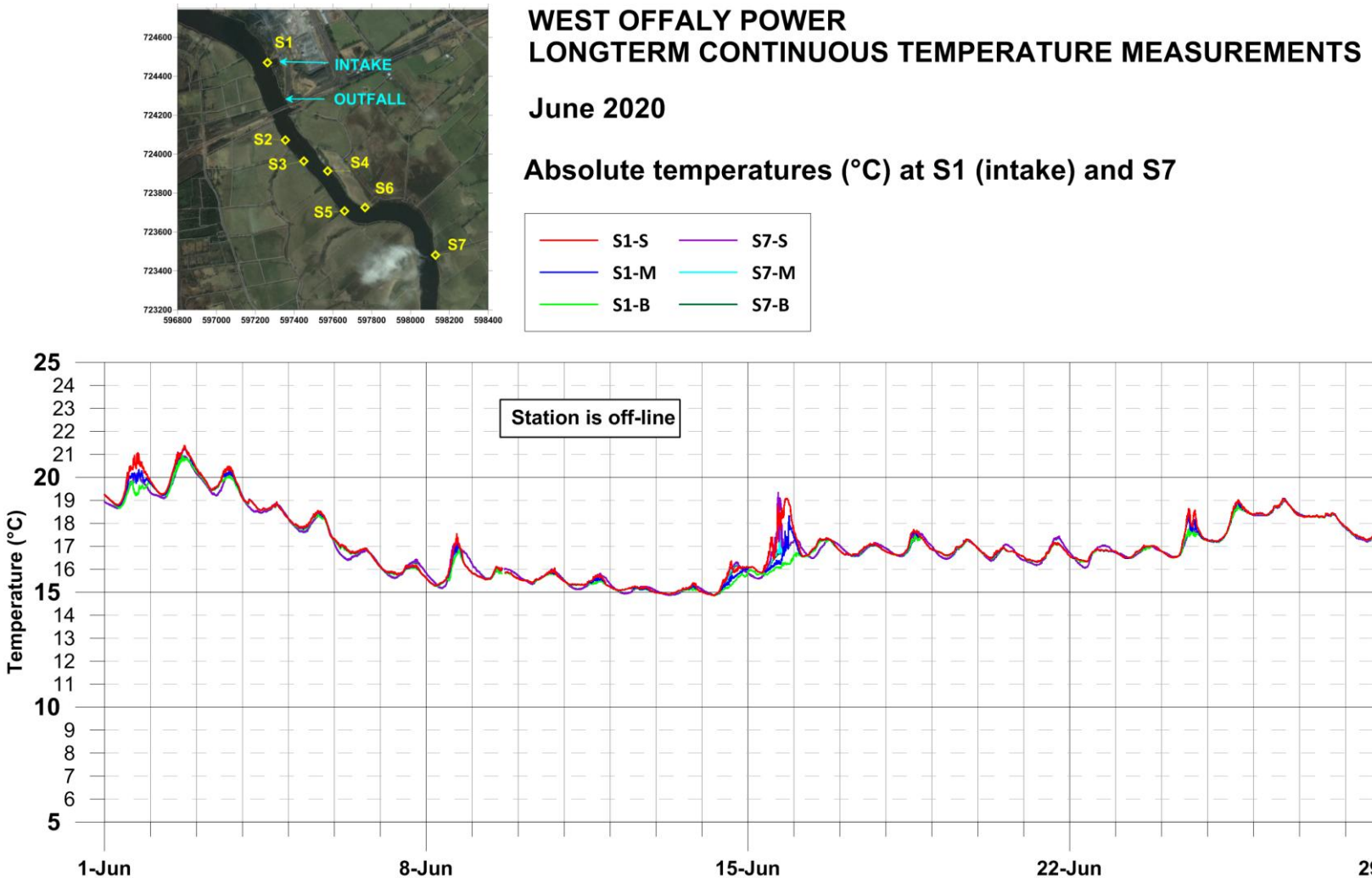

S1
INTAKE
OUTFALL
S2
S3
S4
S6
S5
S7
724600
724400
724200
724000
723800
723600
723400
723200
596800
597000
597200
597400
597600
597800
598000
598200
598400
WEST OFFALY POWER
LONGTERM CONTINUOUS TEMPERATURE MEASUREMENTS
June 2020
Absolute temperatures (°C) at S1 (intake) and S7
S1-S
S1-M
S1-B
S7-S
S7-M
S7-B
Station is off-line
Temperature (°C)
25
24
23
22
21
20
19
18
17
16
15
14
13
12
11
10
9
8
7
6
5
1-Jun
8-Jun
15-Jun
22-Jun
29-Jun

Figure 5.6

6 Water Levels

6.1 OPW water level data from nearby gauges

OPW has historically operated a water level gauge at Shannonbridge (Figure 6.1). A new gauge was installed by OPW at the railway bridge near the WOP outfall in December 2016. Data was acquired from *'waterlevel.ie'* for these gauges. Data for the month of June 2020 is plotted in Figure 6.2.

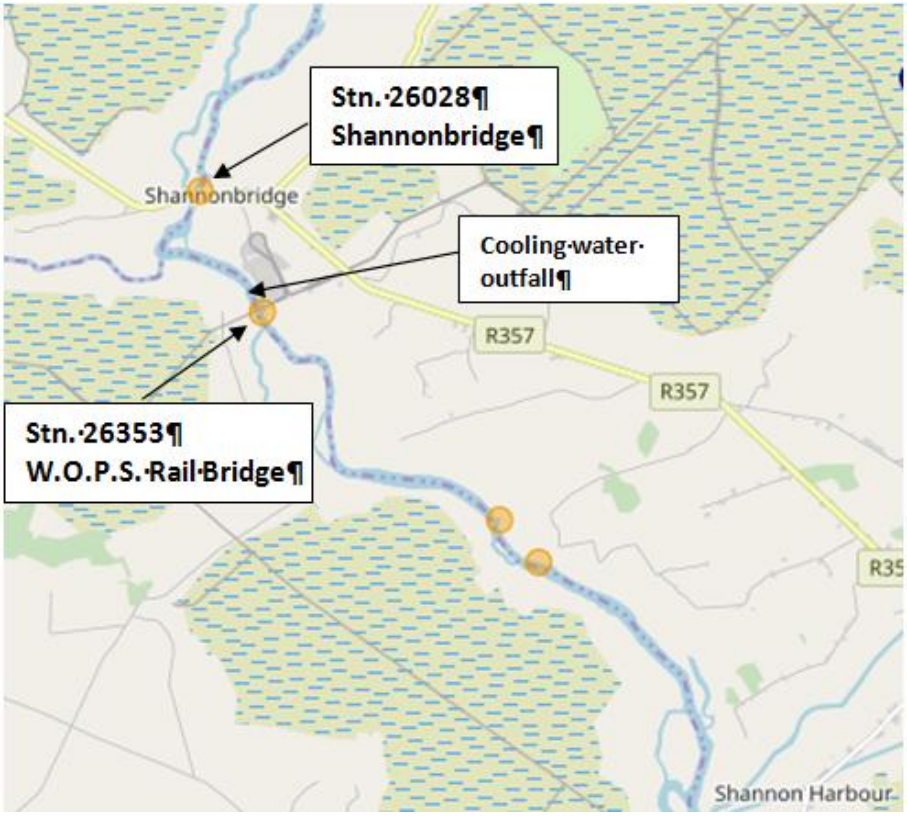


Figure 6.1 Location Map – OPW Water Level Stations 26028 and 26353

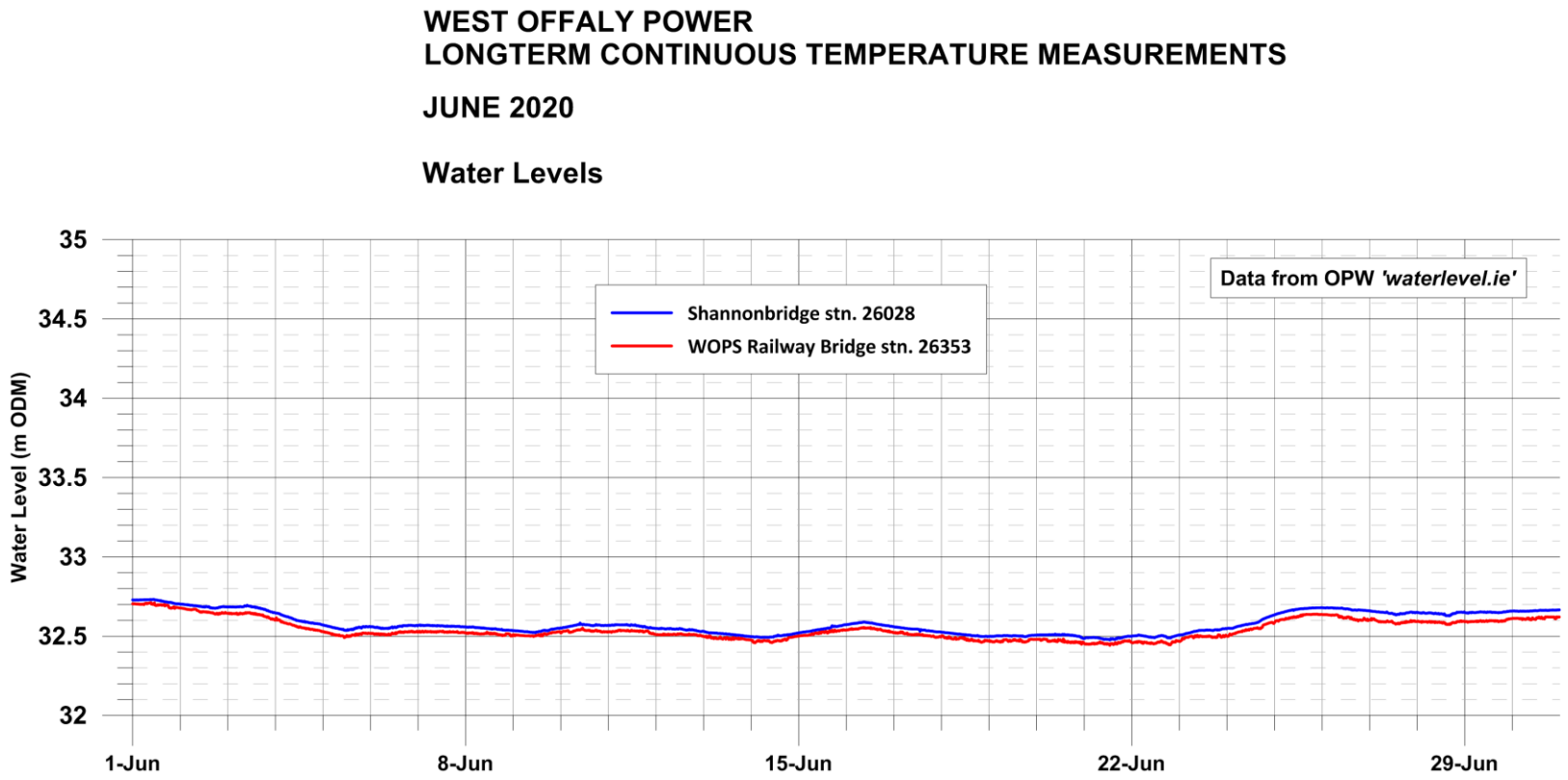


Figure 6.2 Water Level at OPW Stns. 26028 and 26353