Drinking Water Audit Report

County:	Roscommon	**Date of Audit:**	29th April 2015
Plant(s) visited:	Rockingham Drinking Water Treatment Plant (serving Boyle PWS, Boyle/Ardcarne PWS, Hughestown PWS in County Roscommon and Killaraght PWS in County Sligo).	**Date of issue of Audit Report:**	1st May 2015
		File Reference:	DW2009/370; DW2008/87; DW2012/174
		Auditors:	Ms Yvonne Doris (lead auditor) Mr Brendan Wall Mr Darragh Page
Audit Criteria:	• The *European Union (Drinking Water) Regulations 2014 (S.I. 122 of 2014)*. • *The EPA Handbook on the Implementation of the Regulations for Water Services Authorities for Public Water Supplies (ISBN: 978-1-84095-349-7)* • The recommendations specified in the EPA *Drinking Water Report*. • The recommendations in any previous audit reports.		

MAIN FINDINGS

i. **A new treatment plant comprising adsorption clarification, filtration and ultraviolet treatment has been constructed and has been operating since 2nd February 2015. This is an appropriate barrier to *Cryptosporidium* as required by the EPA's 2013 Direction to Roscommon County Council.**

ii. **As a result of the installation of an appropriate *Cryptosporidium* barrier, the Boyle PWS, Boyle/Ardcarne PWS and Killaraght PWS have been removed from the EPA's Remedial Action List.**

1. INTRODUCTION

Under the *European Union (Drinking Water) Regulations 2014* the Environmental Protection Agency is the supervisory authority in relation to Irish Water and its role in the provision of public water supplies. This audit was carried out to assess compliance with EPA direction issued to Roscommon County Council on 5th September 2013 to install a barrier to *Cryptosporidium* on the Boyle and Boyle/Ardcarne public supplies. The deadline in the direction was the 31st August 2014. Work was delayed but a new treatment plant is now in place to meet the needs of the supply zones.

The new Rockingham drinking water treatment plant has two sources comprising three boreholes at Rockingham and three boreholes at Hughestown. The treatment plant capacity is 250m^3/hr and operates for about 18 hours per day. Treatment consists of a multi-barrier approach comprising raw water blending, flocculation and coagulation in adsorption clarifiers, multimedia filtration, UV treatment, chlorination and fluoridation. There are two reservoirs in the network. It serves the Boyle PWS (4,300 people) and Boyle/Ardcarne PWS (1,700 people) which supply water to Boyle town and surrounding areas. It also serves the Killaraght public water supply in County Sligo. Since April 2015 it has been serving part of the Hughestown PWS (approximately 340 people) on the outskirts of Carrick-on-Shannon. The source boreholes are drilled in highly karstified limestone which is extremely vulnerable. Exceedances of coliforms and turbidity standards and detections of *Cryptosporidium* in these

supplies have been notified to the EPA in the past. The Boyle, Boyle/Ardcarne and Killaraght supplies have been on the EPA Remedial Action List for inadequate treatment for *Cryptosporidium* since July 2013. A boil water notice has been in place on all supplies; since March 2012 for Boyle, Boyle/Ardcarne and Killaraght supplies and since April 2015 for Hughestown. The source boreholes at Hughestown and the reservoirs at Carrickmore and Ardcarne were not inspected as part of this audit. They have been inspected at previous EPA audits.

Photographs taken by Yvonne Doris during the audit are attached to this report and are referred to in the text where relevant.

The opening meeting commenced at 11.00am at Rockingham treatment plant. The Site Manager provided a site induction prior to the commencement of the audit. The scope and purpose of the audit were outlined at the opening meeting.

The audit process consisted of interviews with staff, review of records and observations made during an inspection of the treatment plant. Prior to the audit, the EPA conducted an assessment of extensive plant operational and performance data supplied by Irish Water. The audits observations and recommendations are listed in Section 2 and 4 of this report. The following were in attendance during the audit.

Representing Irish Water:

Name – Job Title

Anne Bonner, Compliance Specialist, Irish Water.

Sean Higgins, DBO Engineer, Irish Water.

Victor van der Walt, Asset Strategy (and representing Major Programmes), Irish Water.

Vincent Walsh, Acting Senior Executive Engineer, Roscommon County Council.

Anne McHugh, Senior Resident Engineer, Roscommon County Council.

Neil Geraghty, Resident Engineer, Roscommon County Council.

Gerry Higgins, Networks Team, Roscommon County Council.

Owen McManus, Networks Team, Roscommon County Council.

Gerry Conlish, Networks Team, Roscommon County Council.

Andrew Young, Project Manager 4-Regional Schemes, Glan Agua.

John Fox, Operations Manager 4-Regional Schemes, Glan Agua.

Dessie Gardiner, Plant Operator, Glan Agua.

Representing the Health Service Executive:

Name – Job Title

Dr Melissa Canny, Public Health Specialist.

John Hanily, Principal Environmental Health Officer.

Joan Walsh, Environmental Health Officer.

Representing the Environmental Protection Agency:

Name – Job Title

Ms Yvonne Doris, Inspector (lead auditor).

Mr Brendan Wall, Senior Inspector

Mr Darragh Page, Inspector

2. Audit Observations

The audit process is a random sample on a particular day of a facility's operation. Where an observation or recommendation against a particular issue has not been reported, this should not be construed to mean that this issue is fully addressed.

1.	**Management and Control** a. According to Irish Water, commissioning and process-proving is completed for the Rockingham plant. It is in the operational phase of the Design-Build-Operate contract. Irish Water informed the auditors that there are no outstanding snags to be rectified at the plant. The plant is managed by Glan Agua. The operator attends 7 days per week for 35 hours. There are two stand-in caretakers. Responsibilities and attendance is managed by the Plant Manager. b. The plant has good process controls in place: continuous raw water monitoring; pH monitoring of raw and post-dosing; turbidity monitoring of raw, individual filters and treated water; UVT monitoring of raw, pre-UV and treated water. Duty-standby is in place on all key process equipment and there is storage capacity to allow for UV and other plant maintenance and repairs. All monitors are linked to SCADA and monitoring information is easily available to the plant operator to facilitate management and operation of the plant. All monitors are calibrated monthly. The plant alarms if raw water turbidity >6 NTU. The plant shuts down if final water turbidity is >0.3 NTU. c. An automatic generator is on site in the event of loss of power. It is checked monthly. All signals are fused to protect from electrical surges. Loss of power or phase loss results in an alarm to the plant operator. d. All plant operators have completed the FETAC Certified Water Training Course run by the Water Services Training Group. Two Glan Agua staff have completed informal UV training with Wedeco and will complete a 3-day certified UV training course in Germany with the UV supplier Xylem/Wedeco in June or July 2015. Two UV technicians are available to carry out UV maintenance. e. The Hughestown source was commissioned on 27th April 2015 and is being treated at the Rockingham treatment plant. If the Hughestown boreholes are not used for a week the boreholes are flushed out. f. The Liaison Monitoring Committee comprised Irish Water, Roscommon County Council and Glan Agua representatives meet monthly to discuss and resolve any issues at the treatment plant.
2.	**Source Protection** a. A Groundwater Protection Scheme for County Roscommon has been prepared. Source Protection Reports have been prepared. b. According to Roscommon County Council (RCC) all 85 farms in the zone of contribution (ZOC) to the source have been inspected by RCC, under the Good Agricultural Practice Regulations. 7 farms have been re-inspected and 2 farms have been cross-reported to the Department of Agriculture. RCC is considering legal proceedings relating to one farm. c. All farmers in the ZOC to the source were written to in the past by RCC making them aware of the presence of the drinking water abstraction and highlighting farmers' responsibilities under the Good Agricultural Practice Regulations. Letters were resent in March 2015 advising farmers of the construction of the new treatment plant and reminding them of their responsibilities under the Good Agricultural Practice Regulations. d. Septic tanks inspections have been undertaken by RCC within the ZOC as part of the National Inspection Plan. e. The three boreholes at Rockingham were inspected during the audit and all were located in a secure building at the treatment plant. The boreholes are 30m deep. The pumps are at 15 m and the boreholes are lined to 15m. Borehole 1 is the duty borehole. Borehole 1 has an abstraction rate of 250m^3/hr and it alone can supply the treatment plant. Borehole 2 and 3

	are standby boreholes and each borehole is capable of abstracting 125m^3/hr. Abstraction continues for about 20 hours per day. Water levels and flow rates are recorded and linked to SCADA. Individual boreholes do not have turbidity monitors. f. The source water from either the Hughestown boreholes or the Rockingham boreholes is pumped to a raw water blending tank which allows mixing of raw water depending on quality. There is continuous monitoring of raw water pH, turbidity, colour and UVT at the tank. g. A single raw water TOC sample and treated water TOC sample was taken by Irish Water in April 2015. TOC removal through the plant is 15.27% based on these two samples.
3.	**Coagulation, Flocculation and Clarification** a. The coagulation and filtration process is carried out in a purpose built Corex plant that consists of two adsorption clarifiers and four multimedia filters. b. Chemical dosing of coagulants necessary for treatment is continuous at the plant and is based on jar test results and continuously monitored raw water UVT. If raw water UVT drops to 70%, this triggers an alarm to the plant operator who manually adjusts the dosing rates. Jar tests are carried out if raw water conditions change and this information informs the dosing chart. An automated chemical dosing can be operated at the plant. c. Water from the raw water balancing tank is continuously dosed with coagulant and polymer. At the time of the audit Polyaluminium chloride (PAC) coagulant was being dosed at 38mg/l (100% product) and polymer at 0.1mg/l (0.2% product) into a flash mix chamber. The flow is then split between two adsorption clarifiers. The floc is generated in a void space underneath the adsorption bed (composed of 1,050mm of sand, effective size: 2-2.7mm). Water flows upwards through the adsorption bed where floc is filtered out and the clarifier is capable of removing 70% of the turbidity, colour and UVT from the raw water. d. The adsorption beds in the clarifiers are backwashed every 2-3 hours. The backwash sequence is an air scour at 70m^3/hr for 100 seconds followed by a water rinse (using raw water) to waste at 125m^3/hr for 360 seconds. Backwashing of adsorption clarifier 2 was observed during the audit. e. The clarifiers are designed to cope with raw water turbidity of up to 40 NTU and colour of up to 100 Hazen. To date the plant has successfully treated raw water turbidity of up to 20 NTU and colour of up to 60 Hazen and achieved final water turbidity leaving the plant to below 1 NTU.
4.	**Filtration** a. From the clarifier, water flows to the top of the filter section and is filtered through four rapid gravity multimedia filters comprising a base layer of 550mm depth of quartz sand (effective size 0.54-0.71mm) and a top layer of 450mm anthracite (effective size: 0.9-1.05mm). b. Backwashing of the rapid gravity filters is based on time (20 hours), turbidity (0.25 NTU) or headloss (5 kPa) and can also be initiated manually. A backwash of filter 1a was observed during the audit. A shallow trench was observed in filter 1b but the sand level returned to normal following a backwash. The filter backwash sequence is an air scour at 140m^3/hr for 190 seconds, a low rate water and air scour at 170m^3/hr for 180 seconds, a high rate water only rinse at 210m^3/hr for 230 seconds and a water rinse at 62.5m^3/hr for 500 seconds. The run to waste is controlled by time (100 seconds) and turbidity (<0.3 NTU) prior to bringing the filter back into service. There is a turbidity monitor on the outlet from each filter. c. Filters are cored and tested monthly to check for wear to the media and for mudballing.
5.	**Chlorination and Disinfection** **UV disinfection** a. A single Xylem/Wedeco Spectrum 900e UV reactor (photograph 1) validated to UVDGM

(USEPA) standard is in place to provide a barrier to *Cryptosporidium*. UV disinfection denatures the DNA of *Cryptosporidium* oocysts and prevents its replication[1].

b. The UV reactor is validated to achieve 3-log reduction of *Cryptosporidium*, if operated at an incoming UVT of >69% based on the validation certificate document provided by the manufacturer and documentation stating same provided by Irish Water. Below 69% UVT the reactor shuts down and no undisinfected water can enter supply. An alarm is sent to the plant operator who attends the site on a 24 hour/7 day basis. The auditors discussed the importance of operating the UV treatment system in accordance with its validated range of controls at all times.

c. Incoming UVT, UVI in the reactor, flow rate through the reactor and reactor temperature is recorded continuously. The UVT monitor is checked weekly using a portable UVT monitor and is calibrated monthly. Flow and temperature monitors are calibrated monthly.

d. Target UV dose is 14.4mJ/cm^2 in order to ensure the minimum required UV dose of 12 mJ/cm^2 is achieved. An alarm set-point at 13.2mJ/cm^2 alerts the plant operator to a reducing UV dose.

e. Flow rate through the reactor is typically around 250m^3/hr. The UV reactor is capable of treating multiples of this flow rate based on the calculated dose algorithm of the reactor.

f. The UV reactor houses 12 UV lamps. The lamp life is 12,000 hours (about one year). At the time of the audit lamp hours were 1,932. Lamps reach operating temperature after 300 seconds. No water flows through the UV reactor until the lamps reach operating temperature. All lamps will be replaced at the same time. 12 spare lamps are stored on site with a total of 40 available to Glan Agua personnel locally. Replacing a lamp takes 10 minutes and is done when the UV reactor is not operating. Lamp coffins are stored on site in the event that a lamp breaks during replacement. The evacuation procedure if a lamp breaks and mercury is released is unclear and it was not clear to the auditors how long the UV reactor would be out of operation if this was to occur. A mechanical cleaning system cleans the reactor sleeve once a day. No chemicals are used in the cleaning process.

g. The UV reactor has 2 UVI sensors (photograph 2) which are calibrated annually against a spare sensor. UVDGM (USEPA guidance manual on UV disinfection) recommends monthly calibration of UVI sensors. Spare sensors are stored on site.

h. No water can flow through the reactor when it is not operating.

i. The UV reactor is not operating (as the plant is not running) for about four hours each day. This time is available for maintenance and repairs if needed. There is also 24 hours storage in the network reservoirs should repairs require additional time. Spare ballast cards (for the UV control system) and O-rings (for the mechanical sleeve cleaning system) are stored on site.

Chlorine disinfection

j. To provide further and residual disinfection, chlorination using neat 14% sodium hypochlorite is in place. A day tank with 3-4 days storage is replenished every two days. Chlorine is dosed at two points into the lines supplying the reservoirs. Dosing levels are 2.1-2.2mg/l into the line serving the Carrickmore reservoir and 1.7-1.8mg/l to the line serving the Ardcarne reservoir. Dosing is flow proportional and linked to chlorine residual. Duty and standby chlorine dosing pumps with automatic switchover are in place in the event of the duty pump failing. A chlorine monitor is in place and alarms to the plant operator. Alarm response procedures are in place and alarms are responded to on a 24/7 basis. Sufficient effective chlorine contact time is achieved in the reservoirs (24 hours storage).

k. Residual chlorine levels leaving the Carrickmore reservoir are typically 0.6-0.8mg/l and at Ardcarne are typically 1.3-1.4mg/l. At the time of the audit residual chlorine leaving the Carrickmore reservoir was 0.51mg/l and leaving Ardcarne reservoir was 0.62mg/l. Residual chlorine levels in the network are monitored daily at 6 or 7 points by Roscommon County Council and range from 0.2 to 1.3mg/l.

l. Three additional chlorine monitors have been installed in the network and are connected to the SCADA.

[1] Further information on UV disinfection is available the EPA disinfection manual that all water suppliers should be familiar with. http://www.epa.ie/pubs/advice/drinkingwater/watertreatmentmanualdisinfection.html

6.	**Fluoridation** a. Duty and standby hydrofluorosilicic acid dosing pumps with automatic switchover are in place in the event of the duty pump failing. b. A fluoride monitor is in place and alarms to the plant operator. Alarm response procedures are in place and alarms are responded to on a 24/7 basis.
7.	**Treated Water Storage and Distribution Network** a. Flushing and scouring is ongoing in the network. Each section of the distribution network is flushed and scoured every three weeks. It is intended to carry out a programme of uni-directional flushing and scouring of the distribution network in June 2015. b. The Carrickmore and Ardcarne reservoirs were cleaned in December 2014. c. No customers are served between the Hughestown source and the treatment plant or between the treatment plant and the two network reservoirs.
8.	**Exceedances of the Parametric Values** a. *Cryptosporidium* was detected in the Hughestown PWS on 26/11/14 (0.005 per 10 litres), prior to the connection of the Hughestown source to the new treatment plant and *Cryptosporidium* barrier. This detection was not notified to the EPA.
9.	**Chemical storage and bunds** a. Chemicals are delivered directly into the bulk tanks and are supervised by the plant operator. No delivery can be made without access being provided by the plant operator. b. All chemicals (PAC, poly, chlorine, fluoride) in bulk tanks are in double linked bulk tanks and day tanks are bunded. All chemical tanks are fitted with level sensors to indicate when tanks are almost full. Spill kits are carried in the plant operator's vehicle. c. The fillpoints are not contained in a bunded area (photograph 3). Spill trays are on site for use during deliveries. It was unclear if spill trays could contain the contents of bulk tank delivery pipes. Diesel for the onsite generator is stored in a double lined container. d. All chemical storage tanks are appropriately labelled and fitted with appropriate health and safety signage.
10.	**Hygiene and Housekeeping** a. Colour-coded and labelled water lines (green: raw water, yellow: backwash in; black: backwash out; blue: treated water) were observed as a useful indicator by the audit team. b. Tanks, equipment and treatment buildings were well labelled and appropriately signed. c. Preventative vermin bait boxes were observed throughout the treatment plant.
11.	**Monitoring and Sampling Programmes for Treated Water** a. Roscommon County Council staff test chlorine residual readings daily in the network and communicate the results of their testing to the Glan Agua staff operating the treatment plant.
12.	**Sludge Management** a. Backwash water is sent to a sludge holding tank. A mobile dewatering unit dewaters sludge fortnightly. Sludge cake is sent for reuse in brick manufacture. b. Decanted water is discharged to a nearby stream. The discharge water is monitored for turbidity, pH, aluminium and suspended solids.

3. AUDITORS COMMENTS

The Rockingham treatment plant is well designed with duty-standby on all key process equipment and there is storage capacity to allow for UV and other plant maintenance and repairs. The design and operation of the UV reactor provides a barrier to *Cryptosporidium* for the supplies served by Rockingham treatment plant. Documented process controls and continuous monitoring alerts the plant operator to changes in raw water conditions and treated water quality in sufficient time to make relevant adjustments to the treatment process. The plant operators were very familiar with the operation of the plant under the various conditions that may arise. Treated water leaving the plant currently meets the standards required in the Drinking Water Regulations 2014.

4. RECOMMENDATIONS

Source Protection

1. Irish Water should install a continuous automatic turbidity monitor on each of the borehole sources to alert plant operators of any changes in raw water quality. This monitor would also be of assistance in blending raw water sources.

Coagulation, Flocculation and Clarification

2. Irish Water should continue to develop and refine chemical dosing rates appropriate to the nature of supply and changing conditions. Results should be recorded at the treatment works and used for control of the treatment plant.

Disinfection

3. Irish Water should review the frequency of calibration of the UVI sensors to ensure that the UV disinfection system operates within its validated range at all times.

4. Irish Water should put in place a procedure in the event of the breakage of a UV lamp and the release of mercury.

Chemical Storage and Bunds

5. Irish Water should review chemical storage arrangements at the treatment plant. Fill points for storage tanks should be within a bunded area. Refer to EPA guidance document –"*IPC Guidance Note on Storage and Transfer of Materials for Scheduled Activities*".

6. Irish Water should ensure that the spill trays used during the delivery of chemicals into bulk tanks have sufficient capacity to contain the contents of the delivery pipe.

Hygiene and Housekeeping

7. Irish Water should remove vermin bait boxes from the treatment plant and use alternative methods for vermin control as set out in *EPA Advice Note 13: Pesticides in Drinking Water*.

Management and Control

8. Irish Water should ensure that remaining UV training is completed for relevant plant operators and maintenance personnel.

9. Irish Water should carry out further TOC sampling of raw and treated water and calculate the rate of TOC removal achieved by the plant on a regular basis.

10. Irish Water should ensure that the discharge of settled backwash decanted water is not having an impact on the receiving water. Trigger levels should be set for the monitored parameters.

FOLLOW-UP ACTIONS REQUIRED BY IRISH WATER

During the audit Irish Water representatives were advised of the audit findings and recommendations. This report has been reviewed and approved by Mr David Flynn, Programme Manager, OEE.

Irish Water should now put measures in place to implement the recommendations listed in this report. The actions by Irish Water to address the recommendations taken will be verified by the Agency during any future audits.

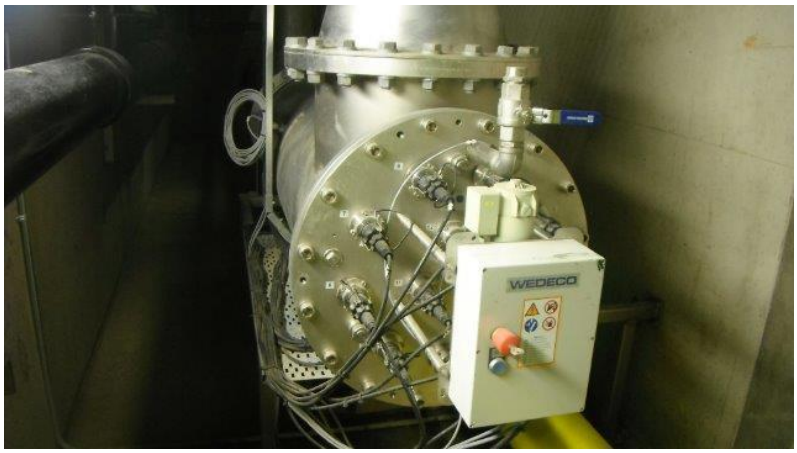
The EPA also advises that the findings and recommendations from this audit report should, where relevant, be addressed at all other treatment plants operated and managed by Irish Water.

Please quote the File Reference Number in any future correspondence in relation to this Report.

Report prepared by: Yvonne Doris **Date:** 1st May 2015

Yvonne Doris

Inspector/ Lead Auditor



Photograph 1: Xylem/Wedeco Spectrum 900e UV reactor.

Photograph 2: UVI sensor on UV reactor.

Photograph 3: Example of delivery pipe to bulk storage tank not within bunded area.