Drinking Water Audit Report

County:	Roscommon	**Date of Audit:**	23rd June 2015
Plant(s) visited:	Lisbrock Drinking Water Treatment Plant (serving Lisbrock PWS).	**Date of issue of Audit Report:**	26th May 2015
		File Reference:	DW2013/12
		Auditors:	Ms Yvonne Doris (lead auditor) Ms Michelle Roche Ms Aoife Loughnane.
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 flocculation, filtration and ultraviolet treatment has been constructed and has been operating since 13th March 2015. This is an appropriate barrier to *Cryptosporidium*.**

ii. **As a result of the installation of an appropriate *Cryptosporidium* barrier, the Lisbrock PWS has 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 the performance of the new treatment barrier to *Cryptosporidium* on the Lisbrock public supply.

The new Lisbrock drinking water treatment plant has seven boreholes at or close to the plant. The plant capacity is 200m^3/hr and operates for about 20 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 is one reservoir in the network serving customers in the Lisbrock supply zone (1,000 people). The source boreholes are in highly karstified limestone which is extremely vulnerable. Exceedances of turbidity standards and detections of *Cryptosporidium* in these supplies have been notified to the EPA in the past. The Lisbrock supply has been on the EPA Remedial Action List for inadequate treatment for *Cryptosporidium* since July 2013.

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

The opening meeting commenced at 15.00am at Lisbrock 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.

Justin Doran, DBO Engineer, Irish Water.

Kieran Madden, Senior Engineer, Roscommon County Council.

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

Anne McHugh, Senior Resident Engineer, Roscommon County Council.

John Gately, caretaker, Roscommon County Council.

Joe Healy, Jennings O'Donovan, Consultant for RCC/IW.

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

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

Tomas Grasza, plant caretaker, Glan Agua.

Representing the Environmental Protection Agency:

Name – Job Title

Ms Yvonne Doris, Inspector (lead auditor).

Ms Michelle Roche, Inspector.

Ms Aoife Loughnane, Inspector.

Mr Darragh O'Connor, work placement.

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 Lisbrock plant. The takeover certificate was received on 22nd April 2015. 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 about 4 hours. Response to alarms is on a 24/7 basis. There is a tiered alarm response system in place. 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 of raw water pH, turbidity, colour and UVT; post-dosing pH; individual filter turbidity; pre-UV UVT; treated water turbidity, UVT, colour, chlorine and fluoride. 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. SCADA readings are checked at Glan Agua head office every morning. All monitors are calibrated monthly. The

	plant alarms if raw water turbidity >1.5 NTU or colour is >20 Hazen or UVT<80%. The plant shuts down if final water turbidity is >1 NTU, <75.3% UVT or if residual aluminium is >0.2mg/l. At the time of the audit raw water turbidity was 0.396 NTU, colour was 1.2 Hazen and UVT was 94.2%. 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. The duty plant operator has completed the FETAC Certified Water Training Course run by the Water Services Training Group. The stand-in caretaker is due to complete this course in October 2015. Two Glan Agua staff have completed informal UV training with Wedeco and will complete a 4-day certified UV training course in Germany with the UV supplier Xylem/Wedeco in August 2015. Two UV technicians are available to carry out UV maintenance. e. 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 not been prepared for Lisbrock. The zone of contribution (ZOC) has not been delineated for the amount of water currently abstracted from the source. A catchment has been delineated based upon a supply from the source of 10,000m^3/day. b. According to Roscommon County Council (RCC) the number of farms within the ZOC has not been determined as the current ZOC has not been delineated. 47 farms were inspected in 2002 (based on the delineated catchment supplying 10,000m^3/day). Farmers in this area were written to in 2015. No recent farm inspections have been completed. c. No septic tanks inspections have been undertaken by RCC within the current ZOC. d. Five of the seven boreholes were inspected during the audit. All of the wellheads are below ground level in concrete chambers within locked fenced areas. None of the well chambers inspected were locked. All had standing water in the chambers. Borehole 4a provided direct access to the groundwater body as the well head is open and not in use. The boreholes were drilled in 2007. They are 50m deep and the water table is at about 10m. The boreholes are not lined and grouted to bedrock. The abstraction rate is 200m^3/hr. Abstraction continues for about 20 hours per day. Two boreholes are acting as duty sources and a third as standby. Water levels and flow rates are recorded and linked to SCADA. Individual boreholes do not have turbidity monitors. e. At the time of the audit raw water quality was 0.396 NTU, 1.2 Hazen and 94.2% UVT.
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. 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. There is facility to dose polymer but this has not been required. At the time of the audit Polyaluminium chloride (PAC) coagulant was being dosed at 15mg/l (100% 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 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 55m^3/hr for 140 seconds followed by a water rinse (using raw water) to

	waste at 50m^3/hr for 430 seconds. e. The clarifiers are designed to cope with raw water turbidity of up to 40 NTU and colour of up to 100 Hazen.
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 (0.8 NTU) or headloss (5 kPa) and can also be initiated manually. A backwash of filter 1a was observed during the audit. The far side of the filter could not be observed during the backwash sequence. The remainder of the filter had an even scour and washed clear. The filter backwash sequence is an air scour at 65m^3/hr for 280 seconds, a low rate water and air scour at 50m^3/hr for 180 seconds, a high rate water only rinse at 110m^3/hr for 440 seconds and a water rinse at for 430 seconds. The run to waste is controlled by time (720 seconds) and turbidity (<0.5 NTU) prior to bringing the filter back into service. There is a turbidity monitor on the outlet from each filter. At the time of the audit these were reading: 1a: 0.052; 1b: 0.049; 2a: 0.033 and 2b: 0.036 NTU. 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 650e UV reactor 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 >73.5% and flow rate of 200m^3/hr based on the validation certificate document provided by the manufacturer and documentation stating same provided by Irish Water. Below 73.5% 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. 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 rate through the reactor is 200m^3/hr. 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. The UV reactor houses 8 UV lamps. The lamp life is 12,000 hours (about one year). At the time of the audit lamp hours were at 1,900 hours. 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. 5 spare lamps are stored on site and a full set is 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. There is an evacuation procedure in place if a lamp breaks and mercury is released. Trained Glan Agua personnel deal with the breakage. Should this occur, the procedure would take two hours until the system would be back in production. A mechanical cleaning system cleans the reactor sleeve once a day. No chemicals are used in the cleaning process. f. The UV reactor has one UVI sensor which is calibrated monthly against a spare sensor. g. No water can flow through the reactor when it is not operating. h. The UV reactor is not operating (as the plant is not running) for about four hours each day.

[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

	This time is available for maintenance and repairs if needed. There is also 1.5 days storage in the reservoir should repairs require additional time. Spare quartz sleeves, UVI sensors, ballast cards (for the UV control system) and O-rings (for the mechanical sleeve cleaning system) are available to Glan Agua at the Roscommon drinking water treatment plant. i. At the time of the audit UVI: 58.7W/m^2; actual UV dose: 69.53mJ/cm^2; flow: 99m^3/hr (one of two trains were in operation at the time) and UVT: 95.3%. **Chlorine disinfection** j. To provide further and residual disinfection, chlorination using neat 14% sodium hypochlorite is in place. A day tank of 1040 litre capacity is maintained 50% full at all times. The caretaker tops it up to 75% every 3-4 days. 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 at Feamore reservoir and alarms to the plant operator. Alarm response procedures are in place and alarms are responded to on a 24/7 basis. The plant shuts down if residual chlorine levels leaving the plant drop below 0.6mg/l. The calculated effective chlorine contact time is 103 mg.min/l. k. The target residual chlorine level leaving the plant is 0.6 mg/l and leaving Feamore reservoir is 0.4 mg/l. Residual chlorine levels in the network are monitored daily at 5 or 6 locations by Roscommon County Council and range from 0.3 to 0.6mg/l. l. A second chlorine monitor has been installed in the network and connected to the SCADA and a further chlorine monitor is planned to be installed in the network shortly.
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. c. The Hydrofluorosilicic acid bulk tanks had been drained following detection of a leak. Investigation by Glan Agua identified the cause of the leak as incorrect construction of the bulk tank. Repairs were scheduled to rectify the cause of the leak.
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 2015. b. The Feamore reservoir was constructed in 2008 as a twin cell with capacity of 6,000m^3 (1.5 days storage). It has not been inspected since construction but is scheduled for inspection in the next 5 years. Six access hatches were unlocked and 12 vents did not have vents sufficiently fine to prevent the entry of insects. c. No customers are served between the treatment plant and the reservoir.
8.	**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, 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 1). Spill trays are on site for use during deliveries. The spill trays in use do not have the capacity to 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.

9.	**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.
10.	**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.
11.	**Sludge Management** a. Backwash water is sent to a sludge holding tank. Glan Agua can bring a mobile dewatering unit to site when required. No sludge dewatering has been required to date. Sludge cake will sent for reuse in brick manufacture. b. Decanted water is discharged to a nearby stream. The discharge water is monitored for turbidity, pH and aluminium.

3. AUDITORS COMMENTS

The Lisbrock 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 Lisbrock supply. 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 ensure that borehole 4a is sealed and standing water in the chamber removed.
2. Irish Water should ensure that all borehole chambers are locked.
3. Irish Water should ensure a schedule of inspection of the borehole chambers is put in place and any standing water in the borehole chambers is removed.
4. Irish Water should ensure the current zone of contribution to the source is delineated.
5. Roscommon County Council should undertake a programme of farm inspections and septic tank inspections in the zone of contribution to the source and follow up any failures with appropriate enforcement actions.

Filtration

6. Irish Water should consider covering the rapid gravity filters to prevent the growth of algae in the filters.

Chemical Storage and Bunds

7. 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*".

8. 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.

Chlorination and disinfection

9. Irish Water should review the procedure for filling the chlorine day tank and ensure that sodium hypochlorite does not degrade through excessive storage in the chlorine day tank.

Treated water storage and distribution network

10. Irish Water should ensure that access hatches are locked and vents are covered with fine mesh at Feamore reservoir.

Management and Control

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

12. 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.

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:** 26th June 2015

Yvonne Doris

Inspector/ Lead Auditor

Photograph 1: Example of delivery pipe to bulk storage tank not within bunded area.