Drinking Water Audit Report

County:	Roscommon	**Date of Audit:**	23rd June 2015
Plant(s) visited:	Killeglan Drinking Water Treatment Plant (serving Killeglan PWS).	**Date of issue of Audit Report:**	25th June 2015
		File Reference:	DW2011/3
		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 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 Killeglan 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 compliance with EPA direction issued to Roscommon County Council on 26th November 2013 to install a barrier to *Cryptosporidium* on the Killeglan public supply. The deadline in the direction was the 31st October 2014. Work was delayed but a new treatment plant is now in place to meet the needs of the supply zone.

The new Killeglan drinking water treatment plant has three sources comprising two boreholes and three and a spring source at the plant. The treatment plant capacity is 350m^3/hr and operates for about 16 hours per day. Treatment consists of a multi-barrier approach comprising raw water blending, flocculation and coagulation in a Dissolved Air Flotation clarifier (DAF), multimedia filtration, UV treatment, chlorination and fluoridation. There is one reservoir in the network serving customers in the Killeglan supply zone (10,000 people). The source boreholes and spring are in highly karstified limestone which is extremely vulnerable. Exceedances of trihalomethanes and turbidity standards and detections of *Cryptosporidium* and Clostridium perfringens in this supply have been notified to the EPA in the past. The Killeglan supply has been on the EPA Remedial Action List for inadequate treatment for *Cryptosporidium* since July 2013. A boil water notice has been in place on the supply since October 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 10.30am at Killeglan 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.

Ivor Kilcline, Senior Executive Engineer, Southern Water District, Roscommon County Council.

Anne McHugh, Senior Resident Engineer, 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.

Annmarie Rooney, Process Optimisation Specialist, Glan Agua.

Tomas Grasza, plant caretaker, Glan Agua.

Representing the Health Service Executive:

Name – Job Title

Dr Melissa Canny, Public Health Specialist.

John Hanily, Principal Environmental Health Officer.

John Keenehan, Environmental Health Officer.

Claire Brennan, Environmental Health Officer.

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. Irish Water report commissioning and process-proving is completed for the Killeglan plant. The takeover certificate was effective from 9th 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 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 >2 NTU or colour is 20 Hazen or UVT<80%. The plant shuts down if final water turbidity is >1 NTU or if residual aluminium is >0.2mg/l. At the time of the audit raw water turbidity was 0.4 NTU, colour was 4-5 Hazen and UVT was 89%. 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 been prepared for Killeglan. b. According to Roscommon County Council (RCC) of the 110 farms in the zone of contribution (ZOC) to the source, 77 have been inspected by RCC, under the Good Agricultural Practice Regulations. 6 farms have been cross-reported to the Department of Agriculture. The remaining farms in the ZOC are to be inspected in 2015. 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. One septic tanks inspection has been undertaken by RCC within the ZOC as part of the National Inspection Plan. No other septic tank inspections have been undertaken. e. The spring and two boreholes at Killeglan were inspected during the audit. The spring source is not regularly inspected and has not been cleaned recently. The boreholes are in situated within fenced and locked areas and are housed in locked concrete chambers. The boreholes were drilled in 2007. They are 25m deep and the water table is at about 5m. The boreholes are lined and grouted to bedrock. The abstraction rate from the spring is 350m^3/hr and it alone can supply the treatment plant. The two boreholes together can also supply the plant, abstracting 175m^3/hr each, effectively a duty and standby source arrangement is in place. Abstraction continues for about 20 hours per day. Abstraction from the spring and the boreholes is from the same groundwater body. Water levels and flow rates are recorded and linked to SCADA. Individual boreholes do not have turbidity monitors. The spring is flushed monthly if it is not in use. f. The access hatch to the spring pump was unsealed along one edge to prevent ingress or access by vermin or to spillages.

3.	**Coagulation, Flocculation and Clarification** a. The coagulation and filtration process is carried out in two tapered flocculation tanks, two covered dissolved air flotation (DAF) units and four multimedia filters. There is facility to adjust pH (using sodium hydroxide) prior to chemical dosing but this not currently being operated as there is sufficient natural alkalinity in the source water. 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. At the time of the audit Polyaluminium chloride (PAC) coagulant was being dosed at 15mg/l. The flow is then split between two twin stage flocculation tanks comprising 10 minutes of fast mixing followed by 10 minutes of slow mixing. The flocculation tanks are drained down for maintenance and cleaning every 6 months. d. The water flows into the DAF tank of 2.5m depth and 10 minutes retention time. The floc is skimmed off once an hour for 20 seconds and this rate can be increased depending on the amount of floc generated. The DAFF units are emptied and cleaned every 6 months.
4.	**Filtration** a. From the DAF units the 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 silica sand (effective size 0.5mm) and a top layer of 450mm anthracite (effective size: 1.0mm). The coagulation and filtration treatment provides 3-log reduction of *Cryptosporidium.* b. Backwashing of the rapid gravity filters is based on time (20 hours), turbidity (0.8 NTU) or headloss (5 m differential) and can also be initiated manually. A backwash of filter 1 was observed during the audit. A very small area of the filter had an uneven air scour and there may be a broken air nozzle. The filter backwash sequence is an air scour at 320m^3/hr for 180 seconds, a water and air scour at 155m^3/hr for 180 seconds and a water rinse at 360m^3/hr for 540 seconds. Filters are run to waste after backwashing. There is a turbidity monitor on the outlet from each filter. During the audit turbidity readings from each of the filters were: Filter 1: 0.118; Filter 2: 0.140; Filter 3: 0.086 and Filter 4: 0.066 NTU.
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 >73.5% and flow rate of 350m^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 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 350m^3/hr. The UV reactor is capable of treating multiples of this flow rate based on the calculated dose algorithm of the reactor.

[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

	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 1,844. 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. g. The UV reactor has 2 UVI sensors which are calibrated monthly against a spare sensor. 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 eight hours each day. This time is available for maintenance and repairs if needed. There is also 14 hours storage in the network reservoirs 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 at the Roscommon drinking water treatment plant. An uninterrupted power supply system is in place to protect the ballast cards in the UV system from a phase loss of power or an imbalance in the power supply. j. At the time of the audit UVI: 42.4W/m2; actual UV dose: 26.8mJ/cm2; flow: 350m3/hr and UVT: 73.5%. **Chlorine disinfection** k. 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 3-4 days. Chlorine dosing levels are 1.0-1.4mg/l into the line serving the reservoir. At the time of the audit residual chlorine leaving the plant was 1.38mg/l. 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 Lugboy 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 53 mg.min/l. l. Residual chlorine levels leaving the Lugboy reservoir are typically between 0.7mg/l and 1.0mg/l and between 0.2mg/l and 0.5mg/l at the end of the network. Residual chlorine levels in the network are monitored by Roscommon County Council and range from 0.2 to 0.5mg/l. m. An additional chlorine monitors 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.
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 Lugboy reservoir was constructed 40 years ago as single cell with capacity of 3,400m^3 (14 hours storage). It was inspected and cleaned in January 2015. It is included in a reservoir refurbishment programme and will be completed in the next few months. 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 2). 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. Settled sludge is mixed with DAFF sludge which is treated in a centrifuge. 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 and aluminium.

3. AUDITORS COMMENTS

The Killeglan 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 Killeglan 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 a schedule of inspection and cleaning (if required) of the spring source is put in place.
2. Irish Water should ensure the access hatch to the spring pump is sealed along its edge to prevent ingress or access by vermin or to spillages.
3. Roscommon County Council should undertake a programme of septic tank inspections in the zone of contribution to the source and follow up any failures with appropriate enforcement actions.

Filtration

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

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.

Management and Control

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

8. 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:** 25th June 2015

Yvonne Doris

Inspector/ Lead Auditor

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

Photograph 2: Example of delivery pipe to bulk storage tank not within bunded area.