Drinking Water Audit Report

County:	Mayo	**Date of Audit:**	23 February 2016
Plant(s) visited:	Swinford WTP	**Date of issue of Audit Report:**	7 March 2016
		File Reference:	DW2014/14
		Auditors:	Ms Derval Devaney Ms Michelle Roche
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*. • EPA Drinking Water Advice Notes No.s 1 to 15. • The recommendations in previous audit reports.		

MAIN FINDINGS

i. **Irish Water has not monitored and characterised the source of the water being treated at the Swinford water treatment plant and was not aware of any source protection measures being carried out in the catchment. Furthermore, no assessment of the zone of contribution of the spring has been carried out.**
ii. **The source water is subject to considerable variation in levels of turbidity and colour. The current chemical dosing regime in place at the plant is insufficient to cater for the variability in the raw water quality leading to aluminium and turbidity exceedances in the final water of the Swinford Pubic Water Supply.**
iii. **Major alarms have been by-passed resulting in elevated levels of turbidity being delivered to the distribution network.**

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 in response to the notification by Irish Water dated 28/10/15 of the failure to meet the aluminium parametric value (as specified in Table C of Part 1 of the Schedule of the Regulations) in the Swinford PWS and subsequent response to the EPA's Regulation 16 Direction issued 27/11/15 regarding this failure.

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

The opening meeting commenced at 9:10am. 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. 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: Pádraig Lynn – Caretaker; Mayo Co. Co. Mark O'Donnell – A/Executive Engineer, Mayo Co.Co. Eddie Munnelly – Senior Executive Engineer, Mayo Co.Co. Sean Higgins - Operations & Maintenance Engineer, Irish Water Representing the Environmental Protection Agency: Ms Derval Devaney, Inspector Ms Michelle Roche, 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.	**Source Protection** a. The Swinford PWS is sourced from the Carrowcanada Spring. Hydrochemistry indicates a flashy vulnerable source which is regularly contaminated (e.g. elevated levels of *E. coli* and Faecal Coliform are evident in the EPA's water monitoring programme 1996 to 2015). b. The EPA's Site Information Assessment Report (dated August 2011) delineates a Zone of Contribution (ZOC) for the supply but states it is difficult to determine its accuracy due to it being a karst spring with little overflow data and therefore requires tracer testing to determine confidence in its boundary. The report states that the supply is heavily influenced by surface water in times of rainfall and this results in high suspended solids. c. There is a turbidity monitor on the raw water which shuts the abstraction down once > 50 NTU for 30 minutes. The spring's turbidity on the day of the audit was 0.616 NTU. The caretaker is alerted with the raw water turbidity reaches > 10 NTU. d. The abstraction rate varies from 700 – 900 m^3/day (depending on leakage in the network). The plant was abstracting 600m^3/day on the day of the audit. The abstraction rate is linked to the reservoir level and cuts off when the water reaches 6 meters and re-starts when the level drops to 4 meters. e. Irish Water and Mayo County Council were not aware of what source protection measures, if any, were carried out in the catchment and stated that this was a matter for the Environment Section of Mayo County Council. f. A *Cryptosporidium* Risk Assessment was completed for the supply in November 2009 and a risk score of 72 (moderate risk) was determined. g. *Cryptosporidium* monitoring is carried out twice/year and the auditors were told all results were clear, however there were no results available for inspection on the day of the audit. h. There is no online pH monitor on the raw water. It was stated that pH monitoring is carried out on the raw water by a handheld meter and varies from 6.6 – 6.7. There were no records in the daily log-book for raw water pH for February 2016. A chart on-site stated that the raw water pH varied from pH 7.1 – 7.3. i. Colour can vary greatly on the raw water from 20 - 300 Hazen in response to rainfall. The caretaker manually tests for colour in the raw and final water morning and evening. The caretaker stated that any change at the source is seen at the water treatment plant 1.5 hours later. j. There are screens at the spring's intake area which remove large debris prior to pumping water to the treatment plant at Kilbride. k. The auditors were informed that this supply falls under the raw water monitoring programme which is to commence during 2016.

2.	**Coagulation, Flocculation and Clarification** a. The plant's design capacity is 75 m^3/hr and the plant is currently operating at 55 m^3/hr. b. The rising main is flow proportionally injected with PAC 10% prior to entry into the contact tanks. A flash mixer was installed on the raw water line to aid mixing. c. Water enters 2 baffled contact tanks - one has fast mixing and the other slow speed mixing to encourage floc formation. The first tank had rusted and was in need of maintenance (see Photo 1). d. The type of Poly used at the plant changed in June 2015 to a cationic material (Clear FLOC903P) and is added 20-30 minutes after the PAC at the end of the contact tank and prior to entry into a splitting chamber. The splitting chamber was installed 3 years ago to ensure the 2 No. DAFF units receive equal volumes of water from the contact tanks. e. There is no pH correction on the raw water. Optimum pH and aluminium dose for effective coagulation was not known. Chemical dosing is dependent on the raw water colour and turbidity concentration and such is displayed on a dosing chart (see Photo 2) which specifies dose concentrations. For example when raw water has a turbidity of 20-40 NTU and a colour of 20-40 Hazen, 100 mg/l of 10% PAC is added and 0.1 mg/l of Poly. Jar tests were last carried out on the supply in July 2015 and there is no facility on-site to carry out jar testing nor does the caretaker have the expertise to complete this test. f. The acrylamide concentration in the Poly dose was not known.
3.	**Filtration** a. The two DAFF units (each of 14.4 m^2) were cleaned and refurbished 2 years ago (filter media and air nozzles replaced, air blower upgraded and air and water combined for back wash). b. Every 15 minutes the scrapers in the DAFF units automatically operate for 3-5 minutes where sludge is removed and diverted to the on-site lagoons. The timing for activation of the scraper can be manually adjusted. c. The air saturation pressure was increased from 5.5 bar to 6.2 bar at the request of Irish Water to increase solids removal. d. Backwash is initiated on a headloss of 1.7 m and occurs every 8-10 hours. The PLC is set so that the filters do not backwash simultaneously. Backwash was observed on DAFF unit No 1. Water is drained to 300 mm above the top of the filter sand media. Air scouring occurs first and lasts for 8-10 minutes (timing which can be manually varied) and this is followed by air and water scouring for 2-3 minutes. A water scour then commences for 12 minutes. A run to waste facility was installed on the DAFF units 5 years ago and water is run to waste for 5 minutes (the length of time water is run to waste can also be manually varied). e. A plate was added about 16 years ago to raise the height on the weir wall to prevent the loss of filter sand media during backwash. Backwash water was observed to leak through a space in this heightened wall which could potentially cause loss of media or preferential flow during backwash (see Photo 3). This was also raised in the previous 2009 audit. f. The DAFF units are cleaned and hosed down once per month and were cleaned 2 days ago. g. There are turbidity monitors in place post the filters and these are linked to a continuous visual display unit. These also read during backwash. During backwash of DAFF unit No. 1 it had turbidity of 0.55 NTU and 0.42 NTU once back in service. DAFF unit No. 2 was reading 0.112 NTU during backwash of DAFF unit No. 1 and final water at the reservoir was 0.132 NTU. The monitors were calibrated the week before the audit, on 17/02/16. h. There is a flow monitor on the backwash water and filtered water.
4.	**Disinfection** a. Chlorine gas is used as a disinfectant at the plant and dosed into the clear water tank on-site. b. There are two chlorine gas cylinders (duty) and 2 no. standby cylinders. The chlorine gas is delivered from the gas cylinders to the chlorinators via a "changeover panel" which automatically switches from the duty cylinder to the standby cylinder upon drop in pressure in the duty cylinder.

	c. There are duty and standby chlorinators with an automatic changeover system in place in the event of breakdown of the duty chlorinator. d. The 2 No. chlorine booster pumps which deliver water from the clear water tank to the chlorinators also have automatic switchover. e. The chlorination system is to be upgraded under Irish Water's Disinfection Programme during 2016 where chlorine gas will no longer be used as a form of disinfection and sodium hypochlorite used instead. f. The online chlorine monitor in place at the outlet from the reservoir was reading 0.87 mg/l free chlorine in the final water on the day of the audit and a pH of 6.69. The chlorine monitor has a low level alarm set at 0.4 mg/l and a high level alarm set at 1.3 mg/l. g. Irish Water aims to maintain 0.5 mg/l of residual chlorine at the end of the distribution network.
5.	**Treated Water Storage and Distribution Network** a. The reservoir on-site holds 2000 m^3/day of treated water (3 days storage).
6.	**Monitoring and Sampling Programme for treated water** a. Daily aluminium results taken at the plant and network show concentrations can vary greatly from day to day (e.g. 0.137 mg/l on 04/02/16 and 0.042 mg/l of 05/02/16 in the network). b. Final water pH (taken manually) varies at the plant (e.g. from 8.69 on 01/02/16 to 6.67 on 23/02/16). c. Turbidity in the final water exceeds 0.5 NTU on many occasions (e.g. 2 NTU on 14/02/16 and 1.47 NTU on 19/02/16).
7.	**Exceedances of the Parametric Values** a. An aluminium exceedance was notified to the EPA on 28/10/15 (1,150 µg/l on 12/10/15). Irish Water stated that the cause for non-compliance was "agitation in the distribution network possibly caused by the opening of a hydrant or other such incomplete flushes on the system." However the daily aluminium concentration measured in the final water at the plant on 12/10/15 was elevated at 227 ug/l. Upon receipt of the elevated aluminium level the care taker stated he turned off the chemical dosing at the plant in an effort to reduce aluminium residual in the final water. b. Final water turbidity results show levels up to 2 NTU frequently occur (for e.g. on 14/02/16, 17/02/16 and 19/02/16). Irish Water stated that the plant is shut-down when the final water is > 0.2 NTU (a setting put in place since January 2016) however it appears that this is not always the case. For example, the final water turbidity on the online monitor for 19/02/16 was 1.47 NTU at 5.30pm and the flow meter pump display for 19/02/16 shows both the raw and final water pumps were operating during this time which would indicate that the plant did not shut-down on this occasion when turbidity levels were elevated. It was stated that raw water was being used during this time to wash the filters and due to work being carried out on the PLC system also, the wash water from the filters was being put directly into the supply which is thought to have caused the elevated turbidity readings.
8.	**Management and Control** a. The daily log book for 2016 showed that the plant shuts down frequently due to the reservoir high level being reached, the coagulation line blocking or due to air scour issues with the filter.
9.	**Sludge Management** a. The washwater from the backwashing of the DAFF units are piped to a lagoon which is lined and the supernatant is discharged to land. Any sludge settlement in the lagoon is not tankered off-site for treatment or disposal. No water quality sampling of the supernatant has been carried out.

3. AUDITORS COMMENTS

The EPA previously audited the Swinford treatment plant in 2008 and 2009 and while progress was made in addressing some of the recommendations outlined in the audit reports such as optimising the filter backwash cycle, upgrading the filter process and increasing control on the disinfection system, other recommendations remain to be completed. These include monitoring and analysing trends in raw water data, liaising with the Environment Section of Mayo Co. Co. on source protection measures and optimising the coagulation process to address elevated turbidity and aluminium levels in the final water.

The EPA notes that a review of the DWTP was recently completed by Irish Water and there are plans to optimise the coagulation, flocculation and filtration process (as detailed in IW's correspondence to the EPA dated 07/12/15). These works are to be included in Irish Water's Minor Programme which is to go to tender by the end of Q2, 2016.

Irish Water must address the recommendations of this audit report as a matter of priority to ensure the supply meets the parametric values set out in the Drinking Water Regulations 2014 and to improve the safety and security of Swinford public water supply.

4. RECOMMENDATIONS

Source Protection

1. Irish Water should liaise with Mayo County Council to ensure that farmers are written to in relation to the requirements of the *European Union (Good Agricultural Practice for the Protection of Waters) Regulations 2014 (SI No.31 of 2014)* so that, unless an alternative setback distance has been set as per Article 17;

    i. Organic fertiliser or soiled water is not applied to land within 200 m of the abstraction point; and
    ii. Farmyard manure held in a field prior to landspreading is not placed within 250 m of the abstraction point.

2. Irish Water should (a) delineate the "zone of contribution" for the spring source and (b) establish links with the Environment Section of Mayo County Council to ensure that both parties are aware of the issues potentially impacting on the raw water abstraction point within the spring's zone of contribution. Irish Water should ensure all potentially polluting discharges into the catchment of the water source are identified and implement mitigation measures, where appropriate, to reduce the potential impact of these discharges.

3. Irish Water should commence the raw water monitoring programme for this supply as planned (to include monitoring for *E .coli* bacteria, *Cryptosporidium*, UVT, alkalinity, field pH, field temperature, colour, turbidity, TOC and iron as an indicator of trends in assessing water quality). Trends in raw water quality should be analysed and used to determine if treatment at the plant is sufficient to cater for any variability in the raw water quality and to determine what the optimum treatment conditions are for the raw water to prevent aluminium and turbidity exceedances arising in the Swinford public water supply and ensure compliance with the Drinking Water Regulations.

Coagulation, Flocculation and Clarification

4. Irish Water should:
    (a) Ensure that jar testing of the raw and coagulated waters is carried out as outlined in Section 3.3.1 and Appendix C of the EPA publication "Water Treatment Manual: Coagulation, Flocculation and Clarification" to determine the optimum chemical coagulant dose and pH for the treatment of the water. The frequency of checks should be 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;
    (b) investigate the feasibility of introducing pH correction prior to coagulation to reduce the

need to add excessive levels of coagulant to bring the pH down to the optimum coagulation pH and to ensure a stable pH is maintained in the final water;

(c) ensure that the dose of polyelectrolyte is such that the average dose does not exceed 0.25 mg/l and no individual short term dose of polyelectrolytes exceeds 0.5 mg/l. (see the UK Drinking Water Inspectorate's List of Approved Products for use in Public Water Supplies). Irish Water should calculate the maximum concentration of acrylamide in the final water, based on the maximum dosage of the chemical at the plant and the upper limit for the content of free acrylamide monomer in the product used and submit the result to the EPA. Irish Water should ensure it meets the parametric value of 0.1 µg/l as specified in Table B of the Drinking Water Regulations 2014;

(d) ensure the contact tank is inspected and maintained on a regular basis so that it is free from rust and structurally sound.

Filtration

5. Irish Water should investigate if the backwash water escaping though a gap in the raised weir wall of DAFF unit No. 1 during the initial backwashing period is causing a loss of filter media or preferential flow and/or uneven scouring during backwash.

6. Irish Water should review the suitability of the current location of the final water turbidity monitor (post the reservoir) to ensure it affords the caretaker time to react in the event of excessive turbidity in the final water.

7. Irish Water should review the operation of the filters to ensure that the levels of turbidity in the filtered water are as low as possible and no greater than 0.5 NTU. If there is a risk of the presence of *Cryptosporidium* in the raw water, then the turbidity of the filtered water should not exceed 0.2 NTU.

Disinfection

8. Irish Water should notify the EPA when the plant has undergone the disinfection programme upgrade during 2016 and provide an outline of what works were completed.

Management and Control

9. Irish Water should put measures in place to ensure that major alarms resulting in automatic plant shut-down are not manually by-passed.

10. Irish Water should take measures to ensure the washings of plant processes (e.g. filters, contact tanks) are not sent into supply for use as drinking water.

11. Irish Water should investigate if frequent plant shut-downs impact on the capability of the plant's treatment process.

Monitoring and Sampling Programmes for Treated Water

12. Irish Water should ensure monitoring results for the supply are available at the plant for inspection during announced audits.

Sludge Management

13. Irish Water should carry on an assessment of the leachate being discharged to land from the drinking water sludge lagoons to ensure that it does should give rise to environmental pollution.

FOLLOW-UP ACTIONS REQUIRED BY IRISH WATER

During the audit Irish Water representatives were advised of the audit findings and that action must be taken as a priority by Irish Water to address the issues raised. This report has been reviewed and approved by Ms Aoife Loughnane, Drinking Water Team Leader.

Irish Water should submit a report to the Agency within one month of the date of this audit report detailing how it has dealt with the issues of concern identified during this audit. The report should include details on the action taken and planned to address the various recommendations, including timeframe for commencement and completion of any planned work.

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:  **Date:**

Derval Devaney — 07/03/16

Inspector

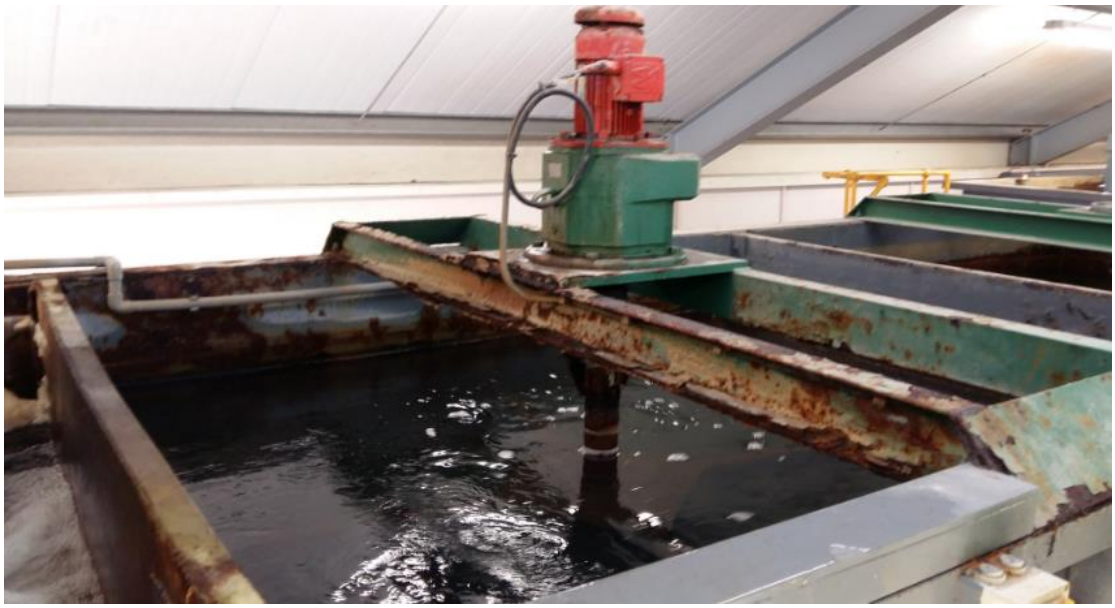
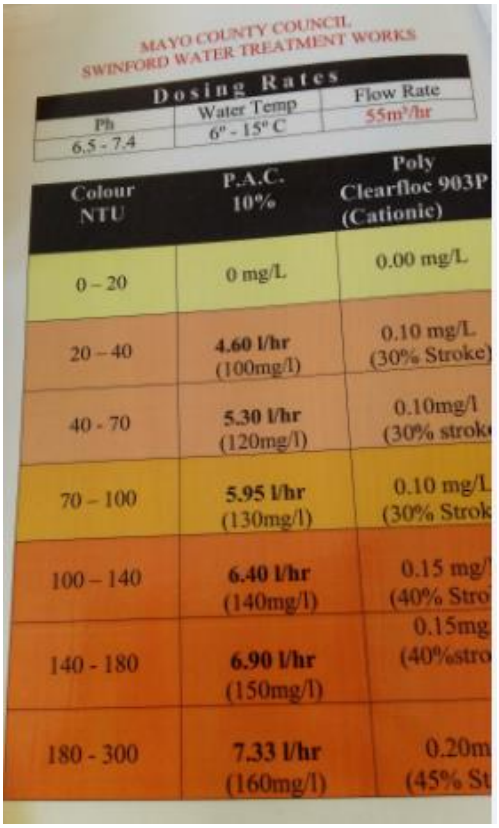


Photo 1 Rust on 1st contact tank



MAYO COUNTY COUNCIL
SWINFORD WATER TREATMENT WORKS

Dosing Rates

Ph	Water Temp	Flow Rate
6.5 - 7.4	6° - 15° C	55m³/hr

Colour NTU	P.A.C. 10%	Poly Clearfloc 903P (Cationic)
0 – 20	0 mg/L	0.00 mg/L
20 – 40	4.60 l/hr (100mg/l)	0.10 mg/L (30% Stroke)
40 - 70	5.30 l/hr (120mg/l)	0.10mg/l (30% stroke
70 – 100	5.95 l/hr (130mg/l)	0.10 mg/L (30% Strok
100 – 140	6.40 l/hr (140mg/l)	0.15 mg/ (40% Stro
140 - 180	6.90 l/hr (150mg/l)	0.15mg (40%stro
180 - 300	7.33 l/hr (160mg/l)	0.20m (45% St

Photo 2 Dosing Rates charted for Swinford WTP

Photo 3 Backwash on DAFF Unit No 1 – water escapes via gap in weir