



Drinking Water Audit Report

County:	Mayo	Date of Audit:	8 th May 2015
Plant(s) visited:	Knappaghbeg Water Treatment Plant	Date of issue of Audit Report:	12 th May 2015
		File Reference:	DW2015/62
		Auditors:	Mr. Darragh Page
Audit Criteria:	<ul style="list-style-type: none"> • The <i>European Union (Drinking Water) Regulations 2014 (S.I. 122 of 2014)</i>. • The <i>EPA Handbook on the Implementation of the Regulations for Water Services Authorities for Public Water Supplies (ISBN: 978-1-84095-349-7)</i> • The recommendations specified in the <i>EPA Drinking Water Report</i>. • The recommendations in any previous audit reports. 		

MAIN FINDINGS

- i. **There was a significant increase in chlorine demand in the network of the Knappaghbeg Water Treatment Plant between 23rd March and 10th April 2015. Though a leak was detected and repaired and the main flushed leading to a reduction in chlorine demand the cause of the increase in chlorine demand was not determined. Irish Water should carry out an investigation into the cause of this increased demand as it may be a possible source of contamination or an indication that more regular mains cleaning and flushing is required.**
- ii. **No assessment of the catchment was carried out between the identification of the outbreak and the day of the audit. Irish Water should liaise with Mayo County Council and ensure that an inspection of the catchment is carried out to identify any potentially polluting activities or discharges.**
- iii. **Issues with the management and operation of the filters were identified including short term hydraulic overloading of the filters which should be addressed by Irish Water as a matter of urgency.**

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 imposition of a precautionary boil water notice on the Westport PWS.

Westport town and its environs (5,000-7,000 population) are supplied with water from Moher Lake which is treated at the Knappaghbeg Water Treatment Plant. The design capacity of the plant is 3,410 m³/d and the supply is supplemented with water from the Lough Mask Water Treatment Plant at times of high demand. Treatment consists of automated pH adjustment using soda ash prior to coagulation using poly aluminium chloride (PAC) and polyelectrolyte, clarification, rapid gravity filtration followed by disinfection using sodium hypochlorite. Fluoridation of the water is also carried out prior to its distribution.

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

The opening meeting commenced at 10:30 am at the Knappaghbeg Water Treatment Plant. 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.

<p>Representing Irish Water: (* indicates that person was also present for the closing meeting)</p> <p>Ms. Anne Bonner, Compliance Specialist, Irish Water*</p> <p>Mr. Anthony Skeffington, SLA Lead, Irish Water*</p> <p>Ms. Louise Brennan, Compliance, Irish Water*</p> <p>Mr. Larry Walsh, Mayo County Council*,</p> <p>Ms. Olivia Feeney, Mayo County Council*,</p> <p>Ms. Collette Scahill, Mayo County Council*,</p> <p>Mr. Patrick Corcoran, Engineer, Mayo County Council,</p> <p>Mr. Paddy Cummins, General Sanitary Supervisor, Mayo County Council*,</p> <p>Mr. Tom Walsh, Caretaker, Mayo County Council*</p> <p>Representing the Environmental Protection Agency:</p> <p>Mr. Darragh Page, Inspector</p>

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.	<p>Source Protection</p> <ol style="list-style-type: none"> a. The source of the Wesport PWS is Moher Lough (see Photo 1). b. Mayo County Council stated that they had communicated with all residents/farmers within the zones defined in the Good Agricultural Practice Regulations in 2011. Farm surveys were carried out in February 2011 and issues were followed up at the time. c. There has been no survey of the catchment since the outbreak was detected and neither Irish Water or Mayo County Council had assessed the catchment to determine if there were any current sources of contamination. d. IW stated that there was an algal bloom on the lake (<i>Asterionella formosa</i>). <i>Asterionella</i> is a diatom that naturally occurs and is generally unrelated to nutrient or pollutant levels in the freshwater.
2.	<p>Coagulation, Flocculation and Clarification</p> <ol style="list-style-type: none"> a. The coagulation process was upgraded in 2011, the details of which are outlined in the previous EPA audit report of 17th January 2012. b. The coagulation stage appeared to be working well and there was no sign of floc carryover from the clarifiers to the filters on the day of the audit.

<p>3.</p>	<p>Filtration</p> <ul style="list-style-type: none"> a. There are 2 no. rapid gravity filters at the Knappaghbeg Water Treatment Plant. These filters were refurbished in 2009. An assessment of the filters was ongoing by an external contractor on behalf of Irish Water at the time of the audit in response to the imposition of the precautionary boil water notice. b. The media depth was 600 mm. There was evidence of significant media loss over the weir (see Photo 2). Irish Water or Mayo County Council were not able to provide information on the design depth of the media. This information should be available and checks should be carried out on the depth of the media to ensure that it is within the design specification. c. The filters are backwashed consecutively every day in the morning. While one filter is being backwashed the volume of water to the second filter doubles. This appears to cause an increase in turbidity levels to approx. 0.2 NTU which is above the normal background levels (see Photo 3). d. The filters are run to waste for a period of 15 mins after backwashing, however, the turbidity levels remain elevated at approx. 0.2 NTU after this 15 min period in filter no. 1 (see Photo 3) due to the doubling of the loading of the filter while filter no. 2 is being backwashed. This may present a risk of filter breakthrough. e. During normal operation the performance of the filters is generally good with turbidity levels usually at 0.05 NTU. f. There were a few incidents where the final turbidity exceeded 1.0 NTU and these are described in more detail in Section 6 below.
<p>4.</p>	<p>Chlorination and Disinfection</p> <ul style="list-style-type: none"> a. Filtered water is disinfected using sodium hypochlorite. b. The target dose is determined based on ensuring a free residual chlorine level of 0.85 mg/l at the inlet of the reservoir which has been found to ensure 0.5 mg/l at the outlet of the reservoir and 0.2 mg/l at the extremities of the network. c. The dose at the plant varied significantly over the period reviewed (i.e. 1st March to 8th May 2015). The results from the chlorine monitor indicate that the average chlorine levels in final water leaving the clear water tank were normally around 1.75 mg/l but the levels were as high as 5 mg/l on occasion. d. MCC stated that the chlorine dose was adjusted to ensure 0.85 mg/l at the reservoir and at times the chlorine demand rose significantly necessitating a higher dose at the plant. The increased chlorine demand did not coincide with poor water quality leaving the plant. MCC also stated that once water entered the reservoir, the chlorine demand was relatively stable. MCC stated that chlorine demand between the plant and the Sandyhill reservoir can rise significantly but they had no explanation for this. e. There was a recent leak on the main that was repaired prior to 10th April 2015. At this time the main was drained down, repaired and flushed. This led to a dramatic drop in chlorine demand. However, MCC stated that it was unlikely that anything was ingressing at the point of the leak as the pipe was under 30 psi pressure at that point. f. Further analysis of the chlorine levels leaving the plant is outlined in Section 6.
<p>5.</p>	<p>Treated Water Storage and Distribution Network</p> <ul style="list-style-type: none"> a. Treated water travels to the Sandyhill reservoir in Westport which is approx. 5 km away. This was not examined as part of the audit.
<p>6.</p>	<p>Monitoring and Sampling Programme for treated water</p> <ul style="list-style-type: none"> a. The turbidity results for 1st March to 8th May 2015 from the raw, filtered (2 no. filters) and final water were examined on the HMI during the audit. A full set of data from the monitors was also provided to the EPA subsequent to the audit via email. b. The results indicate that performance of the filters was generally good with turbidity levels generally around 0.05 NTU.

	<p>c. The final water turbidity exceeded 1.0 NTU on a small number of occasions. Details of these occurrences and the causes are outlined below:</p> <ul style="list-style-type: none"> i. 13th March 2015- Levels of turbidity started rising from a background level of <0.1 NTU at 10:17 and was above 1.0 NTU between 11:16 and 11:27. Turbidity levels fell back below 0.1 NTU after 12:13. IW and MCC stated that this was due to the washing of the settling tank at 10:20 and that no flow during this period entered into supply. However, as flow data is not continuously recorded it was not possible to verify this. ii. 21st March 2015 – Levels of turbidity started rising from a background level of <0.1 NTU at 15:14 and was above 1.0 NTU between 18:39 and 18:48. Turbidity levels returned back below 0.1 NTU at 19:58. No explanation of the cause of these elevated levels was provided. iii. Other incidents of where the turbidity rose above 1.0 NTU were instantaneous readings (i.e. present for 1 min or less) and therefore likely to be anomalous readings. <p>d. The results from the chlorine monitor were examined and indicated that the chlorine dose fluctuates significantly for the reasons outlined in Section 4. An analysis of the data from the chlorine monitor indicates that:</p> <ul style="list-style-type: none"> i. Chlorine levels leaving the plant were stable between 1.7 and 2.0 mg/l from 1st March to 23rd March 2015. After this period the chlorine levels fluctuated. ii. Chlorine levels rose above 3 mg/l on 25th and 26th March and again during the period 30th March to 9th April to levels of up to 5 mg/l. MCC stated that this was due to increased chlorine demand in the network between the water treatment plant and the Sandyhill reservoir and the difficulty MCC experienced in maintaining a satisfactory chlorine residual up to the reservoir. A leak was detected in the main which was repaired on the 10th April 2015. However, MCC stated that ingress at this point was unlikely as it was a small crack in the pipe at a point where the pressure in the pipe was 30 psi. The main was drained down and flushed before being brought back into use. This resulted in a significantly lower chlorine demand on the treated water and chlorine leaving the plant was reduced to 1.7 mg/l and has remained at this level since. iii. The alarm setting on the chlorine monitor at the clear water tank is 0.5 mg/l. The trends on the monitor indicate that levels drop below 0.5 mg/l on occasion for brief periods. This is preceded by a downward trend which corrects itself within a short space of time (see Photo 4 as an example). This occurred on numerous occasions with levels dropping below 0.5 mg/l for brief periods on 13 separate days during the period 1st March to 8th May 2015. No explanation for this was available. <p>e. Monitoring for <i>Cryptosporidium</i> is undertaken at the plant. Two samples were analysed in 2015 prior to the audit. Both samples, on 26th February 2015 and 11th March 2015 were free of any oocysts. A <i>Cryptosporidium</i> rig was installed at the plant on 6th May and a sample was with the lab for analysis. A second rig was set up on the raw water and the sample from this rig and the treated water rig was taken for analysis by MCC during the audit. Results were to be available over the weekend. Daily <i>Cryptosporidium</i> sampling is planned at the plant.</p> <p>f. Monitoring in the distribution network at 5 locations took place on 10th April following repair and flushing of the main. The results were reviewed and were compliant. However, in three of the five results the Dissolved Organic Carbon (DOC) was higher than the Total Organic Carbon (TOC). No explanation for this anomaly was provided.</p>
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3. AUDITORS COMMENTS

The Knappaghbeg Water Treatment plant is generally performing well and producing water with a low turbidity (<0.1 NTU). However, some practices at the plant, in particular the management of the backwash cycle need to be reviewed and improved as they present a risk of breakthrough of *Cryptosporidium* oocysts if present in the raw water source. The negative results for *Cryptosporidium* for daily samples analysed once in February and March 2015 were noted.

The increase in chlorine demand between the clear water tank and the Sandyhill Reservoir 5km away requires investigation. This indicates that there may be a possible source of ingress of contamination along the main between the treatment plant and the reservoir or an indication that more regular mains flushing is required to reduce chlorine demand in the network . Irish Water need to investigate this without delay.

Irish Water also need to ensure that a catchment survey is carried out to determine if there is any potential sources of pollution in Moher Lake that may be a risk to the treatment process.

4. RECOMMENDATIONS

Irish Water should implement the following recommendations within one week of the receipt of this audit report:

Source Protection

1. Irish Water should ensure that a catchment survey of Moher Lake is carried out to identify any potentially sources of pollution.
2. Irish Water should ensure that daily monitoring of the raw and treated water for *Cryptosporidium* is continued for the duration of the outbreak (as determined by the HSE). Also arrangements should be made to carry out daily *Cryptosporidium* monitoring on the treated water from network at Sandyhill Reservoir. Following this Irish Water should continue with weekly monitoring of the raw and treated water, unless a case can be made by Irish Water based on site specific risk assessment for less frequent monitoring.

Filtration

3. Irish Water should investigate the cause of the loss of filter media from the filters into the filter channel and take appropriate action to prevent this loss of media.
4. Irish Water should cease the practice of doubling the hydraulic loading of each filter while the other is being backwashed.
5. Irish Water should review the duration that the filters are run to waste until such time as the filtered water turbidity levels have returned to normal operating levels.
6. Irish Water should provide an explanation for the peak in turbidity in the final water on 21st March 2015.
7. Irish Water should continuously record the flow of treated water from the plant so that it can verify that the design criteria of the plant is not exceeded and verify when the treated water contains elevated levels of turbidity that such water is not entering into supply.
8. Irish Water should submit the details of any remedial actions that are to be taken following the assessment of the filters being undertaken on the day of the audit.

Disinfection

9. Irish Water should investigate the reasons for the activation of the chlorine monitor alarm as described in Section 6(d)(iii) and provide an explanation of same to the EPA.
10. Irish Water should investigate the reasons for the increased chlorine demand that occurred during 23rd March and 10th April 2015 and submit a report to the EPA outlining the actions that are to be taken to prevent a reoccurrence.

Management and Control

11. Irish Water should link the flow meter on the outlet of the clear water tank to the HMI and SCADA.
12. Irish Water should investigate the reasons that the results of analysis for DOC were higher than TOC for three of the samples on 10th April 2015.

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 Mr. Brendan Wall, Manager (Environmental Enforcement).

Irish Water should submit a report to the Agency within one week 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:

12th May 2015

Darragh Page
Inspector



Photo 1. Moher Lough.



Photo 2. Filter Drained Down (Note: sand in the weir)

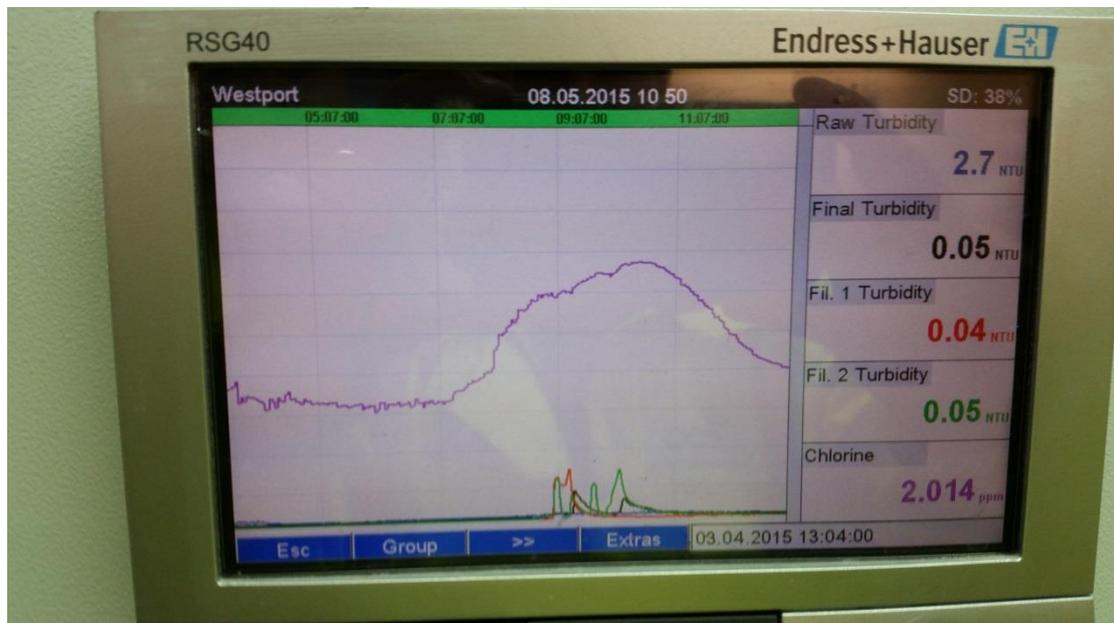


Photo 3. Screen shot of the raw, filtered and final turbidity and chlorine.

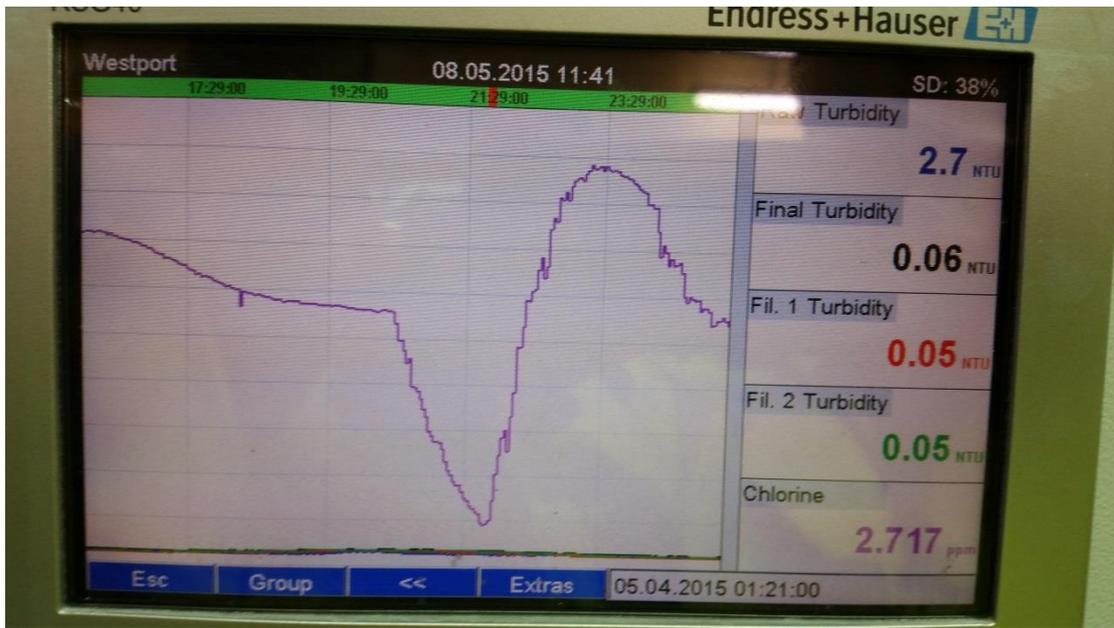


Photo 4. Screen Shot of the Chlorine Monitor Trend.