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BRISTOL WATER PR09

Q9 - Sherborne Lead Removal
Preliminary Design Report

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Q9 - SHERBORNE LEAD REMOVAL SCHEME

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Q9 - SHERBORNE LEAD REMOVAL SCHEME

1. INTRODUCTION

Lead is found naturally in the Sherborne spring water due to the nature of the geology in the catchment area. The lead concentrations are consistently above 10 µg/l with a maximum of 16 µg/l. This is below the current Prescribed Concentration Value (PCV) of 25 µg/l but will exceed the proposed 2013 PCV value of 10 µg/l.

Spring water at the site is currently treated using a pressurised ultra filtration membrane and a chlorination system rated at 4Ml/d. This does not remove the lead as it is typically in soluble form. To remove lead to comply with the proposed 2013 PCV value it is proposed to install new 7Ml/d capacity treatment plant consisting of coagulation, flocculation, submerged membrane plant and sludge treatment facilities.

1.1 OS reference

Proposed location for Sherborne lead removal treatment works

358601, 155045 ST 5855

2. DRIVER FOR SCHEME

Lead is a persistent and accumulative toxic metal. Lead concentration levels must be reduced to a Prescribed Concentration Value (PCV) of 10 µg/l to comply with UK water quality standards by 2013.

It is expected that there will be significant growth in the Shepton Mallet area and bringing Sherborne spring back into service will help to meet this growth.

The drivers as listed in the scheme database are as follows:
Sherborne TW Lead (Quality): **5WA7 - Water treatment - other**
Sherborne TW Lead (Supply Demand): **SDB2 - Growth - treatment/production**

3. OPTIONS CONSIDERED

3.1 Coagulation, Flocculation and Submerged Membrane (selected option)

Coagulation and flocculation will remove nearly 85-95% of lead from raw water. Floc particles carried forward from the flocculation tank can be removed by the proposed submerged membrane filter system. This is a relatively a simple process consuming less power compared to the Ion Exchange process. The plant will have a capacity of 7Ml/d.

3.2 Conventional Treatment instead of Submerged Membranes

The option of installing a conventional treatment process instead of a submerged membrane plant was investigated. In this case the conventional treatment process considered was pressure filters with a UV plant instead of the submerged membrane plant. To assess this option a cost analysis was undertaken and details of this are included in Appendix 8.

The result of this cost analysis are summarised below:

Treatment Type	Capital Cost	OPEX pa	Present Value	Equivalent Annual Cost
Conventional Treatment	£2,410,883	£74,917	£3,442,103	£250,065
Submerged Membrane	£2,861,693	£109,239	£4,365,348	£317,138

Although the equivalent annual cost of membranes is higher than conventional treatment the difference in cost is outweighed by perceived process benefits of using membranes. Submerged membranes were therefore selected as the preferred option.

3.3 Ion Exchange

Ion exchange removes virtually all soluble lead from raw water however the volumes of waste brine are high. There is no sewer system close to Sherborne works to dispose of brine. Tankering of the brine would not be viable and the brine cannot be thickened. It is possible to regenerate brine but it is expensive. The option of Ion Exchange was therefore rejected.

3.4 Reusing the Existing Pressurised Membranes

The capacity of the existing membranes is only 4 Ml/d. It is currently proposed to install treatment plant with a capacity of 7 Ml/d to enable the full yield of the spring to be met. If the existing membranes were reused it would not be possible to meet the full yield of the spring.

Further, if coagulation and flocculation to remove lead were installed before the existing pressurised membranes there is a risk that the floc particles would blind the existing pressurised membranes. This could be mitigated by installing a roughing filter before the existing membranes.

This option was rejected because the full annual yield of spring could not be achieved using only the 4Ml/d plant. The option of installing a duplicate 3Ml/d pressurised membrane together with a 7Ml/d roughing filter was considered but rejected on the basis of cost.

3.5 WR3x – Gurney Slade to Sherborne Scheme

Under scheme WR3x – Gurney Slade to Sherborne it is proposed to transfer Gurney Slade water to Sherborne through a new pipeline. The water would be blended with Sherborne water to lower the lead concentration levels before being treated with a proposed 15 Ml/d capacity submerged membrane plant. As such the scheme is an alternative to this Q9-Sherborne Lead Removal Scheme.

4. INTERACTION WITH OTHER SCHEMES

No interaction with other scheme.

5. GEOTECHNICAL SUMMARY

5.1 Geology

Sherborne Treatment Works is located on the south side of Litton Upper and Lower Reservoirs to the east of East Harptree. It is proposed to construct a coagulation tank, flocculation tank and submerged membrane treatment plant at the site to reduce the lead concentration of the spring water. The site lies on Mercia Mudstone mudstone and halite-

stone. This comprises calcareous mudstones with sporadic beds of hard sandy mudstone. The mudstones will have weathered to clay near the ground surface.

5.2 Constructional aspects

The proposed works comprise a coagulation tank, a flocculation tank and a submerged treatment plant which will be housed in an extension to the existing building. The ground should provide an adequate foundation.

5.3 Recommendations for site investigation

No further site investigation is envisaged.

6. ENVIRONMENTAL DESK STUDY

6.1 Scope

This high-level environmental assessment has used the GIS data provided within the attached table. It is important to note that data is not provided for all environmental receptors that may be considered in an EIA screening. For example, information on Sites of Interest for Nature Conservation would need to be gathered following the Preliminary Environmental Assessment.

6.2 Overall assessment

- Proposed extension of existing building to accommodate installation of a new treatment plant to remove lead from spring water at Sherborne WTW. Primary works are to install new tanks for flocculation and coagulation, upgrading of pumping systems and the installation of a submerged membrane treatment plant. Other associated works will include pipework replacement and small-scale works to upgrade other plant and machinery. The works do not fall within Schedule 1 and do not cover a sufficient area to exceed the indicative thresholds for Schedule 2 of the EIA Regs. '99. This would indicate that an EIA is unlikely to be required. However, as detailed below, the site is located within a sensitive area and the opinion of the local planning authority (LPA) should be sought to confirm whether they would require an EIA for this development.
- The site falls within the Mendip Hills Area of Outstanding Natural Beauty (AONB) which is a formally defined 'sensitive area' under the EIA Regs. This is the most southerly example of carboniferous limestone landscape in Britain.
- The below ground works are not likely to require planning permission as they should fall within Bristol Water's permitted development rights. However, the extension of the building to house the new plant, and any separate temporary works compounds, may require planning permission and consultation should be sought with the LPA.
- If a planning application is required, but an EIA is not required, then a supporting statement should be submitted to the LPA to outline the environmental constraints and actions taken (such as surveys).
- *It is important to note that should an EIA be required by the LPA then all permitted development rights will be lost and a planning application would need to be submitted alongside the Environment Statement (report generated by the EIA).*

6.3 Summary of environmental constraints

- The Sherborne site is located within a patch of woodland. These woodlands are not listed as 'important bird areas' by the RSPB. However, further information should be gathered to establish if any other protected species have been recorded in the woods. If protected species, such as dormice have been identified, then it will be necessary to avoid damage to

any woodland or hedgerows connected to woodland. If hedgerows are to be removed then a Hedgerow Removal Notice should be submitted to the LPA.

- There are two abstractions within 50m of the proposed site. This would be taken into account by the LPA and it is likely that special construction measures will be required to reduce the risk of transmitting polluting materials to groundwater used for abstraction.
- As the proposed works are located within an AONB, consideration should be given to the impacts of the building upon the landscape. Consultation with the LPA regarding landscape assessment may be required.

6.4 Recommendations for future surveys/investigations

- Although the project does not exceed the indicative thresholds for an EIA under Schedule 2, an EIA screening opinion will be required from the LPA as the site is within a designated sensitive areas.
- The LPA will also need to be consulted regarding planning permission for the building extension.
- The treatment process will generate waste lead-laden sludge that will need disposal. Consultation should be undertaken with the Environment Agency to ensure appropriate disposal of waste will be possible and that it can be licensed and agreed before the scheme is built.
- Preliminary Environmental Assessment (PEA) will be required to identify specific environmental issues.
- A phase one habitat assessment / walkover survey will be required to identify potential protected species, invasive species and protected habitats.
- Once identified in the Phase One survey, protected species surveys will be required.
- It may be necessary to gather information on Local Sites of Interest for Nature Conservation before receiving a screening opinion. This information is held by Bristol Regional Environmental Records Centre (BRERC) who makes a minimum charge of £90 per enquiry.
- As there are 2 abstractions within 50m of the works, special construction measures will be required to reduce the risk of transmitting polluting materials to groundwater used for abstraction.

7. HYDRAULIC REVIEW

No hydraulic review has been undertaken at this stage.

8. TECHNICAL DETAILS

8.1 Proposed plant

The new treatment plant will have a capacity of 7 Ml/d and consist of coagulation, flocculation and submerged membranes to remove lead. The existing chlorination system will be used to provide marginal chlorination.

It has been demonstrated by jar testing that by adding a suitable coagulant most of the lead can effectively be removed from the Sherborne spring water. Floc particles containing lead will be filtered out by the submerged membrane. Backwash wastewater from the submerged membrane plant along with CIP neutralised chemical waste will be treated and the sludge will be treated before disposal. Treated water will be chlorinated.

The coagulation tank volume will be 2.43m3 with a depth of 0.75m. The size of the flocculation tank will be 64.8m3 with a depth of 1.5m. The water will be dosed with Poly Aluminium Chloride (PACl) and a PACl storage area will be constructed adjacent to the coagulation tank.

A manually cleaned basket strainer with 2mm screens will be installed prior to the submerged membranes.

The existing membrane plant building will be upgraded by extending the existing building as shown on the Drg. No. Q9-001-1 to accommodate the new submerged membrane plant. The existing pressurised membrane plant will be decommissioned and removed. The existing building slab will need to be modified to include the necessary sumps and bunds required for the proposed plant. The proposed submerged membrane plant will have a foot print of 25m x 11m. It will contain five cells and forty eight modules per cell.

Marginal chlorine (1mg/l) will be applied to treated water using the existing chlorination system.

Sludge will gravitate to a 20 m^3 sludge balancing tank. Forwarding pumps will lift the sludge into a sludge settling tank. The tank will consist of two cells each 25m^3. One cell will contain sludge that is settling while the other cell is filling. Settled sludge will be tankered from site and a tanker fill point will be constructed. Supernatant will gravitate to the local watercourse subject to a consent to discharge.

It should be noted that the site is wooded and the construction of much of the new works will require trees to be felled and the ground cleared.

8.2 Submerged Membrane plant

Submerged membranes are a DWI recognised barrier against cryptosporidium and there is therefore no requirement for DWI approved cryptosporidium monitoring. The membrane can also be used as a primary disinfectant meaning water requires marginal chlorination only. This is to be provided by the existing gas chlorination system.

The membranes are backwashed with air at regular intervals (e.g. 30 to 45 minutes) to dislodge solids build-up on the membranes, and chemically cleaned with hypochlorite or acid on a less frequent basis (e.g. every 28 days). Chemical waste coming from cleaning by acidic, alkaline or chlorinated cleaning agents will be neutralised in a neutralisation tank before being pumped to the neutralised waste holding tank.

Backwash waste water (up to 200m3/d) produced by the membrane plant will be discharged into the existing water course that was used to discharge backwash wastewater from the pressurised membrane treatment plant. The consent will need to checked since the backwash will now be from a different process.

The following process plant is proposed:

Equipment from Membrane supplier:

- Membrane cells
- Filtrate pumps
- Cleaning in place chemical tank
- Backwash water tank
- Air blower, compressor, air receiver
- CIP chemical storage (carboys) and dosing sets
- Media neutralisation unit

Additional equipment included with membrane plant

- CIP waste tank (holds untreated waste prior to treatment by the waste neutralisation unit).

Other equipment not included with membrane plant:

- 2mm pre-filter (manual basket filter on inlet pipe - single or dual perforated basket filter)
- Modifications to pipework
- Neutralisation tank feed pumps to Neutralisation Media Unit
- Neutralised waste storage tank for tanker pickup
- Backwash wastewater storage tank and disposal infrastructure
- Flow and quality meters, other instrumentation

8.3 Pipeline size/ material data

The 300mm DI pipe is to be extended from the existing pressurized membrane plant building as shown on the Drg.No. Q9-001-1. A new 100mm DI pipe is to be laid from sludge settling facilities to dispose supernatant into the existing stream.

8.4 Modification to the Pumping plant

The existing low lift pumping plant near the spring water collection chamber will lift water to the proposed submerged membranes. An additional pump and associated switchgear is to be added to bring the combined duty up to 7 Ml/d. The existing pumping station building is to be extended.

8.5 Collection Chamber

Sherborne spring water collection chamber must be renovated.

8.6 Power Supply

A detailed assessment of the power supply has not been undertaken at this stage however it is anticipated that the load will be similar to the existing works. It is assumed the existing power supply to the site will meet the proposed load.

9. BUILDABILITY

The most significant buildability issues associated with the construction of the plant are:

1) Working close to existing plant on an operational site;
2) Working on a site within an Area of Outstanding Natural Beauty and within a site which is likely to be environmentally sensitive.

10. RISKS AND OPPORTUNITIES

1) Sludge: There may be difficulties in finding a suitable place to dispose sludge that contains higher lead concentrations.
2) Planning: The site is wooded and located in an Area of Outstanding Natural Beauty. The sludge plant will require tanker movements for removal of the sludge. There is therefore a risk that planning constraints will increase the cost of the scheme.
3) Consent to Discharge: There is a risk that a consent to discharge will not be renewed because the water treatment process and volumes of discharge will change.

11. COST INFORMATION

Costs are summarised in the table below (price base 2007/08):

Summary of Netts	£2,861,693
Summary of Contractors overheads & prelims	£1,142,431
Summary of design costs	£186,010
Summary of BW costs (excluding BW supervision)	£765,285
Contingency - to cover change of scope (10% of scheme total)	£495,542
BW costs	£163,529
Scheme CAPEX Total (excl. OPEX costs)	**£5,614,489**
Scheme OPEX Total (pa)	**£109,239**

More detailed cost information is included in the Cost schedule attached in Appendix 6.

12. PROGRAMME

Programme details are attached in Appendix 7.

13. CONCLUSIONS

To comply with the proposed 2013 PCV for lead of 10 µg/l it is proposed to install new treatment plant at Sherborne. The proposed plant will consist of coagulation, flocculation, submerged membranes and sludge treatment facilities with output uprated to 7Ml/d.

APPENDICES

Appendix 1 – General Arrangement Drawing

Appendix 2 – Environmental Constraints Map

Appendix 3 – Environmental Schedule

Appendix 4 – Geological Map

Appendix 5 – Risk Register

Appendix 6 – Cost Schedule

Appendix 7 – Construction Programme

Appendix 8 – Cost Analysis: Conventional Treatment vs Submerged Membranes