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BRISTOL WATER PR09

Q7 - Egford Wells
Preliminary Design Report

January 2009

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Q7 - EGFORD WELLS

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Document issue details:

B&V project no.: 121300-0400 **Client's reference no.:** PR09

Distribution:

Revision no.	Issue date	Issue status	Written	Checked	Reviewed
1		Initial draft	SB		
2	21/10/08	Second Issue	AJW	SB	
3	19/11/08	Third Issue	AJW	SB	
4	27/1/09	Fourth Issue	AJW	SB	JH

Q7 -EGFORD WELLS

1. INTRODUCTION

The Egford wells have the potential to yield 5Ml/d. Nitrate levels at Egford have exceeded the Prescribed Concentration Value (PCV) and caused the works to be removed from service for periods over the last two years. The statistical trends show increasing levels of nitrate over time. To enable the source to be used reliably a blending solution to the nitrate problem is proposed.

When nitrates at Egford are sufficiently low raw water is abstracted from two wells at Egford and pumped to Frome treatment works (TW). The treated water from Frome TW is collected in Frome reservoir.

Oldford Treatment Works is located a few miles away north of Frome and treats raw water abstracted from Oldford borehole. The Oldford TW yield is 15Ml/d and the treated water from Oldford TW contains relatively low level of nitrates. Treated water from Oldford TW is pumped to Frome reservoir with off-takes to Norton St.Philip reservoir, Cuckoo Lane, Frome Vallis Way and a number of small domestic supplies. Before discharging to Frome reservoir a connection enables Egford Booster pumps to lift approximately 7Ml/d up to Leigh-on-Mendip. The remainder is discharged into Frome reservoir. During high demand water back flows from Frome reservoir to the offtakes to Egford booster and the Frome offtakes.

Both Frome and Oldford treatment methods are similar and consist of pressurised ultra filtration membranes and marginal chlorination. The ultra filtration membranes do not reduce the nitrate levels in the Egford raw water. Therefore it is proposed to blend the treated water from Frome and Oldford works prior to discharge into Frome reservoir. A modification to the Egford booster connection arrangement will enable sufficient water to be made available from Oldford for blending. To ensure that the scheme is resilient to a failure of Oldford a 7ML reservoir will be constructed at Egford.

1.1 OS reference

Frome reservoir site: 376461, 148084 ST 7648

2. DRIVER FOR SCHEME

Nitrate is a health hazard in drinking water supply if it exceeds the limit. Nitrate monitors are installed in the Egford well resources. These monitors shut the treatment works down automatically at a pre defined high alarm settings. However, this cannot be accepted as a medium/long term solution. The UK Water Supply (Water Quality) standard is 50mg/l as NO_3. It was observed the nitrate level in Egford treated water exceeds the PCV 50 mg/l in many occurrences. It is therefore necessary to find a treatment solution to reduce nitrate levels in the Egford treated water.

The drivers for the scheme are listed in the scheme database as follows:

5WA1 - Water treatment - nitrate removal
SDB2 - Growth - treatment/production.

3. OPTIONS CONSIDERED

Four principal options were considered:
1) Catchment management
2) Blending treated water from Egford and Oldford TW using:
   (a) a pipe connection with static mixer;
   (b) a blending structure.
3) Blending raw water from Egford and Oldford and extension of Oldford TW to treat the combined yield.
4) Ion exchange treatment at Egford.

3.1 Catchment Management

Bristol Water have spoken to the Environment Agency and the 'Farming and Wildlife Advisory Group' (FWAG) about catchment management initiatives as a long term solution to the increased levels of nitrate seen in the raw water sources during certain times of the year. However, this is unlikely to give any real benefit in the medium term.

3.2 Blending Treated Water

During average demand (and with the necessary Egford booster connection modifications) in excess of 10Ml/d is available from Oldford TW to blend with 5Ml/d from Frome TW. If the treated water from both Frome treatment plant and Oldford treatment plant are blended in 1:1 ratio the average nitrate level in the blended water would be 34 mg/l. This is less than standard limit (PCV) and therefore acceptable. The minimum blend ratio is therefore 1:1 but typically higher blend ratios will be achievable.

Under both the blending treated water options the exisiting treatment works at Frome TW will be operated. The existing membranes at Frome are close to their design life and will need replacement. This should be done under a separate maintenance budget and does not form part of this scheme.

This blend option does not need any chemical inputs such as resin as used in ion exchange. There are no problems of waste generation and disposal and a blending solution will be cheaper than a treatment solution. Environmentally blending is preferred as it produces no waste and uses no chemicals.

Three options were considered to achieve the blending:

(a) A pipe connection with static mixer:

Blending will be achieved by installing a 300mm pipe linking Frome treatment works with the 18" AC pipe from Oldford treatment works at the Frome reservoir site. The pipes will be joined at a tee and a 500mm diameter low head static mixer will be installed downstream of the tee to ensure the flows are adequately blended. Flow meters will be installed on the 300mm pipe from Frome TW and the 18" pipe from Oldford TW. The flow meters will link to a control system to ensure that a 1:1 blend is always achieved. If there is insufficient flow to achieve this blend then the supply from Frome TW will be inhibited.

This option has the disadvantage that high nitrate water from Egford could potentially reach customers connected to the pipeline from Oldford to Frome. This could occur if there was low pressure in the Oldford to Frome main and the inhibit on the Egford supply failed. At this stage this option is rejected as it will require more detailed design work to demonstrate how a control system could make this solution sufficiently robust.

(b) A blending structure:

To prevent Egford water from reaching customers before it has been blended both Oldford and Egford water will freely discharge into a concrete blending structure. An air gap and overflow will ensure that there is no risk of back flow to customers. Blending will be achieved hydraulically using the free fall into the blending structure and using the existing static mixer in the downstream pipework.

(c) A reservoir:

If Oldford treatment works were to fail then the supply from Egford would also be lost if the failure occurred at the same time as high nitrates in Egford. To mitigate against this a reservoir is to be constructed at Egford to provide a buffer volume of water to blend with the Egford water while Oldford is brought into service. It is proposed that 12 hours storage is provided equating to a 7ML reservoir.

If the Oldford Support Scheme is constructed the Egford water can be blended with water from Stowey transferred through the Oldford Support Scheme. In this case it is proposed to provide 4 hours storage to give sufficient time to make the decision to transfer water through the Oldford Support Scheme. This equates to a reservoir of 2.5ML capacity.

If a reservoir is constructed this will provide the required air gap to prevent backflow. The blending can take place on the reservoir outlet using a static mixer.

3.3 Blending Raw Water

The option to blend raw water from Egford and Oldford at Oldford was considered. The capacity of the works at Oldford is 15Ml/d so the works would need to be extended to meet the combined yield. To achieve the raw water blending a new 4km long pipeline from Egford to Oldford would need to be constructed.

To extend the works at Oldford is was proposed to dismantle the existing membranes at Frome TW and reinstall them at Oldford.

The cost of this option to blend raw water was estimated at £11.6M excluding OPEX.

3.4 Ion Exchange

Ion exchange is an efficient treatment process to remove nitrate from water. Recovery is relatively high as compared with other nitrate removal processes. However it needs large amount of chemicals to be stored at the site and regeneration of resin at the site needs a larger footprint. Disposal of brine waste is not cost effective. Wessex Water were approached to see if the brine could be discharged into their sewer but this was not acceptable to them because of the high nitrate levels expected in the brine.

This option was not feasible so was not costed.

4. INTERACTION WITH OTHER SCHEMES

4.1 R3 – Oldford Support Scheme

Oldford TW is the primary source of supply to Frome. If Oldford failed then there is a risk that Frome could lose its supply. The Oldford Support Scheme is a resilience scheme to provide a secondary source of supply to Frome.

Water will be transferred from Stowey through a proposed 23km long pipeline. The pipeline will connect to the existing pipeline between Oldford and Frome reservoirs close

to the Egford Booster offtake. A pumping station will be constructed in Frome close to the Egford Booster pumping station.

5. GEOTECHNICAL SUMMARY

5.1 Geology

The site lies on the Forest Marble Formation, consisting predominantly of clay and calcareous mudstones irregularly interbedded with limestones. It is expected to provide a competent foundation. Immediately to the south of the site is a superficial deposit of sand and gravel.

5.2 Recommendations for site investigation

At this stage no site investigation is proposed.

6. ENVIRONMENTAL DESK STUDY

6.1 Overall assessment

- Proposed above ground works to install blending facilities at Frome reservoir and associated reservoir, pipeline replacement and connection. The works do not fall within Schedule 1 or 2 of the EIA Regs. '99. An EIA is therefore unlikely to be required. However, the opinion of the local planning authority (LPA) should be sought to confirm this.
- The below-ground pipework is not likely to require planning permission as it should fall within Bristol Water's permitted development rights. However, any above ground blending structure and any separate temporary works compounds are very likely to require planning permission and consultation with the LPA.
- If a planning application is required then a supporting statement should be submitted to the LPA to outline the environmental constraints and actions taken (such as surveys).
- The site does not fall within 500m of any statutory receptors as defined by the EIA Regs.

6.2 Summary of environmental constraints

- The site is 838m from Vallis Vale SSSI. Vallis Vale is an ancient woodland site and supports an Ash-Wych Elm stand type with a restricted distribution in Britain.
- The site is also 833m from the Mells Valley SAC.
- There are no archaeological constraints identified within 500m of the site and the nearest scheduled monument (Tedbury Camp) is 1432m away.
- The site is located in agricultural land classified as '3' which indicates that it is likely to be seen as the 'best or most versatile land'. This would be taken into consideration by the LPA during their screening and they may require further study

6.3 Recommendation of surveys required

- An EIA screening opinion will be required from the LPA
- The LPA will also need to be consulted regarding planning permission for the blending structure and any other above ground structures.
- 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 make a minimum charge of £90 per enquiry.

- Information on Public Rights of Way and (built) Conservation Areas will need to be gathered following the PEA.

7. HYDRAULIC REVIEW

The hydraulics of the scheme have been reviewed by Bristol Water's Network Planning Team.

8. TECHNICAL DETAILS

As described in section 4.2(c) above, a reservoir will be constructed at Egford and the treated water from Frome TW and Oldford TW will be blended on the reservoir outlet. A low lift pumping station will lift water into the existing Frome reservoirs.

Three flow meters and seven EOVs will be installed to allow the system to be controlled automatically. The EOVs and flow meters will be used to prevent water preferentially flowing into the reservoirs rather than the blending structure and will be fitted onto the two inlets to the Frome reservoirs and one on the new connection linking the Oldford pipeline to the reservoir.

To ensure that there is sufficient water available for blending it is necessary to lay an additional pipeline from Frome Reservoir to the connection for Egford booster pumps. Typically some 7Ml/d is boosted by the Egford Booster pumps to Leigh-on-Mendip but currently this water is boosted to Leigh before it reaches Frome reservoir. The additional pipeline together with a new outlet from Frome reservoir will allow water from Frome reservoir to be transferred to Egford boosters after it has been blended.

Water from Leigh-on-Mendip is pumped to Millmarsh break pressure tank. To ensure that there is sufficient capacity to make best use of the blended water it is necessary to install a bypass with an EOV at Forum. This will allow water to gravitate from Millmarsh (TWL 275.2m) to Maesbury reservoir (TWL 256.8m) which is currently restricted by a non-return valve.

8.1 Reservoir

A 7ML covered service reservoir is proposed complete with valve chamber and low lift pumping station. Two cells of the reservoir are proposed so that one can be taken out of service for inspection and maintenance. The overall dimensions of the reservoir will be 56m x 28m x 5m high. The reservoir will be constructed partially in the ground and covered so that a balance between cut and fill is achieved.

8.2 Pipeline size/ material data

The following pipelines are required:

1) Frome reservoir to Egford Boosters main: 400mm diam DI, 205m long;
2) Reservoir to Frome reservoir inlet: 500mm diam DI, 80m long
3) Connection from Oldford pipeline to reservoir: 500mm diam DI, 92m long;
4) Egford borehole raw main to Reservoir: 300mm diam DI, 60m long;
5) Bypass at Forum: 300mm diam DI, 9m long.

An overflow and washout pipeline from the reservoir will connect to the existing washout pipeline. The overflow pipeline will be 300mm diameter plastic pipe and 39m long and

include an intermediate manhole and a manhole at the connection to the existing washout. Each manhole is to be 1.2m internal diameter and 2m deep.

8.3 Pumping Station and Pumping plant

A low lift pumping station is to be constructed on the reservoir outlet. The pumping station will have 3 pumps (duty/ duty/ standby) with a total duty of 10Ml/d at 5m head. The pumps are to have variable speed drives.

It is not expected that any changes will be required to Oldford TW pumping plant or Frome TW pumping plant.

8.4 Electrically Operated Valves (EOV)

Seven EOVs are required for automatic control of the system. The valves will be two 450mm diameter, four 500mm diameter and one 300mm diameter butterfly valves.

One 300mm diameter EOV is required at Forum bypass. Approximately 34m of 150mm diam 2 way duct will be required together with 2 drawpits to cable the EOV back to the existing pumping station at Forum.

Three actuators will be mounted on a concrete slab above ground and housed in a Technocover kiosk. The remainder will be inside the valve chamber attached to the reservoir.

8.5 Other

A 500mm diameter directly buried manually operated butterfly valve is required on the inlet to Frome reservoir and on the feed to the new reservoir. One 400mm diameter directly buried manually operated butterfly valve is required on the new outlet pipeline from the reservoir.

Three flow meters are required: two 450mm diameter and one 500mm diameter. One flow meter will be installed inside the existing pumping station and the other two flow meters will be installed in below ground concrete chambers.

Approximately 70m of 150mm two way ducts are required together with 5 drawpits. The instrumentation panel for the EOVs and flowmeter will be installed in the existing treatment building.

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 in a small congested site;
3) working close to a school and housing.

10. RISKS AND OPPORTUNITIES

1) Sufficient space may not be available to install the reservoir. It is not known whether the proposed site can be purchased from the school. If an alternative site is required this may require additional land to be purchased and longer pipe lengths.
2) The site is small and congested with existing plant.

11. COST INFORMATION

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

Summary of Netts	£2,444,928
Summary of Contractors overheads & prelims	£953,876
Summary of design costs	£158,920
Summary of BW costs (excluding BW supervision)	£663,246
Contingency - to cover change of scope (10% of scheme total)	£422,097
BW costs	£ 139,292
Scheme CAPEX Total (excl. OPEX costs)	**£4,782,361**
Scheme OPEX Total (pa) (see below)	**£51,000**

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

If the Oldford Support Scheme is also constructed then the reservoir will reduce in size creating a saving of approximately £700,000.

12. PROGRAMME

Programme details are attached in Appendix 7.

13. CONCLUSIONS

To treat high nitrates in the water from Egford Wells a blending solution is proposed. This is to include a 7ML reservoir, low lift pumping station, actuated valves and inconnecting pipework. If the Oldford Support Scheme is also constructed the capacity of the reservoir can reduce to 2.5ML.

APPENDICES

Appendix 1 – General Arrangement Drawings

Appendix 2 – Environmental Contraints Map

Appendix 3 – Environmental Constraints Summary Table

Appendix 4 – Geological Map

Appendix 5 – Risk Register

Appendix 6 – Cost Schedule

Appendix 7 – Construction Programme