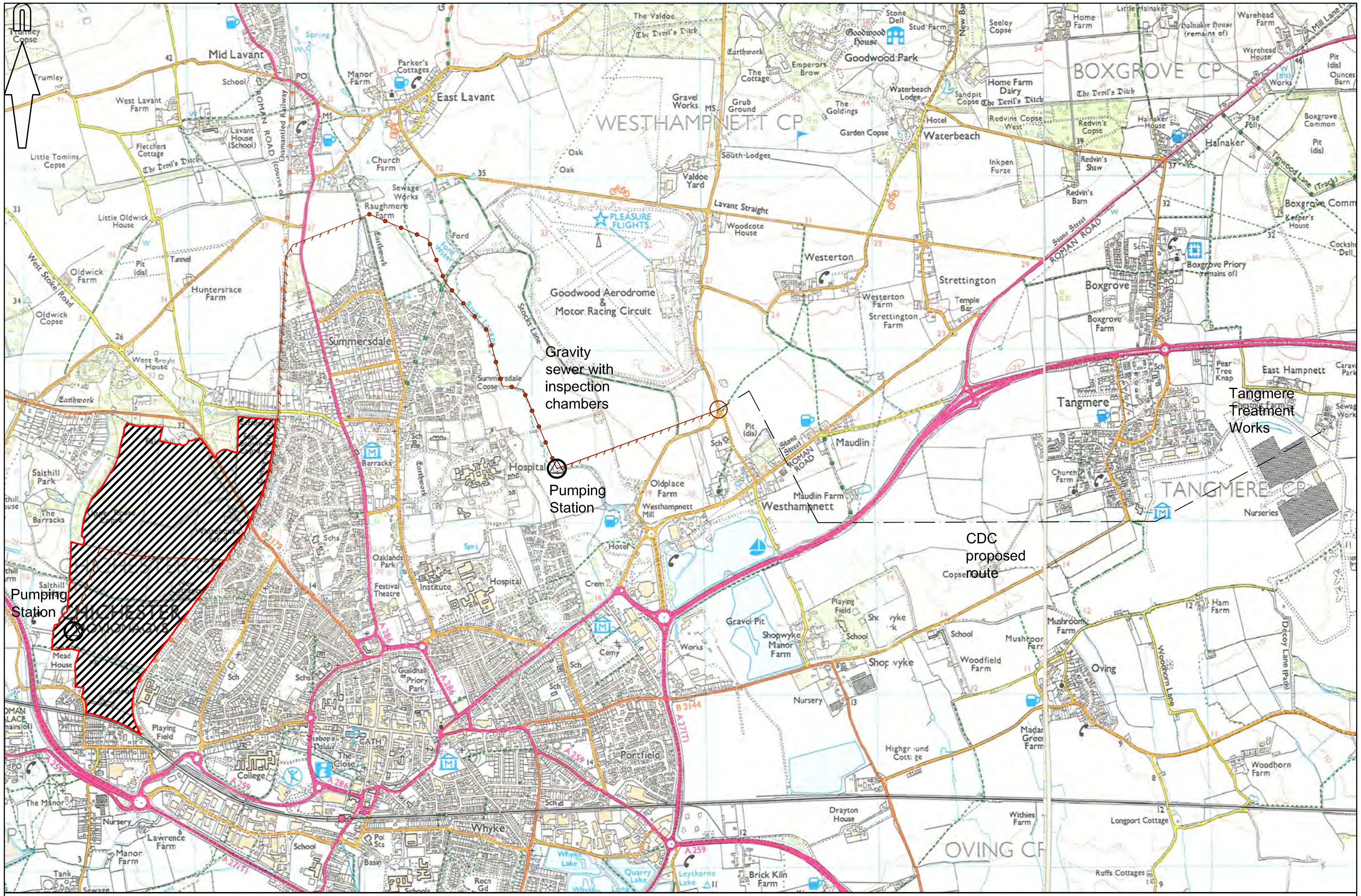
APPENDIX D: INDICATIVE SEWER LINK TO TANGMERE



Site boundary	Rising main (arrows indicate direction of flow)	Gravity sewer (Circles indicate inspection chambers)	Chichester District Council proposed route (Rising main)
Pumping Station	**315mm OD**		
	Total length 3590m	Total length 1970m	Total length 4120m
	Length under fields 3270m	Length under fields 1940m	Length under fields 4060m
	Length under roadway or footpath 320m	Length under roadway 30m	Length under roadway 60m
	400mm OD		
	Total length 1000m		
	Length under fields 960m		
	Length under roadway 40m		

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PRELIMINARY
NOT FOR CONSTRUCTION

rev.	amendment	checked	date
B	Development area and rising main amended	PAS	03/12/2014
A	Showing different pipe diameters	PAS	22/08/2012

mayer brown
Mayer Brown Limited Lion House
Oriental Road Woking Surrey GU22 8AR
Telephone 01483 750 508 Fax 01483 750 437
wokingoffice@mayerbrown.co.uk www.mayerbrown.co.uk

client
MILLER STRATEGIC LAND AND

project
LAND AT WHITEHOUSE FARM, CHICHESTER

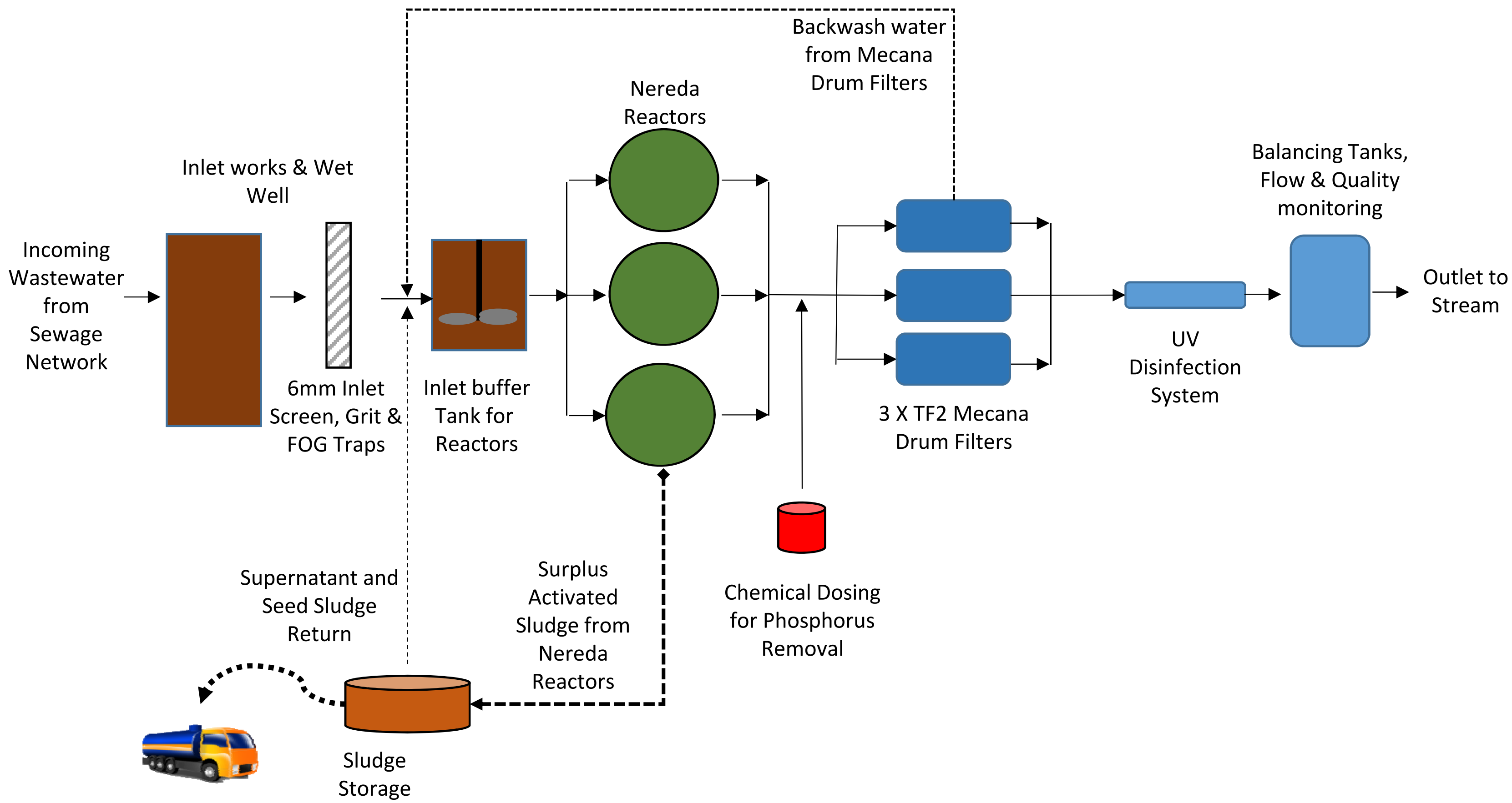
scale 1:25000@A3 | drawn by LS | checked by PAS
date AUGUST 2012 | cad file SK01.dwg

title
INDICATIVE FOUL SEWER- FIGURE 1

drawing number SK01 | rev. B

APPENDIX E: SEWERAGE TREATMENT SCHEMATIC DIAGRAM

Draft Schematic for Proposed WWTW at Whitehouse Farm Chichester



APPENDIX F: ENVIRONMENT AGENCY PRE-APPLICATION RESPONSES

Mr. Paul Stewart
Associate
Mayer Brown Ltd
Lion House
Oriental Road
Woking
Surrey
GU22 8AR

Our ref: EPR-SB3338AD

Your ref: EPR-SB3338AD/MJ/002

Date: 19 August 2013

Dear Mr. Stewart

Environmental Permitting (England and Wales) Regulations 2010, Pre-Application EPR-SB3338AD 2nd Consultation - Summer 2013

Thank you for your correspondence of 8th July 2013 containing *"White House Farm Chichester, Environmental Permit Pre-application (EPR/SB3338AD/A001), July 2013".*

This response summarises our water discharge permit pre-application advice. It is based on the outline proposal for up to 1600 dwellings outlined in the supplementary report. The Environment Agency considers that the key issue of this proposal is the total nitrogen loading of the development and associated waste water discharge and its potential impact on the Chichester and Langstone Harbours Special Protection Area (SPA) and the Solent Maritime Special Area of Conservation (SAC). The development should not lead to a net increase in nitrogen load to Chichester Harbour. We would prefer if the development resulted in a net reduction in load.

Should you apply for a permit, we will assess the likely significant effect of the proposed water discharge activity on this SPA and SAC, in consultation with Natural England. If you demonstrate that you can meet the principle regarding no net increase in nitrogen then we are likely to permit the discharge. Natural England has indicated that it is open to consider this approach to nitrogen loading.

The permit application must include a management system, including maintenance programmes. Further guidance on how to comply with a water discharge activity permit can be found in the guidance document EPR 7.01, which can be found at http://www.environment-agency.gov.uk/business/topics/water/121308.aspx

Your permit application must include substantiated evidence that treatment to achieve the required discharge quality is feasible and practical and that any limits can be met. You would need to confirm whether or not the onsite treatment works is to be designed for adoption under the Water Industry Act.

INVESTOR IN PEOPLE

Baseline data

We consider the generic approach to be sufficient to allow us to determine an application for a permit. We note that supporting data has been put forward within the report with respect to predicted levels of diffuse pollution. The baseline should be taken as the nitrogen load lost to water from the site through adoption of good agricultural practice. If you apply, you must provide an audit of the land use to demonstrate good practice is being applied. You could use a model such as FARMSCOPER on ADAS' website to demonstrate nitrogen load.

The quality of the discharge would need to be such that all other water quality standards would still be met in the receiving water. We are likely to require disinfection of the effluent to protect the shellfish beds. You state that no baseline bacteriological data is currently available for review. You must provide an assessment of the bacteriological impact of the discharge in your permit application.

Other comments

We consider that private treatment plants pose a greater risk to the environment than those owned and operated by a sewerage undertaker. If the permit application is made by a company that is currently a sewerage undertaker (not necessarily for that specific area) then we would treat the application as if it is to mains drainage. We would include a pre-operational condition within the permit that the permit holder must be appointed by OFWAT as the sewerage undertaker for the development area. This condition would need to be complied with before commencement of the discharge.

If you have any queries regarding the above then do not hesitate to get in contact.

Yours sincerely,

R. Pearson

Rod Pearson
Environment Management Team Leader – West Sussex
Direct Dial: 01243 756362
Email: rod.pearson@environment-agency.gov.uk

Please direct queries to Mat Jackson 01243 756343

Paul Stewart

From: PlanningSSD <PlanningSSD@environment-agency.gov.uk>
Sent: 27 August 2014 16:36
To: Paul Stewart
Cc: Stephen Bradley; paul.thomas (Southampton); Ben Rosedale; Richard Ayre (Linden Homes); martin.hawthorne; Andy Evans
Subject: RE: HA/2014/116058 Land West of Chichester/Whitehouse Farm

Dear Paul

Thank you for your email below.

I can confirm that the advice in relation to the consideration of sewerage undertakers provided in our letter to you on 19th August 2013 in response to your pre-permit application consultation under the Environmental Permitting Regulations is still most relevant.

However, this does not change what we would expect to be scoped in as part of the EIA for any planning application. For this reason I do not consider that there is any need to revise our letter to Chichester District Council.

We fully support your intention for Albion Water to make the Environmental Permit Application with the aim of this being determined prior to the planning application.

Given the level of detail regarding the foul drainage proposals any further advice relating to this should be in relation to the Environmental Permit and therefore outside of the scope of our planning advice. I would recommend that you contact our National Permitting Service on 03708 506 506 to commence discussions with our National Permitting Service.

We would be happy to provide you with an offer letter for our planning advice service in relation to ecological issues and flood risk (as requested by your colleague). The offer letter will include a 'programme of works' which will include our time and cost estimates for reviewing any information you wish us to look at. I can provide you with this in the next 10 days.

Kind regards
Catherine

Catherine Hutchins, MRTPI

Sustainable Places Planning Advisor
Environment Agency – Solent and South Downs Area
Tel: 01903 703858
Email : PlanningSSD@environment-agency.gov.uk

From: Paul Stewart [mailto:pstewart@mayerbrown.co.uk]
Sent: 26 August 2014 11:07
To: PlanningSSD
Cc: Stephen Bradley; paul.thomas (Southampton); Ben Rosedale; Richard Ayre (Linden Homes); martin.hawthorne; Andy Evans
Subject: HA/2014/116058 Land West of Chichester/Whitehouse Farm

FAO Catherine Hutchins

Dear Catherine,

Further to our telephone conversation of last Friday, 22nd August. I wish to register my disappointment at the tone of the consultation response provided to CDC in relation to the above project which appears to be a retrograde step on the progress that has been made in discussions with the EA previously.

I agree that the EIA needs to cover the issue of on site treatment fully due to the potential negative impact on Chichester Harbour, this has always bneen our intention.

I have attached the latest EA consultation on the Environmental Pre-application for this proposal, which states “if you can demonstrate that you can meet the principle regarding no net increase in nitrogen then we are likely to permit the discharge. Natural England has indicated that it is open to consider this approach to nitrogen loading”

It further states that the generic approach provided is sufficient to allow determination for a permit, with reference to the Farmscoper model. We have audited the farmer’s usage, he is compliant with the restrictions on use of fertilisers within the NVZ. I have attached a summary of the farmscoper model for your interest.

We would challenge the comment about judging the treatment works as a private treatment works when this is clearly not the intended proposal. Your previous correspondence stated “If the permit application is made by a company that is currently a sewerage undertaker (not necessarily for that specific area) then we would treat the application as if to mains drainage. We would include a pre-operational condition within the permit that the permit holder must be appointed by OFWAT as the sewerage undertaker for the development area. This condition would need to be complied with before commencement of the discharge”

We are working with Albion Water in respect of the treatment works who in partnership with their process engineers have prepared a preliminary scheme. It is our intention for Albion Water to make the Environmental Permit Application as soon as possible with the aim of consent prior to determination of the planning application.

Finally, I have attached correspondence confirming the discussions that we have had with the EA in respect of faecal coliform removal. Albion Water have confirmed that they can comply with this standard.

Firstly, I would be grateful if you could review your comments to the LPA, which appear to cast the on-site treatment solution in a negative light, without considering any of the potential environmental benefits.

Secondly, I would be grateful if you could provide charging advice to arrange a series of pre-application meetings. I would suggest budgeting for 3 meetings to develop the context and detail of the treatment solution and Environmental permit and potentially other ecological issues on site.

I look forward to hearing from you in due course.

Kind Regards,
Paul

Paul Stewart,
Associate
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Paul Stewart

From: Udal, Ian <Ian.Udal@environment-agency.gov.uk>
Sent: 25 October 2013 14:36
To: Paul Stewart; Ben Rosedale
Cc: martin.hawthorne; 'Andy.Evans@miller.co.uk'; Frances Palmer (Linden Homes South West) (Frances.Palmer@LindenHomes.co.uk); Richard.Ayre@lindenhomes.co.uk; Tom Wigglesworth; Matthew Bartram; Hyland, Hannah; McLeod, Catherine; Pearson, Rod; Jackson, Mat; Clement, Maxine
Subject: RE: EPR-SB3338AD - White House Farm, Chichester

Paul

I believe a level of 1100 fc/100ml would be likely to be accepted without the need for additional backup information.

E.coli and faecal coliforms are very similar – most faecal coliform bacteria in the environment are E.coli anyway. The Shellfish Waters Directive standard is likely to move to E.coli soon but the same numeric standard as currently for FC. Any standard set for one will be relevant for the other.

Regards
Ian

From: Paul Stewart [mailto:pstewart@mayerbrown.co.uk]
Sent: 25 October 2013 14:09
To: Udal, Ian; Ben Rosedale
Cc: martin.hawthorne; 'Andy.Evans@miller.co.uk'; Frances Palmer (Linden Homes South West) (Frances.Palmer@LindenHomes.co.uk); Richard.Ayre@lindenhomes.co.uk; Tom Wigglesworth; Matthew Bartram; Hyland, Hannah; McLeod, Catherine; Pearson, Rod; Jackson, Mat
Subject: RE: EPR-SB3338AD - White House Farm, Chichester

Ian,
Thank you for a full response. Just two follow up points of clarification from me.

If we accepted your suggested level of 1100fc/100ml, would you be likely to be satisfied without additional backup information?

Ben described a differentiation between Escherichia coli & faecal coliforms, I am not an expert in this area, but I shall be setting a brief for people that are. You have stated a suggested faecal coliform standard, is there an additional requirement for Escherichia coli or would meeting the one be deemed to satisfy the other?

Kind Regards,
Paul

From: Udal, Ian [mailto:Ian.Udal@environment-agency.gov.uk]
Sent: 25 October 2013 12:26
To: Paul Stewart; Ben Rosedale
Cc: martin.hawthorne; 'Andy.Evans@miller.co.uk'; Frances Palmer (Linden Homes South West) (Frances.Palmer@LindenHomes.co.uk); Richard.Ayre@lindenhomes.co.uk; Tom Wigglesworth; Matthew Bartram; Hyland, Hannah; McLeod, Catherine; Pearson, Rod; Jackson, Mat
Subject: RE: EPR-SB3338AD - White House Farm, Chichester

Paul, Ben

Any microbial treatment will be required to meet the Shellfish Waters Directive standards. Our Shellfish waters policy sets a standard of 110 faecal coliforms per 100 ml, as a geometric mean in the shellfish water. The concentration of faecal coliforms in sewage is assumed to be 2 x 10^7 per 100 ml, as a geometric mean. Therefore, we require the total reduction from influent to the shellfish water to be 180,000 (2 x 10^7/110).

Therefore the standard of 110 faecal coliforms per 100ml as a mean is required at the shellfish water which extends to the top of Chichester Channel. Initial dilution in the Channel and any dilution in the receiving ditch / stream can be taken into account. A dilution of 1 log (x10) would be a suggestion but you may be able to demonstrate a different value. If 1 log was accepted as dilution of the effluent then the end of pipe standard required would only be 1100 faecal coliforms per 100 ml as a mean.

It is worth mentioning that we do not generally permit microbiological treatment using an end of pipe standard. For instance, a UV treatment plant would need to be designed to agreed specifications to meet the required reductions taking into account effluent composition such as suspended solids levels. Compliance is then assessed on parameters such as UV dose based on lamp intensity and other factors. Some microbial monitoring would be required to check effective reduction in bacteria. Membrane filtration would have other compliance requirements.

I hope the standards supplied above are satisfactory to allow you to consider plant design. Please could you pass further enquiries through our customer services as suggested by Mat Jackson below.

Regards
Ian

Ian Udal
Senior Environment Monitoring Officer (Marine),
Environment Agency, South East Region, Portfield Depot,
Oving Road, Chichester, West Sussex, PO20 2AG.

ian.udal@environment-agency.gov.uk
www.environment-agency.gov.uk
external 01243 75 6332
internal 723 6332

From: Paul Stewart [mailto:pstewart@mayerbrown.co.uk]
Sent: 25 October 2013 08:24
To: Ben Rosedale; Matthew Bartram; Udal, Ian
Cc: martin.hawthorne; 'Andy.Evans@miller.co.uk'; Frances Palmer (Linden Homes South West) (Frances.Palmer@LindenHomes.co.uk); Richard.Ayre@lindenhomes.co.uk; Tom Wigglesworth
Subject: RE: EPR-SB3338AD - White House Farm, Chichester

Thanks Ben,
Most useful.

Ian,
Would you be able to confirm an appropriate discharge value for EC, which we can specify to the plant designers?

Kind Regards,
Paul

From: Ben Rosedale [mailto:benr@edp-uk.co.uk]
Sent: 24 October 2013 17:05
To: Matthew Bartram; Paul Stewart; ian.udal@environment-agency.gov.uk
Cc: martin.hawthorne; 'Andy.Evans@miller.co.uk'; Frances Palmer (Linden Homes South West)

(Frances.Palmer@LindenHomes.co.uk); Richard.Ayre@lindenhomes.co.uk; Tom Wigglesworth
Subject: RE: EPR-SB3338AD - White House Farm, Chichester

Matt/ Paul/ Ian,

I have undertaken a bit of research and spoken to Ian Udal @ EA (cc'd)– whom I spoke with previously regarding the Nitrogen levels/ baseline issue (see my email of 8th July). Ian – please feel free to correct any of my assumptions below.

Ian identified that previous STW license applications, with respect to Shellfish Waters, were granted on the basis of the technical specification [proving that specified required levels could be achieved] – rather than having to prove effects/ changes on the basis of fieldwork/ site survey and reference to an known baseline. The baseline, in particular, is problematic due to the incidences of intermittent discharges (ID's) – or winter/ storm water incidences – affecting the shellfish populations within Chichester Harbour (an unusual situation nationally). (As an aside, Ian did note that UV treatment of IDs from Apuldram was due to be installed soon - and therefore improve the situation within the harbour. A new system on the West of Chichester site would obviously not suffer from the problems of infiltration and excessive storm water discharge – nor would they exacerbate the situation at Apuldram.)

'You must provide an assessment of the bacteriological impact of the discharge in your permit application'

The attached '2013' research paper provides useful background. *'The principal aim of the experiment was to identify water concentrations of this faecal indicator organism that resulted in shellfish flesh values around the 300 colony forming units (cfu) per 100 ml Shellfish Waters Directive (SWD) faecal coliform "guideline" standard and to inform policy on an appropriate national standard under the Water Framework Directive (WFD).'* The identification of a water concentration is not straightforward due to the way in which shellfish accumulate EC (and other pollutants) over time. Accumulation is also not consistent between shellfish species: *'Overall, cockles accumulated the bacteria to a higher level than mussels and Pacific oysters.'* (Chichester Harbour is designated a shellfish water due to cockles, oysters and clams.) Ultimately, the study identified that EC levels fluctuate significantly under normal conditions and failed to show that a causal link between discharge and shellfish flesh pollutant levels can be shown in the field (although research is likely on-going).

In terms of the requirement within the EA letter, 'You must provide an assessment of the bacteriological impact of the discharge in your permit application', Ian suggested that end of pipe levels should focus on Escherichia coli (EC)(rather than faecal coliform or enterococci) at levels of 100 EC/ 100ml or less (which I hope he will confirm via email). I understand that tertiary treatment is commonly able to achieve 1000-100 EC/ 100ml – and I expect that this will have to be proven in the specification of our STW to the satisfaction of the EA.

For further reading, see these research papers:

- '2012' – a literature review of the impact of pollution on Shellfish;
- '2011' – a review of improvement pre- and post-improvements in sewage infrastructure. P46 provides data (faecal coliform or enterococci) and a review of changes following improvements to Apuldram. It also includes a useful summary of the Chichester Channel catchment and factors affecting pollutants to shellfish;
- '2010' – with reference to o Chichester Channel consistently failing SWD standards between 2004 and 2008 – also including data on coliform levels in Chichester Harbour between 2001 and 2008.

I can provide copies of these reports if there are any problems in accessing them.

In summary, the issue may be satisfactorily addressed through agreement on the specification to be achieved by any onsite STW (and provided EC levels of <100 EC/ 100ml can be achieved); the 'assessment' being dealt with by way of a desk based study/ literature review, again, the scope of which to be agreed with the EA.

I will call tomorrow morning to discuss but suggest a response from the EA is needed.

Regards,

Benjamin Rosedale BSc (Hons) MSc CMLI AIEMA
Partner, The Environmental Dimension Partnership **t** 01285 640640 **f** 01285 652545 **m** 07920425132

>>> "Jackson, Mat" <mat.jackson@environment-agency.gov.uk> 14/10/2013 09:38 >>>
Paul,

Thank you for your correspondence and early consultation on these particular matters. I am not the appropriate contact for this query so have directed this towards Ian Udal (ian.udal@environment-agency.gov.uk) and Maxine Clement (maxine.clement@environment-agency.gov.uk) who are particular Marine and Water Quality Specialists that may give a better steer on these matters.

Although happy to assist where I can, for future correspondence please can you direct consolidated queries via our customer services/enquiries function in the first instance as this keeps track of progress and assigns appropriate officers.

Regards,

Mat Jackson MSc, BSc (CombHons) AIEMA
Environment Officer, Land & Water West Sussex
Chichester Office, Oving Road, Chichester, PO20 2AG.

mat.jackson@environment-agency.gov.uk
www.environment-agency.gov.uk
DD 01243 756343
Mob 07825 947686

To report a pollution incident please call our Incident Communication Service **0800 80 70 60**
For all other queries please contact Customer Services: **03708 506 506**

From: Paul Stewart [mailto:pstewart@mayerbrown.co.uk]
Sent: 11 October 2013 18:13
To: Jackson, Mat
Cc: Frances Palmer (Linden Homes South West); Andy Evans; Richard Ayre (Richard.Ayre@lindenhomes.co.uk); Matthew Bartram; Ben Rosedale
Subject: EPR-SB3338AD - White House Farm, Chichester

Hi Matt,
I hope that you are keeping well. I will be engaging with some treatment process engineers shortly in respect of the above to flush out the technical aspects in greater detail. I am trying to make sure that all the points in your letter of 19th August are picked up on. One aspect that I need more advice on is the shellfish standard. I understand that we will need to provide non-chemical disinfection and that the Shellfish directive limit is that Faecal coliforms / 100ml flesh should be < 300. How does this translate to an end of pipe limit at the treatment works? Is there an expert at the EA that you can direct me to. Ideally, I just want someone to tell me what the standard needs to be for faecal coliform removal at the plant discharge and we will design appropriate measures to achieve this.

Do we need to get any baseline data of either Chichester Harbour or the shellfish themselves (are the beds actually in the harbour, if so do you have a plan showing their location)? Do you have any information with respect to the existing Southern water discharge?

I look forward to hearing from you soon. Please don't hesitate to contact me to discuss.
Kind Regards,
Paul

Paul Stewart,
Associate

T: 01483 750 508
DDI: 01483 745 440
F: 01483 750 437

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APPENDIX G: NITROGEN STATEMENT / FARMSCOPER ASSESSMENT AND PEER REVIEW

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Technical note:
Review of West Chichester Development Farmscoper Nitrate Modelling

1. Introduction

This note has been prepared in response to an enquiry from Mayer Brown of 10 November 2015. Mayer Brown have carried out an assessment of nitrate leaching in support of a permit application by Albion Water for a wastewater discharge, which forms part of a wider planning application for development at Whitehouse Farm, Chichester (ref 151104 Nitrogen Technical Report, 4 November 2015).

The assessment of nitrate leaching has included use of the ADAS Farmscoper model to assess:

a) Background levels of nitrate leaching (for information only);

b) Current levels of leaching from the existing agricultural land;

c) An indication of the reduction in leaching that could be achieved through the application of suitable mitigation measures.

The Environment Agency has requested that this modelling work should be reviewed by an independent third party, and Mayer Brown contacted Amec Foster Wheeler to that end. This note comprises that review, and is laid out as follows. Section 2 provides observations on the use and setup of the Farmscoper models; Section 3 provides a commentary on the assessment of leaching from the proposed development, and; Section 4 provides a summary and conclusions.

2. Application of the Farmscoper Model

2.1 General observations

- The modelling has been carried out using Version 2.2 of the Farmscoper model, which is the latest version available at this time;
- Two "farms" have been modelled. The "baseline farm" consists entirely of grassland, and represents "background" leaching resulting from factors beyond management control (such as mineralisation of soil nitrogen, and atmospheric deposition of nitrogen). The second Farmscoper model represents the actual land use and management of Whitehouse Farm;
- A variant of the Whitehouse Farm model has been created, which includes additional agricultural mitigation measures against nitrate leaching. This is intended to indicate the lowest practical level of nitrate leaching that could be achieved from productive agricultural land, irrespective of the cost of mitigation applied, and is thus a conservative approach.

2.2 Baseline model

- The baseline Farmscoper model represents the total agricultural land area on Whitehouse Farm of 126.1 ha;
- All land is assumed to be managed as rotational grassland, with no applied nitrogen fertiliser;
- Soils are assumed to be free-draining. This is appropriate given the superficial geology of the site of River Terrace deposits and Head deposits. Although it is noted that the less permeable Reading Beds and London Clay are present at depth, these are unlikely to represent any impediment to soil drainage in the root zone;
- Rainfall is assumed to be in the range 700 mm – 900 mm per annum. This is appropriate for Chichester. The annual average rainfall (AAR) in the period 1980-2010 for Bognor Regis is 725 mm[1];
- The baseline model predicts nitrate losses of 513 kg, equivalent to 4.1 kg/ha. The great majority of this loss is as leaching in soil drainage, with a small proportion lost in runoff;
- The baseline land use could also be represented as permanent pasture, also with no applied nitrogen fertiliser. Farmscoper predictions of nitrate losses from permanent pasture are identical to those of losses from rotational grass, and this therefore confirms this baseline prediction.

2.3 Whitehouse Farm model (no mitigation)

- The Farmscoper model has been used to represent nitrate leaching from the agricultural land at Whitehouse Farm under current management (2015);
- Land use comprises 20 ha of rotational grass, 61.2 ha of spring barley, 39.2 ha of maize and 5.7 ha of other crops;
- It is assumed that these crops receive nitrogen fertiliser as follows:
  - Rotational grassland: no nitrogen applied;
  - Spring barley: 38 kg/ha;
  - Maize: 125 kg/ha;
  - Other crops: 38 kg/ha.
- It is assumed that no organic fertilisers (manures) are used on any crops;
- These fertiliser rates are consistent with, or below the crop requirements given in the Defra Fertiliser Manual (RB209)[2]. For example, the crop nitrogen requirement for maize is given as 150 kg/ha (soils with SNS index 0) to 100 kg/ha (soils with SNS index 1) or 50 kg/ha (SNS index 2);
- The crop requirement for Spring Barley for feed is 160 kg/ha (SNS index 0) to 140 kg/ha (SNS index 1). This is substantially higher than the applied rate, and the land under spring barley is therefore managed as low input land;
- The presence of unfertilised rotational grass suggests that the farm is managed at least in part organically, with part of the crop nitrogen requirement of cereal crops being met by the preceding ploughed out grass crop. However, this has not been confirmed;
- Farmscoper predicts nitrate losses from arable land of 3,683 kg (34.7 kg/ha) and from grassland of 81 kg (4.1 kg/ha). In both cases, the majority of this loss originates from the soil (as opposed to fertiliser) and is lost in soil drainage rather than runoff. These results appear reasonable.

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[1] http://www.metoffice.gov.uk/public/weather/climate/gcp8bswvw (accessed 19 Nov 2015)
[2] http://www.ahdb.org.uk/projects/CropNutrition.aspx (accessed 19 Nov 2015)

2.4 Whitehouse Farm model (additional mitigation)

- The Farmscoper model has been used to evaluate the potential reductions in nitrate losses that could be achieved through the application of mitigation measures;
- Two suites of mitigation measures have been defined. Prior mitigation represents measures that are likely to be already in place due to, for example, existing legislation. These measures will result in a reduced level of "present day" nitrate loss. Additional mitigation represents measures that are not already in place. The application of these measures can further reduce nitrate losses from the farm, but are likely to carry a cost to the farm business;
- The site lies in a Nitrate Vulnerable Zone (NVZ) and the farmer is thus obliged to comply with the NVZ regulations restricting the use of nitrogen fertilisers;
- The Farmscoper model has thus been set up to apply these restrictions as "prior" mitigation. The "baseline" nitrate loss is thus reduced slightly from the value predicted by the "no mitigation" model (Section 2.3), to 3,594 kg (28.5 kg/ha);
- The model has then been used to assess the additional reduction in nitrate loss that could be achieved through the application of additional mitigation methods. A suite of 27 methods has been selected, based on the selection of all methods which are relevant to nitrogen management. The relevance and effectiveness of each method is pre-determined within the Farmscoper model;
- This therefore represents an estimate of the maximum reduction in nitrate loss that could be achieved through mitigation whilst keeping the land in agricultural production, irrespective of the cost of the mitigation. In practice, it is unlikely to be possible to achieve this level of reduction, but this does represent a conservative approach to the estimation of nitrate losses;
- The remaining nitrate loss after mitigation is 3,002 kg (23.8 kg/ha). This estimate appears reasonable.

3. Nitrate Leaching Post-Development

- The nitrate loss from the site post-development has been assessed as two components: diffuse losses from the proposed land uses post-development, and point source losses from the proposed treatment works;
- The diffuse losses from the development have been estimated based on literature values for nitrate losses in leaching and runoff from urban areas, sports fields, allotments and Public Open Space / parks and SuDS land. The difference between the post-development diffuse losses and the estimated losses from agricultural land (with mitigation) is used to estimate the nitrogen headroom for the treatment works;
- The total land area considered post-development is 122 ha. This is slightly lower than the modelled agricultural area of 126.1 ha. This will not make a significant difference to the results of the calculations;
- It is assumed that there will be little or no leaching from paved areas, with runoff losses dominant. Conversely, it is assumed that there will be relatively little runoff from unpaved areas, which is a reasonable assumption given the free draining soils in the area.

The original calculations are summarised in Table 3.1.

Table 3.1 Proposed scenario – estimated nitrogen losses, original calculation

	Area (ha)	Load kg/ha	Load kg
Runoff			
Urban areas	60[1]	4	240
Sports fields	7.1	1	7.1
Allotments	1.6	1	1.6
Gardens	21	0	0
Frontage landscaping	9	0.13	1.2
POS/SuDS/Nature reserve	53.3	0.13	6.9
Leaching			
Gardens	21	11.4	239.4
Frontage landscaping	9	4	36
Sports fields	7.1	22.8	161.9
Allotments	1.6	22.8	36.5
POS/SuDS/Nature reserve	53.3	4	213.2
TOTAL LOADING (kg)			**943.8**

Note 1: The loading of 4kg/ha from urban areas is a bulk figure, including relatively high source areas such as roads and low source areas such as gardens.

- The loading in runoff from gardens and frontage landscaping is included in the bulk urban runoff figure. These items should therefore be removed to avoid double counting;
- The figure for urban runoff of 4 kg/ha is understood to be an area-weighted average. Assuming that approximately one third of the urban area generates runoff, this equates to a loading in runoff from these impermeable areas of 12 kg/ha. This is equivalent to a concentration in 500 mm of drainage of 2.4 mg/l, which is consistent with figures given by Mitchell (2005)[3] of 1.52 mg/l to 2.85 mg/l for total nitrogen event mean concentration;
- The assumed rate of leaching from sports fields and allotments is 22.8 kg/ha. This is stated as equivalent to the agricultural leaching rate (which is actually calculated as 23.8 kg/ha);
- For allotments, this value is consistent with that given by Lerner (2000)[4] of 25 kg/ha/yr;
- For sports fields, this is a conservative assumption; the actual leaching rate might be expected to be substantially lower than leaching rates from productive agricultural land. The "baseline" rate for unfertilised grassland, it will be recalled, is predicted to be 4.1 kg/ha;

[3] Mitchell, G., 2005. Mapping hazard from urban non-point pollution: A screening model to support sustainable urban drainage planning. J. Env. Management, 74 (1), pp1-9.

[4] Lerner, D., 2000. Guidelines for estimating urban loads of Nitrogen to groundwater. MAFF NT1845.

- Leaching from gardens is assumed to be 11.4 kg/ha (half the agricultural rate). Again, this is somewhat higher than the rate given by Lerner (2000) of 5 kg/ha.

These lower figures for losses in leachate from sports fields and gardens are those included in an assessment of nitrogen and phosphorus loadings to groundwater carried out for the Environment Agency in 2010 by Amec Foster Wheeler (ref 27510rr032i3, November 2010), and an accompanying spreadsheet tool.

A revised calculation of nitrogen losses post-development which includes these lower figures is provided in Table 3.2.

Table 3.2 Proposed scenario – estimated nitrogen losses, revised calculation

	Area (ha)	Load kg/ha	Load kg
Runoff			
Urban areas	60	4	240
Sports fields	7.1	1	7.1
Allotments	1.6	1	1.6
POS/SuDS/Nature reserve	53.3	0.13	6.9
Leaching			
Gardens	21	5	105
Frontage landscaping	9	4	36
Sports fields	7.1	5	35.5
Allotments	1.6	22.8	36.5
POS/SuDS/Nature reserve	53.3	4	213.2
TOTAL LOADING (kg)			**681.8**

The revised calculation results in a lower estimate of nitrogen loss post-development, and suggests that the original estimate of available headroom for the treatment works is conservative. However, the overall approach is considered appropriate.

4. Determination of Mass Balance and Adjustment Factors

We have reviewed the approach used to calculate a design nitrogen standard. The calculation uses three adjustment factors to account for attenuation and seasonality:

- Volumetric factor (0.9);
- Flow factor (0.6); and a
- Concentration factor (0.9).

These give a combined adjustment factor (0.9*0.9*0.6 = 0.486) which is applied to the headroom loading (2089.79 Kg) to give a discharge limit of 3.93 mg/l as N. There is a slight error in this calculation and the correct headroom loading should be 2058 kg).

The following comments are made to the approach used:

- An attenuation factor should also be included to account for nitrification of nitrate leached from the soil zone. This factor should only apply to nitrate leached not to nitrate in run-off. An attenuation factor of 0.9 is considered to be reasonable;
- The volumetric factor is considered to be conservative and a factor of 0.95 is suggested, particularly as an attenuation factor is included;
- The flow and concentration factors are considered to be conservative and may include double accounting as a result of multiplying these factors together. An alternative approach would be to calculate a total loading (surface water flow x surface water concentration) and to calculate a single adjustment factor based on average loading divided by peak loading. The net effect of these recommended changes is likely to be a slightly higher adjustment factor;

Overall the adjustment factor (0.486) derived in the Nitrogen Technical Report is considered to be conservative and a minimum design nitrogen standard of 4 mg/l as N is considered to be reasonable.

5. Conclusion

- The impact of a proposed development on nitrate losses to surface water and groundwater has been assessed using the ADAS Farmscoper model, and estimates of urban diffuse nitrate export;
- The Farmscoper models represent "baseline" losses from rotational grassland (for information only), losses under current agricultural management and the potential minimum loss that could be achieved with mitigation measures;
- The models have been reviewed and represent a reasonable estimate of current and potential future nitrate losses from agricultural land;
- The calculation of nitrogen losses post-development has been reviewed and the overall approach is considered reasonable. Some amendments are suggested to some of the estimates of nitrate losses from urban land. A revised estimate of post development losses is provided (Table 3.2) and we suggest the Nitrogen Technical Report is updated based on this revised calculation;
- Estimated diffuse nitrogen losses post-development are in the range 22% to 30% of estimated losses from the current agricultural land use (with mitigation);
- An attenuation factor to account for nitrification in the sub surface should be included in calculation of the design standard (Section 4). However the other factors (volumetric, flow and concentration factors) used to calculate the adjustment factor (0.486) are considered to be overly conservative (Section 4) and a minimum design nitrogen standard of 4 mg/l as N is considered to be reasonable;
- This review confirms that the overall nitrogen balance approach to support the permit application is reasonable.

Author

Paul Davison

Reviewer

Mike Carey

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Technical Note

Nitrate Nitrogen Losses Calculation

Introduction

1.1 This note has been prepared in response to a letter dated 19th October 2015 (Appendix A) from the Environment Agency to Albion Water in relation to their wastewater discharge permit pre-application, which in turn is in support of a planning application for development at Whitehouse Farm, Chichester.

1.2 The application includes a proposal for an on-site sewage treatment works to serve the community, discharging to on site watercourses, which in turn discharge into the Nitrogen sensitive waters of Chichester Harbour.

1.3 The planning application and the environmental permit pre-application contained a methodology to demonstrate that the cessation of fertiliser application on site would provide sufficient headroom to accommodate a treatment works on site and maintain a nil-detriment impact of Chichester Harbour and preferably deliver a degree of betterment.

1.4 The concept of this approach was approved by the Environment Agency in their correspondence of 19th August 2013 (Appendix A) and the use of the ADAS Farmscoper software was suggested as an appropriate methodology for a land use audit. A Farmscoper assessment was undertaken and included in the December 2014 planning and environmental pre-app submissions.

1.5 The 19th October 2015 letter maintains that the key issue of concern with the planning application is quantifying the discharge of Total Nitrogen to Chichester Harbour and highlights a number of aspects where further justification is necessary:

- Assessment of nitrogen attenuation between the farm and the harbour.
- Consideration of additional nitrogen inputs from the proposed development.
- Demonstrate that the existing use scenario incorporates all appropriate mitigation.
- The seasonal impacts of relative nitrogen loads.
- Review of the modelling by an independent third party.

1.6 The following technical note aims to address the first four points above by undertaking a complete review of the initial calculations taking a more comprehensive review.

1.7 The results will demonstrate that the proposed treatment works can meet the requirements if the discharge limit is further reduced from 4.5mg/l as currently proposed by Albion Water to 3.93mg/l. At this level an overall annual betterment of >50% would be realised with the seasonal variation demonstrating nil detriment.

Methodology

1.8 In order to fully address the concerns raised, it is necessary to consider the modelling in greater detail, to incorporate the impacts of nitrogen locked into the soils in addition to direct application of fertiliser.

1.9 The first step was to establish a baseline scenario against which the existing farm use and the proposed development use without the treatment works could be assessed. This was undertaken by building a Farmscoper model for the farm with a grassland use and no application of additional nutrients.

1.10 The next step was to build the existing farm Farmscoper model using the data supplied by the farmer, this is almost identical to the original information submitted with the planning application and environmental permit pre-application.

1.11 To address the question of mitigation, the Farmscoper Evaluation tool was used, which provided a reduction of assumed Nitrate generation from the existing farm.

1.12 To obtain values for nitrate run-off and nitrate leaching to ground the evaluated existing scenario was compared to the baseline (grassland only) scenario.

1.13 In order to take account of the proposed development run-off a schedule of likely land use areas was prepared and run-off and leachate values for the various uses was estimated. As above, the post development scenario was compared to the baseline to derive values for nitrogen leaching and run-off.

1.14 A series of factors were then applied to make appropriate allowances for attenuation losses, seasonal flow variation and seasonal concentration variation.

Baseline and Existing Scenarios

1.15 The Farmscoper results for grassland only use are presented in Appendix B and can be supplied in Excel format. The results for nitrate run-off and leaching to ground are summarised in Table 1 below.

1.16 The Farmscoper results for the existing scenario are presented in Appendix C and can be supplied in Excel format. This is the scenario without any additional assumed mitigation applied and is provided for information only as it is not used in the final assessment. The results for nitrate run-off and leaching to ground are summarised in Table 1 below.

1.17 The Farmscoper Evaluate results for the potential farm use scenario, with the additional mitigation applied are presented in Appendix D and can be supplied in Excel format. The mitigation measures applied by the model are:

- Cultivate compacted tillage soils
- Cultivate and drill across the slope
- Establish in-field grass buffer strips
- Establish riparian buffer strips
- Loosen compacted soil layers in grassland fields
- Allow field drainage systems to deteriorate
- Use plants with improved nitrogen use efficiency
- Fertiliser spreader calibration
- Use a fertiliser recommendation system
- Do not apply manufactured fertiliser to high risk areas
- Do not apply manufactured fertiliser to fields at high risk times
- Use manufactured fertiliser placement technologies
- Incorporate a urease inhibitor into urea fertilisers for arable land
- Use clover in place of fertiliser nitrogen
- Re-site gateways away from high risk areas
- Establish new hedges
- Protection of in-field trees
- Management of in-field ponds
- Management of field corners
- Plant areas of farm with wild bird seed / nectar flower mixtures
- Beetle banks
- Uncropped cultivated margins
- Uncropped cultivated areas
- Unfertilised cereal headlands
- Unharvested cereal headlands

- Leave over winter stubbles
- Use correctly inflated low ground pressure tyres on machinery

1.18 It should be noted that the estimated cost of these measures is £41,643.

1.19 The result of the mitigation is to reduce nitrate leaching by 18.5%, run-off by 47.2% and 20.3% overall. Table 1 Summarises the results

SCENARIO	Baseline - Grassland	Existing - Normal Mitigation	Potential - Additional Mitigation
Nitrate N - Runoff - Fertiliser	NIL	119.61kg	25.83kg
Nitrate N - Runoff - Soil	16.19kg	117.44kg	99.46kg
(Runoff Sub Total)		(237.05kg)	(125.29kg)
Nitrate N - Leaching - Fertiliser	NIL	1134.03kg	714.57kg
Nitrate N - Leaching - Soil	496.46kg (3.94kg/Ha)	2393.56kg	2162.08kg
(Leaching Sub Total)		(3527.59kg)	(2876.65kg)
Total Nitrate N	**512.65kg**	**3764.64kg**	**3001.94kg**

Table 1 – Components of Nitrate Nitrogen Derived From Farmscoper

1.20 To derive values for the impact of agriculture over and above a grassland baseline. The values from the grassland only scenario were subtracted from the potential farmland scenario (with mitigation). The results are shown in Table 2 below:

COMPONENT	MASS PER ANNUM
Nitrate N - Runoff - Fertiliser	25.83kg - 1.04%
Nitrate N - Runoff - Soil	83.27kg - 3.34%
(Runoff Sub Total)	**(109.1kg - 4.38%)**
Nitrate N - Leaching - Fertiliser	714.57kg - 28.71%
Nitrate N - Leaching - Soil	1665.62kg - 66.91%
(Leaching Sub Total)	**(2380.19kg - 95.62%)**
Total Nitrate N	**2489.29kg**

Table 2 – Summary of Agricultural Nitrate nitrogen Discharge Above Baseline

Proposed Scenario

In order to assess the impact of the development proposals without the treatment works it is necessary to make an assumption of land uses. We have assessed the indicative masterplan to estimate these and have tabulated our assumptions in Table 3 below. The Urbanised area has been subdivided as shown in bracketed figures.

LAND USE	AREA
Urbanised Area	60Ha
(20% Roads & Pavements)	(12Ha)
(30% Roofs)	(18Ha)
(35% Enclosed Gardens)	(21Ha)
(15% Frontage Landscaping)	(9Ha)
Sports Fields	7.1Ha
Allotments	1.6Ha
POS / SuDS / Nature Reserve	53.3 Ha

Table 3 – Assumed land uses of proposed development

1.21 For each of the area types a value for nitrogen run-off and nitrogen leaching has been derived. This is tabulated in Table 4 below, but descriptions of how the assumed values were derived is provided in the following paragraphs.

1.22 For the urban area a run-off of 4kg/ha has been assumed. This is derived from US research quoted by the EPA, where a range for medium and high density residential of 2.8 to 4.7 kg/ha (2.5 to 4.2 lbs/acre) is quoted. We have selected a figure towards the upper end, to reflect the denser nature of UK housing schemes. This results in 240kg/annum, which is the value used. As a verification, UK research has suggested a run-off for roads of 10kg/ha is appropriate (120kg/annum) leaving 6.67kg/ha for roof surfaces if 240kg/annum is selected area wide. We consider this to be appropriate.

1.23 For sports field and allotment run-off, we have selected a figure equivalent to the pre-development agricultural assumption, resulting in 1kg/ha.

1.24 For enclosed rear gardens, we have assumed nil run-off suggesting that very little rainfall from enclosed rear gardens will reach a watercourse.

1.25 For frontage landscaping and public open space we have selected a run-off value equivalent to the baseline grassland scenario of 0.13kg/ha.

1.26 For roofs, roads and pavements, we have assumed zero leaching of nitrogen as there will be no fertiliser applied and no leaching of soils. Any pervious paving would assume to be included in the run-off value.

1.27 For enclosed gardens we have assumed a degree of nutrient treatment and culvivation with 50% of the agricultural impact, resulting in leaching of 11.4kg/ha.

1.28 For sports fields and allotments, we have assumed an equivalent leaching value to the agricultural of 22.8kg/ha.

1.29 For Public Open Space, countryside park and SuDS, we have assumed a sympathetic management regime, with leaching identical to the grassland baseline at 4kg/ha.

1.30 As demonstrated in Table 4 below, the Cumulative post development run-off and leaching mass is 943.9kg.

DEVELOPMENT INPUTS	NITROGEN MASS PER YEAR
TN Run-off Urban (4kg/Ha)	240kg
Sports field run-off (1kg/Ha)	7.1kg
Allotments Run-off (1kg/Ha)	1.6kg
Enclosed Gardens Run-off	Nil
Frontage Landscaping Run-off (0.13kg/Ha)	1.17kg
POS Run-off (0.13kg/Ha)	6.93kg
(Subtotal Run-off TN)	**(256.8kg)**
Leaching Roads & Pavements	Nil
Leaching Roofs	Nil
Leaching Gardens (11.4kg/ha - 50% Farm)	239.4kg
Leaching Frontage Landscaping (4kg/Ha)	36kg
Leaching Sports Field (22.8kg/Ha)	161.9kg
Leaching Allotments (22.8kg/Ha)	36.5kg
Leaching POS (4kg/Ha)	213.3kg
(Subtotal Leaching TN)	**(687.1kg)**
Total N	**943.9kg**

Table 4 – Breakdown of Post Development Estimated Nitrogen Run-off & Leaching

1.31 The impact of the of the post development scenario prior to consideration of the treatment works is determined by comparing with the grassland baseline (table 4 values minus table 1 baseline) the resultant values are stated in table 4 below.

COMPONENT	NITROGEN MASS PER YEAR
N Run-off	240.61kg
N Leaching	190.64kg
Total N	**431.25kg**

Table 5 – Summary of Post Development Nitrogen Discharge Above Baseline

Determination of Mass Balance and Adjustment Factors

1.32 The values derived above in Tables 2 and 5 show the impacts of agricultural use and urbanisation as values in excess of a baseline scenario of natural grassland. By taking the values of the potential farmland scenario (with mitigation) and subtracting the post development values we can derive a nitrogen headroom for the treatment works. This is shown in Table 6 below.

COMPONENT	AGRICULTURAL IMPACT	DEVELOPMENT IMPACT	GROSS HEADROOM
N Run-Off	109.1kg	240.65kg	+131.55kg
N - Leaching	2380.19kg	190.64kg	-2189.55kg
N Total			**-2089.79kg**

Table 6 – Gross Nitrogen Headroom

1.33 This demonstrates that the post development scenario slightly increases nitrogen associated with run-off, which would be expected from urbanisation. In total there is an excess of nitrogen to the value of 2089.79kg.

1.34 The EA has requested that attenuation of Nitrogen be taken into account. The principal existing mechanism of nitrogen transfer from the site to the harbour in the current situation is by leaching through the ground. A hydrological conceptualisation has been produced by Amec Foster Wheeler previously and approved by the EA. This model describes how an impermeable layer of London Clay underlies the site, below an upper strata of more permeable River Terrace deposits. At the southern boundary of the site these give way to sand and gravel dominated alluvial fan deposits. The fan deposits overly Reading Beds and further south the Chalk, which underlies the harbour. The Amec Foster Wheeler report is contained in Appendix E, figure 3.1 of that report represents the underlying geology in section

1.35 Sub-surface flows on site are in a southerly direction within the permeable River Terrace gravels, underlain by the impermeable bed of London Clay. These give way to the permeable alluvial fan deposits underlain by the impermeable Reading Beds. The dominant flow is lateral with the solid geology of the London Clay and Reading Beds as a base. This brings groundwater increasingly closer to the surface as it progresses to the harbour. The flow in the chalk underlying the headwaters of the harbour are noted as flowing in an upward direction. Under these conditions it is anticipated that the vast majority of the existing and proposed leaching flows will discharge into the headwaters of the harbour, albeit with a degree of attenuation, which will reduce the discharge peaks associated with seasonal variation (discussed later).

1.36 It should also be noted that the River Terrace deposits on site consist of bands of gravel and clay, which give rise to springing of groundwater within the site, which provides some attenuated flows to the on-site watercourses.

1.37 In selecting a factor to apply to estimate how much of the existing leachate discharges to the harbour, we would suggest a vast proportion, based on the preferential pathways of the on-site watercourses and bands of clay in the superficial deposits, the close proximity of the harbour and topography of the site in relation to the harbour. Not least the impermeable bed of London Clay and Reading Beds, which are overlain by sand and gravel dominated superficial geology all the way to the chalk, which is noted as giving rise to groundwater flows year round. Our suggested factor is **0.9** (or 90%) reaching the harbour.

1.38 The mass of nitrogen available for plant uptake is dependent on flow and concentration. In terms of baseline flows we can refer to the flow monitoring data for Fishbourne Meadows as a guide. This is represented in Figure 3.2 of the Amec Foster Wheeler report (Appendix E) We have removed the December 2009 outlier of high flow and calculated an approximate arithmetic mean value form the October 2009 to October 2011 values. The 23 values over this 2 year period result in a mean value of 119l/s or 10,282m3/day. The peaks for the 2 years (omitting the outlier) were 300l/s and 200l/s. This gives a peak flow variability of between 168% and 252% in relation to the peak flows.

1.39 To look at concentration variability we have reviewed the sampling data, which we gathered in 2012 / 2013 from a sampling point south of the M27. Location SW-F from our previous report. This suggests a variation between 5.5mg/l in September and 8.0mg/l in March (interpolated value). We assume a 6.75mg/l average the peak is 118.5% of the average. Figure 1 below.

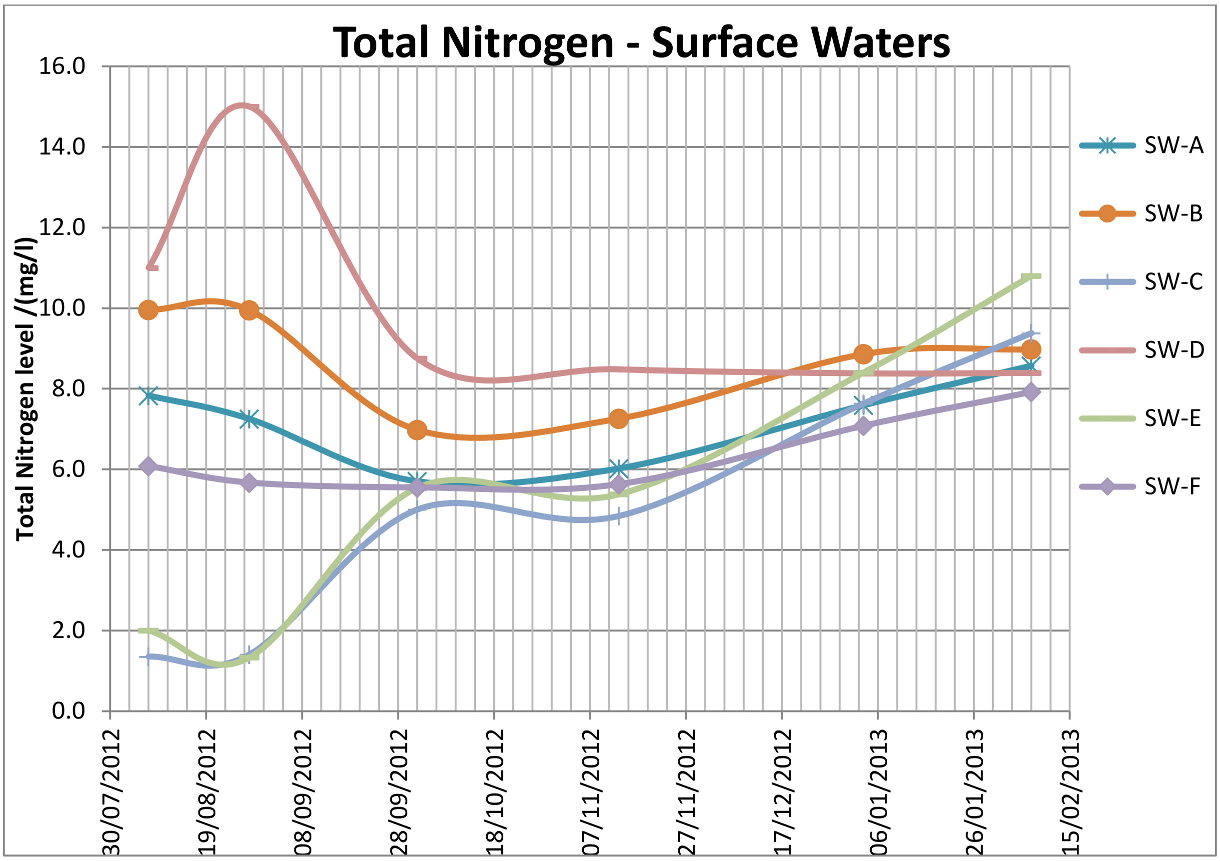

Figure 1 – Surface Water Total Nitrogen Monitoring

1.40 It is noted that the peaks of groundwater flow and concentration are not coincidental. Peak flows are recorded in January / February and Peak concentrations are estimated to occur around April. We would therefore suggest that factors below the peak values are appropriate in combination and would propose 0.6 and 0.9 for flow and concentration variability respectively

1.41 Combining the factors for attenuation of volume, variability of Flow and Variability of concentration can be stated as 0.9(volume) x 0.6(flow) x (0.9) concentration = 0.486

1.42 Applying this factor to the 2089.79kg stated in Table 6 results in a design value for Nitrogen of 1015.64kg/annum

1.43 Assuming a design flow from the treatment works of 258,597,000l/annum (708m^3.day) results in a design nitrogen standard of **3.93mg/l.**

Demonstration of Appropriate Technology

1.44 Albion Water are currently proposing a treatment process to deliver a standard of 4.5mg/l and are confident that they could demonstrate the use of the process selected to deliver a sub 4mg/l standard. However, in the current time frames of the planning application process it is unlikely that process data can be provided of a real world installation in time.

1.45 There are additional treatment stages in common usage, which can reliably deliver sub 4mg/l and even sub 3mg/l. This is commonly a denitrifying filter, such as a sand filter, with the addition of a carbon source, such as glycerol or methanol.

1.46 It is difficult finding UK examples of sub 4mg/l total nitrogen standards as such stringent standards are not generally being applied at present by the regulators. There are examples overseas though and the United States is a good source of examples and research undertaken at existing treatment works. The US EPA recognises the practical lower limit of technology for total nitrogen to be 3mg/l. Below this level removal of the recalcitrant dissolved nitrogen becomes an issue, which could only be reliably removed through reverse osmosis.

1.47 One project which is easily verified is the 'Save the Bay' initiative sponsored by the Chesapeake Bay Foundation in Maryland, USA. This requires the upgrade of 66 treatment facilities to meet a TN standard of 3mg/l. A summary of the sites included in this programme is included in Appendix F.

Conclusion

1.48 The above nitrogen audit demonstrates that it is feasible to redevelop the White House Farm site for the intended development and include an on site sewage treatment plant, discharging to the sensitive headwaters of the Chichester Harbour.

1.49 The audit calculates an overall betterment of >50% annually in terms of total nitrogen released to the harbour, compared to the existing use with an allowance for improvement in farming practices with the setting of a Total nitrogen standard for the works not exceeding 3.93mg/l.

1.50 This above standard addresses concerns over the seasonal variation of nitrogen contribution to the Harbour and ensures that seasonally there shall be nil detriment.

1.51 A standard of treatment at this level is very high and close to the currently accepted limit of technology of 3mg/l. However, there are a sufficient number of existing treatment plants in similar climates worldwide treating to these standards.

1.52 This evidence should be sufficient for the Environment Agency to lift their holding objection as it demonstrates that a scheme to meet their environmental protection interests can be delivered on this site, subject to detailed approval through the environmental permitting process.

Author: Paul Stewart, Technical Director

Date: 4th November 2015

APPENDIX A: Environment Agency Correspondence

Mr Keith Edwards
Quality Manager
Albion Water
Forest House
3-5 Horndean Road
Bracknell
RG12 0XQ

Our Ref: TS/2015/EPR-SB3338AD

Your Ref:

Date: 19 October 2015

Dear Mr. Edwards

White House Farm, Chichester: Wastewater discharge permit pre-application advice

As I discussed with you on Friday 8 October 2015, this response summarises our final comments on your wastewater discharge proposal at White House Farm, Chichester and the information you have submitted to us to date.

The Environment Agency considers that the key issue concerning this proposal remains the total nitrogen loading of the development and the impact of its associated waste water discharge on the Chichester and Langstone Harbours Special Protection Area (SPA) and Solent Maritime Special Area of conservation (SAC).

<u>Baseline data</u>

FARMSCOPER assesses 'nitrate' losses not 'total nitrogen'. The report you have provided assumes nitrate outputs are equivalent to total nitrogen. This is a conservative approach and so we have no further requirements for additional environmental protection or modelling in this regard.

Nitrogen attenuation, in the pathway between the farm and the harbour, either through groundwater or ditches, has not been assessed. The application should demonstrate that it has been considered and why it may or may not be significant. There may be other nitrogen inputs from development, for example, fertilizer on residents' gardens or any proposed park area. This should be considered in the assessment.

The nitrogen load from the existing farmland needs to take into account of best land management practices, including voluntary measures. The farm is in a Nitrate Vulnerable Zone so will already have adopted some good practices. The modelling does not demonstrate that all possible measures (applicable to this farm) have been adopted and taken account of in the nitrogen assessment.

The seasonal impacts of relative nitrogen loads has not been assessed. Farmland nitrogen loss may be higher in winter and spring (depending on the specific farm practices). A sewage discharge nitrogen load will be consistent all year around. We know that nitrogen inputs in the spring and summer will have more of an impact on eutrophication (green weed growth) in the harbour than in the autumn and winter. So, total annual loads between farmland nitrogen and proposed sewage load may be equal but nitrogen inputs during the months of highest environmental impact are currently underestimated.

Given the complexity of the modelling for this site we would like the FARMSCOPER, or any other modelling assessment, to be reviewed by an independent third party. This is needed to demonstrate the validity of the modelling and show that nitrogen loss calculated from the farm is fit for purpose.

NAV status

Albion Water has not yet applied to Ofwat for NAV status. As I explained in our conversation last week, until your NAV status is formalised it is unlikely that we would permit a discharge to take place. Use of a pre-operational condition requiring NAV appointment is possible, if there is a reasonable prospect that the operator can satisfy the condition, but it is not a favoured approach in these circumstances as we would not normally include a pre-operational condition that required an operator to get any other authorisations or permissions from third parties.

Our main concern is the potential environmental impact on Chichester Harbour, caused by nitrogen loading from a relatively large new discharge of treated sewage effluent, and whether the discharge could be permitted on the basis of those potential impacts.

As we discussed on the phone, there will be sufficient capacity in Southern Water's sewer to treat additional discharge from the housing development when Tangmere WwTW becomes operational in December 2017. It would be our preference for the development to connect to this mains sewerage system.

Other comments

Operator competence is a consideration when determining water discharge permit applications. If we are not satisfied that treatment standards can be met, or that the operator is sufficiently competent, we may refuse the permit. Operator competence is demonstrated by having a suitable Environment Management System (EMS). You have provided an EMS as part of the draft submission (EPR-SB3338AD) and this would be assessed during the determination.

Your permit application must include substantiated evidence that treatment to achieve the required discharge quality is feasible and practical and that any limits can be met. The EMS should include sufficient details on contingency in the event of failing to meet the required standards.

There could be potential public health risks, caused by increased bacteriological loading from the housing development into the watercourse and, if you haven't done so already, I would urge you to discuss this with the local Environmental Health Officer prior to submitting an application.

Richard O'Callaghan, Area Environment Manager, is the local Account Manager for this pre-application. Given the amount of pre-application work already provided and as there is no charge levied for water quality pre-application work, additional advice will be limited.

Should you apply for a permit at this time we would encourage you to submit the additional assessment requirements referred to above, and seek independent expert opinion to demonstrate that the discharge would not lead to a net increase in nitrogen load to Chichester Harbour.

If you have any queries regarding the above then please do not hesitate to get in touch.

Yours sincerely

Tamsin Sutton
Permitting Team Leader – Water Quality
Direct Dial: 01392 352311
tamsin.sutton@environment-agency.gov.uk

creating a better place

Environment Agency

Mr. Paul Stewart
Associate
Mayer Brown Ltd
Lion House
Oriental Road
Woking
Surrey
GU22 8AR

Our ref: EPR-SB3338AD

Your ref: EPR-SB3338AD/MJ/002

Date: 19 August 2013

Dear Mr. Stewart

Environmental Permitting (England and Wales) Regulations 2010, Pre-Application EPR-SB3338AD 2nd Consultation - Summer 2013

Thank you for your correspondence of 8th July 2013 containing *"White House Farm Chichester, Environmental Permit Pre-application (EPR/SB3338AD/A001), July 2013"*.

This response summarises our water discharge permit pre-application advice. It is based on the outline proposal for up to 1600 dwellings outlined in the supplementary report. The Environment Agency considers that the key issue of this proposal is the total nitrogen loading of the development and associated waste water discharge and its potential impact on the Chichester and Langstone Harbours Special Protection Area (SPA) and the Solent Maritime Special Area of Conservation (SAC). The development should not lead to a net increase in nitrogen load to Chichester Harbour. We would prefer if the development resulted in a net reduction in load.

Should you apply for a permit, we will assess the likely significant effect of the proposed water discharge activity on this SPA and SAC, in consultation with Natural England. If you demonstrate that you can meet the principle regarding no net increase in nitrogen then we are likely to permit the discharge. Natural England has indicated that it is open to consider this approach to nitrogen loading.

The permit application must include a management system, including maintenance programmes. Further guidance on how to comply with a water discharge activity permit can be found in the guidance document EPR 7.01, which can be found at http://www.environment-agency.gov.uk/business/topics/water/121308.aspx

Your permit application must include substantiated evidence that treatment to achieve the required discharge quality is feasible and practical and that any limits can be met. You would need to confirm whether or not the onsite treatment works is to be designed for adoption under the Water Industry Act.

Environment Agency, Oving Road, Chichester, West Sussex PO20 2AG
Tel: 03708 506506

INVESTOR IN PEOPLE

Baseline data

We consider the generic approach to be sufficient to allow us to determine an application for a permit. We note that supporting data has been put forward within the report with respect to predicted levels of diffuse pollution. The baseline should be taken as the nitrogen load lost to water from the site through adoption of good agricultural practice. If you apply, you must provide an audit of the land use to demonstrate good practice is being applied. You could use a model such as FARMSCOPER on ADAS' website to demonstrate nitrogen load.

The quality of the discharge would need to be such that all other water quality standards would still be met in the receiving water. We are likely to require disinfection of the effluent to protect the shellfish beds. You state that no baseline bacteriological data is currently available for review. You must provide an assessment of the bacteriological impact of the discharge in your permit application.

Other comments

We consider that private treatment plants pose a greater risk to the environment than those owned and operated by a sewerage undertaker. If the permit application is made by a company that is currently a sewerage undertaker (not necessarily for that specific area) then we would treat the application as if it is to mains drainage. We would include a pre-operational condition within the permit that the permit holder must be appointed by OFWAT as the sewerage undertaker for the development area. This condition would need to be complied with before commencement of the discharge.

If you have any queries regarding the above then do not hesitate to get in contact.

Yours sincerely,

R. Pearson

Rod Pearson
Environment Management Team Leader – West Sussex
Direct Dial: 01243 756362
Email: rod.pearson@environment-agency.gov.uk

Please direct queries to Mat Jackson 01243 756343

APPENDIX B: Background Farmscoper

Farmscoper Create
04/11/2015

File Information	
Create File:	FARMSCOPER2_Whitehouse Farm Grass background.xl
Climate:	700 - 900 mm
Soil Type:	Free Draining

	Nitrate (kg)	Phosphorus (kg)	Sediment (kg)	Ammonia (kg)	Methane (kg)	Nitrous Oxide (kg)	Pesticides (units)
Arable	0	0.0	0	0	0	0	0.0
Grass	513	8.5	4,314	0	0	624	0.0
Rough Grazing	0	0.0	0	0	0	0	0.0
Other	0	0.0	0	0	0	0	0.0

Arable Cropping	ha
Winter Wheat (Feed)	0
Winter Wheat (Milling)	0
Winter Barley (Malting)	0
Winter Barley (Feed)	0
Spring Barley	0
Winter OSR	0
Maize	0
Potatoes	0
Sugar Beet	0
Peas	0
Beans	0
Fodder Crops	0
Other Crops	0
Vegetables (Brassicas)	0
Vegetables (Other)	0
Orchards	0
Soft Fruit	0
Bare Fallow	0
Set Aside	0
Woodland	0

Grassland	ha
Permanent Pasture	0
Rotational Grassland	126.1
Rough Grazing	0

Livestock	Count
Dairy	
Cows and Heifers	0
Heifers in Calf (2 years +)	0
Heifers in Calf (< 2 years)	0
Beef	
Cows and Heifers	0
Heifers in Calf (2 years +)	0
Heifers in Calf (< 2 years)	0
Other Cattle	
Bulls (2 years +)	0
Cattle (2 years +)	0
Cattle (1 - 2 years)	0
Cattle (< 1 year) & Calves	0
Sheep	
Sheep	0
Lambs (< 1 year)	0

Livestock	Count
Indoor Pigs	
Sows in Pig & Other Sows	0
Gilts in Pig & Barren Sows	0
Gilts Not Yet in Pig	0
Boars	0
Other Pigs (> 110kg)	0
Other Pigs (80 - 110kg)	0
Other Pigs (50 - 80kg)	0
Other Pigs (20 - 50kg)	0
Other Pigs (< 20kg)	0
Outdoor Pigs	
Sows in Pig & Other Sows	0
Gilts in Pig & Barren Sows	0
Gilts Not Yet in Pig	0
Boars	0
Other Pigs (> 110kg)	0
Other Pigs (80 - 110kg)	0
Other Pigs (50 - 80kg)	0
Other Pigs (20 - 50kg)	0
Other Pigs (< 20kg)	0

Livestock	Count
Poultry	
Layers (Caged)	0
Layers (Uncaged)	0
Pullet	0
Broilers	0
Turkeys	0
Breeding Birds	0
Other Poultry	0

Manure Values	kg N
Dairy FYM	0
Dairy Slurry	0
Beef FYM	0
Beef Slurry	0
Sheep FYM	0
Pig FYM	0
Pig Slurry	0
Poultry Muck	0

Item	Pollutant	Source	Area	Pathway	Type	Timescale	Form	Total Loss (kg)	Area (ha)	Total Loss (kg / ha)	Drainage (mm)	Total Loss (mg / l)
Total	Nitrate	All	All	All	All	All	All	512.65	126	4.07	329	1.24
Total	Phosphorus	All	All	All	All	All	All	8.54	126	0.07	329	0.02
Total	Sediment	All	All	All	All	All	All	4,313.99	126	34.21	329	10.40
Total	Ammonia	All	All	All	All	All	All	0.00	126	0.00	-	-
Total	Methane	All	All	All	All	All	All	0.00	126	0.00	-	-
Total	NitrousOxide	All	All	All	All	All	All	623.62	126	4.95	-	-
Total	Pesticides	All	All	All	All	All	All	0.00	126	0.00	329	0.00
Summary	Nitrate	All	Arable	All	All	All	All	0.00	0	-	0	-
Summary	Nitrate	All	Grass	All	All	All	All	512.65	126	4.07	329	1.24
Summary	Nitrate	All	Rough	All	All	All	All	0.00	0	-	0	-
Summary	Nitrate	All	Other	All	All	All	All	0.00	126	0.00	-	-
Summary	Phosphorus	All	Arable	All	All	All	All	0.00	0	-	0	-
Summary	Phosphorus	All	Grass	All	All	All	All	8.54	126	0.07	329	0.02
Summary	Phosphorus	All	Rough	All	All	All	All	0.00	0	-	0	-
Summary	Phosphorus	All	Other	All	All	All	All	0.00	126	0.00	-	-
Summary	Sediment	All	Arable	All	All	All	All	0.00	0	-	0	-
Summary	Sediment	All	Grass	All	All	All	All	4,313.99	126	34.21	329	10.40
Summary	Sediment	All	Rough	All	All	All	All	0.00	0	-	0	-
Summary	Sediment	All	Other	All	All	All	All	0.00	126	0.00	-	-
Summary	Ammonia	All	Arable	All	All	All	All	0.00	0	-	-	-
Summary	Ammonia	All	Grass	All	All	All	All	0.00	126	0.00	-	-
Summary	Ammonia	All	Rough	All	All	All	All	0.00	0	-	-	-
Summary	Ammonia	All	Other	All	All	All	All	0.00	126	0.00	-	-
Summary	Methane	All	Arable	All	All	All	All	0.00	0	-	-	-
Summary	Methane	All	Grass	All	All	All	All	0.00	126	0.00	-	-
Summary	Methane	All	Rough	All	All	All	All	0.00	0	-	-	-
Summary	Methane	All	Other	All	All	All	All	0.00	126	0.00	-	-
Summary	NitrousOxide	All	Arable	All	All	All	All	0.00	0	-	-	-
Summary	NitrousOxide	All	Grass	All	All	All	All	623.62	126	4.95	-	-
Summary	NitrousOxide	All	Rough	All	All	All	All	0.00	0	-	-	-
Summary	NitrousOxide	All	Other	All	All	All	All	0.00	126	0.00	-	-
Summary	Pesticides	All	Arable	All	All	All	All	0.00	0	-	0	-
Summary	Pesticides	All	Grass	All	All	All	All	0.00	126	0.00	329	0.00
Summary	Pesticides	All	Rough	All	All	All	All	0.00	0	-	0	-
Summary	Pesticides	All	Other	All	All	All	All	0.00	126	0.00	-	-
Component	Nitrate	Soil	Grass	Runoff	Soil	Medium	Dissolved	16.19				
Component	Nitrate	Soil	Grass	Leaching	Soil	Medium	Dissolved	496.46				
Component	NitrousOxide	Soil	Grass	Leaching	Soil	Medium	GasIndirect	19.50				
Component	NitrousOxide	Soil	Grass	Runoff	Soil	Medium	GasIndirect	0.64				
Component	NitrousOxide	Soil	Grass	Gaseous	Soil	Short	Gas	603.48				
Component	Phosphorus	Soil	Grass	Runoff	Soil	Short	Dissolved	0.84				
Component	Phosphorus	Soil	Grass	Leaching	Soil	Short	Dissolved	3.72				
Component	Phosphorus	Soil	Grass	Runoff	Soil	Short	Particulate	3.98				
Component	Sediment	Soil	Grass	Runoff	Soil	Short	Particulate	4313.99				

APPENDIX C: Existing Farmscoper

Farmscoper Create

04/11/2015

File Information	
Create File:	FARMSCOPER2_Whitehouse Farm 2015.xls
Climate:	700 - 900 mm
Soil Type:	Free Draining

	Nitrate (kg)	Phosphorus (kg)	Sediment (kg)	Ammonia (kg)	Methane (kg)	Nitrous Oxide (kg)	Pesticides (units)
Arable	3,683	18.1	11,482	635	0	596	2.5
Grass	81	1.4	685	0	0	99	0.0
Rough Grazing	0	0.0	0	0	0	0	0.0
Other	0	0.0	0	0	0	0	2.6

Arable Cropping	ha
Winter Wheat (Feed)	0
Winter Wheat (Milling)	0
Winter Barley (Malting)	0
Winter Barley (Feed)	0
Spring Barley	61.2
Winter OSR	0
Maize	39.2
Potatoes	0
Sugar Beet	0
Peas	0
Beans	0
Fodder Crops	0
Other Crops	5.7
Vegetables (Brassicas)	0
Vegetables (Other)	0
Orchards	0
Soft Fruit	0
Bare Fallow	0
Set Aside	0
Woodland	0

Grassland	ha
Permanent Pasture	0
Rotational Grassland	20
Rough Grazing	0

Livestock	Count
Dairy	
Cows and Heifers	0
Heifers in Calf (2 years +)	0
Heifers in Calf (< 2 years)	0
Beef	
Cows and Heifers	0
Heifers in Calf (2 years +)	0
Heifers in Calf (< 2 years)	0
Other Cattle	
Bulls (2 years +)	0
Cattle (2 years +)	0
Cattle (1 - 2 years)	0
Cattle (< 1 year) & Calves	0
Sheep	
Sheep	0
Lambs (< 1 year)	0

Livestock	Count
Indoor Pigs	
Sows in Pig & Other Sows	0
Gilts in Pig & Barren Sows	0
Gilts Not Yet in Pig	0
Boars	0
Other Pigs (> 110kg)	0
Other Pigs (80 - 110kg)	0
Other Pigs (50 - 80kg)	0
Other Pigs (20 - 50kg)	0
Other Pigs (< 20kg)	0
Outdoor Pigs	
Sows in Pig & Other Sows	0
Gilts in Pig & Barren Sows	0
Gilts Not Yet in Pig	0
Boars	0
Other Pigs (> 110kg)	0
Other Pigs (80 - 110kg)	0
Other Pigs (50 - 80kg)	0
Other Pigs (20 - 50kg)	0
Other Pigs (< 20kg)	0

Livestock	Count
Poultry	
Layers (Caged)	0
Layers (Uncaged)	0
Pullet	0
Broilers	0
Turkeys	0
Breeding Birds	0
Other Poultry	0

Manure Values	kg N
Dairy FYM	0
Dairy Slurry	0
Beef FYM	0
Beef Slurry	0
Sheep FYM	0
Pig FYM	0
Pig Slurry	0
Poultry Muck	0

Item	Pollutant	Source	Area	Pathway	Type	Timescale	Form	Total Loss (kg)	Area (ha)	Total Loss (kg / ha)	Drainage (mm)	Total Loss (mg / l)
Total	Nitrate	All	All	All	All	All	All	3,764.64	126	29.85	339	8.79
Total	Phosphorus	All	All	All	All	All	All	19.42	126	0.15	339	0.05
Total	Sediment	All	All	All	All	All	All	12,166.61	126	96.48	339	28.42
Total	Ammonia	All	All	All	All	All	All	634.57	126	5.03	-	-
Total	Methane	All	All	All	All	All	All	0.00	126	0.00	-	-
Total	NitrousOxide	All	All	All	All	All	All	695.12	126	5.51	-	-
Total	Pesticides	All	All	All	All	All	All	5.12	126	0.04	339	0.01
Summary	Nitrate	All	Arable	All	All	All	All	3,683.27	106	34.72	341	10.17
Summary	Nitrate	All	Grass	All	All	All	All	81.37	20	4.07	329	1.24
Summary	Nitrate	All	Rough	All	All	All	All	0.00	0	-	0	-
Summary	Nitrate	All	Other	All	All	All	All	0.00	126	0.00	-	-
Summary	Phosphorus	All	Arable	All	All	All	All	18.06	106	0.17	341	0.05
Summary	Phosphorus	All	Grass	All	All	All	All	1.36	20	0.07	329	0.02
Summary	Phosphorus	All	Rough	All	All	All	All	0.00	0	-	0	-
Summary	Phosphorus	All	Other	All	All	All	All	0.00	126	0.00	-	-
Summary	Sediment	All	Arable	All	All	All	All	11,481.85	106	108.22	341	31.69
Summary	Sediment	All	Grass	All	All	All	All	684.76	20	34.24	329	10.40
Summary	Sediment	All	Rough	All	All	All	All	0.00	0	-	0	-
Summary	Sediment	All	Other	All	All	All	All	0.00	126	0.00	-	-
Summary	Ammonia	All	Arable	All	All	All	All	634.57	106	5.98	-	-
Summary	Ammonia	All	Grass	All	All	All	All	0.00	20	0.00	-	-
Summary	Ammonia	All	Rough	All	All	All	All	0.00	0	-	-	-
Summary	Ammonia	All	Other	All	All	All	All	0.00	126	0.00	-	-
Summary	Methane	All	Arable	All	All	All	All	0.00	106	0.00	-	-
Summary	Methane	All	Grass	All	All	All	All	0.00	20	0.00	-	-
Summary	Methane	All	Rough	All	All	All	All	0.00	0	-	-	-
Summary	Methane	All	Other	All	All	All	All	0.00	126	0.00	-	-
Summary	NitrousOxide	All	Arable	All	All	All	All	596.21	106	5.62	-	-
Summary	NitrousOxide	All	Grass	All	All	All	All	98.91	20	4.95	-	-
Summary	NitrousOxide	All	Rough	All	All	All	All	0.00	0	-	-	-
Summary	NitrousOxide	All	Other	All	All	All	All	0.00	126	0.00	-	-
Summary	Pesticides	All	Arable	All	All	All	All	2.47	106	0.02	341	0.01
Summary	Pesticides	All	Grass	All	All	All	All	0.00	20	0.00	329	0.00
Summary	Pesticides	All	Rough	All	All	All	All	0.00	0	-	0	-
Summary	Pesticides	All	Other	All	All	All	All	2.65	126	0.02	-	-

Component	Ammonia	Chemical	Arable	Gaseous	Fertiliser	Short	Gas	634.57
Component	Nitrate	Chemical	Arable	Runoff	Fertiliser	Short	Dissolved	63.33
Component	Nitrate	Chemical	Arable	Runoff	Fertiliser	Medium	Dissolved	56.28
Component	Nitrate	Chemical	Arable	Leaching	Fertiliser	Medium	Dissolved	1134.03
Component	Nitrate	Soil	Arable	Runoff	Soil	Medium	Dissolved	114.87
Component	Nitrate	Soil	Arable	Leaching	Soil	Medium	Dissolved	2314.76
Component	Nitrate	Soil	Grass	Runoff	Soil	Medium	Dissolved	2.57
Component	Nitrate	Soil	Grass	Leaching	Soil	Medium	Dissolved	78.80
Component	NitrousOxide	Chemical	Arable	Runoff	Fertiliser	Medium	GasIndirect	2.21
Component	NitrousOxide	Chemical	Arable	Leaching	Fertiliser	Medium	GasIndirect	44.55
Component	NitrousOxide	Chemical	Arable	Runoff	Fertiliser	Short	GasIndirect	2.49
Component	NitrousOxide	Chemical	Arable	Gaseous	Fertiliser	Short	Gas	131.57
Component	NitrousOxide	Chemical	Arable	Gaseous	Fertiliser	Medium	Gas	11.69
Component	NitrousOxide	Soil	Arable	Leaching	Soil	Medium	GasIndirect	90.94
Component	NitrousOxide	Soil	Arable	Runoff	Soil	Medium	GasIndirect	4.51
Component	NitrousOxide	Soil	Arable	Gaseous	Soil	Short	Gas	308.24
Component	NitrousOxide	Soil	Grass	Leaching	Soil	Medium	GasIndirect	3.10
Component	NitrousOxide	Soil	Grass	Runoff	Soil	Medium	GasIndirect	0.10
Component	NitrousOxide	Soil	Grass	Gaseous	Soil	Short	Gas	95.71
Component	Pesticides	Chemical	Arable	Direct	PPPs	Short	Dissolved	0.29
Component	Pesticides	Chemical	Arable	Runoff	PPPs	Short	Particulate	0.16
Component	Pesticides	Chemical	Arable	Runoff	PPPs	Short	Dissolved	0.64
Component	Pesticides	Chemical	Arable	Leaching	PPPs	Short	Dissolved	1.39
Component	Pesticides	Chemical	Yards	Runoff	PPPs	Short	Dissolved	2.65
Component	Phosphorus	Chemical	Arable	Runoff	Fertiliser	Short	Dissolved	1.95
Component	Phosphorus	Soil	Arable	Runoff	Soil	Short	Dissolved	0.92
Component	Phosphorus	Soil	Arable	Leaching	Soil	Short	Dissolved	4.27
Component	Phosphorus	Soil	Arable	Runoff	Soil	Short	Particulate	10.93
Component	Phosphorus	Soil	Grass	Runoff	Soil	Short	Dissolved	0.13
Component	Phosphorus	Soil	Grass	Leaching	Soil	Short	Dissolved	0.59
Component	Phosphorus	Soil	Grass	Runoff	Soil	Short	Particulate	0.63
Component	Sediment	Soil	Arable	Runoff	Soil	Short	Particulate	11481.85
Component	Sediment	Soil	Grass	Runoff	Soil	Short	Particulate	684.76

APPENDIX D: Existing Farmscoper With Additional Mitigation

Farmscoper Evaluate: Sets of methods
30/10/2015

File Information	
Create File:	FARMSCOPER2_Whitehouse Farm 2015.xls
Evaluate File:	FARMSCOPER2_Evaluate_ Whitehouse Farm.xls
Climate:	700 - 900 mm
Soil Type:	Free Draining

	Fixed Cost	Variable Cost	Total Cost	Nitrate	Phosphorus	Sediment	Ammonia	Methane	Nitrous Oxide	Pesticides	Biodiversity	Water Use	Energy Use
	£	£	£	Kg	Kg	Kg	Kg	Kg	Kg	Units	-	-	-
Baseline Value	0	0	0	3,778	19	12,142	635	0	606	5.1	-	-	-
Prior Implementation Value	147	4,118	4,265	3,607	18	11,269	567	0	584	4.8	2.1	-4.0	-0.2
Impact (Change from prior situation)	£	£	£	%	%	%	%	%	%	%	-	-	-
Set 1	1,910	39,734	41,643	16.4	61.5	83.1	33.5	0.0	4.1	7.5	51.0	0.0	-1.0

Method lists for each set

Method IDs: Set 1	Description
8	Cultivate compacted tillage soils
9	Cultivate and drill across the slope
13	Establish in-field grass buffer strips
14	Establish riparian buffer strips
15	Loosen compacted soil layers in grassland fields
16	Allow field drainage systems to deteriorate
20	Use plants with improved nitrogen use efficiency
21	Fertiliser spreader calibration
22	Use a fertiliser recommendation system
25	Do not apply manufactured fertiliser to high-risk areas
26	Avoid spreading manufactured fertiliser to fields at high-risk times
27	Use manufactured fertiliser placement technologies
301	Incorporate a urease inhibitor into urea fertilisers for arable land
31	Use clover in place of fertiliser nitrogen
78	Re-site gateways away from high-risk areas
80	Establish new hedges
101	Protection of in-field trees
103	Management of in-field ponds
105	Management of field corners
106	Plant areas of farm with wild bird seed / nectar flower mixtures
107	Beetle banks
108	Uncropped cultivated margins
110	Uncropped cultivated areas
111	Unfertilised cereal headlands
112	Unharvested cereal headlands
115	Leave over winter stubbles
117	Use correctly-inflated low ground pressure tyres on machinery

Item	Pollutant	Source	Area	Pathway	Type	Timescale	Form	Baseline Value	Prior Value	New Value	Max Variation	Units
Total	Nitrate	All	All	All	All	All	All	3764.64	3593.63	3001.95	-	kg NO_3-N
Total	Phosphorus	All	All	All	All	All	All	19.42	18.23	7.07	-	kg P
Total	Sediment	All	All	All	All	All	All	12166.61	11269.16	1694.05	-	kg
Total	Ammonia	All	All	All	All	All	All	634.57	567.49	377.64	-	kg NH_3-N
Total	Methane	All	All	All	All	All	All	0.00	0.00	0.00	-	kg CH_4
Total	NitrousOxide	All	All	All	All	All	All	695.12	672.31	648.58	-	kg N_2O
Total	Pesticides	All	All	All	All	All	All	5.12	4.77	4.41	-	Dose Units
Total	Biodiversity	-	-	-	-	-	-	-	2.13	53.11	-	-
Total	Water Use	-	-	-	-	-	-	-	-4.00	-4.00	-	-
Total	Energy Use	-	-	-	-	-	-	-	-0.17	-1.19	-	-
Summary	Nitrate	All	Arable	All	All	All	All	3683.27	3512.26	2920.65	-	
Summary	Nitrate	All	Grass	All	All	All	All	81.37	81.37	81.31	-	
Summary	Nitrate	All	Rough	All	All	All	All	0.00	0.00	0.00	-	
Summary	Nitrate	All	Other	All	All	All	All	0.00	0.00	0.00	-	
Summary	Phosphorus	All	Arable	All	All	All	All	18.06	16.90	5.96	-	
Summary	Phosphorus	All	Grass	All	All	All	All	1.36	1.33	1.11	-	
Summary	Phosphorus	All	Rough	All	All	All	All	0.00	0.00	0.00	-	
Summary	Phosphorus	All	Other	All	All	All	All	0.00	0.00	0.00	-	
Summary	Sediment	All	Arable	All	All	All	All	11481.85	10608.89	1249.75	-	
Summary	Sediment	All	Grass	All	All	All	All	684.76	660.27	444.30	-	
Summary	Sediment	All	Rough	All	All	All	All	0.00	0.00	0.00	-	
Summary	Sediment	All	Other	All	All	All	All	0.00	0.00	0.00	-	
Summary	Ammonia	All	Arable	All	All	All	All	634.57	567.49	377.64	-	
Summary	Ammonia	All	Grass	All	All	All	All	0.00	0.00	0.00	-	
Summary	Ammonia	All	Rough	All	All	All	All	0.00	0.00	0.00	-	
Summary	Ammonia	All	Other	All	All	All	All	0.00	0.00	0.00	-	
Summary	Methane	All	Arable	All	All	All	All	0.00	0.00	0.00	-	
Summary	Methane	All	Grass	All	All	All	All	0.00	0.00	0.00	-	
Summary	Methane	All	Rough	All	All	All	All	0.00	0.00	0.00	-	
Summary	Methane	All	Other	All	All	All	All	0.00	0.00	0.00	-	
Summary	NitrousOxide	All	Arable	All	All	All	All	596.21	573.96	550.23	-	
Summary	NitrousOxide	All	Grass	All	All	All	All	98.91	98.35	98.35	-	
Summary	NitrousOxide	All	Rough	All	All	All	All	0.00	0.00	0.00	-	
Summary	NitrousOxide	All	Other	All	All	All	All	0.00	0.00	0.00	-	
Summary	Pesticides	All	Arable	All	All	All	All	2.47	2.26	1.90	-	
Summary	Pesticides	All	Grass	All	All	All	All	0.00	0.00	0.00	-	
Summary	Pesticides	All	Rough	All	All	All	All	0.00	0.00	0.00	-	
Summary	Pesticides	All	Other	All	All	All	All	2.65	2.51	2.51	-	

Component	Ammonia	Chemical	Arable	Gaseous	Fertiliser	Short	Gas	634.57	567.49	377.64	0
Component	Nitrate	Chemical	Arable	Runoff	Fertiliser	Short	Dissolved	63.33	52.14	11.82	0
Component	Nitrate	Chemical	Arable	Runoff	Fertiliser	Medium	Dissolved	56.28	47.82	14.01	0
Component	Nitrate	Chemical	Arable	Leaching	Fertiliser	Medium	Dissolved	1134.03	1006.63	714.57	0
Component	Nitrate	Soil	Arable	Runoff	Soil	Medium	Dissolved	114.87	114.06	96.96	0
Component	Nitrate	Soil	Arable	Leaching	Soil	Medium	Dissolved	2314.76	2291.61	2083.28	0
Component	Nitrate	Soil	Grass	Runoff	Soil	Medium	Dissolved	2.57	2.56	2.50	0
Component	Nitrate	Soil	Grass	Leaching	Soil	Medium	Dissolved	78.80	78.80	78.80	0
Component	NitrousOxide	Chemical	Arable	Runoff	Fertiliser	Medium	GasIndirect	2.21	1.88	0.55	0
Component	NitrousOxide	Chemical	Arable	Leaching	Fertiliser	Medium	GasIndirect	44.55	39.55	28.07	0
Component	NitrousOxide	Chemical	Arable	Runoff	Fertiliser	Short	GasIndirect	2.49	2.05	0.46	0
Component	NitrousOxide	Chemical	Arable	Gaseous	Fertiliser	Short	Gas	131.57	117.86	101.33	0
Component	NitrousOxide	Chemical	Arable	Gaseous	Fertiliser	Medium	Gas	11.69	10.50	8.53	0
Component	NitrousOxide	Soil	Arable	Leaching	Soil	Medium	GasIndirect	90.94	90.03	81.84	0
Component	NitrousOxide	Soil	Arable	Runoff	Soil	Medium	GasIndirect	4.51	4.48	3.81	0
Component	NitrousOxide	Soil	Arable	Gaseous	Soil	Short	Gas	308.24	307.62	325.64	0
Component	NitrousOxide	Soil	Grass	Leaching	Soil	Medium	GasIndirect	3.10	3.10	3.10	0
Component	NitrousOxide	Soil	Grass	Runoff	Soil	Medium	GasIndirect	0.10	0.10	0.10	0
Component	NitrousOxide	Soil	Grass	Gaseous	Soil	Short	Gas	95.71	95.15	95.15	0
Component	Pesticides	Chemical	Arable	Direct	PPPs	Short	Dissolved	0.29	0.18	0.17	0
Component	Pesticides	Chemical	Arable	Runoff	PPPs	Short	Particulate	0.16	0.14	0.05	0
Component	Pesticides	Chemical	Arable	Runoff	PPPs	Short	Dissolved	0.64	0.56	0.29	0
Component	Pesticides	Chemical	Arable	Leaching	PPPs	Short	Dissolved	1.39	1.39	1.39	0
Component	Pesticides	Chemical	Yards	Runoff	PPPs	Short	Dissolved	2.65	2.51	2.51	0
Component	Phosphorus	Chemical	Arable	Runoff	Fertiliser	Short	Dissolved	1.95	1.71	0.42	0
Component	Phosphorus	Soil	Arable	Runoff	Soil	Short	Dissolved	0.92	0.87	0.29	0
Component	Phosphorus	Soil	Arable	Leaching	Soil	Short	Dissolved	4.27	4.27	4.27	0
Component	Phosphorus	Soil	Arable	Runoff	Soil	Short	Particulate	10.93	10.05	0.99	0
Component	Phosphorus	Soil	Grass	Runoff	Soil	Short	Dissolved	0.13	0.13	0.11	0
Component	Phosphorus	Soil	Grass	Leaching	Soil	Short	Dissolved	0.59	0.59	0.59	0
Component	Phosphorus	Soil	Grass	Runoff	Soil	Short	Particulate	0.63	0.61	0.41	0
Component	Sediment	Soil	Arable	Runoff	Soil	Short	Particulate	11481.85	10608.89	1249.75	0
Component	Sediment	Soil	Grass	Runoff	Soil	Short	Particulate	684.76	660.27	444.30	0

APPENDIX E: Amec Foster Wheeler Hydrological Conceptualisation

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Technical note:
Albion Water West Chichester Development: Hydrogeological Conceptualisation

1. Introduction

1.1 Background

The Land West of Chichester (Appendix A – Location & Sampling Plan) is proposed for residential development (capacity for 1600 dwellings) for which Albion Water are providing the foul sewerage infrastructure solution. The Environment Agency has been consulted on the proposed sewage effluent discharge from this system to a surface watercourse on site (Figure 1.1), which feeds into the Fishbourne and discharges into Chichester Harbour. Concerns were raised by the Environment Agency for the possible impact from effluent being lost to ground through infiltration into the stream bed and sides after discharge, percolating into regionally important groundwater aquifers (Chalk and Lambeth Group).

Albion Water has commissioned Amec Foster Wheeler to undertake a conceptualisation of the hydrogeology beneath the site and beneath the watercourse as it flows off-site, to determine the risk of effluent percolation impacting the water quality of the Chalk aquifer and Lambeth Group (Reading Beds).

A surface water assessment is being undertaken separate to this study by Mayer Brown entitled "Land West of Chichester - Environmental Statement, Volume 1, Chapter 9 – Water Resources and Flood Risk".

1.2 Site Location

The Land West of Chichester residential development site (the Site) is situated on the western side of Chichester. The site is bounded by Chichester to the east, the A27 and arable fields to the west, the Fareham to Worthing railway line to the south and the B2178 to the north (Figure 1.1 / Appendix A).

1.3 Proposed Discharge

Treatment process would result in a 14 l/s effluent discharge to the south-easterly trending unnamed watercourse located at National Grid Reference SU 84218 05284 (Figure 1.1 / Appendix A).

1.4 Hydrology of Receiving Water

The receiving water would be a seasonally dry unnamed watercourse that follows an east-west field boundary (Figure 1.1), measuring approximately 3 m wide by 1.1 m deep and transmits intermittent flows from a spring in the northwest of the Site. During the bed level survey on 10th June 2015, this watercourse was dry. This unnamed watercourse flows south from the site, through the urban area that links Chichester and Fishbourne, turning to the west after Fishbourne Road East and entering a culverted stretch before re-emerging under bridges of the A27, and finally discharges into Chichester Harbour. The watercourse receives Chalk spring flows in the Fishbourne area to the west of the A27.

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1.5 Geology

Superficial

The Site is underlain by both sand and gravel-dominated River Terrace Deposits and Head deposits (Figure 1.1/3.1). As the Head deposits are considered to be reworked River Terrace Deposits and texturally similar (sand and gravel dominated), both deposits are treated together in this study. At the southern boundary of the Site, these give way to sand and gravel-dominated Alluvial Fan Deposits. In the vicinity of the A27, the superficial deposits become Raised Marine Deposits, which are clay and silt dominated.

Solid Geology

The Site is underlain mainly by the London Clay except at its southern boundary where the contact with the Reading Beds (Lambeth Group) is located (Figure 1.2/3.1). The Reading Beds extend south to the Fishbourne Road East where the contact with the Chalk is located.

Figure 1.1 Superficial Geology (red line – Site boundary)

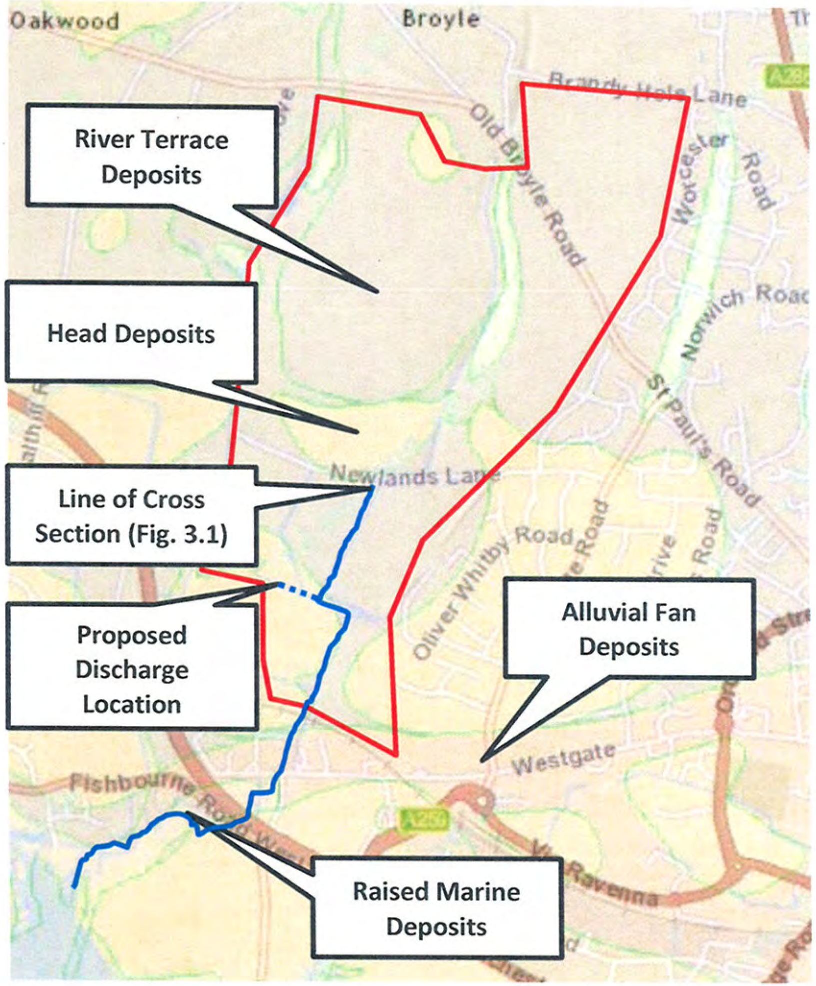
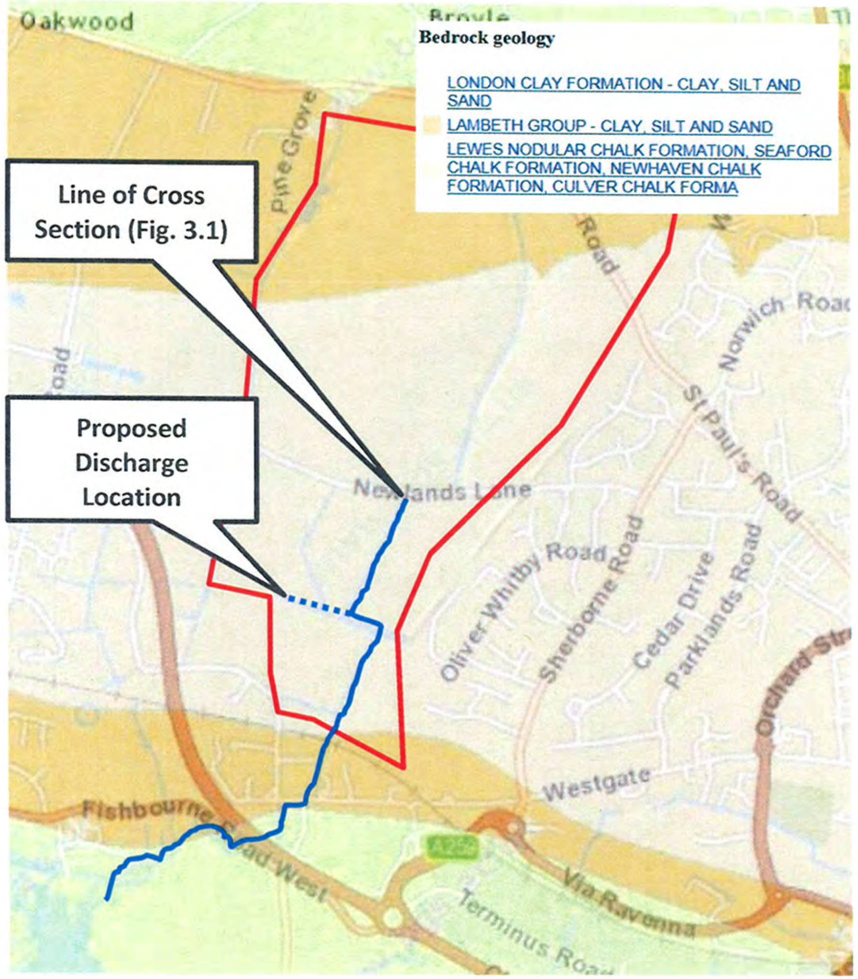


Figure 1.2 Solid Geology (red line – Site boundary)



1.6 Source Protection and Groundwater Vulnerability

The site is located adjacent and to the east of the Inner Source Protection Zone (1c, for subsurface activity only) for Portsmouth Water's Fishbourne abstraction. This zone protects groundwater in the Chalk aquifer that underlies (and is protected by) clay-rich Tertiary deposits within the Chichester Syncline.

The groundwater vulnerability classification for the Site is Minor Aquifer – Intermediate in the north and Minor Aquifer – High in the southern part of the site.

2. Sources of Data Used

The following sources of data have been used to undertake this conceptualisation as follows:

- Topographical Survey from the Mayer Brown Site Investigation;
- Bed level elevations for the unnamed watercourse (receiving water for discharge) from Mayer Brown Site Investigation;
- Geological mapping provided by British Geological Survey (BGS) Open Geoscience website (http://mapapps.bgs.ac.uk/geologyofbritain/home.html);
- Borehole logs from the Mayer Brown Site Investigation;
- Borehole logs from the BGS website (http://www.bgs.ac.uk/data/boreholescans/home.html)
- Water quality monitoring from the Mayer Brown Site Investigation and the Mayer Brown Sewage Treatment Technical Summary (Mayer Brown, 2014);
- Fishbourne Spring flow data (provided by the Environment Agency); and
- East Hampshire and Chichester Chalk Groundwater Model outputs (courtesy of the Environment Agency).

3. Hydrogeological Conceptualisation

3.1 Cross Section

Method

A geological cross section (Figure 3.1) has been drawn for a north-south transect through the Site. The topography plotted is based on the bed level elevations and the topographic survey carried out by Mayer Brown. It should be noted that the topographic line plotted is the bed level of the unnamed watercourse that flows through the site to Chichester Harbour and borehole depths have been plotted using this as the ground level.

The outcrop geology[1] and borehole lithologies were used to represent the solid and superficial geology beneath the Site and downstream of the site to Chichester Harbour. Groundwater levels have been represented from water levels recorded on BGS drilling records and groundwater level monitoring undertaken during the Site Investigation. Borehole logs have been used from three sources as follows:

- On-site borehole (BH4);
- Site investigation boreholes (BH101, BH102 and BH103); and
- BGS borehole records (SU80/SW35, SU80/SW25, SU80/SW22);

[1] BGS Geology of Britain Viewer http://mapapps.bgs.ac.uk/geologyofbritain/home.html

The cross section shows that the hydrogeology of the site is dominated by the Chichester Syncline. The dip of the Reading Beds and the London Clay is to the north.

Pathways and Receptors

Possible receptors for the proposed effluent have been identified in Figure 3.1.

Both the London Clay and the Reading Beds have been described in the drilling records as stiff or firm Clays, and infiltration tests undertaken during the site investigation on both geological units recorded no percolation of water over the course of one day. It is, therefore, concluded that neither the London Clay nor Reading Beds represent a groundwater receptor at risk of percolation of treated sewage effluent from the stream bed. On the site, the main groundwater receptor is the superficial River Terrace Deposits, which the effluent may enter laterally through the river banks. These become thin in the south of the site and effluent entering these deposits would be expected to discharge to the on-site watercourse as no downward percolation is possible on the Site. For this reason, the River Terrace Gravels are not considered to be a receptor.

Immediately to the south of the site, the unnamed watercourse that flows between the site and Fishbourne Road East flows over Reading Beds overlain by Alluvial Fan Deposits (sands and gravels). To the south of Fishbourne Road East, the Reading Beds/Chalk contact is located beneath the transmissive Alluvial Fan Deposits, representing a potential groundwater pathway to the Chalk aquifer. This pathway 'window' extends approximately 100 m to the south where the Alluvial Fan Deposits meet the Raised Beach Deposits, which extend to Chichester Harbour. The Raised Beach Deposits have been described texturally in BGS drilling logs as 'Clay with Flints', so represent a low permeability Drift layer that should provide protection to the underlying Chalk aquifer from percolation of any polluting effluent through the stream bed.

In summary, the main receptors for the effluent are the Chalk groundwater and surface water (which is not assessed any further in this study). Although the River Terrace Deposits may receive inputs of effluent percolating into the stream bed and banks, these deposits are not laterally continuous and their resource vulnerability is low.

Groundwater Levels

Groundwater levels are between 2-3 mbgl in the River Terrace Deposits on Site. In relation to the bed levels of the watercourse, around 1-1.5 m of this depth near the watercourse would be taken up by the watercourse channel.

In the solid geology, groundwater levels in the Reading Beds are between 5 mbgl and 14 mbgl, whereas in the Chalk levels are much higher at 1.3-1.5 mbgl (from borehole logs), plotting within the superficial deposits. This suggests an upward hydraulic gradient between the Chalk and the superficial deposits between Fishbourne Road East and the A27 where these Chalk boreholes are located. There were no Chalk borehole records or groundwater levels available in the vicinity of the watercourse between the A27 and Chichester Harbour.

3.2 Spring Flows

The Environment Agency provided data on the flows at the Fishbourne Spring (Figure 3.2) located at SU 8392 0443, which showed flows all year round from the Chalk aquifer from 2009 to 2011. There was a seasonal variation in flows with the highest flows occurring in winter and spring months (January to April). Figure 3.2 also demonstrates that spring flow continued even in the dry period of autumn/winter 2011.

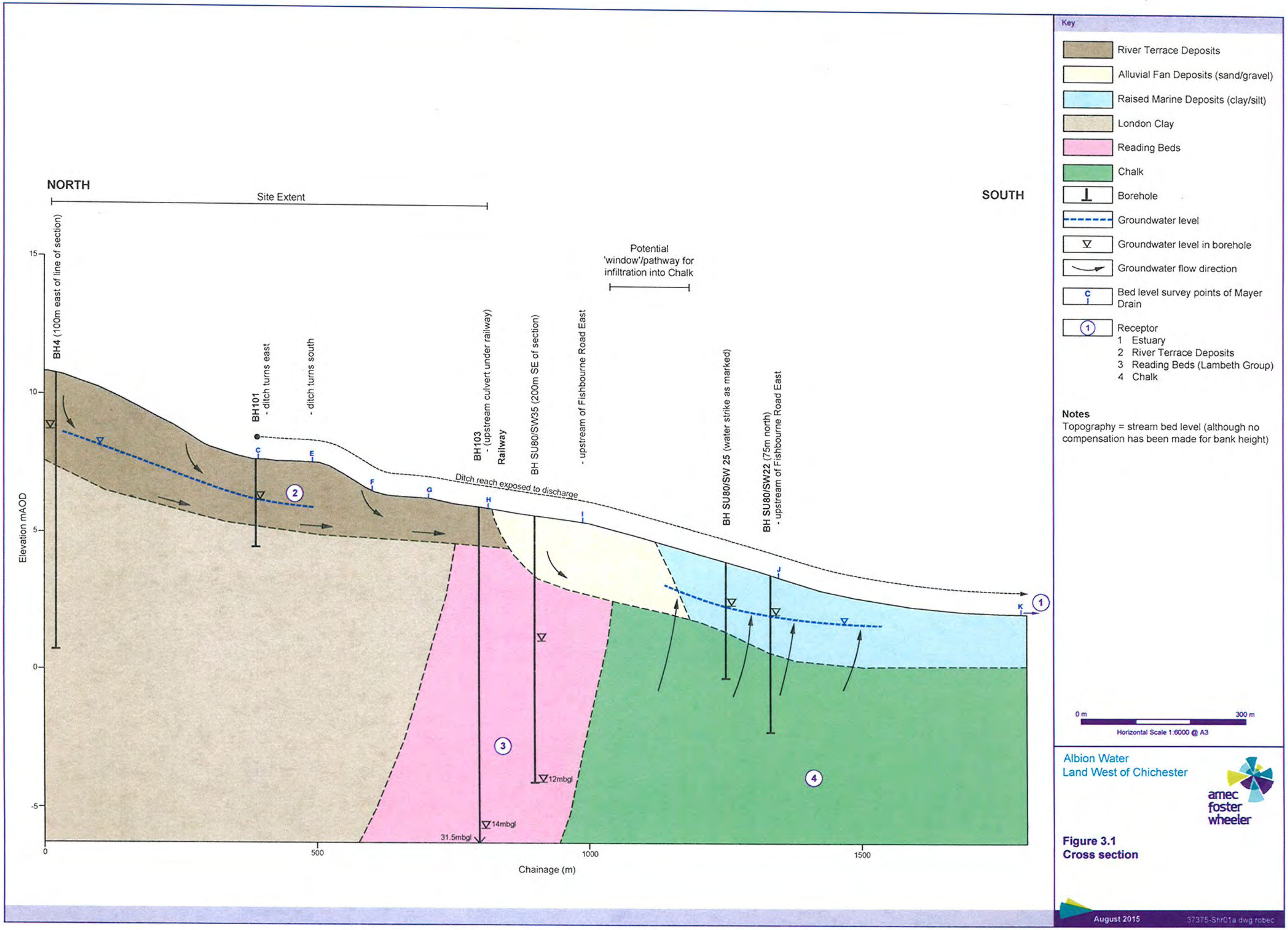
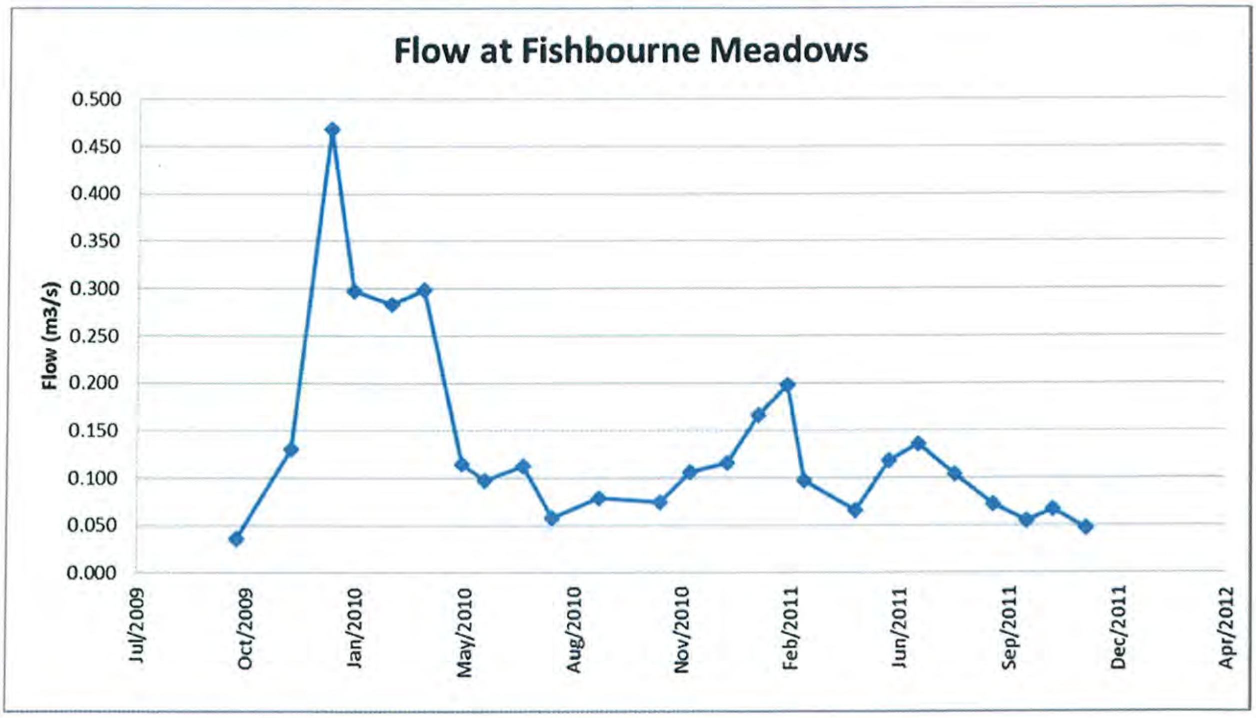


Figure 3.1
Cross section

Figure 3.2 Flows at Fishbourne Meadows (courtesy of the Environment Agency)



3.3 Groundwater Model Simulation

The Environment Agency's East Hampshire and Chichester Chalk (EHCC) Groundwater Model was checked for any information on groundwater-surface water interaction between the Chalk and the unnamed watercourse flowing to Chichester Harbour from the Site.

The scenario examined was the Recent Actual scenario as it would represent a realistic situation in terms of abstraction and drawdown from the Chalk aquifer. To be precautionary, the flow situation examined was one of Low Flows in the stream cells to represent the groundwater-surface water interaction during a dry period when flow in the watercourse would be down at the 5th percentile (Q95 flows). For the scenario examined, each stream cell shows a situation of Chalk groundwater flowing upwards into surface water even during a period of low flows. Therefore, this model simulation suggests permanent upward hydraulic gradient and upward flows of Chalk groundwater into surface water.

By way of caveats, it should be noted that this does not necessarily represent the most extreme combination of a drought period together with an extreme level of groundwater abstraction and drawdown. To model this would require a dedicated model scenario.

The Environment Agency owns and holds the EHCC groundwater model, and therefore are able to check the results of the scenario referred to in this study.

3.4 Hydrogeological Summary

The most vulnerable groundwater receptor is the Chalk aquifer. There is a possible pathway for effluent contained in surface water flows to reach the Chalk aquifer through an approximate 100 m gap between the Reading Beds/Chalk contact and the contact Alluvial Fan Deposits/Raised Marine Deposits. However, Chalk groundwater levels are relatively high in the unconfined Chalk, Chalk springs in the Fishbourne area flow throughout the year and EHCC groundwater model results simulate perennially upward flows of Chalk groundwater into surface water. This suggests that despite the combination of a pathway (high permeability 'window' in the superficial deposits) and a vulnerable groundwater receptor (Chalk aquifer), surface water containing treated sewage effluent is not likely to percolate into and pollute the receptor.

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4. Effluent and Receiving Water Quality

Table 4.1 presents a summary of water quality data for the effluent following treatment using the treatment train proposed by Albion Water, and groundwater and surface water monitoring data (see Appendix A for monitoring point locations). The key points to note from this table are as follows:

- Compared to the River Terrace Deposit groundwater, the concentrations in the treated waste water generally exceed the groundwater concentrations, with the exception of Total Phosphorus. However, these superficial deposits are not regionally important aquifers and their main water resources benefit is support to surface water;
- The treated waste water would exceed the Total Nitrogen and faecal coliform levels in the Reading Beds, but the effluent would not exceed the Ammoniacal nitrogen or Total Phosphorus concentrations of the Reading Beds. However, percolation of effluent into the Reading Beds is very unlikely; and
- The proposed treated waste water would be of higher quality than surface water in the watercourse for the following parameters:
  - Total Nitrogen
  - Total Phosphorus;
  - Faecal Coliforms.

Table 4.1 Water quality summary (numbers in bold indicate mean values)

Water	Monitoring Points	Number of Samples	Ammoniacal Nitrogen (mg N/l)	Nitrate (mg NO_3/l)	Total Nitrogen (mg N/l)	Phosphorus (mg/l)		Faecal Coliforms (fc/100ml)
						Dissolved P	Total P	
Effluent Discharge	-	-	≤0.3	≤5			≤0.09	≤1000
River Terrace Deposits	BH101	2	<0.3	1.27-2.16	1.02-1.16	0.013-0.015	0.04-1.59	<1
Reading Beds	BH103	2	0.8-1.1	0.74-1.66	1.24-1.47	0.017-0.021	0.037-0.513	<1-1
Chalk	-	0	-	-	-	-	-	-
Surface Waters	SW102, SW103, SW104	44	**0.31** (<0.3-0.38)	**23.3** (1-36.2)	**6.7** (1.1-9.27)	**0.1** (0.02-0.232)	**0.18** (0.05-0.46)	**533** (47-1200)

5. Summary

This study presents an assessment of the hydrogeological conceptual model for the Albion Water site west of Chichester and a summary of the water quality monitoring (both groundwater and surface water). This work shows that effluent will not percolate into London Clay and Reading Beds, leaving the Chalk aquifer as the principal groundwater receptor. The River Terrace Deposits are not considered a significant receptor as these are not laterally continuous beyond the site and have low resource potential. Much of the Chalk is protected from contamination from percolating surface waters by the low permeability Raised Marine Deposits, but at the northern extent of the Chalk outcrop, an east-west orientated 'window' of high permeability Alluvial Fan deposits approximately 100 m wide exists over the Chalk, which represents a potential pathway for contamination of this aquifer. Groundwater levels in the Chalk measured by drillers, perennial Chalk spring flows and a model simulation of vertical hydraulic gradients all suggest that upward flows of Chalk groundwater from the Chichester Syncline will prevent any percolation of surface water into the Chalk aquifer.

Water quality data suggest that on the whole, the quality of the proposed treated waste water is higher than the main receiving water: surface water.

On the basis of this conceptual model, it is recommended that a further groundwater risk assessment into potential adverse effects on the Chalk aquifer is not required.

Author

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Reviewer

Mike Carey

Dr Mike Carey

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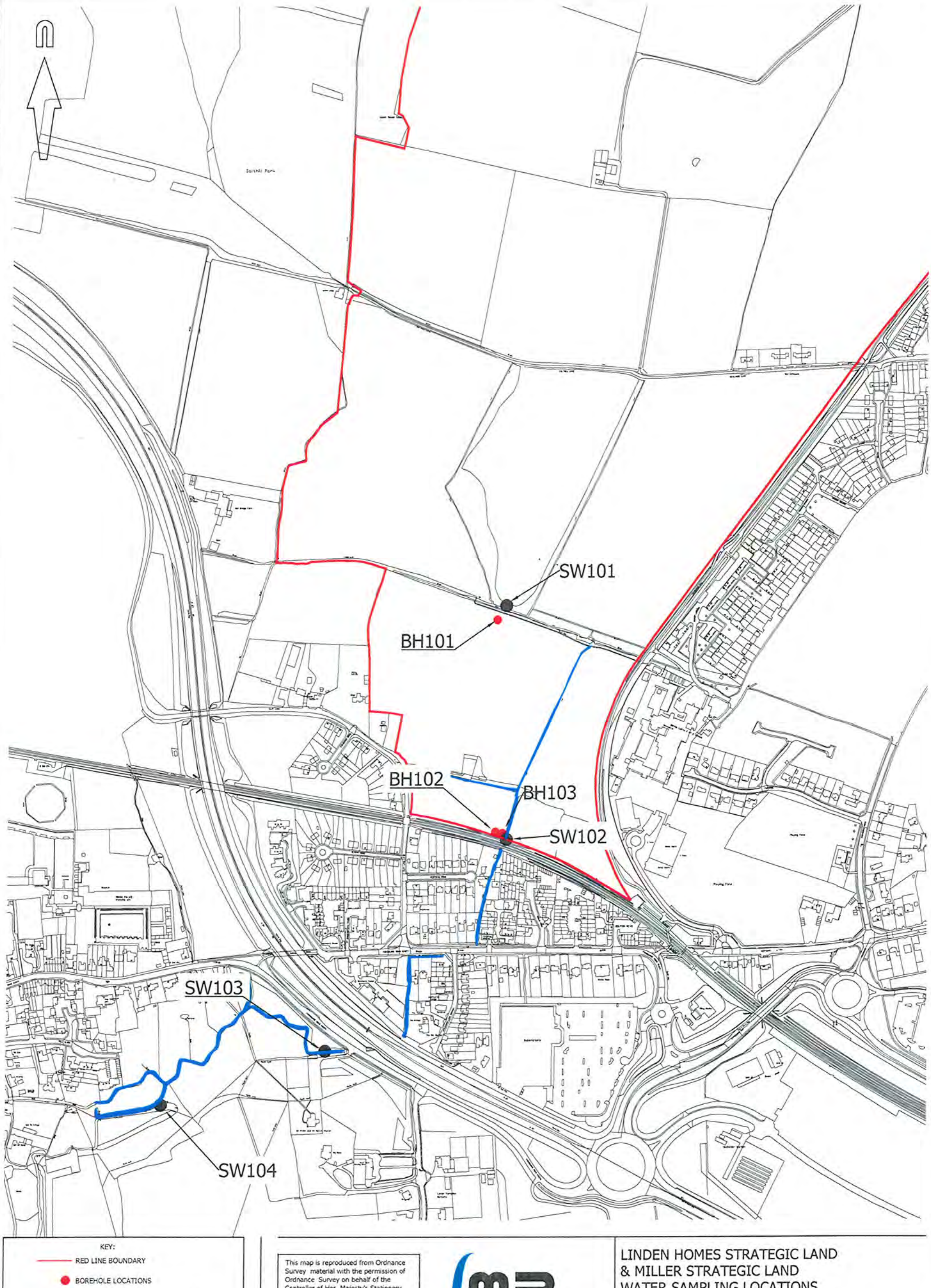
Appendix A
Location and Sampling Plan (Mayer Brown)



KEY:

- RED LINE BOUNDARY
- BOREHOLE LOCATIONS
- SURFACE WATER SAMPLING LOCATION
- WATERCOURSE

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mayer brown

LINDEN HOMES STRATEGIC LAND
& MILLER STRATEGIC LAND
WATER SAMPLING LOCATIONS
WHITEHOUSE FARM, CHICHESTER

Scale 1:5000@A3

APPENDIX F: Chesapeake Bay WWTP sites list

Wastewater Treatment Plants

40632

Reporting Period: MARCH 2011

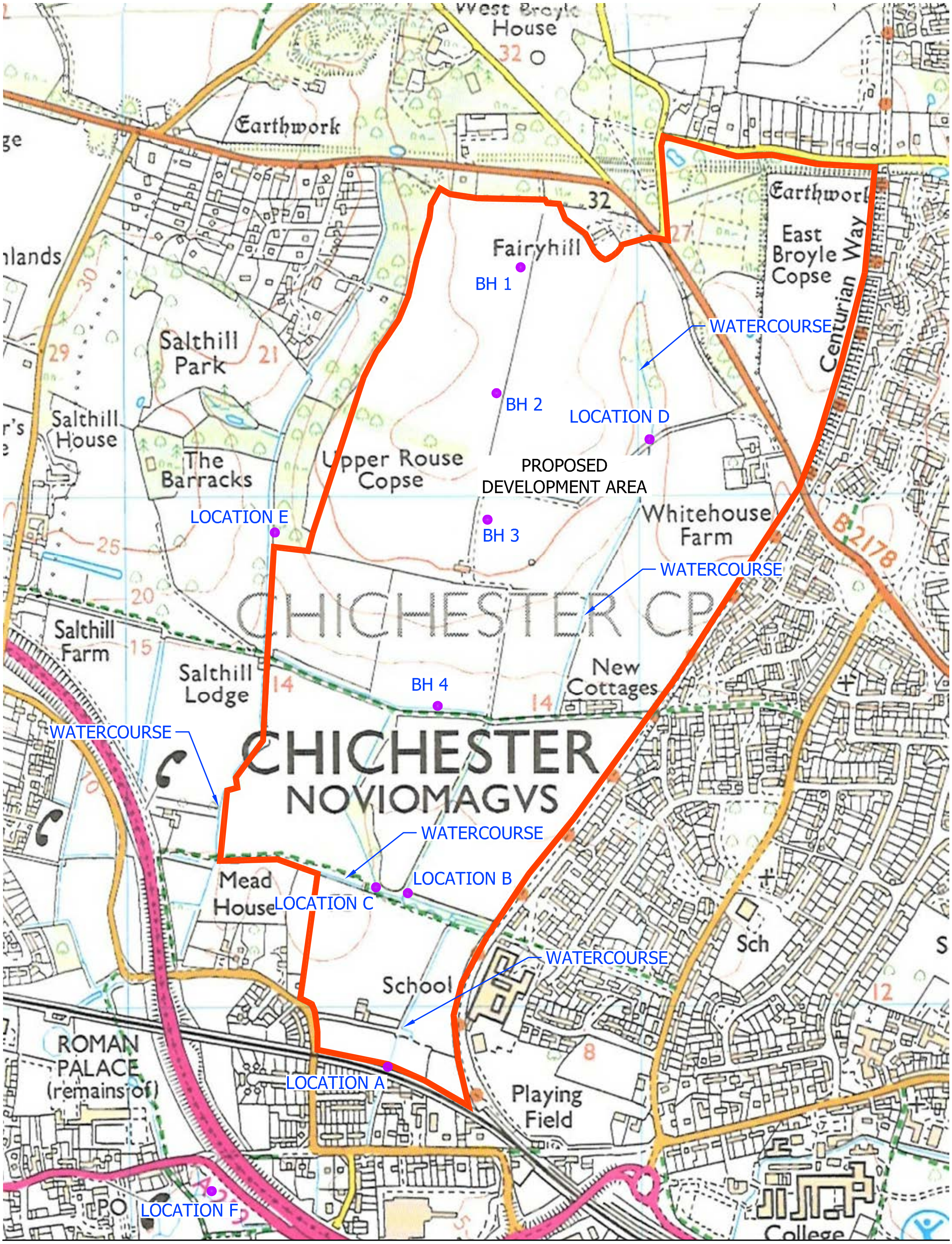
	Tributary	Est. Lbs/Year Nitrogen Reduction from 2008 load to projected 2011 load (2011 flow &TN of 3 mg/l	Est. Lbs/Year Nitrogen Design Flow Reduction*	Upgrade Includes BNR	Start Date Planning	Start Date Design	Start Date Construction	Target Date Construction Complete	Actual Date Construction Complete	Remark
APG-Aberdeen	UPPER WESTERN SHORE	-	127,000	Yes	Complete	Complete	Complete	Complete	3/14/2006	Completed by the US Army. Bids due 2/2/11 for separate work on design of headworks & flow equalization.
Hurlock	LOWER EASTERN SHORE	-	75,000	Yes	Complete	Complete	Complete	Complete	5/15/2006	Construction was completed as scheduled
Celanese	UPPER POTOMAC	-	91,000	Yes	Complete	Complete	Complete	Complete	11/2/2006	Completed with no significant delays
Swan Point	LOWER POTOMAC	-	27,000	Yes	Complete	Complete	Complete	Complete	5/3/2007	Completed by a private developer
Easton	CHOPTANK	-	60,000	Yes	Complete	Complete	Complete	Complete	6/30/2007	ENR is in operation - Contract for additional solids process is under construction.
Kent Island	UPPER EASTERN SHORE	-	137,000	Yes	Complete	Complete	Complete	Complete	8/20/2007	Construction was completed as scheduled
Mattawoman	LOWER POTOMAC	-	304,000	No	Complete	Complete	Complete	Complete	11/8/2007	ENR upgrade was completed at 15 MGD - plant performance indicates it can achieve ENR at 20MGD.
Chestertown	**UPPER EASTERN SHO**	**55,535**	**68,000**	**Yes**	**Complete**	**Complete**	**Complete**	**Complete**	**6/17/2008**	**Final inspection was done-operational optimization is underway**
Brunswick	**UPPER POTOMAC**	**20,274**	**63,000**	**Yes**	**Complete**	**Complete**	**Complete**	**Complete**	**9/15/2008**	**Completed**
St. Michaels	**UPPER EASTERN SHO**	**9,717**	**30,000**	**Yes**	**Complete**	**Complete**	**Complete**	**Complete**	**10/22/2008**	**Construction is completed and ENR optimization is underway.**
Indian Head	**LOWER POTOMAC**	**17,574**	**22,000**	**Yes**	**Complete**	**Complete**	**Complete**	**Complete**	**12/30/2008**	**Construction is complete and ENR is in operation**
Elkton	**UPPER EASTERN SHO**	**112,097**	**139,000**	**Yes**	**Complete**	**Complete**	**Complete**	**Complete**	**12/31/2009**	**ENR is in operation.**
Harve De Grace	**UPPER WESTERN SH**	**16,269**	**34,000**	**Yes**	**Complete**	**Complete**	**Complete**	**Complete**	**3/15/2010**	**Plant is ENR operational. Construction is substantially complete.**
Poolesville	MIDDLE POTOMAC	3,774	9,000	No	Complete	Complete	Complete	Complete	7/3/2010	Construction completed. Final inspection conducted 8/4/10 Project Closeout 10/18/2010
Federalsburg	**LOWER EASTERN SH**	**14,643**	**34,000**	**Yes**	**Complete**	**Complete**	**Complete**	**Complete**	**8/4/2010**	**Construction is complete. ENR process is being optimized.**
Crisfield	**LOWER EASTERN SH**	**20,417**	**45,000**	**Yes**	**Complete**	**Complete**	**Complete**	**Complete**	**8/25/2010**	**ENR is in operation. Under project performance evaluation until June 2011**
Boonsboro (Minor)	UPPER POTOMAC	17,009	22,000	Yes	Complete	Complete	Complete	Complete	10/2/2010	Minor (< 0.5 MGD) was not on the orginal list
Georges Creek	**UPPER POTOMAC**	**13,813**	**27,000**	**Yes**	**Complete**	**Complete**	**Complete**	**Complete**	**11/16/2010**	**Plant is ENR operational. Substantial completion inspection conducted 11/16/10.**
Mt. Airy	PATAPSCO/BACK	6,237	18,000	No	Complete	Complete	Complete	Complete	11/6/2010	Project is substantially complete& walkthrough conducted on 11/16/10. The facility is ENR operational.
Perryville	**UPPER EASTERN SHO**	**10,386**	**25,000**	**Yes**	**Complete**	**Complete**	**Complete**	**Complete**	**12/30/2010**	**ENR is in opeation.**
Hagerstown	**UPPER POTOMAC**	**108,039**	**121,000**	**No**	**Complete**	**Complete**	**Complete**	**Complete**	**12/30/2010**	**Plant is ENR operational. Final inspection to be conducted on 3/5/2011.**
Cumberland	UPPER POTOMAC	193,888	228,000	No	Complete	Complete	Complete	Complete	2/4/2011	Plant is ENR operational. Construciton is substantially complete
Bowie	**PATUXENT**	**26,947**	**50,000**	**No**	**Complete**	**Complete**	**Complete**	**Complete**	**2/28/2011**	**Plant is ENR operational. Plant is undergoing performance testing.**
	GDU TO DATE	***646,620***								
Salisbury	**LOWER EASTERN SH**	**534,042**	**388,000**	**Yes**	**Complete**	**Complete**	**Complete**	**12/31/10**		**Plant is not achieving ENR - Corrective action being evaluated.**
Pocomoke City	LOWER EASTERN SHORE	10,012	67,000	No	Complete	Complete	12/30/2009	03/01/11		Project has stimulus grant. Part-B approved. Project is under construction.
Denton	CHOPTANK	13,430	12,000	No	Complete	Complete	6/28/2010	06/27/11		Project is under construction. Construction started June 28, 2010.
Delmar	**LOWER EASTERN SH**	**15,600**	**38,000**	**Yes**	**Complete**	**Complete**	**6/15/2009**	**06/30/11**		**Project is under construction. Delay due to equipment delivery.**
Thurmont	UPPER POTOMAC	2,588	15,000	No	Complete	Complete	9/8/2010	02/29/12		Project is under construction.
Piscataway	MIDDLE POTOMAC	95,978	456,000	No	Complete	Complete	1/28/2011	07/29/12		Notice to Proced: 01/28/2011. Project is under construction.
Cambridge	CHOPTANK	11,175	123,000	No	Complete	11/15/2009	4/1/2011	10/01/12		Construction Bids opened 01/21/2011. Part-B construction procurement package under review by MDE.
Taneytown	UPPER POTOMAC	1,225	16,000	No	Complete	11/30/2009	5/1/2011	07/30/12		Full scale pilot test incorporating BIOMAG process completed and draft report received by MDE for review.
Aberdeen	UPPER WESTERN SHORE	3,891	60,000	No	Complete	Complete	6/4/2010	08/03/12		Construction started 6/4/2010. Project is under Construction
Joppatowne	UPPER WESTERN SHORE	6,917	14,000	No	Complete	6/11/2010	8/30/2011	08/30/12		Project delay. County selected another design engineer.Design is 60% complete & under County review.
Snow Hill	LOWER EASTERN SHORE	14,532	22,000	Yes	Complete	10/1/2009	6/30/2011	04/15/13		Design started in Oct 09. Design is 100% complete. Bids to open on Feb 28, 2011.
Winebrenner	UPPER POTOMAC	11,971	45,000	Yes	1/16/2007	8/1/2010	1/15/2013	05/01/14		County pilot tested BioMag process for ENR treatment. Testing is complete. Report received 11/19/2010.
Maryland City	PATUXENT	13,071	38,000	No	Complete	10/20/2008	6/30/2011	10/30/12		Final Plans & Specs received on 11/18/10. ENR grant eligibility being finalized with Anne Arundel Co.

	Tributary	Est. Lbs/Year Nitrogen Reduction from 2008 load to projected 2011 load (2011 flow &TN of 3 mg/l	Est. Lbs/Year Nitrogen Desigh Flow Reduction*	Upgrade Includes BNR	Start Date Planning	Start Date Design	Start Date Construction	Target Date Construction Complete	Actual Date Construction Complete	Remark
Little Patuxent	PATUXENT	109,147	380,000	No	Complete	Complete	9/1/2009	11/30/12		100% Design approved by MDE. Project is design/build and under construction.
La Plata	LOWER POTOMAC	1,477	22,000	No	Complete	8/10/2009	6/30/2011	08/30/13		Construction Permit issued. Project has been bid for construction.
Chesapeake Beach	LOWER WESTERN SHORE	-	22,000	No	Complete	1/1/2010	9/1/2011	03/30/13		Design is 60% complete. ENR Eligibility letter sent to Town on 05/12/10
Annapolis	LOWER WESTERN SHORE	82,998	197,000	No	Complete	8/15/2008	4/30/2011	04/30/13		Final ENR eligibility established. Construction bids opened. Final P&S approved & permit 02/17/11.
Marlay Taylor	LOWER WESTERN SHORE	30,594	91,000	No	Complete	9/30/2009	6/30/2011	03/30/13		A/E contract for design and feasibility study approved. METCOM considering BIOMAG process
Ballenger Creek	UPPER POTOMAC	55,379	274,000	No	Complete	Complete	12/14/2009	05/01/13		Project has stimulus loan. Project is under construction.
Patapsco	PATAPSCO/BACK	2,459,636	3,335,000	Yes	Complete	Complete	12/29/2009	05/01/13		Denite filter under construction. Misc Improv. constr.started Jan 2011.Nitrification filter bid opening 5/25/11.
Parkway	PATUXENT	325	114,000	No	Complete	2/1/2009	7/272011	07/01/13		Final Plans & Specs approved & Permit issued. Stormwater Permit issued. Constr. Bids opened 02/09/11.
Freedom District	PATAPSCO/BACK	44,503	53,000	No	Complete	8/1/2010	3/1/2013	03/01/15		Proposed MBR process denied. ENR eligibility provided to MES. BNR/ENR at 59.05%/
Broadwater	LOWER WESTERN SHORE	3,936	30,000	No	Complete	10/20/2008	6/30/2011	12/30/12		ENR grant eligibility letter sent to AA County. Final P&S being reviewed by MDE.
Damascus	MIDDLE POTOMAC	414	22,000	No	Complete	Complete	7/1/2011	09/18/13		Final P & S approved. Pre-Bid meeting held 10/18/2010. Part-B constr. Procurement approved 02/28/11
Leonardtown	LOWER POTOMAC	-	10,000	No	Complete	10/1/2010	11/1/2011	11/01/13		MDE approved new schedule
Broadneck	LOWER WESTERN SHORE	-	91,000	No	Complete	8/4/2008	6/30/2011	12/30/13		Final ENR eligibility established. AA County is the process of bidding project for construction.
Patuxent	PATUXENT	-	114,000	No	Complete	10/15/2008	5/30/2011	01/30/13		ENR grant eligibility approved 8/2/10. Waiting for final plans and specs.
Conococheague	UPPER POTOMAC	10,948	62,000	No	1/16/2007	8/30/2010	5/15/2012	12/30/13		Project is delayed and will be out of permit compliace. Preliminary design report on BioMag is in progress.
Princess Anne	LOWER EASTERN SHORE	1,052	19,000	No	9/1/2009	5/1/2011	5/1/2012	01/01/14		Tentative schedule - may change. County is in process of obtaining engineer for planning.
Fruitland	LOWER EASTERN SHORE	-	12,000	No	2/1/2009	12/1/2010	1/31/2012	01/31/14		Planning study completed. MDE met with plant staff consulting engineer to discuss ENR upgrade options.
Mayo	LOWER WESTERN SHORE	17,493	12,000	Yes	9/1/2006	3/1/2011	6/1/2012	03/01/14		Delayed due to the evaluation and selection of alternative least environmental risk and public interest issues.
Seneca	MIDDLE POTOMAC	51,117	304,000	No	Complete	2/1/2009	4/2/2011	04/01/14		ENR eligibility finalized. Approved final plans and specs. Construction permit issued 01/28/11.
Western Branch	PATUXENT	-	456,000	No	Complete	9/1/2008	5/27/2011	06/01/14		Final plans & specs reviewed by MDE and comments provided to WSSC in Dec 2010.
Frederick	UPPER POTOMAC	118,001	121,000	No	8/30/2008	12/30/2010	7/1/2012	07/01/14		Meeting held 12/22/10 to discuss ENR eligibility. Further discussion on side stream treatment to be held.
Emmitsburg	UPPER POTOMAC	6,896	11,000	Yes	Complete	1/15/2010	7/1/2012	07/01/14		MDE providing supplemental grant.ENR eligibility finalized. USDA providing funds. Project is under design.
Westminster	UPPER POTOMAC	16,409	76,000	No	Complete	2/1/2011	6/1/2012	12/01/14		ENR eligibility finalized. A/E Design agreement being reviewed by MDE.
Sod Run	UPPER WESTERN SHORE	242,380	304,000	Yes	Complete	10/15/2009	9/1/2011	04/30/14		Project delays - design started Oct 09. Design is 95% complete and being reviewed by MDE.
Northeast River	UPPER EASTERN SHORE	-	30,000	No	12/31/2010	12/31/2011	12/31/2012	12/31/14		Meets nitrogen goals, but does not meet phosphorus. Full scale pilot test being conducted Sept thruFeb 2011
Blue Plains (MD PORTION)	MIDDLE POTOMAC	1,519,311	2,591,640	Yes	Complete	Complete	12/1/2010	12/19/15		Blue Plains Tunnel and sturctural work for Nitrification Reactors are under construction
Cox Creek	PATAPSCO/BACK	156,365	228,000	No	Complete	Complete	4/12/2010	06/30/15		Phase I Part-B approved 01/27/10. ENR eligibility established. Phase II is under design.
Hampstead	UPPER WESTERN SHORE	41,508	41,000	Yes	12/1/2010	9/1/2012	9/1/2013	12/01/15		ENR Agreement not signed.Proposed NPDES permit being disputed by Carroll Cnty
Back River	PATAPSCO/BACK	2,288,655	2,741,000	No	Complete	10/1/2008	12/1/2012	01/30/16		Pilot study for denitrification filter completed. Project No.1, Denitrification filter design is 70% complete.
Dorsey Run	PATUXENT	7,661	30,000	No	7/15/2006					Meets ENR at current flow
Centreville	UPPER EASTERN SHORE	2,481	7,000	No	Land Application. ENR may not be required. Facility meeting TMDL limits					Meets ENR at current flow - project is low priority
MCI	UPPER POTOMAC	819	24,000	No	Plant meets ENR standards at current flow - Low priority project					ENR agreement for planning signed.MES to do feasibility study evaluating existing process.

* The difference in nitrogen loading with and without the upgrade at the design capacity

FACILITY		DESIGN	FLOW_AVE	TN_C	TP_C	TN_L	TP_L
BLUE PLAINS		370	308.22	5.68	0.08	5,333,641	74,409
MD portion		169	124.45	5.68	0.08	2,153,592	30,045

APPENDIX H: WATER QUALITY MONITORING



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client	LINDEN & MILLER	scale	1:10,000	drawn by NT	checked by PAS
title	WHITEHOUSE FARM, CHICHESTER WATER SAMPLING LOCATIONS	date	DECEMBER 14	cad file	SK09.dwg
		drawing number	ZL&M CHICHESTER/SK/09	rev.	