Adur Local Plan Examination

Issue 1 – The Duty to Co-operate (Legal Requirement) and the Council's Broad Spatial Strategy (Policy 2)

1.1 This hearing statement is prepared by Boyer on behalf of Hyde New Homes who own the site known as New Salts Farm to the east of Lancing. This site is an omission site. This statement should be read in conjunction with our Regulation 19 Representations (Reps) (Representation No. 61), Hearing Statement Issue 3 and Hearing Statement Issue 7.

Question 1.4

Is the ALP based on a sound process of sustainability appraisal and testing of reasonable alternatives, and does it represent the most appropriate strategy in the circumstances?

1.2 As set out in our Reps we submit that the Adur Local Plan (ALP) is not based on a sound process of sustainability appraisal and testing of reasonable alternatives and as such does not represent the most appropriate strategy in the circumstances. We submit that the sustainability appraisal is based on flawed evidence and inconsistent assessment. Further that had the appraisal and assessment of reasonable alternatives been carried out appropriately it would have been found that additional sites could be allocated for residential development enabling a greater proportion of the objectively assessed housing needs to be met in the ALP.

1.3 As set out in our Reps whilst the sustainability appraisal seeks to carry out an assessment of 291 dwellings per year (the objectively assessed need (OAN) identified in the OAN 2015 (CD08/2)), this is far from thorough and would not constitute an appropriate testing of reasonable alternatives to deliver additional homes. The option tested did not reassess alternative site options previously dismissed and only considered an option which involves additional density and land take on those greenfield sites already proposed to be allocated within the local plan. The approach is therefore inherently flawed and the Council has not considered all reasonable alternatives to deliver the objectively assessed development needs in Adur.

1.4 No further assessment has been undertaken in the Proposed Major Mods Sustainability Appraisal (CD07/03) to consider how the updated OAN of 325 dwellings per year (OAN Update 2016 (CD08/1)) might be met.

1.5 In terms of the sustainability appraisal of the spatial strategy alternatives (Appendix IV) we also raised concerns about the assessments themselves and the scoring in our Reps.

1.6 If a scoring system is applied to the Spatial Strategy Alternatives Appraisal (i.e. 0 for Amber +1 for Green + +2 for Green ++ and -1 for Red – and 12 for Red --), Option B, based on the assessment carried out, scores the same as Option A2 and yet the conclusion identifies it as 'Red' versus 'Amber' for all the other options. It is unclear where this conclusion has come from and further emphasises the inconsistent approach to testing of reasonable alternatives.

1.7 For reasons set out above and in our Reps it is considered that the ALP is not based on a sound process of sustainability appraisal and testing of reasonable alternatives and therefore does not represent the most appropriate strategy.

Has the strategic site selection process been objective and based on appropriate criteria?

1.8 As set out in our Reps we are of the view that the strategic site selection process has not been objective and has been inconsistent, in particular in regards to landscape and flood risk criteria.

1.9 New Salts Farm falls partly within two sites assessed in the site options, Land North East of Hasler Estate and Land North West of Hasler Estate (aka Hasler).

Landscape

1.10 The assessment of the site options in terms of the Countryside criteria has been inconsistent and has not been objective.

1.11 For example in respect of Sompting Fringe this site is found to have 'some impact or potential for impact' in the countryside criteria. The comment section to explain this conclusion makes reference to the Landscape Sensitivity Assessment (2016) (CD14/10) which identifies the site as having a medium to high overall landscape sensitivity and to the Landscape and Ecological Survey of Key Sites within the District (2012) (CD14/2) which sets out indicative proposals that show how development could be laid out to minimise impact on the landscape.

1.12 However in respect of Land North East of Hasler Estate the comment section refers to the Landscape Sensitivity Assessment identifying the site as having a medium high overall landscape sensitivity and yet no reference is made to the 2012 study referred to in the Sompting Fringe assessment which similarly for Land North East of Hasler Estate sets out indicative proposals to show how development could be laid out to minimise impact on the landscape. The overall impact for this site is identified as 'significant impact or conflict'.

1.13 This is an example of a clear inconsistency in approach to the assessment of individual site options.

1.14 In our opinion, had the Council's evidence been considered consistently and appropriately it would demonstrate that New Salts Farm is capable of being allocated for residential development without landscape constraint. The above concern about inconsistency is notwithstanding the inherent concern raised in our Reps about the reliability of the landscape evidence on which the Council have based their assessment.

1.15 Our own studies submitted with our Reps demonstrated that there are a number of sites within the Local Green Gaps with potential to accommodate change. If the sites had been appraised appropriately and based on reliable evidence we submit that additional sites, including New Salts Farm, could have been found to be acceptable and allocated to deliver additional homes to meet objectively assessed housing needs in Adur.

1.16 In response to our Reps, Adur has commissioned additional work including an Adur Landscape Study Update – New Salts Farm October 2016 (CD14/22) and Local Green Gaps Topic Paper (CD07/14) and submitted these as evidence to the ALP.

1.17 Our Clients have engaged Huskisson Brown Associates (HBA) to review these documents and their report is attached at Appendix 1 to this hearing statement. The report is highly critical of CD14/22, on issues of the soundness and appropriateness of the methodology, approach and criteria used, the incorrect interpretation and therefore wrong assessment of the development proposal and the consistency of the approach when considered against other evidence base documents. In particular:

- There is a lack of detailed methodology and the presence of errors and conflicts with the widely recognised guidance in GLVIA3. This results in unclear assessment criteria and flawed, incorrect and inappropriately assessed landscape evidence;
- The Illustrative Masterplan is misinterpreted and incorrectly indicated throughout the New Salts Farm Report. This results in seriously flawed evidence; the assessments being made against wrong and inaccurate data that is carried through into the analysis, effects appraisal/assessment and consideration of mitigation;
- Visual effects are assessed against viewpoints that are mapped in the wrong locations and visibility assessed on this basis;
- The findings of the New Salts Farm Report contradict earlier recommendations made to Adur DC in the Landscape Study 2012 including omitting to address the range of positive effects highlighted in the Landscape Study 2012 and despite design amendments that have taken place. This cannot be considered to represent an objective approach to assessment;
- The New Salts Farm Report demonstrates an inconsistent approach when compared to the New Monks Farm Report, in particular in relation to the consideration of views across the Gap, mitigation opportunities and assessment

1.18 The Local Green Gaps Topic Paper references the Landscape Study 2012 and Landscape Study Update 2016, neither of which specifically address the role that the existing Gap and its constituent components play in meeting the policy function of providing physical settlement separation and preventing coalescence. The Topic Paper fails to expand this evidence in this regard. Whilst quoting the requirement for “necessary separation”, it fails to identify or quantify what this is in real or physical terms.

1.19 Evidence included in support of the site allocations includes the visibility of the site in relation to the identified key viewpoints from the Landscape Study 2012 and Landscape Study Update 2016. This contrasts with the approach taken in the New Salts Farm Report which bases visibility upon two identified key viewpoints and two additional viewpoints. Other evidence analysis that has informed the West Sompting allocation such as the improvement of existing stark development edge equally applies to the New Salts Farm site but has been omitted from the New Salts Farm Report, suggesting a lack of consistency and objectivity in this regard.

1.20 This further bolsters the significant concerns that we raised in our Reps about reliability of the landscape evidence. These concerns about reliability were raised at Reps stage but have not been addressed or responded to appropriately in the Councils Statement of Consultation (CD07/11) which simply reiterates its concerns about the impact of the proposed development on the gap. However if the conclusion from the Council is based on the abovementioned evidence it is inherently flawed.

1.21 We submit that given the notable errors and inconsistencies the New Salts Farm Report (CD14/22) and Local Green Gap Topic Paper (CD07/14) fail to provide sound and objective evidence to the ALP.

Flood Risk

1.22 We set out in our Reps our concerns regarding the assessment of individual sites in regards to potential Flood Risk and with those Reps submitted a Flood Risk Assessment and Sequential and Exceptions Test for the New Salts Farm site.

1.23 In regards to assessment of the site options in the sustainability appraisal in terms of flood risk criteria the assessment for Land North East and Land North West of Hasler refers us to the Sequential and Exception test (CD04/9) for more information.

1.24 Land North West of Hasler Estate and Land North East of Hasler Estate are excluded from the Council's Sequential and Exception Test, the reason given being lack of evidence to suggest that flood issues can be overcome. This approach is flawed. Given the shortfall in meeting objectively assessed housing needs the sites should have been considered. Indeed New Monks Farm was considered as part of the sequential test despite also being in Flood Zone 3 and subject to ground water and surface water flooding.

1.25 The council in their Regulation 22 Statement (CD07/10) state that the sequential test submitted with our Reps is acceptable. The site therefore should have been included in the Councils Sequential and Exception Test which again suggests that their evidence is flawed and approach to site appraisal is inconsistent and not objective.

1.26 The Council state in CD07/10 that further detail is required in the FRA submitted with our Reps to support the Exception test. There is no clear reason why, similar to New Monks Farm, the site could not have been allocated in the ALP and further details in respect of flood mitigation developed over the course of the preparation of the ALP. Indeed to date, following submission of an updated FRA to Adur, EA and WSCC (see Appendix 2), as far as we are aware there is more information available to the council on New Salts Farm on Flood Risk Assessment than New Monks Farm as well as modelling which takes account of the latest climate change allowances, none of which is available for New Monks Farm (to our knowledge).

1.27 Notwithstanding this, given that the Council agreed that our sequential test is acceptable, there is no clear reason why New Salts Farm has not been included in the Councils Exceptions Test. If it had been we submit that it would have passed the exceptions test as it can be demonstrated that the site would score positively in relation to sustainability benefits, particularly in terms of delivery of new homes, including affordable homes, in a sustainable location and potential to deliver high quality landscaping. Further part 2 of the council's exception test was based on the findings of the Strategic Flood Risk Assessment (CD15/1) which, as referenced in our Reps, does not suggest that New Salts Farm is incapable of being developed and suggests potential measures to address flood risk. This is similar to the recommendations for New Monks Farm which is being taken forward as a strategic site allocation.

1.28 It is clear from the evidence that the strategic site selection process has not been objective and the approach that Adur have made to the process is inconsistent. There is no obvious reason why New Salts Farm was excluded from the sequential and exceptions test and New Monks Farm was not. We submit that New Salts Farm should have been assessed within the Sequential and Exceptions Test and if it had it would have passed both elements similar to New Monks Farm. Evidently this would not remove the need for site specific Flood Risk Assessments to be carried out; however this is not dissimilar to the approach for New Monks Farm.

Summary

1.29 For reasons set out above and in our Reps we do not believe that the strategic site selection process has been objective and based on appropriate criteria. We believe that the approach has been inconsistent and is based on flawed evidence and approach, particularly in relation to flood risk and landscape.

Is there clear evidence demonstrating how and why the preferred strategy was selected?

1.30 For the reasons set out above and in our Reps we are of the view that the selection of the preferred strategy was inherently flawed, based on unreliable and flawed evidence, inconsistent and inappropriate. We therefore submit that there is not clear or reliable evidence which demonstrates why the preferred strategy was selected.

Question1.5 Are all the components of the Council's spatial strategy (policy 2) justified and compatible with the principles referred to in paragraph 17 of the NPPF? Will the policies and proposals in the ALP contribute to the sustainable growth of the District?

1.31 For the reasons set out in our Reps and above we submit that the spatial strategy does not make every effort to meet the housing needs of the area or allocate sufficient land to meet those needs. It is therefore not positively prepared, justified or compatible with paragraph 17 of the NPPF.

1.32 The policies would therefore not contribute towards sustainable growth of the District as every effort has not been made to meet objectively assessed housing needs in the District and insufficient land has been allocated for residential development.

1.33 Further greenfield sites need to be released for residential development to contribute towards meeting housing need and we have demonstrated through our Reps and Hearing Statements that New Salts Farm is demonstrated to be deliverable and developable and can help to contribute towards housing need without compromising other objectives.

1.34 As set out in our Reps we submit that the ALP is currently unsound as it has not been positively prepared given it does not make every effort to meet the OAN and is not justified as it has not considered all reasonable alternatives to meet the OAN.

Conclusion

1.35 For the reasons set out above, and in our Reps, we submit that the Plan is unsound as:

- It is not positively prepared, given it does not meet its OAN and has not engage every effort to meet those needs;
- Is not justified as the plan has not considered all reasonable alternatives to meet OAN
- Is not consistent with the policies in the NPPF, namely paras 14, 17, 47 and 152, as it has not struck the right balance in terms of sustainable development given the shortfall in meeting its OAN.

1.36 We submit that the land at New Salts Farm should be allocated within the Local Plan to deliver additional homes in order to address the deficiencies in the ALP and to make the plan sound. We set out at Part 6.7 of our Reps how the ALP should be amended in order to be found sound. We note that this would need to be updated to reflect the most recent evidence in regards to the OAN for the district.

Appendix One – Huskisson Brown Report

Boyer

FINAL

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LANDSCAPE STATEMENT

in support of a

Written Statement by Boyer Planning to the Adur Local Plan 2016 Examination Hearing

on behalf of

Hyde New Homes Ltd

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1 INTRODUCTION AND BACKGROUND

1.1 Huskisson Brown Associates (HBA) is a firm of Chartered Landscape Architects, established in 1987 (as David Huskisson Associates Ltd) and registered since then with the Landscape Institute. HBA has been a member of the Institute of Environmental Management and Assessment since 1992. The Practice is Quality Assured to BS ISO 9001:2008. Directors of the Practice are Chartered Members of the Landscape Institute.

1.2 The Practice has undertaken a range of environmental planning and landscape and visual assessment and design work for many clients including public bodies, private companies and individuals on projects including commercial, industrial, retail, recreational, healthcare, agricultural, infrastructure and residential schemes. The Practice has undertaken assessment work in Conservation Areas, in National Parks and in Areas of Outstanding Natural Beauty and other environmentally sensitive areas. The Practice has also given extensive development control advice to Local Planning Authorities on a wide range of projects and has significant experience in presenting landscape and visual evidence at planning appeals.

1.3 HBA is now retained by Hyde New Homes to provide landscape consultancy in connection with their site at New Salts Farm in Shoreham-by-Sea in which they have a freehold interest.

1.4 This report has been prepared to support a Written Statement by Boyer Planning on behalf of Hyde New Homes to the Local Plan Examination Hearing. It provides a critique / review of the updated landscape evidence base documents to the Local Plan 2016, these being:

- 'Adur Landscape Study Update – New Salts Farm Road Landscape and visual appraisal of development proposals' (October 2016), (referenced in this Landscape Statement as the **New Salts Farm Report**) (CD/14/22);
- 'Adur District Council Submission Adur Local Plan 2016, Local Green Gaps Topic Paper', October 2016 (CD07/14).

1.5 Our comments relate to the soundness of the document in so far as it relates to landscape, visual and Green Gap issues. Where appropriate, comparison is made between the above recently published documents and the other landscape related evidence, notably:

- 'Urban Fringe Study' 2006, (CD14/1);
- 'Landscape and ecological surveys of key sites within the Adur District', Sheils Flynn for Adur DC, November 2012, including appended landscape sensitivity assessment, (collectively referenced in this Landscape Statement as the **Landscape Study 2012**) (CD14/2 and CD14/2A);

- 'Adur Landscape Study Update Local Green Gap & Built-Up Area Boundary policy checks for the emerging Adur Local Plan', Sheils Flynn for Adur DC, January 2016 and the 'Assessment of landscape sensitivity Adur Local Plan area', Sheils Flynn for Adur DC, January 2016, (collectively referenced in this Landscape Statement as the **Landscape Study Update 2016**) (CD14/9 and CD14/10);

- 'Adur Landscape Study Update - New Monks Farm, Landscape and visual appraisal of development proposals', Sheils Flynn for Adur DC, January 2016, (referenced in this Landscape Statement as the **New Monks Farm Report**) (CD14/11);

- 'Adur Landscape Study Update – Shoreham Gateway, Landscape and visual appraisal of development proposals', Sheils Flynn for Adur DC, January 2016, (referenced in this Landscape Statement as the **Shoreham Gateway Report**) (CD14/12).

1.6 This work follows earlier study and reports by HBA (then David Huskisson Associates) to support representations made by Boyer Planning on behalf of Hyde New Homes as part of the 'Call for Sites' exercise and Regulation 19 consultations.

1.7 Significant concerns were raised regarding the transparency and soundness of the approach and findings of the earlier Landscape Studies and other evidence upon which the New Salts Farm Report and Local Green Gaps Topic Paper is based, as part of the Regulation 19 representations.

2 CRITIQUE/REVIEW OF UPDATED LANDSCAPE EVIDENCE BASE

Adur Landscape Study Update – New Salts Farm Road, Landscape and visual appraisal of development proposals, October 2016, Sheils Flynn (New Salts Farm Report)

2.1 The New Salts Farm Report is one of three studies prepared by Sheils Flynn to consider the potential landscape and visual impacts of alternative development proposals; the other studies relating to the New Monks Farm site and Shoreham Gateway site, both dated January 2016. All three studies are stated as being informed by the Landscape Study Update 2016 and the Assessment of landscape sensitivity which forms a technical annex to Landscape Study 2012.

2.2 Our critique of the New Salts Farm Report is set out below against the following key issues of concern:

- Methodology, approach and criteria used;

- Interpretation of Development Proposal;

- Consistency of approach.

Methodology, Approach and Criteria Used

2.3 The New Salts Farm Report states on page 4 that it provides a "*broad landscape and visual appraisal of development proposals and is not a full Landscape and Visual Impact Assessment*" and that it has been "*carried out in accordance with the approach outlined in the (recently updated) Guidelines for Landscape and Visual Impact Assessment*". For clarification, the "recently updated" Guidelines (GLVIA3) are the third edition which were published in 2013. GLVIA3 provides clear and widely-recognised guidance on the principles, process and terminology for carrying out both landscape and visual impact assessment as part of an EIA process and as a standalone appraisal of landscape and visual effects. However, the New Salts Farm Report does not reflect the essential process set out in GLVIA3, specifically on account of the following:

Methodology

- No explanatory information is provided on the methodology used – neither to define the terminology and rankings nor to clarify how criteria have been applied consistently and systematically to reach judgements on predicted landscape and visual effects. This results in a lack of transparency in terms of how any judgements or assessment rankings have been made;

- The New Salts Farm Report switches between citing GLVIA3 (methodology for landscape and visual impact assessment of development) and Natural England's Topic Paper 6 (a discussion document on landscape sensitivity and capacity in relation to landscape character assessment) as the source or reference for the various factors considered. This results in an inappropriate 'hybrid' approach to the appraisal that is not properly tailored to meet GLVIA3 best practice. The basic process and terminologies cited in GLVIA3 are not followed.

Assessment of Significance

- The New Salts Farm Report draws conclusions as to whether the likely predicted landscape and visual effects would be significant without providing any methodology, clarification of rankings or 'benchmark' for significance;

- The recommended GLVIA3 process for assessing 'significance of effect' is not followed (taking into account judgements of the Susceptibility and Value of the receptor to inform Sensitivity then combining judgements of Sensitivity and the likely Magnitude of Effect to inform Significance).

Sensitivity

- Landscape Sensitivity is not considered in relation to the Susceptibility of the receptor to the specific change likely to be caused by the development rather it uses the rather generic basis of inherent sensitivity of wider character-areas;

- The New Salts Farm Report considers Landscape Sensitivity using the rankings

provided in the Landscape Study Update 2016 which considers 'inherent' landscape and visual sensitivity on the basis of Natural England's Topic Paper 6 (2002). The more recent GLVIA3 methodology essentially dismisses the usefulness of such work to the EIA process, stating that such inherent sensitivity assessments "*may provide useful preliminary background information for the assessment. But they cannot provide a substitute for the individual assessment of the susceptibility of the receptors in relation to the change arising from the specific development proposal"* and that they "*cannot reliably inform assessment….It should not be recorded as part of the landscape baseline but should be considered as part of the assessment of effects*" (GLVIA3 Paragraphs 5.41 – 5.42);

- *The 'Overall Landscape Sensitivity'* classifications from the Landscape Study Update 2016 are considered in the New Salts Farm Report to provide *"an appropriate analysis for a baseline assessment"* even though they relate to the sensitivity of a wider landscape character area *"rather than the specific proposals for development of the New Salts Farm site" (page 13)*. This is a flawed approach which directly contradicts GLVIA3 guidance relating to both the consideration of sensitivity (as noted above) and the use of existing character assessment, GLVIA3 stating that *"Even where they are useful and relevant existing Landscape Character Assessments and historic landscape characterisations, it is still likely that it will be necessary to carry out specific and more detailed surveys of the site itself and perhaps its immediate setting or surroundings. This provides the opportunity to record the specific characteristics of this more limited area, but also to analyse to what extend the site and its immediate surroundings conform to or are different from the wider Landscape Character Assessments that exist…. "* In the case of the New Salts Farm Site, the inappropriateness of such an approach is emphasised by the fact that the proposed development would extend over less than half of the landscape character area LCA 6 – New Salts Farm and many of the "relevant key characteristics" of LCA 6 (noted on page 8 of the Report) relate to areas outside of the proposed development site that would remain unaltered. Because the assessment is based upon a generic consideration of 'landscape sensitivity' across a wider area that is provided as part of a baseline study and does not relate to the specific development site or proposal, the starting point for any assessment is skewed and inaccurate. Clearly there is scope for different judgements to be made when sensitivity is assessed not as part of a wider landscape baseline but in relation to a specific development proposal;

- Landscape Value is discussed at paragraph 2.3 of the New Salts Farm Report on a broad and policy/designation-led basis but is not ranked or brought into a site/development consideration of Sensitivity.

Visual effects

- The 'predicted visual effects' section at paragraph 3.2 (page 17) illustrates a 'Broad zone of visual influence' on Figure 10 that is shown "*for the worse case*

scenario, including all areas from which it could be possible to see the development". Figure 10 is reproduced below:

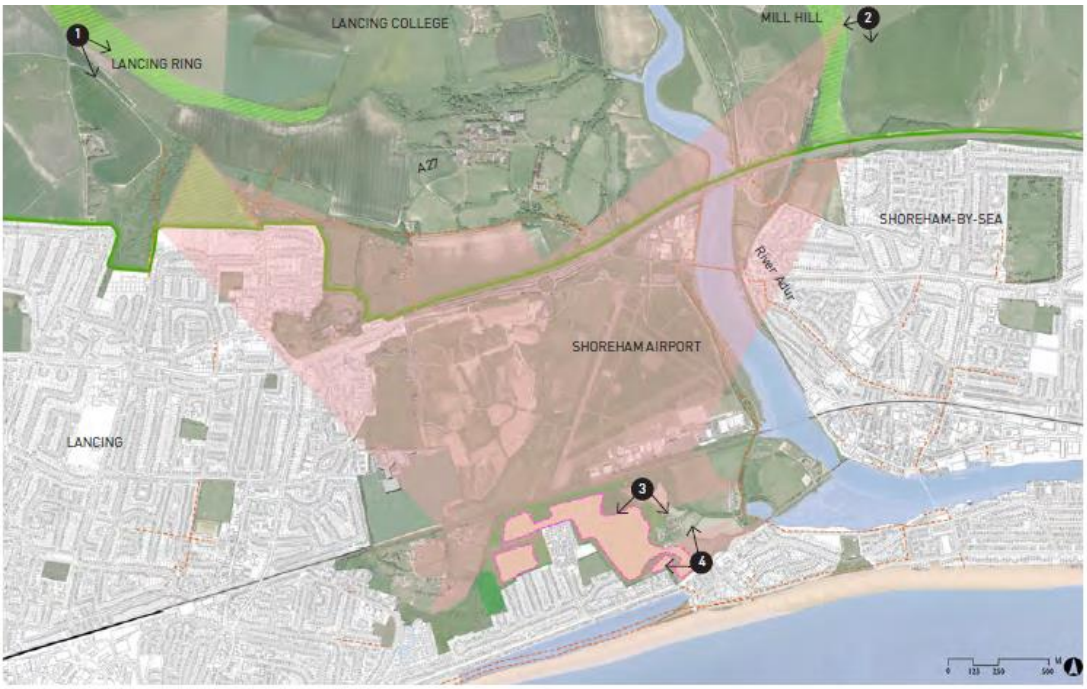

Figure 10 - New Salts Farm development: Broad zone of visual influence

- No information is provided on how the zone of visual influence has been prepared, what assumptions were made about the heights of development, vegetation cover and so on, as would be expected in a GLVIA3 consideration of visual influence. Topography would usually be the starting point for such a broad and 'worse case' consideration of a zone of visual influence, however, the sharp lines and edges illustrated and lack of a map base showing contours or height information would indicate that this has not been the case. This does not appear to reflect a proper zone of visual influence more a diagram showing the cones of vision from different viewpoint locations. Moreover, the viewpoints are inaccurately located (see separate notes below);

- The New Salts Farm Report considers that the view from Lancing Ring (Viewpoint 1, page 18) has "*exceptionally high sensitivity as this is a popular area of open access land (with a car park) used for recreational walks (with spectacular views) within the South Downs National Park*". As no methodology/assessment criteria are given in the report is it unclear why this view is ranked more highly than views from Mill Hill open access land (which is also a popular area with a car park within the National Park). Given the exceptionally high level of sensitivity assessed in the New Salts Farm Report, for

views from Lancing Ring, one might reasonably expect views from this location to also be assessed for the allocated New Monks Farm site. This is not the case, despite the New Monks Farm site and nearby allocated employment site at Shoreham Airport being visible in views from the open access land in this area (refer to **Figure HBA2** at **Appendix 1**);

- The Viewpoint 1 photograph showing the view *"east to south-east towards Shoreham Harbour"* appears to use a zoom lens giving a distorted and misleading interpretation of the view from this location. Our Figure LPEIP-HBA2 illustrates a similar view from Lancing Ring for comparison;

- Viewpoints 1, 2 and 3 are inaccurately located, being some distance from the actual locations where the supporting photographs have been taken from. In the case of Viewpoint 1 from the "exceptionally high" sensitivity viewpoint at Lancing Ring, the New Salts Farm assessment indicates this is on an area of landform that is some 10m lower than the intervening open access land – clearly a view south-east from that location is not available. Our **Figures HBA2** and **HBA3** illustrate the recorded and actual locations on Ordnance Survey mapping.

2.4 Whilst GLVIA3 does not provide a detailed formulaic recipe to be followed in every situation, it establishes a recognised process and principles to help professionals achieve quality and consistency in their approach. The lack of detailed methodology and the presence of errors and methodological conflicts with GLVIA3 throughout the New Salts Farm Report provides unclear assessment criteria and results in flawed, incorrect and inappropriately assessed landscape evidence.

Interpretation of Development Proposals

2.5 The Illustrative Masterplan submitted as part of the Regulation 19 Representations to the Local Plan by Boyer Planning in April 2016 is illustrated as the basis for the appraisal, however it is misinterpreted and incorrectly indicated and assessed throughout the New Salts Farm Report. In this regard alone, the New Salts Farm Report is seriously flawed, the assessments being made against wrong and inaccurate data that is carried through into the analysis, effects appraisal/assessment and consideration of mitigation.

2.6 The extent of the proposed development illustrated in the New Salts Farm Report is inaccurate where shown on the supporting visuals, in particular along the A259 road frontage and the northern extent of housing/open space up to the railway. Acknowledging that the development proposal is illustrative, the scale of plans/figures in the New Salts Farm Report is quite small, such that just a slight plan inaccuracy results in a significant error in terms of the area inaccurately shown. Figure 9 of the New Salts Farm Report is taken as a plan example and is illustrated on **Figure HBA 1** (Appendix 1) of this Landscape Statement with an overlay of the Illustrative Masterplan and the actual extent of built development indicated. It can be seen that the New Salts Farm Report figures indicate a development footprint that extends right up to the A259

frontage and New Salts Farm and closer to the railway line than indicated on the Illustrative Masterplan. The New Salts Farm Report then makes an assessment on this incorrect basis.

2.7 Further serious errors are noted throughout the 'predicted visual effects' section of the report (paragraph 3.2, pages 17 to 21) where the predicted visual effects are based upon four representative views; two of these are 'key viewpoints' as highlighted in the Adur Landscape Studies 2012 and 2016, the other two have been subsequently introduced. Critically the location of three of the viewpoints is wrong. This appears to have resulted in the proposed development being wrongly interpreted in the views or else the inaccurate extent of development shown on the figures has influenced the assessment. When both errors are taken into account, this is a significant fault in the evidence and its analysis.

2.8 Viewpoint 1 is described as the view from Lancing Ring at a height of approximately 150m AOD and a cone of vision and "broad zone of visual influence indicated on this basis. Our **Figure HBA2** (Appendix 1) reproduces Viewpoint 1and its location plan directly from the New Salts Farm Report alongside a HBA version of the view from a closer viewpoint and amended location plan. Photographs are reproduced at the same size as they appear in the New Salts Farm Report for consistency and ease of comparison. Clearly the photographs illustrated and assessed in the New Salts Farm Report cannot be from the viewpoint identified on the aerial photograph on Figure 10a, a location which, by reference to the OS map provided on Figure HBA2 lies at approximately 97m AOD. The open access land at Lancing Ring which would lie in the foreground to any views looking south-east from this location reaches up to approximately 107m AOD and includes areas of woodland to the north, the landform and vegetation effectively screening views from the lower ground to the north. Viewpoint 1 would appear to be taken from the eastern side of the open access land at Lancing Ring, some 800m south-east of the assessed viewpoint location and approximately 20m lower in height. This is a significant error.

2.9 No information is provided to confirm the provenance/approach to photography. The photograph used to illustrate the view east to south-east towards Shoreham-Harbour at Viewpoint 1 is of grainy quality but appears to use a zoom lens with the foreground detail and middleground features appearing noticeably oversized and therefore not representative of the human eye view. Additional photographs are provided on **Figure HBA2** to demonstrate the views from Lancing Ring and also indicate the approximate footprint of the New Salts Farm, New Monks Farm and Shoreham Gateway development proposals within them.

2.10 The visual effects on Viewpoint 1 are described at Page 18 of the New Salts Farm Report, noting that "*It would significantly reduce the perceived extent of the Lancing-Shoreham Gap in this view from Lancing Ring because the airport buildings and railway line would be perceived as the new southern edge of the gap*." By reference to the photographs on Figure HBA1, it can be seen that the buildings at Shoreham Airport already encroach into and can be perceived as the southern edge to the Gap in some views from Lancing Ring.

2.11 Viewpoint 2 is indicated to the north-east of Mill Hill and north of the A27 and a cone of vision and "broad zone of visual influence indicated on this basis. However, the photograph provided in the New Salts Farm Report is clearly taken from the southern side of the A27, some 700m to the south-west and 20m higher than the illustrated location. **Figure HBA3** indicates the correct location of Viewpoint 2. Whilst the narrative supporting the viewpoint at page 19 of the New Salts Farm Report appears to describe the correct location, the supporting graphics and 'broad zone of visual influence' do not and cannot be considered a sound or reliable basis for assessment.

2.12 Viewpoint 3 is wrongly located at the northern end of New Salts Farm Road where there is not an existing view into the site but there are wider views across the remainder of the open space in LCA6 to the east of New Salts Farm Road (which are outside of the proposed site). The photograph is actually taken from the eastern end of the driveway to New Salts Farm approximately 1/3 of the way along New Salts Farm Road. The view looks south across the south-eastern corner of the site which is proposed to be retained as open fields. The New Salts Farm Report wrongly interprets that the development would *"loom large within this view, almost completely removing any sense of greenspace. The view would be across a narrow remnant field to the back gardens of the new houses in phase 2 of the proposed development. The undeveloped green space of this southern part of the Lancing-Shoreham Gap would be infilled and lost"*. By reference to **Figure HBA3** at Appendix 1, it can be seen that in this view, the indicated 'approximate extent of proposed development' is significantly over-emphasised. The proposed building footprint would fill part of the middleground to the view, with a new landscape buffer to the perimeter forming a softer edge to the settlement/gap. A proportion of the greenspace would be retained on the eastern side of the new development (in the foreground to the view and following New Salts Farm Road).

2.13 Viewpoint 4 shows an 'approximate extent of proposed development Phase 1-4 extending across the majority of the view and transforming the view "because the open, undeveloped green character of these fields would be changed to predominantly urban development which extends across the centre of the view" Figure LPEIP-HBA4 indicates the approximate proposed building footprint which would extend built form further east into the view. Accepting the level of screening provided by the foliated vegetation in this summer view, it can be noted from this photograph that the existing development in the area already extends as a line across the middeground of the view. The assessment notes that the development would *"significantly reduce the perceived extent of the Lancing-Shoreham Gap in one of the very few places where there are direct views across the gap from local roads"*. The development as currently proposed would retain views to New Salts Farm, the Downs backdrop and further east to Lancing College Chapel (as indicated at the edge of the photo) and the listed Shoreham Airport terminal building (cropped off of the photo). A new landscape buffer treatment to the boundary could help to enhance the settlement/gap edge and the quality of the remaining views from the A259.

2.14 With regard to mitigation, the New Salts Farm Report states that the proposed development would have *"significant adverse and irreversible landscape and visual*

effects on the open, green and undeveloped character of the Lancing-Shoreham Gap. The scope to mitigate these negative impacts is limited. This would seem a rather unbalanced and broad-brush consideration given the extent of character area LCA6 that would actually remain, the current harsh urban edge created by development in this area and the potential to both improve the settlement/gap edge and enhance views to key landmarks such as the listed airport tower through landscape treatments. Furthermore, the proposed development extent along the A259, New Salts Farm Road and set back from the railway line are all reduced in comparison to Sheils Flynn's own (more positively assessed) 2012 Indicative Development Principles for the same site.

2.15 Page 24 also concludes that "*The retained areas of open countryside alongside New Salts Farm Road and south of the railway would need to be of sufficient scale to achieve the three interconnected objectives described above. The development proposals for New Salts Farm shown on Figure 8 do show a bands* [sic] *of open space to the west of New Salts Farm Road and to the south of the railway, but these are not sufficiently extensive to mitigate the predicted significant adverse landscape and visual effects*". No quantification is provided to suggest what area of land would be sufficiently extensive to provide mitigation. The extent of development has been inaccurately recorded and assessed in the New Salts Farm Report, with the development stated as removing greenspace where it is actually proposed to be retained. No reliance can be placed upon the analysis or findings of the New Salts Farm Report to properly consider whether "sufficient scale" of open space is retained.

2.16 "*The suite of policies within Adur District Council's emerging Local Plan place strong emphasis on conserving landscape character and settlement identity and on preventing the coalescence of settlements. Even the reduced development footprint shown on Figure 15f in the 2012 report would lead to perceived coalescence between the neighbourhoods of Hasler Estate and Shoreham Beach*". This is an erroneous comment. Figure 15f of the 2012 report shows a more extensive footprint than proposed by Hyde New Homes, in particular extending further along the A259 frontage and providing a primary vehicle access off of New Salts Farm Road. The neighbourhoods of Hasler Estate and Shoreham Beach already merge along the A259.

2.17 Consistency of approach

2.18 Notwithstanding the significant errors noted above in relation to the interpretation of the Illustrative Masterplan and its consideration in the effects assessment, the findings of the New Salts Farm Report contradict earlier recommendations made to Adur DC in the Landscape Study 2012 and suggest an inconsistent approach when compared to the New Monks Farm Report.

Comparison to Landscape Study 2012

2.19 The Landscape Study 2012 identified Indicative Development Principles for both LCA6 and LCA7, extending across a slightly larger area than the New Salts Farm site proposed by Hyde New Homes. These indicated potential development areas as well as new public greenspaces, planting and SUDs opportunities within the site. Potential

landscape and ecological impacts were assessed at that stage (albeit in a rather broad-brush manner) based upon the Indicative Development Principles which were prepared by Sheils Flynn, also the authors of the subsequent Landscape Study Update 2016 and the New Salts Farm Report.

2.20 The landscape baseline for the New Salts Farm Report draws from both the Landscape Study 2012 and the Landscape Study Update 2016. Paragraph 2.2.1 of the New Salts Farm Report notes in particular that the Landscape Study 2012 provides a "*more detailed analysis of potential landscape and biodiversity issues and impacts that could arise as a result of development on six sites ….as potential strategic allocation sites. The New Salts Farm site was one of these potential allocation sites*". Despite this acknowledgement, the New Salts Farm Report fails to address the range of positive enhancements that might arise from and development and presents findings that are significantly different to those in the Landscape Study 2012.

2.21 In the first paragraph of Page 13 to the New Salts Farm Report, it is noted that "*the landscape sensitivity assessment recognises there is good potential to improve the interface between housing in South Lancing (Hasler Estate) and the adjacent landscape to north [sic] (LCA7), with new planting and that this approach could soften the poor quality urban edges in the sensitive views from Lancing Ring*". This consideration was included in the Landscape Study 2012 but subsequently omitted from the Landscape Study Update 2016. The landscape advice to Adur DC has therefore been somewhat confused in this regard. Despite the wavering recommendations to Adur DC and the inclusion of a landscape and open space buffer to the perimeter of the proposed development by Hyde New Homes, the New Salts Farm Report does not consider any positive effects that might arise in connection with the proposed development.

2.22 It is worth comparing the effects assessed for the 'Illustrative Masterplan' submitted by Hyde New Homes and those assessed for the scheme developed by Sheils Flynn and included as Indicative Development Principles in the Landscape Study 2012. A comparison of the broad layout and development principles relating to the two schemes is outlined in the table below:

Landscape Study 2012 Indicative Development Principles (*quotes italicised* – HBA underlined/emphasis)	Comparison with Hyde New Homes Illustrative Masterplan
Principal road access off New Salts Farm Road adjacent to New Salts Farm.	Principle road access moved away from New Salts Farm and provided off the A259 close to the existing edge of development at Hasler/West Beach.
Potential development areas extend east of the Hasler Estate along the frontage to the A259 almost up to the A259/New Salts Farm Road roundabout	Eastern–most fields adjoining New Salts Farm Road and the A259 are development free. Potential development areas extend across less than half of the area of the south-east corner with a set back from the A259.
Potential development areas located south of	Potential development areas set further

Landscape Study 2012 Indicative Development Principles (*quotes italicised* – HBA underlined/emphasis)	Comparison with Hyde New Homes Illustrative Masterplan
the railway line with a landscape edge of "*new tree and hedgerow planting*" (page 51)	south of the railway than the 2012 scheme.
Wedge of open space and open water in the north-east corner.	Wedge of open space and open water in the north-east corner.
On the western side of the site (known as 'Land NW of Hasler Estate), large potential development blocks extend almost up to railway line.	On the western side of the site, potential development blocks are set further back from the railway line and include a proposed open space linking between existing housing and the new development and open spaces.
"*By keeping the development edge to the west of New Salts Farm Road, the historic outer edge of the floodplain is legible in the wider landscape and the fields which form the gateway to the Adur Estuary are retained as a key part of the landscape setting of Lancing and Shoreham. This area of 'trapped' estuary land also retains its distinctive and sensitive historic field pattern, with traces of former water channels/flood embankments visible within the fields*" (page 50).	Development edge kept to the west of New Salts Farm Road.
"*The farmland to the east of New Salts Farm Road is particularly visible in longer views (eg from Lancing Ring) and this will be retained, but the smaller area of greenspace to the NW of New Salts Farm Road will be perceived (in long views from the north) as an extension of this 'slice' of greenspace, retaining the sense that there is a depth of greenspace beyond the railway/airport buildings and preventing a perceived coalescence of development*" (page 50)	No proposals to the east of New Salts Farm Road. Illustrative Masterplan indicates the same extent of green space as 2012 scheme and is set further back from the A259/New Salts Farm Road roundabout.

2.23 Given the minor differences between the two schemes and the notable alterations made by Hyde Homes in their Illustrative Masterplan to pull development further back from the A259 and New Salts Farm Road frontages, the resulting assessment findings relating to landscape, visual and gap effects do not tally.

2.24 The predicted landscape, visual and gap effects for both are highlighted in the table below. Quotes from the respective documents are identified in *italics*. Commentary has been provided by HBA and is shown in red text to draw attention to inconsistencies and discrepancies between the two assessments.

Predicted effects in Landscape Study 2012 Indicative Development Principles	Predicted effects in New Salts Farm Report Hyde New Homes - Illustrative Masterplan
Coalescence was not considered to be an effect of the 2012 Indicative Development despite it extending further along the A259 and following broadly the same footprint to the north as the Hyde New Homes proposal.	*Perceived coalescence between the buildings of Shoreham Airport and the urban areas of Hasler Estate/ Shoreham to the south of the railway line, such that the railway would become the new perceived edge of the entire west-central parts of the Lancing-Shoreham gap* No physical coalescence results from the Hyde New Homes proposal. The existing Gap is already compromised in its physical and visual separation functions by the particular configuration and character of existing development adjoining to the east, south and north. The extent of the Gap visible in views from the A259 varies, with the railway line and airport buildings being perceived as an east-west linear strip of development across the Gap generally preventing views of the more open northern area of the Gap from the eastern extent of the A259.
LCA6 (east side of the site): This development would be highly visible from local roads (A259 and New Salts Farm Road) and is in a relatively open landscape towards the fringes of the Adur Estuary. There are not predicted to be detrimental impacts on key views across the Lancing Gap.	*Reduction in the extent of the Lancing-Shoreham Gap and the sense that the gap connects the Downs and the sea, in views from the SDNP and in views northwards towards the downs from the A259*
It would result in a change to the inherent landscape character, but with positive benefits in terms of public access and the development of an enhanced built/ landscape interface in this part of South Lancing.	*Urbanisation of an area that has a distinctive 'untamed' quality and the loss of the sense of an estuary edge landscape – instead this area would become an extension of the adjacent, relatively nondescript urban areas* This clearly conflicts with the 2012 findings relating to an enhanced built/landscape interface despite an Illustrative Masterplan that has less development onto the A259 and New Salts Farm Road.
This development would be highly visible from local roads (A259 and New Salts Farm Road) and is in a relatively open landscape towards the fringes of the Adur Estuary. There are not predicted to be detrimental impacts on key views across the Lancing Gap.	*Loss of part of the landscape settings of Shoreham-by-Sea and Lancing, with the increased urbanisation of part of the sequence of views that forms the approaches to these towns by train and by road.* The open space/landscape buffer on the northern side with the railway is wider than that proposed in the 2012 study and the built development extends across less of the A259 frontage. Views would still be retained across the gap – both from the eastern side of the site and from the remainder of LCA6

Predicted effects in Landscape Study 2012 Indicative Development Principles	Predicted effects in New Salts Farm Report Hyde New Homes - Illustrative Masterplan
	to the east of New Salts Farm Road.
There are not predicted to be detrimental impacts on key views across the Lancing Gap. The north-south extent was not considered to be a key feature of the sensitive views from the Gap at that time.	*Reduced perceived north-south extent of the undeveloped green landscape of the gap in the sensitive, elevated views from the SDNP…..".* This clearly contrasts with previous advice to Adur DC. The Gap does not physically extended to the coast – the view is already foreshortened by the buildings at Shoreham Airport and ribbon of development either side of the A259 between Lancing and Shoreham.
LCA6 (east side of the site): This development would be highly visible from local roads (A259 and New Salts Farm Road) and is in a relatively open landscape towards the fringes of the Adur Estuary. There are not predicted to be detrimental impacts on key views across the Lancing Gap. *It would result in a change to the inherent landscape character, but with positive benefits in terms of public access and the development of an enhanced built/ landscape interface in this part of South Lancing.*	*A significant reduction in the quality and 'green' character of the gap landscape and the gateways to Shoreham and Lancing as experienced in views from the train and from the A259….."* This contrasts significantly with the 2012 consideration that the landscape could be enhanced. It is difficult to understand how the proposed publicly accessible open spaces and landscape buffer (which could be secured in the long term by legal agreement) result in a reduction in the quality of the green character. Whilst the extent of greenspace would be physically reduced on the site itself, a buffer would be retained to the site boundaries (including a green buffer to the railway, New Salts Farm Road and the A259) and open space also incorporated within the site. Existing green space adjoining the site on the eastern side of this area (west of New Salts Farm Road) and in the wider landscape east of New Salts Farm Road would be retained and therefore views to the backdrop of the Downs, Lancing College Chapel and Shoreham airport terminal building would be retained (Refer to **Figure HBA4** showing Viewpoint 4 of the New Salts Farm Report and the site photographs in the Assessments of Landscape Sensitivity which form part of the Landscape Study 2012 and Landscape Study Update 2016) – the proposed landscape edge to the development offering potential to reinforce the attractive views looking north-east. This is not considered in the New Salts Farm Report.
LCA7 (west side of the site): *Development on this site could be accommodated without*	The generally positive and neutral impacts relating to LCA7 are not taken into

Predicted effects in Landscape Study 2012 Indicative Development Principles	Predicted effects in New Salts Farm Report Hyde New Homes - Illustrative Masterplan
detriment to the landscape and visual character of this relatively enclosed part of the Lancing Gap. Development areas could be 'slotted' between areas of retained woodland/ scrub and new belts of woodland would screen views to housing while conserving landscape character. There would be opportunities to provide an excellent multi-functional GI corridor, with much needed public access.	consideration in the New Salts Farm Report despite the Hyde New Homes scheme incorporating more open space and a wider northern buffer.
Development here could provide the catalyst for the sustainable management of land to the east of New Salts Farm Road for public access and nature conservation purposes, with further scope for enhancements to the adjacent Adur Recreation Ground and the footpaths on the edge of the Estuary.	No such positive impacts are considered in the New Salts Farm Report

2.25 As can be noted, a range of positive effects are highlighted in the Landscape Study 2012 that are not addressed in the New Salts Farm Report despite the design amendments that have taken place. These are significant omissions that cannot be considered to represent an objective approach to assessment.

2.26 The New Salts Farm Report attempts to dismiss the Landscape Study 2012 Indicative Development Principles and assessment notes, insisting that the Landscape Study 2012 *"does not evaluate the potential impact of development on the integrity of the Lancing-Shoreham Gap or on the character of the settlements that border the gap"*. Clearly the impacts stated above relate not only to landscape and visual matters but also to the Gap. Technical Annex A of the Landscape Study 2012 also states at paragraph A1.3 that *"Given the importance of the Strategic Gaps in terms of planning policy, the assessment includes a specific analysis of the contribution that each part of the landscape makes to the integrity of the gap and the landscape setting of the towns of Lancing and Sompting…"*. It would seem unfortunate and misleading therefore that the earlier 2012 evidence upon which Adur DC has developed policy did not actually base the 'potential impacts' upon the Gap analysis it claims to be important.

Comparison to New Monks Farm Report

2.27 The New Monks Farm Report considers the potential landscape and visual impacts of alternative development proposals that have come forward since publication of the Proposed Submission Adur Local Plan in 2014. Two options for development are considered – Option 1 and Option 2. Option 2 is considered by the New Monks Farm Report to be the *"preferred from a landscape and visual impact perspective and particularly in terms of predicted impacts on the Lancing-Shoreham Local Green Gap"*.

2.28 The New Monks Farm Report provides a *"comparative analysis between predicted landscape and visual impacts for Options 1 and 2"* but makes no assessment nor

provides indication as to the comparable level of effect of each scheme. Whilst the New Salts Farm Report concludes *"significant adverse and irreversible landscape and visual effects on the open, green and undeveloped character of the Lancing Shoreham Gap"*, the New Monks Farm Report provides no similar assessment ranking or judgement as to the likely level of effect and significance. It is therefore unclear what the actual level of landscape and visual harm would be likely to be. This is compounded by the statement (page 41) that the predicted effects of the New Monks Farm development *"should be considered in conjunction with the predicted effects of the allocated commercial development at Shoreham Airport as there will be cumulative effects"*. No landscape and visual impact assessment has been provided by Adur DC of the allocated commercial development. Not only therefore is the level of effect caused by the New Monks Farm proposal unquantified but the cumulative landscape and visual effects of both developments have not been considered so as to understand potential wider impacts on the Gap landscape.

2.29 Figure 9 of the New Salts Farm Report and Figures 10 and 14 of the New Monks Farm Report provide a 'Landscape Site Appraisal' diagram. Figure 9 from the New Salts Farm Report is copied below for ease of reference:

Figure 9 - New Salts Farm development site: Landscape Site Appraisal

2.30 For comparison, Figure 10 from the New Monks Farm Report is also copied below:

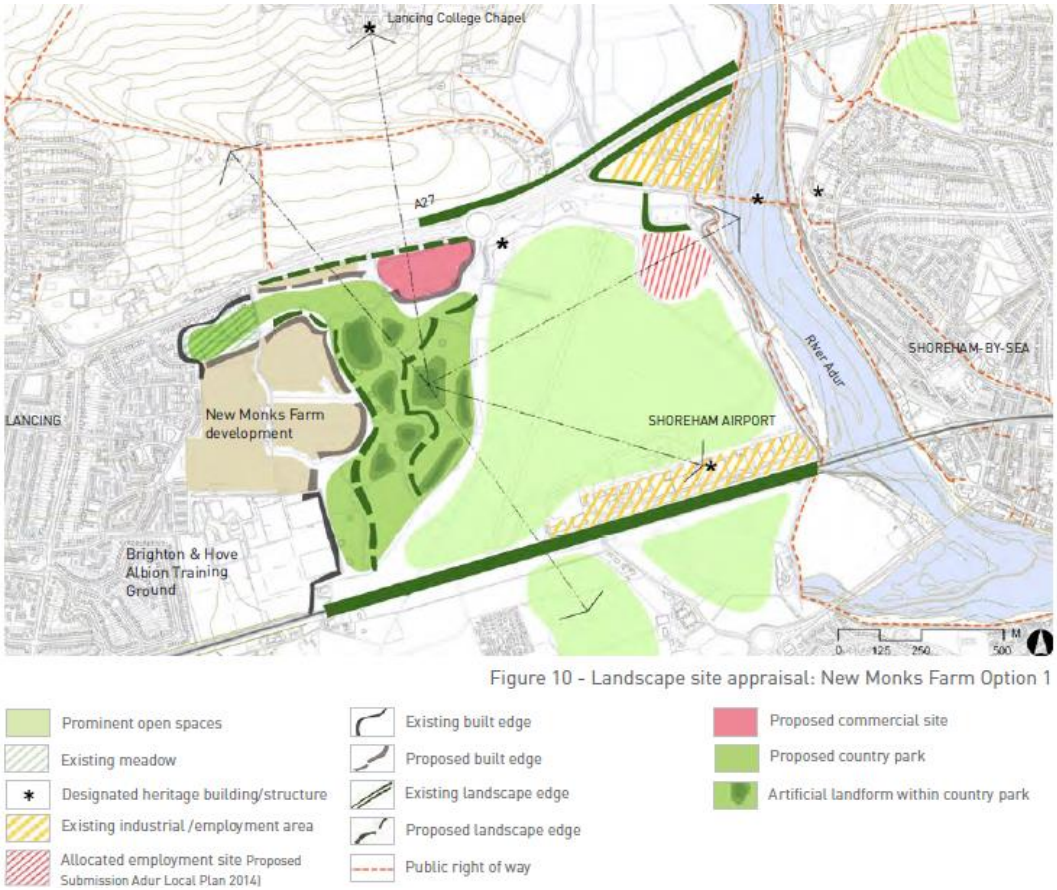

Figure 10 - Landscape site appraisal: New Monks Farm Option 1

2.31 The New Salts Farm Report fails to identify any 'proposed landscape edges' that could be created by the proposed development, through the perimeter open space and landscape buffer, frontage to the A259 and extension from the existing woodland shaw on the western boundary into the development (also unidentified/not considered). The New Salts Farm Report instead indicates only a 'Proposed built edge' to the development.

2.32 This is a striking contrast to the consideration of the allocated New Monks Farm development, the New Monks Farm Report identifying several 'proposed landscape edges' along the perimeter to the proposed residential development and A27 road corridor as well as within the proposed open space (country park) to the east for the 2 development options considered.

2.33 The New Salts Farm Report considers that the view from Lancing Ring (Viewpoint 1, page 18) has "*exceptionally high sensitivity*". It is the only viewpoint ranked this highly in the three development site reports. It is therefore surprising that views from this location are not assessed for the allocated New Monks Farm site, despite the fact that the New Monks Farm site and nearby allocated employment site at Shoreham Airport (noted as having a cumulative effect with New Monks Farm) are visible in views from the open access land in this area (refer to **Figure HBA2** at **Appendix 1**).

2.34 The New Monks Farm Report notes that the west part of the development proposals are within LCA1 and that the country park is within LCA2. This implies that the built

development is only within LCA1, however much of the built form and a new access road and roundabout off of the major A27 trunk road also lies within LCA2. The final paragraph of page 8 of the New Monks Farm Report states, with regard to LCA2, that: "*Other positive aspects of landscape character – the long views to the Downs and Shoreham are not considered to be vulnerable to change*". This directly contradicts the earlier landscape evidence provided in the Landscape Study Update 2016 which states at page 22 that "*Long views to the Downs are not vulnerable to change but views eastwards across the flat, open landscape of Shoreham Airfield would be vulnerable to new development*".

2.35 Paragraph 2.2.3 of the New Monks Farm Report highlights that "*there are very few opportunities for views across the Lancing-Shoreham Gap from local roads because views from the A27 are typically enclosed by the trees along the road corridor*". Whilst it is correct that there are very few views available, the 2016 Assessment of landscape sensitivity (which forms part of the Landscape Study Update 2016) notes the importance of the views that are available on page 23:

> *"The northern part of the Saltworks LCA, alongside the A27, provides an open, 'green' and relatively natural foreground to views across the Gap from the principal (main road) route to Lancing. This is the only point along the A27 from which there are open views across the Gap as this road corridor is typically enclosed by mature bands of trees. The views across the Saltworks LCA from the A27 are a valuable component of the gateway to Lancing and of the town's landscape setting.* (HBA emphasis)

2.36 For broad reference, Viewpoints 2a and 2b in the New Monks Farm Report provide an indication of the general open views from the A27 taken from the nearby public right of way from Hoe Court within the National Park. Given the stated value of such views in the Landscape Study Update 2016, it would seem odd that the visual impact assessment in the New Monks Farm Report does not assess the 'gateway' open views from the A27, instead summarising the "principal predicted effects" at page 26 and page 39 (in relation to the two scheme options considered). As an example, the summary for Option 2 (Sheils Flynn's recommended 'preferred' option to Adur DC) at page 39 describes principal predicted effects as:

- *"A slight reduction in the quality and 'green' character of the gap landscape and the gateway to Lancing as experienced in views from the A27 travelling westwards. With careful design and planting, the proposed roundabout in the centre of the gap could be perceived as part of the open 'green' landscape of the gap, with opportunities for new open views across the airfield from the roundabout"*

- *The negative effects on the gateway views along the A27 corridor and the long views from the SDNP would increase the perception of coalescence between the settlements of Lancing and Shoreham and result in moderate negative effects on the landscape of the Lancing-Shoreham Local Green Gap"*

2.37 These "slight" and "moderate" negative principal effects are not made against defined criteria and are not separately assessed in the New Monks Farm Report. They do however contrast with the visual effects recorded against similar Viewpoints 2a and 2b (pages 34 and 35) and do not accurately reflect the level of change and impact of the specific proposal. Viewpoint 2a noting that the new development would be prominent and may screen views with a "*rather odd and artificial-looking mounded landform to a relatively 'urban' gateway to Lancing, with a less distinctive character* and Viewpoint 2b also recording that "*The new buildings can be expected to completely dominate the view from this close, roadside viewpoint….*"

2.38 The New Monks Farm proposal Option 2 would introduce a major trunk-road roundabout junction (with associated necessary signage, lighting and highways infrastructure) and a new access road. It would be unlikely that such a feature could be carefully designed to the extent envisaged in the New Monks Farm Report and the creation of open views from the roundabout would clearly result in a return view from the viewpoints in the wider countryside and National Park looking back to the roundabout. The New Monks Farm Report considers that the Option 2 proposal would provide "*new opportunities for open views across Shoreham from the new roundabout*"

2.39 The only existing open views from the A27 which are identified as a "*valuable component of the gateway to Lancing and the town's setting*" would effectively be lost or restricted to a roundabout location dominated by highways infrastructure and where the viewer's attention is likely to be on navigation rather than appreciation of a glimpsed view. The New Monks Farm Report gives no proper consideration to these effects and places emphasis instead upon unrealistic mitigation. This should be compared to the situation at New Salts Farm where there are also existing open views from a road across the gap and no major new infrastructure / highways scheme would be required. Here, the proposed development would not remove the only existing open views; open views from the A259 would be retained throughout a stretch of the A259 extending up to 1km in length. This is given no proper consideration in the New Salts Farm Report, neither are the mitigation opportunities that might be available in terms of emphasising or creating an improved setting and edge to the retained views. The landscape evidence in unbalanced in this regard.

2.40 The New Monks Farm Report downplays views from Mill Hill in terms of visual sensitivity, describing the LCAs within which the site is located as "*distant in these views*" (page 12). In those views, the New Monks Farm site lies firmly within the Gap on the eastern side of Lancing (the 'gap' essentially providing east-west physical separation between the settlements). By contrast, the New Salts Farm Report considers in the same analysis section that the relevant LCA here has "*importance in providing a sense of the north-south extent of the gap in the high sensitivity views from …….Mill Hill*". As a point of clarity, it can be noted from aerial photography, mapping and the actual situation on the ground that there is no physical north-south separation between the two settlements, they essentially merge between the Hasler Estate, West Beach and the seafront to the south of the A259. In terms of distance, LCA6 and LCA7 within

which the New Salts Farm site lie are no closer to the viewpoint that LCA 1 and LCA 2 at New Monks Farm.

2.41 The New Monks Farm Report states as part of its baseline consideration that "*overall, there is considered to be good potential to mitigate the impacts of landscape change*" (page 12). It is noted that this is a baseline observation made without any consideration of the specific change proposed. Page 42 of the New Monks Farm Report suggests guiding design principles "*which would mitigate the negative effects associated with the Option 2 masterplan…*" The degree to which the unranked/unquantified negative effects could be mitigated is unclear. Nonetheless, the guiding design principles include a range of measures including landscape treatments, retention/creation of views, setback distances and building heights. It is therefore surprising that such measures are not also considered in relation to the New Salts Farm Site where an Illustrative Masterplan and supporting Landscape Strategy seek to establish landscape treatments, retain and create views, provide setback distances and guide building heights.

2.42 Guiding Design Principles such as "*allow open views to the country park and across Shoreham Airfield from the new roundabout to enhance the perception of openness and greenness in the gap landscape*" provide a misleading suggestion that enhancement might be offered. At New Monks Farm, views from and across a new trunk road junction would replace existing views from the road corridor – this could at best be considered to be a neutral effect but could not be considered an enhancement. In comparison, the New Salts Farm proposal retains a degree of the open views from the road as it does not encroach the length of the A259 or land to the east of New Salts Farm Road. Furthermore a new landscape edge could soften the currently harsh settlement edge in views. However the visual effects at New Salts Farm are described overall as "*significant adverse*" with no mitigation considered that might 'neutralise' this as is the case for New Monks Farm.

Landscape Common Ground

2.43 Hyde New Homes and HBA met with Adur DC regarding landscape / green gap matters at the New Salts Farm on 26th April 2016 and 14th July 2016. On both occasions, Hyde New Homes expressed a strong willingness to work with the Council to address the range of landscape and gap concerns that are now expressed in the New Salts Farm Report and have offered site visits and design modifications to help to allay concerns. We will seek to agree common ground with Adur DC prior to the Local Plan Examination hearing sessions.

2.44 It is worth noting that the scheme put forward by Hyde New Homes is illustrative. It represents one layout for development that could be accommodated on the site and there is scope for adjusting development and open space footprints, notably that might go some way towards meeting the mitigation aims set out on page 24 of the New Salts Farm Report.

Local Green Gaps Topic Paper, October 2016, Adur DC

2.45 The Local Green Gaps Topic Paper states that it explains the Council's approach to the Local Green Gaps and provides background evidence to support it. Notably, it takes reference from the earlier work in the Landscape Study 2012 and the Landscape Study Update 2016 which provide much discussion on landscape setting. As identified in our Regulations 19 representations, neither study specifically address the role that the existing Gap and its constituent LCA or discrete areas play in meeting the policy function of providing physical settlement separation. Whilst the Topic Paper now mentions physical separation, it does not expand the evidence.

2.46 The Topic Paper includes a "*Summary of Landscape Issues for Adur Local Plan Allocations Identified in the studies*" presented in a table from page 17-23. Under "*How has the evidence informed the Local Plan allocation?*", for each site allocation, the visibility of the site is recorded in relation to the identified key viewpoints from the Landscape Study 2012 and Landscape Study Update 2016. This contrasts with the approach taken in the New Salts Farm Report which bases visibility upon two identified key viewpoints and two additional viewpoints.

2.47 Specifically with regard to the West Sompting allocation, on page 19 it is noted that "*While it is recognised that the site is located within a LCA of medium –high overall landscape sensitivity, ….the allocation is in an area of limited visibility from the key viewpoints in the landscape studies undertaken in 2012 and 2016, and the study recognises that there is some scope for development in this area. Additionally, development offers some opportunities to improve the current stark interface between existing development and the local green gap*". The New Salts Farm site is located in an area considered by the Landscape Studies to be of Medium overall landscape sensitivity to the west and to the east forming part of an area considered to be of Medium – High overall landscape sensitivity. At face value, one could therefore consider this to 'average out' as being of lower overall landscape sensitivity than the West Sompting allocation site. On a quantitative basis (as seemingly followed in this Topic Paper) the visibility from the identified key viewpoints is also broadly comparable to the West Sompting allocation and the ability of the New Salts Farm development to deliver improvements to an existing stark built edge to the green gap is also acknowledged in the 2012 report. On the whole, the stated evidence analysis that has informed the West Sompting allocation could be equally applied to New Salts Farm site.

2.48 Paragraph 6.5 of the Topic Paper concludes that:

> *"It is considered that although the gaps would be reduced in size by these allocations, they will still function as gaps and still provide <u>the necessary separation</u> to retain the separate identities of the relevant settlements within the Local Plan area, as verified by the Landscape Study Update 2016." (HBA emphasis)*

2.49 Neither of the Landscape Studies nor the Topic Paper itself describe, identify or quantify what the "necessary separation" required is in real or physical terms. As recorded in

the Regulation 19 representations, neither of the Landscape Studies assess the function of the Gap as a whole or the contribution of the component parts of the Gap make to achieving physical settlement separation and preventing coalescence.

3 SUMMARY

3.1 This report has been prepared to support a Written Statement by Boyer Planning on behalf of Hyde New Homes to the Local Plan Examination Hearing. It provides a critique / review of the 'Landscape Study Update - New Salts Farm Report' and Local Green Gaps Topic paper both dated October 2016. Where appropriate, comparison is made between the recently published documents and the other landscape related evidence, notably provided by Landscape Studies for Adur DC in 2012 and 2016.

3.2 In addition to the issues raised in this Landscape Statement, significant concerns were raised regarding the transparency and soundness of the approach and findings of the earlier Landscape Studies as part of the Regulation 19 representations.

3.3 Numerous criticisms are made of the New Salts Farm Report, relating to issues of the soundness and appropriateness of the methodology, approach and criteria used, the incorrect interpretation and therefore wrong assessment of the development proposal and the consistency of the approach when considered against other evidence base documents. Particular attention is drawn to the following:

- A lack of detailed methodology and the presence of errors and conflicts with the widely – recognised guidance in GLVIA3. This results in unclear assessment criteria and flawed, incorrect and inappropriately assessed landscape evidence;
- The Illustrative Masterplan is misinterpreted and incorrectly indicated throughout the New Salts Farm Report. This results in seriously flawed evidence; the assessments being made against wrong and inaccurate data that is carried through into the analysis, effects appraisal/assessment and consideration of mitigation;
- Visual effects are assessed against viewpoints that are mapped in the wrong locations and visibility assessed on this basis;
- The findings of the New Salts Farm Report contradict earlier recommendations made to Adur DC in the Landscape Study 2012 including omitting to address the range of positive effects highlighted in the Landscape Study 2012 and despite design amendments that have taken place. This cannot be considered to represent an objective approach to assessment;
- The New Salts Farm Report demonstrates an inconsistent approach when compared to the New Monks Farm Report, in particular in relation to the consideration of views across the Gap, mitigation opportunities and assessment.

3.4 The Local Green Gaps Topic Paper references the Landscape Study 2012 and Landscape Study Update 2016, neither of which specifically address the role that the existing Gap and its constituent components play in meeting the policy function of providing physical settlement separation and preventing coalescence. The Topic Paper fails to expand this evidence in this regard. Whilst quoting the requirement for "necessary separation", fails to identify or quantify what this is in real or physical terms.

3.5 Evidence included in support of the site allocations includes the visibility of the site in relation to the identified key viewpoints from the Landscape Study 2012 and Landscape Study Update 2016. This contrasts with the approach taken in the New Salts Farm Report which bases visibility upon two identified key viewpoints and two additional viewpoints. Other evidence analysis that has informed the West Sompting allocation such as the improvement of existing stark development edge equally applies to the New Salts Farm site but has been omitted from the New Salts Farm Report, suggesting a lack of consistency and objectivity in this regard.

3.6 Taking the above notable errors and inconsistencies into account, it is considered that the New Salts Farm Report and Local Green Gaps Topic Paper fail to provide sound and objective evidence.

APPENDIX 1 - Figures:

Figure HBA1 - Development site comparison
Figure HBA2 - Viewpoint 1 comparison
Figure HBA3 - Viewpoint 2 and 3 comparison
Figure HBA4 - Viewpoint 4

Figure 9 - New Salts Farm development site: Landscape Site Appraisal

Figure 9 From New Salts Farm Report

Figure 9 with proposed development as indicated on the illustrative masterplan

Prominent open spaces

Open space within the proposed New Salts Farm Road development

Designated heritage building/structure

Existing industrial /employment area at Shoreham Airport

Public right of way

Existing built edge

Proposed built edge

Existing landscape edge

Proposed development at New Salts Farm Road

Note that no proposed landscape edges are indicated despite the creation of green edges.

Figure 9 overlaid with illustrative masterplan submitted as part of the Regulation 19 Representations to the Local Plan by Boyer Planning in April 2016.

Adjusted proposed development at New Salt Farm as shown on illustrative masterplan- Note that proposed development is set further back from the A259 and railway than assessed in New Salts Farm Report.

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FIGURE HBA 1

Project: NEW SALTS FARM

Title: Development site comparison

Date:16/12/16 Dwg No: LPEIP-HBA1 Rev: /

Scale: NTS Drawn by: KS Chkd: NB Appd:NB

File ref: P:\734\Drawings\HBA\Current Drawings\HBA1

View east to south-east towards Shoreham Harbour

View south-east towards New Salts Farm

Viewpoint 1 and labels from New Salts Farm Report by Sheils Flynn

Figure 10a - Viewpoint 1

HBA View 1

View from open access land at Lancing Ring using a lens equivalent to a 35mm conventional film camera with a 50mm lens. Printed at the same size as original New Salt Farm report photographs for comparison

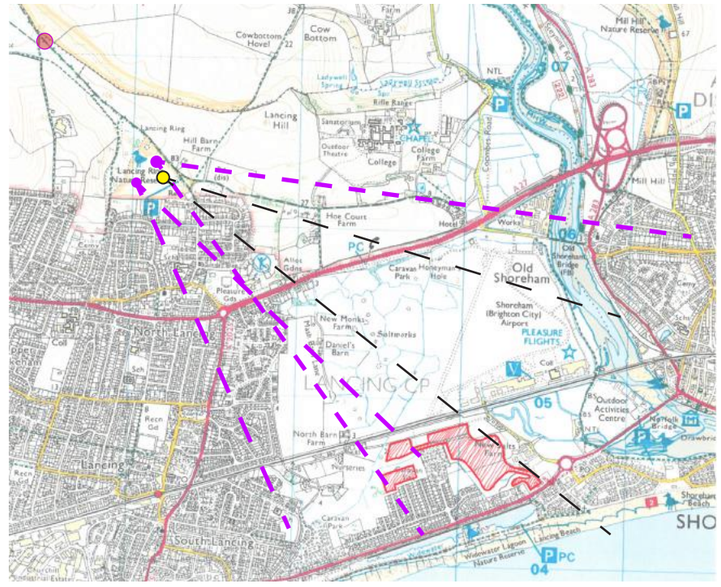
HBA View 2

Demonstrating how view changes as the viewer moves west on the lower ground through the open access land.

- - - - - Approximate footprint of New Salts Farm development

- - - - - Approximate footprint of New Monks Farm development

- - - - - Approximate footprint of Allocated Employment site



- Location shown for Viewpoint 1 in New Salts Farm Report
- Actual Location of Viewpoint 1
- HBA Viewpoints

*Photograph reproduced at same size as they appear in the New Salts Farm Report for consistency and ease of comparison.

FIGURE HBA 2

Project: NEW SALTS FARM

Title: Viewpoint 1 comparison

Date:16/12/16 Dwg No: LPEIP-HBA2 Rev: /

Scale: NTS Drawn by: KS Chkd: NB Appd: NB

File ref: P:\734\Drawings\HBA\Current Drawings\HBA2

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Viewpoint 2 and labels from New Salts Farm Report

Viewpoint 3 and labels from New Salts Farm Report

Viewpoint 3 from New Salts Farm Report annotated to show approximate extent of proposed development on the illustrative masterplan

Approximate footprint of New Salts Farm development

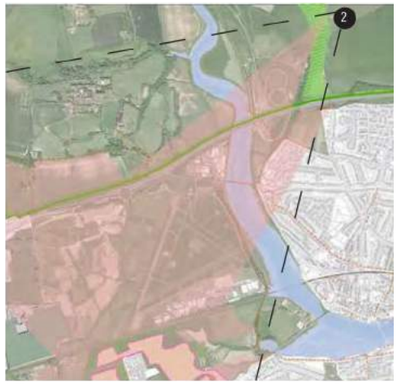
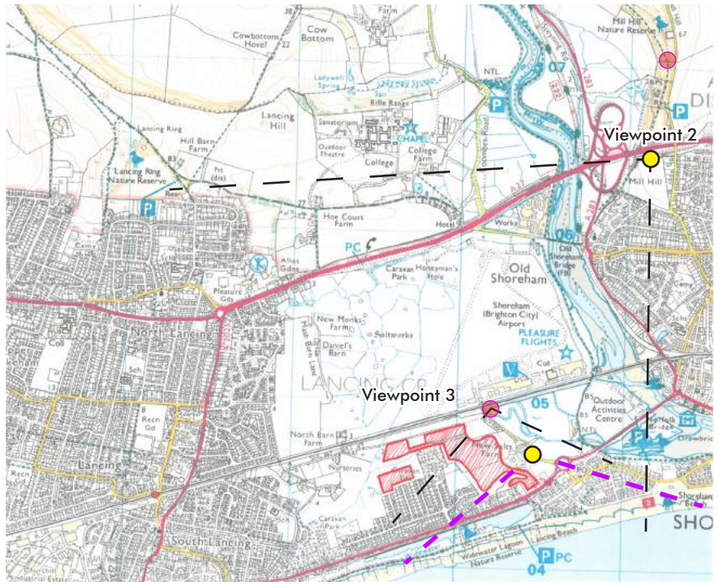


Figure 10b - Viewpoint 2

Figure 10c - Viewpoint 3



Location shown for Viewpoint 2 and 3 in New Salts Farm Report

Actual Location of Viewpoint 2 and 3

FIGURE HBA 3

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*Photograph reproduced at same size as they appear in the New Salts Farm Report for consistency and ease of comparison.

Project: NEW SALTS FARM

Title: Viewpoint 2 and 3 comparison

Date:16/12/16 Dwg No: LPEIP-HBA3 Rev: /

Scale: NTS Drawn by: KS Chkd: NB Appd:NB

File ref: P:\734\Drawings\HBA\Current Drawings\HBA3

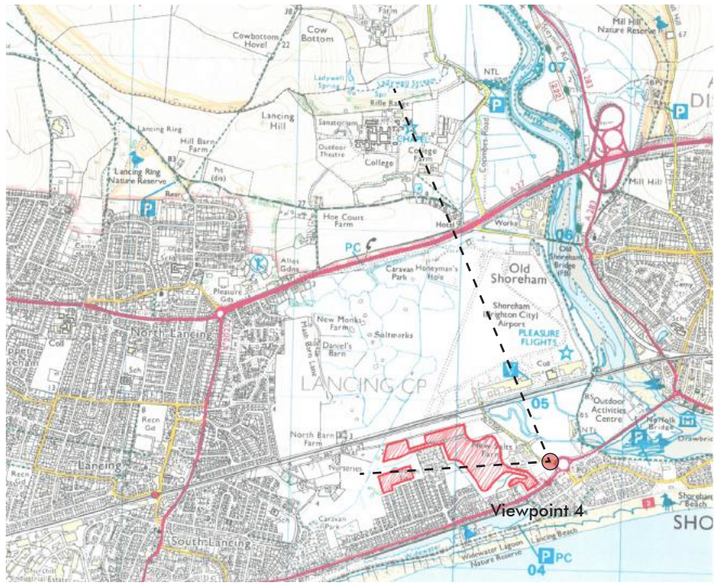
Viewpoint 4 and labels from New Salts Farm Report

Figure 10d - Viewpoint 4

Approximate extent of proposed development

Viewpoint 4 and labels from New Salts Farm Report annotated to show approximate extent of proposed development on the illustrative masterplan

Approximate footprint of New Salts Farm development



Viewpoint 4 Location

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*Photograph reproduced at same size as they appear in the New Salts Farm Report for consistency and ease of comparison.

FIGURE HBA 4

Project: NEW SALTS FARM

Title: Viewpoint 4

Date:16/12/16 Dwg No: LPEIP-HBA4 Rev: /

Scale: NTS Drawn by: KS Chkd: NB Appd:NB

File ref: P:\734\Drawings\HBA\Current Drawings\HBA4

Appendix Two – Flood Risk Assessment

Boyer

Tully De'Ath consultants

Feasibility Research

EIA, Flood Risk & Transport Assessments

Urban Planning and Design

Integrated Transport Solutions

Infrastructure Development

Structural Design

Eco and MMC Focused

Flood Risk Assessment
Issue 4
New Salts Farm - Shoreham
11649
For The Hyde Group

Engineering at its Best

Report For

The Hyde Group

Scheme No: 11649

New Salts Farm Road Land - Shoreham

Flood Risk Assessment
Issue 4

Main Contributors

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20th December 2016

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4.0 Development Proposals

5.0 Flooding Assessment

6.0 Flood Management and Mitigation

7.0 Sustainable Drainage Options

8.0 Surface Water Drainage Proposals

9.0 Phased Development

10.0 Maintenance

11.0 New Flood Defences

12.0 West Beach Estate Drainage

13.0 Conclusion

Appendix A - Site Location Plan

Appendix B – Topographical Survey

Appendix C - Southern Water Sewer Records and Capacity Check Report

Appendix D – Ground Monitoring Results

Appendix E – Development Proposals

Appendix F – Sequential and Exception Test

Appendix G – SFRA Historical Flood Maps

Appendix H – Lancing SWMP Extracts

Appendix I – EA Flood Maps

Appendix J – Indicative Drainage Drawing

Appendix K– SuDS Manual Extracts

Appendix L – Adur Tidal Wall Scheme

Appendix M – West Beach Estate Drainage

Appendix N – Foundation and Ground Floor Construction

Appendix O – Road Improvement Systems

Appendix P – Green/Blue Roof Details

Appendix Q – Lancing Brooks Modelling

1.0 Introduction

1.1 Tully De'Ath have been commissioned by Hyde Group to prepare a Flood Risk Assessment (FRA) in support of the redevelopment of the New Salts Farm for residential development in Shoreham.

To enable the whole of the New Salts Farm to be considered for inclusion within the Local Development Plan this report will review the flood risks across the development area and will demonstrate how these risks can be mitigated.

It is anticipated that the site will be developed over a number of phases and as each future phase is constructed, a phase specific FRA will be provided to accompany each planning application.

1.2 The purpose of the report is to demonstrate to the Planners, the Environment Agency (EA) and West Sussex County Council as Lead Local Flood Authority that the proposed development is subject to an acceptable level of flood risk and should not increase the likelihood of flooding elsewhere.

The report has been prepared in accordance with the National Planning Policy Framework (NPPF) and the 2014 Planning Practice Guidance – Flood Risk & Costal Change, which has recently superseded the Technical Guidance document to the NPPF.

The surface water drainage principles will follow the guidance, Water.People.Places. - prepared by the Lead Local Flood Authorities of the South of England.

The FRA will make reference to the Adur and Worthing Strategic Flood Risk Assessment (SFRA) and the Lancing Surface Water Management Plan (SWMP).

2.0 Site Location

2.1 New Salts Farm is located to the west of Shoreham and covers an area of 28.2Ha. The Farm is bounded by the railway line to the north, New Salts Farm Road to the east and West Beach Estate to the south. The south eastern corner of the site fronts onto the A259, Brighton Road. Shoreham Airport is located to the north and the River Adur to the East.

2.2 Refer to Appendix A for a location plan.

3.0 Existing Conditions

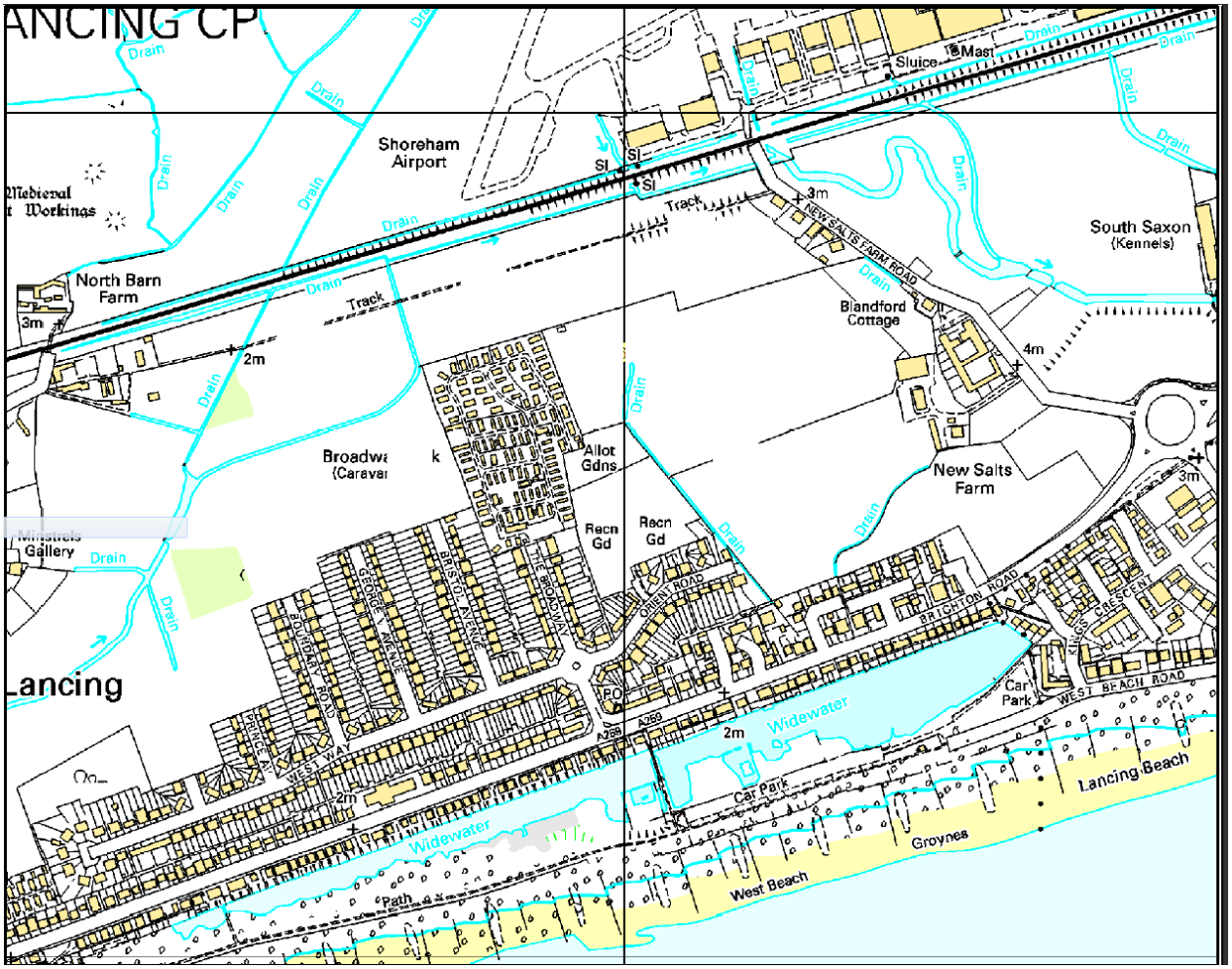
3.1 The Farm comprises agricultural fields which are currently used for grazing.

3.2 Topography

A topographical survey (Appendix B) shows the site levels across the Farm are relatively flat, typically ranging from 1.8m AOD along the southern boundary to 1.4m AOD along the northern boundary. The lowest area of the site is located between the Broadway Park site and the railway where levels are typically 1.4m to 1.1m AOD.

3.3 Water Features

There are a number of drainage ditches across the development area which form part of the Lancing Brooks drainage system. These ditches drain to the northern boundary, adjacent to the railway line, before ultimately discharging into the River Adur to the east. There are two drains highlighted on the survey plans on the eastern side of the site which appear not to drain to any specific outfall but do collect water during wet periods.



Lancing Brooks Drainage System

These ditches are linked to sluice gates (the Lancing Brooks Outfall) on the eastern side of New Salts Farm Road which stop tidal flows from the Adur flowing back into the ditches. Consequently, during high tides the ditches hold water until the levels in the Adur drop.

From the eastern boundary of the site the sluice gates of the River Adur are approximately 200m to the east, with the main river channel of the Adur a further 300m beyond.

Widewater Lagoon is a manmade feature which lies to the south of Brighton Road, approximately 100m from the south western boundary. It is a landlocked brackish Lagoon (approximately 1.2 km long and 50m wide) bordered on its south side by the sea defenses and shingle beach. Water levels rise following high tides and significant rainfall events.

The coast is located 250m to the south of the most southerly section of the site.

3.4 Sewerage System

Southern Water sewer records (Appendix C) indicate that there is an existing adopted 200 dia. foul sewer which runs across the eastern side of the site which appears to drain the buildings on New Salts Farm Road. A rising main crosses part of the site adjacent to the south eastern boundary linking the foul drainage from Wenceling Cottages to the adopted sewer in Orient Road.

The sewer records indicate that there are no adopted surface water sewers on the Farm

3.5 Geology

Geological maps indicate that the natural site geology consists of Alluvium/Marine Deposits over Newhaven Chalk.

Intrusive testing has established that beneath a thin layer of top soil a depth (0.35m-1.85m) of sandy clay overlies sand (0.9m-1.65m) which in turn overlies gravels which was proven to a thickness in excess of 3.5m.

3.6 Ground Water

Ground water was struck during the fieldwork between a depth of 0.7m and 1.7m below ground level (bgl). Ground water monitoring wells and dataloggers were installed which established that the ground water levels on the eastern part of the farm are significantly influenced by the tide, although there appears to be a 1.5 – 2 hour time lag between high tide and high water level. Ground water monitoring results are included within Appendix D.

In the south eastern corner of the site the ground water levels were recorded from December 2015 to November 2016, (WSL4, 5 & 6) although WSL4 stopped working for one month and WSL6 stopped for three months due to corrosion.

Elsewhere on the site additional ground water monitoring wells (WSL108, 109, 110, & 111) were specifically installed in areas which were anecdotally noted to be wet. Ground water levels for these wells were recorded between September 2016 and November 2016.

Locations of Boreholes, Ground Water Data Loggers & Ditch Monitoring Points

Within the south eastern corner ground water levels were generally recorded at 0.4m - 1.0m bgl at high tide, which dropped to 1.7m - 2.4m bgl at low tide. However, one of the dataloggers located adjacent to the southern boundary has consistently recorded above ground levels which suggests that groundwater is periodically artesian. Based upon these findings, this part of the site should periodically flood, however this has not been witnessed, neither are we are aware that this area routinely floods. This could be as a result of localised impermeable clay layer which prevents ground water rising to the surface.

On two occasions over the monitoring period ground water was recorded reaching ground level in WSL6, which upon reviewing the tidal charts, was related to a particularly high spring tide event. The same tide event did not cause similar peaks in any of the other boreholes.

Ground water levels to the western side of the site showed reduced tidal fluctuations in levels which is believed to be as a result of lower permeable geology.

The recorded ground water levels in the additional boreholes all remained below ground level for the duration of the monitoring period. The ground water levels in WSL110 & 111 were constantly below 1.0m bgl with reduced tidal fluctuations. The levels in WSL109 ranged between 0.3m and 0.9m bgl, whereas WSL108 levels remained at depth with the highest level recorded at 1.1m bgl. The levels in WSL107 rose to within 0.55m bgl during high tide events.

Within the SWMP the relationship between the Lancing Brook Ditches and the ground water is discussed. It states that due to the characteristics of the superficial deposits the high ground water levels may provide some base flows to the surface water ditches. However, it "*is likely to be only a relatively small contribution to the overall flow in the surface water channels."*

The EA's Ground Water Vulnerability map shows the site is not within a source protection zone but overlays a Minor Aquifer High Vulnerability.

3.7 Water Level Monitoring within the Ditches

Data loggers were installed to three of the main ditches on the site to establish water levels. The gauge within Ditch 2 disappeared. However, the two that remained were located on the road bridge over the stream on New Salts Farm Road (Ditch 1) and the ditch (Ditch 3) running west/east between the railway line and the West Beach Estate. Five months of data was collected between July 2016 and November 2016 the results of which are provided in Appendix D.

Over the period of monitoring the water levels do rise and fall, typically by 100mm although the rate of change is not particularly fast. The recorded spikes in water levels appear to coincide with spring tide events.

All recorded levels remained in-channel with the exception of one event in Ditch 3 where the water level was recorded just above the bank level. The same event created a similar 200mm rise in water level within Ditch 3.

The water level rises in both ditches closely relate to each other.

4.0 Development Proposals

4.1 The New Salts Farm development is targeting up to 455 new homes together with associated car parking open space and landscaping. Refer to Appendix E for details of an indicative site layout.

It is intended that all the units will have flat roofs incorporating green roofs with integral attenuation below (Blue Roof). Permeable paving will be provided to all roads, parking courts and hard paved areas.

Bioretension areas will be incorporated into the design which will match the existing low points on the site where surface water flooding would naturally occur in extreme events.

A new drainage channel will be constructed within the development site which will run parallel to the main channel within the Network Rail land. This channel will be designed to take additional/exceedance flows from the existing channel. Alternatively, to improve the limited access to the ditch within the Network Rail land it may be preferable to divert the main channel flows into the new channel. This option will should be agreed with the EA and WSCC during the detailed design stage.

Vehicle access to the majority of the site will be via a new access road from the Brighton Road, although limited vehicle access may be provided off the existing roads within the West Beach Estate.

4.2 Sequential and Exception Tests

The Hyde Group are looking to promote the New Salts Farm through the Local Plan process for a development allocation of up to 455 units. It is recognised that the New Salts Farm is located within a flood risk area and if the site is to be identified on the Development Plan then a Sequential and Exception test will be required.

The purpose of the Sequential Test is to demonstrate that there are no sequentially preferable available sites at a lower flood risk within a defined search area which could deliver the proposed development.

On the basis that a Sequential Test has been passed, the site could be considered suitable for residential development where the Exception Test is also passed.

For the Exception Test to be passed it must be demonstrated that the development provides wider sustainability benefits to the community that outweigh flood risk, and a site specific flood risk assessment must demonstrate that the development will be safe for its lifetime.

Within Appendix F Boyer Planning have undertaken a Sequential and Exception Test which demonstrates that both tests are passed and therefore the development site can be considered for residential development to deliver much needed new homes in the Local Plan area to meet housing need.

5.0 Flooding Assessment

5.1 Historic Flood Data

With reference to the SFRA Historic Flood Maps (Appendix G) there are areas of surface water flooding indicated to the western side of the development site, which appear to follow the lines of the existing ditches/drains. The West Beach Estate and the area adjacent to the south western corner of the development site is noted as having tidal flooding incidents. The nearest recorded sewer flooding incident within the SFRA has been recorded in West Way, to the south of the site.

The Lancing SWMP (Appendix H) provides data of historic flooding over the winter of 2013/14 which was the wettest winter on record. During this period regular flooding of the highway occurred on the Broadway, West Way and Prince Avenue.

West Beach Estate suffers from regular surface water and ground water flooding. As part of the wider SWMP, a separate drainage report was produced by CH2M HILL to review the existing drainage issues within the West Beach Estate. The findings indicated that much of the flooding issues on the estate were associated with poor maintenance of the existing drainage system. However, there were ground water flooding incidents associated with high tide events. In addition, it has been established that a number of the estate roads drainage systems were not connected into the adjacent Lancing Brook ditches and as a consequence had no formal outfall.

A number of reports (undertaken in 1994, 2010 and as part of the SWMP) have also reviewed the condition and effectiveness of the Lancing Brook ditches, which form an integral part of the surface water drainage system within Lancing. The reports found that the ditches were poorly maintained which severely reduced their effectiveness (Appendix H).

During June 2012 there was significant flooding across the West Sussex area, however the rain gauge data (Appendix G) demonstrates that the Lancing area avoided the worst of the rainfall and as a consequence did not suffer from any significant flooding.

It is understood that during the winter of 2012 over pumping of the Lancing ditches was undertaken to try and reduce the water levels within the ditches during tide locked events. It is not known what return event caused the flooding and the event is not specifically mentioned within the SWMP.

Over recent years the ditches have been cleaned out, an obstruction has been removed near the outfall and the Lancing Brook Outfall was redesigned to increase its capacity. Consequently, the effectiveness of the ditches has significantly improved. Anecdotal evidence form local residents also suggests that the drainage ditches are working more effectively.

5.2 Flood Maps and Modelling

Within the SFRA, the New Salts Farm site has been assessed as one of the Core Strategy Sites, however it is referred to as 'Land North East of the Hasler Estate'. These details are included within Appendix G. Additional flood maps from the EA were also obtained and are appended within Appendix I.

To summarise the maps:

- Fluvial Flood Risk – Zone 3a for the whole of the New Salts Farm site with a residual risk associated with a breach of the River Adur west bank defences.
- Tidal Flood Risk – Generally Zone 3a although there are areas (39% of the site - to the north and west) which lies within a Zone 3b. There is a residual risk of breaching of the defenses along the River Adur and wave overtopping along the costal frontage.
- Ground Water Flooding – susceptible to ground water emergence is more than 75%. The geological data indicates that there are 'windows' of ground water emergence on the site.
- Surface Water Flood Risk - Low, as the limited areas highlighted as being susceptible to flooding can be aligned to the existing drains/ditches on the site.

- Sewer Flooding – Low, with no reported incident of sewer flooding within the site although there is recorded flooding issues in West Way, to the south east of the site.

The EA have provided flood model data for the New Salts Farm site for a series of storm events which include a 1:75, 1:200, 1:200 plus climate change (CC) and a 1:1000 event for both defended and undefended scenarios (Appendix I). The 1:200 event with an allowance for climate change was the more onerous value with a maximum flood height of 5.391m AOD for the undefended event and 5.050m AOD defended scenario.

The condition of the existing defences has been assessed as "relatively good" (i.e. not poor), consequently the defended 1 in 200 +CC flood level will be used when assessing flood levels.

5.3 Lancing Brooks Modelling

Following a request from the EA, the Lancing Books drainage system adjacent to the site have been modelled by JBA Consulting to assess what impact the new climate change values would have on the development.

In February 2016 new climate change guidance was published by the EA to support the assessment of flood risk in line with the NPPF which sets out how the planning system should help minimise vulnerability and provide resilience to the impacts of climate change. The climate change allowances are predictions of anticipated change for peak river flow by river basin district and peak rainfall intensity.

They are based on climate change projections and different scenarios of carbon dioxide (CO2) emissions to the atmosphere. There are different allowances for different epochs or periods of time over the next century.

In accordance with Table 2 of the updated climate change guidance, a 20% and 40% uplift has been applied to the modelling of the Lancing Brook system to account for the "Central" and "Upper End" anticipated changes in extreme rainfall intensity in small catchments for the 2080s epoch (2070 to 2115).

It had been anticipated that the new modelling would update the 1D model previously undertaken by CH2m Hill. However, in reviewing the details it was found that the original model was steady state rather than hydrodynamic and the flow estimates provided lacked proper justification of the return period assigned to them. This required new hydrology estimates to be generated. Due to the very flat relief it is difficult to identify with confidence topographic watersheds between catchments to apply traditional flow estimations methods therefore the model was converted into InfoWorks ICM and direct rainfall was applied to the wide area to provide in channel flows.

The ICM model also allowed for the representation of the urban drainage infrastructure in the neighbouring roads to be included into the model where relevant and will allow for future outline surface water drainage details to be tested within the wider drainage area.

Much of the catchment to the north of the site was not included as part of the analysis as it would not contribute to the flooding on the site.

The updated model has allowed for the impact of an 18-hour tide lock situation at the outfall of the Adur and the restriction of the New Salts Farm Road bridge. The new drainage channel adjacent to the northern boundary of the site was also included as part of the analysis.

The results of the analysis are included within Appendix Q, which demonstrate that both the 1 in 100+40% CC and the 1 in 1000-year return period remains in channel and do not flood the site.

6.0 Flood Management and Mitigation

6.1 To reduce the flood risk, a number of mitigation measures are proposed.

6.2 Unit Types

All units will provide accommodation at first floor level only and the ground floor areas will be allowed to flood in extreme coastal flooding events. This will provide a safe refuge area above the flood level.

The units will be constructed using flood resilient materials and will be structurally designed to withstand the potentially significant flood depths. The ground floors will be incorporate robust material so that the units can be easily reinstated to a habitable standard. Refer to Appendix E for details of the units.

6.3 Floor Levels

The first floor level will be set at a level 300mm above the 1 in 200+CC tidal event. This equates to a minimum floor level of 5.35m AOD which is in the order of 3.0m above existing ground level.

The preference is to set the ground floor levels 300mm above the existing ground level, with variations to suit localised ground conditions or development constraints. This is to mitigate against the risk of ground and surface water flooding. The surrounding ground levels will be designed to divert flood waters away from the buildings.

6.4 Foundations & Ground Floor Details

It is proposed to use the Abbey Pynford 'Housedeck' system (or similar) which is specifically designed to for use in poor ground conditions. It is a mini piling system which uses continuous flight auger (CFA) piles and a reinforced concrete ground floor slab.

The system uses a continuous hollow stemmed auger which is bored into the ground to the full design depth of the pile. When at the required foundation depth concrete is pumped under pressure down the auger stem to discharge at the base of the auger. The positive pressure of the concrete and the steady rotation of the auger on its withdrawal cycle forces the entire stem to rise allowing concrete to form a complete and solid infilling to the pile bore.

For all modern piling rigs instrumentation is used to record the pressure, the rate of placement of the concrete and the rate of ascent of the auger stem.

The benefit of this piling method is there is never a time during the installation process when an unsupported open bore exists. In addition, the as the concrete is placed under pressure and against a soil surface that is roughened or distributed by the passage of the auger as it is withdrawn, a localized interstitial mixing of soil particles and the cement paste occurs at the soil/pile interface. This means that in the final case there is no preferential pathway for water migration in the long term.

This system is specifically designed so that there is little to no excavation required as the insitu concrete slab can be cast directly on the ground or on collapsible shutters. This enables the slab to be cast above the ground leaving a void below. The details provided within Appendix N demonstrate the two standard options which may be applicable to this site, depending on the final ground levels developed.

Where possible services would be taken into the building externally above the ground floor slab level. Where it is unavoidable and services pass through the slab, two options for a waterproofing solution are available;

- Provide waterproof membrane either above or below the concrete slab and sealing the service openings
- Provide a waterproof concrete slab with a waterstop within the slab

6.5 Surface Water Run-off Rates

Where localised ground conditions indicate that infiltration into the sub-soils is not appropriate, due to high ground water levels or poor infiltration characteristics, surface water will be directed into a new ditch/swale system where the outflows will be restricted to match greenfield run-off rates via the use of flow control devices.

6.6 Surface Water Attenuation

Attenuation will be provided to accommodate a 1 in 100+CC pluvial event via a variety of devices which will include roof top attenuation (blue roof), permeable paving, bioretention areas and swales which is discussed in more detail in Chapter 8.

6.7 Exceedance Events

The attenuation within the permeable paving will be designed to hold a 100+CC event within the sub-base material, assuming no filtration. This will replicate a high ground water event coinciding with a heavy rainfall event. Should the capacity of the attenuation within the hard paved areas be exceeded, any overflow will be directed to the adjacent swales/ditches and bioretention areas. These features will provide additional attenuation as well a means of conveyance and surface water disposal via the Lancing Brooks Outfall. As discussed in Chapter 3, the water levels in the ditches are only partially influenced by ground water.

6.8 Safe Access and Egress

Due to the topography of the surrounding area, it may not be possible to provide a dry means of escape from the buildings in the event of a flood. To overcome this the units will have direct access to the first floor, which will be the primary area for refuge in the event of a major costal flood event.

All units will be linked to the EA's flood warning system and a site specific Flood Evacuation Plan will be provided, which gives guidance and advice to the residents with regards to the flood risks. The plan will also give details of the flood warnings, how the plan is triggered and what actions are required.

The Flood Evacuation Plan will need to be agreed with the local Emergency Planning Team.

6.9 Floodplain Compensation

The main flood risk associated with the site is from tidal/coastal flooding, consequently floodplain compensation will not be required. However, the existing drainage ditches will be extended and new ditches and bioretention areas will be added, which will provide additional surface water flood storage.

6.10 Other Sources of Flooding

Reservoirs

There are no reservoirs in the vicinity of the site and consequently this type of flooding is not applicable to.

Foul Sewers

There are no recorded foul sewer flooding issues on the site, however there is an existing adopted foul sewer which crosses the south-eastern corner of the site. When this part of the site is developed, it is likely that the foul sewer will be diverted under a section 185 agreement with Southern Water.

It was anticipated that the existing foul sewerage system would not be able to accommodate a development of 455 units without the need for sewer upgrade works. Consequently, Southern Water have undertaken a capacity check, the results of which are included in Appendix C.

Southern Water have confirmed that there is currently insufficient capacity within their existing network to accommodate the increase in flows generated by the full development of up to 455 new units. Their report outlines that a total of 455m of existing 150mm dia and 200mm dia sewers require upgrading to 225mm dia. to provide the necessary sewerage infrastructure.

The report concludes that upgrading works are not required to the Wencelling Lancing Pumping Station or the Hasler Lancing Pumping Station.

At the design stage these upgrading works can be secured by way of a Section 98 Agreement (Sewer requisition) with Southern Water.

7.0 Sustainable Drainage Options

7.1 Many existing drainage systems can cause problems of flooding, pollution or damage to the environment and are proving unsustainable. Sustainable drainage systems (SuDS) are an alternative approach to conventional drainage design and implementation; they replicate natural drainage and deal with run-off where it occurs

7.2 Appropriately designed, constructed and maintained SuDS are more sustainable than conventional drainage systems and can help to:

- Reduce run-off rates
- Reduce the risk of flooding
- Encourage natural groundwater re-charge
- Reduce volume of surface water run-off
- Provide habitats for wildlife

However, there are many site-specific factors which will influence the choice of any SuDS devices used within a development. The primary factors are:

- How the land is to be used- whether it be domestic, commercial or industrial
- Soil contamination
- Existing soil conditions i.e. ground permeability, water table levels
- Site topography e.g. steeply sloping
- Space availability – urban or non-urban

7.3 Most advice on the use of sustainable drainage techniques recommends the utilisation of ground infiltration, which may take the form of permeable paving, swales, infiltration basins or soakaways. However, these systems are dependent on the subsoil suitability, unsaturated soil zone to an adequate depth and the absence of leachable contaminants in the subsoil.

7.4 Within this development there is the potential to use a mixture of SuDS devices which could include:

- Water Butts
- Green Roof
- Geocellular Roof Attenuation System (Blue Roof)
- Permeable Paving
- Swales, Bioretention Areas and Infiltration/Conveyance Ditches

7.5 Water Butts

Although not a primary SuDS device, when incorporated into other surface water management systems, water butts can reduce the total volume of storm water run-off and may also provide some additional storm water attenuation.

7.6 Green Roof

Green roofs have the benefit of providing an element of storm water attenuation and reducing the volume of surface water run-off, as well as the removal of air pollutants and dust.

Green roofs will be used across all roofs.

7.7 Geocellular Roof Attenuation Systems (Blue Roof)

These are plastic modular systems with a high void ratio that can be used to create a storage structure. They have the advantage of being flexible, lightweight and the flow control devices are integral with the system.

This system is to be used beneath the green roof system. Details of the Green/Blue roof systems are included within Appendix P.

7.8 Permeable Paving

Permeable paving provides a pavement suitable for pedestrians and vehicles whilst allowing rain water to infiltrate through the surface and into the underlying layers. The water is temporarily stored before infiltrating into the sub-soils. As well as providing surface water attenuation, they are also efficient at removing urban run-off pollutants, making them ideal for use in road and parking areas.

All hard paved areas, parking courts and access roads will be constructed using permeable paving.

Due to the potential for high ground water levels a geo-grid and a geotextile will be incorporated within the foundation of the road and parking areas. The geo-grid is specifically designed to create a stable road foundation within poor ground whilst still allowing infiltration, and the geotextile will prevent the potential upward migration of fine particles. Details of the geo-grid system and correspondence with the Council are included within Appendix O.

7.9 Swales, Bioretention Areas and Infiltration/Conveyance Ditches

Swales, bioretention areas and infiltration/conveyance ditches are broad, shallow, soft landscaped areas designed to convey, store and infiltrate surface water run-off.

On this particular site infiltration into the ground will be permitted. Swales and infiltration ditches will be used to direct surface and ground water away from the buildings in the event of a flood. Where appropriate these diches will also connect into the adjacent the Lancing Brooks drainage system which directly discharges into the River Adur.

Bioretention areas will be located to match the existing low points on the site where surface water flooding would naturally occur in extreme events.

8.0 Surface Water Drainage Proposals

8.1 Guidance within The SuDS Manual states that surface water runoff from new developments should be dealt with in the following order of preference:

1. Discharge to the ground
2. Discharge to a surface water body
3. Discharge to a surface water sewer
4. Discharge to a combined sewer

With reference to the indicative drainage drawing in Appendix J. The proposed method of surface water disposal will generally be via shallow infiltration. Should there be localised areas where the ground water levels are particularly high the surface water will be directed into the adjacent swale drainage system which will link into the Lancing Brooks ditches. These swales will also collect surface water for storage and release into the Lancing Brook system during high ground water events. Where necessary non-return values will be incorporated into the new ditch system to avoid water from the Lancing Brooks backing up into the new diches during a tide lock event.

Other SuDS devices will be incorporated within the drainage design and include:

- All units will incorporate roof attenuation (blue roof) below a green roof system, which will restrict the outflows to the minimum practical value of 0.2 l/s. The attenuation system will be designed to accommodate a 1 in 100 return period which includes an allowance for climate change.
- The discharge from the roof attenuation system will connect into the sub-base of the permeable roads and car parking areas.
- The new access road, parking courts and hard paved areas will be permeable with base infiltration.
- The sub-base thickness within the roads and hard paved areas will be designed to accommodate a 1 in 100 return period with an allowance for climate change. The design of the sub-base thickness will include the design flows from the houses.
- New infiltration ditches/swales will be introduced either side of the new access road which will be linked into the existing ditch system on the site. They will also provide additional exceedance event storage.
- Bioretention areas will be introduced within the landscaping design to provide additional exceedance event storage. These retention devices will be specifically located in lower ground areas which are more susceptible to surface flooding.
- A new drainage channel will be constructed within the development site which will run parallel to the main channel within the Network Rail land. This channel will be designed to take additional/exceedance flows from the existing channel drainage ditch as well as providing additional flood storage capacity.

  Alternatively, to improve the limited access to the ditch within the Network Rail land it may be preferable to divert the main channel flows into the new channel. This option will should be agreed with the EA and WSCC during the detailed design stage.

- All the existing ditches within the development area will be widened to improve the hydraulic characteristics as well as increasing the storage capacity within them.

8.2 Surface Water Treatment

To protect the quality of the ground water, all surface water run-off from the roof and hard paved areas will receive an element of surface water treatment before discharging into the ground.

The tables below make reference to Chapters 26 within The SuDS Manual (Appendix K) which demonstrate that the proposed Pollution Mitigation Measures exceeds the Pollution Hazard Index, which as a consequence satisfies the level of treatment recommended within The SuDS Manual.

Table1: Pollution hazard indices for different land use classifications

Land Use	Pollution Hazard Level	Total Suspended Solids (TSS)	Metals	Hydrocarbons
Residential Roofs	Very low	0.2	0.2	0.05
Individual property driveways, residential car parks, low traffic roads (e.g. cul de sacs, homezones and general access roads) and on-residential car parking with infrequent change (eg schools, offices) i.e. <300 traffic movements/day.	Low	0.5	0.4	0.4
Commercial yards and delivery areas, non-residential car parking with frequent change (e.g. hospitals, retail) all roads except low traffic roads and trunk roads/ motorways.	Medium	0.7	0.6	0.7

Table 2: Indicative SuDS mitigation indices for discharge to groundwater

Characteristics of the material overlying the proposed infiltration surface, through which the runoff percolates	TSS	Metals	Hydrocarbons
Constructed permeable pavement (where a suitable filtration layer is included that provides treatment and including a geotextile at the base separating the foundation from the subgrade) underlain by a soil with good contaminant attenuation potential of at least 300mm in depth.	0.7	0.6	0.7

As each phase is developed the level of treatment prior to discharging will need to satisfy the above criteria.

9.0 Phased Development

It is anticipated that the development will be built over a number of phases. The drainage principles and flood mitigation measures previously discussed will be used throughout all of the phases. However, the ground conditions for each phase will need to be reviewed as the intrusive ground investigations undertaken to date has established that the geology and ground water levels across the development area do vary. If intrusive testing identifies that infiltration may not be appropriate, then surface water will discharge into the adjacent Lancing Brook drainage ditches.

Across the development phases new drainage ditches/swales will be introduced to provide additional surface water attenuation when the Lancing Brooks outfall becomes tide locked. If infiltration is not appropriate within any area, these swales can be used as a means of surface water disposal as they will be linked into the Lancing Brook ditch system. The new swales and bioretension areas will be designed to accommodate the additional volume associated with a tide lock period during a 100+CC event.

The ground floor levels will be locally raised to reduce the risk of ground water flooding accommodation will only be permitted at first floor level, which will be set at the 1 in 200+CC level with an additional 300mm freeboard allowance.

Those areas which are currently located within a Flood Zone 3b (39% of the site) will not be developed until the Adur Tidal Wall scheme has been constructed which would then place these areas within a Flood Zone 3a.

10.0 Maintenance

Maintenance of any drainage scheme is essential to ensure that it continues to perform as designed. The SWMP notes that in the past the Lancing Brooks drainage system has been poorly maintained which has created a number of flooding issues.

The Lancing Brook ditches within the New Salts Farm site are an integral part of the drainage strategy and as a consequence will require regular maintenance to prevent silt build-up and plant over growth in order to maintain an effective cross-sectional area of the ditch system.

The new surface water drainage system will require regular inspection/clearing to prevent blockages due to accumulation of silt. It is recommended that the system is initially inspected and cleared by a suitable trained person every 6 months for at least the first 2 years of operation to establish a long-term inspection/clearing interval appropriate for this site. Inspection/clearing should also be carried out after every major storm and flood event. The SuDS maintenance schedule will need to be agreed with the LLFA as part of the detailed design.

The SuDS features proposed within this development will be in areas that are visible and can be accessed without the need to access private land.

Details of the type and frequency of maintenance required for each element of the drainage system (including the Lancing brooks) will be noted within the site Health, Safety and Maintenance file.

The freehold will be retained by Hyde, who are a housing association, and any reasonable maintenance obligations in respect of flooding and drainage can be secured by a S106 agreement.

11.0 New Flood Defences

It should be noted that the above mitigation measures are based upon the current flood data and does not take into account the benefits of the Adur Tidal Wall Scheme, which has recently obtained a planning approval. These defenses were programmed to start construction in Spring 2016 and are due to be completed in 2018.

Upon completion, the Adur Tidal Wall Scheme will provide up to a 1 in 300 level of flood protection from tidal events to the New Salts Farm development site. This will reclassify the areas which are currently Flood Zone 3b to Flood Zone 3a. Details of the flood scheme are included in Appendix L.

12.0 West Beach Estate Drainage

The surface water drainage issues on the West Beach Estate are well documented. The historic plans suggest that it was the intention to drain the West Beach Estate roads onto the New Salts Farm, although it appears that the final connections were never made. The CH2M Hill report states that residents on two of the estate roads have made an informal connection onto the New Salts Farm land, whilst a number of the other roads have not (Appendix M).

The development of the New Salts Farm will look to formalise the surface water drainage connections from the West Beach Estate into the development proposals. Consequently, this would help to reduce the existing flooding issues currently experienced on the estate. As an interim measure, new ditches have recently been constructed adjacent to the site boundary (Appendix M), however these ditches will be subject to realignment during the detailed design stage of the adjacent construction phase.

13.0 Conclusion

New Salts Farm is located within a Flood Zone 3 area, where the main flood risk for the development is associated with coastal flooding. To overcome this, no accommodation will be provided at ground floor level and the first floor level will be set 300mm above the 1 in 200+CC tide event. All units will be constructed using flood resilient materials and will be structurally designed to withstand potentially high flood depths.

Long term ground water monitoring has been undertaken on the site. Ground water levels are high in certain areas of the site and fluctuate with the tides. To reduce the risk of ground water flooding to the units the ground floor levels will be locally raised.

The ground water monitoring has established that for the majority of the development area it would be possible to use shallow infiltration as a means of surface water disposal. However, where the local ground conditions dictate that infiltration is not appropriate, or during very high ground water level events, the surface water will discharge into new ditches and swales. These will in turn link into the Lancing Brooks drainage system. The new diches will be designed to accommodate a 1 in 100+CC storm event during a tide lock scenario and will incorporate non-return valves to ensure that flows from the main channels do not back flow into them.

The Lancing Brooks drainage system cross the development site, collecting surface water from the surround areas. They ultimately discharge to the River Adur via the Lancing Brooks Outfall. Historically these ditches have been poorly maintained which has caused a number of flooding issues. Recently these ditches have undergone a number of improvements/repairs throughout the Lancing Brooks network to improve their capacity and effectiveness.

It is proposed to divert part of the ditch system which runs through Network Rail land into this development which will provide improved access for inspection and maintenance as well as providing additional flood storage.

As part of the development the existing ditch system within the site will be widened to further improve the hydraulic characteristics of the ditches as well as increasing the storage capacity within them.

A new hydraulic model of the Lancing Brook has been undertaken which has confirmed that the flows within the ditches remain in channel for the 1 in 100+40% CC and 1 in 1000 pluvial event during a tide lock scenario.

All units will have green roofs with integral surface water attenuation (blue roof) which is designed to accommodate a 1 in 100+CC event. The run-off from these areas will be restricted to the minimum flow rate, which will, in turn, connect into the permeable sub-base of the roads.

All roads and hard standings will be permeable with base infiltration. The formation levels will generally sit above the high ground water levels. For particularly high ground water events the road foundations are designed to be stable if the water level rises to be within the road make-up. The sub-base thickness of the permeable paving will be designed to hold a 100+CC event to replicate a tide lock situation.

To reduce the risk of pollution all surface water run-off will receive the necessary level of treatment to accord with the requirements of The SuDS Manual.

A detailed maintenance strategy will be developed to ensure the drainage system continues to work as designed for the lifetime of the development. The long-term maintenance will be undertaken by a management company controlled by the Hyde Group for the lifetime of the development.

There are areas on the New Salts Farm which lie within a Flood Zone 3b. However, when the Adur Tidal Wall is completed the whole of the Farm will have improved flood protection. Those areas which currently fall within a Flood Zone 3b will be re-categorized as 3a. The mitigation methods proposed do not rely on the completion of the Adur Tidal Walls but once completed they will clearly provide additional flood protection.

As part of the New Salts Farm development, new drainage diches will be implemented to formally collect the surface water run-off the part of the West Beach Estate. This will help to reduce the surface water flooding issues currently experienced across part of the estate.

The principles developed to reduce the flood risks both within and beyond the site will be used when developing across all phases of the development. However, those areas which currently lie in Flood Zone 3b will not be brought forward until the Adur Tidal Wall scheme has been implemented.

The mitigation measures proposed will provide significant flood protection for the lifetime of the development.

A Sequential and Exception Test has been undertaken which demonstrates that the wider benefits of the proposed development outweigh the flood risks.

Extending the drainage ditches within the development area and providing an enhanced level of maintenance will also help to improve the efficiencies of the Lancing Brook Ditches. This, combined with improving the drainage to the West Beach Estate will also help to reduce the risk of flooding beyond the site.

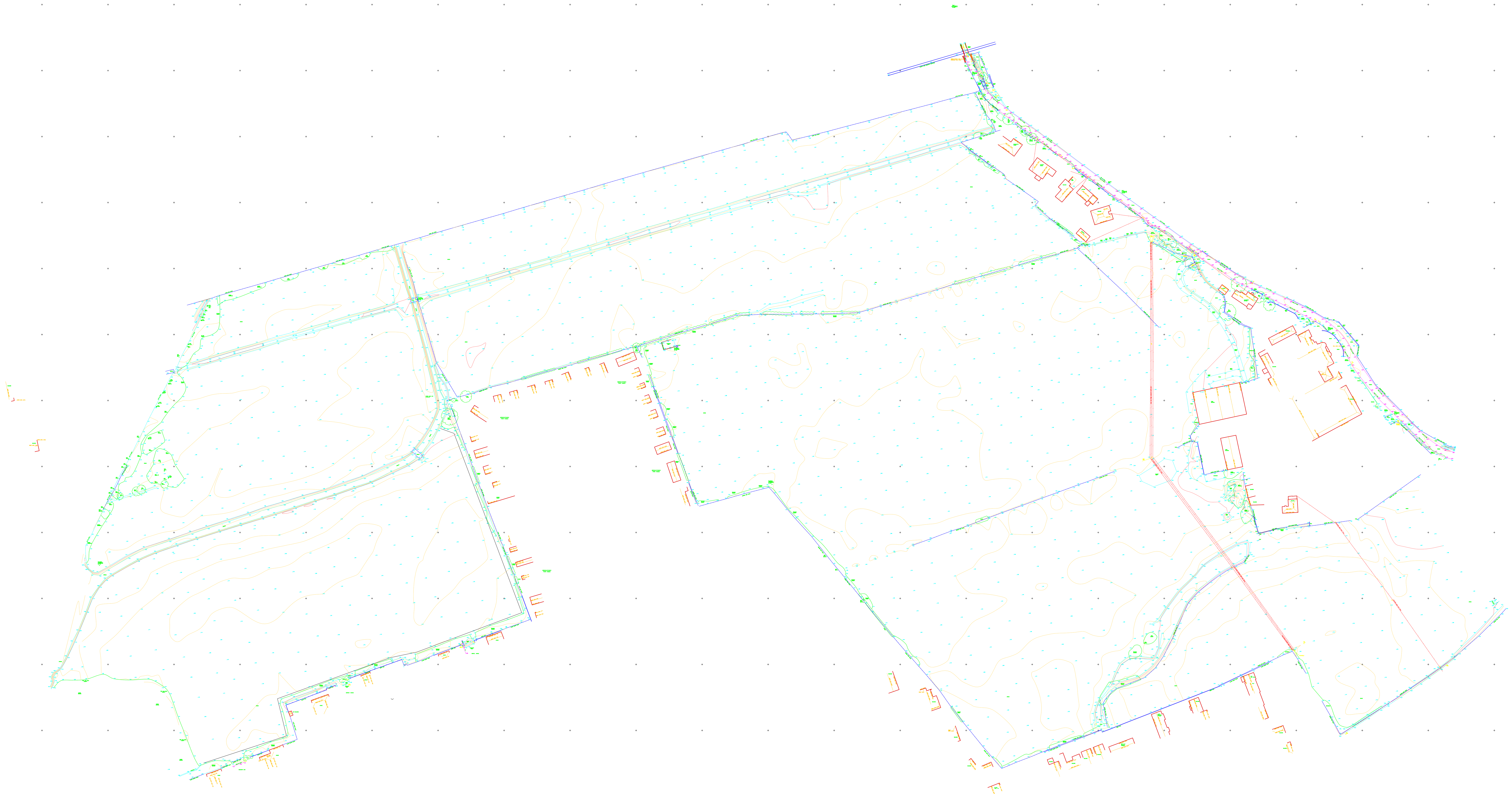
By introducing the above measures, it is considered that the proposed development would be suitable for inclusion within the Local Development Plan.

Appendix A – Site Location Plan

Site Location Plan

New Salts Farm Road,
Shoreham-by-Sea,
West Sussex,
BN43 5FE

Appendix B – Topographical Survey



LEGEND

AOD	ABOVE ORDNANCE DATUM	**TREES**	
AV	AIR VALVE	ALD	ALDER
B	BOLLARD	BCH	BEECH
BH	BOREHOLE	CED	CEDAR
BB	BELISHA BEACON	CHY	CHERRY
BT	BRITISH TELECOM COVER	CON	CONIFER
BTB	BRITISH TELECOM JUNC. BOX	CYP	CYPRESS
BS	BUS STOP	FRT	FRUIT
CATV	CABLE TELEVISION COVER	HAW	HAWTHORN
CONC	CONCRETE	HLY	HOLLY
CPS	CONCRETE PAVING SLABS	HCH	HORSE CHESTNUT
DK	DROP KERB	LAB	LABURNUM
DP	DOWNPIPE	LAR	LARCH
ECB	ELECTRICITY CONTROL BOX	LIM	LIME
ELCP	ELECTRICITY CABLE PIT	LOC	LOCUST
EP	ELECTRICITY POLE	LRL	LAUREL
ERC	EARTH ROD COVER	MPL	MAPLE
FH	FIRE HYDRANT	PNE	PINE
FB	FLOWER BED	POP	POPLAR
FL	FLOOR LEVEL	RWN	ROWAN
FP	FLAG POLE	SIB	SILVER BIRCH
GP	GATE POST	SPR	SPRUCE
GV	GAS VALVE	SCH	SWEET CHESTNUT
GU	GULLEY	SYC	SYCAMORE
IC	INSPECTION COVER	WLW	WILLOW
LB	LETTER BOX	UNK/SPU	SPECIES UNKNOWN
LH	LAMP HOLE	Species Dia x No of trunks	eg OAK D0.2 x3
LP	LAMP POST		
MH	MANHOLE		
MP	MARKER POST	**BUILDINGS**	
NP	ROAD NAME PLATE	CL	CEILING LEVEL
OSBM	O.S. BENCHMARK	FL	FLOOR LEVEL
PCE	PRE-CAST CONCRETE EDGING	EL	EAVES LEVEL
PCK	PRE-CAST CONCRETE KERBS	RL	RIDGE LEVEL
PM	PARKING METER	C	CILL HEIGHT
RE	RODDING EYE	H	HEAD HEIGHT
RS	ROAD SIGN	FRL	FLAT ROOF LEVEL
RWP	RAINWATER DOWNPIPE	**FENCES**	
SP	SIGN POST	BWF	BARBED WIRE FENCE
STN	SURVEY STATION	CBF	CLOSE BOARD FENCE
STP	STACK PIPE	CIF	CORRUGATED IRON FENCE
SV	STOP VALVE/COCK	CLF	CHAIN LINK FENCE
TAP	WATER TAP/STANDPIPE	CPF	CHESTNUT PALING FENCE
TBM	TEMPORARY BENCHMARK	CWF	CHICKEN WIRE FENCE
TCB	TELEPHONE CALL BOX	IRF	IRON RAILING FENCE
TH	TRIAL HOLE	PMF	POST & MESH FENCE
TL	TRAFFIC LIGHT	PRF	POST & RAIL FENCE
TP	TELEGRAPH POLE	PWF	POST & WIRE FENCE
VENT	VENT PIPE	GATE	
WL	WATER LEVEL	STILE	
WM	WATER METER		TELEPHONE CABLE
WMSV	WATER METER/STOP VALVE		ELECTRICITY CABLE
WO	WASH OUT		
WT	WATER TROUGH		

Note

Tree species named on this plan are for general information only and should be confirmed by a taxonomist prior to any design.

Coordinate System:
Site grid is a Scale Factor 1, site centred around Stn.Field1, derivative of Ordnance Survey National Grid

project
New Salts Farm
Lancing

client
Hyde New Build Ltd

drawing title
Land Survey

Dorset Land Surveying
Land Surveyors
Setting Out Engineers
Civil Engineering Design
Measured Building Surveys
Elevations and Street Scenes
Expert Witness Reports
GPS Surveys
Monitoring
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scale	1:500	paper size	NA
drawn by	MT/JP	date	14th April 2015
checked	MJH	grid	OSGB36*
datum			OSGM02
drawing number	6205	revision	

Appendix C – Southern Water Sewer Records and Capacity Check Report

105377

Node	Cover	Invert	Size	Material	Shape	
0101X	3.23	3.23	225	VC	CIRC	
0201X			UNK	UNK	CIRC	
0202X			UNK	UNK	UNK	
020DX			150	UNK	CIRC	
0302X			200	VC	CIRC	
0303X			UNK	UNK	CIRC	
0304X			UNK	UNK	UNK	
0305X			UNK	UNK	UNK	
0306Y	1.83		200	UNK	CIRC	
0307X			UNK	UNK	CIRC	
0308X			UNK	UNK	CIRC	
030DX	1.13		200	VC	CIRC	
031DX			150	UNK	CIRC	
032DX			150	UNK	CIRC	
034DX			UNK	UNK	CIRC	
03ADX			200	UNK	CIRC	
03BDX			UNK	UNK	CIRC	
0401X			UNK	UNK	CIRC	*
0401X	4.79	2.56	150	VC	CIRC	*
0402X			UNK	UNK	CIRC	
0403X			UNK	VC	CIRC	
0404X			UNK	VC	CIRC	
0405X			UNK	VC	CIRC	
0406X			UNK	UNK	CIRC	
040DX			UNK	UNK	CIRC	
0501X	3.41	1.96	150	VC	CIRC	
0502X	3.05	1.52	150	VC	CIRC	
0503X	2.31	0.89	150	VC	CIRC	
0601X	2.06	0.21	150	VC	CIRC	
0602X	2.13	−0.25	150	VC	CIRC	
0603X	1.92	−0.37	150	VC	CIRC	
0604X	1.89		150	VC	CIRC	
0605X			175	VC	CIRC	
060PY			175	VC	CIRC	
0904X	0.4		200	VC	CIRC	
1001X	1.9		200	VC	CIRC	
1103X			OTHER	OTHER	CIRC	
1150X	4.77	2.32	675	CP	CIRC	
1151X	4.82	2.49	900	CP	CIRC	
1201X	4.95	2.96	150	VC	CIRC	
1202X	4.97	2.85	150	VC	CIRC	
1250X	4.86	3.17	600	CP	CIRC	
1251X	4.73	2.34	600	CP	CIRC	
1301X			200	VC	CIRC	*
1301X	2.5	1	300	VC	CIRC	*
1302X	1.97		UNK	UNK	CIRC	
1303X	2.07		150	VC	CIRC	
1304X			UNK	UNK	CIRC	
1305X	1.82		200	VC	CIRC	
1306Y	2		200	VC	CIRC	
130DX			UNK	UNK	CIRC	
130ZX			100	VC	CIRC	
131DX			UNK	UNK	CIRC	
132DY			200	VC	CIRC	
133DX			150	VC	CIRC	
134DX			150	VC	CIRC	
13ADX			200	VC	CIRC	
1401Y	4.53	1.8	150	VC	CIRC	*
1401X			UNK	UNK	CIRC	*
1401X	4.53	1.8	150	VC	CIRC	*
1402X	4.66	2.02	150	VC	CIRC	
1501X	2.38	1.1	150	VC	CIRC	
150DX			150	VC	CIRC	
151DX			UNK	VC	CIRC	
1601X	2.03	−0.48	200	VC	CIRC	
1602X	2.79		150	VC	CIRC	
1605X	2.32		150	VC	CIRC	
1901X	1.99		150	VC	CIRC	
1903X	2.33	1.54	150	VC	CIRC	
2001X	2.03	−0.26	200	VC	CIRC	
2002X	2.07	−0.18	150	VC	CIRC	
2003X			350	UNK	CIRC	
200DX			350	SI	CIRC	
2302X	2.08		150	VC	CIRC	
2303X	2.1	0.28	200	VC	CIRC	
231DX			200	VC	CIRC	
2401X	1.86		200	UNK	CIRC	
2901X	2.22	1.31	150	VC	CIRC	
3001X	2.27	1.41	150	VC	CIRC	
3002X	2.01	0.07	200	VC	CIRC	
3003X	2.13	0.29	200	VC	CIRC	
3004X			150	VC	CIRC	
3005X			100	VC	CIRC	
300DX			150	VC	CIRC	
301DX			150	VC	CIRC	
302DX			200	VC	CIRC	
303DX			150	VC	CIRC	
304DX			150	VC	CIRC	
3102X			100	VC	CIRC	
3103X			100	VC	CIRC	
3104X			100	VC	CIRC	
3105X			100	VC	CIRC	
3202X	5.73		150	ST	CIRC	
3203Y	5.75		100	VC	CIRC	*
3203X	5.75	4.8	150	ST	CIRC	*
3204X	5.87		150	ST	CIRC	
3301X	2.12	1.32	150	VC	CIRC	
3403X	2.05		200	VC	CIRC	
3404X			200	UNK	CIRC	
3406X	2.07	−0.15	200	VC	CIRC	
3407X			200	VC	CIRC	
3408X			UNK	UNK	CIRC	
3409X			UNK	UNK	CIRC	
3410X			UNK	UNK	CIRC	
3411X			UNK	UNK	CIRC	
3601X		−1.35	200	VC	CIRC	
3701X	3.28	1.68	200	VC	CIRC	
3703X			200	VC	CIRC	
4001X	2.25	1.25	150	VC	CIRC	
4003X	1.99	0.5	200	VC	CIRC	
4004X			UNK	UNK	CIRC	
4005X			UNK	UNK	CIRC	
4006X			UNK	UNK	CIRC	
4007X			UNK	UNK	CIRC	
4008X			UNK	UNK	CIRC	
4009X			UNK	UNK	CIRC	
400DX			200	VC	CIRC	
4010X			UNK	UNK	CIRC	
4011X			UNK	UNK	CIRC	
401DX			UNK	UNK	CIRC	
4101X	1.9	0.62	200	VC	CIRC	
4102X	2.21	1.25	200	CI	CIRC	
4103X			UNK	UNK	UNK	
4106X			100	VC	CIRC	
410AX			350	UNK	CIRC	
410DX			200	VC	CIRC	
411AX			250	UNK	CIRC	
4201X	6.11		150	ST	CIRC	*
4201X			UNK	UNK	CIRC	*
4401X	2.12	0.04	200	VC	CIRC	
4402X	2.29	0.09	200	VC	CIRC	
4403X	2.91	0.71	200	VC	CIRC	
4404X	1.72	0.38	150	VC	CIRC	
4405X	1.91		UNK	VC	CIRC	
441DX	0.35		200	VC	CIRC	
442DX	0.37		150	VC	CIRC	
443DX			UNK	UNK	CIRC	
4501X	1.08	−0.04	200	VC	CIRC	
5001X	2.33	1.49	150	VC	CIRC	
5101X			UNK	VC	UNK	
5102X			200	VC	CIRC	
5103X	1.4	0.51	150	VC	CIRC	
5104X			UNK	UNK	CIRC	
510DX			UNK	VC	UNK	
5201X	1.75		200	CI	CIRC	
5202X	1.82	1.19	200	CI	CIRC	
5203X			150	VC	CIRC	
5204X			UNK	UNK	CIRC	
5301X			225	VC	CIRC	
5302X			225	VC	CIRC	*
5302X			100	VC	CIRC	*
5303X			UNK	UNK	CIRC	
531DX			UNK	UNK	CIRC	
5401X	2.3	0.46	200	VC	CIRC	
5403X	2.14	1.03	150	VC	CIRC	
5408X			100	VC	CIRC	
5409X			100	VC	CIRC	
5410X			100	VC	CIRC	
5412X			UNK	UNK	CIRC	
5501X	2.03		150	UNK	CIRC	
5502X	2.19	1.3	150	UNK	CIRC	
5503X	2.21		150	UNK	CIRC	
5504X	2.4		150	UNK	CIRC	
5505X	2.37	0.68	150	UNK	CIRC	
5507X			150	UNK	CIRC	
6101X	2.02	1.34	150	VC	CIRC	
6102X	1.99	1.2	150	VC	CIRC	
6103Y	1.9	0.78	200	VC	CIRC	
6104X	1.4	0.82	150	VC	UNK	
6105X	1.4	0.76	150	VC	UNK	
6106X	1.4	0.57	150	VC	UNK	
6107X			UNK	UNK	CIRC	
610DX			UNK	VC	CIRC	
6201X	1.75	0.56	200	CI	CIRC	
6202X			UNK	UNK	UNK	
6203X			UNK	VC	CIRC	
6301X	2.36	1.56	150	VC	CIRC	*
6301X	1.97		200	CI	CIRC	*
6302X			225	VC	CIRC	*
6302X			UNK	UNK	UNK	*
6303X			UNK	UNK	UNK	
6304X			225	VC	CIRC	*
6304X			UNK	UNK	UNK	*
630DX			200	CI	CIRC	
6401X	2.16		150	VC	CIRC	*
6401X	2.01	1.34	200	CI	CIRC	*
6402X	2.16		150	VC	CIRC	*
6402X			UNK	UNK	CIRC	*
6403X			UNK	UNK	CIRC	

Node	Cover	Invert	Size	Material	Shape	
6405X	2	0.7	150	VC	CIRC	
6407X	2.34		150	VC	CIRC	
6408X			UNK	UNK	UNK	
640DX			UNK	UNK	CIRC	
6501X	2.58	0.36	150	UNK	CIRC	
6504X	2.51	0.08	150	UNK	CIRC	
7101X	1.98	1.27	150	VC	CIRC	
7102X	2.23	1.35	150	VC	CIRC	
7201X	1.84	0.24	200	VC	CIRC	
7202Y	1.81	0.51	200	VC	CIRC	
7203X	1.78		200	CI	CIRC	
7204X			UNK	VC	CIRC	
7205X			200	CI	CIRC	
7206X			UNK	VC	CIRC	
720DX			UNK	UNK	CIRC	
722DX			UNK	VC	CIRC	
723DX			200	CI	CIRC	
7301X			225	VC	CIRC	*
7301X			UNK	UNK	CIRC	*
7302X			225	VC	CIRC	
7401X			UNK	UNK	CIRC	*
7401X	3.11	0.74	150	VC	CIRC	*
7402X			UNK	UNK	CIRC	*
7402X	3.29	1.29	150	VC	CIRC	*
7403X	3.31	1.54	100	VC	CIRC	*
7403X			UNK	UNK	CIRC	*
7404X			UNK	UNK	CIRC	
7405X			UNK	UNK	CIRC	
7501X	2.11	0.3	150	UNK	CIRC	
7503X	2.02		150	UNK	CIRC	
7504X			150	UNK	CIRC	
7505X	1.88		150	UNK	CIRC	
7506X	2.01	0.28	125	CI	CIRC	
7507X	2.05	0.67	150	UNK	CIRC	
7508X	1.94		150	UNK	CIRC	
7509X	1.65		150	UNK	CIRC	
750PX			125	CI	CIRC	
7510X			UNK	UNK	CIRC	
7512X			150	UNK	CIRC	
7513X			UNK	UNK	CIRC	
7514X			UNK	UNK	CIRC	
7515X			UNK	UNK	CIRC	
7516X			UNK	UNK	CIRC	
751DX			UNK	VC	CIRC	
8201X	2.19	1.29	150	VC	CIRC	
8202X	2.33	1.29	150	VC	CIRC	
8203X	1.85	0.49	200	CI	CIRC	
8204Y	1.87		200	VC	CIRC	
8205Y			150	VC	CIRC	
8206X			350	UNK	CIRC	
8207X			150	VC	CIRC	
820DX			150	VC	CIRC	
820PX			250	UNK	CIRC	*
820PY			200	VC	CIRC	*
821DX			150	VC	CIRC	
822DX			UNK	UNK	CIRC	
823DX			UNK	UNK	UNK	
824DX			200	CI	CIRC	
8301Y			UNK	UNK	CIRC	
8302X			200	CI	CIRC	
8303X			UNK	UNK	CIRC	*
8303X	4.6	3.57	150	VC	CIRC	*
8304X			UNK	UNK	UNK	
8305X			UNK	UNK	UNK	
8306X			UNK	UNK	UNK	
830DX			UNK	UNK	CIRC	
831DX			UNK	UNK	UNK	
832DX			UNK	UNK	CIRC	
8401X	1.92	−0.52	150	VC	CIRC	*
8401X			UNK	UNK	CIRC	*
8402X			UNK	UNK	UNK	
8403X			UNK	UNK	UNK	
8404X			150	UNK	CIRC	
8405X			150	VC	CIRC	
8406X			150	VC	CIRC	
840DX			150	VC	CIRC	
8501X	2.23		150	UNK	CIRC	
8502X	2.3		UNK	UNK	UNK	
850ZX			125	CI	CIRC	
8615X	1.97	−0.91	150	UNK	CIRC	
8616X	2.1	0.73	150	UNK	CIRC	
9201X	2.28	1.29	150	VC	CIRC	
9202X	1.84	1.84	200	CI	CIRC	
9203X			UNK	VC	CIRC	
9204X			UNK	VC	CIRC	
9301X	1.81	0.56	200	VC	CIRC	
9302X			UNK	UNK	CIRC	
9303X			UNK	UNK	CIRC	
9304X			UNK	UNK	CIRC	
9305Y			150	VC	CIRC	*
9305X			UNK	UNK	UNK	*
9306X			UNK	UNK	UNK	
9307X			UNK	UNK	UNK	
9308X			UNK	UNK	UNK	
9309X			UNK	UNK	CIRC	
930DX			150	UNK	CIRC	
9310X			UNK	UNK	CIRC	
9312X			UNK	UNK	UNK	
931DX			150	UNK	CIRC	
932DX			150	UNK	CIRC	
933DX			UNK	UNK	CIRC	
934DY			UNK	UNK	CIRC	
93ADY			UNK	UNK	CIRC	*
93ADX			150	VC	CIRC	*
9401X	4.63	3.05	150	VC	CIRC	*
9401X			UNK	UNK	UNK	*
9402X			100	VC	CIRC	
9403X			100	VC	CIRC	
9501X	3.09	1.13	150	UNK	CIRC	
9503X	2.67	0.74	150	UNK	CIRC	
9504X			UNK	UNK	UNK	
9602X	2.07		150	UNK	CIRC	
9603X	2.27	0.33	150	UNK	CIRC	
9604X	2.1		150	UNK	CIRC	
9605X	2.06	0.34	150	UNK	CIRC	
960AX			125	CI	CIRC	
9610X			UNK	UNK	UNK	
9611X			150	UNK	CIRC	

Node	Cover	Invert	Size	Material	Shape

LINE STYLES / COLOURS

- Brown: Foul; Foul Syphon Sewer; Foul Vacuum Main; Foul Rising Main
- Red: Combined; Combined Syphon Sewer; Combined Rising Main; Lateral Drain
- Orange: Building Over Agreement Area
- Dark Blue: Treated Effluent
- Purple: Sludge; Sewer Catchment; Section 104 Area
- Light Blue: Surface Water; Surface Water Rising Main
- Yellow: Private
- Green: Access Shaft; Decommissioned

MATERIALS

AK Alkathene
BAC Bonded Asbestos Cement
BRC Brick (Common)
BRE Brick (Engineering)
CC Concrete Box Culvert
CI Cast Iron
CO Concrete (In-Situ)
CP Concrete (Pre-Cast)
CSB Concrete Segments (bolted)
CSU Concrete Segments (unbolted)
DI Ductile Iron
GRC Glass Reinforced Concrete
GRP Glass Reinforced Plastic
MAC Masonry in regular Courses
MAR Masonry in random Courses
PE Polyethylene
PF Pitch Fibre
PP Polypropylene
PVC Polyvinyl Chloride
RPM Reinforced Plastic Matrix
SI Spun Iron
ST Steel
VC Vitrified Clay
XXX Other
ZZZ Unknown

WARNING: BAC pipes are constructed of Bonded Asbestos Cement

LEGEND - SEWERS

Manhole (SW); Manhole (F&C); Lamp hole (SW); Lamp hole (F&C); Pumping Station (SW); Pumping Station (F&C); Side entry manhole (SW); Side entry Manhole (F&C); Blind shaft (SW); Blind shaft (F&C); Ejector station (SW); Ejector station (F&C); Watertight door (SW); Watertight door (F&C); Flushing ch. Mn-e (SW); Flushing ch. Mn-e (F&C); Flushing ch. No-e (SW); Flushing ch. No-e (F&C); Demarcation Chamber

Washout (SW); Washout (F&C); Rodding Eye (SW); Rodding Eye (F&C); Gauging point (SW); Gauging point (F&C); Intercept chamber (SW); Intercept chamber (F&C); Storm Tank (SW); Storm Tank (F&C); Vortex chamber (SW); Vortex chamber (F&C); Label ellipse; Dummy/S24 manhole; Outfall; Penstock chamber; Damboards; Storm Overflow; Backdrop manhole

Other (s); Other; Change in sewer (s); Change in sewer; Reflux valve; Flap valve; Cascade; Anode; Valve; Closed Valve; Air Valve; Hatch box (SW); Hatch box (F&C); Direction arrow; Emptying valve; Catchpit; Soakaway; Inlet; Balancing Pond

Wastewater treatment works; Marine treatment works; Outfall headworks; Vent; Vent column; Tidal storage tank; Blank end; Head of Public Sewer; Micro Pumping Station

SHAPES (S)

A Arched; B Barrel; C Circular; E Egg; H Horseshoe; R Rectangular; S Square; T Trapezoidal; U U Shape; X Other

NODE REFERENCING SYSTEM

1st digit: hundred metre easting identifier
2nd digit: hundred metre northing identifier
3rd digit: sewer type identifier 0-4 = Foul/Combined 5-9 = Surface Water
4th digit: next sequential node

WARNING: Unknown (UNK) materials may include Bonded Asbestos Cement

O.S. Ref.	TQ2004SW	Drawn by:	kumaria
Scale:	1:2500	Date:	17/02/2016

Title: 210503_1 Millennium Close, Sho

N

Southern Water

The information contained on this plan is provided as a guide to the approximate position of existing public sewers. The accuracy thereof cannot be guaranteed.

THIS INFORMATION MUST BE TREATED WITH CAUTION AND THE ACTUAL POSITION OF THE PUBLIC SEWERS MUST BE ESTABLISHED ON SITE, IN ALL CASES.

Southern Water must be informed before lifting manhole covers or excavating trial holes.

103439

519061

521198

SEWER RECORDS

Southern Water

Tully De'Ath Consultants
Sheridan House
Hartfield Road
Forest Row
East Sussex
RH18 5EA

Developer Services
Southern Water
Sparrowgrove House
Sparrowgrove
Otterbourne
Hampshire
SO21 2SW

Tel: **0330 303 0119**
Email: ***developerservices@southernwater.co.uk***

Your Ref:

Our Ref:
CC-SUSS-00371

Date:
7th July 2016

F.A.O: Andrew Picton

Site: New Salts Farm, Shoreham-by-Sea, West Sussex

Dear Sirs,

Further to your recent application for a level 2 enquiry regarding the above development site.

FOUL WATER

Please find enclosed the report which details the extent of works required in order for your proposed development site to be accommodated within the local sewerage infrastructure. It should be noted that the report is only a hydraulic solution to provide capacity for the proposed development site. There are other options available to you/ your client in discharging your proposed flows from the site such as making a connection application/requisition to a sewer at a point where capacity is currently available. Section 98 of the Water Industry Act 1991 provides a legal mechanism through which the appropriate infrastructure can be requested (by the developer) and provided to drain a specific location.

As you are aware the owner or occupier of the premises or private sewer or drain must give the sewerage undertaker notice of the proposed works. Upon receipt of the notice the undertaker may, within 21 days, refuse to allow him to make the connection if it considers that the mode of construction or the condition of the connecting sewer or drain either does not satisfy the standards reasonably required by the undertaker, or is such that the making of the communication would be prejudicial to its sewerage system.

The right of refusal is limited to these criteria alone and the undertaker cannot refuse to allow the connection on the grounds that the sewerage system is inadequate to take the extra liquid that the connection will discharge into it. This is a matter that should be dealt with at the planning stage.

Yours faithfully

Developer Services

Please note: - The information provided above does not grant approval for any designs /drawings submitted for the capacity analysis. The results **are an** indicative hydraulic assessment and should not be used as a basis for design. The results quoted above are only valid for 12 months from **the date** of issue of this letter.

Southern Water

INFRASTRUCTURE ASSESSMENT FOR FOUL DRAINAGE AT

NEW SALTS FARM,

NEW SALTS FARM ROAD,

SHOREHAM-BY-SEA,

WEST SUSSEX

BN43 5FE

7th July 2016

REQUESTED:
TULLY DE'ATH CONSULTANTS

Infrastructure Assessment for Foul Drainage at New Salts Farm

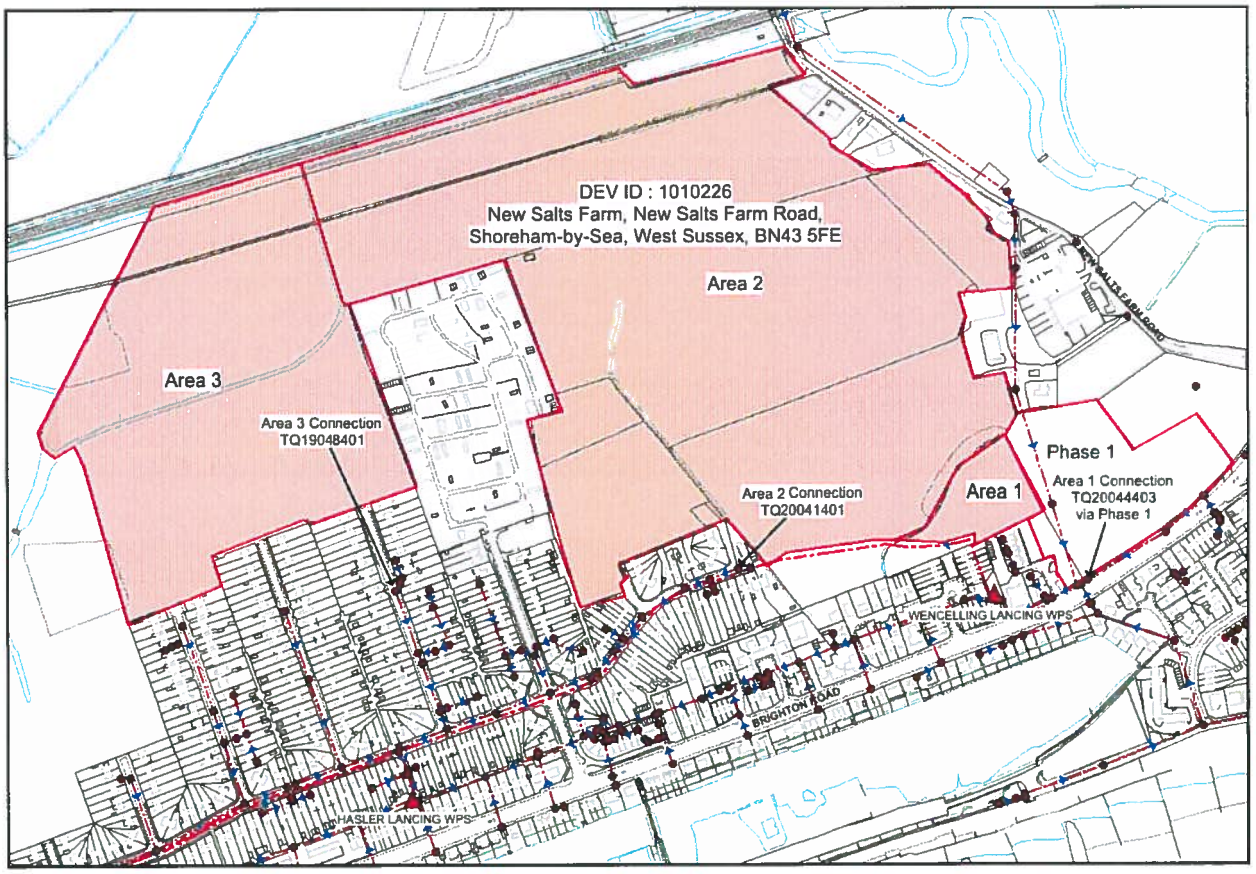
---

I. Development Details:

No preferred discharge manholes were specified in the application. The Development has been subdivided into three areas to allow discharge to local manholes as shown in Figure 1 below.

- Area 1 to discharge to Manhole TQ00044403 on Brighton road via the Phase 1 Development (see CC-SUSS-00372).
- Area 2 to discharge to Manhole TQ20041401 on Orient Road.
- Area 3 to discharge to Manhole TQ19048401 on Bristol Avenue.

Figure 1 - Proposed Development



II. Results and Conclusions:

Foul Water:

There is currently inadequate capacity within the local foul sewerage network to accommodate the foul flow from the proposed development site at MHs TQ20044403, TQ20041401 and TQ19048401. The proposed development would increase flows to the local network and as a result existing properties and land may be subject to a greater risk of flooding. Additional off-site sewers or improvements to existing sewers will be required to provide sufficient capacity to service the proposed development as indicated in Figure 2 and Table 2 below, in addition to those indicated in the Phase 1 Development response (see CC-SUSS-00372).

Figure 2 - Proposed Improvement – Foul system

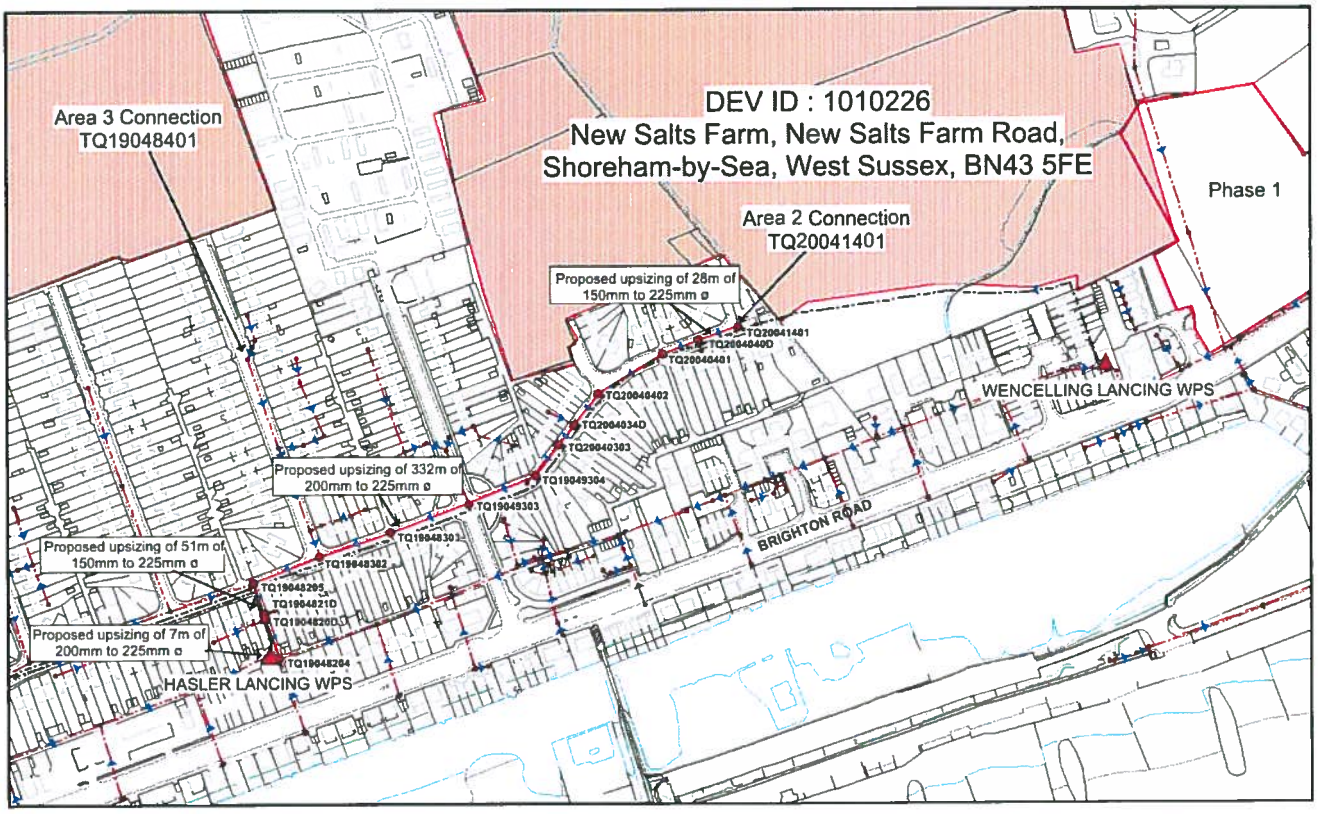


Table 2 Proposed Improvements Schedule

Manhole	Manhole	Sewer Diameter (mm)		Av. Depth (m)	Length (m)
		Existing	Proposed		
TQ20044403	TQ2004441D	200	225*	2.6	8
TQ2004441D	TQ20044402	200	225*	2.3	4
TQ20044402	TQ20044401	200	225*	2.2	25
TQ20041401	TQ2004040D	150	225	1.2	28
TQ2004040D	TQ20040401	200	225	1.2	25
TQ20040401	TQ20040402	200	225	1.2	48
TQ20040402	TQ2004034D	200	225	1.2	26
TQ2004034D	TQ20040303	200	225	1.2	15
TQ20040303	TQ19049304	200	225	1.2	25
TQ19049304	TQ19049303	200	225	1.2	46
TQ19049303	TQ19048303	200	225	1.3	53
TQ19048303	TQ19048302	200	225	1.5	48
TQ19048302	TQ19048205	200	225	1.6	46
TQ19048205	TQ1904821D	150	225	1.7	20

TQ1904821D	TQ1904820D	150	225	1.7	4
TQ1904820D	TQ19048204	150	225	2.0	27
TQ19048204	TQ1904820P	200	225	2.3	7
				Total	455

*Upsizing required for Phase 1 Development (see CC-SUSS-00372)

Surface Water System:

As a surface water capacity check has not been requested it is assumed that all Surface Water will be disposed of by alternative means i.e. Soakaway or any local drainage watercourses, subject to all interested parties approval.

Before any connections are made, an application form needs to be completed and approved by Southern Water Services.

Please note: - The information provided above does not grant approval for any designs /drawings submitted for the capacity analysis. The results are an indicative hydraulic assessment and should not be used as a basis for design. The results quoted above are only valid for 12 months from the date of issue of this letter.

Appendix D – Ground Monitoring Results

Our Ref: AH/BC/J12495

24 February 2016

Southern Testing
Environmental & Geotechnical

Keeble House, Stuart Way
East Grinstead, West Sussex RH19 4QA

t 01342 333100 f 01342 410321
e info@southerntesting.co.uk w southerntesting.co.uk

Hyde Housing
c/o Tully De'Ath Consultants
Sheridan House
Hartfield Road
Forest Row
East Sussex - RH18 5EA

For the attention of Mr Andrew Picton

Dear Sirs,

Re: Groundwater Monitoring Investigation at: New Salts Farm, Shoreham
National Grid Reference: TQ 204 045
Geology: Alluvium/Marine Deposits over Newhaven Chalk

Introduction

The site comprises a grass covered rural plot, and it is proposed to develop the site with housing.

A ground investigation has been undertaken for the proposed development (our ref: J12495) to which the reader is referred. The investigation included the installation of groundwater monitoring wells and dataloggers (instruments used to automatically measure groundwater level), in 3 No. boreholes (WLS4 to 6).

It was also requested that groundwater monitoring wells be installed in the grass covered area to the north and northwest of the proposed development plot (WLS1 to 3), to determine the groundwater regime for this area. During the drilling of the first borehole in this area (WLS 1), the ground conditions were found to comprise running sands, and unfortunately, due to these ground conditions, and having to allow for the borehole to be scanned for UXO, and redrilled, the drilling equipment became 'locked' together, and the installation of groundwater monitoring wells at these positions were not completed.

We returned to site on 10th February to install 3 No. drive-in (hand driven) monitoring wells. These monitoring wells have a narrower diameter than the dataloggers, so the depth to groundwater was manually measured over the course of a day, to determine if the groundwater is influence by the tide.

Presented here are the results thus far from the dataloggers installed in WLS 4 to 6, and the results from a day's monitoring of WLS1 to 3.

Findings

A graph (fig 2) has been produced showing the results of the day's monitoring carried out on WLS1 to 3. It can be clearly seen that groundwater level in both WLS2 and 3 are influenced by the tide. The groundwater level in WLS 1 shows little fluctuation, and is therefore shown to have negligible tidal influence.

The time of high tide at Shoreham-by-Sea Harbour has been shown on the graph. There is a clear time lag between high tide and the peak groundwater level in WLS2 and 3. An approximate time lag of +131min and +163min has been calculated for WLS3 and WLS2 respectively.

It is unclear at this stage why there is no apparent tidal influence at WS1, but this may be due to lower permeability geology.

Graphs (fig 3, 4 and 5) have also been included showing the groundwater level between mid December 2015 and mid February 2016 for WLS 4, 5 and 6. The groundwater level in these trial holes can also be seen to have a tidal influence. From these graphs, the groundwater levels at high tide for WLS 4 and 6 generally fluctuates between around 0.4m and 1.0m below ground level. The groundwater level at high tide in WLS 5 consistently rose above ground level, indicating that groundwater is periodically artesian.

Groundwater during low tide is generally between 1.7m and 2.4m below ground level in WLS 4 and 6, and 1.2m and 1.5m in WLS5.

A graph (fig 6) has also been included that shows the groundwater levels for WLS 4, 5 and 6 over the course of a single day, and the time of high tide at Shoreham-By-Sea Harbour. The time lag between the high tide and the high groundwater in the boreholes is approximately +111min, +106min and +101min for WLS 4, 5 and 6 respectively.

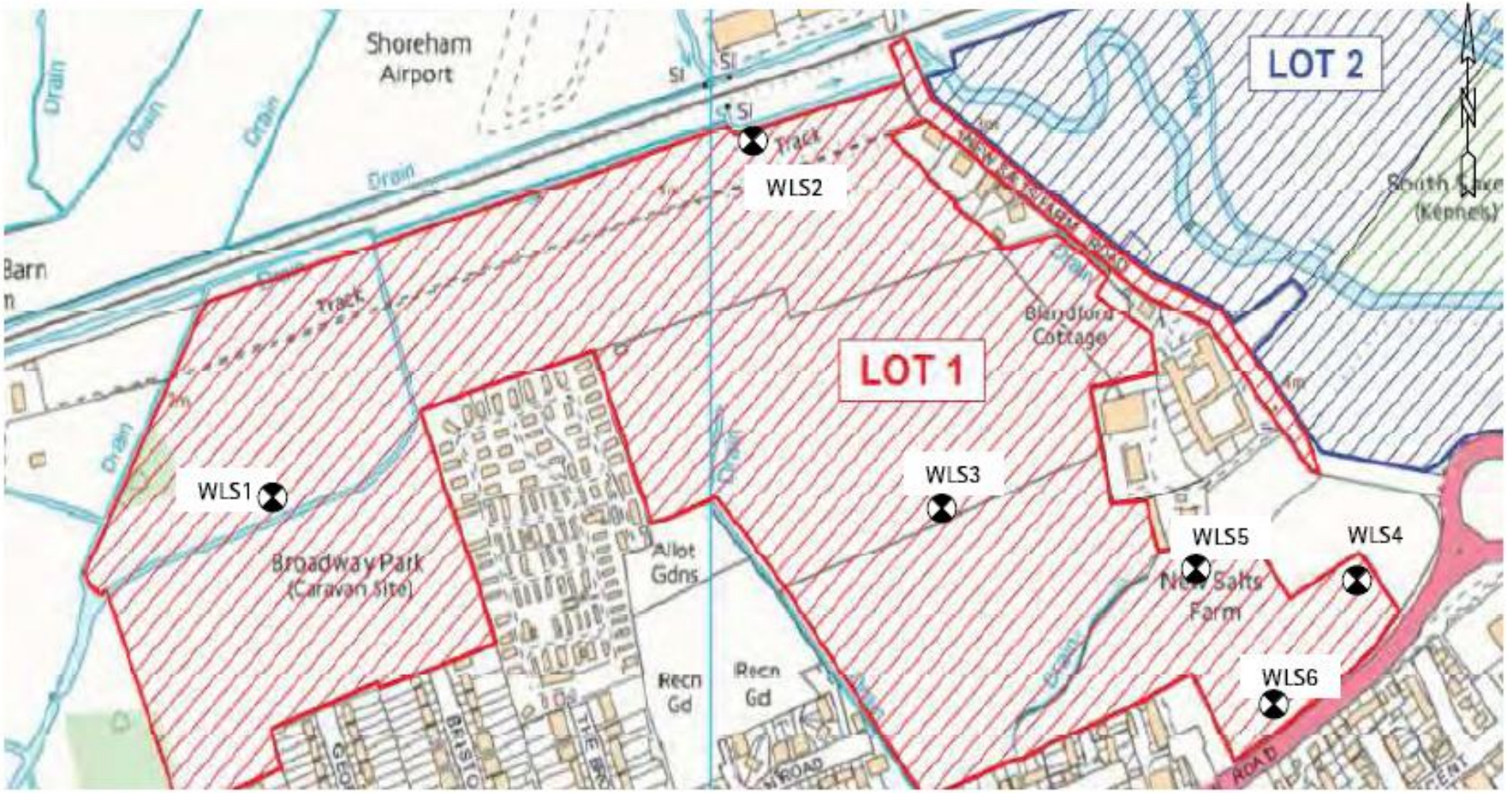
Based on these findings, the ground around WLS5 should be periodically flooded. We have not witnessed, neither are we aware that this area routinely floods, which could be the result of the impermeable clay layer that covers the site preventing the groundwater from rising to the surface. There is therefore, a risk that any development that penetrates this clay 'cap' could form a pathway for groundwater, and thus could instigate flooding.

The influence of storm surges or high spring tides has not been investigated. It is possible that higher groundwater levels than that measured in this investigation, may become evident under certain climatic or tidal conditions.

We hope that the information is useful. Should you require any further information, please do not hesitate to contact us.

Yours faithfully,

Andrew Holley MSc FGS
Senior Geological Engineer
For and on behalf of
Southern Testing Laboratories Limited



NB: Positions of Boreholes and/or Trial Pits are only indicative unless dimensioned

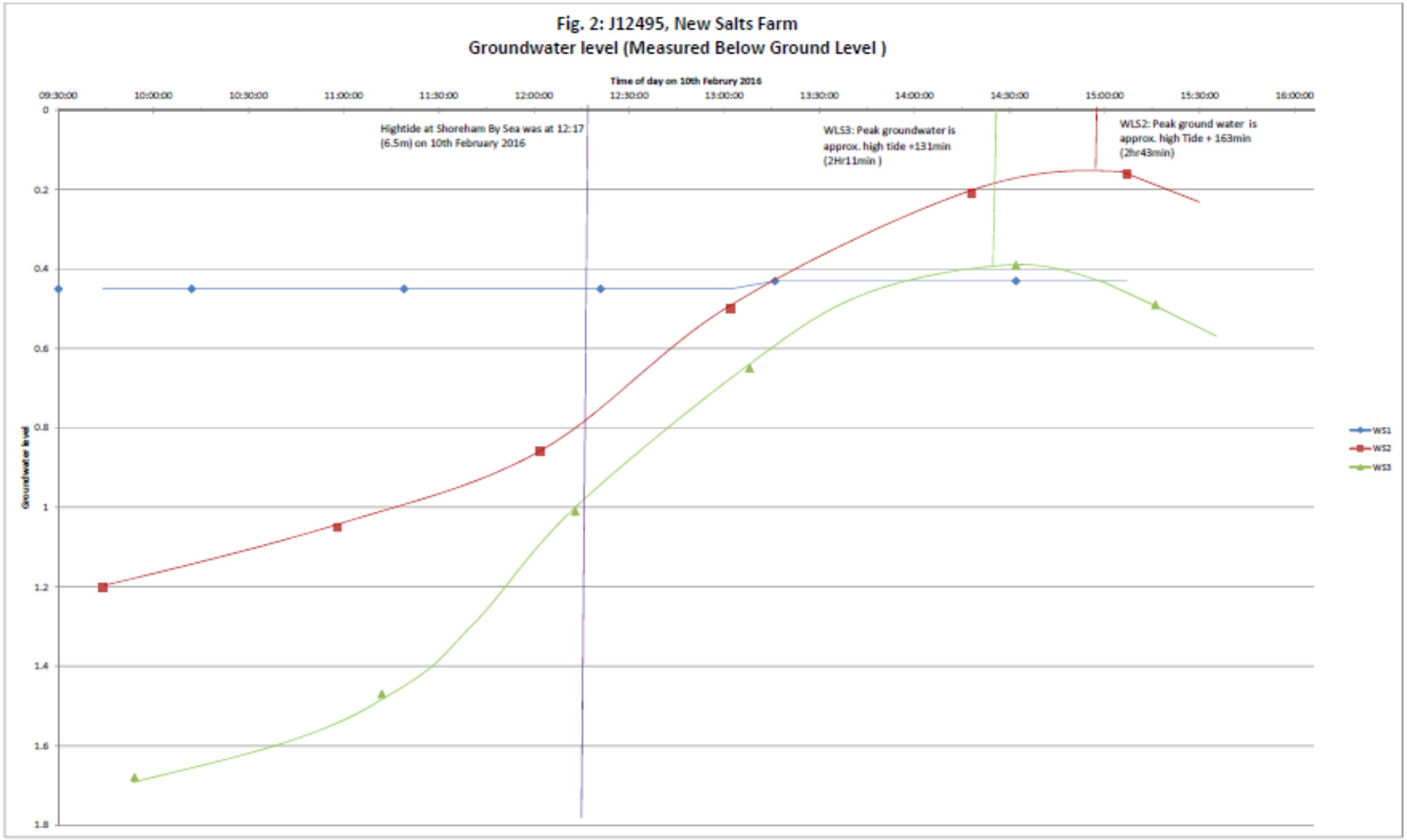
Site: New Salts Farm, Shoreham-By-Sea	STL: J12495	Fig No: 1
Date: 12 February 2016	Trial Hole Location Plan	

Southern Testing

Southern Testing: Keeble House, Stuart Way, East Grinstead, West Sussex RH19 4QA
ST Consult: Twigden Barns, Brixworth Road, Creaton, Northampton NN6 8NN

ST Consult

Fig. 2: J12495, New Salts Farm
Groundwater level (Measured Below Ground Level)



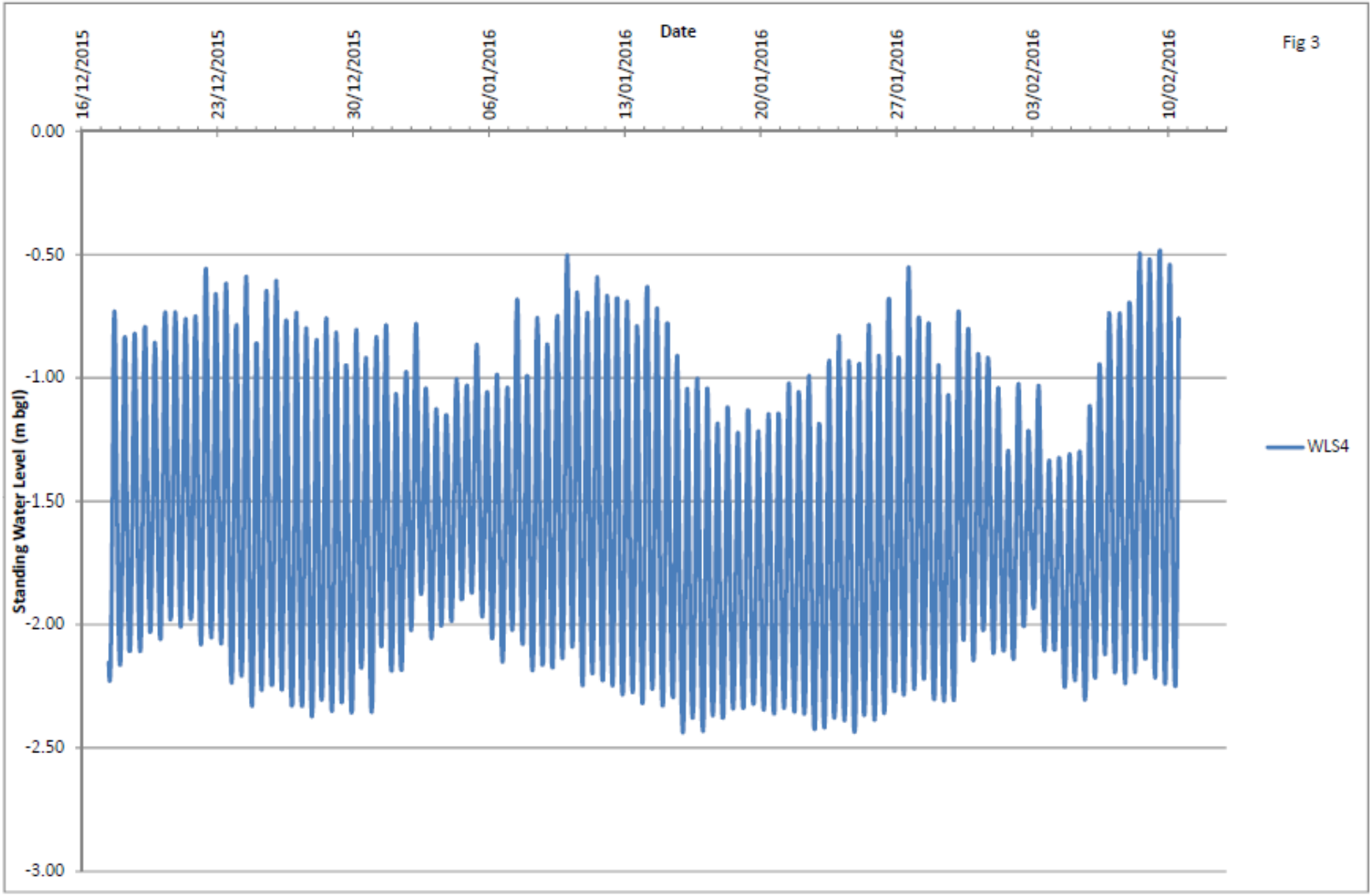

Date
16/12/2015
23/12/2015
30/12/2015
06/01/2016
13/01/2016
20/01/2016
27/01/2016
03/02/2016
10/02/2016
Standing Water Level (m bgl)
0.00
-0.50
-1.00
-1.50
-2.00
-2.50
-3.00
WLS4

Fig 3

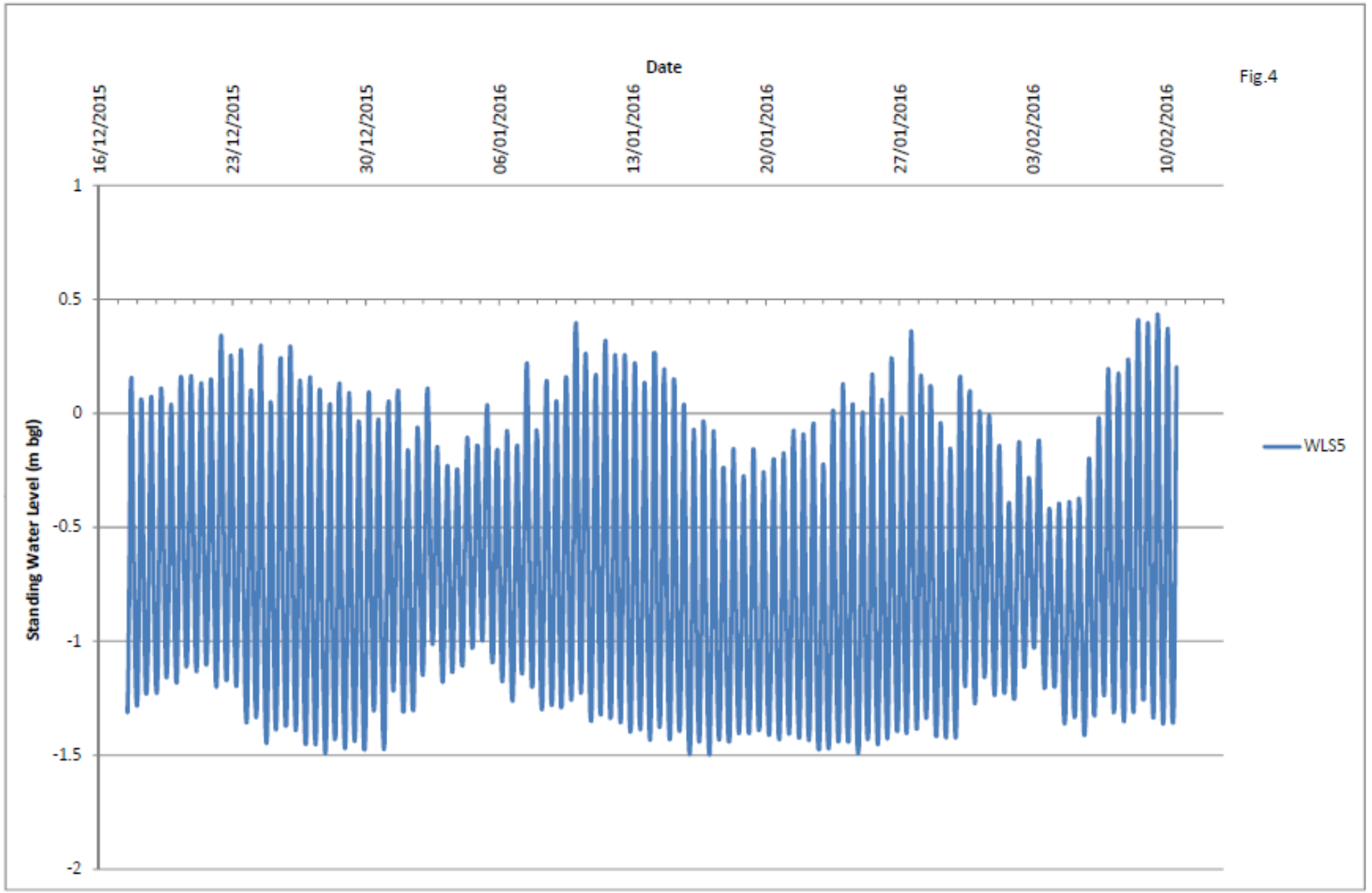
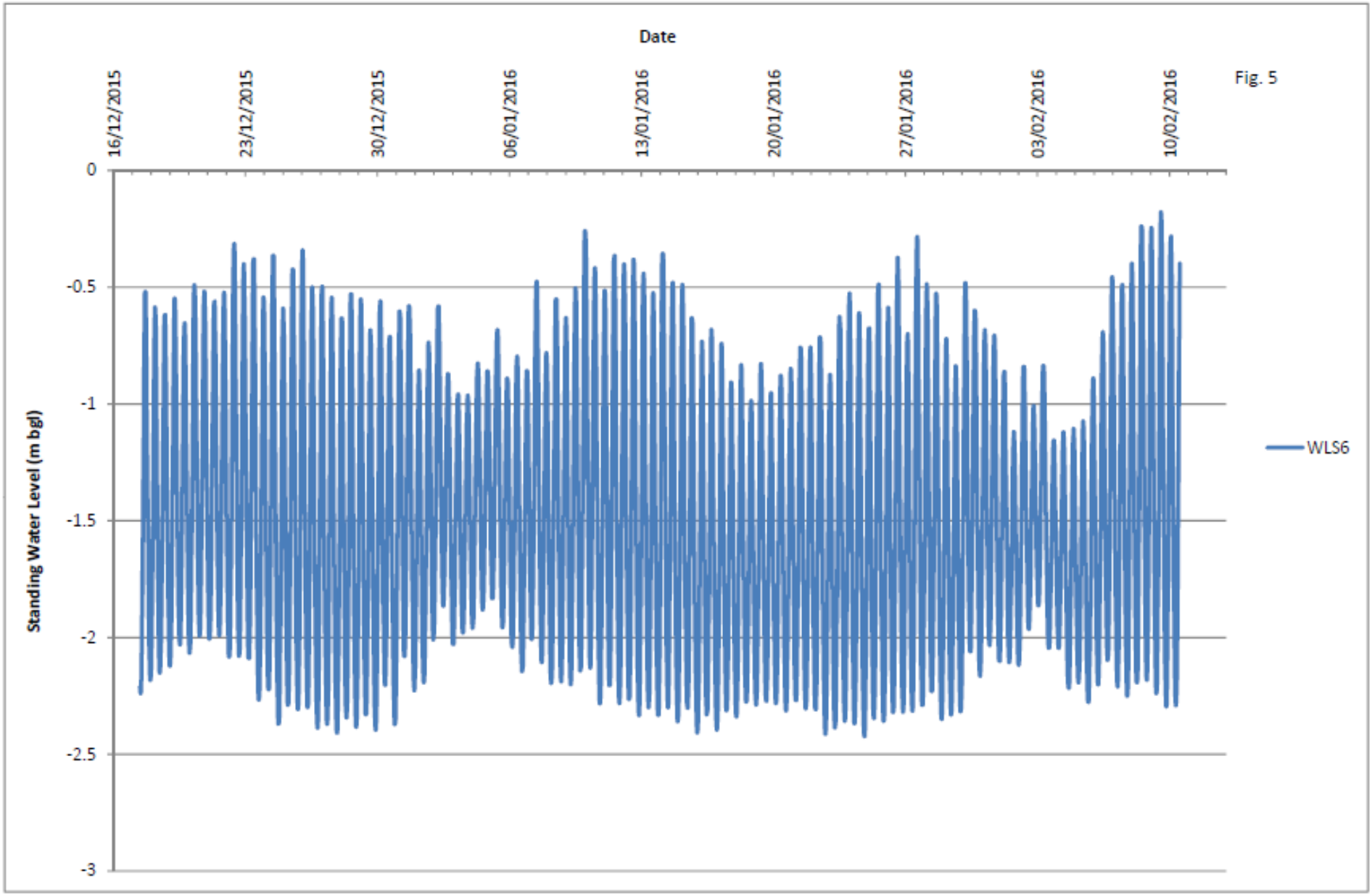

Date
16/12/2015
23/12/2015
30/12/2015
06/01/2016
13/01/2016
20/01/2016
27/01/2016
03/02/2016
10/02/2016
Standing Water Level (m bgl)
1
0.5
0
-0.5
-1
-1.5
-2
WLS5

Fig.4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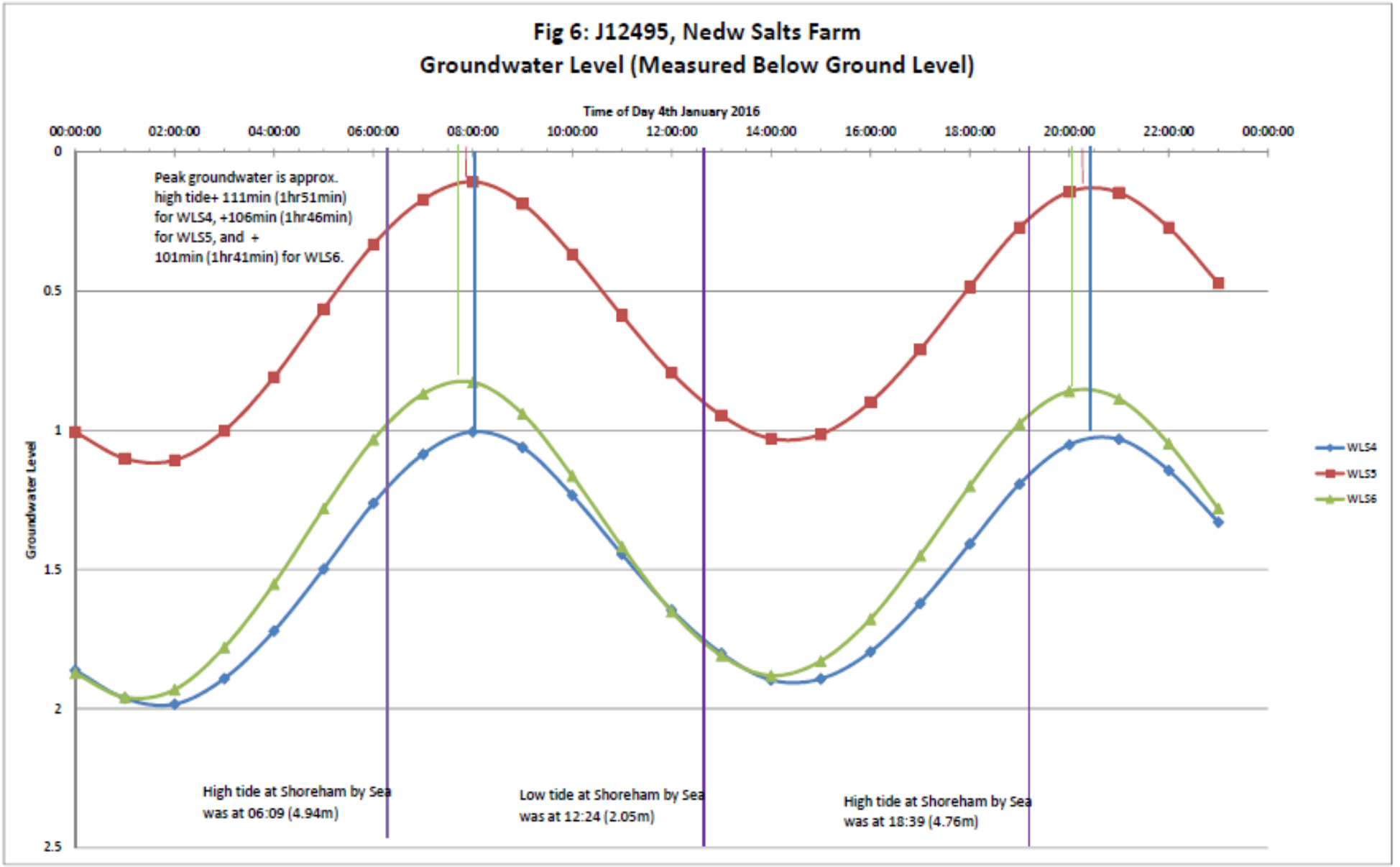
27/01/2016
03/02/2016
10/02/2016
Standing Water Level (m bgl)
0
-0.5
-1
-1.5
-2
-2.5
-3
WLS6

Fig. 5

Fig 6: J12495, Nedw Salts Farm
Groundwater Level (Measured Below Ground Level)



Southern Testing ST Consult

Project Name:	New Salt Farm	**Project ID:**	J12765
Location:	Shoreham-By-Sea	**Engineer:**	AH
Client:	Hyde Housing	**Scale:**	1:5000

Site Plan

Legend Key

Boreholes - Boreholes

Our Ref: AH/J12765

29 September 2016

Southern Testing
Environmental & Geotechnical

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e info@southerntesting.co.uk w southerntesting.co.uk

Tully De'Ath Consultants
Sheridan House
Hartfield Road
Forest Row
East Sussex - RH18 5EA

For the attention of Mr Andrew Picton

Dear Sirs,

Re: Geotechnical and Groundwater Monitoring Investigation at: New Salts Farm, Shoreham
National Grid Reference: TQ 204 045
Geology: Alluvium/Marine Deposits over Newhaven Chalk

Introduction

The site has been subject to several phases of ground investigation, and additional work has been requested to determine the groundwater regime on parts of the site, that have not previously been investigated.

Presented here are the logs of the recently drilled boreholes, a borehole location plan, and the results of all the groundwater monitoring that has been carried out since June 2016. The results for January to June 2016 have already been provided.

Scope

The site investigation was conducted and this report has been prepared for the sole internal use and reliance of Hyde Housing and their appointed Engineers. This report shall not be relied upon or transferred to any other parties without the express written authorization of Southern Testing Laboratories Ltd. If an unauthorised third party comes into possession of this report they rely on it at their peril and the authors owe them no duty of care and skill.

Fieldwork

During previous phases of investigation, 3 No. groundwater monitoring wells (WLS 4, 5 and 6) were installed in boreholes drilled in the south-eastern part of the site, and 3 No. monitoring wells were also positioned in a ditch that pass through the site (D 1, 2 and 3). Dataloggers were installed in each of these groundwater/ ditch water level monitoring wells to facilitate the automatic measuring of the water level at regular intervals.

Three further drive-in peizometers wells were also installed (WLS1, 2 and 3). These monitoring wells are measured manually.

During the course of this supplementary ground investigation, an additional 5 No. groundwater monitoring wells (WLS107 to WLS111) were installed. The boreholes were cased to support the sides, and drilled using

a windowless drilling rig. A UXO engineer was in attendance during the fieldwork, and scanned the borehole positions with a magnetometer at ground level, and at a depth of 1m bgl

Findings

The borehole logs and the results of the groundwater monitoring carried out thus far have been attached to this letter. Groundwater monitoring is scheduled to continue for the next 6 months.

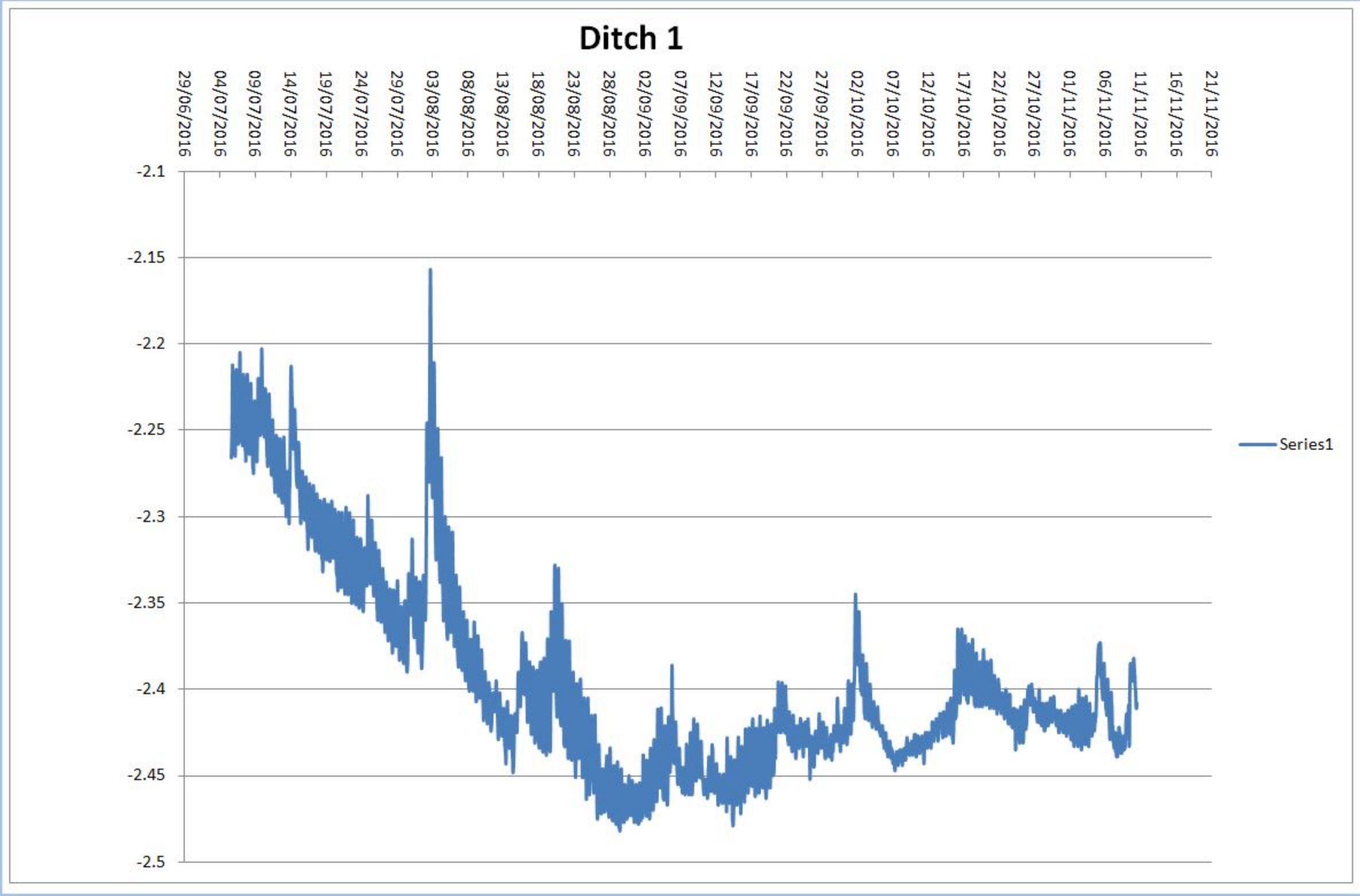
The monitoring well at D2 has been removed (by an unknown person) and all the data has been lost. The drive-in peizometer at WLS1 has also been lost in the undergrowth.

The dataloggers in WLS4 and 6 have both been damaged, possibly caused by the saline groundwater condition, and some data has been lost. These dataloggers have been replaced.

We hope that the attached information if of assistance.

Yours faithfully,

Andrew Holley MSc FGS
Senior Geological Engineer
For and on behalf of
Southern Testing Laboratories Limited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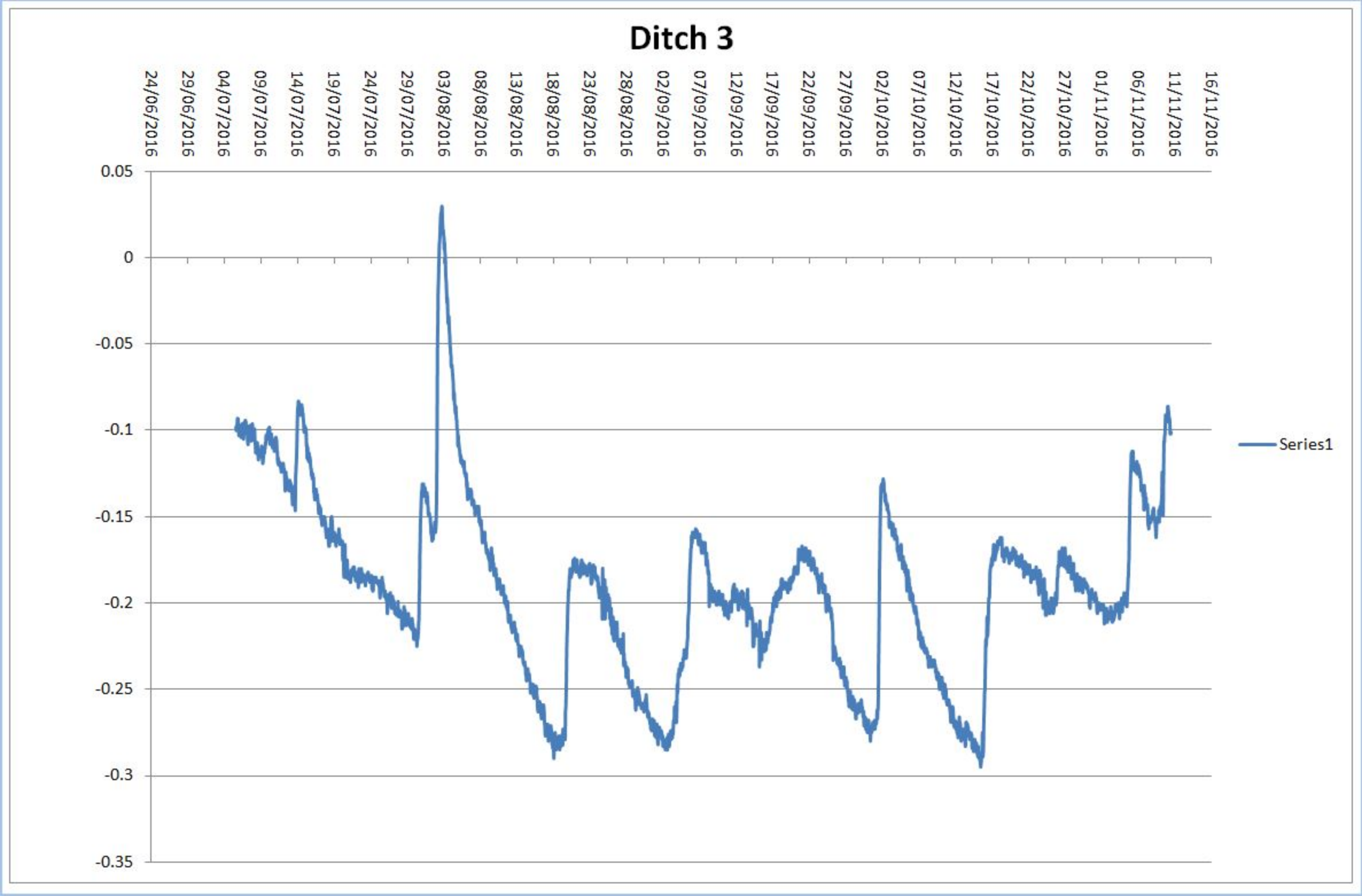
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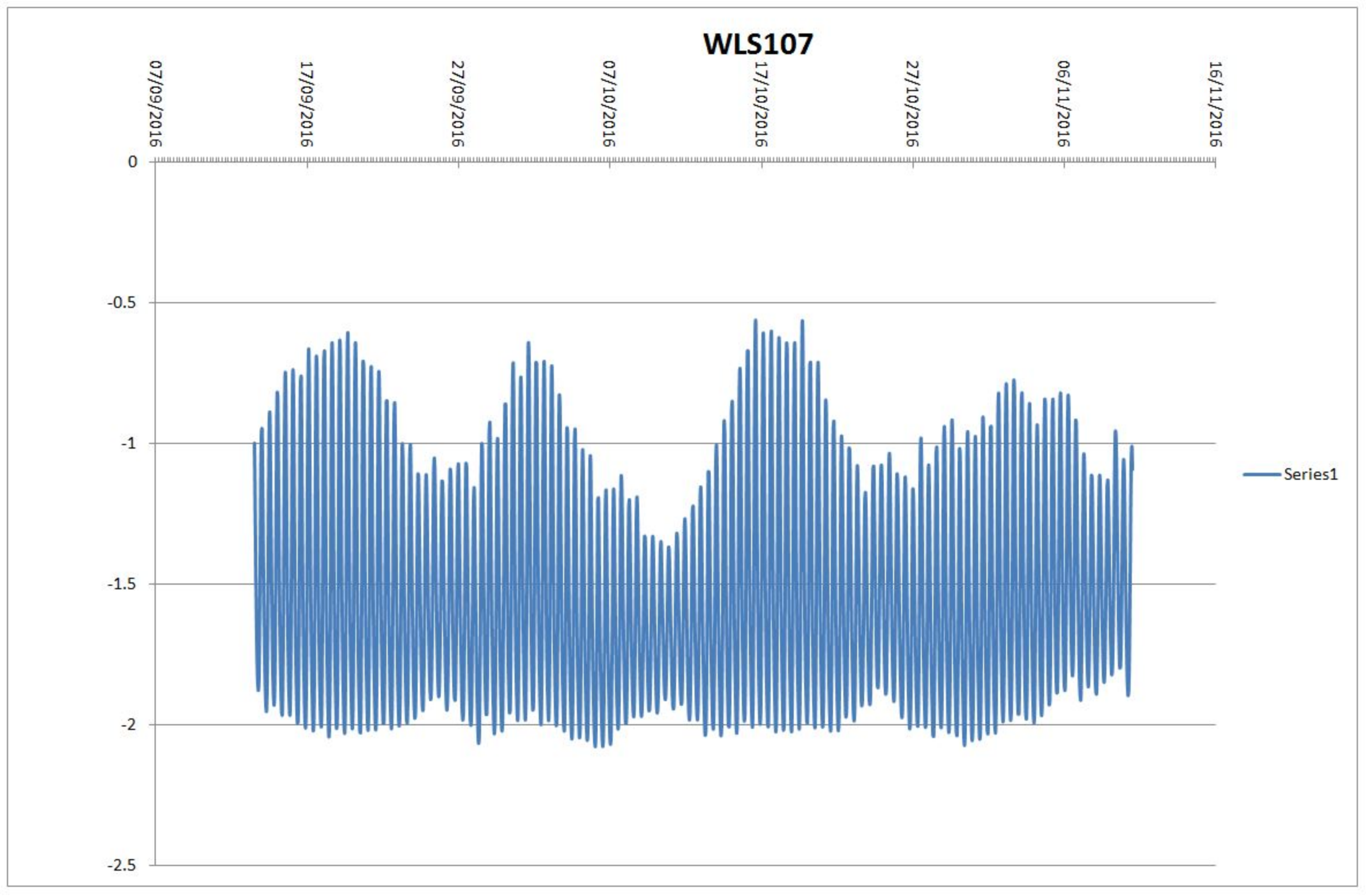
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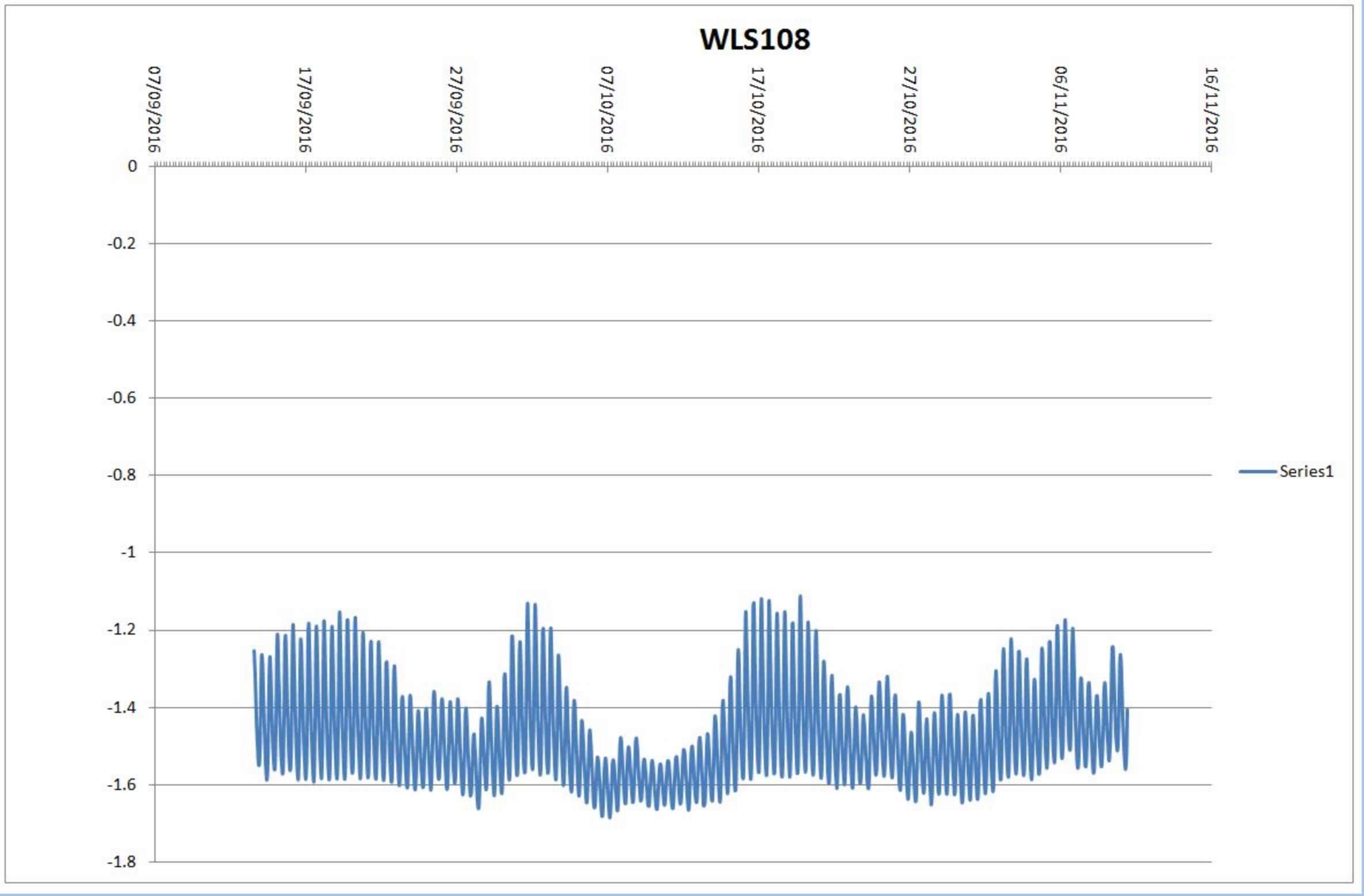
Series1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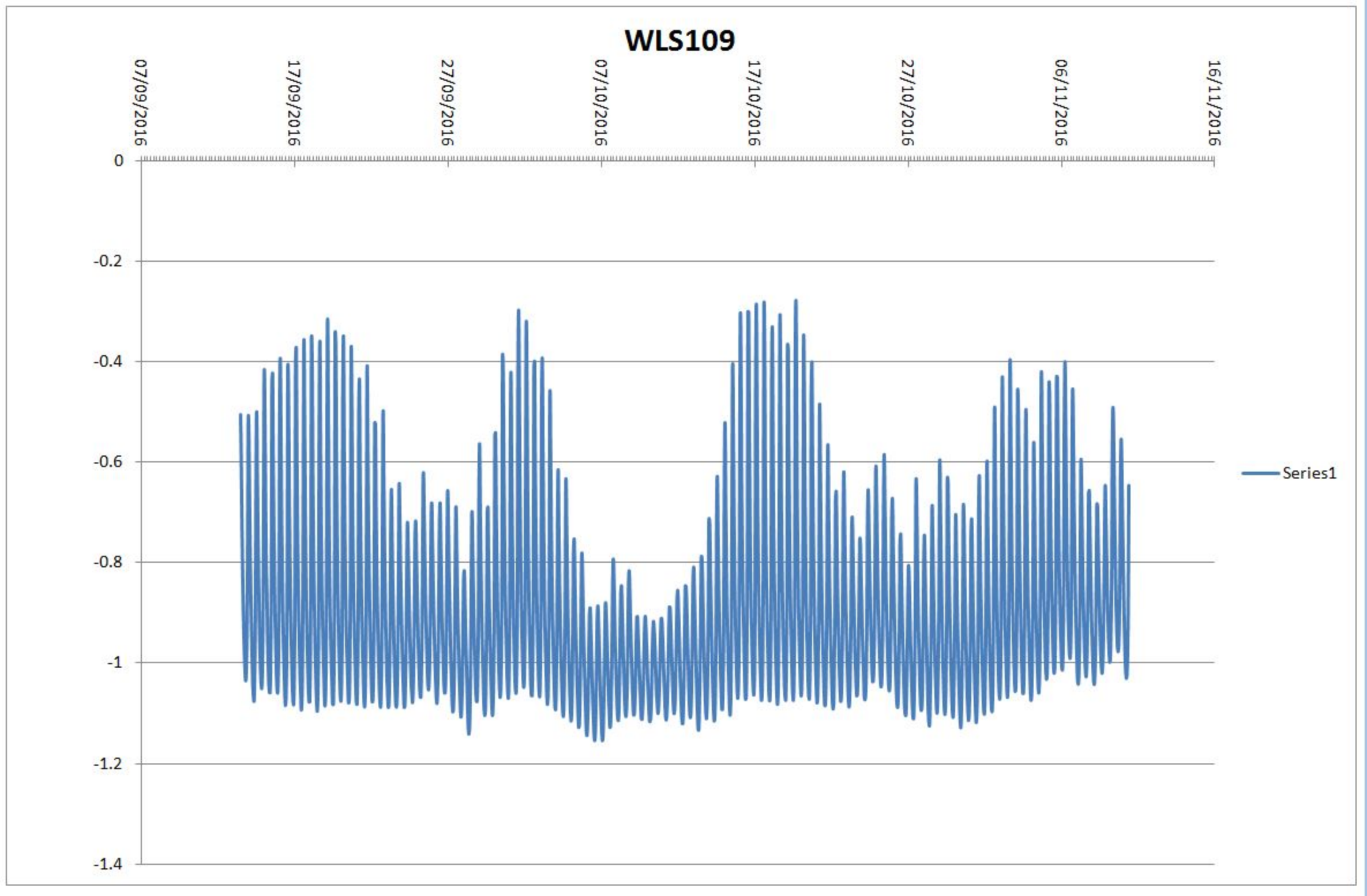
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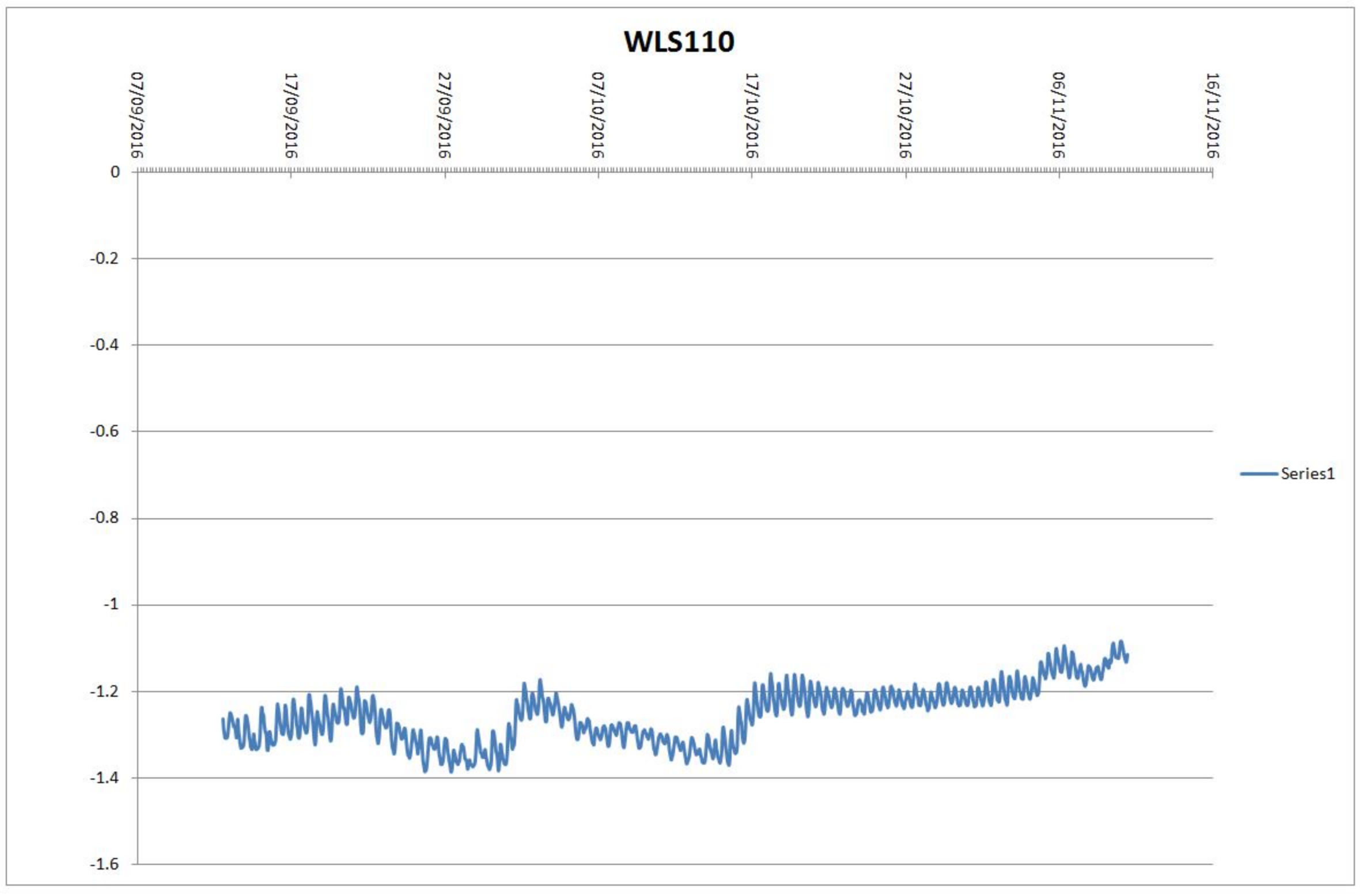
Series1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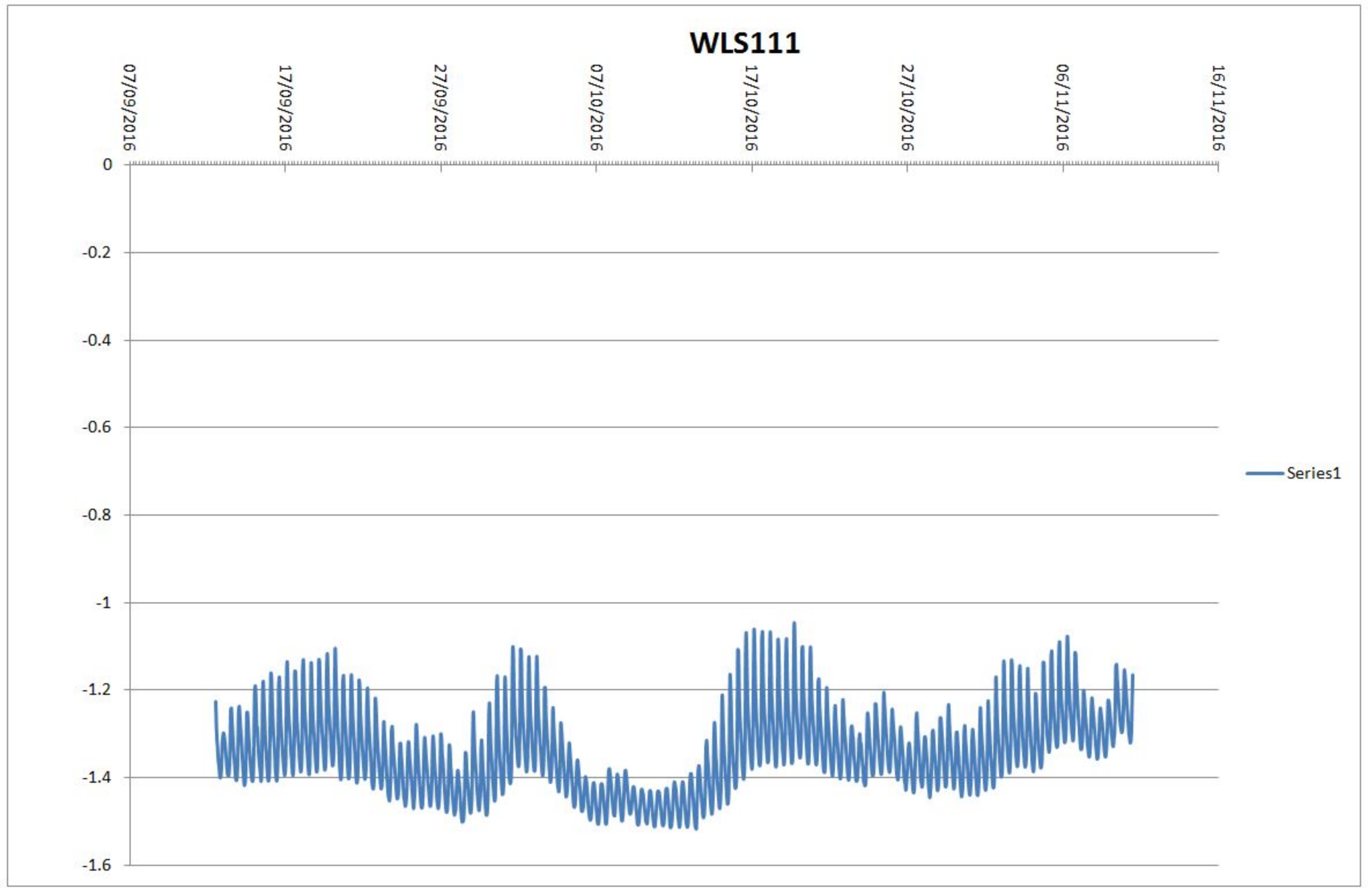
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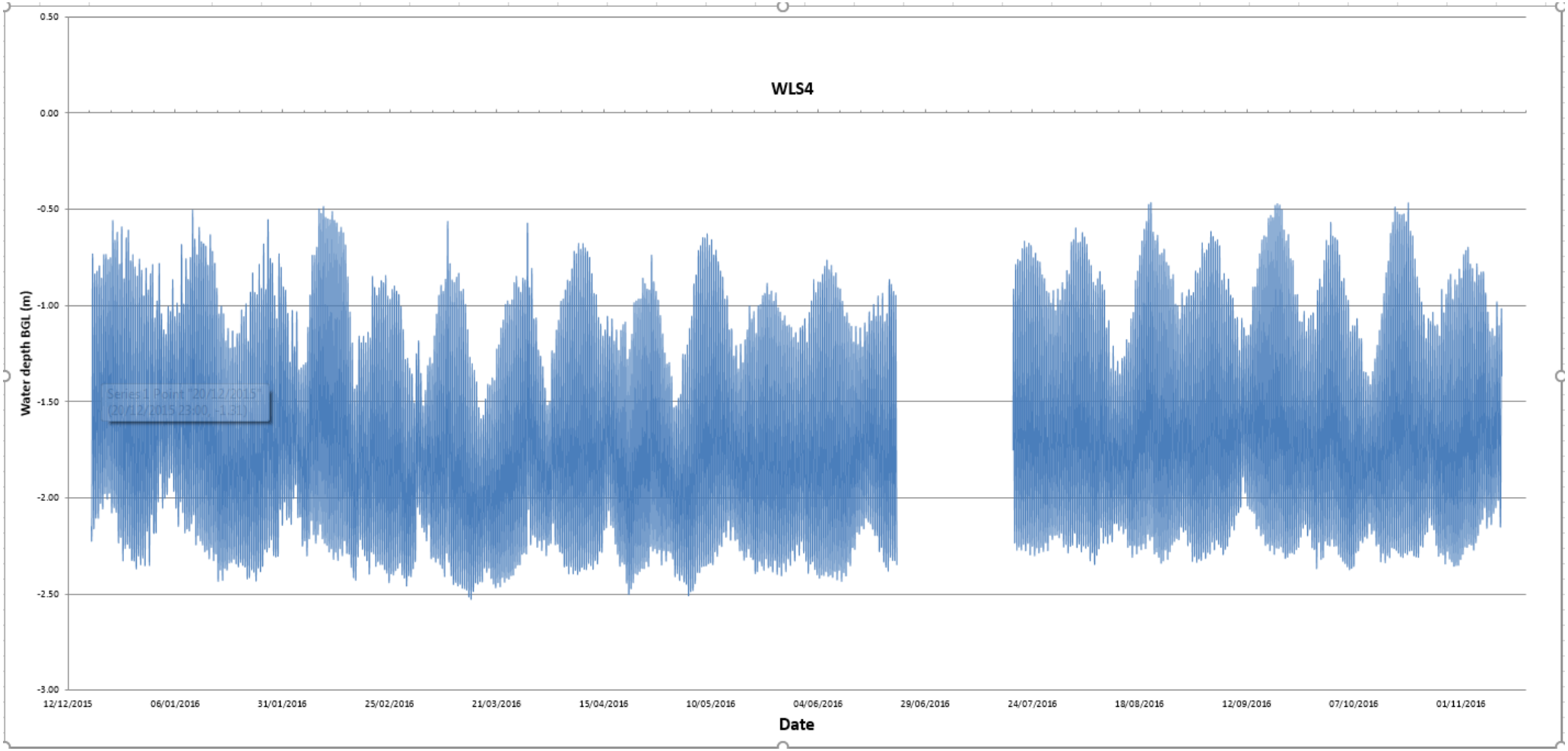
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-1.00
-1.50
-2.00
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-3.00
Series1 Point "20/12/2015" (20/12/2015 23:00, -1.30)
12/12/2015
06/01/2016
31/01/2016
25/02/2016
21/03/2016
15/04/2016
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24/07/2016
18/08/2016
12/09/2016
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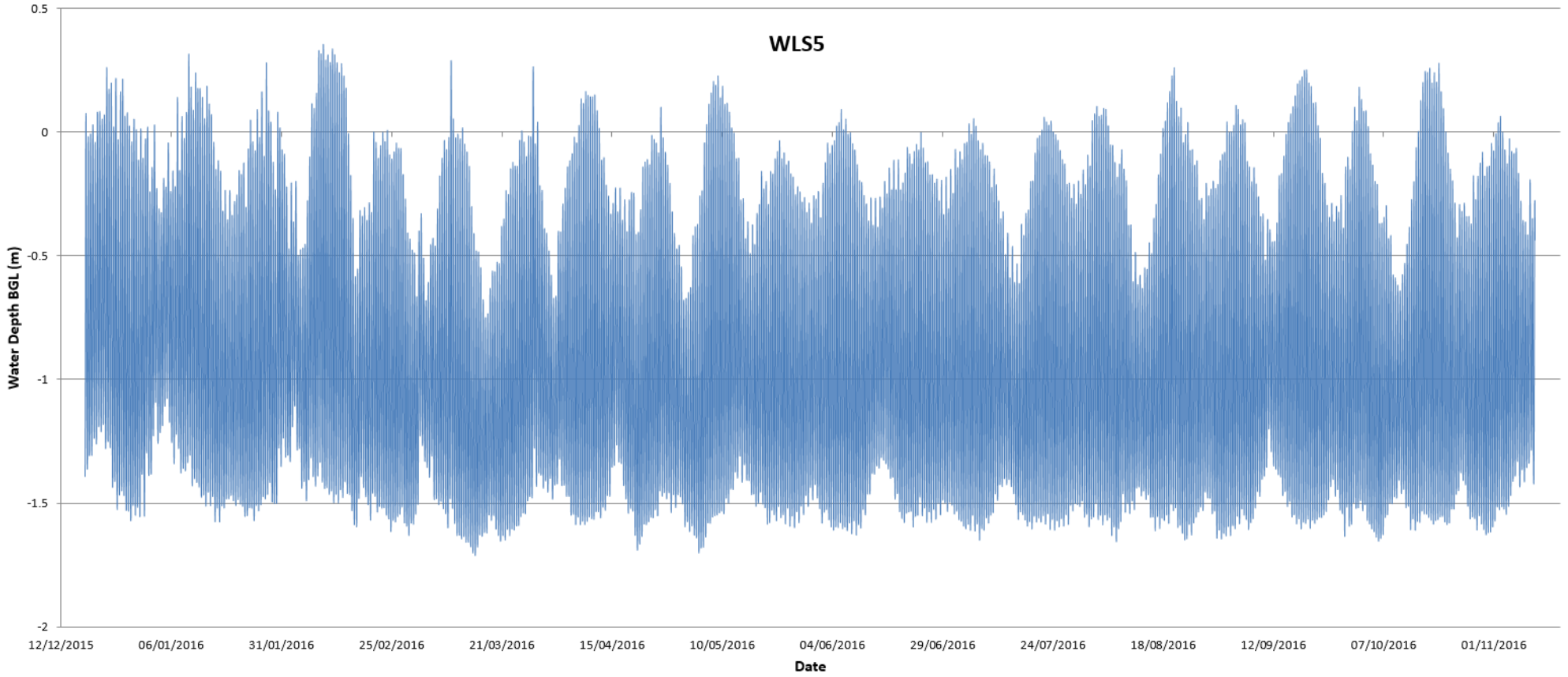
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Water Depth BGL (m)
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-2
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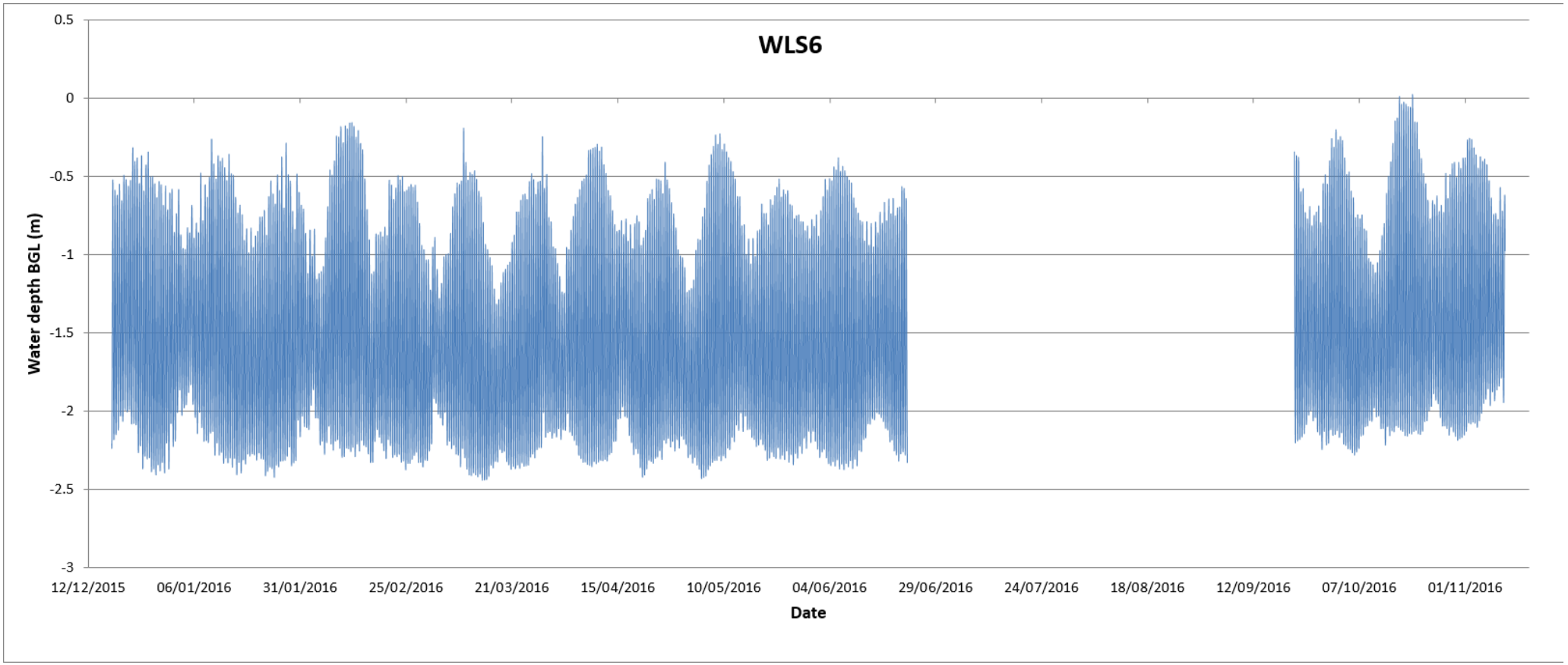
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Water depth BGL (m)
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0
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-3
12/12/2015
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21/03/2016
15/04/2016
10/05/2016
04/06/2016
29/06/2016
24/07/2016
18/08/2016
12/09/2016
07/10/2016
01/11/2016
Date

Appendix E – Development Proposals

REVISIONS			
B	26.08.16	Phase 1 updated. Air corridor lines removed.	IS
A	26.08.16	Air corridor added. Site Layout amended to avoid the air corridor.	IS

NOTES:

FOR COMMENT

0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100m

CLIENT: The Hyde Group
Making a lasting difference

TITLE: NEW SALTS FARM
PROPOSED MASTERPLAN

HGP ARCHITECTS
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Scale @ A0: 1/1000
Date: FEBRUARY 2016
Drawn by: CK
Checked by: GG
Drawing No: 15.003_010
Revision: B

Appendix F –Sequential and Exception Test

Sequential & Exception Test

New Salts Farm

Boyer

Prepared on behalf of Hyde New Homes | December 2016

Report Control

Project: New Salts Farm	
Client: The Hyde Group	
Reference: 14.455	
File Origin:	http://lucas/sites/Boyerplanning/twickenham/14.455/4 Boyer Planning/4.02 Reports/EiP/FRA and SandE/161205 SandE Test Whole Site Update FINAL.docx
Primary Author: Dinny Shaw	
Checked By: Andrew Williams	

Issue	*Date*	*Status*	*Checked By*
1	16/12/2016	DRAFT	Andrew Williams
2	16/12/2016	FINAL	Dinny Shaw

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3. The Sequential test 6
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   - Housing Target 6
   - Phasing of Development 7
   - Strategic Flood Risk Assessment and Sequential and Exceptions Test 7
   - Defining the Search Area 8
   - Applying the Sequential Test - Identifying Potential Alternatives 8
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5. The Exception Test 14
   - Background 14
   - Sustainability Benefits to the community 14
   - Safe for Its Lifetime 19
   - Conclusion 21
6. Conclusion 22

EXECUTIVE SUMMARY

This report has been prepared by Boyer on behalf of The Hyde Group in support of the redevelopment of their site at New Salts Farm for residential development. It is considered that the site could deliver around 455 new homes along with associated car parking and landscaping. The site is located within Flood zone 3a and part within 3b.

This report comprises a Sequential and Exception Test for the site to demonstrate that both tests have been passed and the site is suitable for residential development.

Adur District Council is not meeting its objectively assessed housing need in the Emerging Adur Local Plan (Amendments to the Proposed Submission Adur Local Plan 2016). It is therefore necessary for additional housing to be delivered within the plan period to meet housing need.

The Sequential Test has considered alternative sites within Adur District, having regard to the Strategic Housing Land Availability Assessment 2014 (CD04/11) and Update 2016 (CD07/20). The report has found that there were no other sites within Adur District of a similar capacity which could provide the development proposed at New Salts Farm and which would fall into an area with a lower probability of flooding. Therefore the Sequential Test has been passed.

On the 1st June 2016 planning permission was approved for Shoreham Adur Tidal Walls scheme, a scheme for improved flood defences in the River Adur. When implemented these will have a positive impact at the New Salts Farm site by partly addressing concerns regarding tidal and fluvial flooding. It would also redesignate those parts of the site within Flood Zone 3b as Flood Zone 3a.

The Exception Test has taken the Shoreham Adur Tidal Walls scheme into account. It comprises a review of the development site against the sustainability objectives of the Emerging Adur Local Plan Sustainability Appraisal (October 2016) (CD07/02). The results show that the development site scores positively in regard to the sustainability objectives and therefore would provide wider sustainability benefits to the community that outweigh flood risk, in particular the provision of new homes. The second part sets out what measures could be included in the development to manage and mitigate flood risk to demonstrate that it could remain safe for its lifetime, supported by a site specific Flood Risk Assessment prepared by Tully De'Ath. Therefore the two parts of the Exception Test have also been passed.

The Sequential and Exception Tests have been carried out in accordance with the National Planning Policy Framework and Planning Practice Guidance. It has demonstrated that the proposed development would pass both the Sequential and Exception Tests and therefore can be considered suitable for residential development.

1. INTRODUCTION

1.1 This report has been prepared by Boyer on behalf of The Hyde Group in support of the redevelopment of their site at New Salts Farm (Figure 1) for residential development.

Figure 1 - New Salts Farm Illustrative Masterplan

1.2 It is considered that the site could accommodate approximately 455 dwellings together with associated car parking, open space and landscaping, as demonstrated through the illustrative masterplan, and would represent a positive and beneficial contribution towards meeting housing need in Adur District.

1.3 The site is bounded by New Salts Farm road to the east, the railway to the north and Shoreham Airport beyond and existing residential properties, Broadway Park and Brighton Road to the south. It is within Flood Zones 3a and 3b.

1.4 The Council has previously raised concerns over flood risk issues at the site, and a lack of evidence to demonstrate that these can be overcome. The site was excluded from the Council's own Sequential and Exception Test (CD06/10) for the Emerging Adur Local Plan on that basis. We have therefore prepared a site specific Sequential and Exception Test for the development site.

1.5 This report relates to the whole New Salts Farm site for development of 455 homes.

2. POLICY CONTEXT

2.1 The National Planning Policy Framework (NPPF) states at paragraph 100 that:

'inappropriate development in areas at risk of flooding should be avoided by directing development away from areas at highest risk, but where development is necessary, making it safe without increasing flood risk elsewhere'.

2.2 Paragraph 101 continues saying that:

'the aim of the Sequential Test is to steer new development to areas with the lowest probability of flooding. Development should not be allocated or permitted if there are reasonably available sites appropriate for the proposed development in areas with a lower probability of flooding.'

2.3 Para 102 of the NPPF states that:

'if, following application of the Sequential Test, it is not possible, consistent with wider sustainability objectives for the development to be located in zones with a lower probability of flooding, the Exception Text can be applied if appropriate. For the Exception Test to be passed:

it must be demonstrated that the development provides wider sustainability benefits to the community that outweigh flood risk, informed by a Strategic Flood Risk Assessment where one has been prepared; and

a site specific flood risk assessment must demonstrate that the development will be safe for its lifetime taking account of the vulnerability of its users, without increasing flood risk elsewhere, and where possible will reduce flood risk overall.'

2.4 Further guidance at paragraph 103 states that:

'When determining planning applications, local planning authorities should ensure flood risk is not increased elsewhere and only consider development appropriate in areas at risk of flooding where, informed by a site-specific flood risk assessment following the Sequential Test, and if required the Exception Test, it can be demonstrated that:

within the site, the most vulnerable development is located in areas of lowest flood risk unless there are overriding reasons to prefer a different location; and

development is appropriately flood resilient and resistant, including safe access and escape routes where required, and that any residual risk can be safely managed, including by emergency planning; and it gives priority to the use of sustainable drainage systems.'

2.5 Paragraph 033 of the Planning Practice Guidance (PPG) provides further guidance to the application of the Sequential Test. It states that:

'the area to apply the Sequential Test across will be defined by local circumstances relating to the catchment area for the type of development proposed'. It goes on to say that 'when applying the Sequential Test, a pragmatic approach on the availability of alternatives should be taken'.

2.6 Paragraph 023 of the PPG provides guidance on the Exception Test and states that:

'Essentially, the two parts to the test require proposed development to show that it will provide wider sustainability benefits to the community that outweigh flood risk, and that it will be safe for its lifetime, without increasing flood risk elsewhere and where possible reduce flood risk overall.'

2.7 The PPG defines the flood risk vulnerability classifications of which residential development falls within the 'More Vulnerable' classification.

2.8 Table 1 below sets out the flood risk vulnerability and Flood Zone compatibility:

Table1 – Flood Risk Classification

Flood Zones	Flood Zone – Vulnerability Classification				
	Essential Infrastructure	Highly Vulnerable	More Vulnerable	Less Vulnerable	Water Compatible
Zone 1	✓	✓	✓	✓	✓
Zone 2	✓	Exception Test Required	✓	✓	✓
Zone 3a	Exception Test Required	X	Exception Test Required	✓	✓
Zone 3b	Exception Test Required	X	X	X	✓

2.9 This report has been prepared in accordance with the guidance contained in the NPPF and PPG.

3. THE SEQUENTIAL TEST

Background

3.1 The purpose of the Sequential Test is to demonstrate that there are no sequentially preferable available sites at a lower flood risk within a defined search area which could deliver the proposed development.

Housing Target

3.2 In previous years the South East Plan set the housing requirement for Adur, however this was revoked in March 2013. The National Planning Policy Framework now requires that Local Planning Authorities use their evidence base to ensure that their Local Plan meets the full, objectively assessed needs (OAN) for market and affordable housing in the housing market area, as far as is consistent with the policies set out in the Framework.

3.3 The Statutory Development Plan in Adur comprises the Adur Local Plan (1996). All housing allocations in the Adur Local Plan 1996 have been delivered and the policies relating to housing targets are considered out of date.

3.4 The Emerging Adur Local Plan (Submission Adur Local Plan 2016 (CD07/01)) proposes a 'capacity based' target of 3609 dwellings over the plan period (2011 – 2032) equating to 172 dwellings per year. The SHLAA Update 2016 (CD07/20) proposes to review this target to 3718 dwellings between 2011 and 2032, 177 per year.

3.5 Comparatively the Objectively Assessed Housing Need UpdateSeptember 2016 (CD08/1) is the most up to date assessment of housing need in the absence of an adopted, up to date, Local Plan.

3.6 The OAN for housing in Adur has been identified as 6,825 homes over the plan period equating to 325 homes per year.

3.7 The Strategic Housing Land Availability Assessment (SHLAA) 2014 and Update (2016) considers a number of sites within Adur District, the aim to identify a future supply of land which is suitable, available, and achievable for housing uses over the plan period.

3.8 Adurs Housing Implementation Strategy (CD07/21) suggests that including two greenfield site allocations the plan can deliver 3718 new homes over the plan period.

3.9 This leaves a shortfall of 3107 dwellings for the plan period when measured against the 2016 OAN.

3.10 Given the significant shortfall in housing delivery against the OAN, we consider that more sites should be introduced as Strategic Allocations based on the SHLAA as there will continue to be a need for new housing to be delivered within the Local Plan area.

Phasing of Development

3.11 The proposed development at New Salts Farm would be broken down into Phases and delivered over approximately 7 years. The Phasing would take into account the completion of the Adur Tidal Walls Scheme. A suggested phasing plan is set out below in Table 2 with the later phases of development being on land currently within Flood Zone 3b which will be redesignated as 3a following completion of the Adur Tidal Walls.. This demonstrates that the site is available and development is capable of being delivered in a sequential approach in the short and medium term within the plan period providing much needed new homes to contribute towards housing need.

Table 2 – New Salts Farm Potential Phasing Plan

	2018/2019	2019/2020	2020/2021	2021/2022	2022/2023	2023/2024	2024/2025
No. of Homes	25	75	55	75	75	75	75

Strategic Flood Risk Assessment and Sequential and Exceptions Test

3.12 The Adur and Worthing Councils Strategic Flood Risk Assessment (SFRA) (2012) (CD15/1) identifies that 8 of the 10 allocated sites in Adur are at risk of flooding from the River Adur and wave overtopping and are in Flood zone 3a with 6 partially in Flood Zone 3b.

3.13 Recommendations in the SFRA in respect of New Salts Farm identify that the site would need to demonstrate it passes the Exception Test and provide a site specific Flood Risk Assessment, it also suggests a sequential approach to development to minimise flood risk.

3.14 The Sequential and Exception Test for the Amendments to the Proposed Submission Adur Local Plan (2016) (CD06/10) dismisses the site as not sequentially preferable as it is located in Flood Zone 3a and 3b and that no evidence has yet been submitted to overcome concerns regarding surface water and groundwater flooding. Although the report does accept that the flood risk from tidal sources at the site would improve with the Adur Shoreham Tidal Walls.

3.15 This site specific Sequential and Exceptions Test and the accompanying Flood Risk Assessment have been prepared with reference to the Strategic Flood Risk Assessment in order to provide the further evidence to demonstrate that there are no flooding constraints to development of the site and therefore enable the Local Planning Authority to allocate the site for housing.

Defining the Search Area

3.16 It was considered appropriate that the search area in this case should comprise the same boundary as the area defined in the Emerging Adur Local Plan. The reason for this is that the development is proposed to provide residential use towards meeting housing need in the district and therefore this would be an appropriate catchment area.

Applying the Sequential Test - Identifying Potential Alternatives

3.17 To identify potential sites that are available for development, a review of the Council's SHLAA 2014 and SHLAA Update 2016 has been undertaken.

3.18 The SHLAA considered a number of sites within the district and giving consideration to known constraints, neighbouring uses and planning history, determined the availability, suitability and achievability of individual sites. The sites assessed were put into one of four categories: Potential Site; Rejected Site – Monitor; Rejected Site; Committed Site.

3.19 New Salts Farm has been considered in the SHLAA and in past assessments has been identified as 'Rejected Site – Monitor' as a site being *'broadly suitable for housing development but not currently available for development and considered that they may offer development potential in the longer term and as such will be monitored on an annual basis.'*

3.20 However in the recent SHLAA update 2016 it has been assessed as 'Rejected' although there appears to be no clear justification as to why it has been moved to this category.

3.21 The alternative sites we have considered in addition to New Salts Farm for the purposes of this Sequential Test are those within the defined search area which have a similar capacity and therefore could deliver the proposed development of 455 homes and have been identified as 'Potential Sites' or 'Rejected Sites – Monitor' in the SHLAA. This is considered an appropriate approach as the Council has either accepted the site or accepts that there is potential for the site to be allocated for housing.

3.22 The alternative sites selected are noted in Table 3.

Table 3 – Alternative Sites

SHLAA ID	Site Address	Flood Zone	Estimated Approx. Capacity	Allocated in Emerging Local Plan	Potential Constraints
ADC/106/13	New Salts Farm	3	455***	No	Flooding Landscape
ADC/122/13	New Monks Farm	3	600**	Yes	Flooding Landscape

	Lancing				Transport
ADC/125/13	Land at West Sompting	1	480**	Yes	High visibility – design needs to be sensitive to this Transport - Transport Assessment required Ground Water Flooding – mitigation required
**estimated capacity taken from SHLAA 2016 ***estimated capacity based on The Hyde Group masterplan					

3.23 It is evident from viewing the above table that of the comparable sites both have been allocated and that similar to New Salts Farm, New Monks Farm also falls within Flood Zone 3. Only Land at West Sompting has a lower probability of flooding and this site which has already been proposed to be allocated for residential development with an estimated capacity of 480 homes.

3.24 It is noted that New Monks Farm which is one of the two greenfield sites proposed to be allocated for housing in the Emerging Local Plan also falls within Flood Zone 3 and has issues with groundwater flooding. Both sites are outside of the built up area boundary on the Proposals Map 1996 and are designated as Countryside and are within the Lancing / Sompting Strategic Gap.

3.25 In respect of New Monks Farm the SHLAA 2016 states that '*various constraints, including flood risk, transport and landscape impact are currently being addressed*'.

3.26 The same report identified that in respect of New Salts Farm '*constraints, including flood risk and landscape impact have not been addressed to the satisfaction of the local planning authority . . Until it has been demonstrated that these issues can be overcome to the satisfaction of Adur District council, West Sussex County Council (as Lead Local Flood Authority) and the Environment Agency, the site is not considered suitable for residential development'.*

3.27 The New Salts Farm site is being actively promoted by the landowner. Therefore in response to the concerns noted by the Council the landowner has actively engaged relevant technical consultants to prepare detailed reports in order to satisfy the local planning authority that the constraints identified relating to flood risk and landscape impact are capable of being addressed and mitigated and that the site is therefore available and residential development is achievable. This information was submitted to Adur in response to the Call for Site and Regulation 19 Consultation and meetings have been held with the Council, WSCC and EA to discuss the details submitted. We are therefore engaged in ongoing discussion seeking to address the constraints which the Council have identified and to demonstrate that these are not constraints to development of the site.

3.28 As was noted earlier all the sites identified in the SHLAA and proposed to be allocated in the Emerging Local Plan cannot deliver enough housing to meet the OAN in the area. There is therefore a need to look for further suitable sites.

3.29 There are no other sites identified in the SHLAA 2016 as Potential or Rejected Monitor which could deliver the level of proposed development at New Salts Farm that have not yet been proposed to be allocated in the Emerging Local Plan

3.30 It is therefore clearly demonstrated that there are no other suitable, available sites within the defined search area that could deliver the level of proposed development at New Salts Farm and fall into an area at a lower risk of flooding.

3.31 Development at New Salts Farm would make a significant contribution towards meeting Adur's housing need.

Conclusion

3.32 Paragraph 101 of the NPPF seeks that development should not be allocated or permitted if there are reasonable available sites appropriate for the proposed development in areas with a lower probability of flooding.

3.33 The above has demonstrated that following a review of potential alternative sites within Adur district, taking account of the SHLAA 2014 and SHLAA Update 2016, there are no other suitable, available sites within Adur of a similar capacity which could provide the level o development proposed at New Salts Farm and which falls into an area with a lower probability of flooding.

3.34 Further, as noted, additional sites are required to come forward in order to meet Adur's full objectively assessed housing need and this site is available and deliverable within the Local Plan period.

3.35 On this basis it is considered that the Sequential Test has been passed and the site could be considered suitable for residential development where the Exception Test is also passed.

4. ADUR TIDAL WALLS

4.1 The Environment Agency submitted a planning application to Adur District Council in November 2015 for works known as the 'Shoreham Adur Tidal Walls' scheme (ref: AWDM/1614/15). The application was heard at the Adur Planning Committee on the 15th March 2016 and the Planning Committee resolved to grant planning permission subject to conditions. The application was approved on 1st June 2016.

4.2 The scheme involves a range of improvement works on the flood defences along the west and east banks of the River Adur to manage the risk of tidal flooding to the town of Shoreham-by-Sea.

4.3 The proposed works include:

- improvements to 1.8km of defences on the east bank between Coronation Green and the A27 road bridge and 5.4km of defences on the west bank between Shoreham Old Fort and Shoreham Toll Bridge;
- steel sheet piling, concrete walls, flood glass and earth embankments;
- a section of road raising, scour protection in the form of rock revetment, matting, planted terraces and gabions;
- Creation of a 1.3ha intertidal salt marsh; and
- Landscape improvements to Town Quay and Shoreham Old Fort car park.

4.4 If no works are undertaken to the defences then rising sea levels and the continued deterioration of the defences could lead to a catastrophic failure in just 1-in-20 year event. With the proposed new defences in place the residential and commercial properties in Shoreham currently at risk from flooding would be protected into the future from a 1-in-300 year (0.33% AEP) tidal flood event. As sea levels rise the number of properties that the improved defence will protect will increase, up to the 50-year design life of the Scheme.

4.5 In addition once the defences have been constructed, areas designated Flood Zone 3b will be redesignated 3a. This includes areas within the New Salts Farm development site. This would alter the flood risk vulnerability classification of development permissible in the area.

4.6 The Core Strategy site Flood Risk Assessment (2012) states *that 'these new defences are likely to have a positive affect on the present day and future 'defended' flood extents, and future development proposals should give regard to the detailed outputs from the Adur Tidal Walls study'.*

4.7 The works are anticipated to be completed in 2018.

4.8 This is an important consideration for New Salts Farm. The completion of these works would partly address tidal and fluvial flooding at the site. It would also redesignate parts of the site currently in Flood Zone3b to Flood Zone 3a, meaning ‘more vulnerable’ development (in the flood zone vulnerability classification) in these areas would become appropriate, subject to an Exception Test. Given it is anticipated that the works would be completed in 2018 this would enable the site to be phased appropriately to deliver new housing across the whole site within the plan period, contributing towards housing need in the District.

5. THE EXCEPTION TEST

Background

5.1 In line with the approach set out in the NPPF and PPG and the Flood Zone Classification table, having demonstrated that it is not possible for the development to be located in zones with a lower probability of flooding, the Exception Text has been applied to the site. In doing so we have had regard to the Shoreham Adur Tidal Walls scheme as advised in the Core Strategy Flood Risk Assessment.

5.2 Approximately 60% of the site falls within Flood Zone 3a whereby an Exception Test is required for residential development.

5.3 The remainder of the site currently falls within Flood Zone 3b, which is not considered suitable for residential development. However on completion of the Shoreham Adur Tidal Walls scheme these areas will be redesignated to Flood Zone 3a, and would then be in the same flood risk vulnerability classification as the rest of the site and subject to an Exception Test for residential development.

5.4 In approaching this Exception Test we have had regard to the Shoreham Adur Tidal Walls Scheme and the anticipated timing of completion of these works in 2018. We consider that the proposed redevelopment of New Salts Farm could be sequentially designed and phased so as to deliver residential development taking account of the completion of the Shoreham Adur Tidal Walls works ensuring that no development would be completed within areas currently designated as Flood Zone 3b prior to completion of those works.

5.5 For the Exception Test to be passed it must be demonstrated that the development provides wider sustainability benefits to the community that outweigh flood risk, and a site specific flood risk assessment must demonstrate that the development will be safe for its lifetime without increasing flood risk elsewhere and where possible decrease flood risk overall.

Sustainability Benefits to the community

5.6 The PPG states at paragraph 024 that *'evidence of wider sustainability benefits to the community should be provided, for instance, through the sustainability appraisal'.*

5.7 We have reviewed the potential of the proposed development to provide wider sustainability benefits by considering the scheme alongside the sustainability objectives set out in the Sustainability Appraisal of the Adur Local Plan 2016 (CD07/02), having regard to that document and the Adur and Worthing Strategic Flood Risk Assessment (2012).

5.8 Table 4 below sets out the sustainability objectives identified in the Sustainability Appraisal and how the development could be designed to meet those objectives.

Table 4 – Compliance with Adur Sustainability Objectives

Sustainability Objectives	Compliance
Increase energy efficiency and encourage the use of renewable energy sources	The proposed development will incorporate renewable/low carbon energy sources where demonstrated appropriate and feasible. The proposed development has been designed using the 'fabric first' principle. The dwellings are designed to be highly insulated, reduce heat loss and air leakage, which in turn reduces the heating requirements for the dwellings. The heating that is required will be delivered using energy efficient technologies accompanied with low or zero carbon technologies. The design target for the dwellings is to achieve 19% CO2 reduction beyond Part L 2013.
Protect and enhance water quality and encourage the sustainable use of water Reduce pollution and the risk of pollution to air, land and water	Sustainable Drainage Systems (SuDS) will be incorporated in the development (as detailed later in this report) which shall manage the surface water run-off from the development. To reduce water consumption within the dwellings each dwelling shall be fitted with water efficient sanitaryware to enable the predicted consumption to be no greater than 105l per person per day. To protect the quality of groundwater all surface water run-off from the roof and hard paved areas will receive surface water treatment to satisfy the level of treatment recommended within the SuDS Manual, before discharging into the ground. There is potential for noise impact on the new development from the airport and railway, however this would be capable of being mitigated in any new development through detailed design.
Improve land use efficiency by encouraging the re-use of previously developed land, buildings and materials	The proposed development is on a greenfield site. However Adur have already accepted that some greenfield land would need to be allocated to contribute towards meeting housing need, although it has not allocated enough sites to meet that need. For reasons noted earlier in this report New Salts Farm is considered to be suitable, available and achievable and should be allocated for housing to contribute towards meeting housing need.

Conserve, protect and enhance biodiversity and habitats	The site contains BAP habitats and NERC habitats and supports a number of protected species. However a site specific preliminary ecological appraisal has identified that whilst there are areas of higher ecological interest these can be accommodated within the scheme and maintained and enhanced with potential to also provide ecological benefits on the site. For example the existing ditch network would be maintained in the scheme including a buffer zone in order to maintain the existing water features and supporting habitats. There is also an opportunity to enhance the ditch network by removing invasive species. The wider site illustrative masterplan includes areas of open space and there is potential for these to be left as unmanaged space to maintain some of the grazing floodplain habitat and ensure reptiles can be retained on the site.
Protect and enhance the historic environment including townscapes, buildings, archaeological heritage, parks and landscapes Protect and enhance the countryside Protect and enhance public open space / green infrastructure and accessibility to it	The most recent landscape sensitivity assessment 2016 (CD14/10) carried out on behalf of Adur identifies the site as having a medium-high visual sensitivity and provides a valuable 'slice of green' separating urban areas. A landscape and visual appraisal of development proposals at new salts farm (2016) (CD14/22) suggests that development at New Salts Farm would have significant and irreversible landscape and visual effects. Although goes on to suggest options to mitigate these negative impacts. We have substantial concerns regarding the reliability of Adur's evidence base in this regards which is set out in detail in our Regulation 19 Reps. Our client commissioned a separate study reviewing the work done on behalf of Adur which demonstrates that New Salts Farm has a moderate-high capacity to accommodate housing and would not result in coalescence as a significant areas of space would be retained as a Local Green Gap. A landscape strategy has been development for the proposed site which seeks to integrate the development into the existing landscape by inclusion of soft boundary treatments and tree planting; retention of open boundary treatment to the east and north to retain a sense of openness; incorporation of ditches in the development and informal amenity and recreation areas.

	Whilst the development would result in the loss of a greenfield site, the proposed illustrative layout, along with landscape measures proposed, has the potential to respond to the sensitivities of the local landscape character and safeguard the qualities of the local green gap and provide a number of positive landscape enhancements.
Ensure that all developments have taken into account the changing climate and are adaptable and robust to extreme weather events Avoid, reduce and manage the risk from all sources of flooding to and from the development	A Flood Risk Assessment for the site (discussed further below) has identified how flood risk in the present and future would be managed and mitigated to ensure the development would remain safe for its lifetime and not result in an increase in flood risk elsewhere. The Environment Agency are progressing the Shoreham Adur Tidal Walls Scheme which will improve flood defences and would partly address tidal and fluvial flooding at New Salts Farm. This scheme will also redesignate those parts of the site within Flood Zone 3b as 3a.
Improve health and wellbeing and reduce inequalities in health	The development would provide new areas of accessible open space which would have health benefits for new and existing residents.
Reduce crime, the fear of crime and antisocial behaviour	The layout of the proposed development has sought to design out elements that can contribute towards crime and antisocial behaviour, thereby contributing towards reducing crime, the fear of crime and anti-social behaviour.
Promote sustainable transport and reduce the use of the private car	The site is close to Shoreham Town Centre with a number of local services including supermarkets, doctor and dentist surgeries. There are good pedestrian footways and cycle routes in the vicinity which the proposed development could connect to. Bus routes are located along Brighton Road close to the site. It is therefore considered that the site is well located close to sustainable modes of transport and hence will reduce the need for future residents to travel by car.
Reduce poverty, social exclusion and social inequalities Meet the need for housing and ensure all groups have access to decent / appropriate housing Create and sustain vibrant	The proposed development would deliver new housing of a mix of tenures, including affordable housing, and sizes and hence would go towards meeting the objectively assessed housing needs in Adur District. A mix of homes, including affordable homes, would create a vibrant community in a sustainable location and would contribute towards creating mixed and balanced communities which would help to reduce social exclusion and inequalities.

communities which recognise the needs and contributions of all individuals	
Promote sustainable economic development with supporting infrastructure, and ensure high and stable levels of employment and a diverse economy	The proposed development by providing new homes, including affordable homes, in a sustainable location close to local facilities would help to attract people to live and work in the district thereby supporting this objective. Additionally in the short term construction jobs would be created which would help the economy.
Improve the range, quality and accessibility of key services and facilities and ensure the vitality and viability of existing centres	The site is in a sustainable location with good access to existing local facilities in Shoreham Town Centre by bus, foot and cycle. It would introduce new housing which would utilise local services thereby contributing towards the viability and vitality of existing centres.
Create places, spaces and building that work well, wear well and look good	HGP are high quality architects who have been engaged to develop a scheme on the site. They have prepared an initial illustrative masterplan to demonstrate how the site could be developed to deliver a high quality residential scheme. Further design development will seek to achieve high standards and create places, spaces and buildings that work well, wear well and look good.
Raise educational achievement and skills levels to enable people to remain in work and to access good quality jobs	No education/training facilities are proposed on the site, although financial contributions towards education are likely to be required as part of a planning application.
Reduce the amount of domestic and commercial waste going to landfill as per the waste hierarchy	The waste arrangements for the development will be designed so as to minimise waste and encourage recycling and other waste management prior to sending waste to landfill

5.9 It can be seen from the table above and assessment of the proposed development against the sustainability objectives of the Emerging Adur Local Plan that the development of the site has the potential to give rise to significant sustainability benefits and generally scores positively. In particular it will provide additional homes, including affordable housing, within a sustainable location and set within high quality landscaping and open space, close to local facilities and with the ability to connect to existing sustainable transport modes.

5.10 The proposal scores positively against the aims and objectives of the sustainability appraisal and demonstrates that the sustainability benefits of the development to the community outweigh the flood risk, therefore passes this first part of the Exception Test.

Safe for Its Lifetime

Introduction

5.11 The use proposed at the site is residential which falls within the more vulnerable category. For those areas within Flood Zone 3a the site is suitable for residential development where the Exception Test is passed.

5.12 It is noted that part of the site is currently within Flood Zone 3b and considered not suitable for more vulnerable development. However, the planned improvements to flood defences in the River Adur would remove this area from Flood Zone 3b and redesignate it as Flood Zone 3a. This would make those parts of the site to be redesignated suitable for residential development after that time, where the Exception Test is passed. The proposed new defences are anticipated to be completed in 2018 therefore enabling delivery of housing on this site within the Local Plan period.

5.13 Paragraph 038 of the PPG states that '*the developer must provide evidence to show that the proposed development would be safe and that any residual flood risk . . . can be overcome to the satisfaction of the local planning authority*.' It goes on to say that '*the developer's site-specific flood risk assessment should demonstrate that the site will be safe and that people will not be exposed to hazardous flooding from any source*'.

5.14 A site specific Flood Risk Assessment (FRA) has been prepared for the development site by Tully De'Ath. This report should be read in conjunction with that document, although it has been summarised below.

Flood Risk

5.15 In respect of fluvial flood risk the site is in Flood Zone 3a with a residual risk associated with a breach of the River Adur flood defences. The site is within Flood Zone 3a and 3b for Tidal Flood Risk associated with a residual risk of breaching of defences along the River Adur and wave overtopping along the coastal frontage.

5.16 The site is also susceptible to ground water flooding (ground water emergence is more than 75%). It has a low surface water flood risk with those areas highlighted as susceptible to flooding being aligned to existing drains and ditches on the site. There is no reported incident of sewer flooding within the site.

5.17 Flood model data from the Environment Agency suggests that the 1:200 event with an allowance for climate change was the most onerous with a maximum flood height of 5.391m AOD for the undefended flood event and 5.05m AOD for a defended scenario.

5.18 The existing defences have been assessed as being in relatively good condition. Further, as noted earlier, proposed improvements to the flood defences as part of the Shoreham Adur Tidal Walls scheme will partially address tidal and fluvial flooding at the site and redesignate those parts of the site within Flood Zone 3b as Flood Zone 3a.

Flood Management and Mitigation

5.19 The FRA sets out a number of flood management and mitigation methods which could be incorporated in the final design to address flooding at the site which are summarised below.

5.20 All units would provide accommodation at first floor level only with this floor set above the 1 in 200+CC tidal event. This would equate to a minimum floor level of 5.35m AOD which is 3m above existing ground level. Ground floor levels would also be locally raised by 300mm to mitigate against the risk of ground and surface water flooding. All units would be designed using flood resilient materials and structurally designed to withstand potential flood depths.

5.21 All units would have direct access to first floor which would be the primary area for refuge in the event of a major flood event. All units would be linked to the EA's flood warning system and a site specific Flood Evacuation Plan will be provided and agreed with the Emergency Planning Team which gives guidance and advice to residents with regards to flood risks.

5.22 Surface Water run-off will be restricted to match greenfield run off rates via use of flow control devices.

5.23 Surface water attenuation will be provided in a variety of devices including roof top attenuation, permeable paving and swales.

5.24 Attenuation will be designed to hold a 6hr 100+CC event within the sub-base material with overflow directed to the adjacent swales and ditches should this be exceeded.

Surface Water Drainage Proposals and Sustainable Drainage Systems (SuDS)

5.25 The proposed method of surface water disposal will be via shallow infiltration and sustainable drainage systems (SuDS) will also be incorporated including:

- Water butts which can reduce the total volume of storm water run-off and provide additional attenuation;
- Green roofs on all roofs will provide storm water attenuation and reduce run off;
- Geocelular roof attenuation systems beneath the green roofs will create an additional storage structure which will discharge into the sub-base of permeable roads;
- Permeable paving with base infiltration will be included to all hard paved areas and will allow water to infiltrate and be temporarily stored before infiltrating into the sub-soils;
- New swales / infiltration trenches will be introduced either side of the new access road and linked to the existing ditch system on site;
- Bio retention areas will be introduced in the landscaping to provide additional exceedence event storage.

5.26 All surface water run-off from the roof and hard paved areas will receive an element of surface water treatment before discharging into the ground to satisfy the level of treatment recommended in the SuDS Manual.

Flood Risk Assessment Conclusion

5.27 The FRA has identified the current and future flood risk to the site and demonstrated how this would be managed and mitigated over the developments lifetime to demonstrate that the development can be designed so as to remain safe for its lifetime and would not increase flood risk elsewhere.

5.28 The principles for management and mitigation of flood risk will be incorporated across the site, although those areas which are currently within Flood Zone 3b will not be developed until the Shoreham Adur Tidal Walls scheme is completed and they have been redesignated.

5.29 The proposals have therefore demonstrated that the second part of the Exception Test has also been passed.

Conclusion

5.30 This chapter has demonstrated that the development site offers wider sustainability benefits to the community that outweigh flood risk, and that the development can be designed to incorporate measures to mitigate and manage flood risk now and for the lifetime of the development and not increase flood risk elsewhere.

5.31 While some parts of the site are currently within Flood Zone 3b and would not be considered appropriate for residential development at this time these would be redesignated once the Shoreham Adur Tidal Walls scheme is complete to Flood Zone 3a and would not be developed until after this time.

5.32 It is concluded that the Exception Test has been passed, and the site can be considered appropriate for residential redevelopment.

6. CONCLUSION

6.1 The NPPF sets out tests to protect people and property from flooding. It requires a sequential approach to site selection to ensure development is as far as possible directed to the areas at lowest risk of flooding. Where development needs to be in locations at risk from flooding it should demonstrate that it provides sustainability benefits to the wider community and would be safe for its lifetime.

6.2 It has been demonstrated that Adur District Emerging Local Plan does not currently allocate enough development sites to meet its objectively assessed housing need. It is therefore clear that further development sites should be brought forward to meet this need.

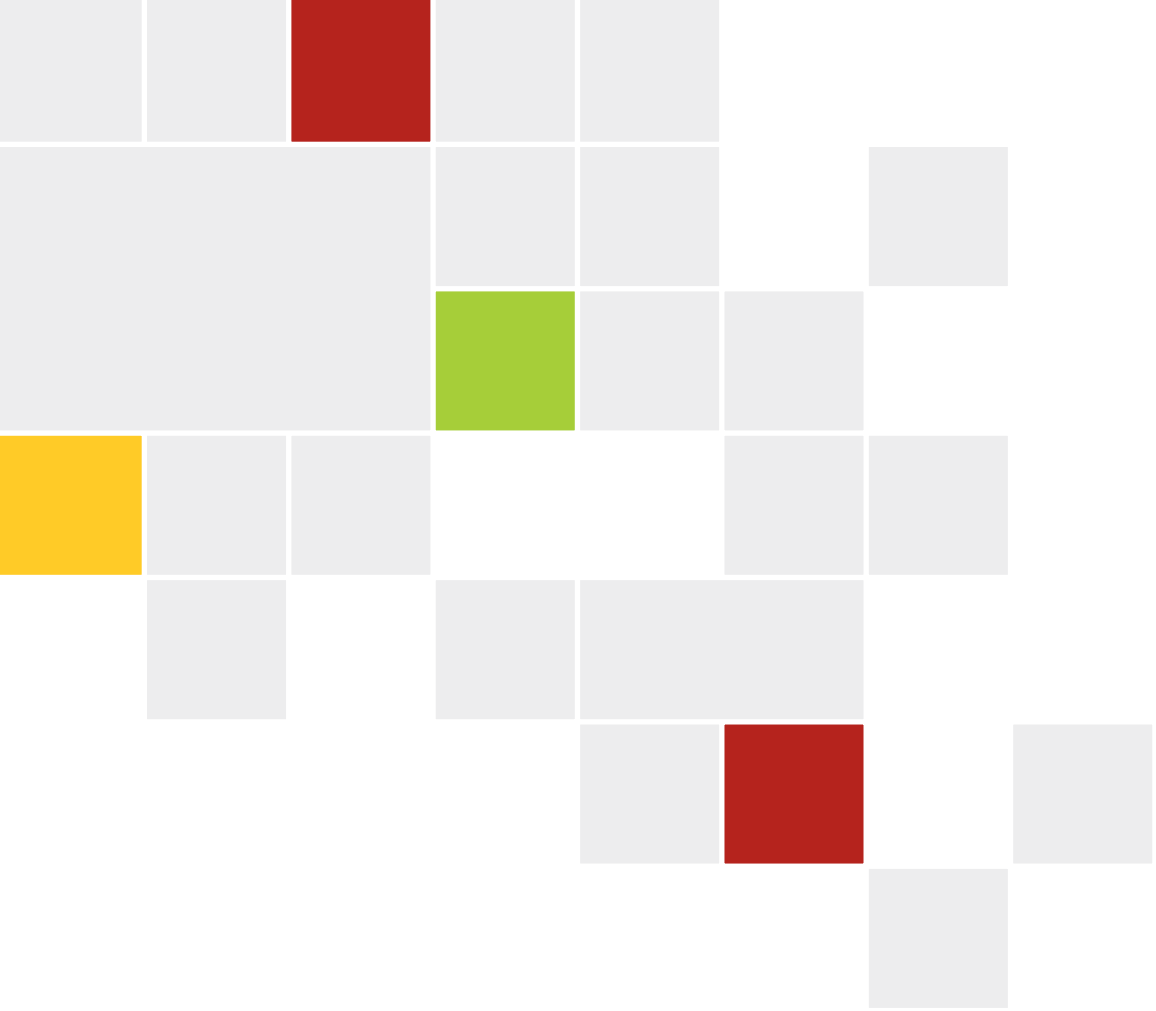
6.3 This report has demonstrated that the development site at New Salts Farm would pass the Sequential Test as there are no other available sites within a lower Flood Zone that could provide the development proposed.

6.4 It is relevant that the Shoreham Adur Tidal Walls proposals to improve flood defences in the River Adur would have a positive impact on the development site in terms of flooding and would open up areas of the site currently not considered suitable for residential development. These defences are anticipated to be completed in 2018 and would enable deliverability of new housing on the site within the plan period.

6.5 In respect of the Exception Test, this report has demonstrated that the proposed development would provide sustainability benefits to the wider community that outweigh flood risk, particularly through the provision of new housing, including affordable housing, to meet objectively assessed need. Further the Flood Risk Assessment has demonstrated that the proposed development would incorporate through its design, measures to manage and mitigate flood risk at the site to demonstrate that it would be safe for its lifetime without increasing flood risk elsewhere.

6.6 In accordance with the NPPF and PPG it has been demonstrated, informed by a site specific Flood Risk Assessment, taking account of the future Adur Tidal Walls Scheme and following the Sequential and Exception Tests that the development is appropriately flood resilient and resistant, any residual risk can be safely managed and sustainable drainage systems have been incorporated and there is no increase in flood risk elsewhere.

6.7 The Sequential and Exception Tests have been passed and the development can therefore be considered appropriate and be permitted in line with the NPPF.



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Appendix G – SFRA Historical Flood Maps

Core Strategy Site Flood Risk Assessment: summary and recommendations

Site Details

Site Name	Land North East of the Hasler Estate
Site Location (OS NGR)	TQ200046
Site Area (ha)	30.4
Proposed use	Residential
Flood risk vulnerability classification (PPS25 Table D2):	More Vulnerable
Brown/Greenfield	Greenfield

Flood Risk

Flood Zones (Fluvial & Tidal)		Comments
Flood Type	Fluvial and Tidal	River Adur, tidal estuary and coastline
Percentage of site in Flood Zone 3b	39%	
Percentage of site in Flood Zone 3a	61%	
Percentage of site in Flood Zone 2	0%	This excludes any area contained within Flood Zone 3
Percentage of site in Flood Zone 1	0%	Flood Zone 1 indicates the area lying outside of Flood Zones 2 and 3
Defended?	Formal defences along the River Adur and the coastline.	Maintainer: Local Authority, private and EA Standard of Protection: Less than 1 in 20 year.

Surface water flooding

Susceptibility	The susceptibility to surface water flooding during a 1 in 200 year event for the majority of the site is shown to be less to intermediate .
Flood map for surface water	There are small pockets of flooding, some deep, associated with the 1 in 30 year and 1 in 200 year event across the site according to FMfSW.

Other sources of flood risk

Groundwater Flood Risk	The site is underlain by the Newhaven Chalk Formation, and is within the EA's major aquifer high vulnerability zone. Consequently the area may be susceptible to groundwater emergence. According to the EA groundwater susceptibility map, the site resides in a series of 1km squares where the proportion of each 1 km square that is susceptible to groundwater flood emergence is more than 75%.
Sewer Flood Risk	No reported incidents of sewer flooding within the site. Reported incident to south west of the site (West Way)

Residual risk

Fluvial Residual Risk	Yes - there would be a residual risk associated with breach of the River Adur west bank defences.
Tidal Residual Risk	The Flood Zones show the site would be inundated if undefended, therefore there is a residual risk associated with breach of the defences along the River Adur. Also, detailed modelling has been undertaken to assess the impact of wave overtopping along the coastal frontage. The results show that the site is at a high risk of inundation as a result of wave overtopping in both the 1 in 20 and 1 in 200 year events.

Effect of climate change

Detailed modelling undertaken to assess the impact of climate change of the tidal flood extent show that the entire site would suffer inundation in the future (2115) 1 in 200 year event. The impact of climate change on surface water or groundwater has not been assessed as part of this SFRA.

Is a site specific Flood Risk Assessment required?

FRA required?	Yes	Site is over 1ha and has significant areas within Flood Zone 3a. Small areas at residual risk from wave overtopping. Additional high risk of groundwater emergence and surface water flooding. The site is at significant risk from the affects of climate change.
Exception test required for proposed use?	Yes	The majority of the site is within Flood Zone 3a. The exception test would need to be met for more vulnerable development within the site. Notably, to meet the exception test the FRA would need to demonstrate that the development is 'safe'.

Recommendations for Development

The site is within Flood Zones 3a, and 3b and has a history of flooding. All development proposals should be accompanied by a FRA. Flood Zone 3b is not considered suitable for less, more, or highly vulnerable developments. Flood Zone 3a is not suitable for highly vulnerable developments. The Exception Test is required for essential infrastructure and more vulnerable proposals. Water compatible land uses are considered compatible. Future development should be mindful of the various sources of flood risk, and where possible implement sequential design throughout the site to try to reduce flood risk within the development.

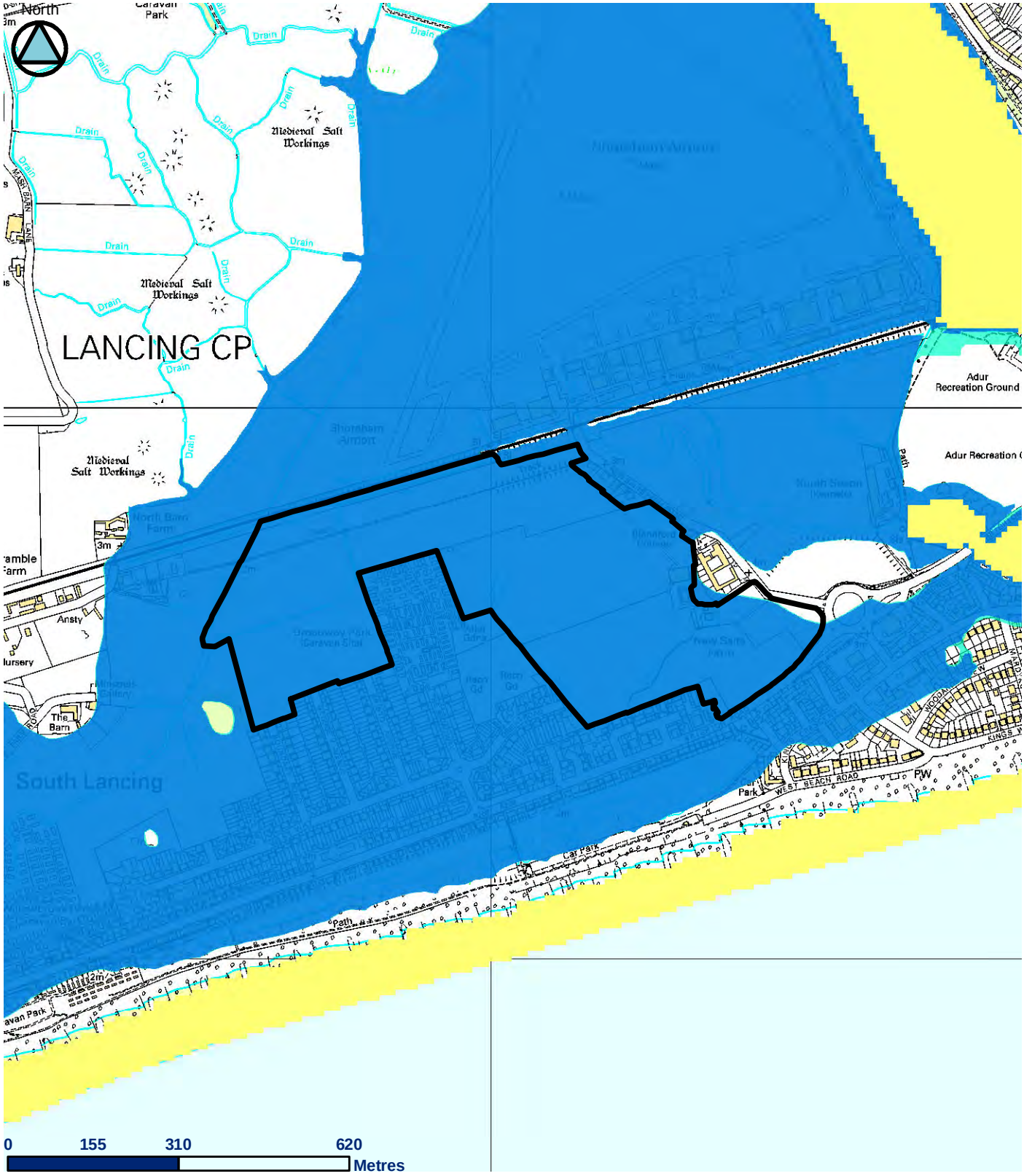
The effect of climate change should be considered for all new development, at present it is shown that the risk of flooding will increase in the future if the current defences remain unchanged as a consequence of reduced SoP.

There is also a risk from wave-overtopping, an assessment should be carried out on the impact of wave overtopping so that any future development can be designed with this in mind. Future developments should be resilient to the effects of wave overtopping and the site should be sequentially designed ensuring the development remains safe in the event of wave overtopping i.e. situating resilient uses on the ground floor.

The site is also at risk of groundwater and surface water flooding, therefore steps should be taken to reduce the consequence of flooding. Any future development should ensure that it would not increase the surface water flood risk elsewhere, to achieve this any existing flow paths would need to maintained. The site is greenfield so surface water drainage techniques should be built into any new design to ensure the runoff rate does not increase.

Improvements to the tidal walls along the River Adur in the vicinity of the site have been proposed (see section 4.3.4 of the main report for more information). When these improvements occur the floodplain designation will change, and areas designated 3b will be redesignated 3a. This will alter the flood risk vulnerability classification of development permissible in the area. These new defences are likely to have a positive affect on the present day and future ‘defended’ flood extents, and future development proposals should give regard to the detailed outputs from the Adur Tidal Walls study. At present available information indicates that the planned improvements are to the present day 1 in 200 year standard. This standard of protection is expected to decrease in the future with climate change and this should be considered early in the design of the development, including directing the highest vulnerability land uses to areas of lowest risk. Any new development should be resilient to future climate change, as well as the effect of wave overtopping and a failure in the defence. A detailed FRA will be required to assess these aspects.

Adur and Worthing SFRA update
Flood Risk Summary Map



Legend

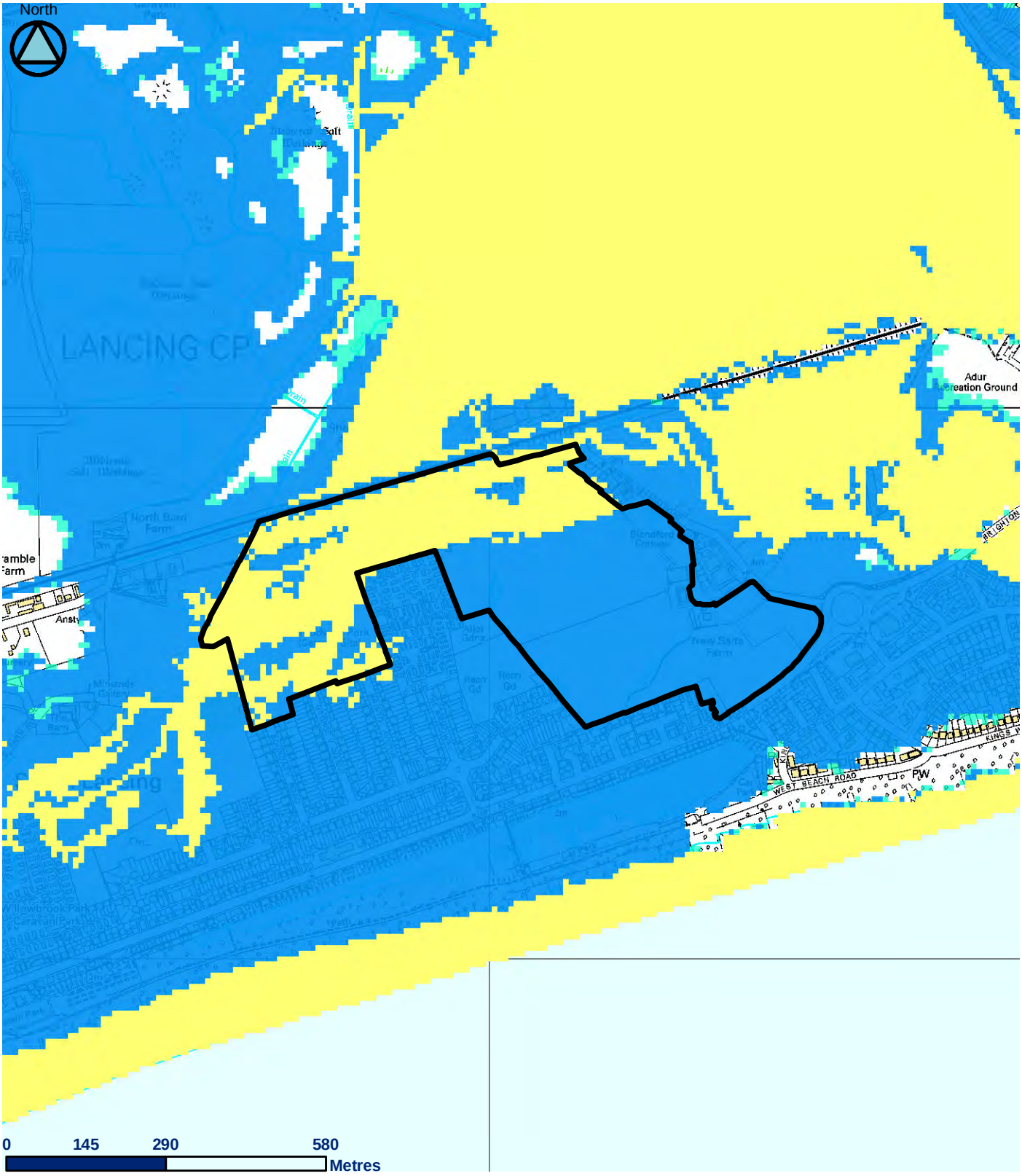
- Land to the North East of the Hasler Estate
- Flood Zone 3b
- Flood Zone 3a
- Flood Zone 2

Land to the North East of the Hasler Estate

Fluvial Flood Risk

(Floodplain Delineation - Undefended)

Adur and Worthing SFRA update
Flood Risk Summary Map



Legend

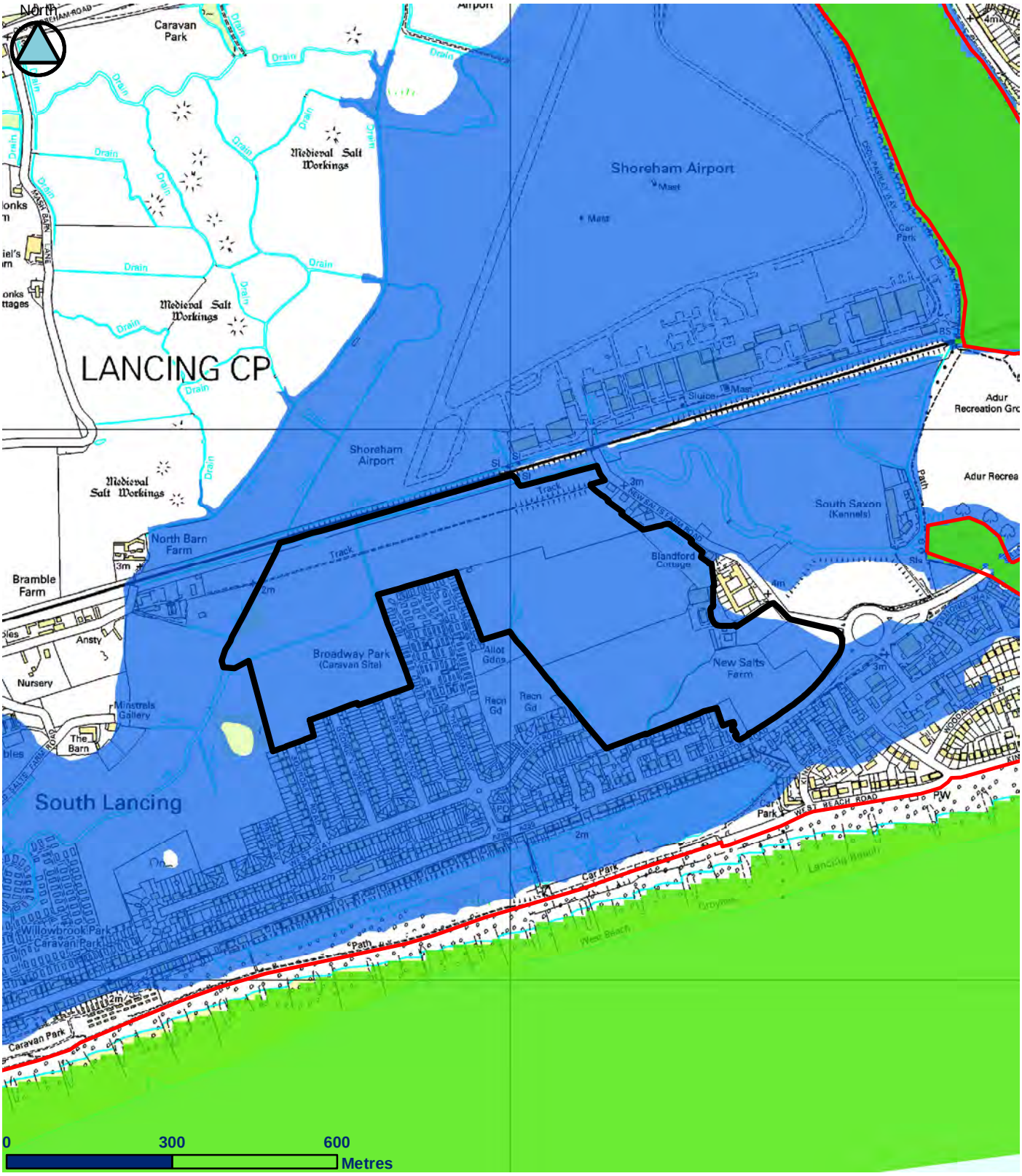
- Land to the North East of the Hasler Estate
- Flood Zone 3b
- Flood Zone 3a
- Flood Zone 2

Land to the North East of the Hasler Estate

Tidal Flood Risk

(Floodplain Delineation - Undefended)

Adur and Worthing SFRA update
Flood Risk Summary Map



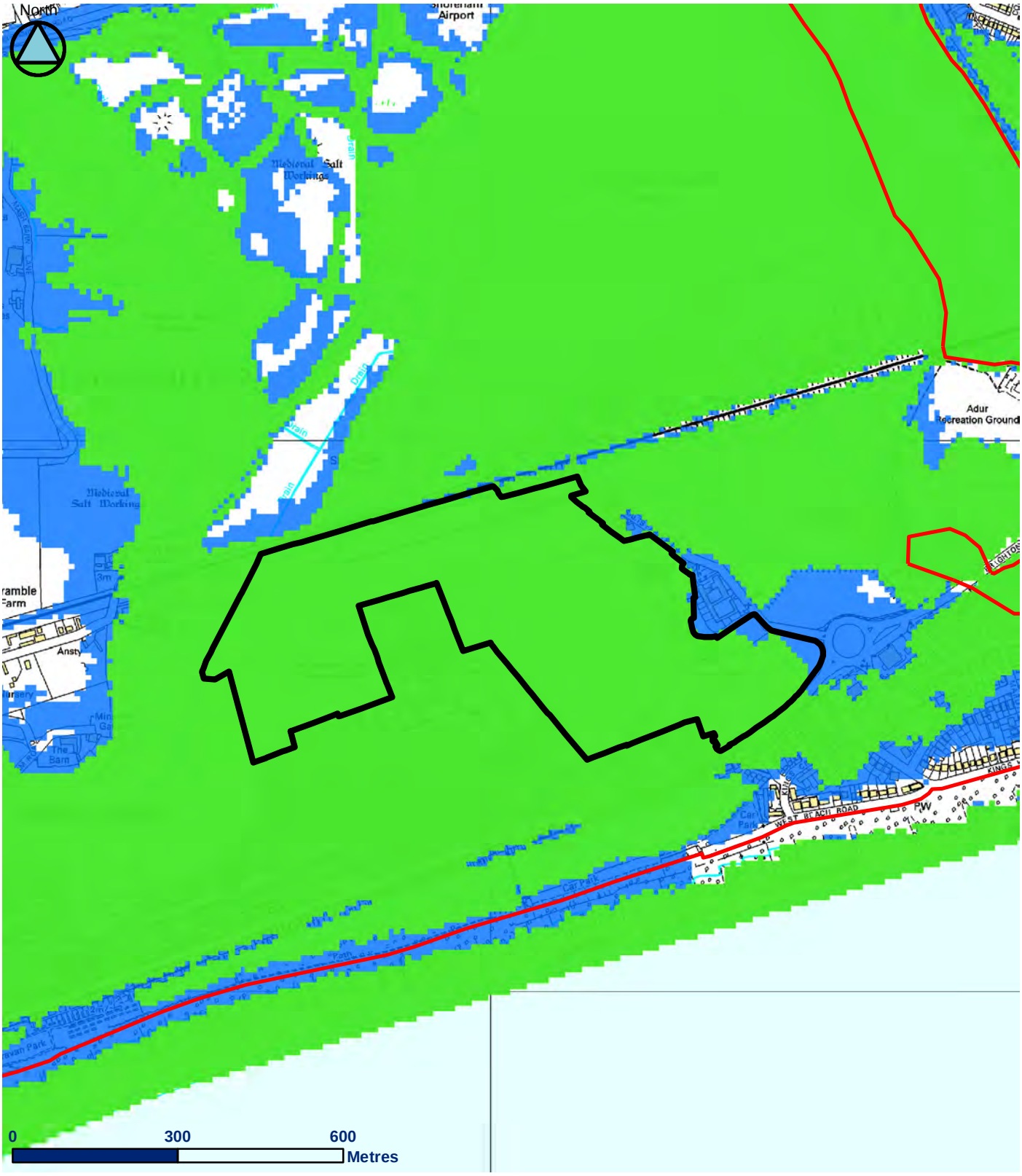
Legend

- Land to the North East of the Hasler Estate
- Adur and Worthing Defences
- 1% AEP Defended
- Flood Zone 3a

Land to the North East of the Hasler Estate

Actual Fluvial Flood Risk (with defences)

Adur and Worthing SFRA update
Flood Risk Summary Map



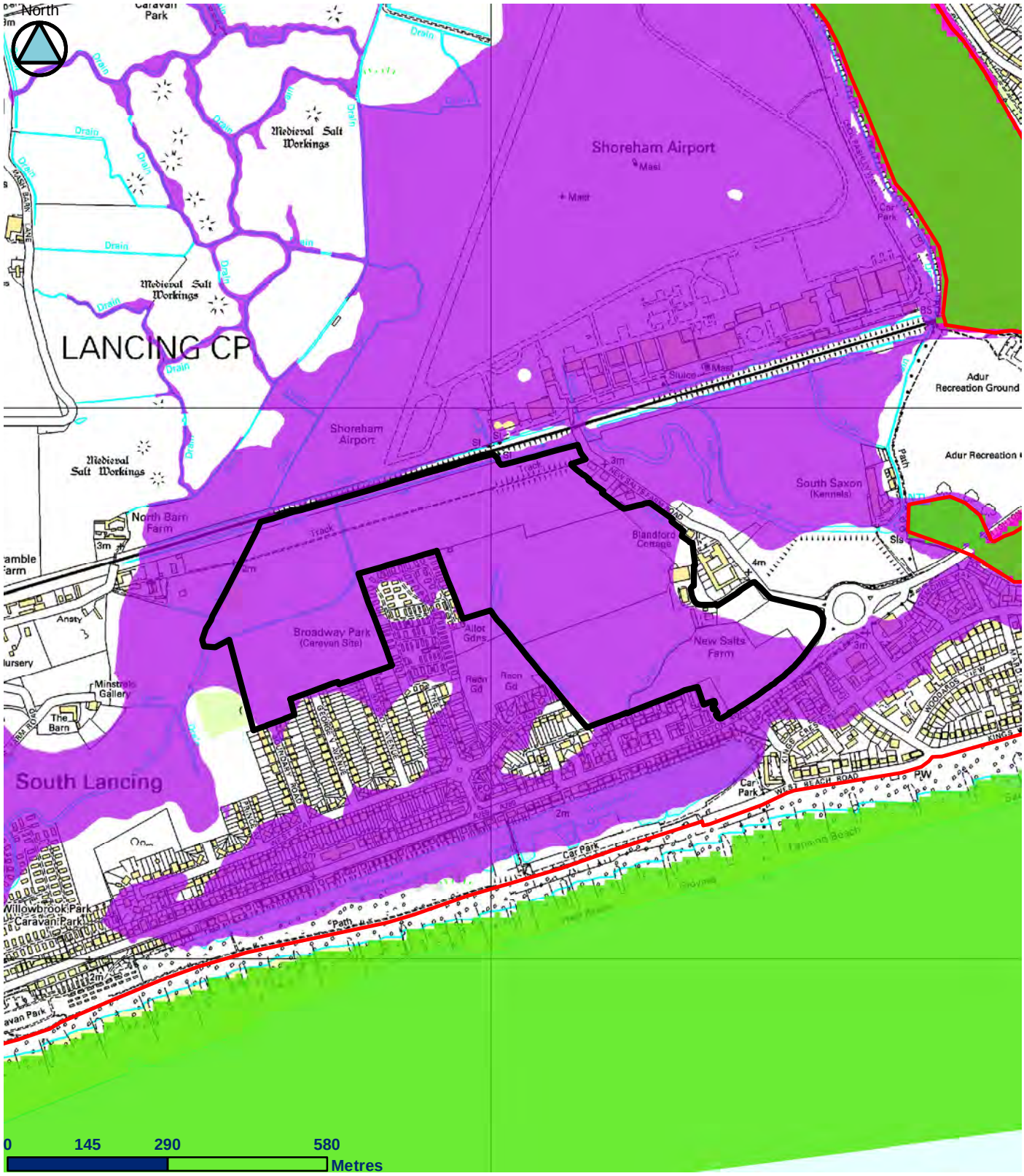
Legend

- Land to the North East of the Hasler Estate
- Adur and Worthing Defences
- 0.5% AEP Defended
- Flood Zone 3a

Land to the North East of the Hasler Estate

Actual Tidal Flood Risk (with defences)

Adur and Worthing SFRA update
Flood Risk Summary Map



Legend

- Land to the North East of the Hasler Estate
- Adur and Worthing Defences

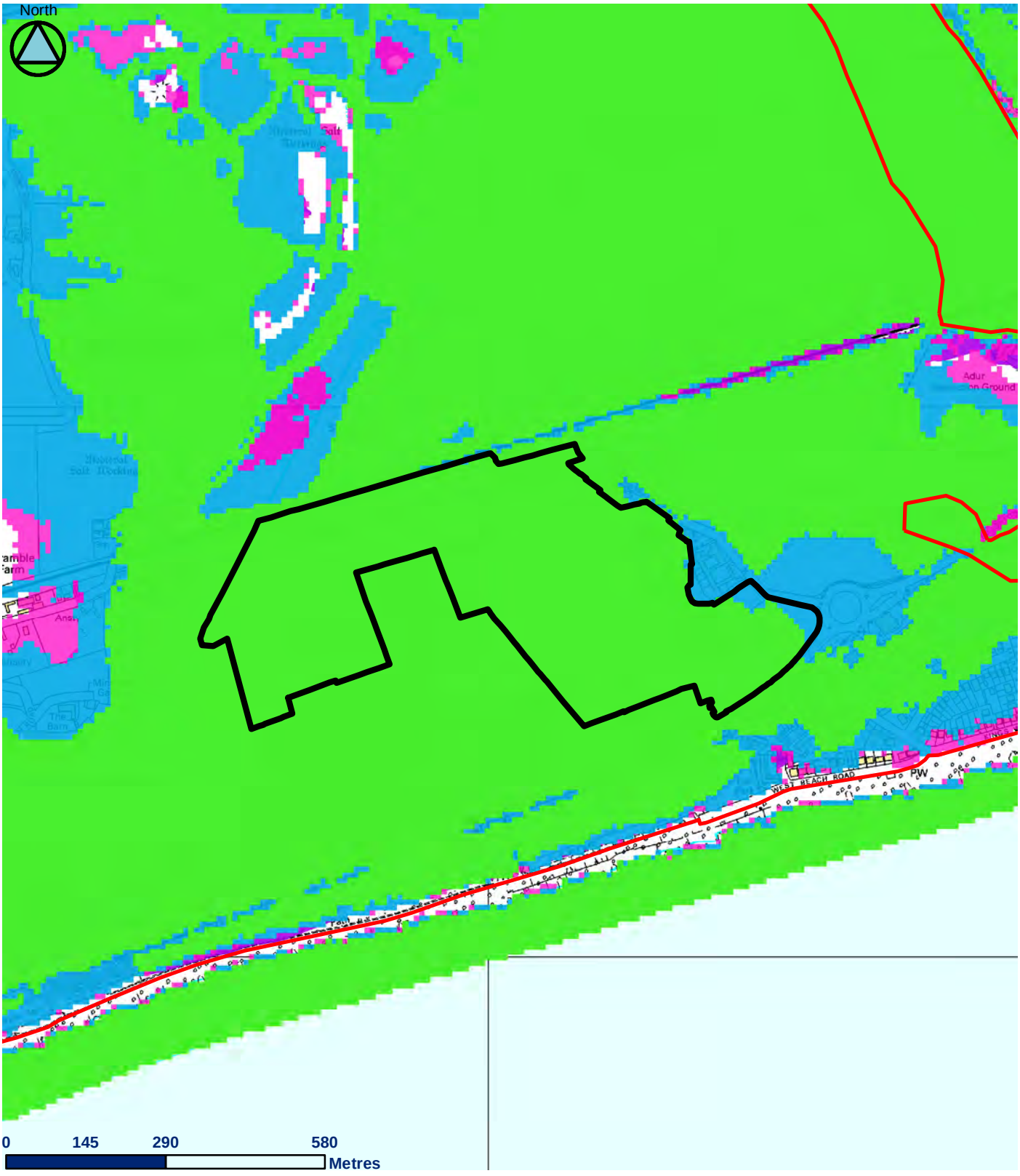
1% AEP Defended

- Present Day
- Climate Change (2056)
- Climate Change (2106)

Land to the North East of the Hasler Estate

Future Fluvial Flood Risk (with defences)

Adur and Worthing SFRA update
Flood Risk Summary Map



Legend

- Land to the North East of the Hasler Estate
- Adur and Worthing Defences

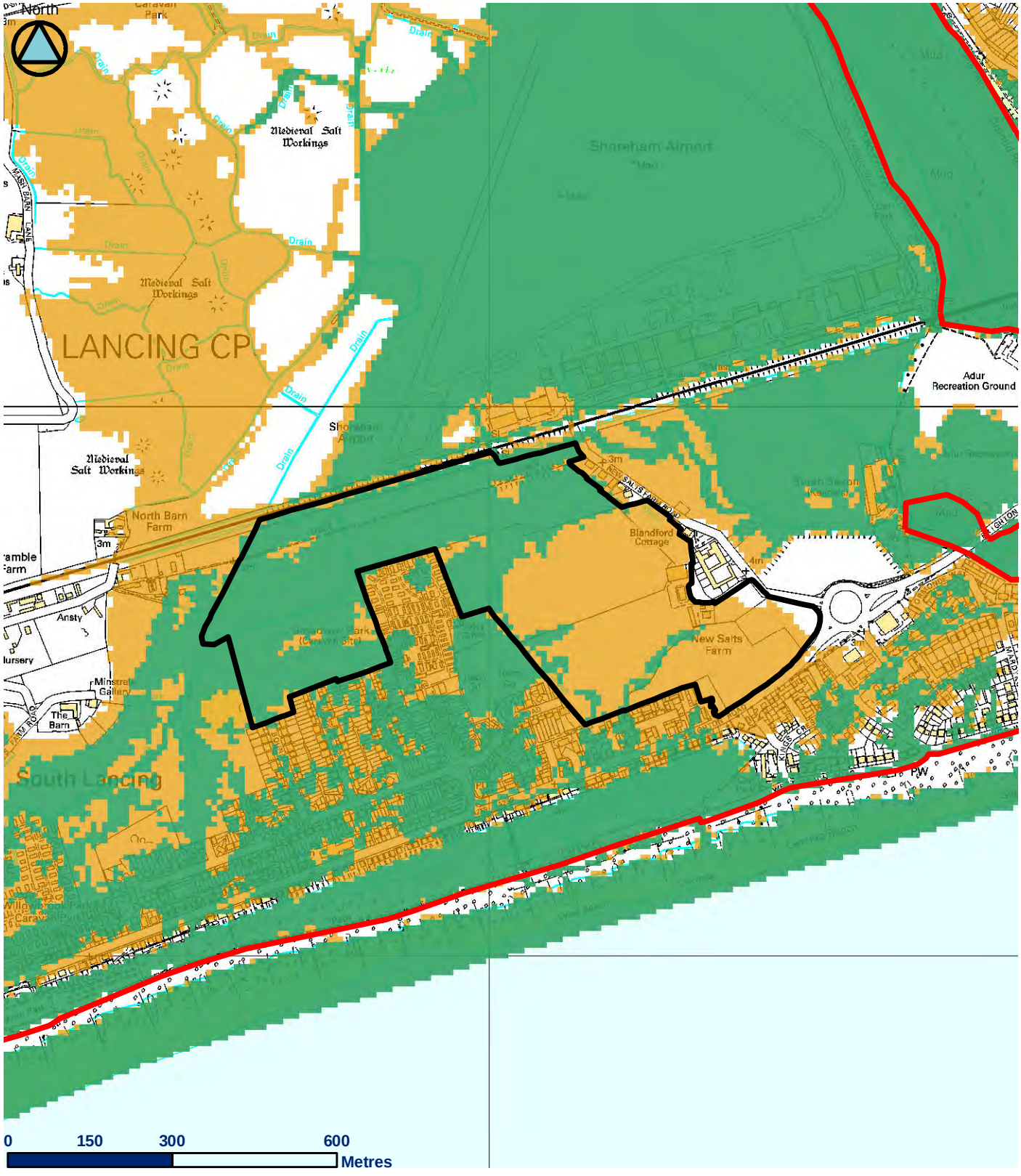
0.5% AEP Defended

- Present Day
- Future 2070
- Future 2115

Land to the North East of the Hasler Estate

Future Tidal Flood Risk (with defences)

Adur and Worthing SFRA update
Flood Risk Summary Map



Legend

- Land to the North East of the Hasler Estate
- Defences

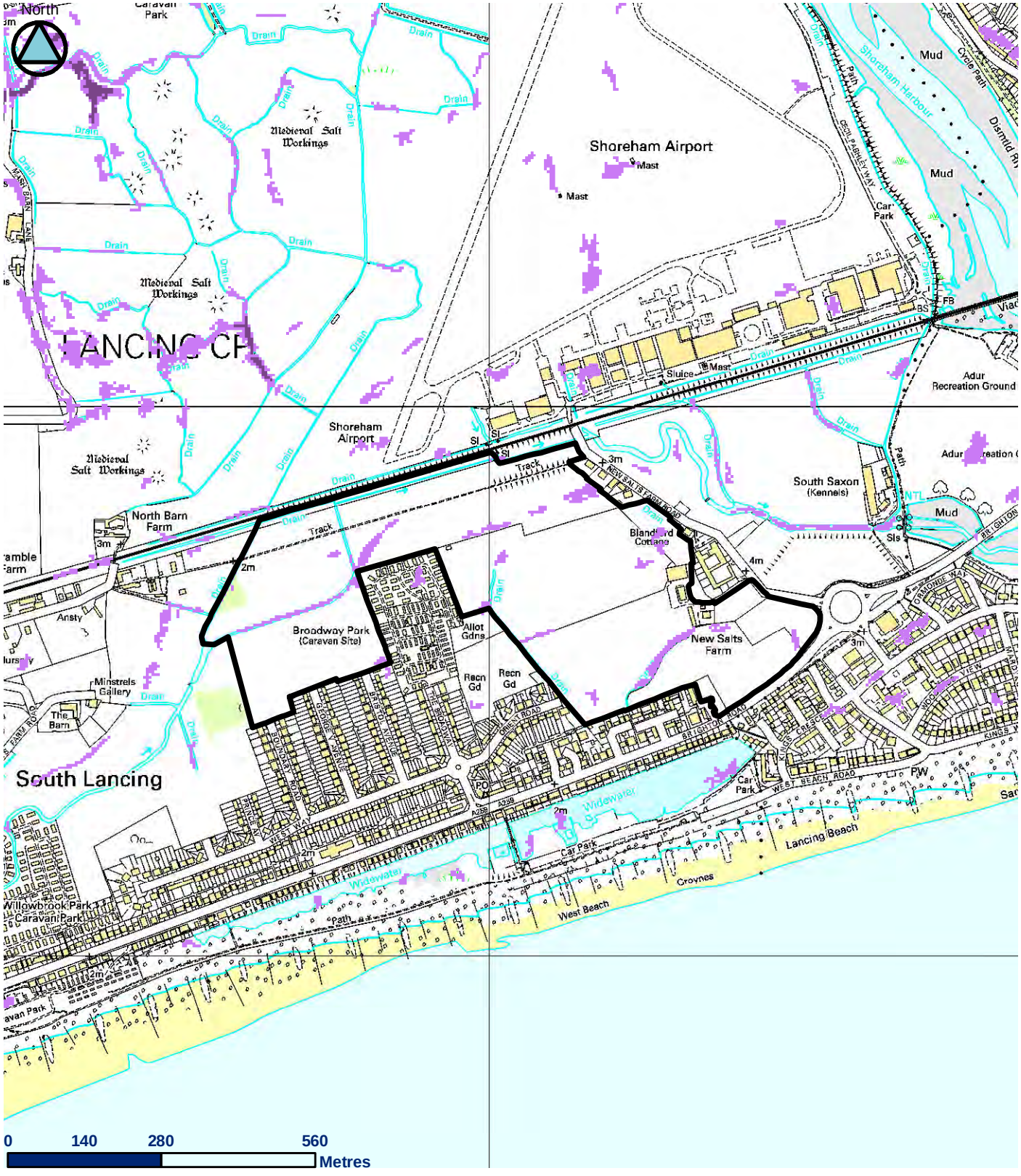
Defended present day with wave overtopping

- 5% AEP
- 0.5% AEP

Land to the North East of the Hasler Estate

Residual Tidal Flood Risk
Wave Overtopping

Adur and Worthing SFRA update
Flood Risk Summary Map



Legend

Land to the North East of the Hasler Estate

Depth

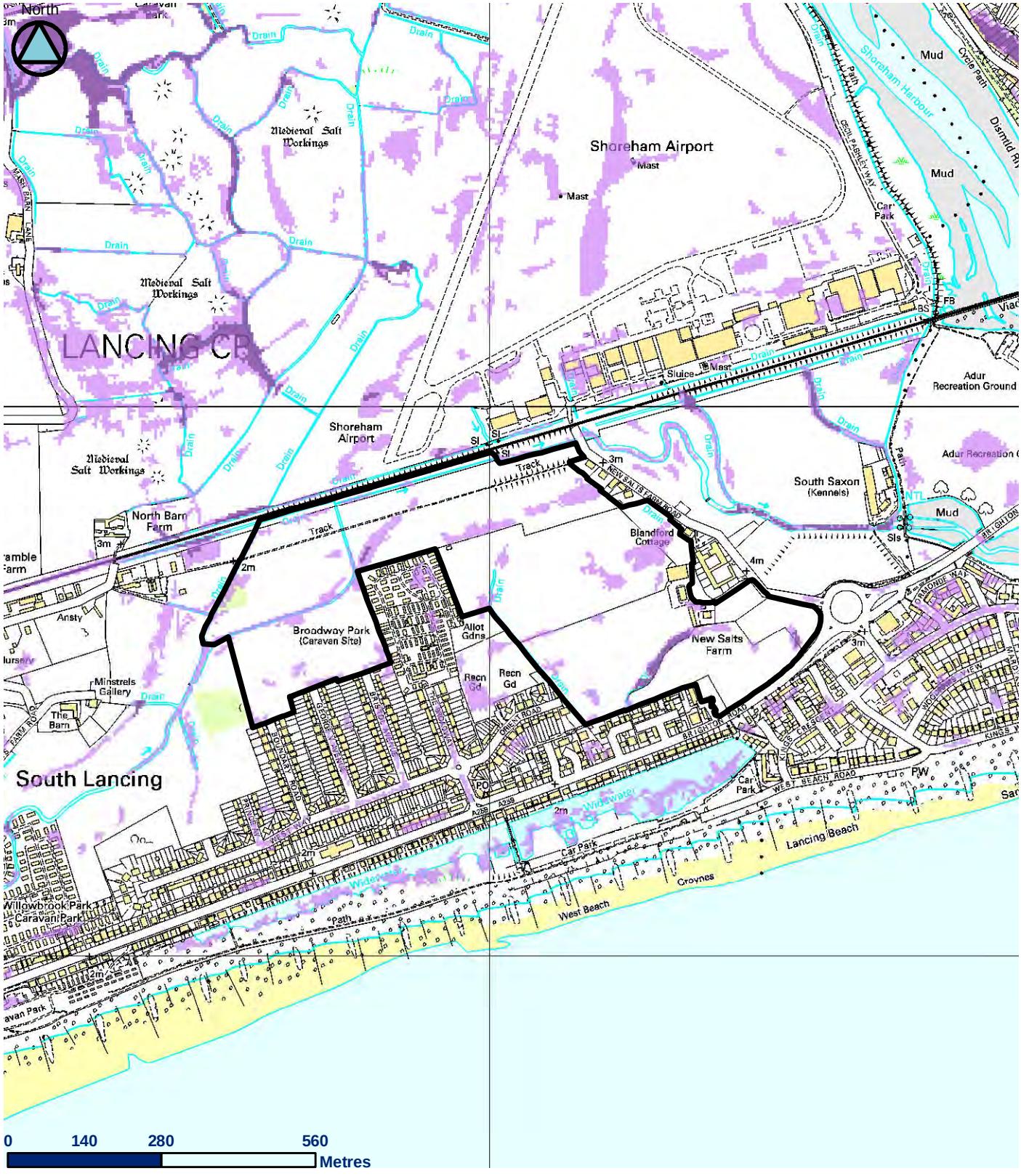
> 0.1m

> 0.3m

Land to the North East of the Hasler Estate

Surface Water Flood Risk
(Flood Map for Surface Water 1 in 30 year)

Adur and Worthing SFRA update
Flood Risk Summary Map



Legend

Land to the North East of the Hasler Estate

Depth

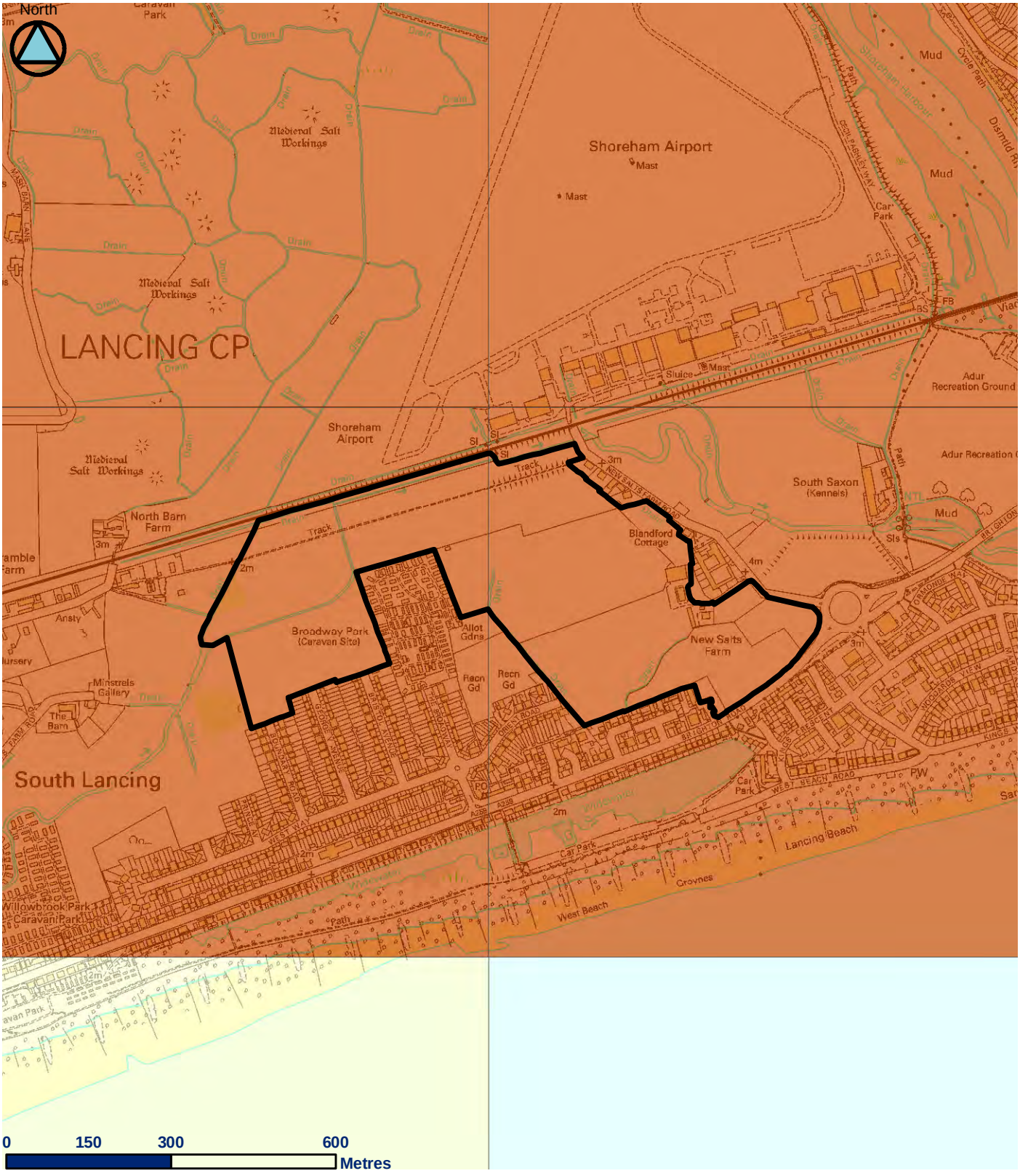
> 0.3m

> 0.1m

Land to the North East of the Hasler Estate

Surface Water Flood Risk
(Flood Map for Surface Water 1 in 200 year)

Adur and Worthing SFRA update
Flood Risk Summary Map



Legend

Land to the North East of the Hasler Estate

AStGWF

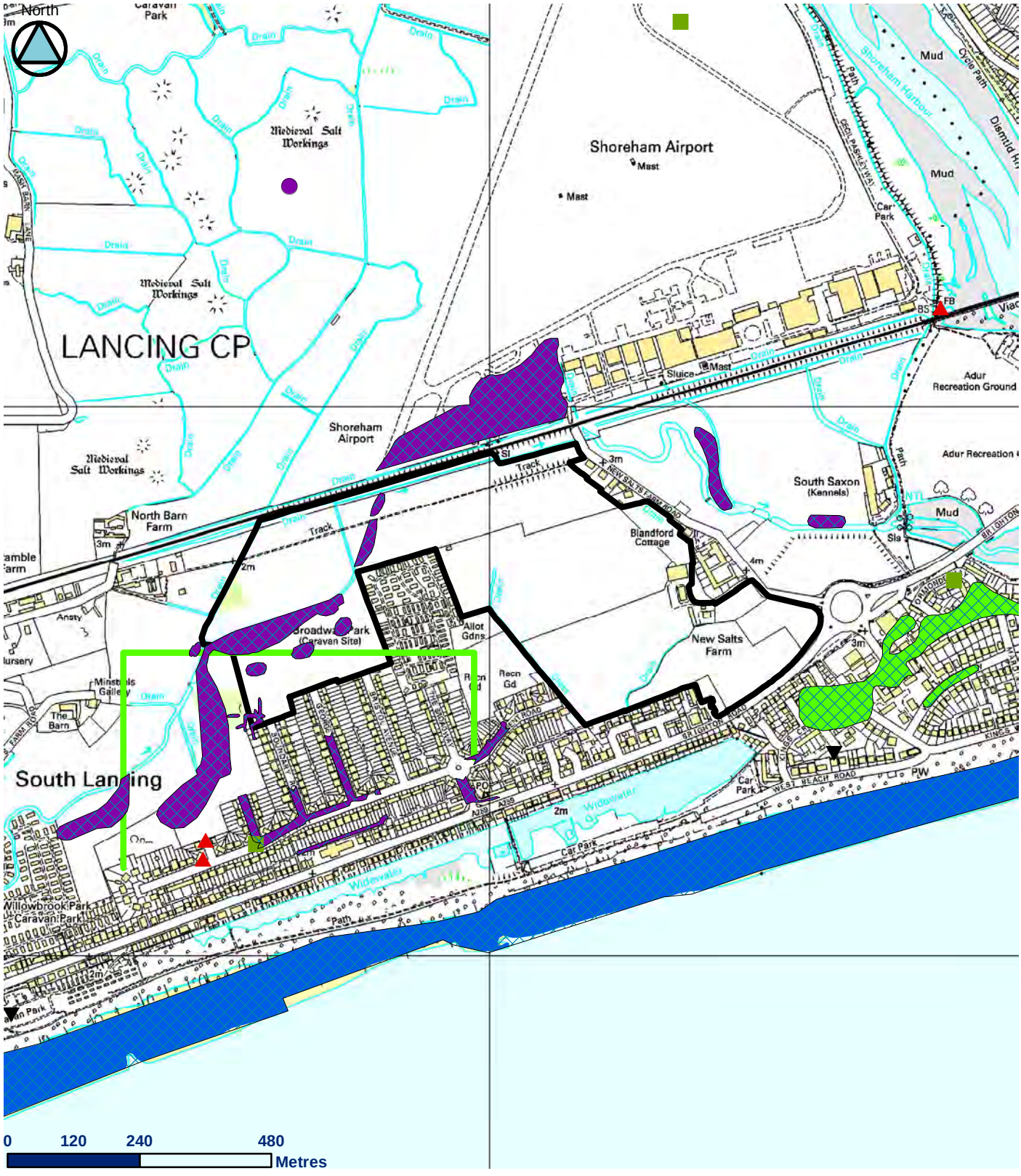
RISK

- >= 75%
- >= 50% <75%
- >= 25% <50%
- < 25%

Land to the North East of the Hasler Estate

Groundwater Flood Risk
(Areas Susceptible to Groundwater Flooding)

Adur and Worthing SFRA update
Flood Risk Summary Map



Legend

- Land to the North East of the Hasler Estate
- EA Historic Flood Map
- Fluvial Flooding
- Sewer Flooding
- Unknown Flooding
- Coastal Flooding
- Surface Water Flooding
- Surface Water Flooding
- Surface Water Flooding
- Tidal Flooding
- Tidal Flooding

Land to the North East of the Hasler Estate

Historic Flooding

North

ADUR DISTRICT COUNCIL

Worthing BOROUGH COUNCIL

LEGEND

Adur and Worthing Boundary

Flood Defence Type

- coastal protection (man-made)
- coastal protection (natural)
- culverted channel
- maintained channel
- raised defence (man-made)
- raised defence (natural)
- sea defence (man-made)
- sea defence (natural)

JBA consulting

Map 16
Flood Defences

Scale 1:55,000

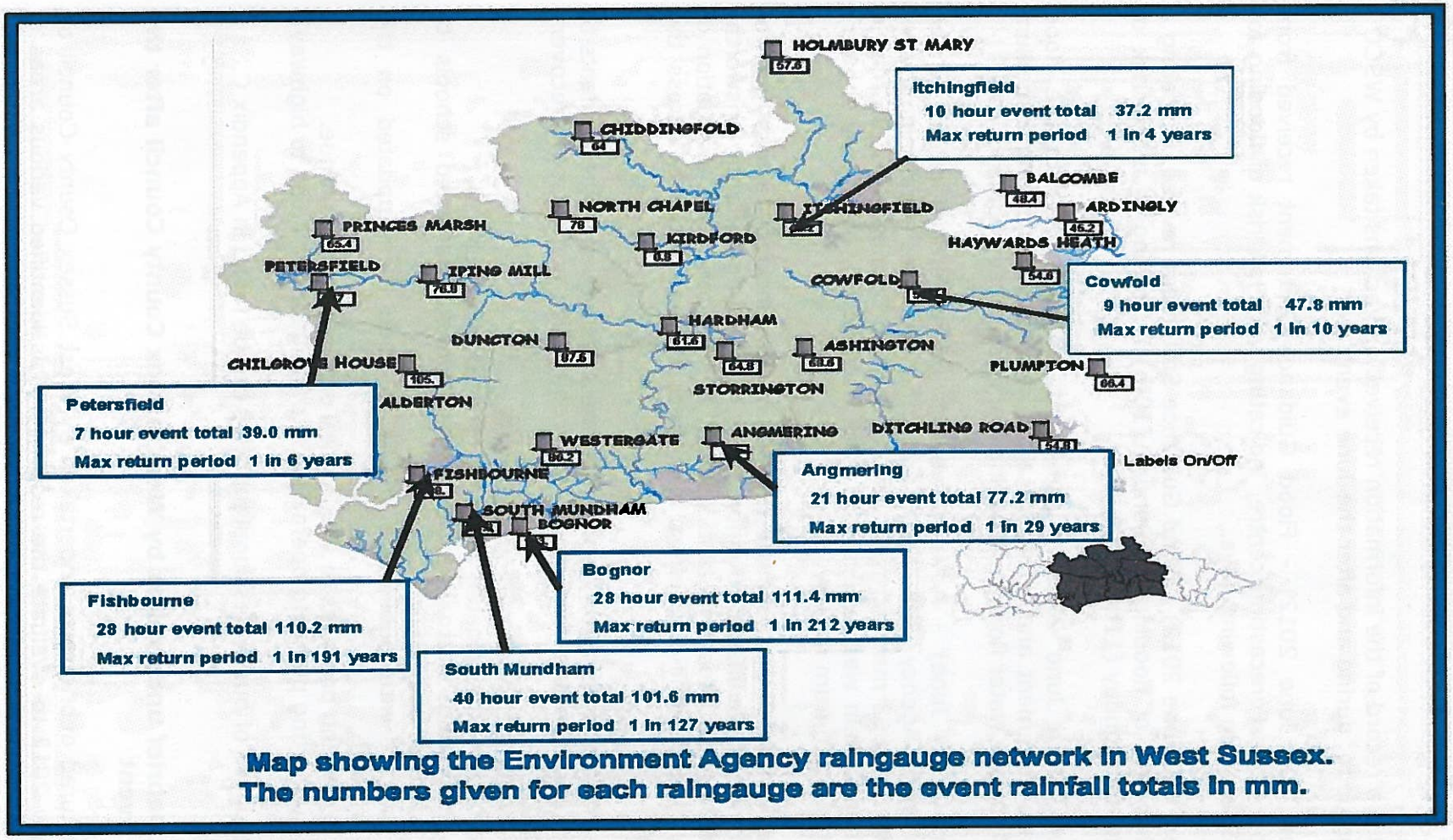


Figure 3 – Environment Agency rain gauge network across West Sussex.

Appendix H – Lancing SWMP Extracts

SECTION 4

Flooding history

4.1 Summary of flooding

There is good anecdotal evidence of flooding within Lancing from the wet winters of 2012/13 and 2013/14, and ongoing reporting from local residents throughout 2014 and 2015. Local residents have provided detailed information on the timing, location and impacts of flooding in Lancing. This has enabled a comprehensive picture of flooding to be established over the past two to three years. Flooding in Lancing has been a long-standing problem, but the best anecdotal evidence of flooding is from the last two to three years. Given that 2013/14 was the wettest winter on record it is reasonable to assume that the available anecdotal evidence from the past two to three years provides a good basis to assess the flooding impacts. Table 4-1 provides an overview of the key locations affected by flooding in Lancing.

Table 4-1 Locations affected by flooding in Lancing

Location	No. properties flooded internally[16]	Other impacts	Dates of flooding
Grinstead Lane, Manor Way, Manor Close	Two garages flooded in Manor Way	Extensive flooding on Grinstead Lane (impassable), restricted toilet use, garden flooding, and overpumping of foul network into ditch network	December 2012 and December 2013 January 2015 although flooding impacts significantly reduced
Old Shoreham Road[17]	None	Flooding on Old Shoreham Road Garden flooding	December 2012 and December 2013, January 2014 and 2015
Barfield Park and Monks Avenue	1 home affected on Barfield Park 1 property flooded near Monks Avenue/Hadlow Way	Garden flooding in other locations	December 2013, Summer 2014
The Paddocks	None, but some garages affected	Flooding on the highway	Flooding occurred regularly following heavy rainfall (until work completed (see Section 2.4.3)
West Beach Estate	None	Flooding across most of The Broadway, and parts of Westway and Prince Avenue	Flooding occurs regularly
A27	None	Northern carriageway of A27 flooded	December 2013
Shoreham Airport	None	Airport flooded, although main runway was still operational	December 2013

[16] Defined as flooding within a building, and includes the main buildings / garages of a property

[17] This refers to the cul-de-sacs south of the A27 (NB: The A27 is also known as Old Shoreham Road)

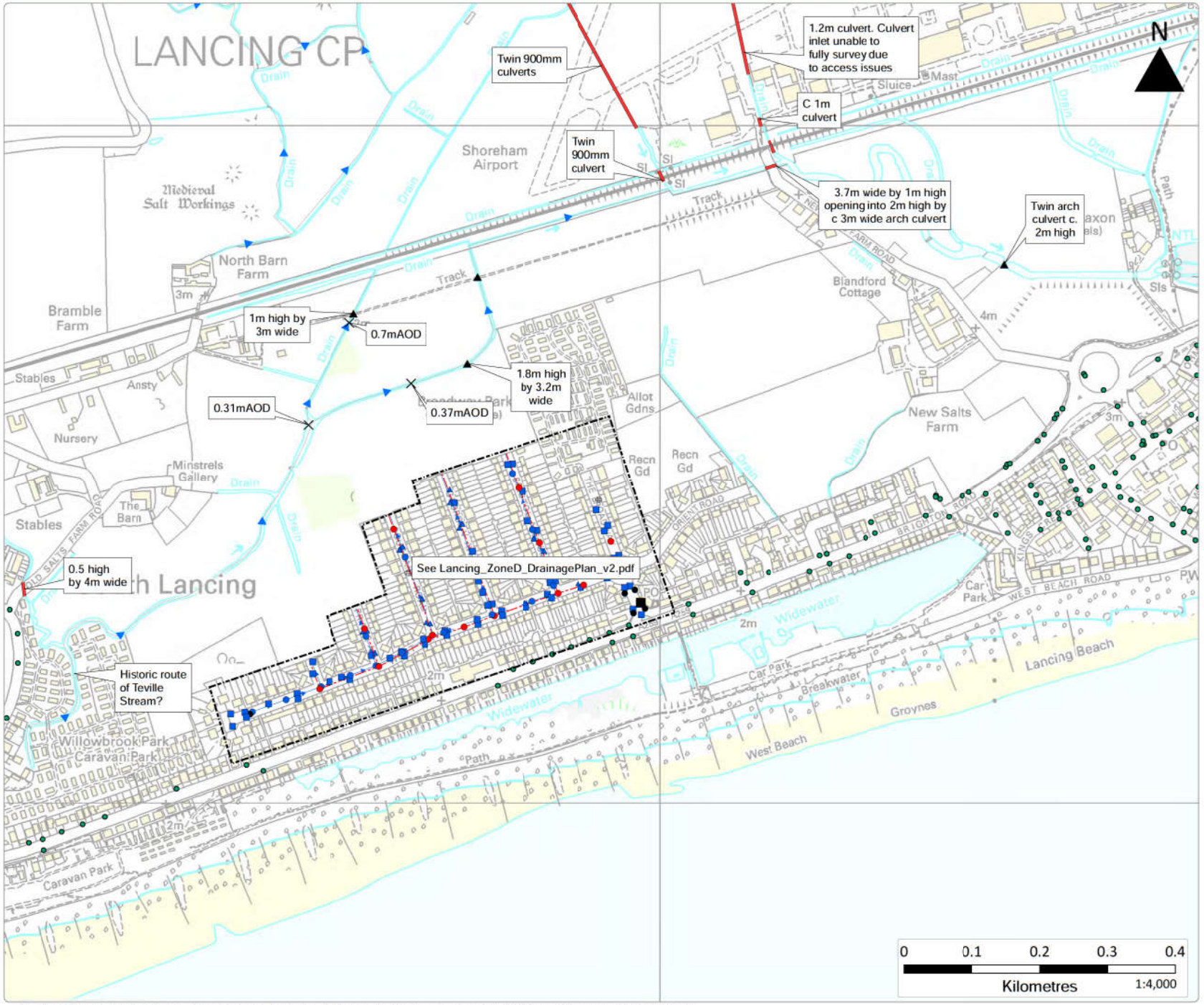
Table 5-1 Summary of flooding reports from residents of West Beach Estate (bold & italic text identifies a linked event)

ID	Date/Time flooding	Date/time high tide	What is flooded? And to what extent? (All are quotes from local residents)		Other useful information	Level of high tide (mAOD)	Groundwater level at Sussex PAD (mAOD)	Rainfall total (Applesham Farm)	Dry / Wet	Tide level at time of flood
			The Broadway	The Westway						
1	05/11/2013 2:30pm	05/11/2013 12:05pm				6.61	1.36	25.6mm two days earlier2.2mm	Wet	High
2	27/12/2013 7:00am	27/12/2013 05:43am	The Broadway is continually flooded from the entrance to the crossroads 6-9 inches deep		The flood Plain behind West Beach is pooling on Old Salts Farm	5.06	2.17	4.2mm on 27/11, 10.9mm on 26/11	Wet	Low
3	01/01/2014 2:00pm	01/01/2014 10:49am	Was flooded to the centre of the road but numerous cars including a lowered mini was able to enter/exit the estate area		All areas were deep, making it difficult to drive through	6.51	2.29	12.2mm on 01/01, 11.5mm on 31/12	Wet	High
4	10/08/2014 Time Unknown		The Broadway is continually flooded	West beach is continuing to flood badly all this week		Tide >6m	1.31	17.8mm on 08/08 and 4.5mm on 09/08 and 7.5mm on 10/08	Wet	High
4a	***13/08/2014 4:10pm***	***13/08/2014 1:59pm***	***Unknown***	***Flooding either side of Westway above ankle deep, but not to middle of road***		***6.96***	***1.30***	***1mm on 13/08, 12/08 dry***	***Dry***	***High***
5	25/08/2014 7:00am				Flooding of woodland area	Tide <6m	1.31	29.2mm on 25/08	Wet	Low
6	11/09/2014 3:00pm	11/09/2014 1:38pm		Flooding either side of Westway limited to one side of the road	Water bubbling up onto Westway (video). Water drained away by 5.30	6.96	1.27	Dry	Dry	High
7	08/10/2014 1:00PM	08/10/2014 11:50am	Unknown	Flooding across most of width of Westway. Fairly deep in places	The flood plain behind west beach is now flooded. Prince Avenue flooded	6.74	1.32	5.3mm 08/10 and 20.0mm on 07/10	Wet	High
8	22/10/2014 1:30PM	22/10/2014 11:06am			Prince Avenue flooded across whole width of road	5.66	1.37	Unknown	Unknown	Low
9	03/11/2014 09:00am	03/11/2014 7:50am	Broadway flooded, extent / depths unknown	Westway also flooded, extent unknown?	Roads were at 9am. About a foot of concrete was not under water. Water still sitting in Westway and Broadway at 6pm	5.62	1.40	18.3mm on 02/11 and 13.8mm 03/11	Wet	Low
9a	***07/11/2014 12:15pm***	***07/11/2014 11:13am***	***Broadway flooded, extent / depths unknown***	***Westway flooded, half way across the road but quite deep. Also looks to be flowing***		***6.54***	***1.42***	***5.1mm on 06/11 and 5.2mm on 07/11***	***Dry***	***High***
9b	***08/11/2014 1:30pm***	***08/11/2014 11:54am***	***Broadway flooded, extent / depths unknown***	***Flooding across most of width of Westway. Fairly deep in places***	***Also flooded 9th November 2014, high tide was 6.32m AOD***	***6.49***	***1.43***	***13.7mm on 08/11***	***Wet***	***High***

ID	Date/Time flooding	Date/time high tide	What is flooded? And to what extent? (All are quotes from local residents)		Other useful information	Level of high tide (mAOD)	Groundwater level at Sussex PAD (mAOD)	Rainfall total (Applesham Farm)	Dry / Wet	Tide level at time of flood
			The Broadway	The Westway						
9c	***10/11/2014 3.25pm***	***10/11/2014 1:13pm***	***Broadway badly flooded across whole length of road, buses couldn't stop at edge of road***		***Orient Road flooded near junction with Broadway***	***6.05***	***1.51***	***0.3mm on 10/11***	***Dry***	***High***
10	23/11/2014 1:00pm	23/11/2014 11:26am	The Broadway / Orient Rd are flooding badly again. Flooding almost across the total width of the road	Limited flooding on Westway?	Broadway north of junction also flooded one side of the road	6.24	1.83	9.4 on 22/11 and 15.3mm on 23/11	Wet	High
10a	***28/11/2014 Time Unknown***		***Refer to previous photographs of the flooding on the Broadway and crossroads of Westway / Orient Road***		***The flooding has been constant and not abated ,yesterday it was across the entire road and causing problems with the flow of traffic especially smaller cars which have to travel down the centre of the road***	***Tide <6m in afternoon***	***1.91***	***10.8mm on 25/11, .88mm on 26/11 and 0.3mm on 28/11***	***Wet***	***Low***
11	12/12/2014 09:30am		Broadway and crossroads Orient Road and Westway almost across road near junction with A259		Just to keep you informed The Broadway is still partially flooded 2 days after the precipitation	Not linked to high tide	1.85	14.7mm on 11/12 and 0.2mm on 12/11	Wet	Low
11a	***17/12/2014 3:30pm***		***The Broadway is badly flooded nearly to the middle of the road but still passable. Corner of Orient Flooded***	***No flooding on Westway***	***Low tide but heavy precipitation.***	***Tide <5m***	***1.76***	***13.2mm on 16/12 and 1.4mm on 17/12***	***Wet***	***Low***
11b	***19/12/2014 12:00pm***		***Broadway flooded, but less water compared to 2 days earlier. Still across most of road***			***Tide <5.5m***	***1.72***	***6.8mm on 18/12 and 0.1mm on 19/12***	***Dry***	***Low***
12	03/01/2015 Time Unknown		The Broadway badly flooded , cascading water off A 259 , reaching middle of road etc as previous	No flooding on Westway	Unsure of time of flood, email was as 12:47pm	Tide <5.75m	1.81	9.4mm on 02/01 and 5.6mm on 03/01	Wet	Low
13	08-01-2015 11:00am		The Broadway badly flooded , cascading water off A 259 , reaching middle of road etc as previous	Flooding Westway half way across road, focussed on area between George V and Bristol Avenue		Not related to tide level	1.88	23.6mm on 07/01 and 17.9mm on 08/01	Wet	Low
14	14-01-2015 3:35pm		The Broadway junction floods in all four directions (into Orient Rd, up and down Broadway as well as into the Westway). If it rains heavily, the whole junction floods heavily	Not flooded		Low tide 2 hours earlier	2.50	11.3mm on 14/01	Wet	Low
14a	***17-01-2015 11.30am***		***Majority of Broadway flooded***	***Not flooded***		***High tide @ 8am, only 5.2m AOD***	***2.79***	***4.7mm on 17/01***	***Dry***	***Low***
15	23-01-15 2.30pm	23-01-15 @1.30pm	Flooding but still receding	Water bubbling up through Westway, but only isolated flooding		6.83	2.60	6.6mm on 23/01	Dry	High

ID	Date/Time flooding	Date/time high tide	What is flooded? And to what extent? (All are quotes from local residents)		Other useful information	Level of high tide (mAOD)	Groundwater level at Sussex PAD (mAOD)	Rainfall total (Applesham Farm)	Dry / Wet	Tide level at time of flood
			The Broadway	The Westway						
16	13-02-2015 4.00pm		The Broadway is flooded to about a quarter due to surface water runoff from the A 259 after precipitation this	pooling significantly along the curbs to a quarter of the Broadway and orient / Westway		High tide 4.97 @ 5pm	Data not yet available	Data not yet available	Unknown	Unknown

Lancing SWMP



Legend

- Manhole Data from WSCC
- Bed Level
- Farm Crossing
- Gullies
- Soakaway
- Culvert
- Open Channel
- Catchpit
- Foul Chamber
- Gully
- Kerb Inlet
- Surface Chamber
- Unknown Chamber
- Assumed Foul Pipe
- Assumed Surface Water Pipe

West Beach

CH2MHILL.

Created by: Helen Winter (02/04/2015)
Checked by: Ali Cotton (02/04/2015)

Document Path: W:\we\Urban Water Market Sectors\Urban Water UK\Projects\West Sussex SWMP framework\Lancing SWMP\GIS\Drainage_Plans_individual_Lancing_A2.mxd

TECHNICAL
NOTE

CH2MHILL®

Lancing Site Notes - Zone D

PREPARED FOR:	Ali Cotton Mike Barker
COPY TO:	Ammar Ahmad
PREPARED BY:	Pearce, Toby/UKS
DATE:	November 13, 2014
PROJECT NUMBER:	488929

The following technical note has been prepared to summarise the findings of the Lancing SWMP site walkover.

Site Overview

Zone D is comprised of the privately owned West Beach Estate. The estate is bounded to the south by the A259. The A259 is typically 400mm higher than the highways in West Beach Estate. The northern boundary of zone D is the drainage ditch downstream of zone B and C. Figure 1 shows the zone D boundary.

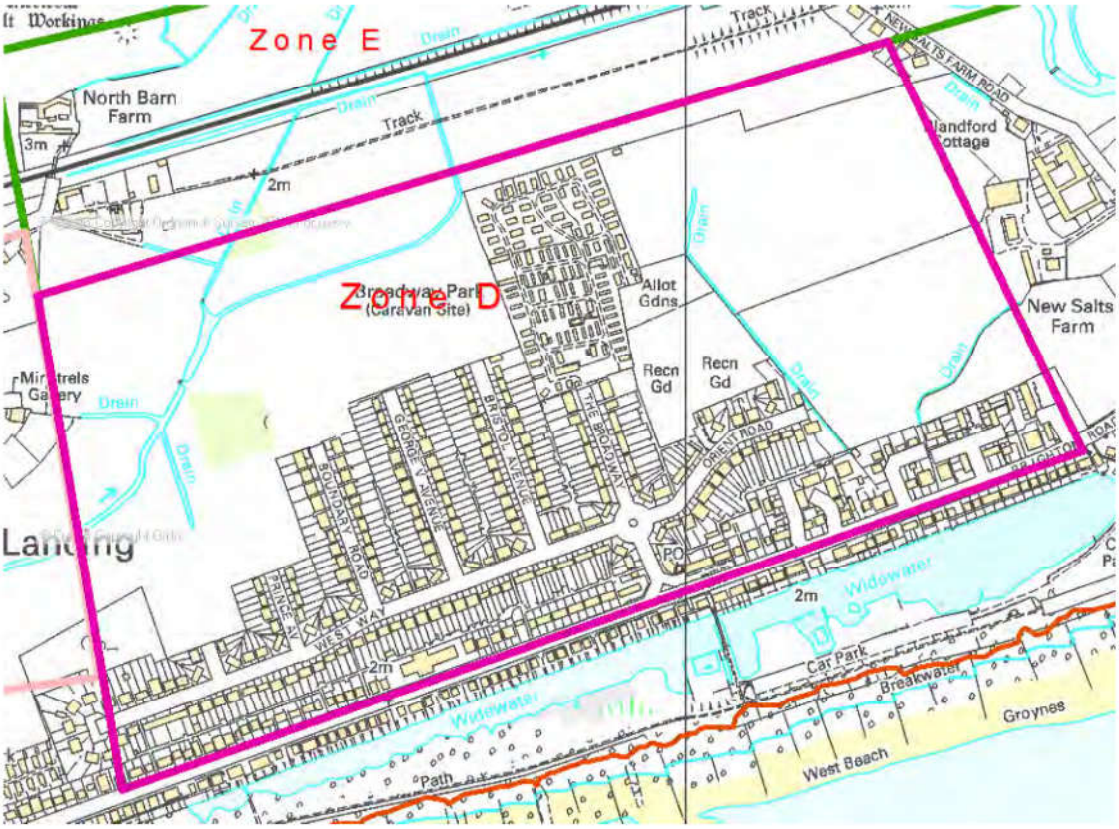


Fig.1. Zone D boundary

Ditch Network

The main ditch flows from west to east along the northern boundary of the study area. No connection was found between the surface water sewer network and the ditch network. The ditch network was heavily overgrown with reeds where it entered the zone in the west to the point where the ditch turns north adjacent to the caravan park. From this point to the northern boundary the ditch was clear of vegetation. Anecdotal evidence suggests the ditch is maintained by the landowner (farmer) in this location. Figure 2 shows the ditch where it is overgrown with reeds. Figure 3 shows the ditch where it has been cleared of vegetation.

Fig.2. vegetated section of ditch

Fig.3. Ditch maintained winter 2013

Surface Water Sewer Network

A record was collected of the location of all manholes and gullies within zone D. The survey was carried out the day after an approximately 6 hour rainfall. Siginificant flooding of the highway was observed at the entrance to West Beach Estate from the A259 'Brighton Road' as shown in figure 4. It was not possible to view inside gullies at this point due to the high water level. Although not accurately measured there was no discernable change in water level here throughout the day despite the changing tide levels. These gullies at the entrance to the estate drain to a soakaway. This area at the entrance is the lowest topographical point in the estate according to the digital terrain map (DTM).

The survey of manholes and gullies in the remainder of the estate found that surface water sewers ran in a northerly direction along all the minor roads coming of West Way. Surface water sewers were found in West Way however the connectivity of these sewers is unknown. Figure 5 shows a typical manhole along West Way at the head of Boundary Road.

Fig.4. Surface water flooding at entrance to West Beach Estate

Fig.5. Manhole at head of Boundary Road

Outlets to these surface water sewers have recently been excavated at the head of Bristol Avenue and George V Avenue. No outlets were found at the end of the other roads within the estate. Figure 6 shows the outlet at the head of George V Avenue. The existing ground level at the end the roads in West Beach Estate is typically 650 mm higher than the ground level adjacent to the ditch at the north of site D.

Fig.6. Surface water sewer outlet at end of George V Avenue

in the aquifers during the period of groundwater measurement. The monitoring showed that the aquifers layers respond separately to the influence of recharge and discharge, with a time lag in response between the two layers. Additionally, due to the clay/alluvium acting as an aquiclude the pressure in the Chalk aquifer was found to be artesian after the period of heavy rainfall during February. The Chalk aquifer in this location was therefore behaving as a confined aquifer with groundwater in the superficial layer acting as a perched water table. Based on this evidence, there is no significant contribution to surface water flows from the underlying Chalk in this location. There was found to be a tidal influence in the Chalk aquifer at BH07. The groundwater level was found to react quickly to the diurnal tidal cycle. Elevated levels of sodium and chloride were recorded for BH07D only. It was concluded that this was representative of a more direct and deeper hydraulic link to groundwater in the Chalk beneath the Adur estuary or beneath the coast.

The report recommended that the development site was not at risk of groundwater flooding, provided that the development did not disturb the geological units (i.e. development did not extend into the Chalk formation. As part of the review for the SWMP there is no evidence that would counter the conclusions of the New Monks Farm hydrogeological investigations. A summary description of the geology in the area can be found in Section 3.4.

2.4 Actions taken to alleviate flooding in the catchment

2.4.1 Clearance of Lancing Brooks

Collectively, the Monson and Royal Haskoning studies have considered the drainage ditch network in considerable detail to understand pinch points and remedial works required. Significant ditch clearance work was carried out by Adur and Worthing Councils and landowners in 2010 and 2013. In 2010 extensive ditch clearance was undertaken on the northern floodplain east of Mash Barn Lane[12], and on the southern floodplain south of the railway line (downstream of Barfield Park). Furthermore in 2013 the ditch sections which run through residential areas were dredged and cleared (beds lowered by up to 500mm)[13]. The ditch clearance work addresses most of the recommendations of the Monson and Royal Haskoning reports.

As part of the SWMP new and comprehensive cross-section survey of the ditch network was undertaken in in December 2014 and January 2015 to understand the current flow regime and levels of siltation and vegetation. The purpose of this was to assist WSCC and Adur and Worthing District Councils in identifying an optimal maintenance regime. The findings of the cross-section survey are described in Section 6. In January 2015 the landowner of the golf course development undertook a comprehensive clearance of the ditches.

2.4.2 Improvements to foul sewerage network

Since the winters of 2013/13 and 2013/14 Southern Water have undertaken a number of actions to reduce the risk of foul sewer flooding, including:

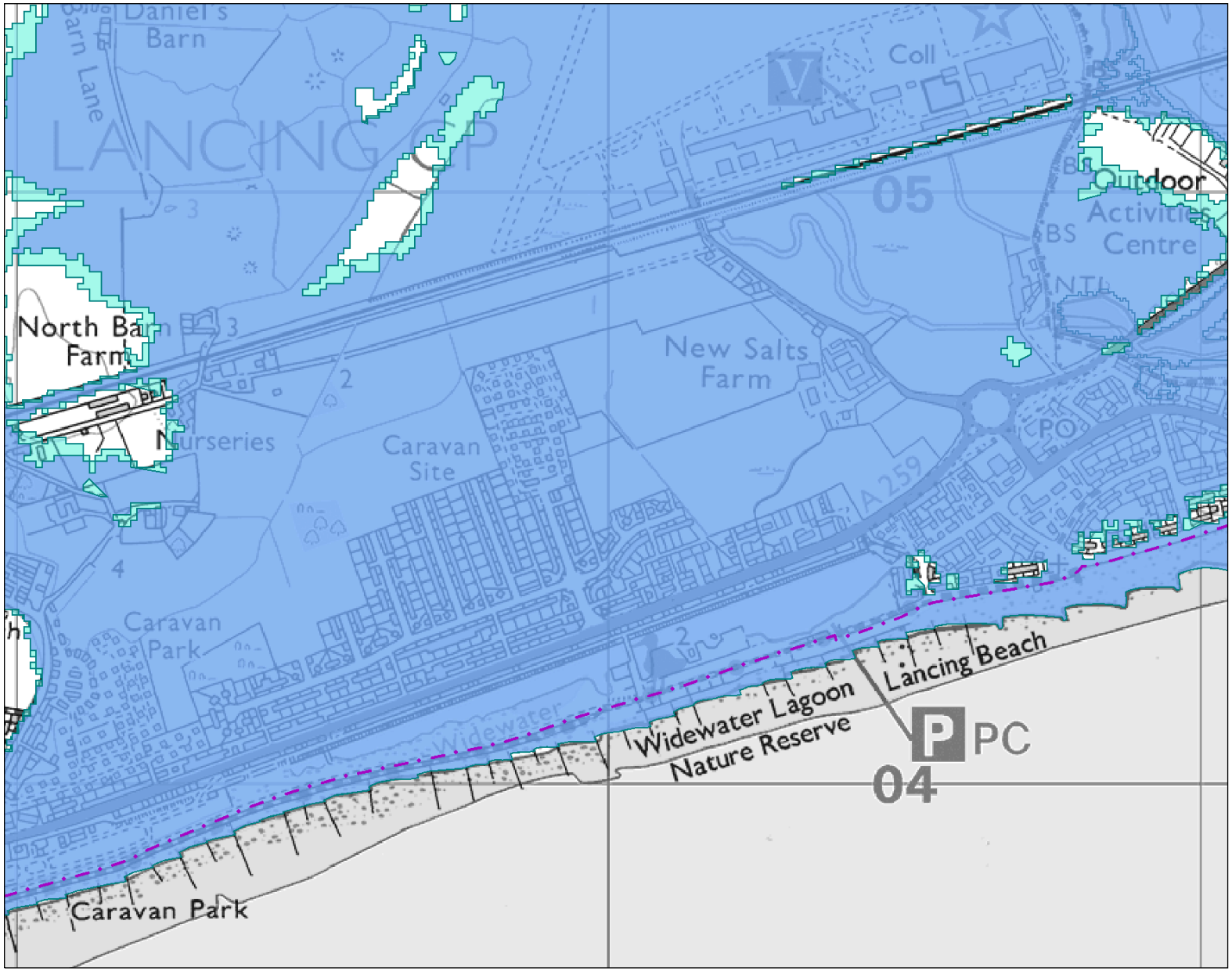
- developing an Infiltration Reduction Plan (IRP) for North Lancing which sets out the strategy for managing infiltration into the sewer network;
- sealing of the sewer network to reduce infiltration;
- installation of a level alert system which triggers a tanker call out when sewer levels go above a certain threshold, and;
- production of an Emergency Action Plan (EAP) which identifies trigger levels and associated actions depending on sewer levels and forecast flooding.

[12] In January 2015 the landowner also undertook ditch clearance of the northern floodplain within the golf course area

[13] Ken Argent, *pers. comm.*

Appendix I– EA Flood Maps

Flood Map for Planning (Rivers & Sea) centred on New Salts Farm, Shoreham - created 19/05/2015



Environment Agency

Scale 1:10,001

N W E S

Flood Map for Planning (Rivers and Sea)

- Flood Map - Defences
- Areas Benefiting from Flood Defences
- Flood Map - Flood Storage Areas
- Flood Map - Flood Zone 3
- Flood Map - Flood Zone 2

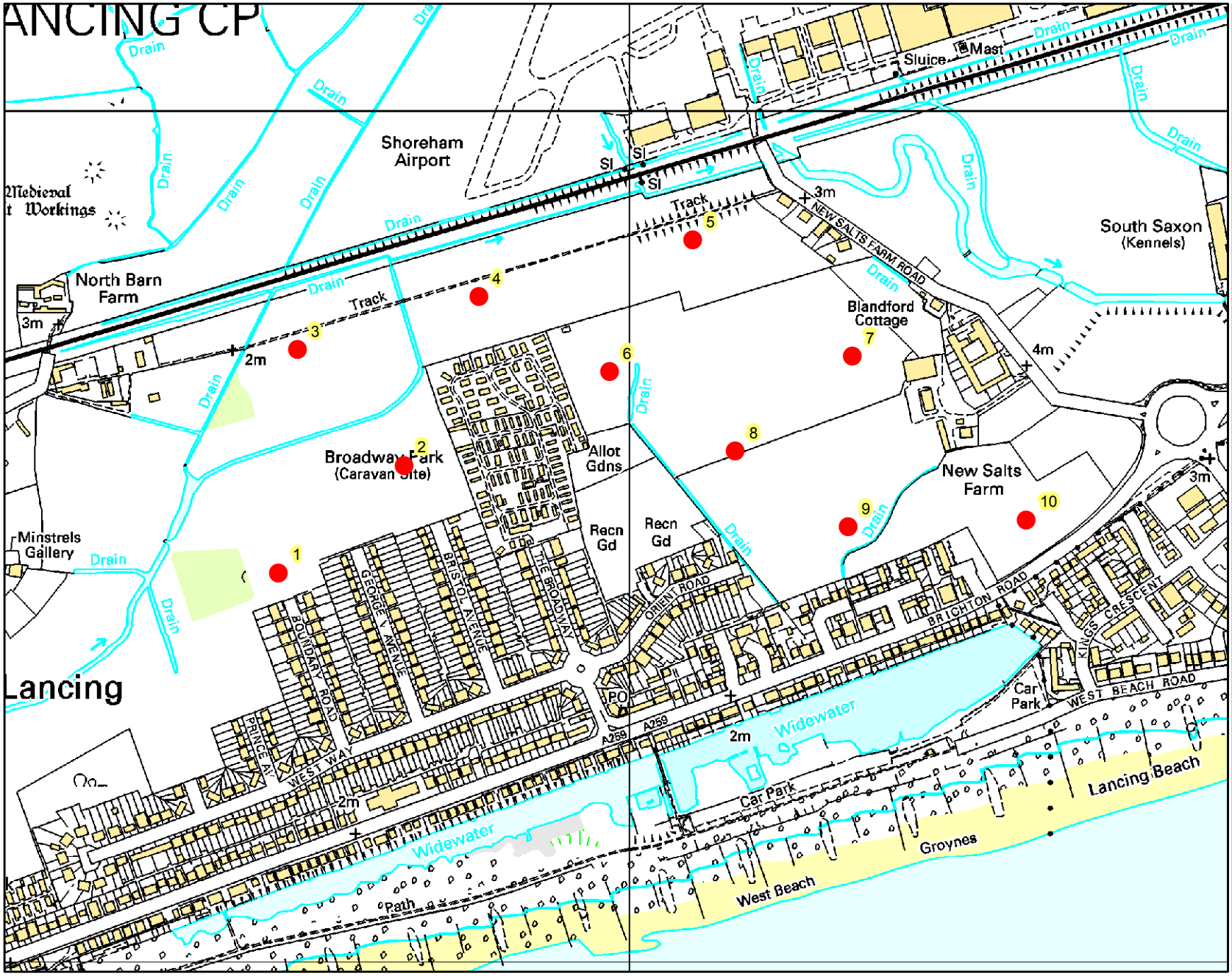
Flood Map for Planning (Rivers and Sea) (assuming no defences)

Flood Zone 3 shows the area that could be affected by flooding:
- from the sea with a 1 in 200 or greater chance of happening each year
- or from a river with a 1 in 100 or greater chance of happening each year.

Flood Zone 2 shows the extent of an extreme flood from rivers or the sea with up to a 1 in 1000 chance of occurring each year.

Contact Us: National Customer Contact Centre, PO Box 544, Rotherham, S60 1BY. Tel: 03708 506 506 (Mon-Fri 8-6). Email: enquiries@environment-agency.gov.uk

Flood Levels Location Points



Legend

- Location Points

1:6,544 *

*when printed at A4.

N

0 130 260

Metres

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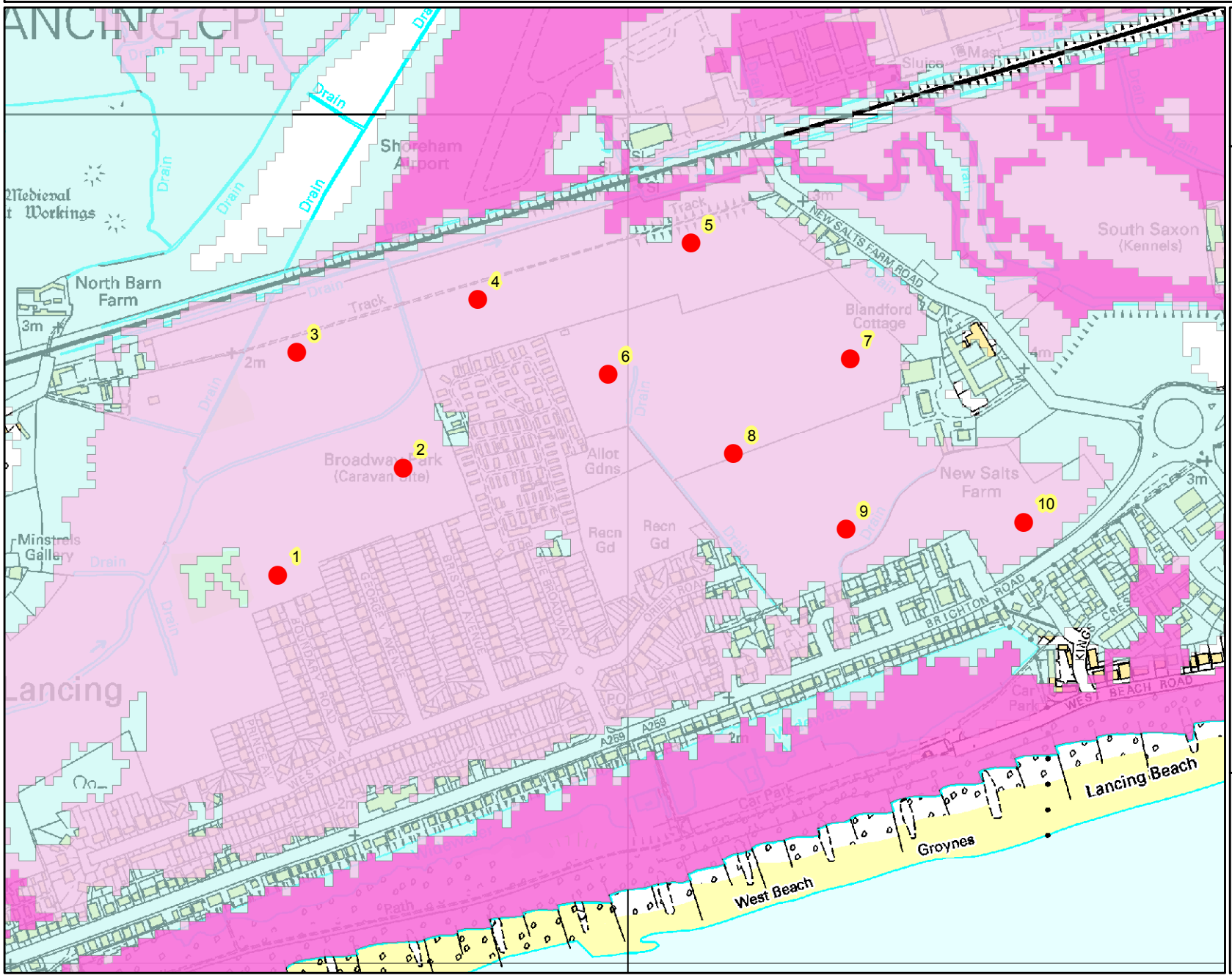
			1 in 75 undefended		1 in 200 undefended		1 in 200+cc undefended		1 in 1000 undefended	
Point	Easting	Northing	depth	height	depth	height	depth	height	depth	height
1	519,585	104,456	2.468	4.111	2.607	4.250	3.756	5.399	2.835	4.478
2	519,735	104,581	2.405	4.113	2.544	4.252	3.687	5.395	2.770	4.479
3	519,609	104,716	2.388	4.116	2.526	4.255	3.667	5.395	2.753	4.481
4	519,823	104,779	2.996	4.117	3.136	4.256	4.270	5.391	3.360	4.481
5	520,075	104,847	2.541	4.119	2.681	4.258	3.810	5.388	2.904	4.482
6	519,976	104,693	2.548	4.116	2.688	4.256	3.823	5.390	2.912	4.480
7	520,261	104,709	2.430	4.116	2.571	4.257	3.704	5.390	2.794	4.481
8	520,125	104,600	2.376	4.114	2.517	4.255	3.653	5.392	2.741	4.479
9	520,257	104,508	2.563	4.113	2.705	4.255	3.842	5.393	2.929	4.479
10	520,468	104,520	2.252	4.115	2.395	4.258	3.529	5.391	2.618	4.481

depth = metres height = mAOD

			1 in 75 defended		1 in 200 defended		1 in 200+cc defended		1 in 1000 defended	
Point	Easting	Northing	depth	height	depth	height	depth	height	depth	height
1	519,587	104,452	0.336	1.970	0.786	2.420	3.415	5.050	1.649	3.284
2	519,736	104,581	0.261	1.970	0.712	2.420	3.341	5.050	1.575	3.283
3	519,612	104,717	0.304	1.970	0.755	2.420	3.383	5.049	1.617	3.283
4	519,823	104,780	0.775	1.970	1.226	2.420	3.854	5.049	2.087	3.282
5	520,073	104,847	0.398	1.970	0.849	2.420	3.477	5.048	1.711	3.282
6	519,976	104,693	0.402	1.970	0.852	2.420	3.481	5.049	1.715	3.283
7	520,263	104,710	0.358	1.970	0.808	2.420	3.437	5.049	1.672	3.284
8	520,125	104,595	0.248	1.970	0.698	2.420	3.327	5.049	1.561	3.284
9	520,255	104,509	0.420	1.970	0.870	2.420	3.499	5.049	1.734	3.285
10	520,467	104,519	0.107	1.970	0.558	2.420	3.187	5.050	1.423	3.286

depth = metres height = mAOD

Flood Extents - Taken from Arun to Adur Flood Modelling (2012)



Environment Agency

Legend

- Location Points
- 1 in 20 year defended
- 1 in 75 year defended
- 1 in 75 year undefended

1:6,544 *

*when printed at A4.

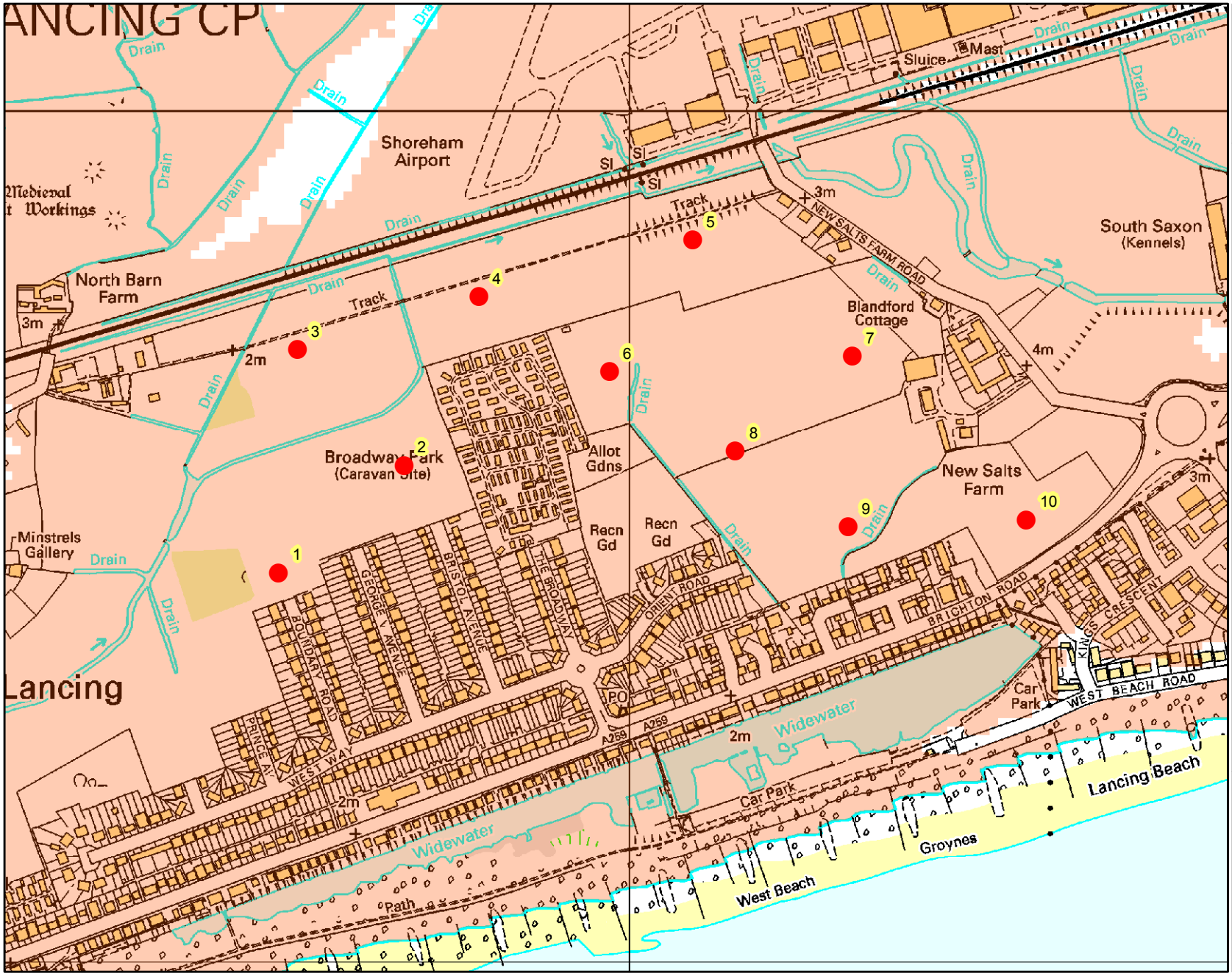
N

0 130 260

Metres

Contact Us: National Customer Contact Centre, PO BOX 544, Rotherham, S60 1BY. Tel: 08708 506 506 (Mon-Fri 8-6). Email: enquiries@environment-agency.gov.uk

Flood Extents - Taken from Arun to Adur Flood Modelling (2012)



Environment Agency

Legend

- Location Points
- 1 in 200 year undefended

1:6,544 *

*when printed at A4.

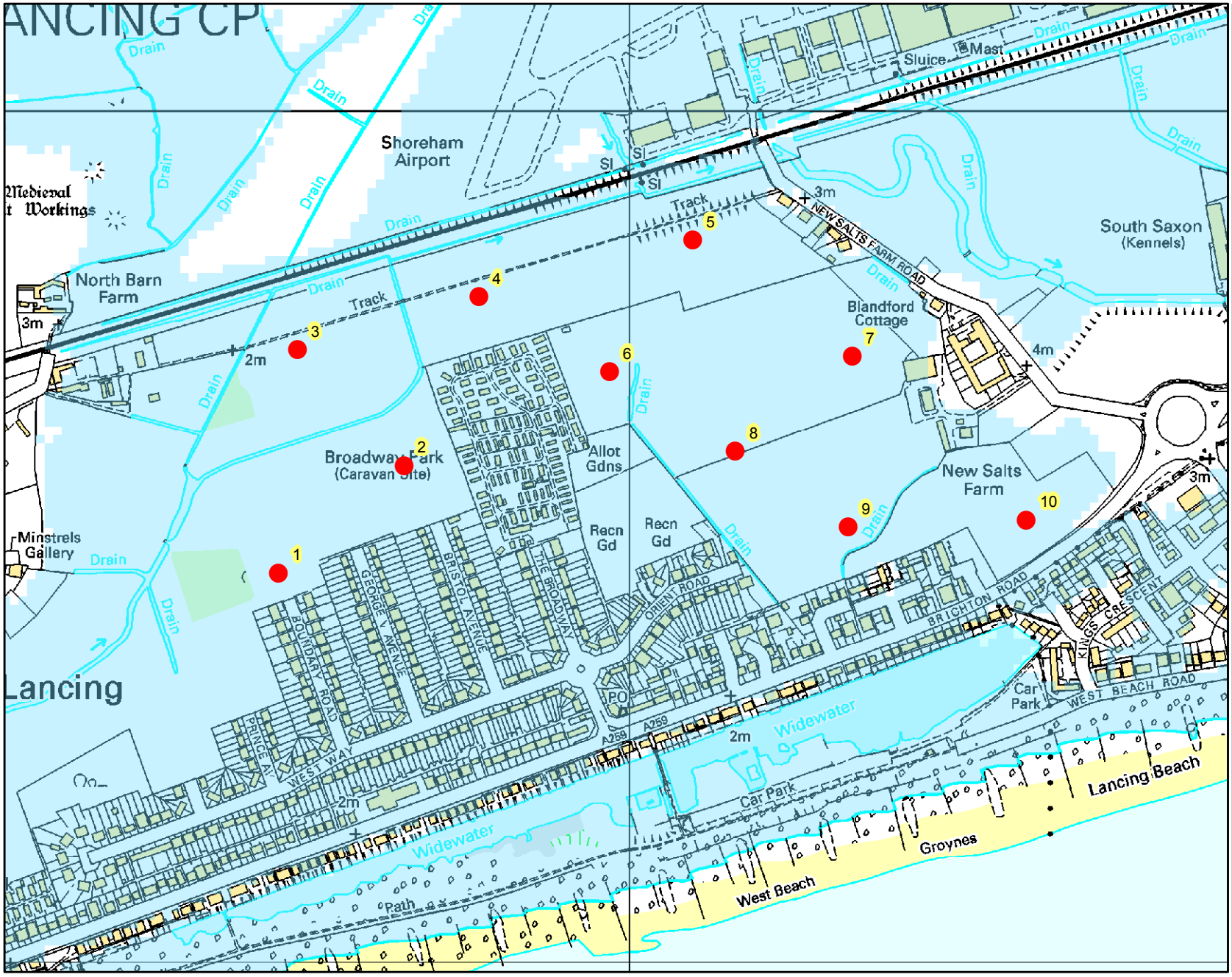
N

0 130 260

Metres

Contact Us: National Customer Contact Centre, PO BOX 544, Rotherham, S60 1BY. Tel: 08708 506 506 (Mon-Fri 8-6). Email: enquiries@environment-agency.gov.uk

Flood Extents - Taken from Arun to Adur Flood Modelling (2012)



Environment Agency

Legend

- Location Points
- 1 in 200 year defended

1:6,544 *

*when printed at A4.

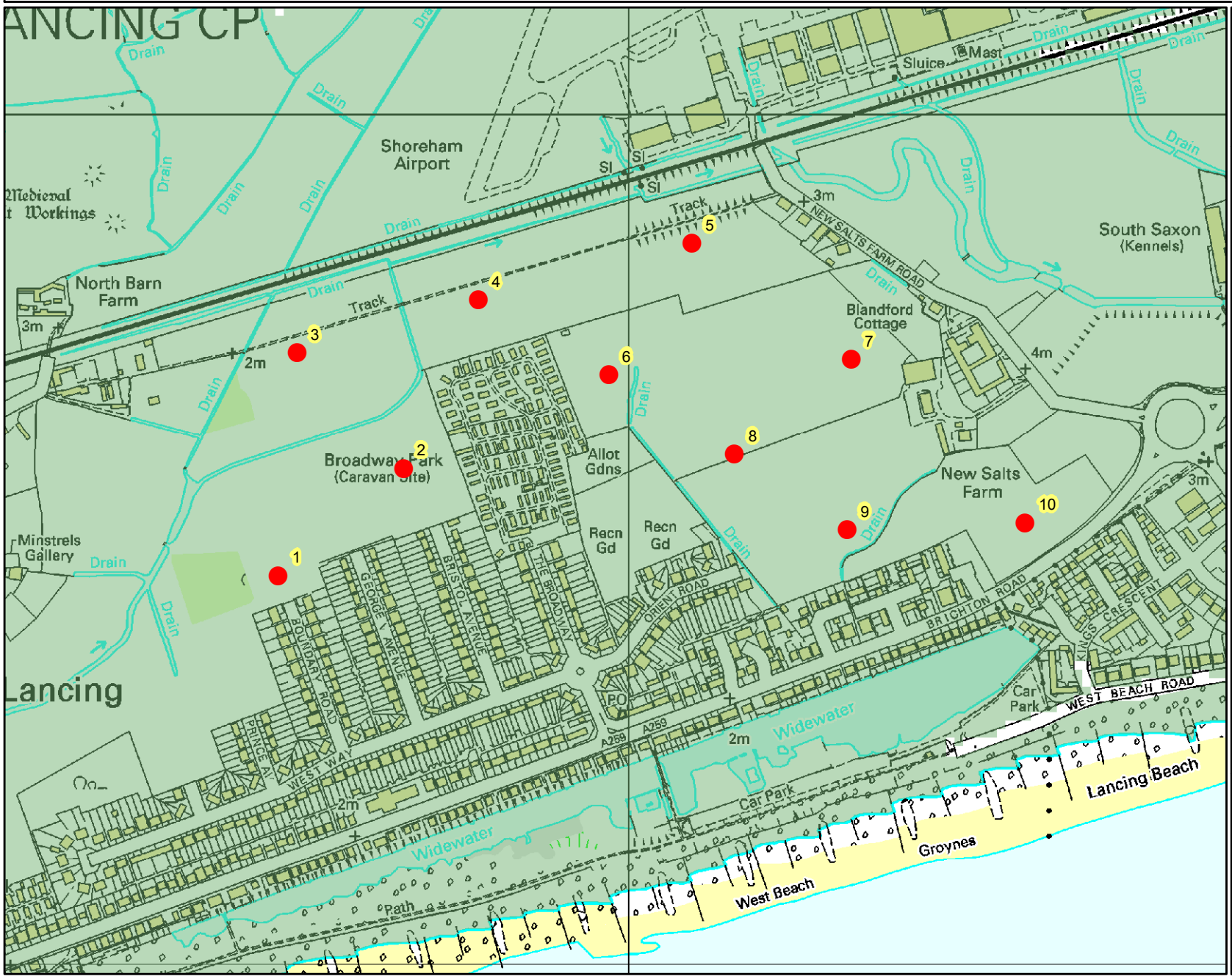
N

0 130 260

Metres

Contact Us: National Customer Contact Centre, PO BOX 544, Rotherham, S60 1BY. Tel: 08708 506 506 (Mon-Fri 8-6). Email: enquiries@environment-agency.gov.uk

Flood Extents - Taken from Arun to Adur Flood Modelling (2012)



Legend

- Location Points
- 1 in 200 year+cc undefended

1:6,544 *

*when printed at A4.

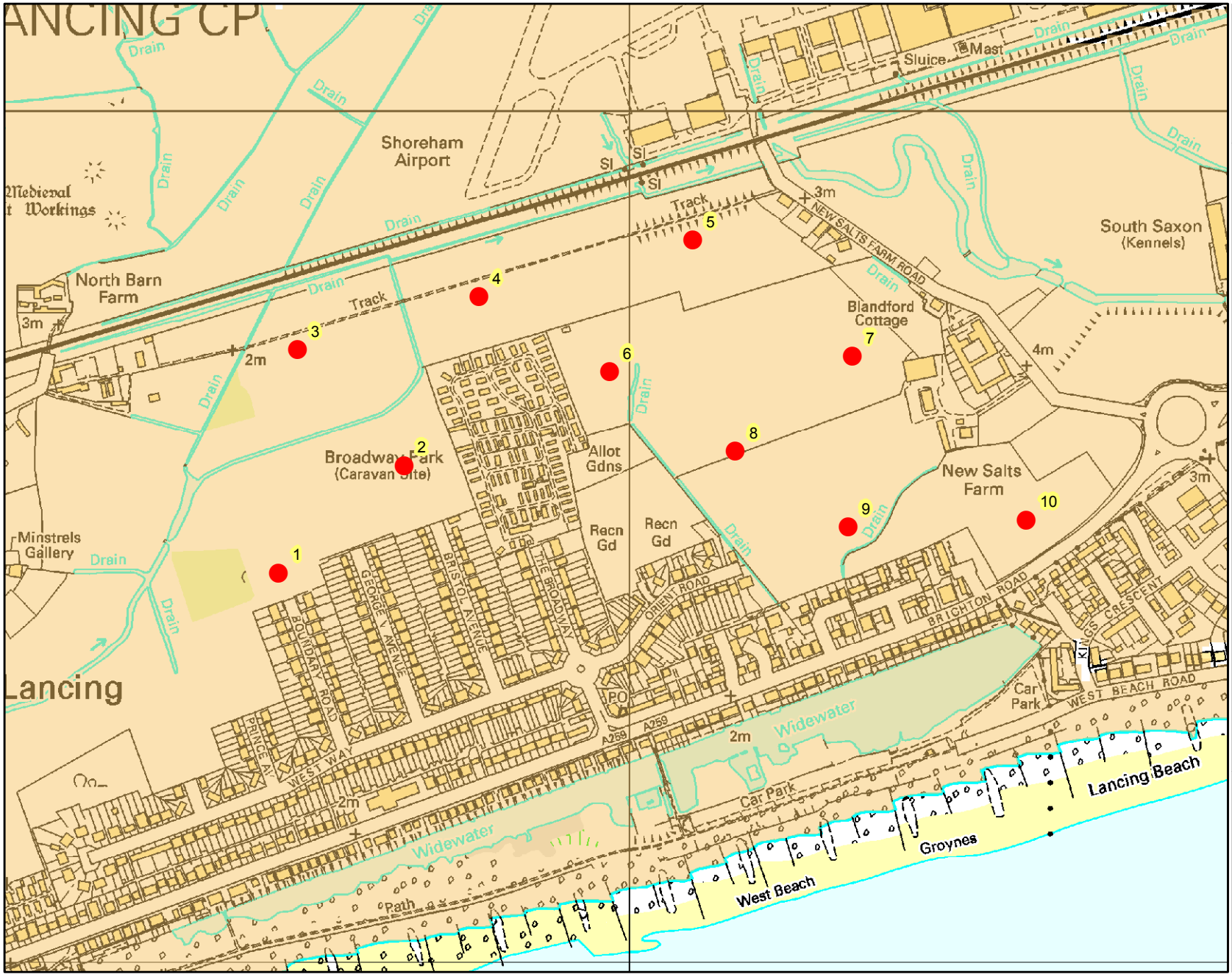
N

0 130 260

Metres

Contact Us: National Customer Contact Centre, PO BOX 544, Rotherham, S60 1BY. Tel: 08708 506 506 (Mon-Fri 8-6). Email: enquiries@environment-agency.gov.uk

Flood Extents - Taken from Arun to Adur Flood Modelling (2012)



Legend

- Location Points
- 1 in 200 year+cc defended

1:6,544 *

*when printed at A4.

0 130 260

Metres

N

Contact Us: National Customer Contact Centre, PO BOX 544, Rotherham, S60 1BY. Tel: 08708 506 506 (Mon-Fri 8-6). Email: enquiries@environment-agency.gov.uk

			1 in 75 undefended		1 in 200 undefended		1 in 200+cc undefended		1 in 1000 undefended	
Point	Easting	Northing	depth	height	depth	height	depth	height	depth	height
1	519,585	104,456	2.468	4.111	2.607	4.250	3.756	5.399	2.835	4.478
2	519,735	104,581	2.405	4.113	2.544	4.252	3.687	5.395	2.770	4.479
3	519,609	104,716	2.388	4.116	2.526	4.255	3.667	5.395	2.753	4.481
4	519,823	104,779	2.996	4.117	3.136	4.256	4.270	5.391	3.360	4.481
5	520,075	104,847	2.541	4.119	2.681	4.258	3.810	5.388	2.904	4.482
6	519,976	104,693	2.548	4.116	2.688	4.256	3.823	5.390	2.912	4.480
7	520,261	104,709	2.430	4.116	2.571	4.257	3.704	5.390	2.794	4.481
8	520,125	104,600	2.376	4.114	2.517	4.255	3.653	5.392	2.741	4.479
9	520,257	104,508	2.563	4.113	2.705	4.255	3.842	5.393	2.929	4.479
10	520,468	104,520	2.252	4.115	2.395	4.258	3.529	5.391	2.618	4.481

depth = metres height = mAOD

			1 in 75 defended		1 in 200 defended		1 in 200+cc defended		1 in 1000 defended	
Point	Easting	Northing	depth	height	depth	height	depth	height	depth	height
1	519,587	104,452	0.336	1.970	0.786	2.420	3.415	5.050	1.649	3.284
2	519,736	104,581	0.261	1.970	0.712	2.420	3.341	5.050	1.575	3.283
3	519,612	104,717	0.304	1.970	0.755	2.420	3.383	5.049	1.617	3.283
4	519,823	104,780	0.775	1.970	1.226	2.420	3.854	5.049	2.087	3.282
5	520,073	104,847	0.398	1.970	0.849	2.420	3.477	5.048	1.711	3.282
6	519,976	104,693	0.402	1.970	0.852	2.420	3.481	5.049	1.715	3.283
7	520,263	104,710	0.358	1.970	0.808	2.420	3.437	5.049	1.672	3.284
8	520,125	104,595	0.248	1.970	0.698	2.420	3.327	5.049	1.561	3.284
9	520,255	104,509	0.420	1.970	0.870	2.420	3.499	5.049	1.734	3.285
10	520,467	104,519	0.107	1.970	0.558	2.420	3.187	5.050	1.423	3.286

depth = metres height = mAOD

Appendix J – Indicative Drainage Drawing

General Notes

Legend

Swale/Piped ditch
(Infiltration – swale 400–500mm deep)
(Conveyance – piped at road crossings

Blue roof
(Discharge into permeable paving sub–base at <0.25 l/s)

Bioretention area
(Infiltration – exceedance storage set 200–300mm below adjacent ground levels)

Permeable paving
(Infiltration – 450–600mm thick pavement, OGCR accommodates 100yr+30% return period storm event)

Existing Watercourse/ditch
Drain

Drainage Channel
(Drainage channel 15m wide x 1.5m deep)

All highways, parking areas and private drives to be formed of permeable paving (full infiltration). Sub–base structure to acomodate storage requirements of 100yr +30% climate change critical storm event.

Testing should be undertaken for each development phase to establish the infiltration rate. In the event of infiltration not being suitable in localised areas surface water will be discharged to swales and ditches.

INFORMATION

REV	DATE	DESCRIPTION	BY	CHK'D
B	15.12.16	Drainage Channel added. Layout updated to latest Architect layout and drainage amended to suit.	CH	JT
A	12.08.16	Drawing status amended.	CH	.

hyde

TITLE:
Drainage Strategy
Sheet 1 of 2

PROJECT:
New Salts Farm

SCALE: 1:1000@A1 DATE: Mar '16 DRAWN: JT CHK'D: .

DRG NO. 11649–CIV–110
REV. B

Tully De'Ath consultants
Engineering at its Best
T: 01342 828 000
E: info@tullydeath.com
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General Notes

Legend

Swale/Piped ditch
(Infiltration – swale 400–500mm deep)
(Conveyance – piped at road crossings

Blue roof
(Discharge into permeable paving sub-base at <0.25 l/s)

Bioretention area
(Infiltration – exceedance storage set 200–300mm below adjacent ground levels)

Permeable paving
(Infiltration – 450–600mm thick pavement, OGCR accommodates 100yr+30% return period storm event)

Existing Watercourse/ditch
Drain

Drainage Channel
(Drainage channel 15m wide x 1.5m deep)

All highways, parking areas and private drives to be formed of permeable paving (full infiltration). Sub-base structure to acomodate storage requirements of 100yr +30% climate change critical storm event.

Testing should be undertaken for each development phase to establish the infiltration rate. In the event of infiltration not being suitable in localised areas surface water will be discharged to swales and ditches.

INFORMATION

REV	DATE	DESCRIPTION	BY	CHK'D
C	15.12.16	Drainage Channel added. Layout updated to latest Architect layout.	CH	JT
B	11.08.16	Drawing status amended.	CH	.
A	11.08.16	Phase 1 layout updated to suit Architects layout.	CH	.

hyde

TITLE:
Drainage Strategy
Sheet 2 of 2

PROJECT:
New Salts Farm

SCALE: 1:1000@A1 DATE: Mar '16 DRAWN: JT CHK'D:

DRG NO. 11649–CIV–111 REV. C

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Appendix K – SuDS Manual Extracts

TABLE 26.2 Pollution hazard indices for different land use classifications

Land use	Pollution hazard level	Total suspended solids (TSS)	Metals	Hydro-carbons
Residential roofs	Very low	0.2	0.2	0.05
Other roofs (typically commercial/ industrial roofs)	Low	0.3	0.2 (up to 0.8 where there is potential for metals to leach from the roof)	0.05
Individual property driveways, residential car parks, low traffic roads (eg cul de sacs, homezones and general access roads) and non-residential car parking with infrequent change (eg schools, offices) ie < 300 traffic movements/day	Low	0.5	0.4	0.4
Commercial yard and delivery areas, non-residential car parking with frequent change (eg hospitals, retail), all roads except low traffic roads and trunk roads/motorways[1]	Medium	0.7	0.6	0.7
Sites with heavy pollution (eg haulage yards, lorry parks, highly frequented lorry approaches to industrial estates, waste sites), sites where chemicals and fuels (other than domestic fuel oil) are to be delivered, handled, stored, used or manufactured; industrial sites; trunk roads and motorways[1]	High	0.8[2]	0.8[2]	0.9[2]

Notes

1 Motorways and trunk roads should follow the guidance and risk assessment process set out in Highways Agency (2009).

2 These should only be used if considered appropriate as part of a detailed risk assessment – required for all these land use types (Table 4.3). When dealing with high hazard sites, the environmental regulator should first be consulted for pre-permitting advice. This will help determine the most appropriate approach to the development of a design solution.

Where a site land use falls outside the defined categories, the indices should be adapted (and agreed with the drainage approving body) or else the more detailed risk assessment method should be adopted.

Where nutrient or bacteria and pathogen removal is important for a particular receiving water, equivalent indices should be developed for these pollutants (if acceptable to the drainage approving body) or the risk assessment method adopted.

Where the mitigation index of an individual component is insufficient, two components (or more) in series will be required, where:

$$\text{Total SuDS mitigation index} = \text{mitigation index}_1 + 0.5\ (\text{mitigation index}_2)$$

Where:

$\text{mitigation Index}_n$ = mitigation index for component n

A factor of 0.5 is used to account for the reduced performance of secondary or tertiary components associated with already reduced inflow concentrations.

TABLE 26.4 Indicative SuDS mitigation indices for discharges to groundwater

Characteristics of the material overlying the proposed infiltration surface, through which the runoff percolates[1]	TSS	Metals	Hydrocarbons
A layer of dense vegetation underlain by a soil with good contaminant attenuation potential[2] of at least 300 mm in depth[3]	0.6[4]	0.5	0.6
A soil with good contaminant attenuation potential[2] of at least 300 mm in depth[3]	0.4[4]	0.3	0.3
Infiltration trench (where a suitable depth of filtration material is included that provides treatment, ie graded gravel with sufficient smaller particles but not single size coarse aggregate such as 20 mm gravel) underlain by a soil with good contaminant attenuation potential[2] of at least 300 mm in depth[3]	0.4[4]	0.4	0.4
Constructed permeable pavement (where a suitable filtration layer is included that provides treatment, and including a geotextile at the base separating the foundation from the subgrade) underlain by a soil with good contaminant attenuation potential[2] of at least 300 mm in depth[3]	0.7	0.6	0.7
Bioretention underlain by a soil with good contaminant attenuation potential[2] of at least 300 mm in depth[3]	0.8[4]	0.8	0.8
Proprietary treatment systems[5, 6]	These must demonstrate that they can address each of the contaminant types to acceptable levels for inflow concentrations relevant to the contributing drainage area.		

Notes

1 All designs must include a minimum of 1 m unsaturated depth of aquifer material between the infiltration surface and the maximum likely groundwater level (as required in infiltration design – Chapter 25).

2 For example as recommended in Sniffer (2008a and 2008b), Scott Wilson (2010) or other appropriate guidance.

3 Alternative depths may be considered where it can be demonstrated that the combination of the proposed depth and soil characteristics will provide equivalent protection to the underlying groundwater – see note 1.

4 If significant volumes of sediment are allowed to enter an infiltration system, there will be a high risk of rapid clogging and subsequent system failure.

5 See Chapter 14 for approaches to demonstrate product performance. Note: a British Water/Environment Agency assessment code of practice is currently under development that will allow manufacturers to complete an agreed test protocol for systems intended to treat contaminated surface water runoff. Full details can be found at: **www.britishwater.co.uk/Publications/codes-of-practise.aspx**

6 SEPA only considers proprietary treatment systems as appropriate in exceptional circumstances where other types of SuDS component are not practicable. Proprietary treatment systems may also be considered appropriate for existing sites that are causing pollution, where there is a requirement to retrofit treatment. WAT-RM-08 (SEPA, 2014) also provides a flowchart with a summary of checks on suitability of a proprietary system.

The following should be noted:

- Where the indices are not considered representative by the designer, a risk assessment can be undertaken (Section 26.7.3).
- Components should always be designed for treatment, as described in the design guidance set out in the individual component chapters. If they are undersized, incorrectly designed or constructed or inadequately maintained, their treatment performance could be significantly affected. Component checklists (Appendix B) can be used to confirm design and construction adequacy and set appropriate maintenance regimes.
- Where the infiltration component itself does not provide sufficient pollution mitigation, the design should include upstream SuDS components that are lined to prevent infiltration from occurring. The mitigation indices set out in Table 26.3 (for discharges to surface water) should be used for any upstream treatment.

Appendix L – Adur Tidal Wall Scheme

Notes

Key to Symbols

Legend

- Soldiers Point - Reach W1
- Emerald Quay and South Wharf - Reach W2
- Riverside Road - Reach W3
- Ferry Bridge - Reach W4
- Riverbank Reach - Reach W5
- Recreation Ground - Reach W6
- Shoreham Airport - Reach W7
- Old Railway Reach - Reach E3
- Ropetackle - Reach E2
- Tollhouse Bridge - Reach E1

Reference drawings

Rev	Date	Drawn	Description	Ch'k'd	App'd

Mott MacDonald
Mott MacDonald House
8-10 Sydenham Road
Croydon CR0 2EE
United Kingdom
T +44 (0)20 8774 2000
F +44 (0)20 8681 5706
W www.mottmac.com

Client

Environment Agency
Guildbourne House
Chatsworth Road
Worthing
BN11 1LD
T +44 (0)3708 506 506
E shorehamwestbank@ea.gov.uk
W www.gov.uk/environment-agency

Title

Shoreham Adur Tidal Walls

Reach Design Names

Designed	NC		Eng Check	DC	
Drawn	NC		Coordination	NC	
GIS Check	BR		Approved	PP	
Scale at A1	1:5,000	Status	INF	Rev	00

Drawing No.
MM - 339663 - DES - GIS - 000 - 0001 - 00

Aerial Imagery: © Environment Agency 2014

0 100 200 300 400 Metres

Notes

1. All dimensions are in metres unless noted otherwise.
2. All levels are in metres relative to Ordnance Datum Newlyn (OD).
3. All positions are in metres relative to National Grid.
4. Limit of deviation is extended 1.0m from the toe of embankment or sheet pile walls on each side.
5. The Boundary of Works lines should be 10m from the Flood Defence Wall riverward unless the Mean Low Water is encountered before, then Boundary of Works lines turns to be Mean Low Water.

Key to symbols

- Flood Defence (Wall or Embankment)
- MLW — Mean Low Water (MLW)
- MHW — Mean High Water (MHW)
- E1 — Reach extent
- Boundary of works
- Limits of deviation
- Satellite site compounds
- Site access from public road
- Temporary Works
- Permanent Works

Key plan

Reference drawings

1:5000 0 250m 500m

Rev	Date	Drawn	Description	Ch'k'd	App'd
P01	20.10.15	IAS	For Planning Approval / Tender	NJC	PJP

Mott MacDonald

Mott MacDonald House
8-10 Sydenham Road
Croydon, CR0 2EE
United Kingdom

T +44 (0)20 8774 2000
F +44 (0)20 8681 5706
W www.mottmac.com

Client

Environment Agency

Title

Shoreham Adur Tidal Walls

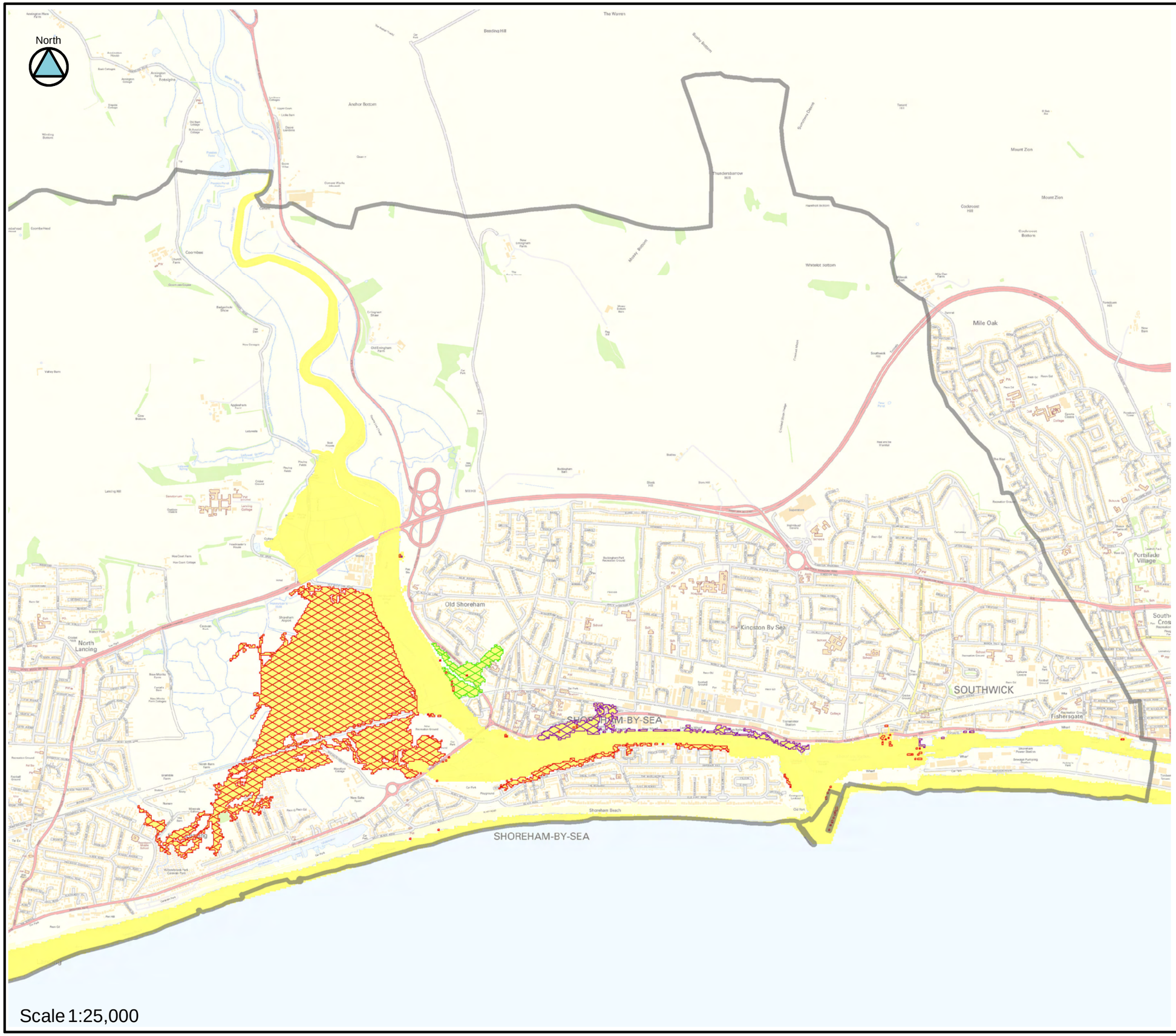
Planning Drawing - Overview

Designed	F Loy	FL	Eng check	D Collery	DC
Drawn	I A Sussex	IAS	Coordination	N J Clarke	NJC
Dwg check	P M Starnes	PMS	Approved	P J Phipps	PJP

Scale at A1	Status	Rev	Security
1:5000	D2	P01	STD

Drawing Number

MMD-339663-C-DR-01-XX-1030



Scale 1:25,000

ADUR DISTRICT COUNCIL

Worthing BOROUGH COUNCIL

LEGEND

- Adur and Worthing Boundary
- 1 in 20 year Present Day

Defence improvements

- Adur Tidal Walls (ATW)
- Ropetackle defences
- Shoreham Harbour walls

Note: The cross-hatched polygons show those areas that will no longer be inundated in the 1 in 20 year event if the defence improvements along the River Adur are undertaken.
Three scenarios are shown:
1. Improvement to the Adur Tidal walls
2. Improvement to the Adur Tidal walls and Ropetackle defences
3. Improvement to the Adur Tidal walls and Shoreham Harbour walls
These extents are based on the modelling undertaken as part of the West Bank Tidal Walls (Arun to Adur Model update) 2011.

JBA consulting

Map 17
Impact of proposed defence improvements on the 1 in 20 year (Flood Zone 3b) extent.

Appendix M – West Beach Estate Drainage

KEY

~ NEW DITCH

~ NEW DRAINAGE CONNECTION

Airport

Drain

North Barn Farm

Track

3m

2m

Bramble Farm

Stables

Ansty

Nursery

Minstrels Gallery

The Barn

Stables

OLD SALTS FARM ROAD

South Lancing

Broadway Park (Caravan Site)

NEW DITCHES ARE NOT TO CONNECT

BOUNDARY ROAD

GEORGE V AVENUE

BRISTOL AVENUE

THE BROADWAY

PRINCE ANDREW WAY

WEST WAY

Willowbrook Park Caravan Park

Caravan Park

Widewater

1500

500 TYPICAL

300

TYPICAL DITCH DETAIL.

NOTE

DEPTH AND LOCATION OF NEW SURFACE WATER CONNECTIONS ARE NOT KNOWN. TO BE ADVISED.

TITLE: WEST BEACH DITCH

PROJECT: NEW SALTS FARM

SCALE: | DATE: | DRAWN: | CHK'D:

JOB NO. 11649 | DRG NO. SK100 | REV. A

Tully De'Ath consultants
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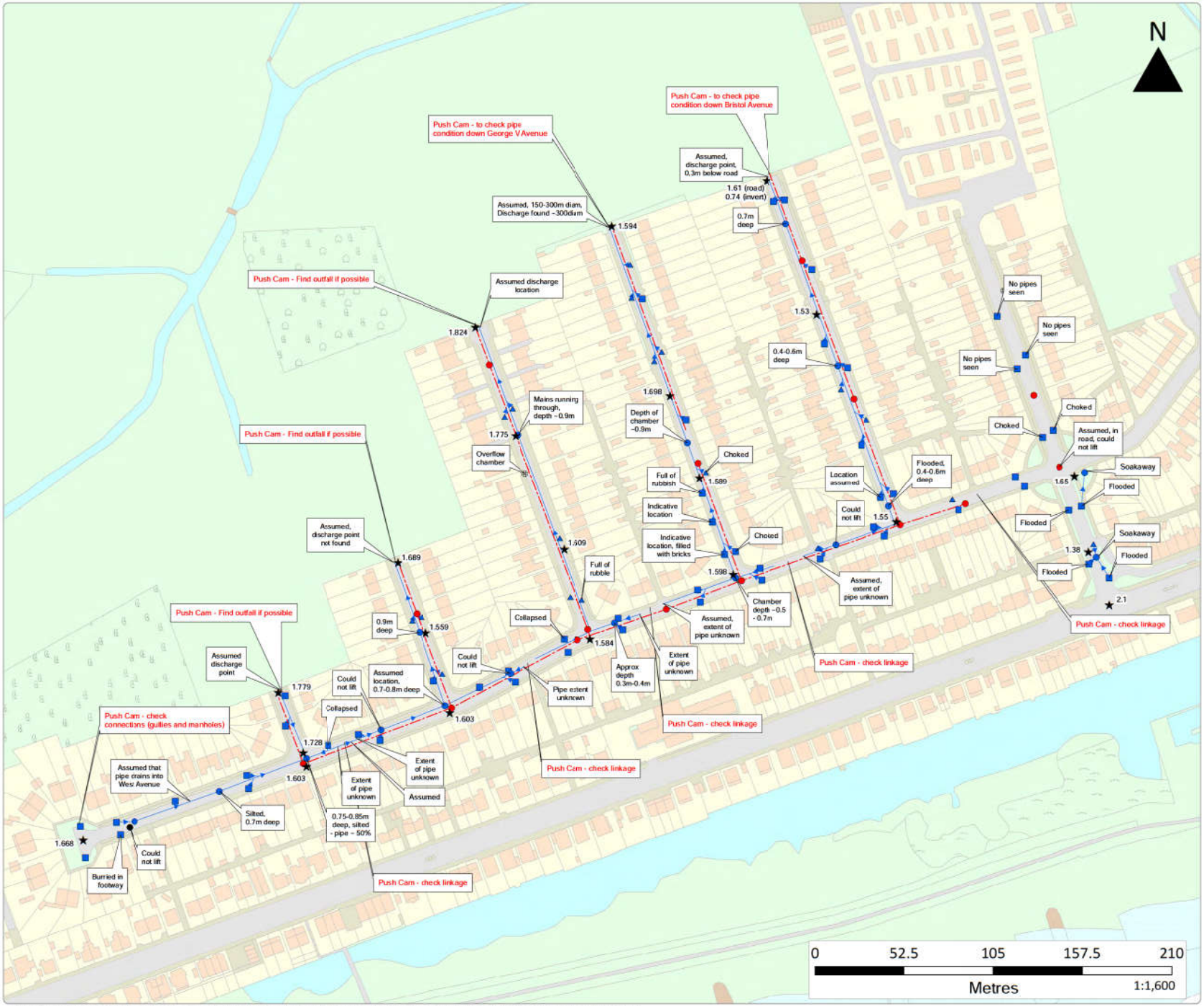
EMAIL info@tullydeath.com WEB SITE www.tullydeath.com

Lancing SWMP



Legend

- ★ Temporary Bench Mark Level (m)

Assets (Points)

- Catchpit
- Foul Chamber
- Gully
- Kerb Inlet
- Surface Chamber
- Unknown Chamber

Assets (Lines)

- Assumed Foul Pipe
- Assumed Surface Water Pipe

Notes:
- Foul chambers not lifted
- Orient Road & Mobile home park not surveyed
- Adur & Worthing CC knowledge that Orient Road & lower end of Broadway are drained via soakaways

Drainage Plan (Zone D)

CH2MHILL.

Created by: Helen Winter (20/04/2015)
Checked by: Ali Cotton (20/04/2015)

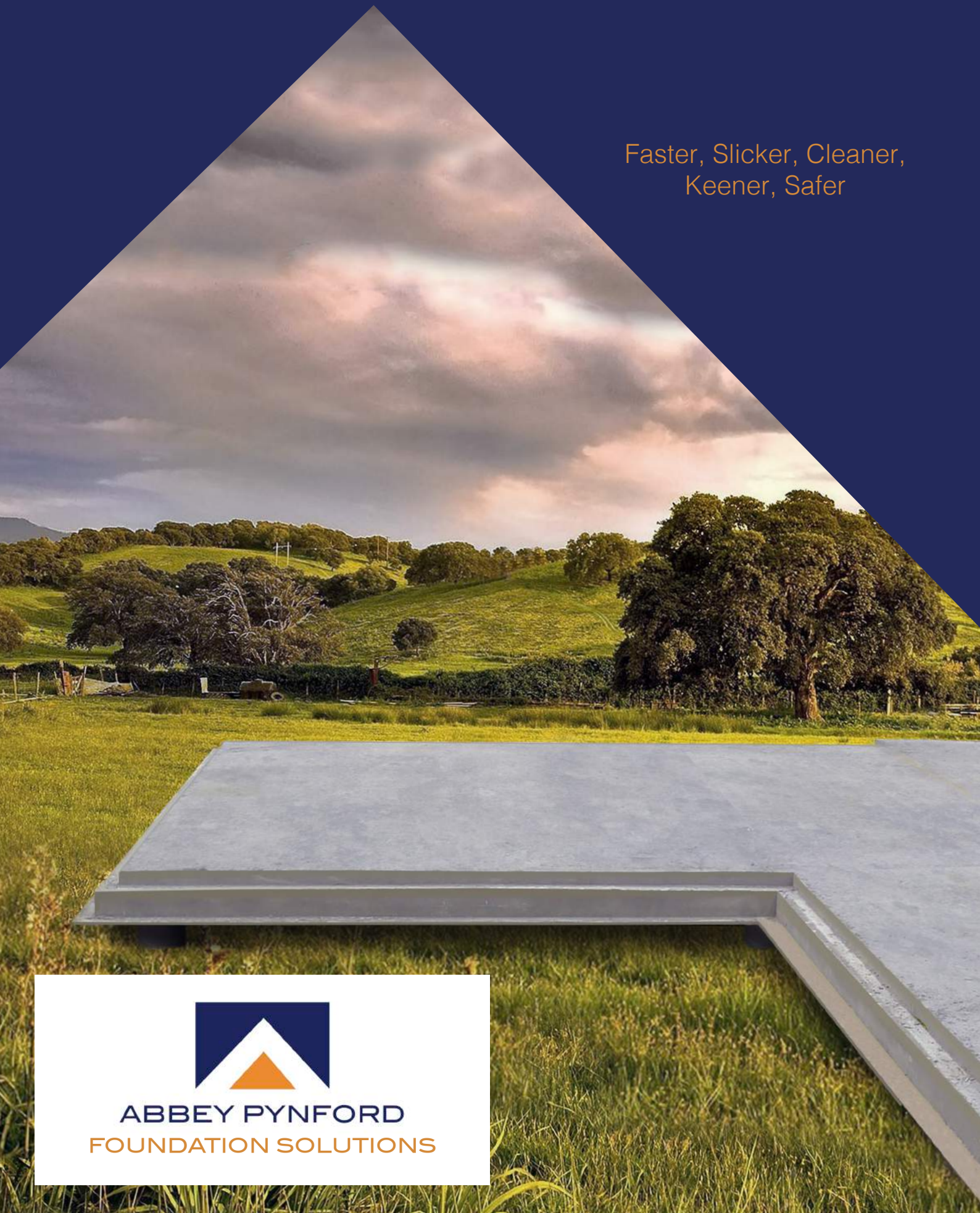
Document Path: W:\we\Urban Water Market Sectors\Urban Water UK\Projects\West Sussex SWMP framework\Lancing SWMP\GIS\Lancing_DrainagePlanA2.mxd

Appendix N – Foundation and Ground Floor Construction

HOUSEDECK®

Specialist Foundation and Ground Engineering Solutions

Faster, Slicker, Cleaner,
Keener, Safer



ABBEY PYNFORD
FOUNDATION SOLUTIONS

Introduction to Housedeck®

Our Housedeck® Foundation system benefits over the traditional pile and beam approach.

Housedeck® replaces the following elements:

Piling mat (95% of projects)

Setting out piles

Pile trimming

Excavations for ground beams

Ground beam construction

Sub-structure brickwork

Blinding within footprint

Pre-cast floor

Resources to manage all of the above

Benefits

Faster construction time, between 1/2 and 2/3 of the traditional construction methods

More competitive

Adaptable due to ability to avoid most sub-surface obstructions

Minimal or no spoil away

Low carbon footprint

Best system to be used adjacent to trees

Service design and construction to DPM (after landscaping)

Ideal system on contaminated and **Brownfield sites**

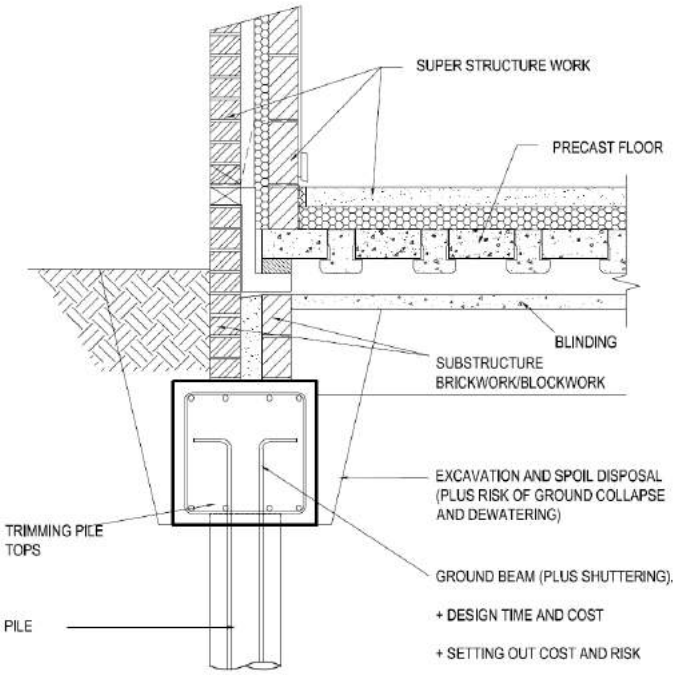
Responsive pro-active **support** on site

LABC and **NHBC** pre-appoved

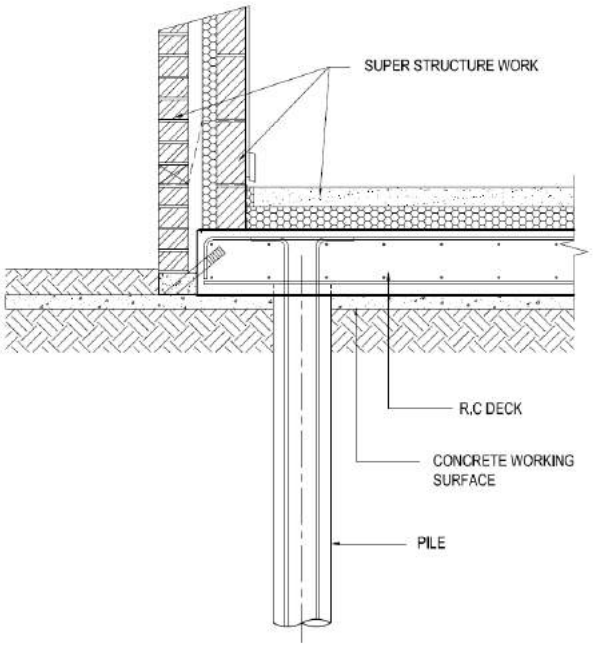
Housedeck is suited to both large multi-plots and one off sites

Pile and Beam

Traditional approach to pile and beam



Abbey Pynford's Housedeck® approach to pile and beam

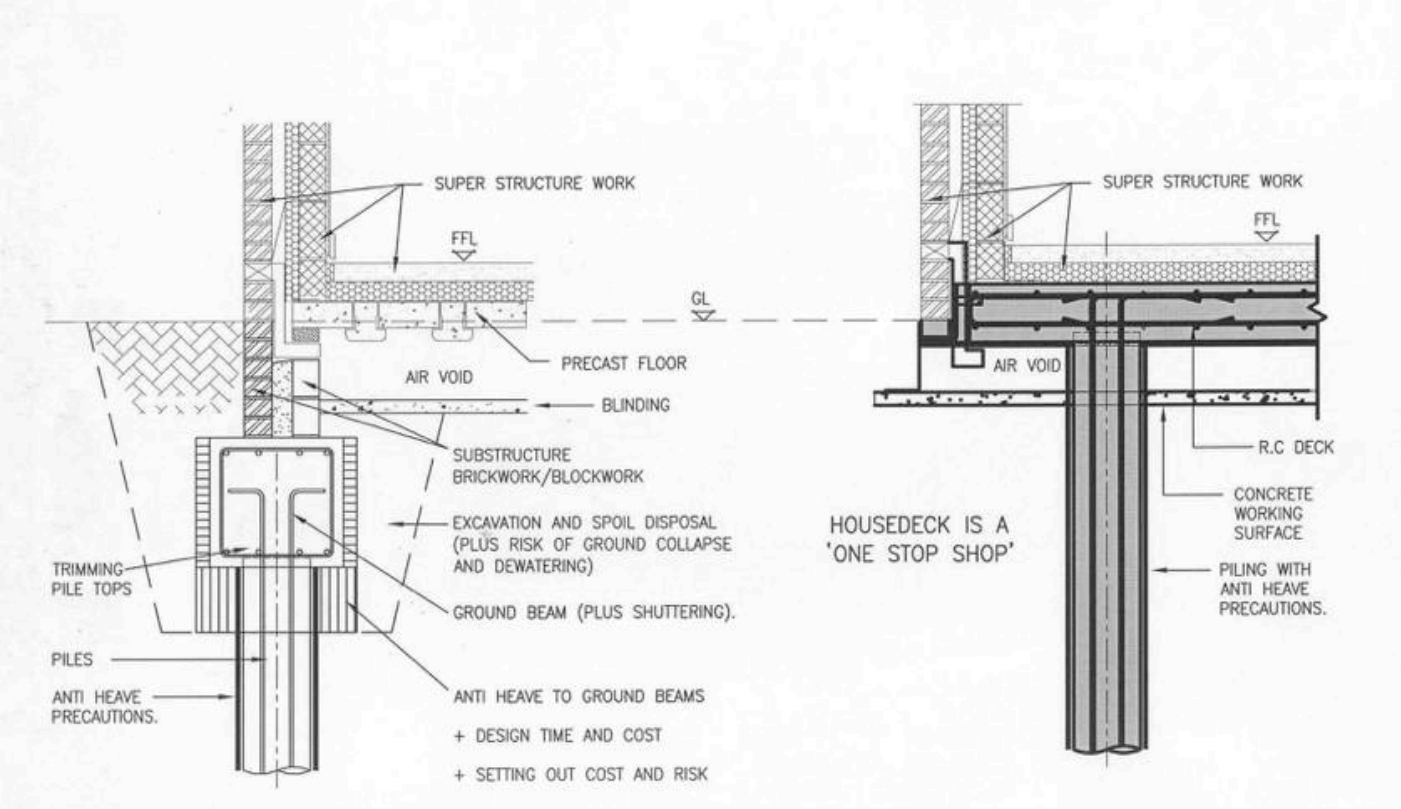


Enlarged edge detail - section

Voided

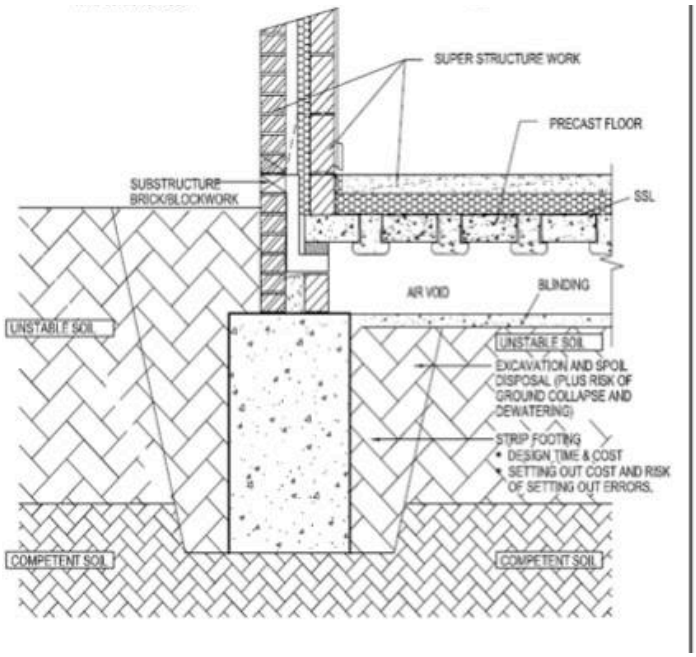
Traditional approach to driven

Abbey Pynford's Housedeck® approach with under slab void

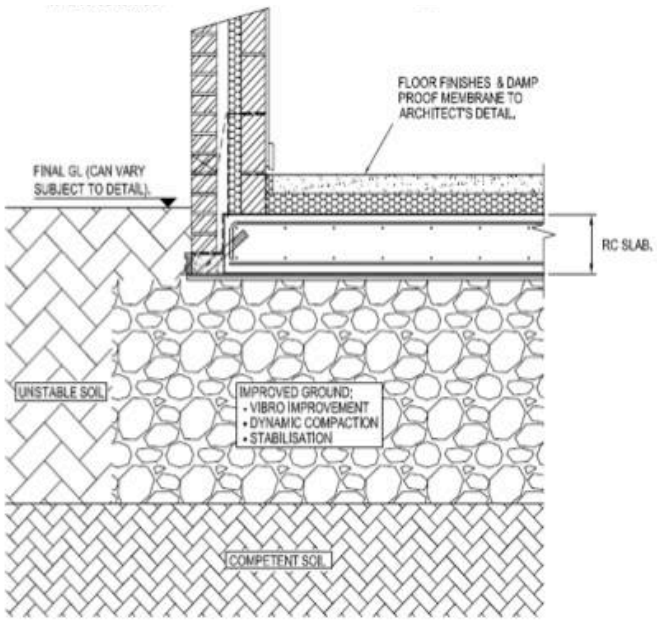


Ground Improvement

Traditional approach to excavated footings



Abbey Pynford's Housedeck® approach to improved ground



Our commitment to you:

You will receive the same attention and quality of service whether you are a small developer or corporate builder

We will provide you with a fully documented offer within two weeks after receiving all required information

Our dedicated in-house design team, using the latest software finite element analysis, ensures that each project is value engineered

We will always operate in the best practice, complying with Health, Safety and Environmental legislation

We promise to serve in your best interests and if we believe that one of your Housedeck systems is not the most appropriate scheme for your needs, we will advise you accordingly

Selection of clients:

Able Construction
Balfour Beatty
Barratt Homes
Carillion Region Building
Clancy Consulting
Corus Group
Crest Nicholson
Dacorum Borough Council
David Wilson Homes
Fairview Homes
Geoffry Osbourne
Jarvis Homes
Laing Homes
Leadbitter
Linden Homes
Mansell Construction
McCarthy & Stone
Northampton Country Council
Oakey Executive Homes
Oakwood Building Limited
Octavia Housing
Persimmon Homes
Redrow Homes
Taylor Wimpey Developments
Taylor Woodrow
V. E. Parrott Limited
Wates Construction
Watford Borough Council
Westbury Homes
Willmott Dixon Construction and Housing

Installation Methods

We offer two basic systems; Standard and Voided. Both can be constructed using Large (40t) midi (15t) or mini (1-5t) piling rigs.

Standard Ground Bearing Slab System

Concrete working surface

Used to support our piling rigs, act as a working surface for steel and brickwork support units and often saves the need for a traditional piling mat.

Piling

We offer a wide range of piling systems , however, wherever possible we elect to use a rig where the concrete working surface will replace the need for a piling mat. We have a range of rig types that are able to offer this on most Housedeck projects.

Brickwork support system (BSUs) and reinforcing

Are fixed after drainage. The BSUs are unique to us, they are fixed in a fraction of the time of traditional shutters and allow an immediate start for follow on trades.

Completion

This will often be achieved within 2/3 days of the time of a traditional foundation, it negates the need for substructure brickwork and pre cast floor slab.

Construction of Anti-Heave Incorporating Voided System

Photo shows a light weight piling rig running on a 50mm concrete working surface instead of a traditional piling mat, saving on the cost of a dig and imported material.

Deck support units are placed on the concrete working surface. Decking is then placed on our proprietary deck support units.

Subsequently, our proprietary brick support units (shown) are fixed to the tanalised plywood, followed by steel fixing, final levelling and concrete pour.

Fix void guard to prevent soil migration into void. Clear site for follow on trades (brick-work). Unique use of stainless steel brickwork support allows almost immediate start for follow-on trades.

Piling Methods

We have the widest range of Piled Support Methods:

Helical
(Helical displacement piles)

DCIP
(Driven cast in place)

Driven
(Driven concrete or steel tubes)

VCIP
(Vibro cast in place)

CHD
(Continual helical displacement)

CFA
(Continuous flight auger)

Bored
(Open bored and cased)

SFA
(Segmented flight auger)

Ground Improvement Methods

We have the widest range of Ground Improvement Methods:

Vibro replacement
(Introduces new materials)

Vibro floatation
(Densifies existing ground)

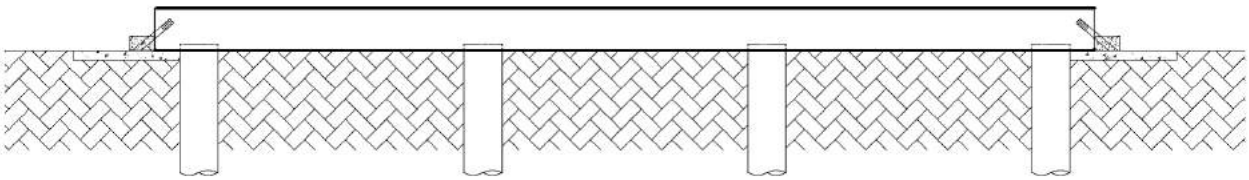
Dynamic compaction
(By drop weight or dynamic rolling)

Soil stabilisation
(Ex situ introduction of hydration powders)

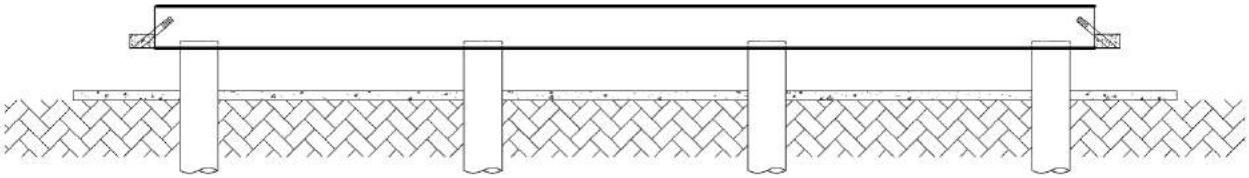
Soil mixing
(In situ introduction of hydration powders)

Engineered fill
(Often imported, may be existing treated by one of the above)

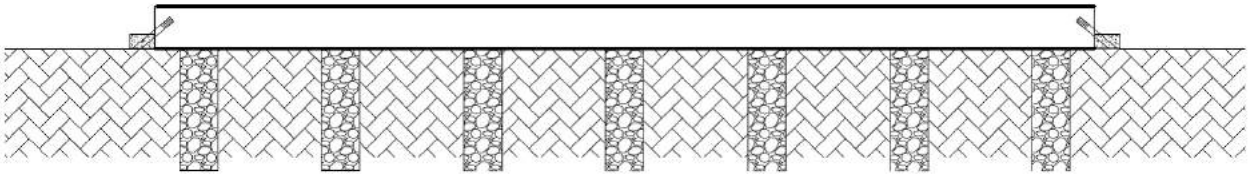
Range of systems for all ground conditions



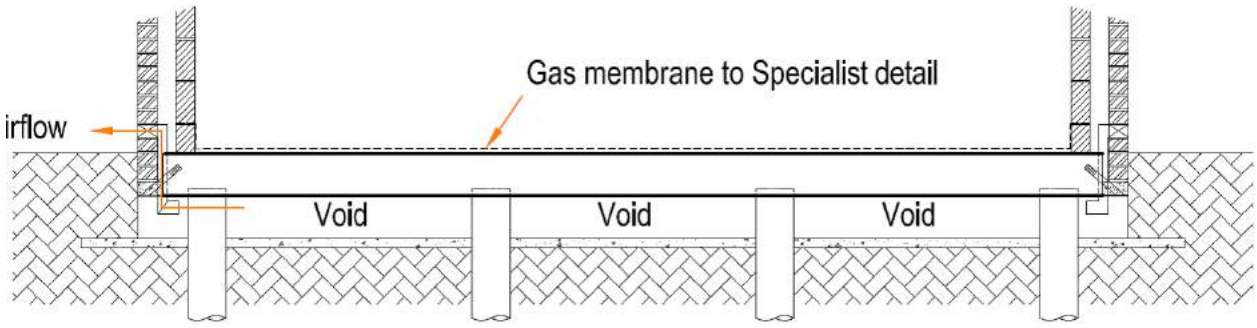
OPTION 1
Standard ground bearing slab



OPTION 2
Anti heave incorporating void
(for highly shrinkable clays)



OPTION 3
Vibro replacement stone columns/
Ground improvement techniques

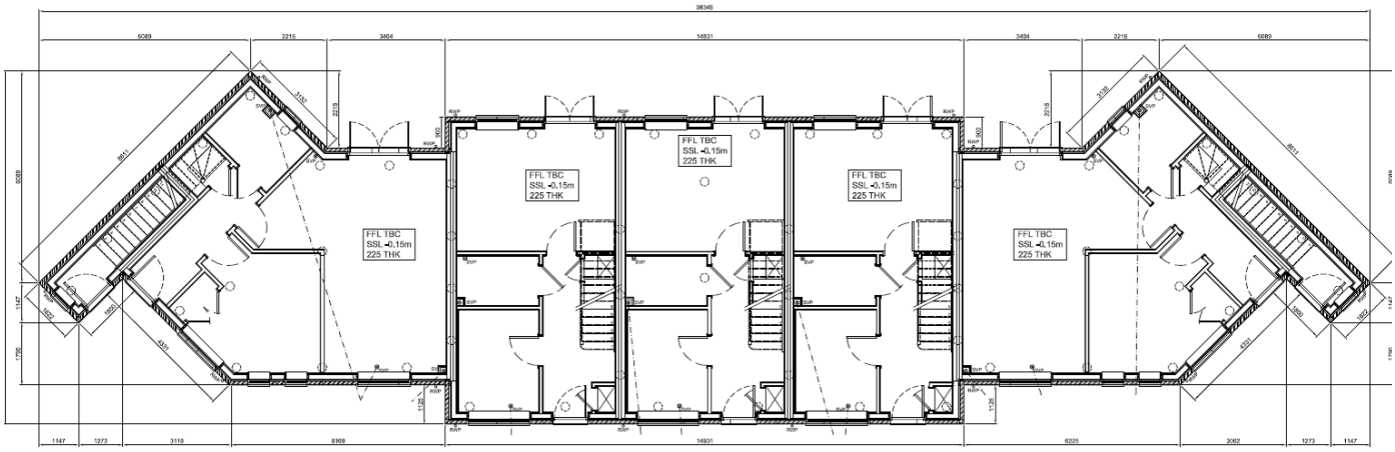


OPTION 4
Gas membrane (for contaminated
and radon sites)

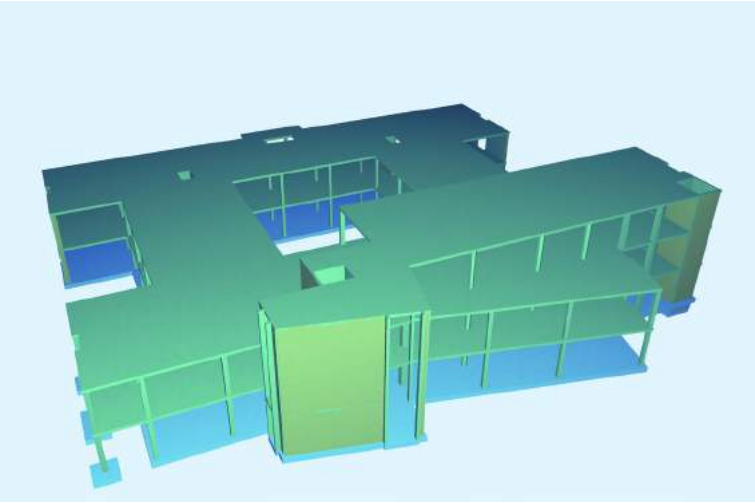
Design

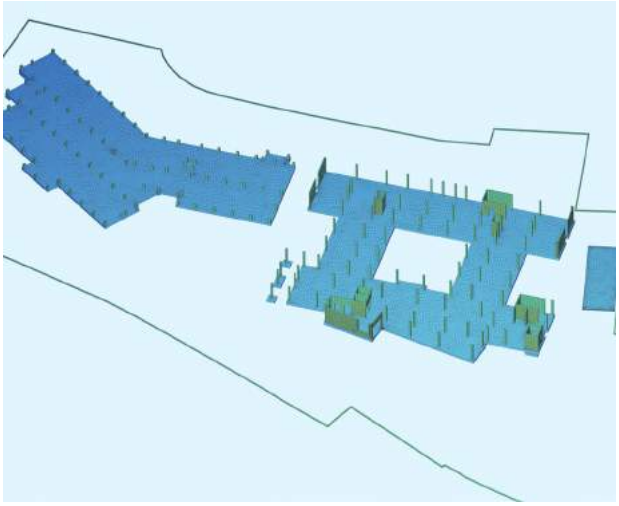
Housedeck® and Comdeck® are complete design and build packages. Abbey Pynford's in-house Design Department provides detailed pile layout drawings, slab design, bending schedules and calculations for submission to Local Authority Building Controle (LABC) or NHBC. The design software Sofistik is one of the most advanced flat slab software packages in Europe. This software allows piles to be relocated on screen and immediately produces pile loads and reinforcing steel requirements thus allowing a prompt response in addressing the presence of obstructions such as tree roots and man made obstructions.

SOFiSTiK
FINITE ELEMENT SOFTWARE



3D Finite Element Software - provides in-house capability for modelling structures in 3 dimensions, using finite element methods in an AutoCAD environment





Services

Our service always includes:

- Design of deck
- Design of piling or ground treatment
- Setting out
- When no piling mat used – construction of the concrete working surface
- Pile trimming or post ground treatment protection
- Drainage to edge of footprint
- Proprietary decking system (replaces floor slab and substructure brickwork)
- Site management and customer liason
- QMS system
- Pro-active service

Our service can also include:

- Site investigation
- Design of engineered fill
- All drainage installation
- Associated pre-foundation groundworks, site strip etc.
- Fixed price
- Warranty
- Retaining walls
- Lift pits
- Bolt boxes
- Starter bars for RC frames
- Other associated structural features

Introduction to Comdeck®
Industrial and Commercial Foundations

Comdeck® is a natural extension of our proven Housedeck® system, but designed to support heavier loads as are typically imposed by industrial and commercial structures. This proprietary piled raft style foundation system uses the same principles as the Housedeck® system – the significant differences being that pile sizes tend to be larger and slab thickness is typically (although not always) increased from 225mm to 300+mm.

The benefits of Comdeck® are normally the same as those for Housedeck® although speed is often the most attractive benefit.

Chipping Hill Primary School

The school commissioned by Essex county council is desperately required to meet the rising demand in the area and replace the existing outdated and failing facilities. By re-engineering the original scheme which required anti heave precautions, piles and ground beams was converted to the Comdeck slab system supported off stabilised ground. This treated ground enabled Abbey Pynford to eliminate the piles and slim down the overall construction build-up, this drastically reduced off site spoil disposal.

Area: 1500 sq. m
Programme: 8 weeks

Harris Academy

The programme was to install Vibro & CFA piles with ground beams, pilecaps, lift pits, service pits, drainage, underslab services, ground preparation, underslab insulation and cast concrete ground floor. Despite an adverse change in ground conditions, an additional site investigation, redesign and associated change to scope of works, the contractual period was not exceeded.

Area: 6650 sq. m
Programme: 14 weeks

Portway Primary School

Abbey Pynford proposed to remove the requirement for piles by treating the granular made ground by using a variable amplitude roller. This considerably reduced the risk on site by removing the requirement to install bored piles through the asbestos contaminated Made Ground. Due to Abbey Pynford's in house geotechnical expertise the raft thickness was reduced to 300mm offering considerable savings.

Area: 406 sq. m
Programme: 6 weeks

ABBEY PYNFORD

Abbey Pynford work with clients from design through to project competion in the following areas:

- House Foundations - Housedeck®
- Industrial/Commercial Educational Foundations - Comdeck®
- Piling - open site, restricted site, augered, bored and driven
- Mini-piling
- Commercial and Domestic Underpinning - widest range of underpinning systems available
- Industrial Machinery Foundations
- Space creation in the refurbishments market (high level Pynford beams)
- Lifting and moving structures and buildings
- Basements

ABBEY PYNFORD

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575-599 Maxted Road
Hemel Hempstead
Hertfordshire
HP2 7DX

Tel: 01442 212112
Email: info@abbeypynford.co.uk

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as recognised by SSIP SAFETY SCHEMES IN PROCUREMENT

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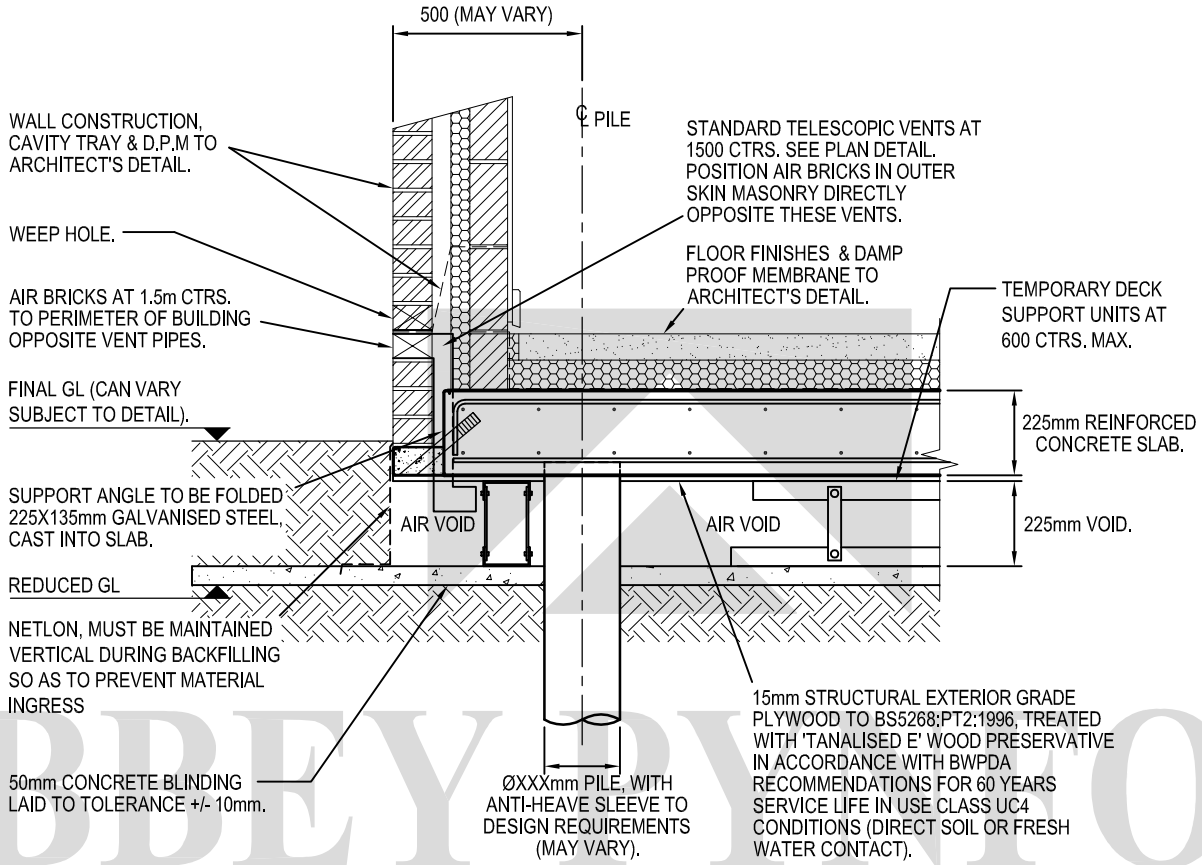
DETAIL FOR INDICATIVE PURPOSES ONLY AND MUST BE TO ARCHITECT'S DESIGN AND APPROVAL.



TYPICAL SECTIONAL ELEVATION FOR 225 THICK VOIDED SLAB WITH BLOCKWORK INNER SKIN

SCALE 1:20

Rev	Description	By	Chk	App	Date

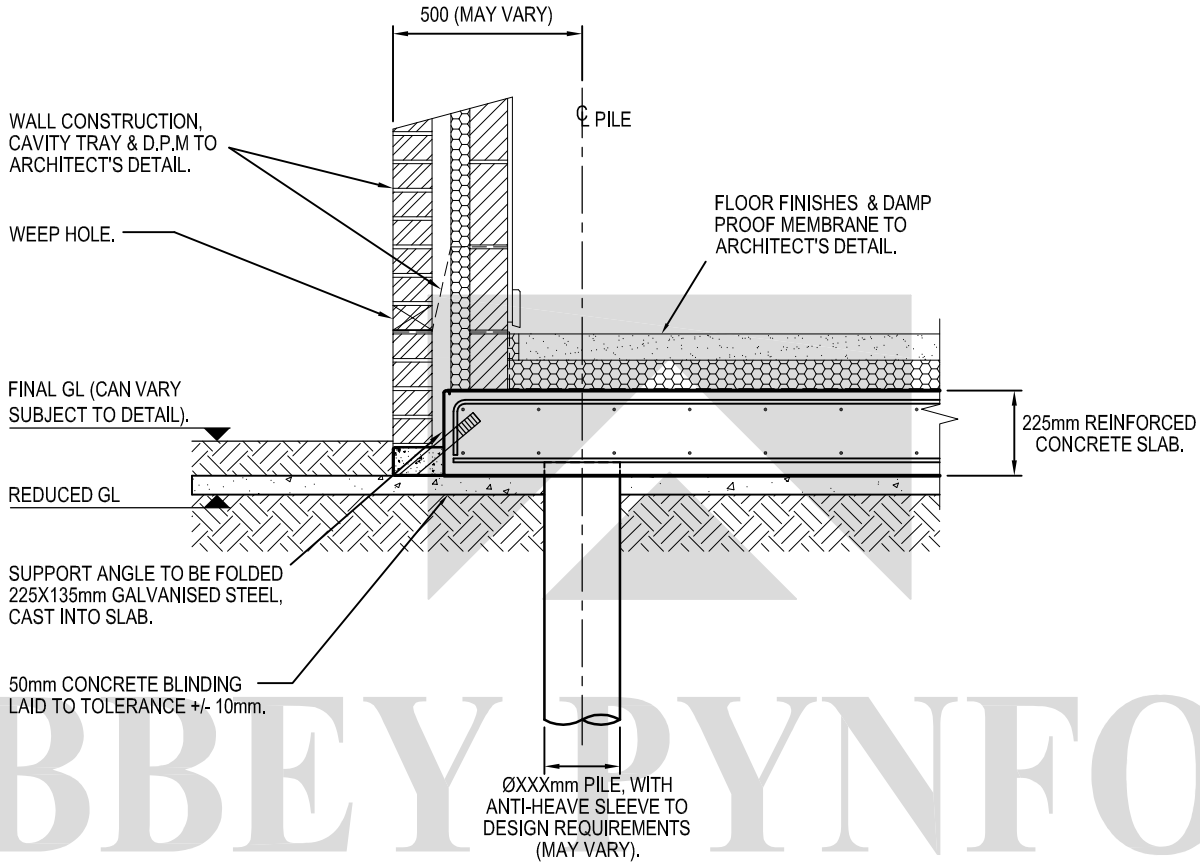
ABBEY PYNFORD
Second Floor, Hille House,
132 St. Albans Road,
Watford, Herts. WD24 4AQ
Tel : 0870 085 8400 Fax : 0870 085 8401
E mail : info@abbeypynford.co.uk
Web : www.abbeypynford.co.uk

Scale at A4	Drawn By	Date	Checked By	Date	Approved By	Date
1:20	HD	11-2012	PCN	11-2012		

Project No.	Office	Type	Drawing No.	Revision
	W	HD	01	-

Drawing Title:
TYPICAL SECTIONAL ELEVATION FOR 225 THICK VOIDED SLAB WITH BLOCKWORK INNER SKIN WITH VENT

DETAIL FOR INDICATIVE PURPOSES ONLY AND MUST BE TO ARCHITECT'S DESIGN AND APPROVAL.



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	W	HD	20	-

Drawing Title:
TYPICAL SECTIONAL ELEVATION FOR 225 THICK SLAB WITH BLOCKWORK INNER SKIN

Appendix O – Road Improvement Systems

Tully De'Ath Consultants

Details and Examples of the Road Improvement System for New Salts Farm

Project Number - 11649
New Salts Farm Road Land – Shoreham

To create a stable road for the New Salts Farm development, it is proposed to use a 3 dimensional geo-grid, filled with open graded stone to form a road foundation. This system is specifically developed for working in very poor ground conditions, as the vehicle loads are transferred horizontally rather than vertically. Examples of the Geoweb road improvement system and product literature are included within this document. All the examples have very poor ground conditions (probably more onerous than New Salts Farm) of which, two specifically refer to constructing roads in saturated soils.

It is proposed that all the roads and parking areas on New Salts Farm will be of a permeable road construction, with the potential for base infiltration. The Geoweb system works well for permeable roads as the cells will be filled with large open graded stone and the side walls of the geo-grids are slotted to allow for horizontal migration of water. Consequently, Geoweb is a standard detail for constructing roads in no-dig root protection zones.

A number of CBR tests have been taken on Phase 1 and a value of 3% has been recommended, which takes account of the potential for high ground water. The Geoweb system is designed to work on ground which is significantly softer than this and we have successfully used it on a private estate road in Tunbridge Wells. This construction is very similar to that which is proposed on New Salts Farm, in that it is permeable with base infiltration on potentially soft ground. Attenuation is also provided within the voids of the sub-base material. The road was constructed during a very wet winter (2012) where the ground had become saturated with no recordable CBR value at formation level. The road had to be constructed to enable the adjacent houses to be built. The Geoweb system was introduced into the road make-up which enabled the construction of the road to be completed. The attached photos were taken in April 2016, where the road shows no signs of distress.

A road design (attached) by Soiltec has been undertaken based on a CBR value of 3%, with construction traffic loading. It should be noted that the construction traffic will be more onerous in terms of loading design than when the road is completed. During the construction phase a macadam base course is generally used over the Geoweb system as a temporary running surface. This is then either removed or holes punctured through it (to allow percolation) at the end of the construction phase. The final surface courses are then added.

Ground water monitoring wells have been installed across New Salts Farm, of which, 3 are located within Phase 1. They have established that the ground water levels within Phase 1 fluctuates with the tide, with approximately a 2-hour time lag between high tide levels and high ground water levels. During high tide events ground water levels typically get to within 0.4m below ground, dropping to 1.0m below ground level at low tides. However, there are areas on the site where ground water levels do, on occasion, reach ground level. It is intended that the road level will be raised slightly above ground level so that the formation level will generally be above the high tide water level. However, should the ground water level rise further, the introduction of the Geoweb system will provide additional support.

The Geoweb system is specifically designed for roads in very poor ground conditions and is regularly used in Germany and America. Whilst the recorded CBR values are not particularly poor, the fluctuating ground water levels could potentially impact on the construction of the road. The introduction of the Geoweb system will provide good structural stability during the construction phase as well as providing long term stability of the road.

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Presto®

GEOSYSTEMS
GLOBAL LEADER • GLOBAL PARTNER

creating
sustainable
environments™

GEOWEB®
load support

APPLICATION OVERVIEW

our commitment:
providing the highest quality products/solutions

eco-economic solutions for load support

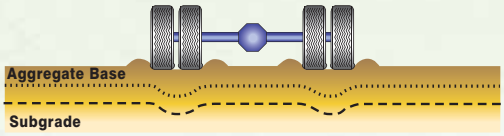
GEOWEB®

the GEOWEB® *system*

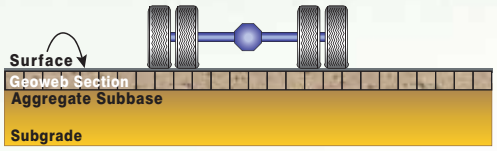
LOW-COST LOAD SUPPORT SOLUTIONS

The Presto Geoweb® load support system is a highly effective, economical solution to unacceptable road, parking, and yard surface problems that result from subgrade material failure or base material instability. Under concentrated or distributed loads, the three-dimensional cellular structure confines infill material and controls shearing, lateral and vertical movement of the infill material.

As a base stabilization system under pavement, the Geoweb material significantly improves pavement life cycle costs. When confined, **base material requirements can be reduced by 50% or more** by substantially reducing the loading on sub-surface soils. As a result, reduced excavation and granular infill needs reduce overall installation cost.



UNCONFINED GRANULAR PAVEMENT SYSTEM



THE GEOWEB GRANULAR PAVEMENT SYSTEM

As a surface stabilization system, the Geoweb structure distributes surface pressures for dynamic and static loading, controlling rutting and **reducing long-term maintenance requirements and costs**. Using permeable infill with a high porosity, the system offers environmental and stormwater management benefits.

With topsoil/aggregate infill, the Geoweb material can create a vegetated surface that supports occasional loads.

GEOWEB® *system benefits*

- Produces a stiff base with high flexural strength; acts like a semi-rigid slab by distributing loads laterally.
- Minimizes impact of differential and overall settlement even on low-strength subgrades.
- Increases effective structural number, reducing fill depth requirement by 50%.
- May allow use of poor-quality granular fills in place of more costly imported materials.
- With permeable infill, reduces stormwater runoff and effectively performs as an on-site stormwater retention/detention "basin" storage, reducing need and costs for stormwater ponds.

TYPICAL APPLICATIONS:

- Permanent and temporary site access roads
- Permeable, load-supporting surfaces
- Intermodal/port facilities
- Transportation/storage yards
- Roadway shoulders (vegetated or porous aggregate)
- Stabilized base for asphalt/modular block pavements
- Stabilized drainage layer
- Railroad track ballast / subballast structures
- Trails and walkways
- Boat ramps and low water crossings
- Pile cap structures
- Foundation mattresses & pipeline protection
- Trench inverts
- Driveable vegetated surfaces

RESULTS SUPPORTED BY RESEARCH

Test results from numerous research initiatives confirm the benefits of confined aggregate within the Geoweb cellular confinement system vs. unconfined aggregate.

- Reduces thickness and weight of structural support elements by 50 percent or more.
- Allows subgrade materials to withstand more than 10 times the number of cyclic-load applications before accumulating the same amount of permanent deflection.
- Provides over 30% stress reduction when supporting aggregate under pavement.
- Distributes load between pilings, reducing intersoil stress by 40%.

key application areas

The Geoweb® system creates a stabilized structural support system, providing considerable benefits to unstable soils in key areas:

1. Base Stabilization under Paved Surfaces/Subsurfaces
2. Surface Stabilization for Unpaved Permeable Surfaces
3. Load Distribution System over Weak Soils
4. Flexible Concrete Mat

1 base stabilization
UNDER PAVED SURFACES/SUBSURFACE

As base support, the Geoweb® load support system creates a stabilized layer under asphalt, concrete or modular block pavement that holds up under heavy, repeated traffic. The system acts like a semi-rigid slab, distributing loads laterally and reducing subgrade contact pressures.

Selection of infill materials for base stabilization is determined by anticipated load characteristics and overall performance requirements. The system is especially effective in soft-soil areas where substantial pavement problems and regular maintenance costs exist or are anticipated as a result.

STABILIZING BASE MATERIALS WITHIN THE THREE-DIMENSIONAL GEOWEB® SYSTEM:

- Requires 50% or less base material when material is confined to achieve the same load support requirements.
- Minimizes load-related deformation and settlement, and reduces pavement degradation and cracking typically associated with soft subgrades.
- Allows the use of lower quality sand and aggregate materials, even over soft subgrades.
- Proven solution for challenging soft-soil stability problems.

2 surface stabilization
FOR UNPAVED AND PERMEABLE SURFACES

With permeable infill, the Geoweb® surface stabilization system provides a cost-effective alternative to hard surface pavements with many environmental benefits. By confining aggregate infill, the system improves the load distribution characteristics of unpaved roads and pavement areas, reducing long-term maintenance requirements and costs.

Grass pavement systems offer structural support and the desirable aesthetics of green space, ideal for infrequent traffic requirements.

STABILIZING INFILL MATERIALS WITHIN THE GEOWEB SYSTEM:

- Distributes pressures from dynamic and static loadings throughout the system, reducing lateral and vertical displacement of the infill and undesirable surface rutting.
- With aggregate infill, performs double duty as a load support system and an on-site water detention/retention storage "basin"; may eliminate requirements and costs for on-site stormwater containment systems.
- Reduces stormwater surface runoff, maximizes groundwater replenishment.
- Creates a cooler surface, reducing the heat island effect associated with hard surface pavements.
- Contributes to green building LEED® credits for stormwater management and reducing heat island effect

3 load distribution system
OVER WEAK SOILS

The Geoweb® system creates a stabilized base layer, significantly reducing excavation and base material requirements, especially over low-strength subgrades. The system minimizes load deformation and settlement and is especially effective when constructing pavements in coastal or soft-soil areas where infill material requirements and costs are high.

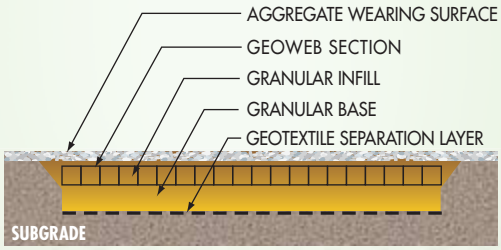
4 flexible concrete mat

Flexible concrete-filled Geoweb® mats are quickly created for applications such as boat ramps, low water crossings, or as flexible cover mats for utility protection.

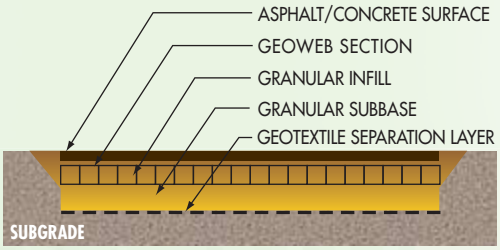
key components

The complete Geoweb® load support system application may include some or all of the following:

- Geoweb sections
- Cell infill materials
- Geotextile separation layer
- ATRA® Key connection device
- ATRA® Anchors
- Geocomposite drainage materials
- Integral polymeric tendons
- Fasteners



SURFACE STABILIZATION SYSTEM



BASE STABILIZATION SYSTEM

size options

Geoweb® sections are available in various cell sizes, cell depths and section lengths to address specific project needs. Load support system details are influenced by the characteristics of subsoil strength, applied load, available granular infill and surface type. Generally, the heavier the applied load and/or the poorer the quality of subsoils, the greater the required cell depth.

integral system components

The following components may be integrated to facilitate and expedite construction or to meet engineering requirements:

ATRA® ANCHORS

In load support applications, anchors are typically not part of the permanent design requirements but rather used to aid construction. Used with 1/2 inch rebar stakes or 10-12 mm dia. rods, ATRA® Anchors are easier to drive than J-hook stakes, improving installation productivity. (1)

When specific conditions dictate permanent anchoring an engineering array of surface anchors may be used.

ATRA® KEY CONNECTION DEVICE

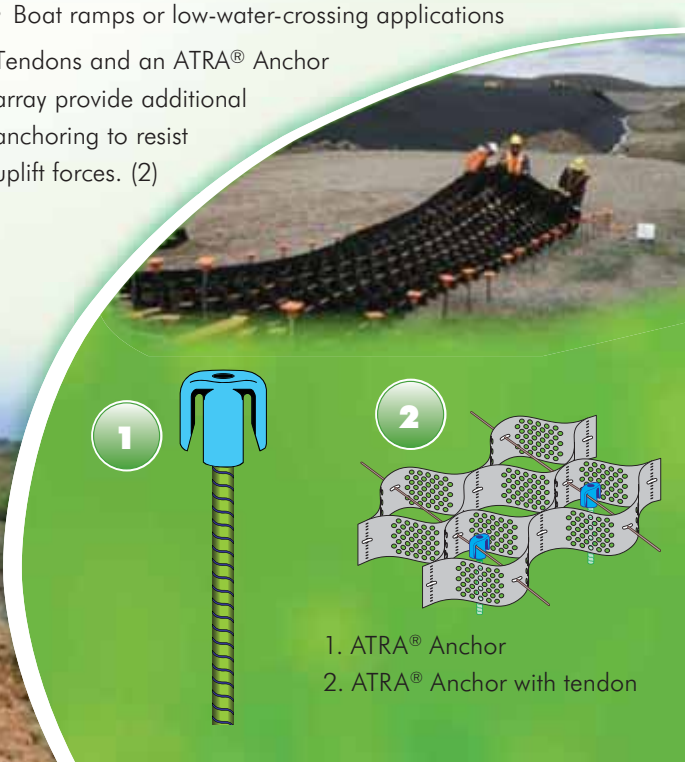
For quick and easy connection of Geoweb® sections, the exclusive ATRA® key connection device reduces contractor installation costs and provides a three-times-stronger connection of Geoweb sections.

TENDONS

Tendons may be required for providing additional hold-down and stability in the following applications:

- Traffic loadings on a grade
- Wet or saturated soil conditions on trails or access roads through wetlands
- Boat ramps or low-water-crossing applications

Tendons and an ATRA® Anchor array provide additional anchoring to resist uplift forces. (2)



1. ATRA® Anchor
2. ATRA® Anchor with tendon

comprehensive tools and services

Presto Geosystems and our distributors/representatives offer the most-complete services in the industry to support project design and installation requirements.

TOOLS:

- Technical resources binder/CD
- Engineering analysis/technical overviews
- Online SPECMaker® specification development tool
- Project case studies
- Detailed construction instructions

SERVICES:

Project Evaluation Service: We provide engineering analysis of specific project needs and provide recommended preliminary designs for each project.

Construction Services: Qualified on-site field support specialists can be available for construction training, and start-up installation supervision.

PRESTO GEOSYSTEMS' COMMITMENT — *To provide the highest quality products and solutions.*

Presto Geosystems and our worldwide network of knowledgeable distributors/representatives are committed to helping you apply the most cost-efficient solutions to your load support requirements. Our solutions-focused approach to solving problems adds value to every project. Rely on the leaders in the industry when you need a solution that is right for your application.

LEADING-EDGE INNOVATION

Presto is the original developer of the cellular confinement technology and leads the industry in research and development resulting in meaningful product improvements, innovative features, advanced engineering methodologies, proven field results and ultimately long-term solutions to challenging problems.

UNSURPASSED QUALITY

Presto's commitment to quality begins with manufacturing and continues through final installation.

- Quality management system certified to ISO 9001:2000 CE Certification.
- Sections manufactured from high-quality polyethylene provide consistent and maximum seam weld strength.
- Materials engineered to established geosynthetic industry guidelines.
- Sections backed by a 10-year limited warranty.

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Appleton, Wisconsin 54912-2399, USA

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Presto Geosystems
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Geosynthetic spins 'web' of success

Twelve years after installation, polyethylene cellular confinement system holds Wisconsin highway's base course in place as rest of road is prepared for reconstruction

edited by Larry Flynn

The polyethylene geosynthetic material is installed in 1984. Aluminum stretcher frames, used to expand the material, are removed after the material is infilled.

Wisconsin winters are notorious for the damage they can cause to roads. An example of winter's influence was seen on Highway E, a winding, two-lane asphalt road that serves commuters between Little Chute and Oneida. Once called the worst stretch of road in Outagamie County, it was plagued by cracking and heaving during the winter months. Similar problems occur elsewhere in the region where sub-base sand silt pockets enclosed in the state's thick clays become highly saturated and freeze.

The speed limit on a half-mile stretch of Highway E had to be reduced from its normal 55 mph to 15 mph during the winter months. "Heaving could start as early as November and be a problem through March," said Mike Marsden, Outagamie County Highway Commissioner. "We could tell when the frost was out of the ground in the spring because the road would flatten out. We'd put up flashing barriers and advance warning signs. It was really difficult to plow snow in the area."

Little did Marsden know that he'd find a solution to the heaving problem in his own county. The corporate offices of Presto Products Company and the Geosystems group are located in Appleton, Wis. Presto Products Company helped pioneer cellular confinement technology in cooperation with the Army Corps of Engineers in the late '70s. The company's Presto Geoweb Cellular Con-

Defining a geosynthetic: Type and functions

The first use of fabrics in reinforcing roads was attempted by the South Carolina Highway Department in 1926. A heavy cotton fabric was placed on a primed earth base, hot asphalt was applied to the fabric, and a thin layer of sand was put on the asphalt. The department published the results of this work in 1935, describing eight separate field experiments. Until the fabric deteriorated, the results showed that the roads were in good condition and that the fabric reduced cracking, raveling and localized road failures. This project was certainly the forerunner of the separation and reinforcement functions of geosynthetic materials as we know them today.

In all, geosynthetics, perform five major functions: separation, reinforcement, filtration, drainage and moisture barrier. There are six families of geosynthetics: geotextiles, geogrids, geonets, geomembranes, geocomposites and "geo-others."

- **Geotextiles** form the largest group of geosynthetics. They are indeed textiles in the traditional sense, but consist of synthetic fibers rather than natural ones, such as cotton, wool or silk. Geotextiles are porous to water flow across their manufactured plane and also within their plane, but to a widely varying degree.
- **Geogrids** represent a small but rapidly growing segment of the geosynthetics area. Rather than being a woven, nonwoven or knit textile (or textile-like) fabric, geogrids are plastics formed into a very open, gridlike configuration, i.e., they have large apertures. Often they are stretched in one or two directions for improved physical properties. By themselves, there are at least 25 application areas, and they function in two ways: reinforcement and separation.
- **Geonets** constitute another specialized segment of the geosynthetics area. They are usually formed by a continuous extrusion of polymeric ribs at acute angles to one another. When the ribs are opened, relatively large apertures are formed in a netlike configuration. Their design function is completely within the drainage area where they have been used to convey fluids of all types.
- **Geomembranes** represent the second largest group of geosynthetics, and in dollar volume their sales are essentially equal to that of geotextiles. They are impervious thin sheets of rubber or plastic material used primarily for linings and covers of liquid- or solid-storage facilities. Thus, their primary function always is as a liquid or vapor barrier. The range of applications, however, is very wide.
- **Geocomposites** consist of geotextile and geogrid; or geogrid and geomembrane; or geotextile, geogrid, and geomembrane; or any one of these three materials with another material (e.g., deformed plastic sheets, steel cables, or steel anchors). Major functions of this creative effort encompass the entire range of five functions listed for geosynthetics discussed.
- Geo-Others is a general area of geosynthetics that has exhibited such innovation that many systems defy categorization. For want of a better phrase, geo-others describes items, such as threaded soil masses, polymeric anchors, and encapsulated soil cells. As with geocomposites, their primary function is produce-dependent and can be any of the five major functions of geosynthetics. •

The above information war excerpted from the book Designing With Geosynthetics, *Second Edition, by Robert hf. Koemer, Ph.D., P.E. Copyright 1990 by Prentice Hall, Englewood Cliffs, N.J.*

finement System is designed to strengthen structural fill by increasing its shear strength and stiffness.

The system originally was developed for building roads across insufficiently supported grounds, such as beach sands. The system was used to build sand roads for rubber-tired vehicles during the Persion Gulf War.

"Our first project with Outagamie County was at the county landfill site," said Gary Bach, product manager. "We used the system to construct an access road into one of the landfill cells. That application was a success and led us to the Highway E project." To combat Highway E's washboarding pavement, the county worked with the company in 1984 to produce a cross-section design of the road. Presto staff were on site during installation.

The system is an expandable honeycomb-like structure made of high-density polyethylene. The system is designed to produce a stiff base with high flexural strength. According to the company, under load, the system generates powerful lateral confinement forces and high soil-to-cell wall friction. It is to provide a bridging action and improve the long-term load deformation performance of common granular fill materials.

On Highway E, an 8-in. deep system was installed in the problem area. The asphalt pavement was removed and stored for recycling and final topping after reconstruction. The silty clay subbase was cut down 18 in. below the water table level and covered with a geotextile. Next, a 6- to 8-in. layer of 3½-in. to 4½-in. clean crushed stone was added. The system was expanded, positioned and secured at the edges with granular fill. It was then infilled with sand and topped with a 15-in. base course of crushed stone. The completed area was then compacted with a vibratory roller and was immediately ready for traffic.

"Because of our soil conditions, we always use a 15-in. base course on all of our roads, Marsden said. "We probably could have gotten by with less, but we decided not to. If we hadn't used the confinement system, we probably would have reworked the subgrade and added 2 ft of base course. Even though we had fill material available just 6 miles away, it was less expensive to complete the renovation project with the Geoweb material than without it."

Unpaved, the road performed well throughout the following winter, and was surfaced with the recycled asphalt in the summer of 1985.

The system was installed in Highway E in 1984. Now, more than 10 years later, the road still is level and holding up well under all weather conditions. The highway is scheduled to be rebuilt in 1997. The county will widen the highway, fill some valleys, improve sight distance and flatten curves.

"We're not going to touch the section of the road that has the confinement system in it," Marsden said. "The road will be widened, but we won't alter the alignment or the system. We're very pleased with the way it has solved the problems for us on Highway E." •

Reprinted from March 1996 **Roads & Bridges** Magazine

Geoweb carries the load

Cellular confinement system stabilizes poor soil base

"One area that many counties struggle with in road construction is poor soils," says Tom Byle, maintenance and local road construction engineer for the Kent County Road Commission, Kent County, Mich. "Many country roads in America were built over muck, swamps or other similar, inadequate soils. Most counties cannot justify the expense of the standard peat-removal treatment, digging the peat out and replacing it with sand. Many counties end up leaving the road gravel or, if the road is blacktop, shimming the settlements with blacktop until its thickness is literally measured in feet."

Paved surfaces that are built over weak soils can experience subsoil movement and base deterioration, which causes deflections, rutting and cracking in the asphalt surface. One way to combat this problem is to stabilize the weak base and increase the load capacity of those soils. The Geosystems® Group of Presto Products Co., Appleton, Wis., provides a product, the Geoweb® Cellular Confinement System, which is designed to help stabilize road bases for paving.

Cellular confinement comprises base

The Geoweb cellular confinement system is an expandable, honeycomb-like structure made of high-density polyethylene. The three-dimensional network of interconnected, perforated cells are filled with select infill materials, such as aggregates, topsoil, crushed limestone, concrete or a combination of these materials. For structural infills, native soils can be used as long as the fraction of fines, such as silt and clay particles, does not exceed 10 percent and the plasticity index of the material is less than 6 percent. The maximum size of aggregate that can be used to fill the cells depends on the cell depth and radius, neither of which should the aggregate exceed. The chosen aggregate must also be able to stay inside the cell when acted

These two photos show the before and after appearance of 108th Street in Caledonia Township, Mich. The wet, swampy soil (above) gave way to a 200-foot (61-m) mud wave while crews were trying to cut the subgrade. Once the base had been stabilized (at right), the road was paved with asphalt and, four years later, remains smooth and free from deflections, cracks or rutting.

upon by the forces of gravity and fluids.

The Geoweb system confines the base material within its cell walls, decreasing the rate of the infill material's lateral movement and creating passive resistance between adjacent-filled cells. By adding cohesion to cohesionless material, the Geoweb system strengthens the structural fill used in load support applications. The product helps create a stiff base and acts as a semi-rigid slab by distributing loads laterally and cutting down on subgrade contact pressures.

According to Presto Products Co., by using confined versus unconfined aggregate, the material thickness can be reduced by 50 percent. In addition, when aggregate is confined within cellular walls, the subgrade materials may withstand more than 10 times the number of cyclic load applications before accumulating the amount of deflection that an unconfined aggregate experiences, according to the manufacturer. "The Geoweb helps maintain integrity of the pavement base material to the point where it degrades much slower — at the rate of 12 to 15 times slower," says Dan Senf, Presto Products marketing manager. "It can extend the life of the pavement from four to six years to 50 to 60 years."

The Geoweb sections come in various sizes, cell sizes and cell depths. A standard section measures 8 feet (2.4 m) wide by 20 feet (6.1 m) long, with special section lengths ranging from 2 feet (0.6 m) to 30 feet (9.1 m). Larger cell sections are 8 feet (2.4 m) wide by 40 feet (12.2 m) long, with special section lengths ranging from 4 feet (1.2 m) to 60 feet (18.2 m). The standard cell size is 9.6 inches (244 mm) by 8 inches (200 mm), with larger cells measuring 19.2 inches (488 mm) by 16 inches (400 mm). The cell depths for both cell sizes are 3 inches (75 mm), 4 inches (100 mm), 6 inches (150 mm) and 8 inches (200 mm). Cell depth and size is determined by the specific application and details of the base that is being stabilized.

Each section is connected to another section to prevent movement during the infilling operation. Heavy-duty metal staples from a pneumatic stapler are used to connect units. The Geoweb cellular confinement system is anchored into the ground by stakes that bear against the top of the cell wall or against tendons passing through the cell.

The sections also come in two cell types: perforated and nonperforated. The perforations along the cell walls allow water to move from cell to cell, reducing unwanted ponding and providing lateral drainage. They also help in preventing a shear plane from developing between the infill and cell walls.

Geoweb provides stable bases in Michigan

"There are specific benefits for using the Geoweb system with asphalt pavements," says Geoweb distributor John Price, owner of Price and Co., Grand Rapids, Mich. "First of all, it supplies a maximum load distribution, or stress relief, from the asphalt surface to the subgrade with the least amount of thickness. Second, when used on soft subgrades, or with utilities, the Geoweb provides a stiffer base for the pavement."

When used with geotextiles, the cellular confinement system should turn a swampy strip of land into a stable, paved road. For example, Kent County used this technique on the largest project they have constructed — Reeds Lake Blvd. in East Grand Rapids. "In two areas, totaling 1,900 feet (48 m), this stretch of road is literally floating on 30 to 35 feet (9 to 11 m) of wet, soft muck," explains Byle.

"The road is built over swamp land and floods every spring. The water would rise (in the swamp) when the snow melted and it would go right over the road. We ended up closing the road every year at that time. Since we've done the project, though, we have not had to close the road. And the asphalt that was placed over it looks pretty good. There is no cracking on it."

Byle used geotextile, cellular confinement, plastic pipe and lightweight slag on this project. The biggest challenge for Kent County was constructing the culvert that provides the inlet to Reeds Lake. The culvert, located in an area where the muck was over 30 feet (9 m) deep, required three 36-inch (914-mm) smooth, lined plastic pipes. Removing the old culverts destroyed what there was of the existing road bed. The geotextiles were used to keep the culverts from sinking into the muck by tying them back into the existing road bed. The Geoweb cellular confinement system was used to spread the load and stiffen the road bed over the culverts.

Another project took place in Grand Rapids Township, on Leffingwell Ave., from Knapp Ave. to 3 Mile Road. Byle explains that 450 feet (137 m) of this road was in a muck swamp. The crews stripped off the original asphalt and found that the gravel underneath had been placed directly on the muck and at a thickness of less than 6 inches (150 mm). "Running the dozer literally caused eruptions of soft muck up through the gravel," says Byle. "So, we decided to modify our original design and place the cellular confinement system full width across the road bed to stiffen grade and spread the live load."

Crews lay down geotextile and Geoweb cellular confinement sections. Once the Geoweb is placed, slag aggregate is added to fill and cover the cells.

Kent County then took this same technique and applied it to one of the worst road conditions imaginable — a subgrade that, once cut, produced a 200-foot (61-m) long mud wave. The project, which was constructed on 108th Street in Caledonia Township, involved grading, stabilizing and paving the road. An initial solution was to stabilize the grade with geotextile, add underdrain, and cover with lightweight oversize slag. As the dozer operator spread the slag, however, the wave shifted and the underdrain came up through the slag behind the dozer.

Kent County decided to again use the Geoweb cellular confinement system — several 8-foot (2.4-m) by 20-foot (6.1-m) sections of it. The cells were filled and then covered with 2.25 feet (0.69 m) of #4 slag aggregate. Another layer of synthetic geotextile was laid, then covered with 6 inches (150 mm) of 22A slag aggregate. Asphalt was then placed on top of everything. When the project was completed, 2.5 feet (0.8 m) of materials had been added between the top of the subgrade and the bottom of the first lift of asphalt.

"The roadway shows no sign of distress at all," says Byle. "One fact to keep in mind with this type of construction, though, is that settlement is not eliminated. Settlement will occur; but hopefully it will be kept uniform — or, in other words, controlled settlement."

Price adds another suggestion: "The gravel being used needs to go between the bottom of the asphalt and the top of the Geoweb, so that when the asphalt gets hot, it doesn't melt over the Geoweb and get cut through — like a cookie cutter."

Making sure the application of the materials is done correctly is important. To assist with the planning of the project, Presto's Geosystems provides the SPECMaker™ Specification Development Tool. The SPECMaker software system develops complete material and construction specs for the Geoweb cellular confinement system. The program writes a project description based on what materials are available and what design has been provided. The software allows the user to specify the type of application — such as load support on a roadway — performance criteria, cell depth, cell type, anchoring system and infill material selection. ▮

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GEOWEB®

BASE STABILIZATION SOLUTION FOR SOFT SUBGRADES

New Mexico

OVERCOMING SITE CHALLENGES:

- TIME CONSTRAINTS
- EXTREMELY SOFT SUBGRADES
- SHALLOW UNDERGROUND UTILITIES

GEOWEB® SYSTEM STRENGTHENS HIGHWAY SUBGRADE

THE PROJECT

New Mexico's State Highway and Transportation Department (NMSH&TD) made news with innovative financing and a record setting pace in the construction of 118 miles (190 km) of four lane highway along a route in the northwestern part of the state formerly known as Highway 44. With a construction timetable of just two years, and with the construction season limited by cold Rocky Mountain winter weather, design engineers needed to solve construction challenges without delay.

THE GEOWEB SYSTEM MET SITE CHALLENGES

Presto Geosystems' **GEOWEB®** Cellular Confinement System was the perfect answer to a unique soft subgrade problem that threatened to stop paving operations with just a half mile of highway to complete and cold winter temperatures only months away.

While most of the highway, now known as U.S. 550, runs through remote and open country, the highway passes through the small town of Cuba. With time pressures, extremely soft subgrade conditions, relatively shallow underground utility lines running under the highway, and a need to tie in to the existing elevations of sidewalks and parking lots of businesses adjacent to the highway, design engineers were faced with a challenge.

Dumping sand infill in the GEOWEB cellular confinement system.

The finished roadway is paved with asphalt.

GEOWEB®

BASE STABILIZATION SOLUTION FOR SOFT SUBGRADES

New Mexico

Expanding the GEOWEB sections over a geotextile.

Connecting adjacent GEOWEB sections prior to infill.

Infilling the GEOWEB sections with locally-available sand.

"The GEOWEB® System addressed the problem in far less time than any other alternative we had available. It went in quickly, without any complications for the construction crew. The GEOWEB® section will be included in a twenty year monitoring program we have scheduled for the entire U.S. 550 project."

- NMSH&TD Project Engineer Allan Whitesel

THE GEOWEB SOLUTION FOR STIFFENING SOFT SUBGRADES

Unable to proceed on a timely basis with any of the three conventional alternatives (*excavating deep deposits of saturated soils and replacing with more stable materials, thickening the base and subbase structural section to a higher elevation in order to bridge the soft subgrade, or strengthening the limited structural sections with conventional chemical stabilizers or other geotextile/geogrid type products*), they turned to the Presto **GEOWEB®** System. The **GEOWEB®** System is based on cellular confinement (geocell) technology with a proven record of providing an easily deployed stiffened flexural beam for bridging extremely soft subgrade conditions.

USING LOW-COST ONSITE INFILL SAVES COST

Because **GEOWEB®** cells are functional with either clean sand or aggregate infill materials, designers selected a locally available low cost source of free-draining sand for placement within the six inch deep cell structure. The system was deployed over a geotextile to protect the sand infill from contamination.

Working half the width of the highway at a time, crews rapidly installed the **GEOWEB®** for the final half mile. The project required 189,000 sq ft of product. With the firm **GEOWEB®** working platform in place, base construction and asphalt paving were quickly completed, facilitating a timely grand opening for the 118 mile highway improvement project.

PRESTO GEOSYSTEMS

Call 800-548-3424 for more information.
www.prestogeo.com

Ropers Gate, Tunbridge Wells – Example of permeable paved road with base infiltration, surface water storage within the sub-base and the use of the Geo-web system

LOAD SUPPORT SYSTEM
GENUINE GEOWEB®

Project: New Salt farm

Projectnumber: E-2016-077

Date: 29.04.2016

Project description

Project description:

A new access road needs to be constructed on soft soil. A CBR value of 3.0% is assumed for the existing subgrade. Geoweb® geocells offer a cost-effective solution to improve the bearing capacity and in-service performance of those structures due to its unique load transfer mechanism. At loading, hoop stresses within the cell walls and passive earth resistance in the adjacent cells are mobilised, which restricts the horizontal deformation of the infill material. As a result the stiffness of the fill material is increased and due to this the vertical stresses and the settlements are reduced.

Given Documents/Parameters:

Loading parameters (axle load; load area; traffic passes):	given by client (RFPE)
Subgrade parameters (CBR; stiffness; angle of friction):	given by client (RFPE)
Layer parameters (angle of friction, stiffness):	assumed by editor

Soil Parameters:

Soil mechanical parameters of the subgrade material were assumed by the client. Preliminary design is therefore carried out for a CBR value 3 percent, which leads to a net bearing capacity of approx. 220,29 kN/m² (depending on the correlation between undrained shear strength and CBR). Soil mechanical parameters of single pavement layers were not provided by the client and were assumed on basis of experience of Soiltec GmbH. Soil parmeters are assumed to be similar in the entire construction area. If in-situ soil parameters are different than assumed the pavement design can differ/should be modified.

Load Parameters:

According to the given information the area is loaded by trucks and pilling rick.
A tyre load of 50 kN is assumed for the design. The tyre load is distributed over a contact area of 0,08 m², which leads to a static contact pressure of 625 kN/m². The number of passes is considered in the serviceability analysis by an increased static reference load, which is calculated due to a load increase factor. Design is carried out for 100000 axle crossings. If load parameters are different than assumed the pavement design can differ/should be modified.

Geoweb® Parameters:

Limited State Analysis:

The verification of the bearing capacity is based on the German version of the EuroCode 7, DIN EN 1997-1:2004 + AC:2009, in conjunction with the National Annex DIN EN 1997-1/NA:2010-12 and the supplementary provisions of German Standard DIN 1054. The calculation is based on the partial safety concept. In the partial safety concept the characteristic actions (loads) are increased by multiplying them with prescribed partial factors to produce design actions (loads). The characteristic resistances or soil properties are decreased by dividing them with prescribed partial factors to produce design resistances or soil properties. If the design resistance or soil properties are equal or higher than the design actions an adequate margin of safety against collapse can be assumed. By defining the degree of utilization μ as the quotient of design actions to design resistance or soil properties, a value of μ less than one means a safe design.
For the verification of the safety of the Geoweb® access road, limited state analyses were conducted according to DIN 4017 (proof of sufficient safety against shear failure in limit state GEO-2). Limit state GEO-2 implies the design approach 2* of DIN EN 1997-1:2004 + AC:2009. Herein the actions are increased and the resistances are reduced.
Shearing occurs if the applied pressure on the subgrade soil is higher than the bearing capacity of the subgrade material. The bearing capacity of the subgrade soil is determined on basis of the undrained shear strength (qult. = 5.14 x cu), the existing pressure on the subgrade is calculated according to the state of the art by the load distribution through the Geoweb® stabilized pavement construction, whereas the load distribution angle was determined depending on the infill material of the cells by several large scale and in-situ tests which have been carried out.

Servicability Analysis:

An analytical model on basis of state of the art was used to estimate the settlement of the pavement construction. In the analytical model, the settlements within the Geoweb® layer and beneath the Geoweb® layer are calculated separately and summarized to the overall settlements afterwards. The improvement effect due to the Geoweb® layer is taken into account by an equivalent load area beneath the Geoweb® layer. Settlements are calculated on basis of German Standard DIN 4019. It is assumed that the modified model is adequate for the estimation of settlements.
The pavement design is carried out for maximum allowable settlements of 15 mm.

LOAD SUPPORT SYSTEM
GENUINE GEOWEB®

Project: New Salt farm

Projectnumber: E-2016-077

Date: 29.04.2016

Input parameters

loading conditions:		
Loading type:	SLW 30 - Wheel load 50 kN	DIN EN 1072
Tire load (static) [kN]:	50,00	wheel load from trucks
Axle crossings N [-]:	100.000	
Loading area [m²]	0,080	
Contact pressure (static) [kN/m²]	625,00	
Contact pressure (dynamic) [kN/m²]:	1044,43	
Load increasing factor [-]:	1,67	
Geoweb and infill material:		
Description:	G3V306	
Cell height h [m]:	0,150	
Cell diameter d [mm]:	300,00	
Infill material description:	Gravel 0-32mm	
angle of internal friction [°]	35,00	
infill unit weight [kN/m³]	18,00	
friction coefficient between infill and geocell material [-]:	0,80	
subgrade soil parameters:		
Description:	Soft Subgrade	
Excavation depth before Geocell installation [m]:	0,00	
Unit weight of subgrade material [kN/m³]:	0,00	
angle of internal friction [°]:	0,00	
Undrained cohesion of subgrade [kN/m²]:	0	
CBR-value of subgrade [%]:	3,0	**assumed**
uniaxial compression stiffness [kN/m²]:	0	
calculated uniaxial compression stiffness [kN/m²]:	6000	based on correlations between CBR and stiffness
Load case according to partial safety concept:		
Load case:	LF 1	*LF1 - Permanent constructions*
Partial safety factor reaction forces [-]:	1,50	*LF2 - temporary constructions*
Partial safety factor restoring forces [-]:	1,40	BS - without factors
settlement reduction factor [-]:	0,20	
allowable settlements [mm]	15,00	according to client

Pavement design with Geoweb® **:

soil layers	angle of friction [°]	unit weight [kN/m³]	layer thickness [m]	stiffness E_s [kN/m²]
Asphalt Layer	45,000	19,000	0,100	120.000
G3V306+Gravel 0/32mm	45,000	18,000	0,150	120.000
Overtopping of Geoweb	35,000	18,000	0,150	120.000
nonwoven geotextile 70 kN/m				

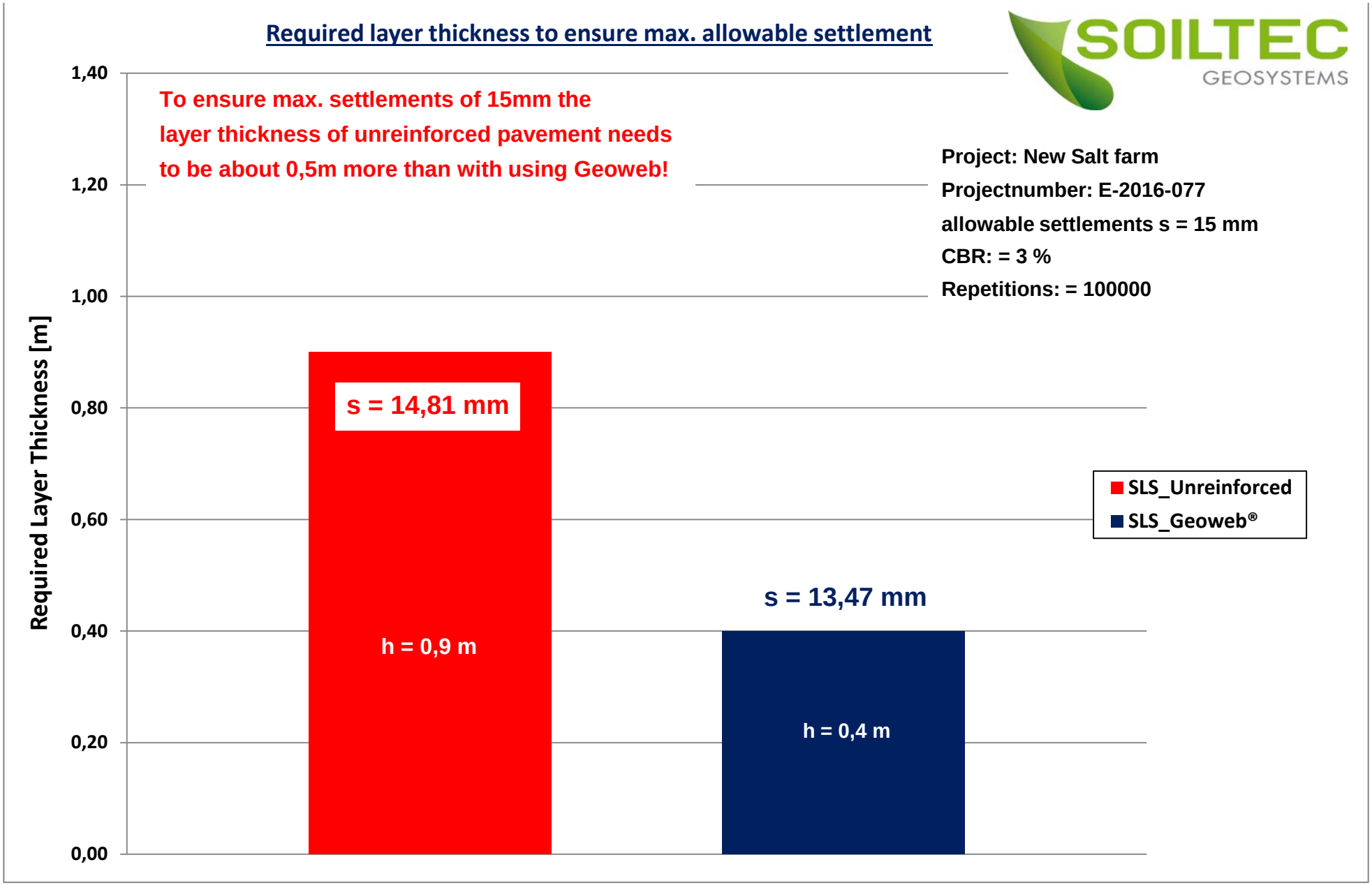
** designed pavement layout considering the specific subgrade strenght and traffic passes for this project.

Pavement design without Geoweb® if available: Required layer thickness to have same settlements as with Geoweb**

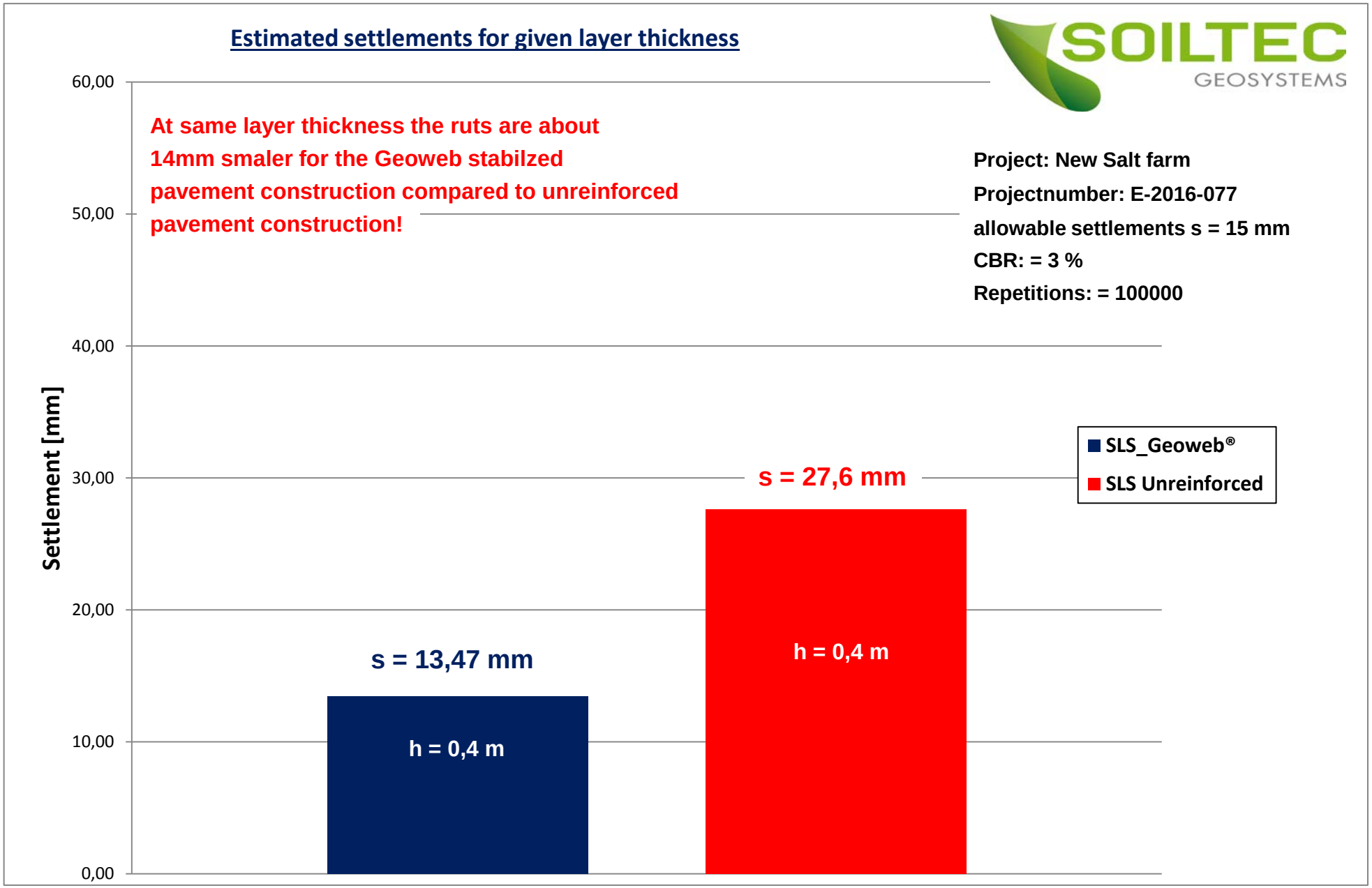
soil layers	angle of friction [°]	unit weight [kN/m³]	layer thickness [m]	stiffness E_s [kN/m²]
Asphalt Layer	45,000	19,000	0,100	120.000
Complete Gravel Layer	35,000	18,000	0,800	80.000

** designed pavement layout considering the specific subgrade strenght and traffic passes for this project.

Required layer thickness to ensure max. allowable settlement



Estimated settlements for given layer thickness



Becky Warrener

From: Andrew Picton
Sent: 05 October 2016 16:09
To: 'Ken Argent'
Cc: Kevin Macknay; Julian Turner; Sarah Poulter; Jackson, Adrian; 'Dinny Shaw'
Subject: RE: New Salts Farm - Road Construction & Levels

Ken,

Apologies for the delay in responding.

It is the intension that the services (where ever possible) will be kept out of the carriageway. Generally, they will be located beneath the footway or within a service strip running parallel to the road. Where perpendicular service crossing occur, ducting will be provided. The footways will be of more standard from of impermeable construction which will facilitate an easier form of reinstatement.

We have spoken to the suppliers of the Geo-Grid system and it is possible to dig a trench through this type of road although it will clearly require additional supervision to ensure that a new strip of geo-grid is correctly installed when the road is reinstated.

The roads within the site are to remain private so we do have a little more flexibility on the location of the services and the manner in which the repair/installation of the services are carried out.

With a permeable road construction there will be no road gullies or surface water drainage system within the road which will also help to avoid digging up the road.

Regards

From: Ken Argent [mailto:ken.argent@adur-worthing.gov.uk]
Sent: 29 June 2016 08:55
To: Andrew Picton <ajp@tullydeath.com>
Cc: Kevin Macknay <kevin.macknay@westsussex.gov.uk>; Julian Turner <jct@tullydeath.com>; Sarah Poulter <sarah.poulter@hyde-housing.co.uk>; Jackson, Adrian <adrian.jackson@environment-agency.gov.uk>
Subject: Re: New Salts Farm - Road Construction & Levels

Andrew.

i promised to give this product a bit more though after our last meeting, i have copied the EA into my comments which follow:

The system clearly is suitable for weak ground, it also clearly acts as a permeable layer, but the literature does not state that the subgrade can be permanently saturated, as a result high ground water periods during the wet months, unless you utilise the ATRA anchor and tendon.(page 5)

But

Whilst you will strive to install all the necessary services at the time of construction, we all know what utility providers are like, they seem to be attracted to new pristine surfaces, - what effect will trench or localized excavations have on the geogrid integrity, once the tendons and anchors are damaged or the geogrid is cut out?.

Ken Argent | Engineer | Engineering Team | Adur & Worthing Councils
01903221374

On 25 April 2016 at 15:34, Andrew Picton <ajp@tullydeath.com> wrote:

> Kevin, Ken
>
> Further to our meeting last week I have attached some product literature for the geogrid system we are looking to use on this site. There are a number of suppliers of the Geoweb system but they are all fundamentally the same. We have successfully used this system on a number of private estate roads where we were required to provide a no-dig road, built directly onto the top soil, or where the ground conditions were very poor (CBR values were non-existent). Generally we have used this system on a permeable road, with base infiltration and attenuation provided within the structure of the road, which is similar to what is proposed for this development.
>
> As typical with estate road design, the construction phase is the more onerous loading situation. Usually a sacrificial impermeable DBM layer sits on top of the Geogrid system during the construction phase which is either left in place with holes punctured into it to allow percolation, or is removed when the permeable surfacing is installed.
>
> We are working up some site specific details and will send them across to you shortly.
>
> I have also attached a copy of the New Salts Farm topographical survey for you information. It was mentioned at our meeting that Phase 1 was located in a low part of the site. Upon closer inspection of the levels, the majority of Phase 1 is relatively high (typically 1.8m AOD) with levels falling to the north. The ditch adjacent to the northern boundary of Phase 1 is the local low point where levels beyond the ditch rise (to the north) up to 1.6.-1.8m AOD before falling again towards the northern boundary.
>
> Kind regards
>
> **Andrew Picton | Associate Director**
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> **Tully De'Ath Consultants, Sheridan House, Hartfield Road, Forest Row, East Sussex, RH18 5EA**

Appendix P – Green/Blue Roof Details

Tully De'Ath Consultants

Examples and Details of Green/Blue Roofs for New Salts Farm

Project Number – 11649
New Salts Farm Road Land - Shoreham

All the houses on the New Salts Farm Development will incorporate Green Roofs with water attenuation (Blue Roof) below. It is well documented on the benefits of Green Roofs in terms of reducing the volume of surface water run-off. The introduction of the Blue Roof system below the green roof will enable further controlled outflows from the roof.

Typically, the green/biodiverse roof area has an undulating, 50-150mm depth of growing medium, which could include a sedum mix, or a local wildflower seed mix and/or selected plug plants; sand, pebble, stone, log piles and animal, insect, bird habitats. The Blue element consists of thin plastic storage crates with an integral flow control device. The Blue Roof system does not store any permanent volumes of water for more than a 12/24-hour period. It will constantly flow/empty and will only restrict the flow when the appropriate design storm event hits.

The size of the crates are designed to attenuate surface water run-off (with a restricted outflow) for all events up to the 1 in 100-year storm with an additional 30% allowance for climate change.

The restricted outflow will discharge to RWP's, external to the building.

The typical roof details provided refer to the ABG system however there are other similar Green/Blue Roof systems available, such as Polypipe and Alumsac. ABG provide warranties and are accepted by the NHBC (see attached documentation).

The maintenance of this type of roof will be dependent on the system used. For the ABG system, a 6-monthly maintenance inspection is required (see attached ABG Green Roof Maintenance Document). The Blue Roof chambers need to be visually checked and the RWP outlet separately cleaned as appropriate. If required, the Blue Roof chamber's internal filter geotextile board can be changed. The Polypipe systems claim to be maintenance free although as a minimum it is recommended that the outlets and flow control devices are inspected at least once a year.

The current intension is that Hyde, as Estate Manager, will manage and maintain the Blue Roof system.

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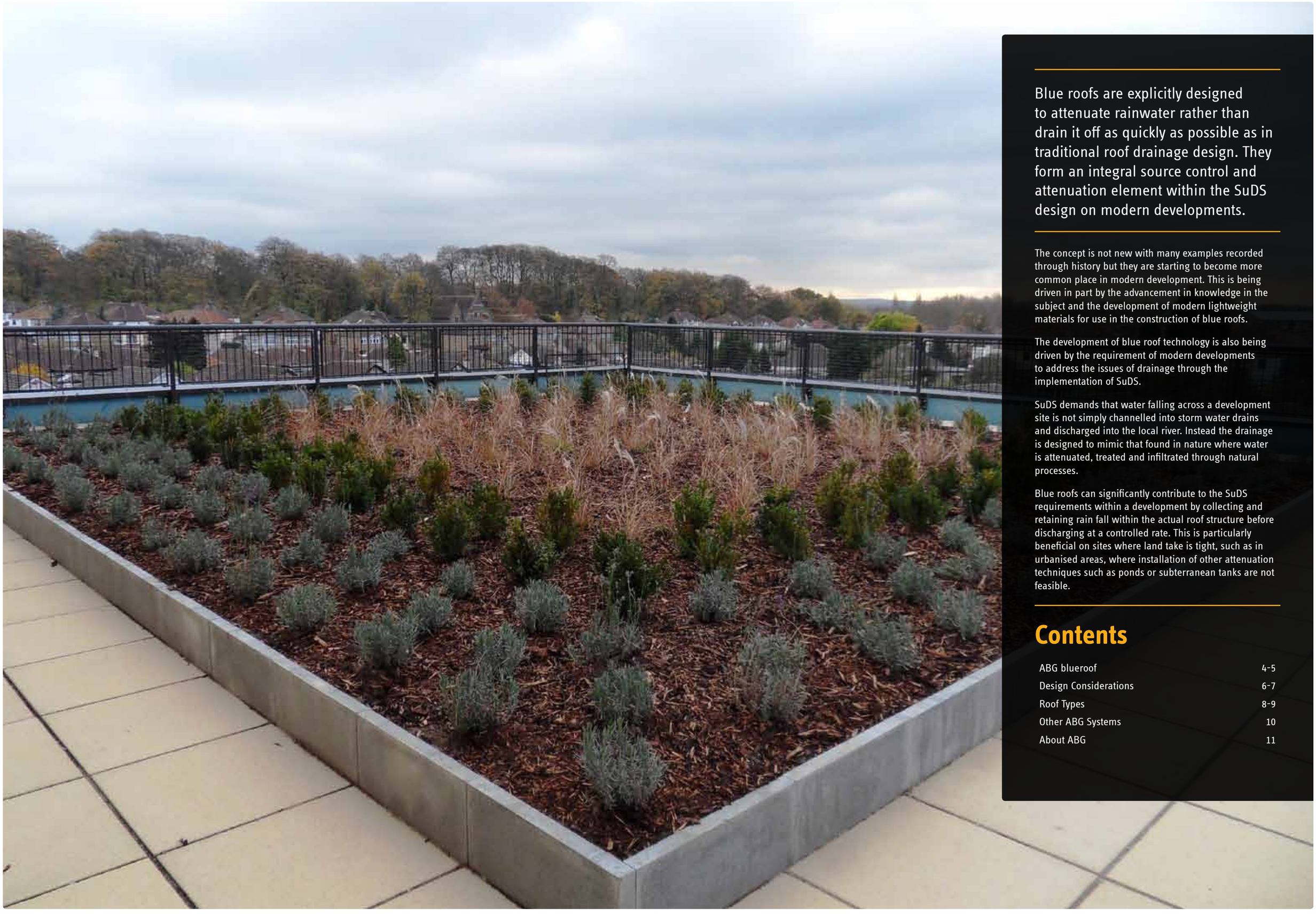
blueroof

A guide to the selection and specification of ABG blue roof system for the attenuation of storm water.

abg creative geosynthetic engineering



Blue roofs are explicitly designed to attenuate rainwater rather than drain it off as quickly as possible as in traditional roof drainage design. They form an integral source control and attenuation element within the SuDS design on modern developments.

The concept is not new with many examples recorded through history but they are starting to become more common place in modern development. This is being driven in part by the advancement in knowledge in the subject and the development of modern lightweight materials for use in the construction of blue roofs.

The development of blue roof technology is also being driven by the requirement of modern developments to address the issues of drainage through the implementation of SuDS.

SuDS demands that water falling across a development site is not simply channelled into storm water drains and discharged into the local river. Instead the drainage is designed to mimic that found in nature where water is attenuated, treated and infiltrated through natural processes.

Blue roofs can significantly contribute to the SuDS requirements within a development by collecting and retaining rain fall within the actual roof structure before discharging at a controlled rate. This is particularly beneficial on sites where land take is tight, such as in urbanised areas, where installation of other attenuation techniques such as ponds or subterranean tanks are not feasible.

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ABG blueroof

ABG **blueroof** provides attenuation capacity within the green roof or podium deck construction of a development. Utilising this space in this way means that the attenuation capacity required to meet SuDS best practice can be met without the requirement for land consuming ponds and retention basins or the challenges of constructing large subterranean geocellular storage tanks.

blueroof comprises a combined drainage and attenuation void within the roof structure and a roof outlet system designed to release the attenuated water at a controlled discharge rate as permitted in the planning consent of the site.

Designing a green roof in this way allows storage capacities suitable for up to a one in a hundred year storm event, plus an allowance (typically 30%) for the effects of climate change, to be achieved.

This stored water, as with a 'traditional' storage system, can be released at a controlled rate or even used as grey water or irrigation for the vegetation across the development.

The ABG **blueroof** System consists of two key components:

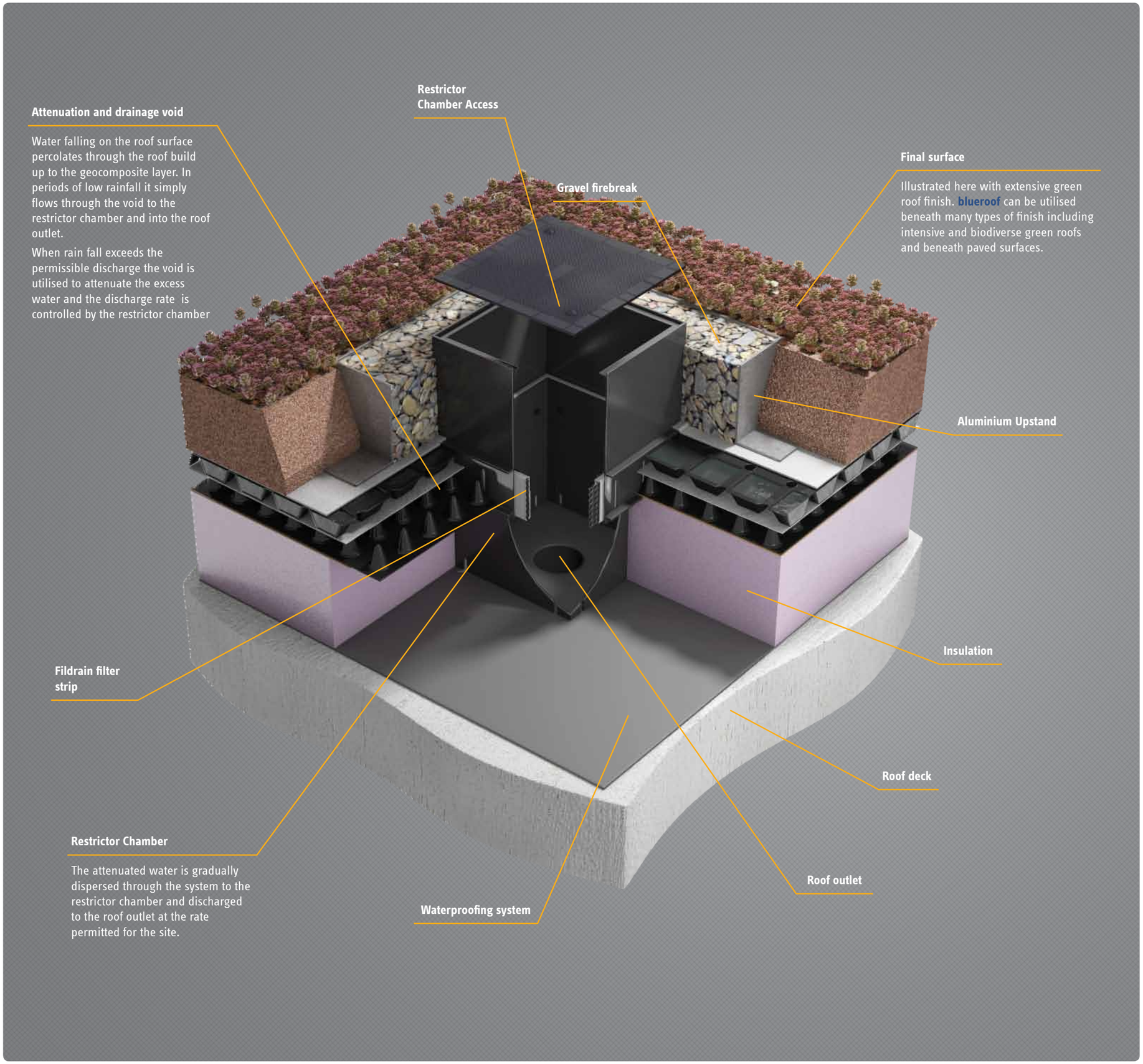
- A drainage geocomposite system with integral filter geotextiles and a series of restrictor chambers. Excess water not absorbed by the vegetation, filters through the green roof and builds up in to the drainage void formed by the geocomposite layers below.
- This water is gradually dispersed through the system to the restrictor chamber and discharged to the roof outlet at the rate permitted for the site.

The storm water attenuation requirements are met within the roof construction, therefore the need for underground storage can be eliminated. The benefits to the overall project include the removal of the excavated material, disruption on site, and the time and cost of installing an underground tank.

Placing the storage within the footprint of the building also has advantages in heavily urbanised developments where external space is at a premium and on site working space and materials storage is limited. This reduction in material movements also helps reduce the carbon footprint of the project.

blueroof is suitable for:

- Supermarkets
- Distribution centres
- Schools and colleges
- Shopping centres
- Underground car parks
- Housing
- Flats
- Office blocks



Design Considerations

Design Factors

As part of the design process ABG will develop response calculations to model the behavior of the roof during storm events. The information required is usually contained within the surface water run-off assessment for the specific site.

The modelling looks at a number of key factors including

- Required rate of discharge.
- Attenuation volume requirement.
- Time to completely discharge attenuated water from the roof structure.
- Roof type.

Rainfall depths for the specific site are calculated according to location, duration and return period (the number of times in set period a storm of that magnitude is likely to occur; 1 in 30 years and 1 in 100 years storms are usually considered). An allowance is also made for future climate change.

Rainfall and run-off should be considered simultaneously to give an actual representation of the **blueroof** behaviour under storm conditions.

Design Capacity

Should attenuation reach its maximum level the restrictor chamber has a built in safety mechanism designed to release excess water into the drainage system. Design capacity will always come with a factor of safety allowing for additional capacity.

In reality, provided the **blueroof** is designed and maintained properly, its designed storage capacity will never be exceeded.

Outlet Design

Traditional roof design tends to have a conservative approach when designing the rainwater outlets with usually more outlets installed than actually required. When designing a blue roof the restrictor chambers are an integral component in controlling the discharge of water from the roof and as such the number required is calculated exactly. Typically this may mean that less outlets are required, less outlets means less penetrations, less detailing and greatly reduces the potential of leaks occurring. The reduction in outlets also has a positive impact on both the construction time, costs and service risers running through the building meaning the construction saves both time and money.

Water Quality

Using the **blueroof** system has a positive impact on the quality of the water discharged. Before the water reaches the roof outlet it has already passed through several processes that remove particulates and pollutants including vegetation and growing medium (if the roof is green) and more importantly through at least two, in a basic system, layers of non-woven, needle punched geotextile whose filtration properties are well documented. The water is treated to such a degree that it reaches the level required in treatment train stage one allowing the water to be released from the roof directly into the river system

In a truly holistic design consideration should be given to using the attenuated water for secondary uses such as the irrigation of gardens and washing paths etc. The water could also be considered for grey water reuse applications although it may need to undergo a further treatment stage in order to do so.

Structural Considerations

The introduction of a **blueroof** may have loading implications for the structure of the building. It is vital to consult a structural engineer at an early stage especially when designing for a SuDS solution where water will be stored within the roof structure. This will enable you to determine any constraints you may be under, although this is not as onerous as may be expected.

Traditional structural loadings in roof design take into account the dead weight of the roof structure, the materials used to construct it, plus an allowance for load applied by snow falling on the roof.

blueroof stores collected water across the entire area of the roof at a shallow depth, typically less than 100mm. At full capacity this would exert a maximum additional load of 1.0kN/m^2.

In reality it is exceedingly unlikely that the roof will ever reach full capacity as it will start to drain as a soon as it starts to rain and will continually drain throughout the storm event at the rate determined by the restrictor outlet.

When taking into account that there is no screed required to achieve a fall on the roof and construction tolerances the additional design allowed for load is, in fact, usually negligible.

ABG Technical Department are able to advise on the loadings the roof will generate when fully charged.

Waterproofing Design

A key element of any roofing system is the waterproofing. **blueroof** is compatible with all modern waterproofing materials (ABG recommend monolithic bonded systems). The selection of which waterproofing type is down to the type of roof construction and, to a degree, personal preference. As a concept **blueroof** is compatible with both warm and inverted roof constructions.

Once installed it is recommended that the waterproofing layer be electronically tested for integrity before being covered installation of the blueroof components commences.

Care should be taken during installation of subsequent layers however once the insulation is installed the waterproofing system is covered and protected from damage from further works during normal operations.

As with other roof types the waterproofing should be detailed to a height of 150mm higher than the final fill level.

ABG work with leading manufacturers and installers of waterproofing systems and can offer project specific advice and guidance to ensure the optimum solution is selected.

Access and Maintenance

The British Standards Institution state that all new builds must provide access to the roof area to enable a minimum of two inspections per year. In achieving this compliance to working at height regulations must be considered. If a building is of a height which can cause an injury from a fall, including roofs under 2m, then edge protection is required.

The level of maintenance required is dependent on the final finish. Paved podium decks and extensive green roofs are relatively low maintenance where as intensive green roofs require maintenance like any garden.

Specific attenuation should be given to the **blueroof** elements such as the outlets which should be checked a minimum of twice annually.

As with any green roof the design should allow for the safe removal of materials from the roof

Thermal Performance

blueroof needs to meet the building regulations required to achieve the thermal performance. At the moment, as with green roofs, the **blueroof** build up cannot be considered as part of the roof build up when calculating thermal performance so insulation specification must be done as per a traditional roof design.

It is recommended that the insulation material be extruded polystyrene (XPS) and not expanded polystyrene (EPS). EPS in contact with water degrades which will result in the roof losing thermal performance ultimately leading to the requirement for an expensive reroofing operation.

However, research shows that the introduction of layers of drainage, growing media and vegetation have an impact on the thermal performance and can offer additional benefits on the development including cost benefits and reducing the carbon footprint.

Geography

Geographical location and orientation are an important part of designing a **blueroof**. Which area of the country, the amount of average rainfall in that area and the prevalent wind direction all affect the design and must be considered.

When using a vegetated finish the geographic location impacts the species selection with many species suitable for green roofs being specific to a region.

Final Finishing

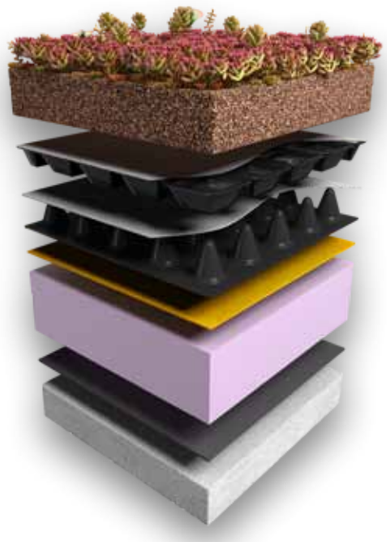
blueroof can be designed beneath all green roof types including extensive, intensive and biodiverse (brown). It is also suitable for use beneath paved or trafficked areas such as frequently used on podium decks. Suitable surfaces include permeable block paving, rubberised asphalt, ballasted etc. **blueroof** is also suitable for use with photovoltaic cells (PV).

The options are endless and comes down to the clients requirement for the final finish of the roof.

ABG Technical department are able to advise and assist with project specific design guidance to help meet the clients requirements.

Inverted Roof

In inverted roofs two layers of composite are used above the XPS insulation layer overlaid with a slimline separation membrane. In conjunction with a restrictor outlet chamber the two layers of composite provide a combined drainage and attenuation function across the roof area.



Podium Deck

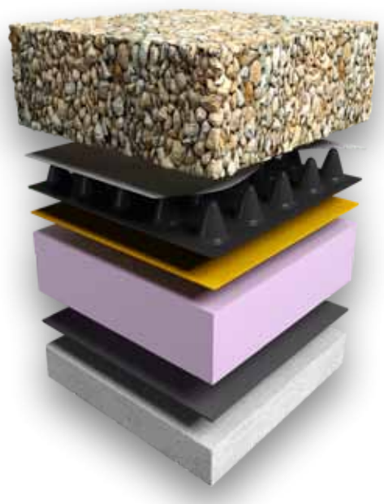
In podium deck construction typically the system utilises two layers of Deckdrain within the system. The upper layer forms a free flowing layer addressing drainage requirements during low flow whilst the layer beneath providing attenuation capacity during and after storm events.

Warm Roof

In warm roof construction the composites behave in much the same way as within the inverted roof construction with the whilst providing protection to the waterproofing system laid over the insulation.

Ballasted Roof

In ballasted roof construction the void within the ballast provides additional attenuation capacity therefore negating the requirement for a second layer of composite. The composite provides the main attenuation void across the roof area.



Roof Types

Like green roofs blue roofs are suitable for use on a wide range of substrates and are compatible with most modern waterproofing systems.

They are also flexible when it comes the roof build up being equally as effective on an uninsulated podium construction as they are within a warm or inverted roof construction

The illustrations on the left represent some of the more common roof build-ups with which the blueroof system can be used but they do not define its entire extent. The highly modular nature of the blueroof components mean that a system can be designed for most flat roofs and podium decks.

specific advice and guidance on individual project requirements is available through the ABG Technical Team who are happy to review your scheme and determine suitability.

SuDSpave

The SuDSpave system comprises complementary components that create an integrated porous paving system to effectively manage the safe collection, treatment, management and dispersal of surface water.

SuDSpave is configurable to individual project requirements and offers a range of surface solutions to meet the aesthetic and performance requirements. In addition, a range of geogrids and geocells can minimise construction depth whilst meeting the structural requirements. In addition high performance geotextiles help treat collected water to meet quality expectations. Finally geocomposites can allow the formation of a free storage void across the paved area to attenuate surface water during storm events.

Drainage

ABG drainage geocomposites offer high performance cost effective alternatives to traditional stone groundwater drainage solutions and have been used extensively in a wide range of civil engineering, environmental and building drainage applications.

Drainage geocomposites offer very high flow capacity, many times that of traditional crushed stone (specific data is available), this is achieved through the unique open structure created by the cuspated core construction which allows unhindered water flow through the system.

Geotextiles ensure that fines do not enter the flow void minimising the occurrence of blockages and allowing continuity of flow through the whole life of the installation

Webwall Retaining Walls

Webwall is a geosynthetic system designed for the construction of flexible retaining walls. It uses a geocellular mattress which is laid in layers with each expanded and filled with site won materials to form a structure with a vegetated face.

The Webwall system offers a solution in many SuDS applications with its primary use being in the construction of steep embankments on SuDS structures such as swales, channels and attenuation basins and ponds. Constructing steeper embankments minimises the land take of the structure freeing up more land for development.

As with all ABG systems a full design service is offered through our in-house team of chartered civil engineers.

Erosion control systems

ABG offer a broad range of erosion control products that includes biodegradable and non-biodegradable erosion control mats, They can help with the surface protection of many elements within the SuDS scheme including swales, channels, ponds and attenuation basins

Silt laden run-off from exposed soil slopes is a major concern for the Environment Agency who consider it a pollutant. Erosion control systems help to ensure the environment is protected throughout the life of the project from construction to establishment of the vegetation.

As with all ABG products design advice on which materials are appropriate for your specific requirement and their specification is available from our technical department.

About ABG

ABG is a market leader in the design, development, manufacture and technical support of high performance geosynthetic systems for use in a wide range of civil engineering, environmental and sustainable building projects.

Formed in 1988, based in Meltham, in the heart of the Pennines, ABG have developed an excellent reputation for developing quality products and delivering outstanding service. The ability for rapid product development ensures that the most innovative, up to date and cost effective solution can be found for many engineering problems.

ABG's involvement in roof drainage goes back over twenty five years and we have a complete range of products developed specifically for use in this technically demanding application.

Technical support is provided by our trained and experienced staff, many of whom are Chartered Civil Engineers. This extensive support extends to full design, design validation, feasibility studies, cost advice and advice on meeting regulatory requirements.

Part of this technical support includes developing and driving knowledge within our active markets including working with both international and local regulatory bodies on developing guidance and best practice in the use of innovative geosynthetics to solve complex engineering issues.

For further information or to discuss your project specific requirements contact ABG:

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INVESTORS IN PEOPLE

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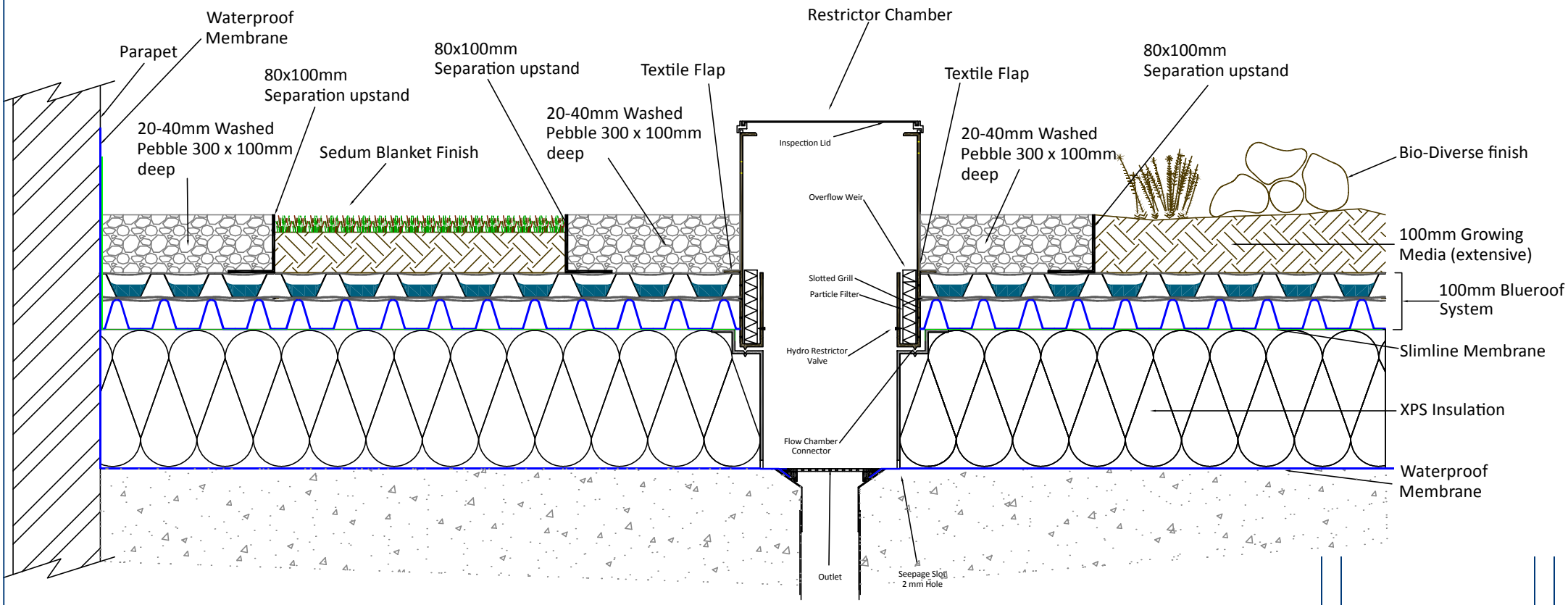

Rev:	Comments:	By:	Date:

Project:	BLUE ROOF
Title:	BR01
Drawn by: GJB	Date: 29/10/15
Scale: NTS	Drawing Ref: 01 / Rev: XX

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ABG blueroof System 10/20/30 Year Warranty

Warranty Serial Number:			
Contract/Building Name:			
Building Owner:			
Building Address:			
	Roof/Podium Area 1	**Roof/Podium Area 2**	**Roof/Podium Area 3**
Waterproofing Membrane System Type & Install Team Name:			
ABG blueroof System Type & ABG Approved Install Team Name:			
Final Surface FinishType & Install Team Name:			

Date of Substantial Completion and Final Inspection:	

Details of the ABG blueroof System:

ABG Ltd ('ABG'), warrants to the owner of the building described above ("Owner"), that subject to the terms, conditions, and limitations stated herein, ABG will warranty the performance of the "ABG **blueroof** System" for the Warranty period commencing with the date of substantial completion of the installation of the ABG **blueroof** System.
This warranty applies to ABG **blueroof** systems for which:
1. All work has been completed by ABG, or it's approved installer, for supply & installation of the ABG **blueroof** System.
2. The underlying waterproofing system has been tested for water-tightness using electronic leak detection, and inspected and certified by the manufacturer or installer.
3. The waterproofing has been maintained in a protected condition between the time that the waterproofing has been installed and the ABG **blueroof** System has been installed.
4. The installation of the ABG **blueroof** System has been completed using an approved ABG installer and ABG supplied materials.
5. The Owner maintains the ABG **blueroof** System in line with the ABG Operating & Maintenance (O&M) procedures provided on practical completion of the installation which will include regular scheduled inspections of the roof or podium area (including visual inspections of the ABG **blueroof** restrictor chamber boxes), and appropriate care and maintenance of the final surface finishes for the duration of the warranty.
6. The Owner of the building provides safe access to all roof or podium areas where the ABG **blueroof** Systems have been installed for the duration of the warranty and where appropriate has maintained safety systems incorporated into the building.
7. If the final surface finishes (including any vegetated/green roof, hard or soft landscaping, pavers, or ballasted finishes) have been supplied & installed by an ABG approved installer, then this warranty will apply to this additional buildup above the ABG **blueroof** System.
Where ABG's approved installer has installed a vegetated/green roof final surface finish, ABG will warrant the vegetated cover performance to achieve and maintain a foliage coverage rate of seventy (70) percent for the duration of this warranty. The appropriate level of care, weeding, fertilization, and irrigation must be provided by the Owner, as required within the ABG O&M procedures.

TERMS, CONDITIONS, LIMITATIONS
1. The Owner shall notify ABG on the first business day immediately following the discovery of a failure in the ABG **blueroof** System, and confirm in writing within 10 working days.
2. If, on inspection by ABG, ABG determines that the identified failure in the ABG **blueroof** System is caused by a defect then ABG shall affect repairs. The decision of ABG with respect to repairs shall be final and binding.
3. This warranty does not extend to conditions caused by, and ABG shall not be responsible for any damage caused by:
(a) Any act of negligence, accident, or misuse including, but not limited to, lack of maintenance, damage by other persons or trades, vandalism, falling objects, civil disobedience, or act of war, or:
(b) Vehicular, Pedestrian travel or recreational use, except in areas specifically designated for these purposes, or:
(c) Damage by a natural disaster including, but not limited to, earthquake, lightning, fire, hail, high winds, hurricane, tornado, flood, erosion, drought, acid rain, thermal shock or other acts of God, or:
(d) Damage caused by animals, birds, or insect or disease infestation, or:

(e) Other building components, including cracking, building movement, settlement, deflection of roof deck, deterioration of walls, movement of metal work, water entry other than the roof, and defects in the materials used as a base under the roof, or:
(f) Service to or maintenance of any roof top equipment or traffic of any nature on the roof except in designated areas, or:
(g) Removal of any portion of the ABG **blueroof** System, including any of the final surface finishes above the ABG **blueroof**, and disturbance of the ABG **blueroof** restrictor chamber boxes , without prior written approval by ABG, or:
(h) Chemical attack, including but not limited to petroleum-based products, solvents, contaminants, chemical waste, exhaust or heat generated by mechanical units, deicing materials, fertilizers, herbicides and pesticides that are not approved by ABG, and alike, onto the final finished surface level, ABG **blueroof** system, and waterproofing system, or:
(i) A proscribed activity, including the failure to comply with Operating & Maintenance Plan, and any construction or installation subsequent to the installation of the ABG **blueroof** system that has not been authorised in writing by ABG. The Owner must promptly notify ABG in writing of any proposed alterations, additions or changes of any kind that will affect the ABG **blueroof** System, or:
(j) Alterations or repairs made on or through the completed ABG **blueroof** System, or objects such as but not limited to fixtures, equipment, or structures are placed on or attached to the completed ABG **blueroof** System or the final surface finishes, without first obtaining written authorisation from ABG, or:
(k) Failure by the Owner or their lessee to use reasonable care in maintaining the roof or podium area as described in the building or sites Operating & Maintenance plan, or:
(l) Poor irrigation water quality, in particular reference to where vegetated/green roof final surface finishes are installed by the ABG nominated installer, or another contractor, or:
(m) Deficient design applied to the ABG **blueroof** System such as contact with incompatible materials and/or substrates, installation next to highly reflective surfaces without an irrigation system, exposure to heat below roof deck, such as from steam or hot water pipes, insufficient drainage design, or:
(n) Any change of use of the roof or podium area, associated loading parameters, or changes in the final surface finishes, not discussed and approved by ABG prior to the commencement of these changes, or:
(o) The Owner or their lessee fails to comply with every term and condition stated herein.
4. During the period of this warranty, ABG, its agents and employees, shall have free access to the roof or podium areas during regular business hours
5. No liability will be accepted for any disruption caused by any repair work.
6. ABG shall have no obligation under this warranty until all invoices for materials and services associated with the ABG **blueroof** System, and where applicable for the final surface finishes, have been paid in full.
7. This warranty will apply only to installations where the final surface finishes have been agreed with ABG prior to installation; the maintenance is provided exclusively by an installer accepted by ABG; and an ABG **blueroof** Maintenance Agreement, compliant with the Operating & Maintenance Plan, is in effect for the duration of the warranty.
8. Where present the appearance of the vegetated/green roof final surface finishes should be expected to change over the years. A process of natural succession will result in the botanical evolution of the vegetated/green roof cover. The future distribution of plants species cannot be accurately predicted. The long-term coverage of the vegetated cover can be guaranteed only in conjunction with an ABG **blueroof** Maintenance Agreement required under this Warranty.
9. The Owner shall notify ABG in writing within 48 hours of discovering that any of the final surface finishes/coverage is insufficient, changed or damaged according to this warranty.
10. ABG's cumulative cost to repair or replace the ABG **blueroof** System shall not exceed the original cost of the ABG **blueroof** System (including only when applicable, costs for the final surface finishes when installed by an ABG approved installer).
11. ABG's failure at any time to enforce any of the terms or conditions stated herein shall not be construed to be a waiver of such provision.
12. All warranties set forth herein relating to the performance of the ABG **blueroof** System, including without limitation, the warranty relating to any the final surface finishes, will be voided if the Owner fails to maintain an ABG **blueroof** Maintenance Agreement with a contractor accepted by ABG for the duration of this warranty. The Owner shall supply copies of the executed ABG **blueroof** Maintenance Agreement on demand as proof that the maintenance programme complies with the Operating & Maintenance Plan and includes regularly scheduled inspections, and appropriate care of both the ABG **blueroof** System and the final surface finishes.
13. This warranty is extended solely and exclusively to the Owner of the Building at the time the ABG **blueroof** System is installed. It does not extend nor is it otherwise assignable or transferable to any other party unless approved in advance and in writing by ABG.

NO REPRESENTATIVE OF ABG HAS AUTHORITY TO MAKE ANY REPRESENTATIONS OR PROMISES EXCEPT AS STATED HEREIN.

This Warranty is effective from: …… For: ……years.

Signed for and on behalf of ABG Ltd: …… Name: ……

Position: ……

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ABG **blueroof** – NHBC Requirements

The NHBC have approved various site-specific, ABG **blueroof** installations, with a stormwater attenuation/control system at roof and/or podium levels. Note 1

Key elements of the ABG **blueroof** system and that have been previously, NHBC approved:

- A zero-falls system.
- A hot melt (fully bonded, monolithic), or cold liquid applied, weathering membrane system.
    - Typically an inverted construction, but can also be a warm roof system.
    - A BBA approved system, and installed by an approved contractor by the manufacturer.
- An extruded (XPS) polystyrene insulation build-up (where an inverted build-up).
    - A BBA approved solution, and installed by an approved contractor by the manufacturer.
- Flow control chambers (minimum of 2 no. per roof area; final number TBC by ABG and Project Engineer)
    - With integral overflow capability.
    - Ability to cater for multiple design storm events (as required by the planning parameters).
- Installed by Geogreen team (part of ABG Ltd, and hence an approved installer of the blue roof system).
- Multiple layers of filter geotextiles within the blue roof construction, fulfilling SuDS requirements.

ABG will provide:

- Component details for the blue roof system (CE datasheets & product information). Note 2
- Section details for the specific project, blue roof construction. Note 3
- Blue roof calculations, showing storage rates and run-off rates for the project engineer's approval. Note 4
- Dual warranty with the flat roofing manufacturer/contractor, based on ongoing maintenance programmes & contracts being in place (as required for final surface finishes e.g. green roofs). Note 5
- Confirmation that ABG is happy to work with the BBA approved flat roofing manufacturer.

The BBA approved flat roofing manufacturer (and their nominated/approved contractor) will provide:

- Leak test certification and visual inspection of the roof deck and installed membrane.
    - Any remedial works that may be required & then reported back to the NHBC.
- Confirmation that the membrane system is suitable for zero falls, and any structural requirements (see last point below).
- Confirmation that they are happy to work with ABG's **blueroof** system.
- Confirmation that the insulation is suitable for zero falls, and any structural requirements (see point last below).
- Based on the project structural engineer's design requirements, will also provide compliance with:
    - Deflection analysis based on the installation of a blue roof system & any surface finishes.
    - Any further requirements for loadings, movement joints, position of outlets, drainage, and roof construction strengthening.

Notes:
ABG will provide details of:

1. ABG & NHBC site-specific approved project list.
2. ABG CE marking & product datasheets.
3. ABG **blueroof** section.
4. ABG **blueroof** calculation.
5. ABG **blueroof** warranty document.

Green roof case study

abg creative geosynthetic engineering

Center Parcs Holiday Village, Woburn Forest, Bedfordshire

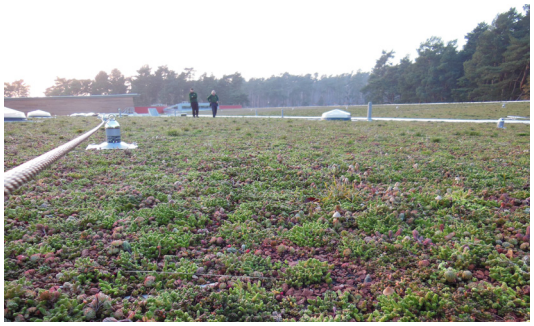
Center Parcs, Woburn Forest, Bedfordshire is the latest addition to Center Parcs UK resorts. Like many of their resorts it is set in woodlands drawing inspiration in its design from the surrounding environment. The development opened in June 2014 and represents a total investment of £250m.

Creating and managing biodiversity is at the heart of the philosophy of Center Parcs. It is considered fundamental to the guest experience and is a key element of the Center Parc villages that the design both protects and enhances the environment in which the village is set.

ABG have played a part in the development installing extensive green roofs across three structures within the complex including The Pancake House, Aqua Sana Spa and The Venue (a dedicated event space, with theatre style seating for up to 800 delegates, or 680 delegates for a gala dinner) comprising eight individual and flexible event suites, and a business centre, Jardin des Sports, and

Project information

Main contractor	Bowmer and Kirkland
Client	Center Parcs
Architect	Holder Mathias
Installation sub-contractor	Geogreen Solutions (ABG)
Project size	9,200m^2 across three roof areas
Roof substrate	Kalzip metal, profiled deck except The Pancake House which is single-ply warm roof.
Products	Roofdrain Green roof growing medium Planting On-going maintenance



service yard canopy roof.

Working for the main contractor, Bowmer and Kirkland, Geogreen Solutions began the installation during October 2013. The works included laying of the Roofdrain drainage and storage layer, spreading of the green roof growing medium before hydro-seeding or planting plug-plants across the roof area.

Roofdrain is a high performance drainage composite which forms a highly efficient drainage void above the waterproofing whilst also providing water storage to irrigate the planting dueing periods of dry weather. It comprises a cuspated HDPE drainage core onto which a geotextile filter fabric is bonded. The filter fabric allows water to percolate through the roof build up and into the void formed by the core whilst stopping fines entering the drainage system.

ABG's green roof growing medium is specially developed for use on roof structures. It comprises a blend of crushed brick and organic waste materials and is designed to provide the nutrients required to ensure the establishment of healthy vegetation across the green roof structure.

Maintenance

Following installation, Geogreen were retained on a maintenance contract requiring four visits in the first year following installation, and then an on-going contract requiring two visits per year to ensure the roof remains healthy and free from weeds.

About ABG

ABG are a market leader in the development of high performance geosynthetic systems for use in the built environment. Established for over 25 years ago and based in the UK, in the heart of the Yorkshire Pennines, ABG have built a reputation for delivering innovative system led solutions combined with technical support and outstanding customer service. Contact ABG today to discuss your project specific requirements and discover how ABG knowledge and products can help on your project.

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ABG Design, Supply & Install
- Geogreen Green Roof Projects

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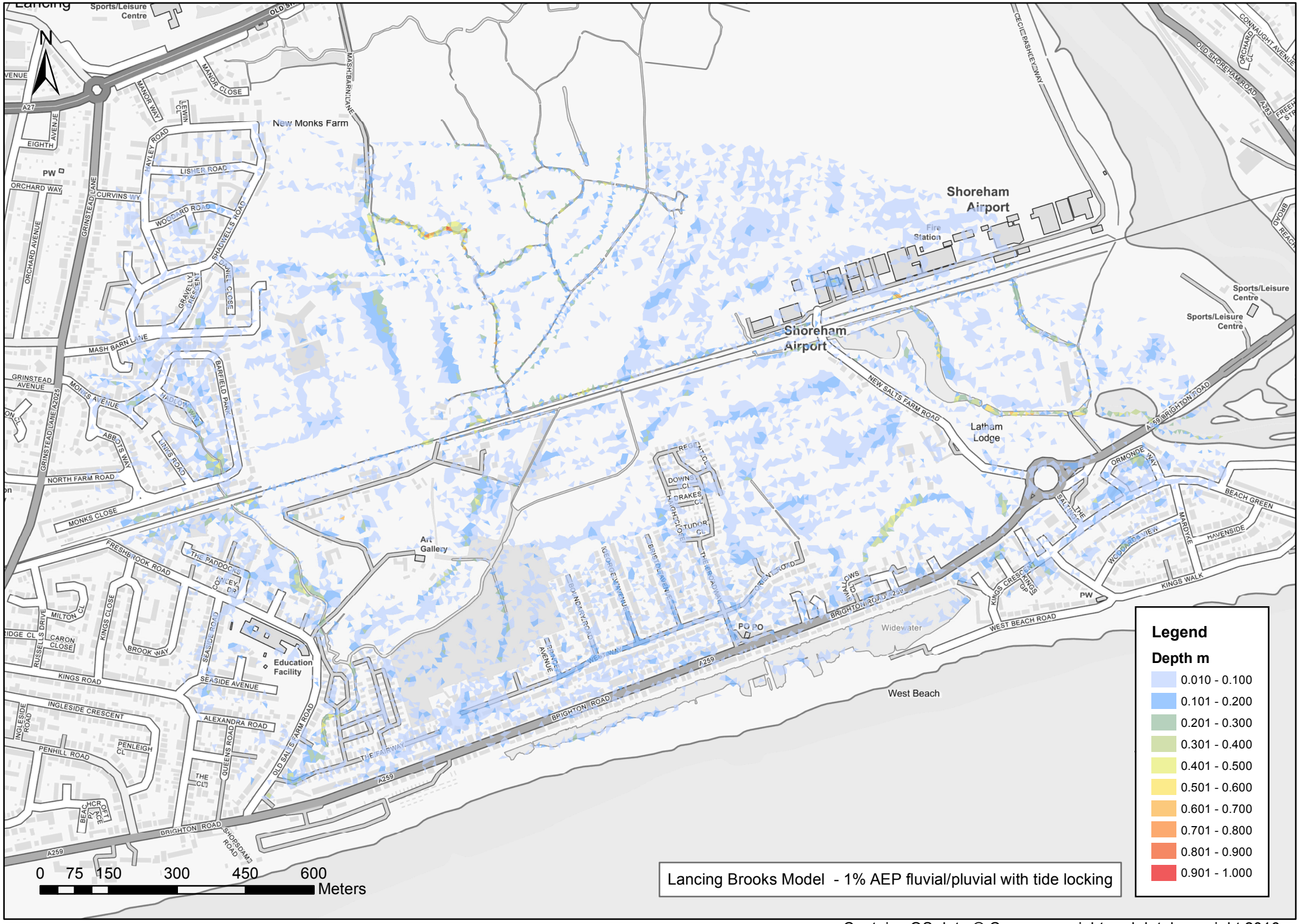
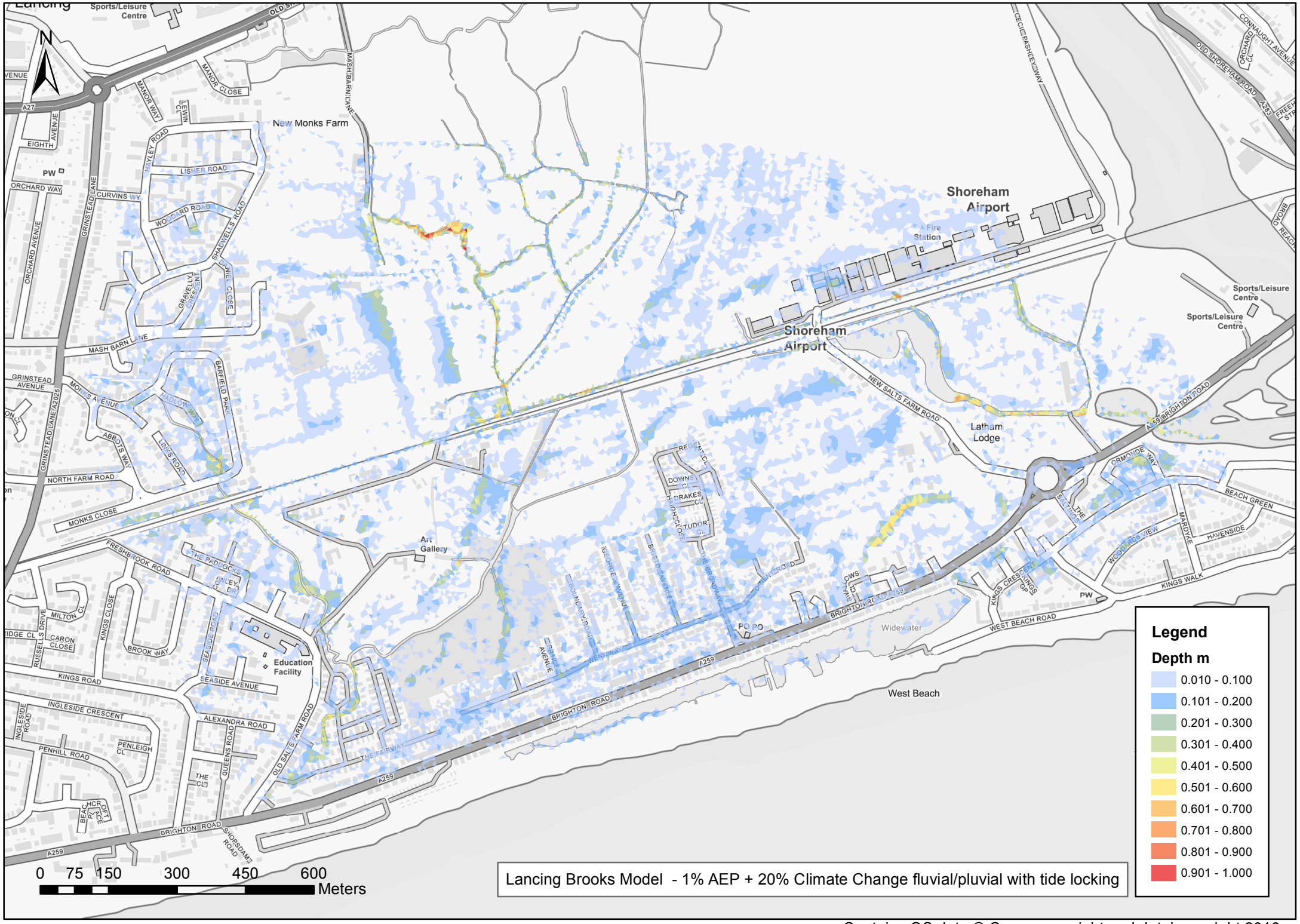
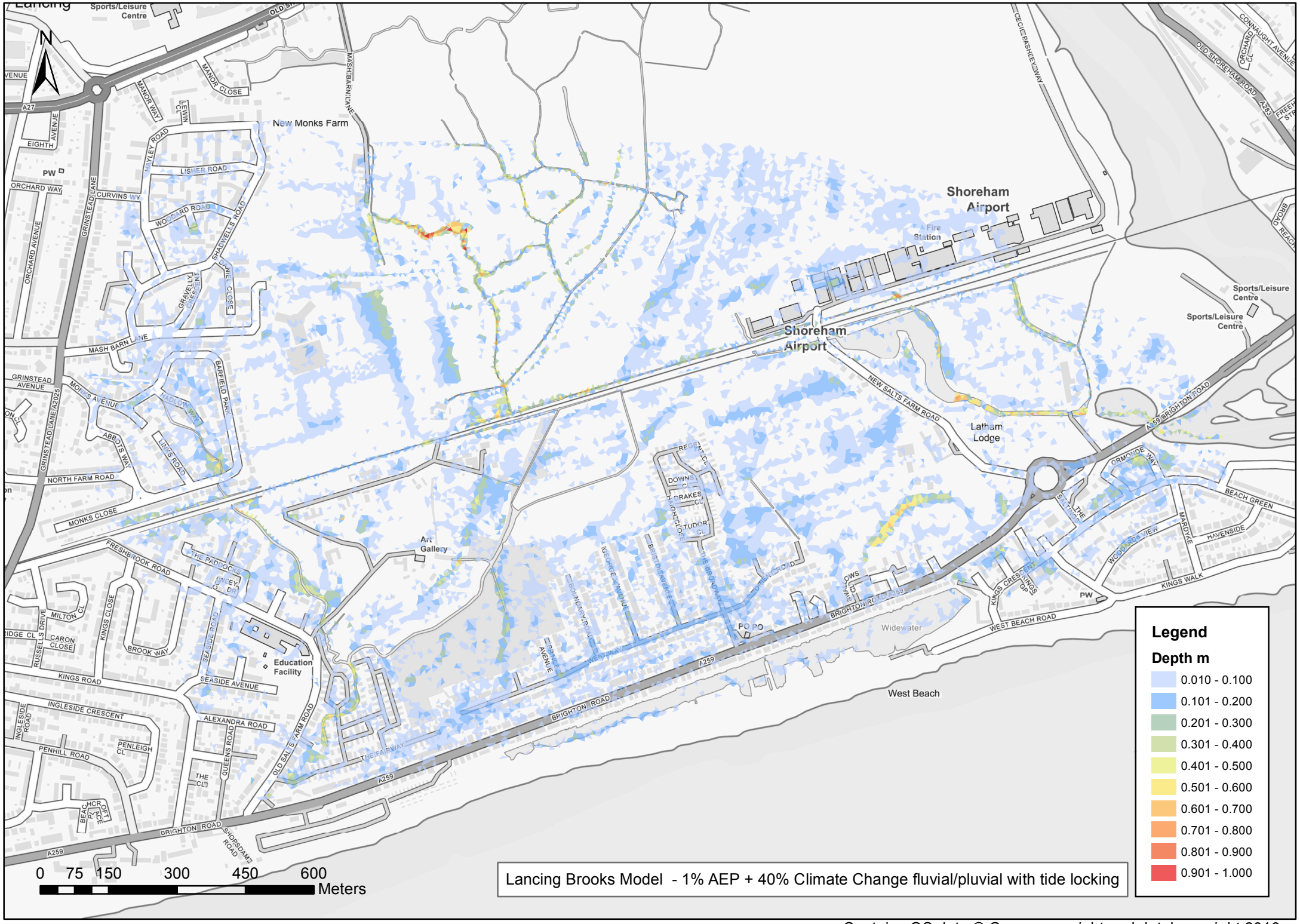
Appendix Q – Lancing Brooks Modelling

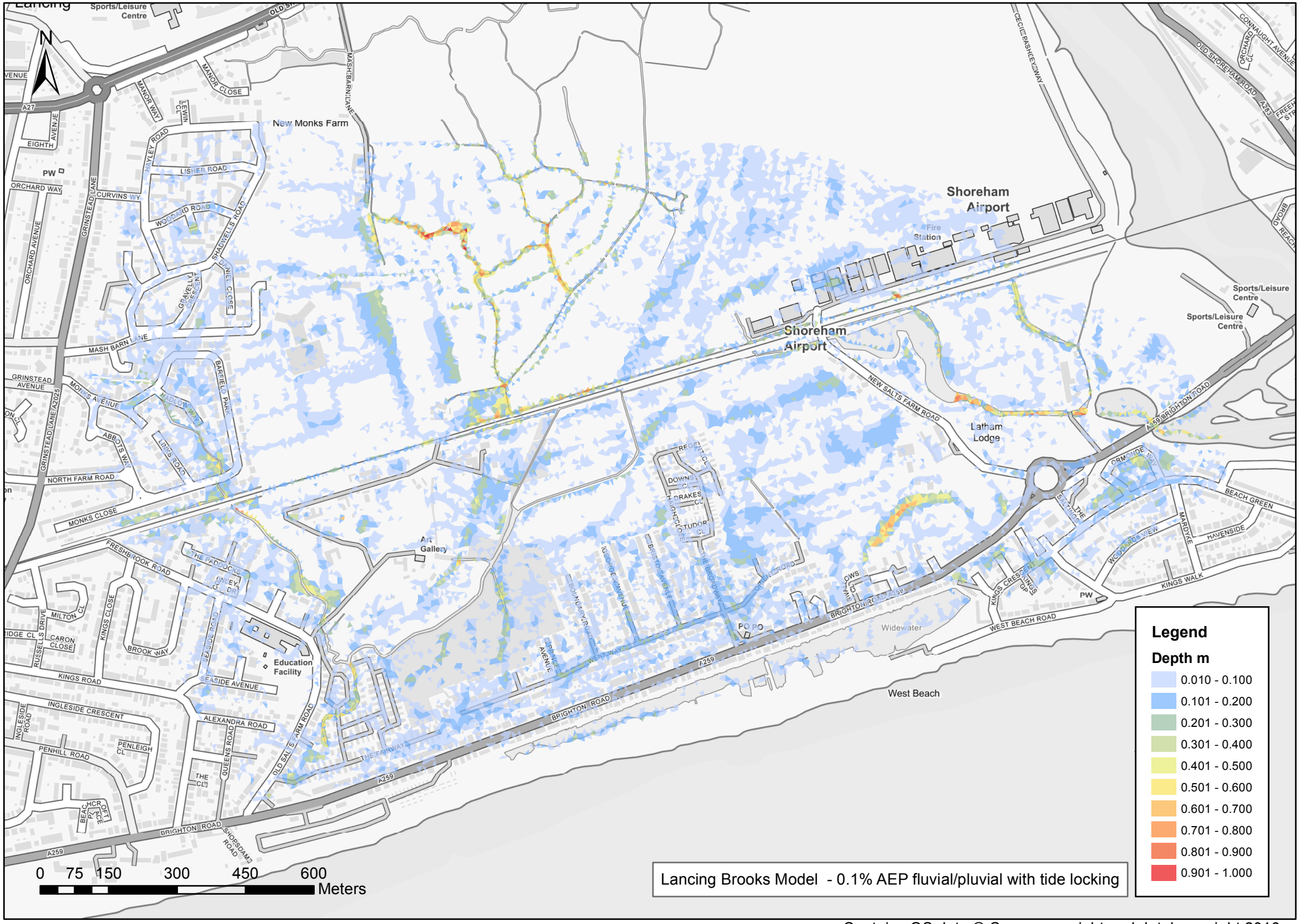


Lancing Brooks Model - 1% AEP fluvial/pluvial with tide locking



Lancing Brooks Model - 1% AEP + 20% Climate Change fluvial/pluvial with tide locking





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