

BLACK SLUICE

INTERNAL DRAINAGE BOARD



Structures Committee Meeting

Tuesday, 21st March 2023 at 2pm

Station Road, Swineshead, Lincolnshire PE20 3PW



Black Sluice Internal Drainage Board

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Our Ref: IW/DPW/B10_1

Your Ref:

Date: 14th March 2023

To all Structures Committee Members

Notice is hereby given that a Meeting of the Structures Committee will be held at the offices of the Board on Tuesday, 21st March 2023 at 2:00pm at which your attendance is requested.

Ian Warsap
Chief Executive

A G E N D A

1. Recording the meeting.
2. To welcome guests and receive apologies for absence.
3. Declarations of Interest.
4. To review the Structures Committee Terms of Reference (**page 1**)
5. To receive and, if correct, sign the Minutes of the Structures Committee Meeting held on the 22nd March 2022 (**pages 2 - 12**)
6. Matters arising.
7. To review the Structures Replacement Policy (No. 09) (**pages 13 - 16**)
8. To receive the Structures Report 2023 (**pages 17 - 22**)
 - (i) Stantec Technical Note Trinity College Pumping Station (**pages 23 - 60**)
9. Any Other Business.

BLACK SLUICE INTERNAL DRAINAGE BOARD

STRUCTURES COMMITTEE - 21 MARCH 2023

AGENDA ITEM 04

TERMS OF REFERENCE: STRUCTURES COMMITTEE

1. **GENERAL**

The Committee shall have EIGHT members who will be appointed by the Board.

The Chairperson shall be elected by the committee at the triennial general meeting of the Board, being the first board meeting following an election.

2. **MEETINGS OF THE COMMITTEE**

The Committee shall meet at least once in every 12-month period and a quorum shall be FOUR members.

No one other than the Committee members, **members of the public and Board Officers** shall be entitled to attend Committee Meetings, but any other persons may attend meetings **as a guest** if invited by the Committee.

3. **POWERS OF THE COMMITTEE**

If a Board replacement structure benefit contribution cannot be agreed between the Officers and an Owner/Occupier the Committee will have final determination as highlighted in section **6.5(iii)** of The Structures Replacement Policy.

Delegated powers are given to the Chief Executive and the relevant Structures or Works Committee Chairpersons to reconstruct structures as long as the budgets are not exceeded and the Owner/Occupier pays a contribution towards the cost in line with the guidelines in the Structures Replacement Policy. In all other cases, the power to determine applications is delegated to the Structures Committee, the appropriate Works Committee or the Executive Committee, unless a Board meeting is more timely.

4. **RESPONSIBILITIES OF THE COMMITTEE**

The responsibilities of the Committee shall include:

- a) To operate within the guidelines of the Structures Replacement Policy.
- b) To determine all other relevant decisions relating to structures and report these to the Board.

5. **REPORTING**

Minutes of meetings of the Committee shall be presented to the next meeting of the Board.

The Committee shall review its terms of reference after every triennial general meeting and its own effectiveness and recommend any necessary changes to the Board.

REVIEWED BY THE COMMITTEE: 21 MARCH 2023
APPROVED BY THE BOARD:

BLACK SLUICE INTERNAL DRAINAGE BOARD

MINUTES

of the proceedings of a meeting of the Structures Committee

held at the offices of the Board on
22nd March 2022 at 2pm

Members

Chairperson - * Mr J G Fowler

| | |
|-------------------------|------------------|
| * Mr W Ash | * Mr V A Barker |
| * Mr P Holmes (virtual) | * Cllr M Cooper |
| * Mr P Robinson | * Cllr P Skinner |
| * Mr C Wray | |

* Member Present

In attendance: Mr I Warsap (Chief Executive)
Mr P Nicholson (Operations Manager)
Mr M Gildersleeves (Assistant Director – Planning & Strategic Infrastructure for Boston Borough Council, East Lindsey District Council and South Holland District Council)

1945 Recording the Meeting - Agenda Item 1

Members were informed that the meeting would be recorded.

1946 Welcome guests and receive apologies for absence - Agenda Item 2

There were no apologies received.

Invited guest, Mr M Gildersleeves, was welcomed, in addition to Mr C Wray in attendance at his first Structures Committee meeting.

1947 Declarations of Interest - Agenda Item 3

Declarations of interest were received from Mr V Barker in relation to Minute 1954 – to discuss the cost and viability of additional access culverts for the Board's machinery.

1948 Minutes of the last Structures Committee Meeting - Agenda Item 4

Minutes of the last meeting held on the 24th March 2021, copies of which had been circulated, were considered and it was AGREED that they should be signed as a true record with the following amendment:

- Minute 1759(d) – paragraph 15 – spelling error 'Mr V Barker felt that two seasons is very *admiral...*' should be '*admirable*'

1949 Matters Arising - Agenda Item 5

(a) Small Drove – No. 718 – FX1760 – Minute 1759(c)(vii)

Mr V Barker requested an update on this culvert.

The Operations Manager reminded the committee that this culvert is under a highway and therefore the responsibility of Lincolnshire County Council (LCC). LCC have completed a temporary repair and will replace it when they have the budget to do so.

(b) Quadring Fen – No. 50 FX1761 – Minute 1759(c)(viii)

Mr V Barker requested an update on this culvert.

The Operations Manager reminded the committee that this culvert is under a highway and therefore the responsibility of Lincolnshire County Council (LCC). LCC have completed a temporary repair and will replace it when they have the budget to do so.

The Chief Executive felt it may be worthwhile contacting the LCC to remind them of these culverts.

1950 Byelaw Infringements and how can we engage more with our local planning officers - Agenda Item 6

The Chief Executive introduced this item, highlighting the high amount of land that has been transferred from agricultural to special levy this year (118 acres) and therefore the increased amount of land being developed (although a large proportion of the 118 acres is the Bicker Electricity Sub-Station Complex).

The Chief Executive next referred to the Board's 9 metre byelaw policy, which protects a strip adjacent to the watercourse, for the Board's continuous maintenance of the watercourse. However, there are becoming an increasing number of issues whereby building developers are not complying with the 9 metre byelaw. Internal constant discussion takes place about how the Board can 'convince' the planning applicant of the need for the 9 metre byelaw for future maintenance or improvement works. The Chief Executive gave the example of the use of heavy excavators tracking on surfaces that are not designed for it, e.g., block paving, and causing damage. Further using the scenario of when the watercourse is desilted and the spoil is left on the top of the bank, it is not only unpleasant for the residents, but if there is nowhere to spread it as it usually would be in the field, it will just keep building up over time.

It was explained that the Board's Planning and Byelaw Officer, Operations Manager and Mr M Gildersleeves have met prior to this meeting to have initial discussions around this.

Mr M Gildersleeves introduced himself and his role, giving a brief background to the planning regulations, explaining as follows.

Certain works fall within permitted development rights, in which case the individual does not require planning permission to complete the works, for example, building a conservatory (which could be within the 9 metre byelaw distance) could fall under this and therefore there is nothing the planning authority can do about this. In terms of planning applications, they are assessed against the local plan which has a number of policies within it, and it is weighed up whether or not the application is in line with the plan. The key driver of the current plan is around growth, delivery of houses and jobs.

Mr M Gildersleeves continued that the key obstacle with this problem is that the planning authority can only operate within the legislation available to them and that, from government direction, they are guided to let the other statutory bodies deal with their own legislation. Continuing, Mr M Gildersleeves noted that he can completely see the need for the work of the IDB and the benefits and need to maintain the strip, however, the developer would want to make efficient use of that land, adding that they must already meet particular requirements including car parking, gardens, affordable housing, education etc. and that it could be about making a trade off and using that 9 metre byelaw strip for multiple purposes e.g.

Mr M Gildersleeves further explained to the committee that if the authority doesn't get enough houses built per annum on a consistent basis, they would be put in 'special measures' which would then undermine their ability to make planning decisions.

However, Mr M Gildersleeves highlighted the emphasis on partnerships and trying to find a way forward, noting the planning authority has good policies regarding design and so can refuse applications that are not acceptable in design terms. Further referring to the national design guide, regarding using the same piece of land for multiple purposes, i.e. biodiversity, surface water, open space etc.

Mr M Gildersleeves next referred to some of the initial ideas discussed between himself, the Operations Manager and Planning and Byelaw Officer:

- Starting the conversation with local developers in the form of workshop that looks to identify what would work from all sides of the development – the argument being that whilst the important work of the IDB is recognised is it right and proper to leave a 9 metre strip when houses are in demand, and it could be used for other purposes?
- Planning and drainage meetings – East Lindsey currently hold the meetings to look at applications at an early stage. Can look to spread it across to Boston if it would be of interest.
- Potential to look at some standardised wording to attach to the permission.
- Commuted sum to offset long term costs, however, this is not something that could be facilitated through planning.

The Chief Executive thanked Mr M Gildersleeves for the information given, responding as follows:

- Planning and drainage meetings – unfortunately the meetings covering Boston and Spalding have never really had much uptake.
- Multi-agency meetings – used to invited to, but unfortunately stopped being invited to attend due to speaking up.

- Commuted sum – a commuted sum has almost reached agreement with Longhurst Housing Association for one of their developments

The Chief Executive further referenced the scenario of a conservatory being constructed, noting that although it is out of the control of the planning authority to give permission, is it not regulated by Building Regulations / Development Control?

Mr M Gildersleeves responded that with development management, the planning authority have very little control, adding that some works can take place without regulations, with just a notice being served. Mr M Gildersleeves suggested that it may be beneficial to see if the communication process could be enhanced between our organisations to be able to flag any potential issues to the IDB, noting that Boston Borough Council are behind in terms of facilitating sharing data.

Mr M Gildersleeves further noted that there may be a role for this within the wider planning officer group to come to some form of shared ambition and best practice approach.

The Chief Executive added that the Board's officers are currently looking at a planning application for a development that has an undeveloped strip of land running through the middle of it, which is for the overhead high voltage cables, it being his ambition that the same principle would apply for the IDB's 9 metre byelaw. Mr M Gildersleeves noted that this is something that has to be done under the National Grid requirements and can see why the IDB would aim for something similar.

Mr W Ash believed the process was being made more confusing than what was necessary. He felt that it could be kept simple, and it be made clear that the 9 metre strip is a necessity. The developer would then be able to bid to purchase the land knowing that he would not be able to develop on that strip of land. Mr W Ash raised his concern for the future and the risk of flooding if maintenance can't be carried out. Further adding, that more land could be identified for development to counteract for the 9 metre byelaw strips.

Mr M Gildersleeves acknowledged Mr W Ash, but highlighted the knock on impact of leaving 9 metres on each required development, how much that would add up to and the effect of trying to find further land for development on factors such as biodiversity, landscape etc.

Mr W Ash argued that it is just a small proportion of the development area and that there isn't a watercourse around every development, reiterating that there will be a time when there is flooding, and it will not be accessible for the machinery to help.

Mr M Gildersleeves responded by suggesting that machinery has developed so much already and so it is possible that it wouldn't require a large machine to carry out maintenance in the future. Also adding that it is not an efficient use of land and that if more land is then required, it then takes more land from agriculture. Mr M Gildersleeves confirmed that the planning authority does not have the power to enforce it, they can only encourage.

The Operations Manager highlighted that once the site has been developed, that is what the Board are left with for access, and it is often the case that the Board are left to pick up the pieces afterwards. The Board want to be recognised and involved in the early stages of proposed land development. Realistically, 9 metres is not that much room in relation to the size of machinery and depositing of spoil. The Board accept that they won't be able to stop these developments but would like to see them built in a way that the Board can still do their job, which ideally is an unrestricted 9m access. Ultimately, if not unrestricted access, it is going to cost the Board more to do their job. The Chief Executive added that all UK IDBs have a standard of 9 metres, but it could be reduced in different cases.

Mr M Gildersleeves acknowledged this, noting that the development needs to be designed in a way to allow this access and so it is about educating on the requirements needed so that it can be designed accordingly.

Cllr P Skinner noted that there is a handbook containing guidance on SUDs which most developers use and abide by, suggesting that a similar handbook for this byelaw matter may be useful.

Mr P Holmes supported the view of Mr W Ash and was disappointed in the lack of support received from the planning authority. He noted that agricultural land and building land have similar value, and farmers are happy to give up some of their land for the IDB to do their work in order to 'keep our feet dry', being of the opinion that IDBs should be a first port of call, instead of finding out retrospectively.

Mr M Gildersleeves acknowledged Mr P Holmes opinion, but outlined that the planning authority can not enforce it because it is dealt with through separate legislation. Mr M Gildersleeves also noted that if it was a 'blanket no' to using the 9 metre byelaw for building on all developments, then the building targets wouldn't be met and would therefore undermine the planning authority's ability to make the decision in the first place. It is going to have to be through partnership and making developers aware through the early stages.

The Chairperson referred to it as being a matter of educating about the necessity of long term resilience critical to prevent flooding, noting that he is not sure the developers understand that or want to hear it.

Mr M Gildersleeves noted that it is regular developers in the area, referring to the potential of a handbook and being able to distribute it to them.

Mr W Ash re-enforced that the 9 metre byelaw should not be negotiable as it is vital to keep houses and land dry.

Mr C Wray questioned, once built, the powers of the byelaw and if the Board would be liable for any damage caused?

The Chief Executive responded that these are discussions being had now. In theory, in some cases, it could be maintained from the roadside, however, there are additional costs involved in that, such as traffic management. The liability is addressed through a commuted sum upfront payment from the housing association.

Mr C Wray suggested taking a charge on the land, as it could potentially devalue the houses and therefore would be an incentive not to do it.

Mr M Gildersleeves highlighted that from a developer point of view, they will argue that the Board will receive long term maintenance funding through the special levy payment paid by the council.

The Chairperson added that he felt that the information flow between the planning authority and IDB needs to be refined. Giving the example of a case, where he noticed two trees that had been planted in the middle of the 9 metre byelaw strip, and only knew about them because he had driven past and seen.

Mr M Gildersleeves acknowledged that he can pick up the communication element. However, did argue what would be wrong with planting trees in the access strips and that planning is not required for planting a tree, outlining that he doesn't want to set unreasonable expectations.

The Chief Executive noted that it would be good to agree to be involved in the early development with the planning authority and developer.

Mr V Barker questioned who would be responsible for damage after the 25 year commuted sum? Mr M Gildersleeves thought it might be the responsibility of the IDB, but that the commuted sum should ease these issues.

The Operations Manager referred to another development, Broadgate Homes, where it will have a more of a severe impact because of the size of the watercourse and where the silt arisings from the watercourse will be spread, as they will just keep building up overtime.

Mr M Gildersleeves also referred to the local plan which outlines where the future planning is going to be. He also noted that when the plan is reviewed, it would be a good time for the IDB to get involved and try and build in their requirements to the plan. Mr M Gildersleeves also referred to the concept of developing a comprehensive guidebook.

The Chief Executive suggested that they will arrange a meeting to take this further.

The committee thanked Mr M Gildersleeves for his attendance and discussion. Mr M Gildersleeves left the meeting.

1951 Review of the Structures Committee Terms of Reference - Agenda Item 7

The Chairperson presented the Terms of Reference.

All AGREED that the Structures Committee Terms of Reference be RECOMMENDED to the Board for approval.

1952 Review of the Structures Replacement Policy - Agenda Item 8

The Chairperson presented the Structures Replacement Policy.

Cllr M Cooper noted the set fee of £250 + VAT for inspections during the construction phase (paragraph 6.8), questioning whether this needs increasing due to rising costs of everything else? All AGREED to increase by £50 to £300 + VAT.

All AGREED that the Structures Replacement policy (No. 9) be RECOMMENDED to the Board for approval with the above amendment of increasing the fee for inspections to £300.

1953 Receive the Structures Report 2022 - Agenda Item 9

The Operations Manager presented the Structures Report 2022, with accompanying photographs displayed on screen.

(i) Structures Replacement / Contribution Programme 2022/23

All AGREED the Structures Replacement Programme 2022/23 as below:

| | | | | |
|----------|-------------|--------------|-------|---------------------------|
| No. 635 | Swineshead | 15m x 0.6m | Armco | £1k max contribution |
| No. 1795 | Kirton | 12m x 0.6m | Armco | £1k max contribution |
| No. 2880 | Kirton | 9m x 0.6m | BAT | Potential to give this up |
| No 1469 | Bicker Fen | 18m x 1200mm | Armco | £1k max contribution |
| No 2757 | Holland Fen | 12m x 600mm | Armco | £1k max contribution |

(a) Boston West – No 2757 – FX1764 – 12m x 600mm Armco (Field entrance, close to road)

The Operations Manager noted that he has been out to site, and it is still in a similar state of disrepair. If it worsens and blocks the conveyance of the watercourse, the Board will remove it.

(b) Bicker Fen – No 1469 – FX21769 – 18M X 1200MM Armco (Farm track field entrance)

The Operations Manager noted that it was the extension of the existing culvert that has failed, which is now causing the headwalls of the existing culvert to start failing. The extension was placed by the Board for access with machinery.

Mr V Barker highlighted the importance of having enough cover over the top of the pipe – the larger the pipe the more cover required, questioning if there is enough cover going on the top?

The Operations Manager responded that the Board only provide specification for the invert levels of the pipe and for the fill material around the pipe, but other than that, it is the landowners discretion to what materials and quantity they wish, the Board only specify to 'suitably fill'.

The Operations Manager noted that these culverts were put in in the 1960's and specifications and size/weight of machinery have changed a lot since then.

Mr P Robinson added that it is in the landowner's own interest to do it properly.

The Chief Executive added that the Board won't offer a specification for it as it would then mean the Board were working under terms not covered by their professional indemnity.

(ii) Culvert Surveys Reports

The Operations Manager informed the committee of the new app that the Board's GIS & Environmental Technician has developed, which means all culvert surveys can be carried out using this GIS based app as opposed to pen and paper surveys.

The Operations Manager further explained that, despite best intentions, they have only managed to survey 53 culverts this year, noting that the results of the surveys are included on pages 20 and 21 of the agenda, as requested at a previous meeting. The Operations Manager referred to those classed as 'poor condition' noting that if they are landowner responsibility, they will inform the landowner, if it is blocking the watercourse then the Board will remove it.

Mr P H Holmes questioned whether it would be beneficial to add another column about the Board's use of the culvert and potential contribution? The Operations Manager noted that this can be added.

Mr J Fowler questioned if most of the surveys are carried out at this time of year before weed growth becomes an issue?

The Operations Manager responded that it is difficult to establish an optimal time of year to survey the culverts. This time of year, there is little growth, which is beneficial, however, water levels are higher. Later in the year, water levels are reduced but there is more growth. It also being noted that some culverts are within a water level that will never reduce enough to complete a survey so the water levels will need reducing in those areas in order to complete the surveys.

The Chairperson questioned whether focus should be given to those that are critical as opposed to area based? The Operations Manager responded that the outstanding 950 culverts do need to be surveyed soon, as it will then be a case to decide the remit time for repeating surveying. The Operations Manager noted that they are done in catchment areas currently so that when water levels are reduced all in that area can be completed.

Mr V Barker referenced the culvert survey maps included within the agenda, particularly noting the two culverts showing on the Dowsby Lode drain, thinking this is incorrect. The Operations Manager noted that the maps show all structures, not just culverts, but will investigate it.

(iii) Culverts reported in a poor condition

(a) Morton Fen – No 16 – FX1772 30m x 900mm Armco

The Operations Manager explained to the committee that this culvert has collapsed, which forms the driveway to a property. The Operations Manager met on site with the landowner in December 2021 to discuss a way forward, an estimate of £30,000+ was provided to replace the existing 30 m x 900 mm culvert. The landowner has since asked if the Board would consider rerouting the drain around the properties (shown by a red line on Fig. 1 on page 25 of the agenda). The landowner was advised that they would require an application, which has not yet been received.

Mr W Ash noted that he believes the landowner is looking to sell the properties.

The Chairperson also referenced the suggestion from the landowner for a 6 metre grass strip, noting the 9 metre byelaw previously discussed.

(iv) Information on investigations at Ewerby, South Kyme and Damford Pumping Stations & Trinity College Pumping Station water seepage from Long Skerth

The Operations Manager noted the technical information from Stantec included within the report, acknowledging that it is a lot of information, but felt that it was worthy of inclusion.

The Operations Manager explained that the investigation works have now been completed, and a technical note from Stantec provided for each site which outlines a recommendation about how to cure the problem.

The Operations Manager explained that funding of £50,000 from the Environment Agency (EA) was secured. £14,250 has now been allocated for Stantec to carry out investigation works at Trinity College Pumping station, which will mean that almost all the £50,000 has been spent.

Stantec have noted that the next stage would be for them to provide a design proposal for each of the sites, which would cost c£50,000. The Operations Manager has discussed with the Chief Executive and Grant in Aid Manager and can't see what further information is required, and that if that amount of money was spent, it would mean that £100,000 had been spent without starting any of the works. The Operations Manager therefore suggested that there is enough information in the technical reports from Stantec to provide to a third party for a design, which either the Board could implement ourselves if possible or take it forward to tender. At this point, the funding would need to be considered, whether it be out of the Board's budget or trying to gain external funding, the Operations Manager being of the opinion that they would go through the Grant in Aid process to try and gain funding.

Mr V Barker referenced that they are all built on peat, sand and gravel and that the gravel causing the issue, therefore noting that any construction work needs to be below the gravel.

The Chief Executive further noted that the recommended works within the Stantec reports are works within the banks, which are owned by the EA and therefore believed the Board has the right to ask for further funding, adding that by providing funding for the investigation works, they have already admitted responsibility.

The Operations Manager also noted that there is a possibility that in the future, these sites may not be required, as a result of the South Lincs Reservoir (SLR) project, which may make it more difficult to achieve funding. The Chief Executive added that the preferred location for the SLR will be released towards the end of April. Dependant on the location, it could involve the reconfiguration of the catchment and pumping stations.

Mr C Wray questioned how long it would be before the reservoir and changes are made? The Chief Executive responded that the aim is to be transferring water from the reservoir in mid-2030's. Mr C Wray noted that the pumping stations still needs to be operating for another 5 -6 years at least.

Mr C Wray further noted the reference to using a bentonite slurry within Stantec's solution, noting that it could still wash out. Brief discussion took place around sheet piling and construction methods.

The committee were of the opinion for the Board to source the design from another company, cost the work up by the Board and externally if required, whilst trying to achieve funding from the EA for it.

The Chief Executive noted, as a further matter of interest, that a number of the Board's sub-catchments are currently being surveyed, in order to look at a 'bigger picture' and the possible future amalgamation of pumping stations.

The Chief Executive further referred to the Lower Witham Catchment Strategy, currently being undertaken on behalf of the Environment Agency (EA), in addition to the survey data being undertaken, the Board has requested that various ordinance data levels are taken at seven of the Board's pumping stations, which will be able to be compared to the construction levels on the original drawings to see if they have settled.

1954 To discuss the cost and viability of additional access culverts for the Board's machinery – Agenda Item 10

The Operations Manager introduced this item, explaining that the current route of the excavators has been reviewed and it has been identified that the addition of four new culverts, presented within the agenda, would enable the Board to complete their work more efficiently as it would provide a crossing point to allow access to both sides of the watercourse. There is currently no budget allocated for this, if approved, the Board would look to develop a budget over the coming years.

Cllr P Skinner noted that presumably there will be savings by constructing the culverts.

Mr V Barker noted that he has seen, on numerous occasions, the amount of time that the excavator spends time waiting for the Unimog or the Unimog is waiting for the excavator. Mr V Barker further noted that in 2-3 years' time there could be two more new culverts identified, therefore increasing the budget required, believing that another alternative should be considered - the possibility of a purchasing a different machine (wheeled) that is more transportable.

Mr P Holmes suggested asking whether the landowner would use it and asking for a contribution.

The Operations Manager noted that a 2022/23 budget of £20,000 has been identified for alternative access works, this is also used to do additional bushing works required for access.

Mr W Ash noted that the Board needs to keep improving the system and that it would be a big benefit to be able to access and maintain from both sides. Mr W Ash left the meeting.

Cllr M Cooper echoed how much time it would save.

1955 Any Other Business - Agenda Item 11

(a) Possible syphon at Dunsby Fen Pumping Station

Mr V Barker referenced the concept of pump amalgamation noted at a previous meeting and his initial concern about the concept, but having looked into it further, can now see the potential for it.

Mr V Barker next referred to Pinchbeck Pumping Station, visited at the last Southern Works Inspection, where Mr J Atkinson noted he had a problem with getting his water away, it being identified that the Dunsby Fen pump is one metre lower than Pinchbeck, with consideration being given to syphon. Mr V Barker felt it important this be documented on a plan to indicate the plan to put a syphon there because of the potential proposed deepening and widening of the South Forty Foot Drain (SFFD) plans.

The Operations Manager noted that the whole catchment survey is intended to commence in April, with a report of findings completed in November, aiding the Board to be as well informed as possible when discussions and decisions start taking place about these proposals.

There being no further business the meeting closed at 16:34.

Black Sluice Internal Drainage Board

Policy No: 9

Structures Replacement Policy

Review Dates:

| | |
|--------------------------------------|-----------------------------|
| Board Approved | |
| Reviewed by the Structures Committee | 21 st March 2023 |

1. PURPOSE

This document sets out the policy of the Black Sluice Internal Drainage Board concerning the repair or replacement of structures where the integrity of the structure deteriorates to such an extent that it is unable to convey the necessary flow in the drainage channel, or if it becomes unsafe for either vehicle or pedestrian traffic to cross the watercourse.

In the first instance, if a structure has deteriorated to such an extent that it is holding up the flow of water, then the obstruction shall be removed by the Board.

2. INTRODUCTION

The structures that will be included in this policy include:

- a) Clear span bridges constructed to take all types of vehicles.
- b) Clear span bridges for pedestrian use only.
- c) Culverts constructed to provide access across the watercourse.
- d) Culverts constructed for the purpose of maintaining the flow in watercourses where there is instability to the banks.

3. BLACK SLUICE POLICY

This policy is concerned with the replacement of existing structures only.

The Board has a separate policy which addresses applications to place new structures in/over watercourses.

4. REASONS FOR THE POLICY

The policy formalises the baseline conditions above and gives written guidelines for more specific instances. The benefits of the policy are:

- Fairness and uniformity in the Owner/Occupier contributing to the cost of reconstructing sub-standard structures.
- The provision of clear guidelines to the Owners/Occupier.
- Powers are delegated giving a more efficient and timely service.

However, this policy is not intended to cover every eventuality and the Board (in formal meeting) may waive the policy and make a determination on the basis of reasonable fairness to all parties.

5. DELEGATED POWERS

Delegated powers are given to the Chief Executive and the relevant Structures or Works Committee Chairpersons to reconstruct structures as long as the budgets are not exceeded, and the Owner/Occupier pays a contribution towards the cost in line with the guidelines in this policy.

In all other cases, the power to determine applications is delegated to the Structures Committee, the appropriate Works Committee or the Executive Committee, unless a Board meeting is more timely.

6. GUIDELINES

Guidelines are given below on the following types of structures:

- a) Structures carrying Highways maintained by LCC.
- b) Structures used by the Owner/Occupier.
- c) Structures used by both the Board and the Owner/Occupier.
- d) Structures constructed by the Board to allow free drainage of the land.

6.1 Structures Carrying Highways

It is generally the case that all clear span bridges and culverts carrying LCC highways are owned and maintained by LCC. If replacement is required because the structure is substandard then LCC will be responsible for the total cost of the reconstruction.

6.2 Clear Span Foot Bridges

It is generally the case that all clear span footbridges which carry footpaths over Board maintained watercourses are owned and maintained by LCC. If replacement is required because the structure is substandard, then LCC will be responsible for the total cost of the reconstruction.

6.3 Clear Span Access Bridges

These in general provide access for farm machinery to fields or to individual properties. They are mostly constructed in large watercourses.

If refurbishment or replacement is required because the structure is substandard, then the Owner/Occupier will be responsible for the total cost of the reconstruction.

These in general will not be used by Board's machinery to gain access to the opposite side of the watercourse.

However, if a substandard structure is infrequently used by the Board, and the Owner/Occupier of the structure proposes to refurbish or reconstruct the bridge, the Board may offer a contribution in line with clause 6.6 (b) towards the cost of this work.

6.4 Structures owned by the Board and Used for Access by the Owner/Occupier

These structures are required by the Board as well as the landowner to gain access for maintenance of watercourses.

The cost of any reconstruction of substandard structures in this category will be paid for by the Board and the structure will remain as a structure to be maintained by the Board.

6.5 Structure Used by all Parties

- a) These structures are required by the Owner/Occupier to gain access to their land and could be used by the Board for their maintenance activities.
- b) If a structure has been inspected and reported as substandard and in need of reconstruction the landowner will be notified in writing.
 - (i) Provided there is an accepted need for a structure at this location, the Owner/Occupier and Operations Manager will meet. A reconstruction quotation will be offered along with a benefit contribution in relation to the Board's use of the structure as a crossing point.
 - (ii) After the structure has been reconstructed, it will be deemed that the landowner will be responsible for its future maintenance.
 - (iii) If a benefit contribution cannot be agreed the Operations Manager will send all the relevant information to the Structures Committee for further review and determination.
- c) Before any consideration is given to the reconstruction of the structure, the Owner/Occupier should be approached to ascertain if there is a future need for the structure. Consideration should be given to removing two or more accesses into a field and the provision of one in the future.
- d) A culvert shall be constructed with a top width of 6.0 metres. If the Owner/Occupier requests a culvert with a wider top width, then they shall pay for the total extra cost of this work.
- e) After the culvert has been replaced, the Owner/Occupier will be responsible for any future maintenance, or reconstruction of the structure.
- f) If a structure has been constructed in a Board maintained watercourse, and there is clear evidence that the Board has written to the Owner/Occupier confirming the future maintenance arrangements, then the Owner/Occupier shall be totally responsible for the reconstruction of the structure.
- g) If a structure is removed by the Board because it is holding up the flow of water and has not been replaced by a new structure within a period of five years, then the offer of contribution will no longer be applicable, and the Owner/Occupier will be required to pay the full cost of the construction of a new structure at this location.
- h) If the Board undertake a watercourse improvement scheme which includes the reconstruction of a structure, the Board will pay the total cost of the reconstruction, but the Owner/Occupier will be required to be responsible for the future maintenance of the structure.

6.6 Culverts Used for Free Drainage

Examples of these lengths of culverts are:-

- Lengths of watercourse culverted instead of undertaking revetment works.
- Lengths of watercourse culverted to allow disposal of excavated soil.

These are the Board's responsibility, and any reconstruction required will be paid for by the Board. Responsibility for the future maintenance of the asset will remain with the Board.

6.7 Redundant Structures

If the Board agrees with the Owner/Occupier that a structure is redundant, the Board will remove the structure, and all backfill material and deposit any suitable materials on fields adjacent to the location of the culvert.

If agreed and required, the Board will dispose of the excavated material at an agreed cost with the Owner/Occupier.

6.8 Further Guidance

If the Owner/Occupier is unhappy about the circumstances of a particular structure designation, then this should be referred to the Structures Committee for final determination.

Contractors may be appointed by the Owner/Occupier to complete the works, the Board will set an invert level on site, offer specification suggestions and inspect the works during the construction phase, a set fee of £300 + VAT will be offset against any contribution made by the Board.

Inspection's frequencies to be completed by the Board, adequate notification time to be received from the contractor:

- when excavation to invert level and bases for headwalls is complete.
- when the pipe is laid prior to being backfilled, invert level checked and verified.
- when the headwalls are being constructed.

The next stage of construction should not go ahead until the previous stage has been inspected / approved by the Board.

BLACK SLUICE INTERNAL DRAINAGE BOARD

STRUCTURES COMMITTEE - 21 MARCH 2023

AGENDA ITEM 08

STRUCTURES REPORT 2023

1. Structures Replacement / Contribution Programme 2023/24

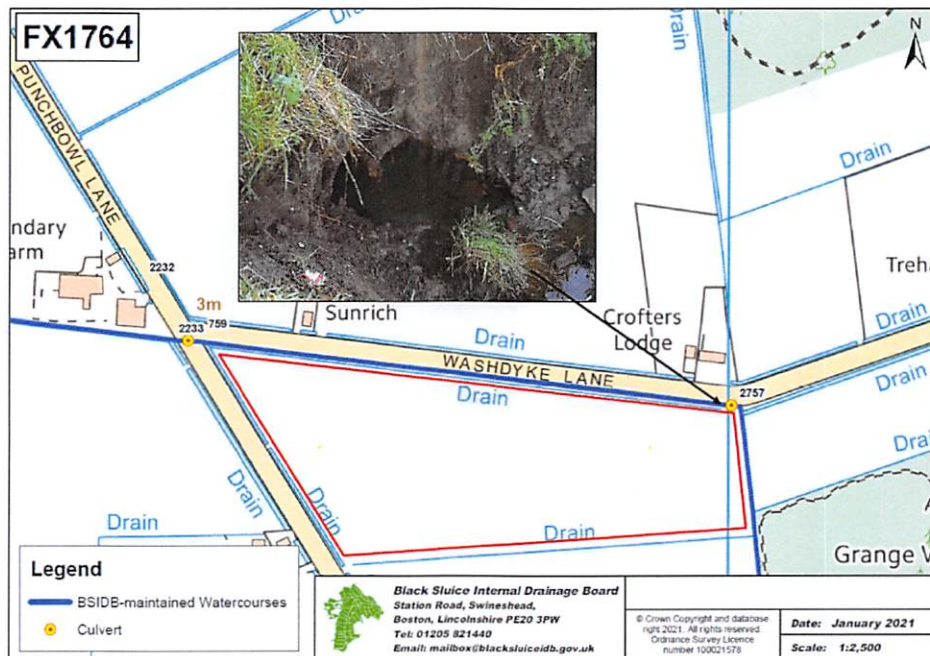
Proposed replacement/contribution towards for 2023/24, none of these completed in 2022/23:

| | | | | |
|----------|-------------|--------------|-------|----------------------|
| No. 635 | Swineshead | 15m x 600mm | Armco | £1k max contribution |
| No. 1795 | Kirton | 12m x 600mm | Armco | £1k max contribution |
| No. 2989 | South Kyme | 18m x 1200mm | Armco | £1k max contribution |
| No 1469 | Bicker Fen | 18m x 1200mm | Armco | £1k max contribution |
| No 2757 | Holland Fen | 12m x 600mm | Armco | £1k max contribution |

(a) Boston West - No 2757 - FX1764 - 12m x 600mm Armco (Field entrance, close to road)

The condition of this culvert is monitored, LCC have been informed about the landowners concerns and the proximity to the highway. The land is tenanted, and the tenant requires the culvert to be replaced.

A contribution may be beneficial and offered towards the replacement of this culvert: £1,000 estimate.



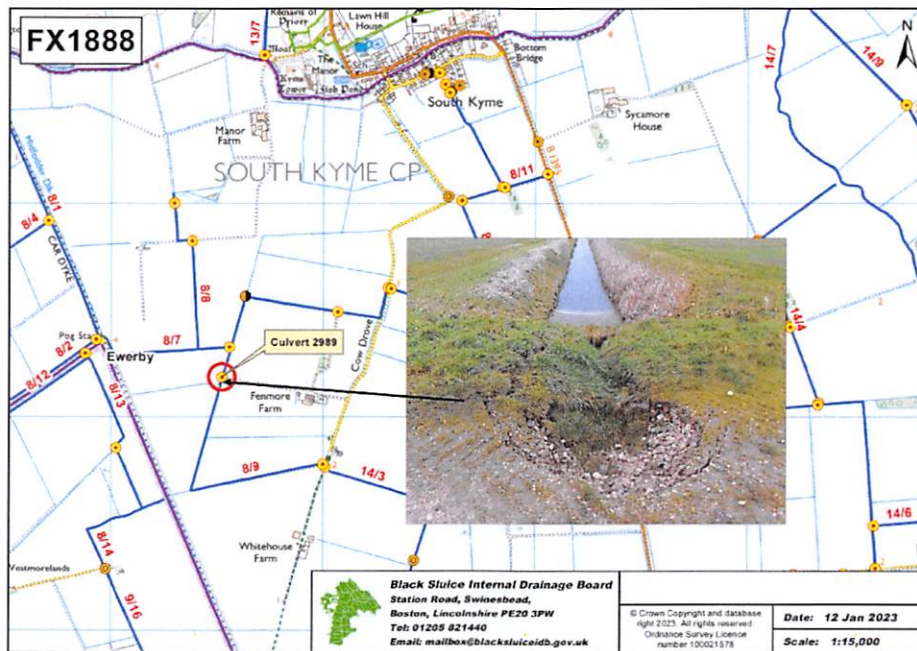
(b) Bicker Fen - No 1469 - FX1769 - 18m x 1200mm Armco (Farm track Field entrance)

This culvert has partially collapsed, the blockage removed by the Board. The Operations Manager has discussed with the landowner about potential replacement.

A contribution may be beneficial and offered towards the replacement of this culvert: £1,000 estimate.



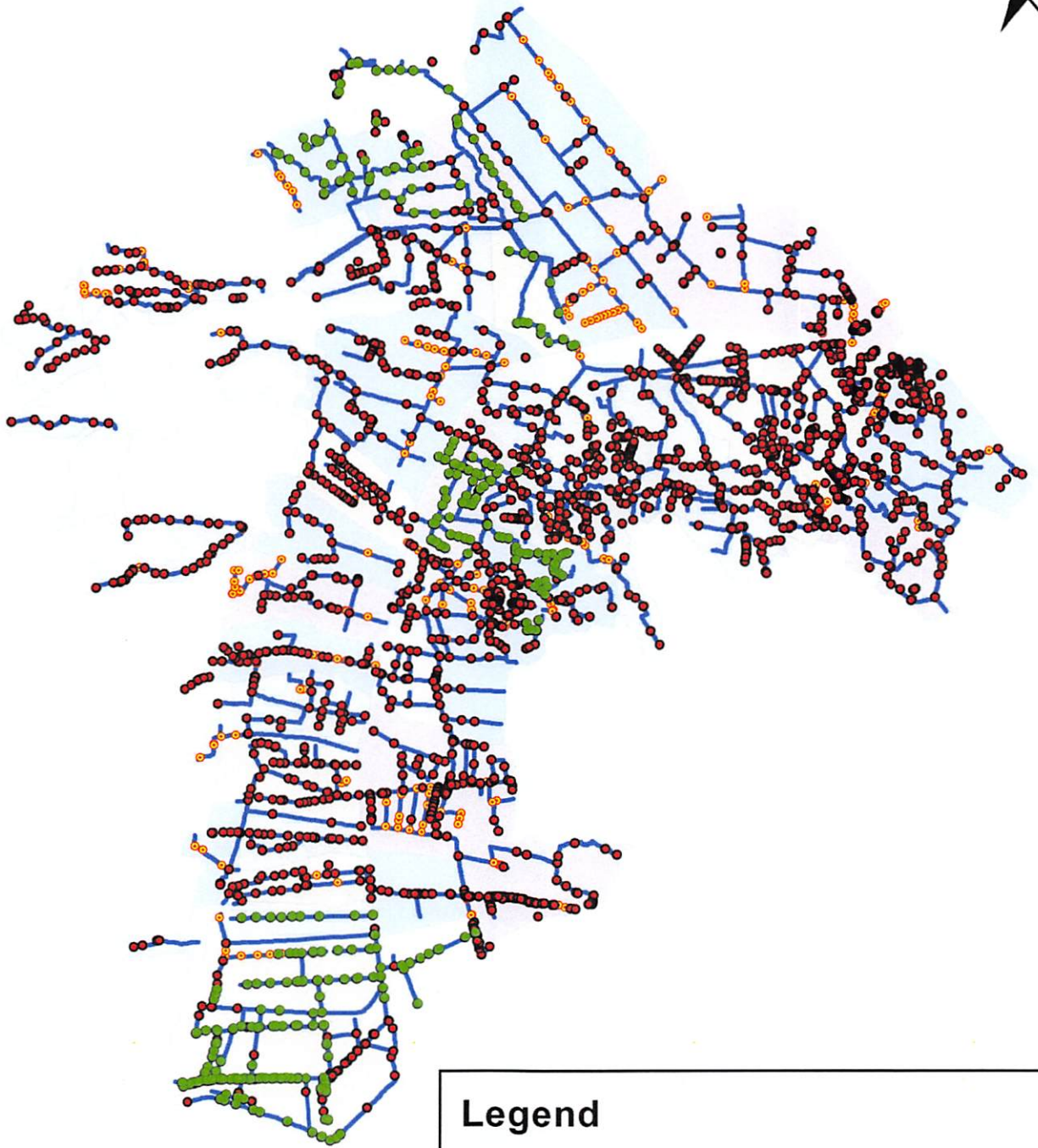
(c) South Kyme Fen – No 2989 – FX1888 – 18m x 1200mm Armco (Field Entrance)



This culvert has partially collapsed, the blockage removed by the Board. The Operations Manager has discussed with the landowner about potential replacement. An estimate of £20,000 was provided to the landowner for the Board to replace this culvert, which was agreed and has now been replaced. A contribution may be beneficial and offered towards the replacement of this culvert: £1,000 estimate.

2. Culvert Surveys Reports

As in the previous year Board's Operatives have been using an App on their phones to complete culvert surveys. ArcGIS Survey123 is one of the apps in ArcGIS software. It is a form-centric app for creating, sharing and analysing survey data. It is used to collect data via web or mobile devices. It can be used when disconnected from the Internet.



Legend

- Culverts Inspected 2022
- Culverts Inspected since 2005
- Culverts yet to be inspected
- BSIDB-maintained Open Watercourses

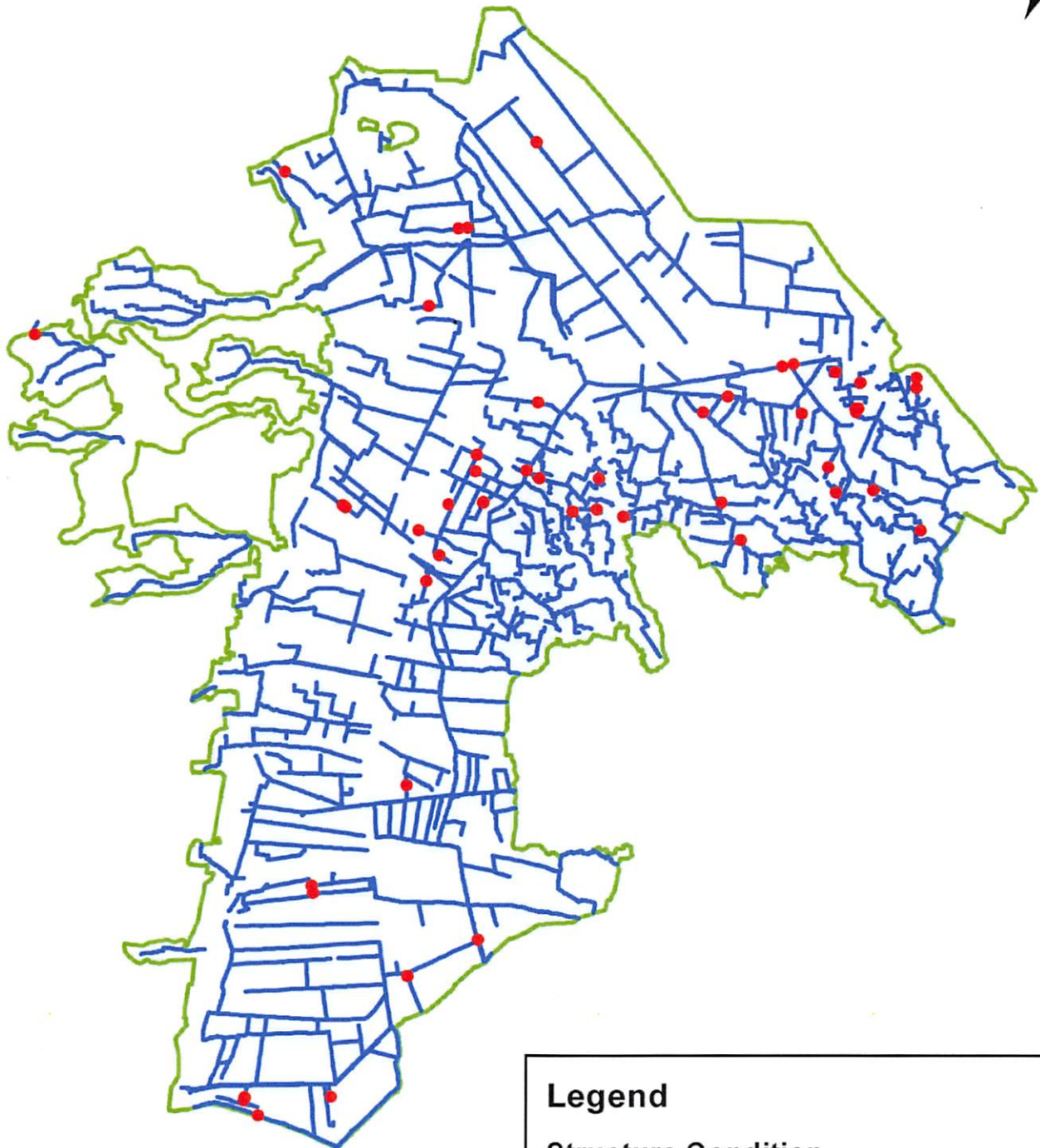


Black Sluice Internal Drainage Board
Station Road, Swineshead,
Boston, Lincolnshire PE20 3PW
Tel: 01205 821440
Email: mailbox@blacksluiceidb.gov.uk

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Ordnance Survey Licence number 100021578

Date: March 2023

Scale: 1:175,000



Legend

Structure Condition

- Very Poor
- BSIDB-maintained Open Watercourses
- Black Sluice IDB District Boundary



Black Sluice Internal Drainage Board
Station Road, Swineshead,
Boston, Lincolnshire PE20 3PW
Tel: 01205 821440
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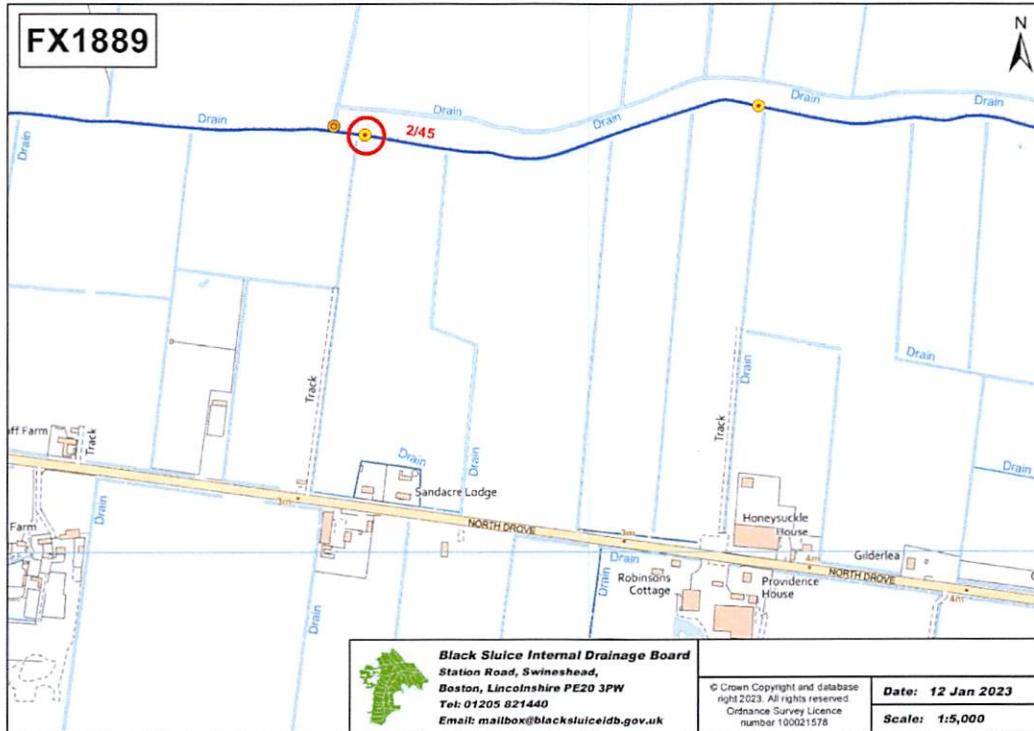
Date: March 2023

Scale: 1:175,000

(a) Culverts reported in a poor condition

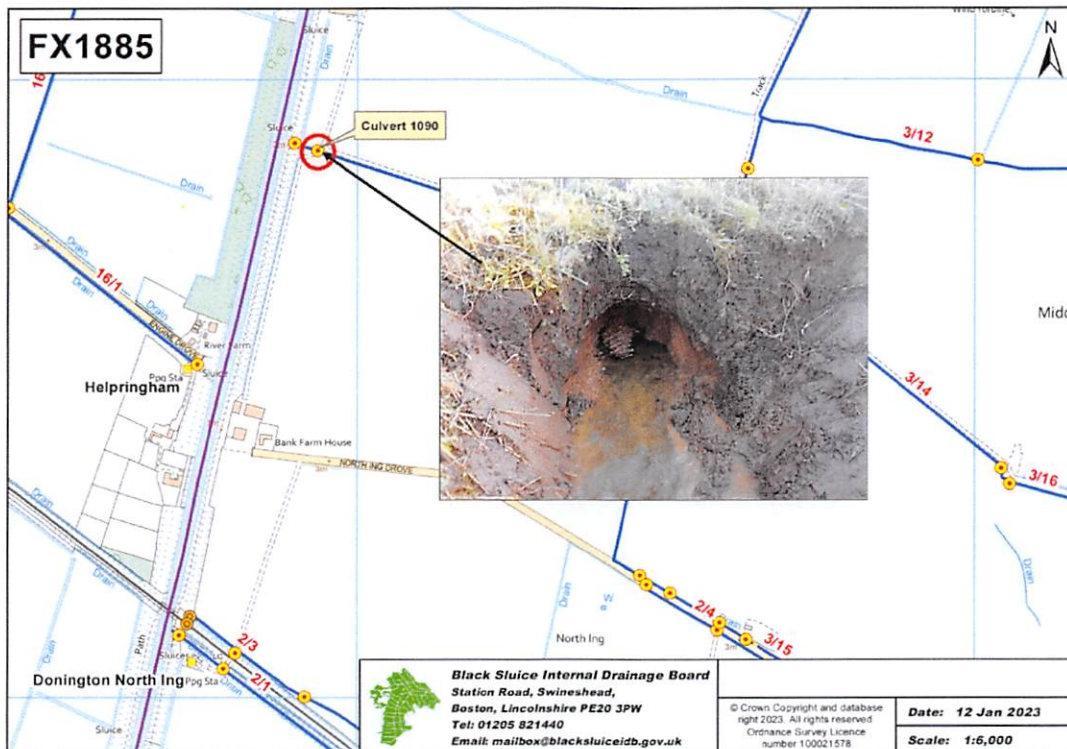
Quadring Fen - No 3353 – FX1889 – 15m x 600mm Armco (Field Entrance)

This culvert has partially collapsed and is being monitored. The Operations Manager has discussed with the landowner about potential replacement.



Bicker Fen – No 1090 – FX1885 – 12m x 600mm Armco (Farm track Field access)

This culvert has partially collapsed, the blockage removed by the Board. The Operations Manager has discussed with the landowner about potential replacement.



3. Information on investigations at Ewerby, South Kyme & Damford Pumping Stations

Trinity College p/s water seepage from Long Skerth

As reported previously during the latest events, reports were received, that during high water levels, water has also started to seep through the banks of the main river outfall adjacent to Trinity College P/S. Stantec produced a proposal for this site and completed a site inspection, and have now completed ground investigations at this site, which are included on (pages 23 – 60).

Information on next stage proposal from Stantec for Ewerby, South Kyme, Damford & Trinity College Pumping Stations

As reported previously on completion of the ground investigation at these sites, Stantec were asked to provide a proposal for consideration towards a solution to the problem.

The proposed costs at £17,500 for Phase 1 and budget estimate costs for Phase 2 between £22,000 & £32,000 dependent upon findings in Phase 1, would be another additional c£50,000 on top of the c£50,000 spent. However, there would also be additional costs not specified in their proposal, as a topographic survey for each site would be required as a minimum.

Following this proposal discussion has taken place with the Environment Agency about the next stage. The initial response has been that of a watching brief, but as explained although conditions are currently dry the problem has not been resolved and will occur again during the next high water level event, which could result in a total failure of a raised embankment.

TECHNICAL NOTE

Job Name: Trinity College Pumping Station
Job No: 332510682
Note No: TN002
Date: 24/05/2022
Prepared By: L Truslove (Principal Engineer)
Reviewed By: L Tomlin (Senior Associate)
Approved By: D Sharp (Director)
Subject: **GROUND INVESTIGATION**

1. Introduction

Stantec has been commissioned by Black Sluice Internal Drainage Board (IDB) (the Client) to design, monitor and report upon a ground investigation at the site of their Trinity College Pumping Station. The purpose of this Technical Note is to summarise the ground conditions recorded during the ground investigation works. The work was commissioned after movement in one of the wingwalls was noticed and seepage was observed to be occurring through the wingwalls either side of the pumping station.

The pumping station is located approximately 2km west of Amber Hill, Lincolnshire at approximate national grid reference TF 21745 45833 (521745E, 345833N). The pumping station is situated at the head of a water body known as Holland Dyke and pumps water up to the higher level water body known as Head Dyke. The pumping station is situated atop an embankment between these two water bodies.

2. Background

The IDB reported water seepage through the embankment on the western side of the pumping station at times of high-water levels within the Head Dyke during the extreme wet weather of January 2021. Following this, Stantec carried out a site visit and produced a technical note (332510682 TN001, dated 27th July 2021) summarising the observations made and making recommendations for ground investigation. The visit recorded evidence of ground settlements within the embankment and settlement and rotational movement of the concrete wingwalls (refer to photographs in **Appendix A**). This Technical Note (TN002) is to be read in conjunction with TN001.

A construction drawing shared by the client (see **Appendix B**) shows the substructure of the pumping station. This suggests that the station building is founded on driven precast concrete piles. The landing at the top of the external stairs on the western side of the pumping station appears to be an extension of the pumping station floor slab, with the steps apparently bearing on the ground beside the pumping station. The drawing does not show how the wingwalls either side of the pumping station building are founded, however it is expected that they are bearing in the embankment fill.

Geological mapping indicates that the site is underlain by Tidal Flats Deposits (typically comprising soft silty clay, with layers of peat, sand and basal gravel) which overlie bedrock strata of the Amphill Clay Formation (typically comprising mudstones that weather to clays near surface).

3. Ground Investigation

The ground investigation aims were as follows:

- Record the composition, thickness and geotechnical properties of the Embankment Fill.
- Record the composition, thickness and geotechnical properties of the Tidal Flats Deposits.
- Record the below ground construction of the wingwalls adjacent to the pumping station.

The fieldwork was undertaken by Stantec on the 21st and 22nd March 2022 in general accordance with BS5930 and BS10175 and comprised:

- one cable percussion borehole (BH01).

TECHNICAL NOTE

- one dynamic sample borehole (WS01) with follow-on dynamic probing through the base of the borehole (DP01).
- 2 hand excavated trial pits (HP01 and HP02).

Due to access restrictions associated with getting a standard towed cable percussion rig to the site, BH01 was sunk using a cut-down rig which is delivered in pieces and assembled on site. BH01 was proposed to be sunk to 20m bgl, however, limitations of the rig prevented sinking the borehole beyond 11m bgl.

WS01 was infilled with bentonite pellets on completion of the borehole. The trial pits were infilled with compacted arisings.

The records of the exploratory holes are presented in **Appendix C** with an exploratory hole location plan presented at the end of this Technical Note.

Disturbed small and bulk samples of soil were recovered from the boreholes and pits and in-situ standard penetration testing (SPT) was undertaken at 1m depth intervals in the window sampler borehole, in the cable percussive borehole the SPT testing was alternated with undisturbed thin wall samples (UT100).

SPT N values recorded on the logs have been corrected for hammer energy ratio in accordance with BS EN ISO 22476-3:2005+A1:2011. The dynamic probing employed the DPSH-B apparatus and was carried out in accordance BS EN ISO 22476-2:2005+A1:2011.

Soil samples were submitted for laboratory geotechnical testing for soil classification purposes for the following:

- Natural Moisture Content.
- Atterberg Limits.
- Particle Size Distribution.
- Chemical Testing.
- Undrained Triaxial Testing.

The laboratory test data is presented in **Appendix D**.

4. Encountered Ground Conditions

The ground investigation recorded Embankment Fill material overlying Tidal Flat Deposits which was in line with expectations. Full details are displayed on the borehole logs included in **Appendix C**. A summary of the thickness and base elevations of the strata encountered are given in Table 1 below:

Table 1 - Thickness and base elevations of the strata encountered

| Exploratory Hole | Embankment Fill | | Tidal Flats Deposits - Cohesive | | Tidal Flats Deposits - Granular | |
|------------------|-----------------|-----------|---------------------------------|-----------|---------------------------------|------|
| | Thickness | Base | Thickness | Base | Thickness | Base |
| BH01 | 2.4m | 0.3m AOD | 4.5m | -4.2m AOD | >3.9m | - |
| WS01 | 2.7m | -0.5m AOD | 3.4m | -3.9m AOD | >0.85m | - |
| HDP01 | >1.25m | - | - | - | - | - |
| HDP02 | >1.25m | - | - | - | - | - |

Embankment Fill

Embankment Fill, comprising 0.1m to 0.25m of topsoil over a firm or firm to stiff clay was recorded in all of the exploratory holes with the base of the deposit being proved in BH01 and WS01. A granular stratum 0.2m to 0.3m thick was recorded beneath the surface topsoil in BH01 and HDP01 which probably represents material laid as a track surface historically. A 0.05m thick gravelly sand stratum was recorded within the clay fill at 1.45m bgl in WS01.

The following geotechnical properties were recorded in the Embankment Fill:

- 3 no. SPT N values of 4, 5 and 9.
- 5 no. Undrained shear strength values recorded by hand shear vane ranged from 44kN/m² to 61 kN/m².

TECHNICAL NOTE

Atterberg Limit tests recorded liquid 74% and 69% and plastic limits of 29% and 30% and plasticity index values of 45% and 39% respectively. This indicates the material is a high plasticity clay with a medium to high volume change potential according to BRE Digest 240.

Tidal Flats Deposits

BH01 and WS01 recorded Tidal Flats Deposits (TFD) immediately beneath the Embankment Fill. This deposit comprised near surface cohesive strata overlying granular strata.

Cohesive Strata

The near surface cohesive strata are typically described as very soft to soft grey to dark grey slightly silty clay with occasional medium gravel sized pockets of black fibrous peat. Bands of fibrous peat between 0.1m and 0.25m thick were recorded locally in the deposit.

The following geotechnical properties were recorded in the deposit:

- 6 no. SPT N values ranging from 0 (i.e., the apparatus sinking under their own weight) to 2.
- 12 no. Undrained shear strength values recorded by hand shear vane ranged from 11kN/m² to 34 kN/m².

An undrained triaxial test carried out on a sample recovered from BH01 at 4.5m bgl recorded an undrained shear strength of 22 kN/m² which is indicative of a very low strength clay. Bulk density of this sample was recorded as 1.81 Mg/m³.

Atterberg Limit tests recorded liquid 29% to 107% and plastic limits of 19% to 40% respectively and plasticity index values of 10% to 67% (mean of 36%). This indicates the material is variable ranging between low to extremely high plasticity clay with a low to high (typically medium to high) volume change potential according to BRE Digest 240.

Granular Strata

The granular strata typically comprise grey very gravelly fine to medium sand or sandy gravel with the gravel comprising fine to medium rounded flint.

Four SPTs were undertaken in the sands recorded N values of 8, 19, 17 in BH01 and 51 in WS01 which are indicative of a range of relative density of loose to dense. The dynamic probing uses the same mass of hammer and hammer drop height as the SPT apparatus and between 7m and 11m bgl in DP01 this recorded blows per 100mm of penetration ranging between 2 and 20. The data shows a trend on increasing blow count and therefore relative density with depth. It also recorded a zone of low blows of 2 and 3 between 8.6 and 8.9m bgl which are indicative of loose material. Overall, the data indicates that the granular strata are typically a medium dense to dense material and locally can include loose bands.

Particle size distribution tests on two samples of the material show it is highly variable with sand contents of 25% and 79% and gravel contents of 74% and 17% respectively. Fines contents (clay and silt material below 63 microns in size) were recorded at 2% and 4%.

Groundwater

Groundwater was encountered in WS01 at a depth of 3.1m bgl rising to 3.0m bgl after 20 minutes of monitoring and at 5.9m bgl rising to 3.6m bgl after 20 minutes. Groundwater strikes were not encountered in BH01, however, this is considered due to groundwater strikes being masked by the addition of water into the bore to assist drilling and to maintain a positive head of water in the bore to prevent 'blowing/boiling' of the base of the borehole in the granular soils.

On completion of the ground investigation a monitoring standpipe piezometer was installed in BH01 and the water levels in the installation were recorded on two occasions (28th April and 11th May 2022). On both occasions the groundwater level stood at 2.77m bgl (-0.07m AOD).

5. Substructure

Figures 3a and 3b present sketches of the below ground structures encountered in trial pits HDP01 and HDP02 respectively.

TECHNICAL NOTE

At HDP01 the western wingwall was founded in the Embankment fill at 0.9m bgl (1.75m AOD). The heel on the back of the wall was 0.3m thick and extended 0.55m back from the rear face of the wall.

At HDP02 the short section of eastern wingwall was founded in the Embankment fill at 0.5m bgl (1.85m AOD). The heel on the back of the wall was 0.2m thick and extended 0.55m back from the rear face of the wall.

HDP02 also recorded the base of the pumping station slab on the eastern side of the building at 1.1m bgl (1.25m AOD).

HDP02 recorded that the gap observed above ground between the wingwall and pumping station building carries on below ground where it is approximately 10mm wide.

6. Characteristic Geotechnical Parameters

The recommended characteristic geotechnical parameters for use in design are discussed below and summarised in the following table.

Table 5.1 Summary of Recommended Characteristic Values

| Stratum | Bulk Unit Weight kN/m ³ | Undrained Shear Strength | | Drained Shear Strength | | Elastic Modulus, MPa | Poisson's Ratio |
|--------------------------------|---------------------------------------|------------------------------------|--------------------|------------------------|-------|-------------------------|-----------------|
| | | C _u , kN/m ² | Φ _u , ° | c', kN/m ² | Φ', ° | | |
| Embankment Fill | 18 | 45 | 0 | 0 | 21 | 5 | 0.40 |
| Tidal Flat Deposits - Cohesive | 18 | 20 | 0 | 0 | 21 | 2 | 0.40 |
| Tidal Flat Deposits - Granular | 19 | - | 34 | 0 | 34 | 10 | 0.30 |

Bulk unit weights of the Embankment Fill is based on the description of the material, its recommended characteristic undrained shear strength and the recommendations of Figures 1 and 2 of BS 8002, 2015.

Bulk unit weight of the cohesive Tidal Flat Deposits is based on the measured value from the triaxial test and the recommendations of Figures 1 and 2 of BS 8002, 2015.

Bulk unit weights of the granular soils are based on the description of the materials, their consistency and the recommendation of Figures 1 and 2 of BS 8002:2015.

Undrained shear strength of the cohesive soils are based on the visual descriptions of the soils and the results of hand shear vane undrained shear strength data.

Undrained friction angles (Φ_u) of the cohesive soils are assumed to be zero.

Undrained and effective angles of friction (Φ') for the granular strata are based on the visual description, gradings and SPT N values of the materials and the recommendations of BS 8002, 2015.

Effective angles of friction (Φ') for the cohesive soils are based on the visual description of the materials, the measured plasticity index values and the recommendations of BS 8002, 2015.

For the cohesive and granular soils effective cohesion (c') is assumed to be zero.

Young's modulus values for the cohesive and granular soils are based on the consistency and soil type and Table 11.7 of Look (2005).

Poisson's ratio values are taken from Look (2005) Table 11.17 and are based on soil type and plasticity.

The recommended characteristic values should be reviewed and selected by the Designer, taking into consideration the limit states and design methods being used, and the process should be documented in the Geotechnical Design Report.

With respect to groundwater levels, it is expected that a hydraulic gradient will exist across the site associated with the flow of groundwater from the elevated Head Dyke to the Holland Dyke at the lower level. The position of the groundwater beneath the site will tend to vary with the relative elevations of the water levels in the two water bodies and design work will have to take this into account with respect to the design limit state under consideration.

TECHNICAL NOTE

7. Discussion

The settlement and separation of the wingwall from the eastern side of the pumping station and the settlement, cracking and tilting of the western wingwall are likely to have occurred due to the differences in foundations. The pumping station is founded on piles and would not be expected to move significantly, whereas the wingwalls have ground bearing footings at high level, and have moved. The movement of the walls is likely to be due to one or more of the following:

- Long term consolidation settlement of the high compressibility clays of Tidal Flat Deposits under loading from the embankment and concrete wall.
- Long term creep settlement of peat layers within the Tidal Flat Deposits.
- Downslope ground movements in the embankment in front of the wingwalls.
- Shrinkage/swelling of the clay fill forming the embankment associated with seasonal wetting and drying.

It is routine for foundations for buildings to be founded at a minimum of 1.0m bgl in high plasticity clay soils (i.e. >40% plasticity index) such as those of the embankment fill, to prevent them being affected by seasonal shrinkage or swelling of the clays due to moisture changes. However, the eastern wingwall was founded in the clay fill at 0.5m bgl and the western wingwall at 0.9m bgl and this may have contributed to shrinkage/swelling movements occurring beneath the concrete walls.

It is considered that the most appropriate form of remediation for the wingwalls would be to replace them with new walls. The most efficient method for this is likely to be to use interlocking sheet piles capped with a concrete wall. This will allow the embankment and the soils beneath it to continue settling without the ground movements affecting the concrete wingwall. Furthermore, the sheet piles should reduce the leakage of water through the embankment. The sheet piles would need to be taken down to toe into a stiff stratum such as the granular soils of the Tidal Flat Deposits.

The flow of water through the embankment would be impeded by the sheet piles, however, there are seepage paths through the clay embankment fill close to the pumping station on its western side, which should also be addressed to prevent recurrence of the seepages. Groundwater flow through an embankment can lead to internal erosion and slope instability. Possible remediation measures could include:

- Excavate the embankment fill locally and place clay fill (either reworked embankment fill or imported fill) in accordance with an Engineer designed earthworks specification.
- Install a low permeability barrier/cut-off to groundwater flow by excavation of a trench in the embankment fill behind the new wingwall and fill with bentonite slurry or compacted clay fill.

7. References

BRE Digest 240 Low-rise buildings on shrinkable clay soils: Part 1. 1993. Building Research Establishment.

BS 5390:2015 Code of practice for ground investigations. BSI.

BS 10175:2011+A2:2017 Investigation of potentially contaminated sites. Code of practice. BSI.

BS EN ISO 22476-2:2005+A1:2011 Geotechnical investigation and testing - Field testing - Part 2: Dynamic probing. BSI.

BS EN ISO 22476-3:2005+A1:2011 Geotechnical investigation and testing - Field testing - Part 3: Standard penetration test. BSI.

Exploratory Hole Location Plan

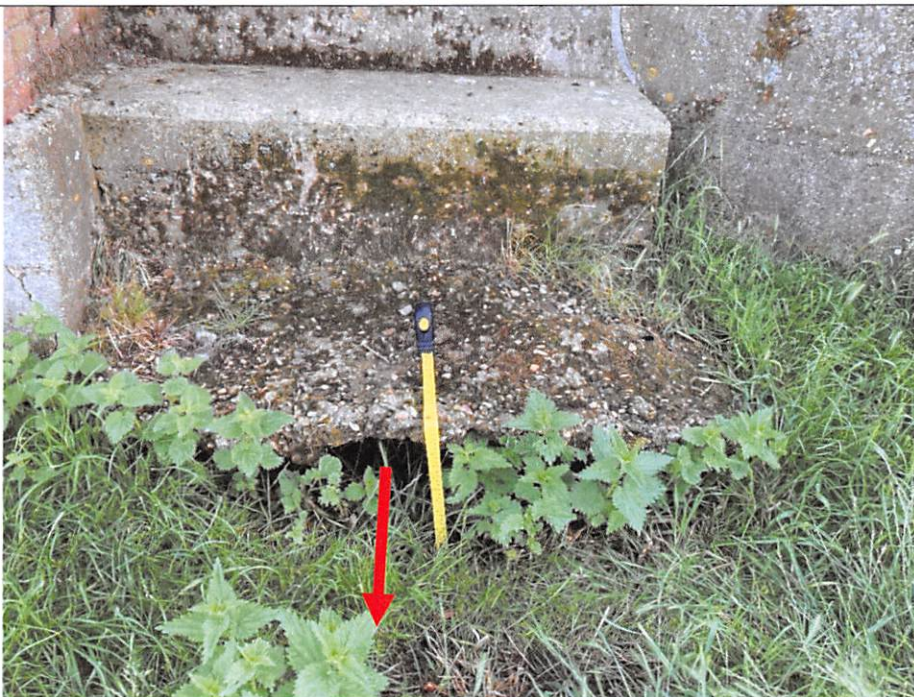


TECHNICAL NOTE

APPENDIX A SITE WALKOVER PHOTOGRAPHS



Photograph 1 - West side of pumping station. Settlement of the soils beneath the stairs leading into the pumping station building. Photograph taken looking north. Arrow denotes seepage water flow.



Photograph 2 - A void present beneath the bottom of the concrete steps to the west side of the pumping station as a result of ground settlement. Water has been noted to flow through this void during high water levels. Arrow denotes seepage water flow.

TECHNICAL NOTE


Photograph 3 - Western side of pumping station. Movement and dislocation of the concrete wingwall sections downwards and to the left of view, and evidence of temporary repairs of cracks in the wall. Tape 1m long for scale.



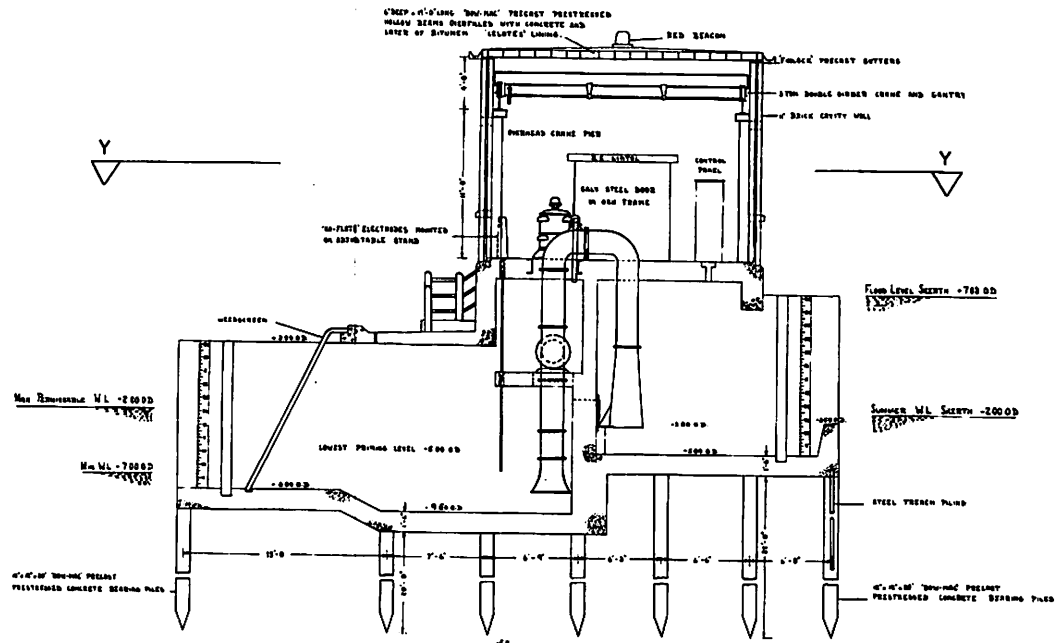
Photograph 4 - Western side of pumping station. Settlement of soils on the northern side of the wingwall. Yellow arrows show indicate rotation of the concrete sections towards the north.

TECHNICAL NOTE

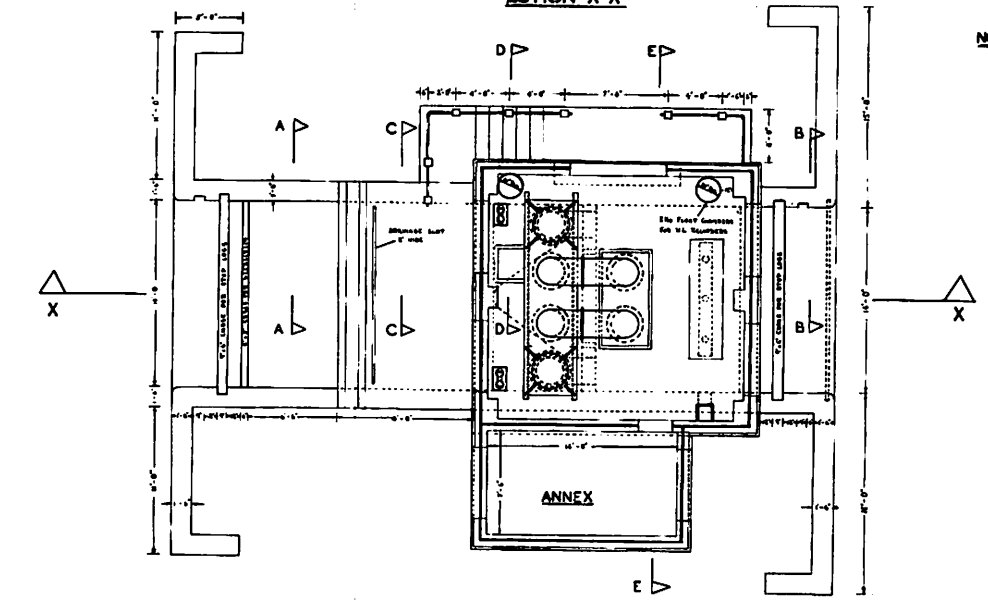
Photograph 5 - Eastern side of pumping station looking north. Wingwall has moved downwards and away from the building to leave a gap through which water flowed. Arrow denotes seepage water flow.

TECHNICAL NOTE

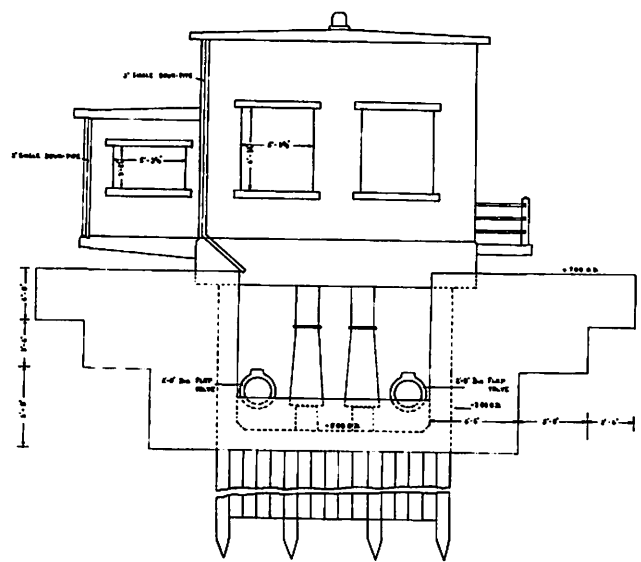
APPENDIX B IDB SUPPLIED DRAWING



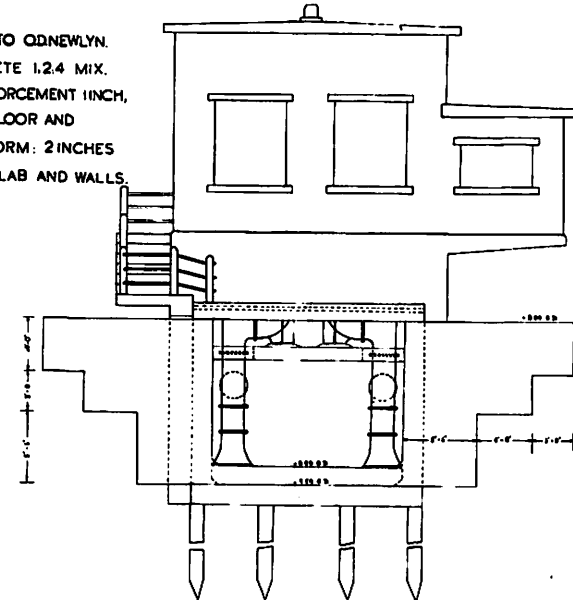
SECTION X-X



SECTION Y-Y



ELEVATION DISCHARGE SIDE



ELEVATION SUCTION SIDE

NOTES: LEVELS REFER TO ODNEWLYN.
 REINFORCED CONCRETE 1:2:4 MIX.
 MIN. COVER TO REINFORCEMENT 1 INCH,
 FOR MOTOR ROOM FLOOR AND
 WEEDSCREEN PLATFORM: 2 INCHES
 COVER FOR BASE SLAB AND WALLS.

DWC NO 140/4
 DWG. NO. 5/7 22 3 03

BLACK SLUICE INTERNAL DRAINAGE BOARD

TRINITY COLLEGE PUMPING STATION


SCALE:
 1/4 INCH TO 1 FOOT

DRAWN BY: B.R.
 TRACED BY: B.R.
 CHECKED BY:
 DATE, MAY 1961

L.I. CLARK, A.M.I.C.E.,
 ENGINEER TO THE BOARD,
 72, CARLTON ROAD,
 BOSTON, LINCS.


TECHNICAL NOTE

APPENDIX C EXPLORATORY HOLE RECORDS

| | | | | | |
|--|--|--|--|---|--|
| Project Name Trinity Pumping Station | | Project No: 332510682 | |  | BOREHOLE |
| Client Black Sluice Drainage Board | | Start Date 21/03/2022 | End Date 22/03/2022 | | BH01 |
| Contractor A F Howlands | | Ground Level 2.70m OD (OSGB) | | | |
| Method/Plant Cut down Cable Percussion Rig | | Energy Ratio 68 % | Coordinates (OSGB) 521732 E 345834 N | | Logged By: MRG Checked By: LT |
| | | | | | Sheet 1 of 2 Scale 1:50 |


| (m) | Samples and Insitu Tests | | | Water | Legend | Depth (Thickness) | Level (m OD) | Stratum Description | Instrumentation /Backfill |
|-----|--------------------------|------|----------|-------|--------|----------------------|-----------------|--|------------------------------|
| | Depth | Type | Results | | | | | | |
| | 0.30 | D1 | | | | (0.20) | 2.50 | MADE GROUND: soft to firm dark brown slightly sandy silty organic CLAY topsoil with many fine rootlets MADE GROUND: Creamish brown very sandy fine flint & limestone GRAVEL . MADE GROUND: Firm mid brown slightly silty CLAY with occasional orangish brown mottling (EMBANKMENT FILL). | |
| | 0.50 | D2 | | | | 0.20 | | | |
| | 0.60 - 1.00 | B1 | | | | 0.50 | 2.20 | | |
| 1 | | | | | | | | | |
| | 1.50 | S | N=5 | | | (1.90) | | | |
| | 1.50 - 1.95 | D3 | | | | | | | |
| 2 | | | | | | | | | |
| | 2.20 | D4 | | | | | | | |
| | 2.50 - 2.95 | UT1 | Ublow=7 | | | 2.40 | 0.30 | Very soft to soft greyish brown slightly sandy silty CLAY with rare to occasional remnants of drilling disturbed peat [TIDAL FLAT DEPOSITS] | |
| | 2.50 - 3.00 | B2 | | | | | | | |
| 3 | | | | | | | | | |
| | 3.00 | S | N=2 | | | | | | |
| | 3.00 - 3.45 | D5 | | | | | | | |
| | 3.50 | S | N=2 | | | | | | |
| | 3.50 - 3.95 | D6 | | | | | | | |
| 4 | | | | | | | | | |
| | 4.50 - 4.95 | UT2 | Ublow=10 | | | (4.50) | | | |
| 5 | | | | | | | | | |
| | 5.00 | D7 | | | | | | | |
| 6 | | | | | | | | | |
| | 6.00 | S | N=2 | | | | | | |
| | 6.00 - 6.45 | D8 | | | | | | | |
| 7 | | | | | | | | | |
| | 6.90 | D9 | | | | 6.90 | -4.20 | Medium dense grey sandy fine to medium GRAVEL. Gravels are subrounded to subangular of limestone and flint [TIDAL FLAT DEPOSITS] | |
| | 7.50 | C | N=8 | | | | | | |
| | 7.50 - 7.95 | B3 | | | | | | | |
| 8 | | | | | | | | | |
| | 8.50 | D10 | | | | (3.20) | | | |
| 9 | | | | | | | | | |
| | 9.00 - 9.40 | B4 | | | | | | | |
| 10 | | | | | | | | | |
| | 10.00 | C | N=19 | | | | | | |
| | 10.00 - 10.45 | B5 | | | | | | | |

| | | | | | | | | | |
|--|------------------------|-------|------------|---------------------|-------------|---------|-------------------|----|----------|
| General Remarks 1. Location CAT scanned prior to excavation. 2. Hand dug inspection pit to 1.20 m. 3. No groundwater encountered. 4. Slotted Standpipe installed to 10.80 m. 5. SPT Hammer Energy Ratio = 68%. 6. Water added to assist boring and maintain a positive 'head' of water in the granular strata. | Boring Progress | | | Water Strike | | | Chiselling | | |
| | Date/Time | Depth | Cas. Depth | Strike | Time (mins) | Rose To | From | To | Duration |
| | 21/03/2022 17:00 | 6.50 | 6.00 | | | | | | |
| | 22/03/2022 09:00 | 6.50 | 6.00 | | | | | | |
| | 22/03/2022 | 10.80 | 10.80 | | | | | | |

| | | | | | |
|--|--|--|--|---|---|
| Project Name Trinity Pumping Station | | Project No: 332510682 | |  Stantec | BOREHOLE |
| Client Black Sluice Drainage Board | | Start Date 21/03/2022 | End Date 22/03/2022 | | BH01 |
| Contractor A F Howlands | | Ground Level 2.70m OD (OSGB) | | | Sheet 2 of 2 |
| Method/Plant Cut down Cable Percussion Rig | | Energy Ratio 68 % | Coordinates (OSGB) 521732 E 345834 N | | Logged By: MRG Checked By: LT Scale 1:50 |

| (m) | Samples and Insitu Tests | | | Water | Legend | Depth (Thickness) | Level (m OD) | Stratum Description | Instrumentation /Backfill |
|-------|--------------------------|------|---------|-------|--------------------------|----------------------|--|---------------------|------------------------------|
| | Depth | Type | Results | | | | | | |
| 10.80 | C D11 | N=17 | | | 10.10 (0.70) 10.80 | -7.40 -8.10 | Medium Dense to dense grey sandy fine to medium GRAVEL. Gravels are subrounded to subangular of limestone and flint [TIDAL FLAT DEPOSITS] Medium dense greyish brown slightly clayey slightly gravelly fine to medium SAND [TIDAL FLAT DEPOSITS] End of Borehole at 10.80m | | |
| 11 | | | | | | | | | |
| 12 | | | | | | | | | |
| 13 | | | | | | | | | |
| 14 | | | | | | | | | |
| 15 | | | | | | | | | |
| 16 | | | | | | | | | |
| 17 | | | | | | | | | |
| 18 | | | | | | | | | |
| 19 | | | | | | | | | |
| 20 | | | | | | | | | |

| | | | | | | | | | |
|--|------------------------|-------|------------|---------------------|-------------|---------|-------------------|----|----------|
| General Remarks 1. Location CAT scanned prior to excavation. 2. Hand dug inspection pit to 1.20 m. 3. No groundwater encountered. 4. Slotted Standpipe installed to 10.80 m. 5. SPT Hammer Energy Ratio = 68% | Boring Progress | | | Water Strike | | | Chiselling | | |
| | Date/Time | Depth | Cas. Depth | Strike | Time (mins) | Rose To | From | To | Duration |
| 17:00 | | | | | | | | | |

| | | | | | |
|--|--|---|---|---|--|
| Project Name Trinity Pumping Station | | Project No: 332510682 | |  | DYNAMIC SAMPLE WS01 |
| Client Black Sluice Drainage Board | | Start Date End Date 21/03/2022 21/03/2022 | | | |
| Contractor A F Howlands | | Ground Level 2.20m OD (OSGB) | | Logged By: MRG Checked By: LT | |
| Method/Plant Dando Windowless Sampling Rig | | Energy Ratio 63 % | Coordinates (OSGB) 521757 E 345826 N | | Sheet 1 of 1 Scale 1:40 |

| (m) | Samples and Insitu Tests | | | Water | Legend | Depth (Thickness) | Level (m OD) | Stratum Description | Instrumentation /Backfill |
|-----|--------------------------|------|---------|-------|--------|----------------------|-----------------|---|------------------------------|
| | Depth | Type | Results | | | | | | |
| | | | | | | (0.51) | | MADE GROUND: Soft to firm dark brown slightly sandy silty organic CLAY topsoil with many fine rootlets | |
| | | | | | | 0.51 | 1.69 | MADE GROUND: Firm greyish brown mottled orangish brown slightly sandy silty CLAY (EMBANKMENT FILL). | |
| 1 | 1.00 | D2 | | | | | | | |
| | 1.20 | S | N=9 | | | | | | |
| | 1.20 - 1.65 | D | | | | | | | |
| | 1.20 - 2.00 | L1 | | | | | | | |
| | 1.50 | D3 | | | | | | | |
| | 1.75 | HSV | 51 kPa | | | (2.19) | | <u>Band of gravelly fine to coarse SAND. Gravels are fine to medium rounded flints</u> | |
| | 1.75 | HSV | 44 kPa | | | | | | |
| 2 | 2.00 | S | N=4 | | | | | | |
| | 2.00 - 2.45 | D | | | | | | | |
| | 2.00 - 3.00 | L2 | | | | | | | |
| | 2.00 | HSV | 61 kPa | | | | | | |
| | 2.25 | HSV | 57 kPa | | | | | | |
| | 2.50 | D4 | | | | | | | |
| | 2.50 | HSV | 56 kPa | | | 2.70 | -0.50 | Very soft to soft grey to dark grey slightly silty CLAY with occasional medium gravel sized pockets of black fibrous peat. [TIDAL FLAT DEPOSITS] | |
| | 2.75 | HSV | 11 kPa | | | | | | |
| 3 | 3.00 | S | N=0 | | | | | | |
| | 3.00 - 3.45 | D | | | | | | | |
| | 3.00 - 4.00 | L3 | | | | | | | |
| | 3.00 | HSV | 14 kPa | | | | | | |
| | 3.25 | HSV | 15 kPa | | | | | | |
| | 3.50 | D5 | | | | | | | |
| | 3.50 | HSV | 17 kPa | | | | | | |
| | 3.75 | HSV | 27 kPa | | | | | | |
| 4 | 4.00 | S | N=0 | | | | | | |
| | 4.00 - 4.45 | D | | | | | | | |
| | 4.00 - 5.00 | L4 | | | | | | | |
| | 4.00 | HSV | 32 kPa | | | (3.43) | | | |
| | 4.25 | HSV | 14 kPa | | | | | | |
| | 4.50 | HSV | 19 kPa | | | | | | |
| | 4.75 | HSV | 33 kPa | | | | | <u>bands of laminated black fibrous PEAT</u> | |
| 5 | 5.00 | S | N=0 | | | | | | |
| | 5.00 - 5.45 | D | | | | | | | |
| | 5.00 - 6.00 | L5 | | | | | | | |
| | 5.00 | HSV | 34 kPa | | | | | | |
| | 5.25 | HSV | 14 kPa | | | | | | |
| | 5.50 | D6 | | | | | | | |
| | 5.90 | D7 | | | | | | <u>band of black fibrous silty PEAT</u> | |
| 6 | 6.00 | S | N=51 | | | | | | |
| | 6.00 - 6.45 | D | | | | 6.13 | -3.93 | Dense grey very gravelly fine to medium SAND. Gravels are fine to medium rounded flints [TIDAL FLAT DEPOSITS] | |
| | 6.00 - 7.00 | L6 | | | | | | | |
| | 6.00 | HSV | 15 kPa | | | (0.87) | | | |
| | 6.10 - 7.00 | B1 | | | | | | | |
| 7 | | | | | | 7.00 | -4.80 | End of Window Sample at 7.00m | |
| 8 | | | | | | | | | |

| | | | | | | | |
|---|--------------|-------------|---------|-------------------|-----|-----------|--------|
| General Remarks 1. Location CAT scanned prior to excavation. 2. Hand dug inspection pit to 1.20 m. 3. Groundwater struck at 3.10 m and rose to 3.00 m in 5 mins and 10 mins and 15 mins and 20 mins. 4. Groundwater struck at 5.90 m and rose to 3.75 m in 5 mins, 3.64 m in 10 mins, 3.62 m in 15 mins and 3.60 m in 20 mins. 5. SPT Hammer Energy Ratio = 63%. 6. Dynamic Probe DP01 was sunk through the base of the borehole (refer to separate log). | Water Strike | | | Window Sample Run | | | |
| | Strike | Time (mins) | Rose to | Start | End | Dia. (mm) | Rec. % |
| | 3.10 | 20 | 3.00 | | | | |
| 5.90 | 20 | 3.60 | | | | | |

| | | | | |
|--|---|---|------------------------------------|-------------|
| Project Name Trinity Pumping Station | Project No: 332510682 |  | DYNAMIC PROBE | |
| Client Black Sluice Drainage Board | Start Date 21/03/2022 | | End Date 21/03/2022 | DP01 |
| Contractor A F Howlands | Ground Level 2.20m OD (OSGB) | | | |
| Method/Plant Dando Windowless Sampling Rig | Coordinates (OSGB) 521757 E 345826 N | | Rig Crew: Checked By: LT | |
| | | | Sheet 1 of 2 Scale 1:50 | |


| Depth (m) | Blows / 100mm | | | | | Torque (Nm) | Remarks |
|-----------|---------------|---|----|----|----|-------------|---------|
| | 0 | 5 | 10 | 15 | 20 | | |
| 1 | | | | | | | |
| 2 | | | | | | | |
| 3 | | | | | | | |
| 4 | | | | | | | |
| 5 | | | | | | | |
| 6 | | | | | | | |
| 7 | 2 | 6 | 11 | 13 | 13 | 13 | |
| | | | | 13 | 13 | 13 | |
| | | | | 13 | 13 | 13 | |
| | | | | 13 | 14 | 13 | |
| 8 | | | | 15 | | | |
| | | | | 13 | 12 | 13 | |
| | | | | 10 | 11 | | |
| | 2 | 3 | 7 | | | | |
| | 3 | 3 | | | | | |
| 9 | | | 8 | 13 | 13 | 14 | |
| | | | | 13 | 13 | | |
| | | | | 11 | 12 | 12 | |
| | | | | 12 | 12 | | |
| | | | | 17 | 15 | 17 | |
| 10 | | | | 15 | 17 | 18 | |


| | | | | |
|--|-----------------|--------------|----------------|---------------|
| General Remarks DP01 was sunk through the base of of borehole WS01 (refer to separate log). | Drop Ht (mm) | | Cone Dia. (mm) | 50 |
| | Hammer Wt (kg) | | Damper | |
| | Final Depth (m) | 11.00 | Type | DPHS-B |

| | | | | | |
|--|---|---|------------------------------------|-------------------------------|-------------|
| Project Name Trinity Pumping Station | Project No: 332510682 |  | DYNAMIC PROBE | | |
| Client Black Sluice Drainage Board | Start Date 21/03/2022 | | | End Date 21/03/2022 | DP01 |
| Contractor A F Howlands | Ground Level 2.20m OD (OSGB) | | | | |
| Method/Plant Dando Windowless Sampling Rig | Coordinates (OSGB) 521757 E 345826 N | | Rig Crew: Checked By: LT | | |
| | | | Sheet 2 of 2 Scale 1:50 | | |


| Depth (m) | Blows / 100mm | | | | | Torque (Nm) | Remarks |
|-----------|---------------|--|--|--|--|-------------|---------|
| 0 | | | | | | | |
| 1 | | | | | | | |
| 2 | | | | | | | |
| 3 | | | | | | | |
| 4 | | | | | | | |
| 5 | | | | | | | |
| 6 | | | | | | | |
| 7 | | | | | | | |
| 8 | | | | | | | |
| 9 | | | | | | | |
| 10 | | | | | | | |
| 11 | | | | | | | |
| 12 | | | | | | | |
| 13 | | | | | | | |
| 14 | | | | | | | |
| 15 | | | | | | | |
| 16 | | | | | | | |
| 17 | | | | | | | |
| 18 | | | | | | | |
| 19 | | | | | | | |
| 20 | | | | | | | |


| | | | | |
|-----------------|-----------------|--------------|----------------|---------------|
| General Remarks | Drop Ht (mm) | | Cone Dia. (mm) | 50 |
| | Hammer Wt (kg) | | Damper | |
| | Final Depth (m) | 11.00 | Type | DPHS-B |

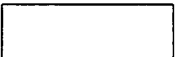
| | | | | | | |
|--|--|---|-------------------------------|---|------------------|--|
| Project Name Trinity Pumping Station | | Project No: 332510682 | |  | TRIAL PIT | |
| Client Black Sluice Drainage Board | | Start Date 21/03/2022 | End Date 21/03/2022 | | HDP01 | |
| Contractor A F Howlands | | Ground Level 2.65m OD | | Logged By: MRG | | |
| Method/Plant Hand tools | | Coordinates 521733 E 345836 N | | Checked By: LT | | |
| | | | | Sheet 1 of 1 | | |
| | | | | Scale 1:20 | | |

| (m) | Samples and Insitu Tests | | | Water | Legend | Depth (Thickness) | Level (m OD) | Stratum Description | Instrum entation /Backfill |
|-----|--------------------------|--------|---------|---|---|----------------------|-----------------|--|----------------------------------|
| | Depth | Type | Results | | | | | | |
| 1 | 1.00 | D1 | | |  | (0.15) | 2.50 | MADE GROUND: Soft to firm dark brown slightly sandy silty organic CLAY topsoil with many fine rootlets | |
| | | | | | | 0.15 | | | |
| | | | | | | (0.20) | 2.30 | MADE GROUND: Probable medium dense light brown very clayey slightly sandy gravel. Gravel was fine to medium flint. Above the foundation outstep a soft orangish brown clay was encountered (EMBANKMENT FILL) | |
| | | | | | | 0.35 | | | |
| | | (0.75) | 1.55 | MADE GROUND: Firm to stiff grey clay with localised orangish brown mottling (EMBANKMENT FILL) | | | | | |
| | | | | | | 1.10 | 1.55 | End of Trial Pit at 1.10m | |
| 2 | | | | | | | | | |
| 3 | | | | | | | | | |
| 4 | | | | | | | | | |

| | | | |
|--|--|-------------------------------------|--|
| General Remarks 1. Location CAT scanned prior to excavation. 2. See report figures for foundation details | | Water Strike Standing Flow | Stability: Pit Dimensions <div style="border: 1px solid black; width: 100px; height: 20px; margin: 5px auto;"></div> |
|--|--|-------------------------------------|--|

| | | | | | |
|--|--|---|-------------------------------|---|------------------|
| Project Name Trinity Pumping Station | | Project No: 332510682 | |  | TRIAL PIT |
| Client Black Sluice Drainage Board | | Start Date 21/03/2022 | End Date 21/03/2022 | | HDP02 |
| Contractor A F Howlands | | Ground Level 2.35m OD | | | Sheet 1 of 1 |
| Method/Plant Hand tools | | Coordinates 521752 E 345830 N | | Scale 1:20 | |
| | | Logged By: MRG | | Checked By: LT | |

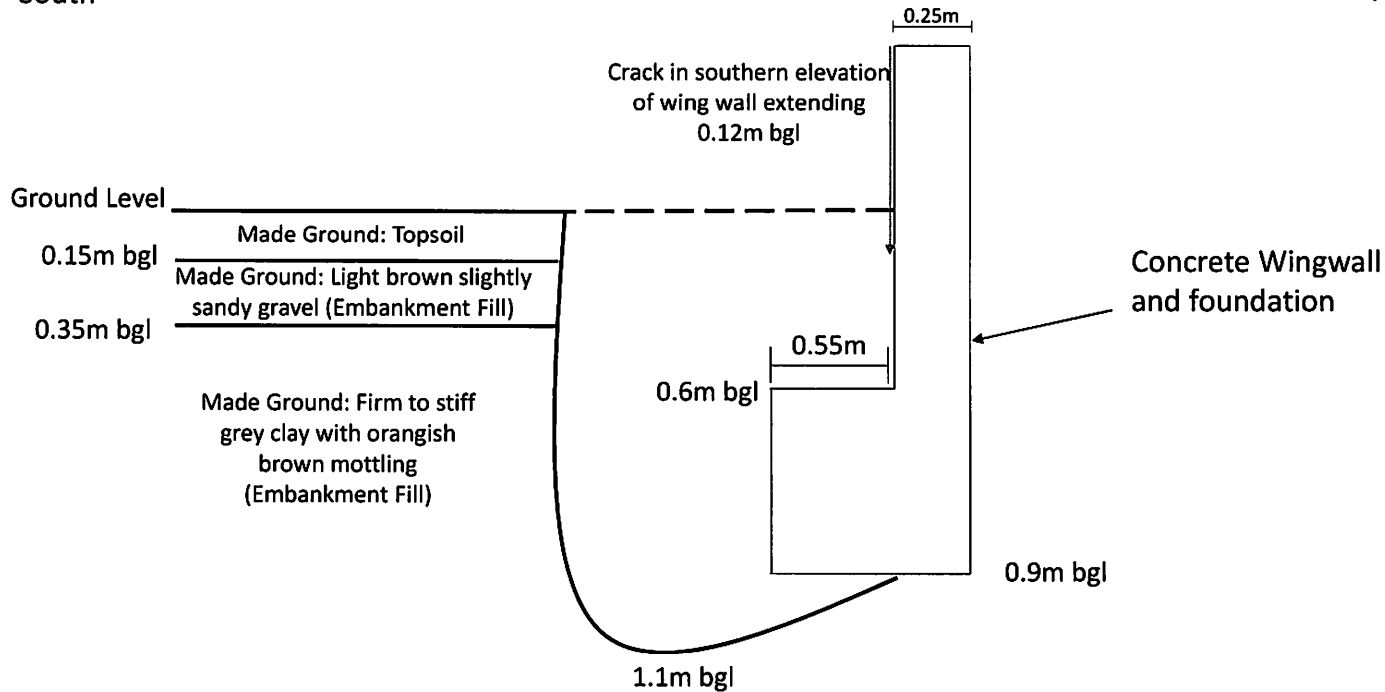
| (m) | Samples and Insitu Tests | | | Water | Legend | Depth (Thickness) | Level (m OD) | Stratum Description | Instrumentation /Backfill | |
|-----|--------------------------|------|---------|-------|---|----------------------|-----------------|--|------------------------------|--|
| | Depth | Type | Results | | | | | | | |
| 1 | | | | |  | (0.10) | 2.25 | Made Ground: Soft to firm dark brown slightly sandy silty organic CLAY topsoil with many fine rootlets | | |
| | | | | | | 0.10 | | MADE GROUND: Firm grey slightly sandy silty CLAY (EMBANKMENT FILL) | | |
| | | | | | | | (0.35) | 1.90 | | MADE GROUND: Firm to stiff grey silty CLAY with occasional orangish brown mottling (EMBANKMENT FILL) |
| | | | | | | | 0.45 | | | |
| | | | | | | (0.80) | 1.10 | End of Trial Pit at 1.25m | | |
| | | | | | | 1.25 | | | | |
| 2 | | | | | | | | | | |
| 3 | | | | | | | | | | |
| 4 | | | | | | | | | | |

| | | |
|--|-------------------------------------|---|
| General Remarks 1. Location CAT scanned prior to excavation. 2. See report figures for foundation details | Water Strike Standing Flow | Stability: Pit Dimensions |
| | |  |

Cross-Section

South

North



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Scaling Note: Do not scale from this drawing - any errors or omissions shall be reported to Stantec without delay.
Utilities Note: The position of any existing public or private sewers, utility services, plant or apparatus shown on this drawing is believed to be correct, but no warranty to this is expressed or implied. Other such plant or apparatus may also be present but not shown. Persons referring to this drawing are therefore advised to undertake their own investigation where the presence of any existing sewers, services, plant or apparatus may affect their operations.

Client/Project:
 Trinity Pumping Station
 Black Sluice Internal
 Drainage Board

| | | |
|-----------|----------|----------|
| Prepared: | Checked: | Date: |
| MRG | LT | May 2022 |

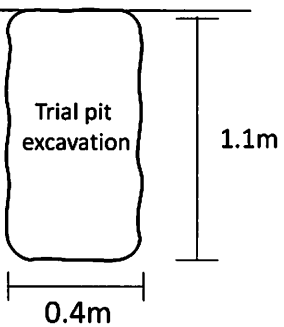
Title
 HDP01 Trial Pit Sketches

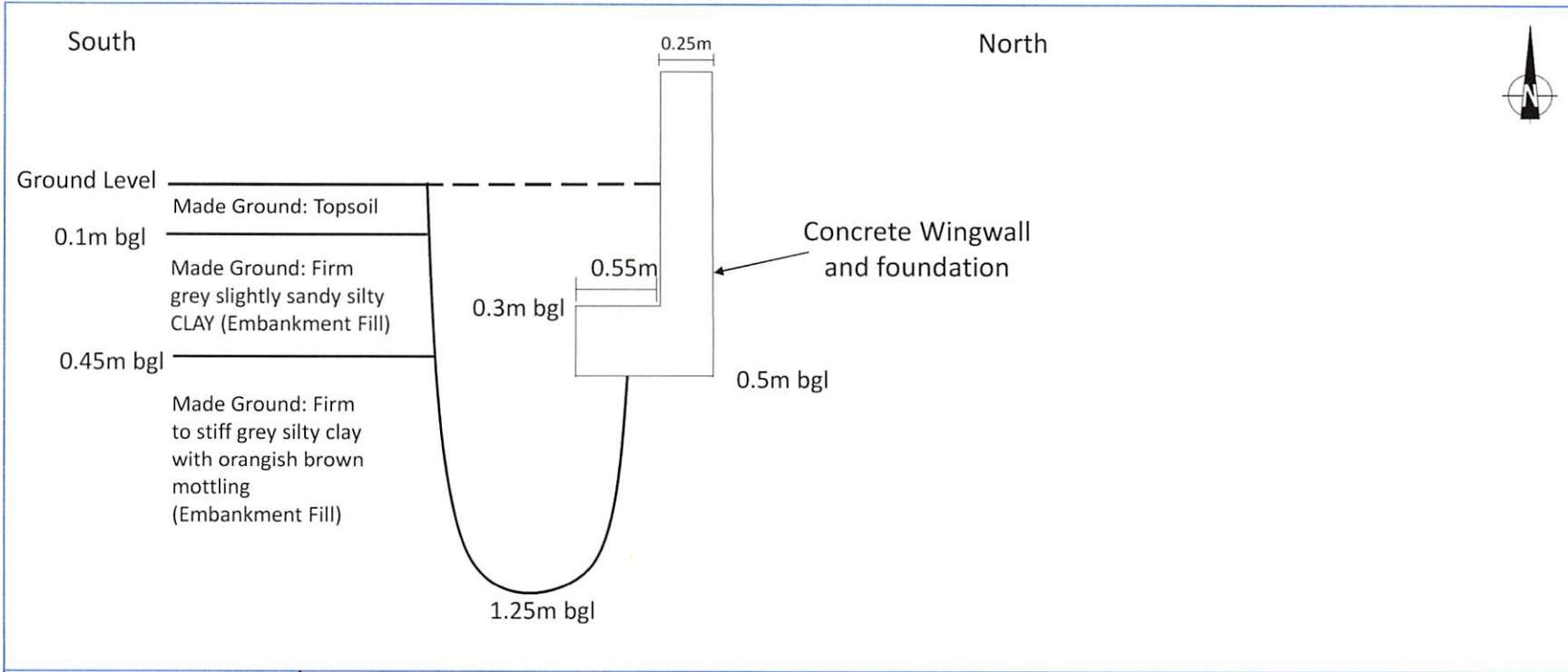
Not to Scale

| | |
|-----------|---------|
| Revision: | Figure: |
| 0 | 3a |

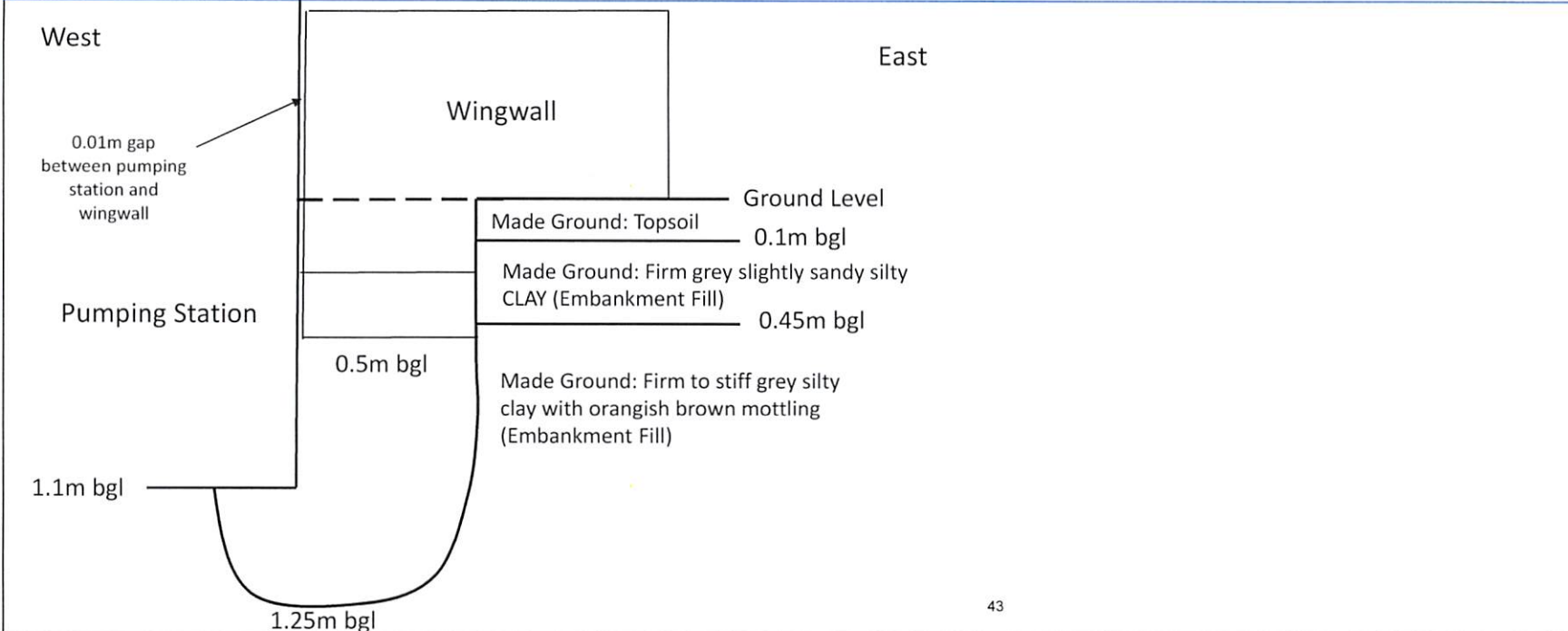
Plan

Wingwall





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Scaling Note: Do not scale from this drawing – any errors or omissions shall be reported to Stantec without delay.
Utilities Note: The position of any existing public or private sewers, utility services, plant or apparatus shown on this drawing is believed to be correct, but no warranty to this is expressed or implied. Other such plant or apparatus may also be present but not shown. Persons referring to this drawing are therefore advised to undertake their own investigation where the presence of any existing sewers, services, plant or apparatus may affect their operations.

Client/Project:
 Trinity Pumping Station
 Black Sluice Internal
 Drainage Board

Prepared: MRG Checked: LT Date: May 2022

Title
 HDP02 Trial Pit Sketch
 (Cross –Sections)

Not to Scale

Revision: 0 Figure: 3b


TECHNICAL NOTE**APPENDIX D LABORATORY TEST RESULTS**



TEST REPORT
ISSUED BY SOIL PROPERTY TESTING LTD
DATE ISSUED: 26/04/2022



0998

| | | | |
|---|--|--|--|
| Contract | Trinity Pumping House | | |
| Serial No. | 40462_1 | | |
| Client: | <i>Soil Property Testing Ltd</i> | | |
| Stantec UK Limited 3rd Floor 50-60 Station Road Cambridge CB1 2JH | 15, 16, 18 Halcyon Court, St Margaret's Way, Stukeley Meadows, Huntingdon, Cambridgeshire, PE29 6DG Tel: 01480 455579 Email: enquiries@soilpropertytesting.com Website: www.soilpropertytesting.com | | |
| Samples Submitted By: Stantec UK Limited | Approved Signatories: | | |
| Samples Labelled: Trinity Pumping House | <input checked="" type="checkbox"/> J.C. Garner B.Eng (Hons) FGS Technical Director & Quality Manager <input type="checkbox"/> W. Johnstone Materials Lab Manager  | | |
| Date Received: 25/03/2022 | Samples Tested Between: 25/03/2022 and 26/04/2022 | | |
| Remarks: | For the attention of Matt Green Your Reference No: 332510682 | | |
| Notes: | <ol style="list-style-type: none">1 All remaining samples or remnants from this contract will be disposed of after 21 days from today, unless we are notified to the contrary.2 Opinions and interpretations expressed herein are outside the scope of UKAS accreditation.3 Tests marked "NOT UKAS ACCREDITED" in this test report are not included in the UKAS Accreditation Schedule for this testing laboratory.4 This test report may not be reproduced other than in full except with the prior written approval of the issuing laboratory.5 The results within this report only relate to the items tested or sampled. | | |



TEST REPORT

ISSUED BY SOIL PROPERTY TESTING LTD
DATE ISSUED: 26/04/2022



0998

| Contract | | Trinity Pumping House | | | | | | | | | | | | |
|-------------------------|------|-----------------------|-----------|--|----------|----------|----------|--------------------|----------|------------|---|---|---|----------------|
| Serial No. | | 40462_1 | | | | | | Target Date | | 25/04/2022 | | | | |
| Scheduled By | | Stantec UK Limited | | | | | | | | | | | | |
| | | | | | | | | | | | | | | |
| Schedule Remarks | | | | | | | | | | | | | | |
| Bore Hole No. | Type | Sample Ref. | Top Depth | <div style="display: flex; justify-content: space-between;"> Water Content (BS51) Liquid/Plastic Limits Wet Sieve Preparation Particle Size Distribution (BS1377) Triaxial Test Sulphate Content/pH Value </div> | | | | | | | | | | Sample Remarks |
| | | | | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | |
| CP101 | D | 4 | 2.20 | 1 | 1 | 1 | | | | | | | | |
| CP101 | UT | 2 | 4.50 | 1 | 1 | 1 | 1 | | | | | | | |
| CP101 | D | 8 | 6.00 | 1 | 1 | 1 | | | | | | | | |
| CP101 | B | 3 | 7.50 | | | | 1 | | | | | | | |
| CP101 | B | 5 | 10.00 | | | | 1 | | | | | | | |
| HDP101 | D | 1 | 1.00 | 1 | 1 | | | | | | | | | |
| HDP102 | D | 1 | 1.10 | 1 | 1 | | | | | | | | | |
| WS101 | D | 2 | 1.50 | | | | | | | | 1 | | | |
| WS101 | D | 5 | 4.50 | 1 | 1 | | | | | | 1 | | | |
| WS101 | B | - | 6.20 | | | | | | | | 1 | | | |
| Totals | | | | 6 | 6 | 1 | 4 | 1 | 3 | | | | | |
| End of Schedule | | | | | | | | | | | | | | |



TEST REPORT

ISSUED BY SOIL PROPERTY TESTING LTD
DATE ISSUED: 26/04/2022



0998

| Contract | | Trinity Pumping House | | | | | | | | | | | | |
|--|-------------|------------------------------|------|-------------------|------------------|-------------------|----------------------|-----------------|--------------------|-------------------|---------------------|-------------------|---|-------|
| Serial No. | | 40462_1 | | | | | | | | | | | | |
| SUMMARY OF WATER CONTENT, LIQUID LIMIT, PLASTIC LIMIT, PLASTICITY INDEX AND LIQUIDITY INDEX | | | | | | | | | | | | | | |
| Borehole /Pit No. | Depth (m) | Type | Ref. | Water Content (%) | Liquid Limit (%) | Plastic Limit (%) | Plasticity Index (%) | Liquidity Index | Sample Preparation | | | | Description | Class |
| | | | | | | | | | Method | Ret'd 0.425mm (%) | Corr'd W/C <0.425mm | Curing Time (hrs) | | |
| CP101 | 2.20 | D | 4 | 38.8 | 64 | 30 | 34 | 0.26 | From Natural | 0 (A) | | 24 | Soft brown silty CLAY with rare orange staining, shell debris and selenite crystals | CH |
| CP101 | 4.50 - 4.95 | UT | 2 | 42.6 | 57 | 25 | 32 | 0.55 | From Natural | 0 (A) | | 27 | Soft very dark grey organic silty CLAY | CH |
| CP101 | 6.00 - 6.45 | D | 8 | 34.7 | 29 | 19 | 10 | 1.57 | Wet Sieved | 22 (M) | N/R* | 29 | Very soft olive and very dark grey slightly gravelly slightly sandy silty organic CLAY. Gravel is fine and medium chert and quartzite | CLO |
| HDP101 | 1.00 | D | 1 | 37.2 | 74 | 29 | 45 | 0.18 | From Natural | 0 (A) | | 26 | Firm closely fissured yellowish brown CLAY with rare shell debris and recently active roots | CV |
| HDP102 | 1.10 | D | 1 | 37.3 | 69 | 30 | 39 | 0.19 | From Natural | 0 (A) | | 26 | Firm yellowish brown CLAY with rare shell debris | CH |
| WS101 | 4.50 | D | 5 | 81.0 | 107 | 40 | 67 | 0.61 | From Natural | 0 (A) | | 26 | Very soft brownish grey organic CLAY with occasional decayed roots and plant material | CEO |
| Method Of Preparation: BS EN ISO: 17892-1: 2014 & BS 1377: Part 2:1990:4.2 Method of Test: BS EN ISO: 17892-1: 2014 & BS 1377: Part 2:1990:3.2, 4.4, 5.3, 5.4 Type of Sample Key: U = Undisturbed, B = Bulk, D = Disturbed, J = Jar, W = Water, SPT = Split Spoon Sample, C = Core Cutter Comments: *Corrected water content assume material greater than 0.425mm is non-porous. See BS1377: Part 2: 1990 Clause 3 Note 1. Where N/R, corrected water content is not reported due to material type. Table Notation: Ret'd 0.425mm: (A) = Assumed, (M) = Measured | | | | | | | | | | | | | | |



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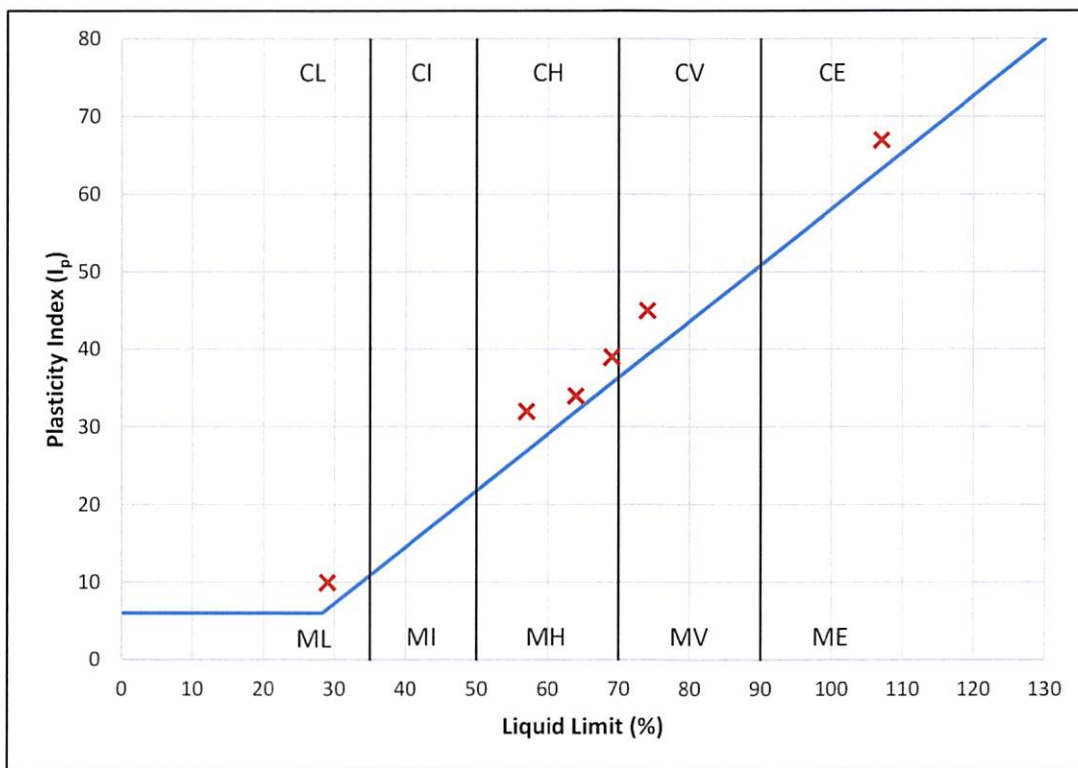


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|-------------------|-----------------------|
| Contract | Trinity Pumping House |
| Serial No. | 40462_1 |

PLOT OF PLASTICITY INDEX AGAINST LIQUID LIMIT USING CASAGRANDE CLASSIFICATION CHART

| Plasticity | | | | |
|------------|--------|------|-----------|----------------|
| Low | Medium | High | Very High | Extremely High |



Plasticity Chart BS5930: 2015: Figure 8

| | |
|--------|------------------------------|
| High | NHBC Volume Change Potential |
| Medium | |
| Low | |

| | |
|------------------------|---|
| Method of Preparation: | BS 1377: Part 2: 1990: 4.2 |
| Method of Test: | BS1377: Part 2: 3.2, 4.4, 5.3, 5.4 |
| Type of Sample Key: | U = Undisturbed, B = Bulk, D = Disturbed, J = Jar, W = Water, SPT = Split Spoon Sample, C = Core Cutter |
| Comments: | Volume Change Potential: NHBC Standards Chapter 4.2 Unmodified Plasticity Index |



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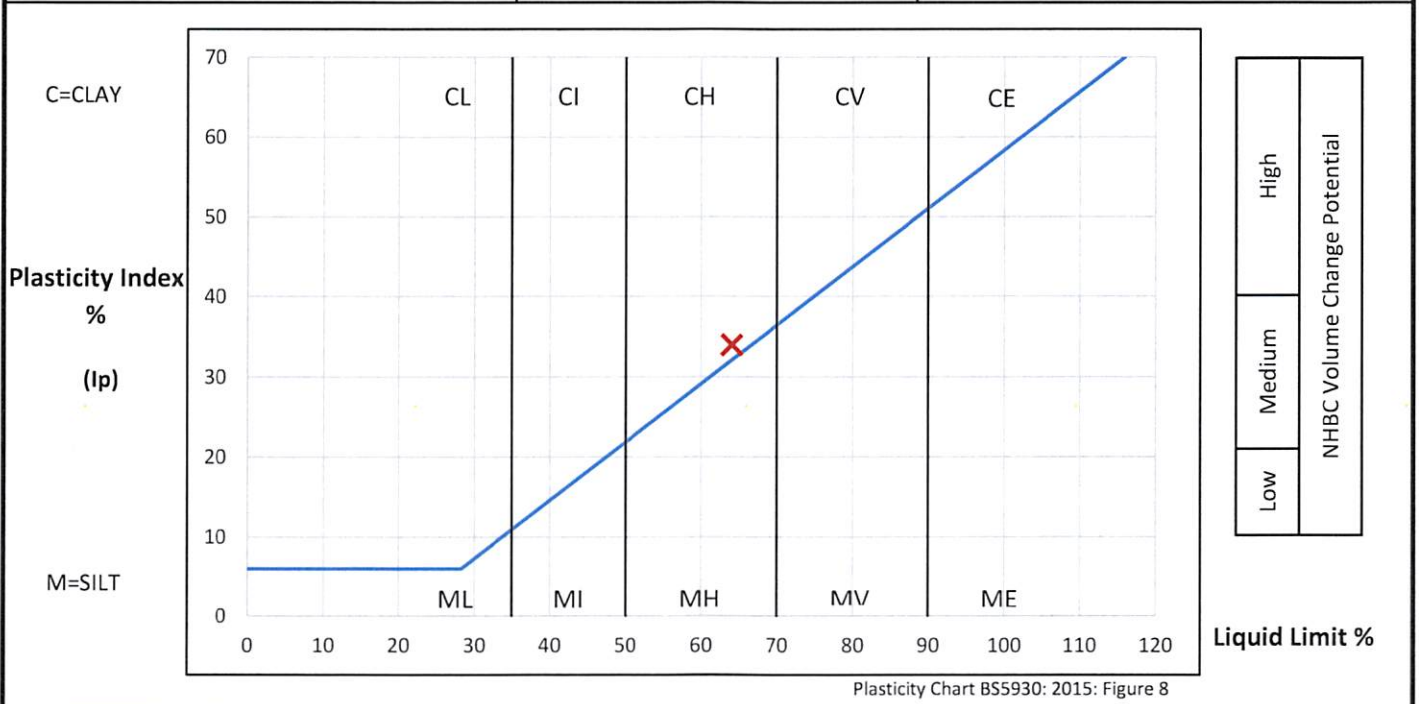
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|-------------------|------------------------------|
| Contract | Trinity Pumping House |
| Serial No. | 40462_1 |

DETERMINATION OF WATER CONTENT, LIQUID LIMIT AND PLASTIC LIMIT AND DERIVATION OF PLASTICITY INDEX AND LIQUIDITY INDEX

| Borehole / Pit No. | Depth m | Sample | | Water Content (W) % | Description | Remarks |
|--------------------|------------|--------|-----------|------------------------|---|---------|
| | | Type | Reference | | | |
| CP101 | 2.20 | D | 4 | 38.8 | Soft brown silty CLAY with rare orange staining, shell debris and selenite crystals | |

| | | | | | |
|--|-----------|--------------|---------------------|------------------|------|
| PREPARATION | | | Liquid Limit | 64 % | |
| Method of preparation | | From natural | Plastic Limit | 30 % | |
| Sample retained 0.425mm sieve | (Assumed) | 0 % | Plasticity Index | 34 % | |
| Corrected water content for material passing 0.425mm | | | Liquidity Index | 0.26 | |
| Sample retained 2mm sieve | (Assumed) | 0 % | NHBC Modified (I'p) | n/a | |
| Curing time | 24 hrs | Clay Content | 33 % | Derived Activity | 1.03 |



Method of Preparation: BS EN ISO: 17892-1: 2014 & BS 1377: Part 2: 1990: 4.2
 Method of Test: BS EN ISO: 17892-1: 2014 & BS 1377: Part 2: 1990: 3.2, 4.4, 5.3, 5.4
 Type of Sample Key: U=Undisturbed, B=Bulk, D=Disturbed, J=Jar, W=Water, SPT=Split Spoon Sample, C=Core Cutter
 Comments:



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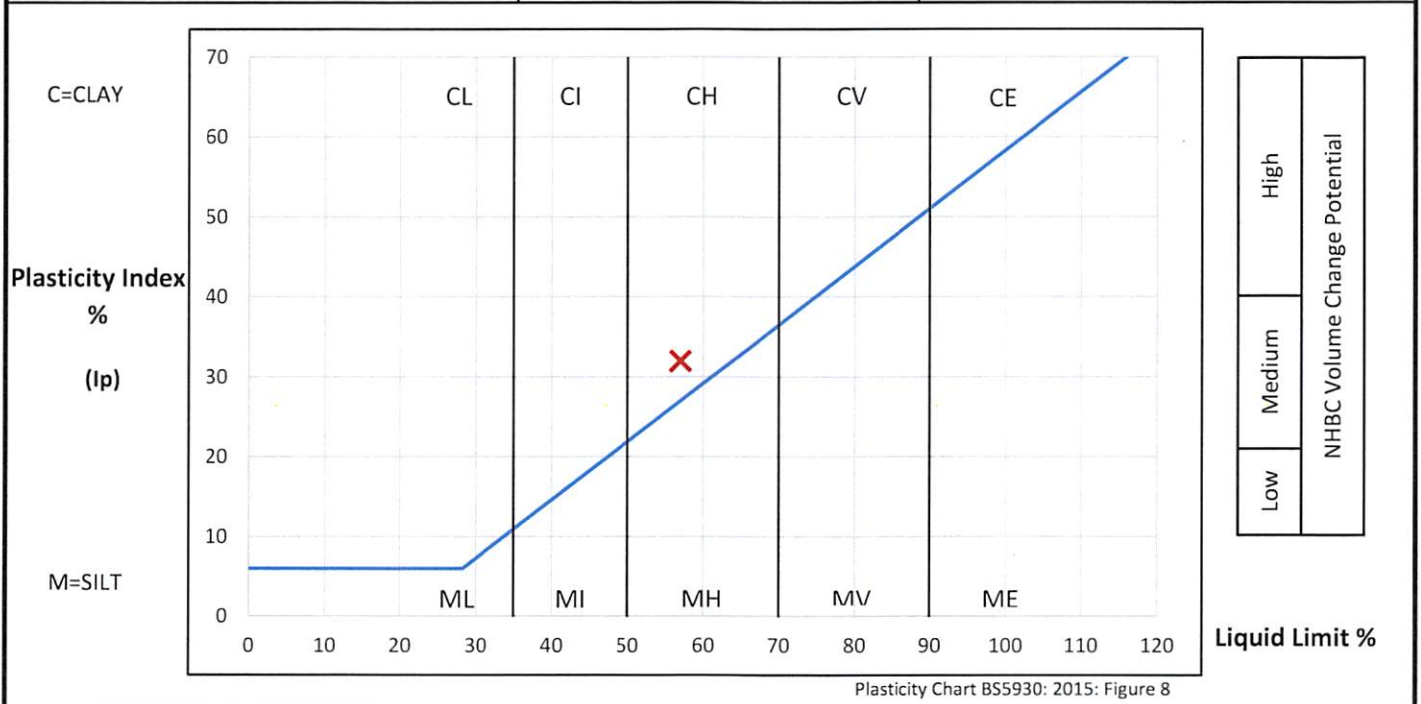
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|-------------------|------------------------------|
| Contract | Trinity Pumping House |
| Serial No. | 40462_1 |

DETERMINATION OF WATER CONTENT, LIQUID LIMIT AND PLASTIC LIMIT AND DERIVATION OF PLASTICITY INDEX AND LIQUIDITY INDEX

| Borehole / Pit No. | Depth m | Sample | | Water Content (W) % | Description | Remarks |
|--------------------|-------------|--------|-----------|---------------------|--|---------|
| | | Type | Reference | | | |
| CP101 | 4.50 - 4.95 | UT | 2 | 42.6 | Soft very dark grey organic silty CLAY | |

| | | | | | |
|--|---------------|---------------------|---------------------------------|------------------|-------------|
| PREPARATION | | | Liquid Limit | 57 % | |
| Method of preparation | | From natural | Plastic Limit | 25 % | |
| Sample retained 0.425mm sieve | (Assumed) | 0 % | Plasticity Index | 32 % | |
| Corrected water content for material passing 0.425mm | | | Liquidity Index | 0.55 | |
| Sample retained 2mm sieve | (Assumed) | 0 % | NHBC Modified (I _p) | n/a | |
| Curing time | 27 hrs | Clay Content | 29 % | Derived Activity | 1.10 |



Method of Preparation: BS EN ISO: 17892-1: 2014 & BS 1377: Part 2: 1990: 4.2
 Method of Test: BS EN ISO: 17892-1: 2014 & BS 1377: Part 2: 1990: 3.2, 4.4, 5.3, 5.4
 Type of Sample Key: U=Undisturbed, B=Bulk, D=Disturbed, J=Jar, W=Water, SPT=Split Spoon Sample, C=Core Cutter
 Comments:



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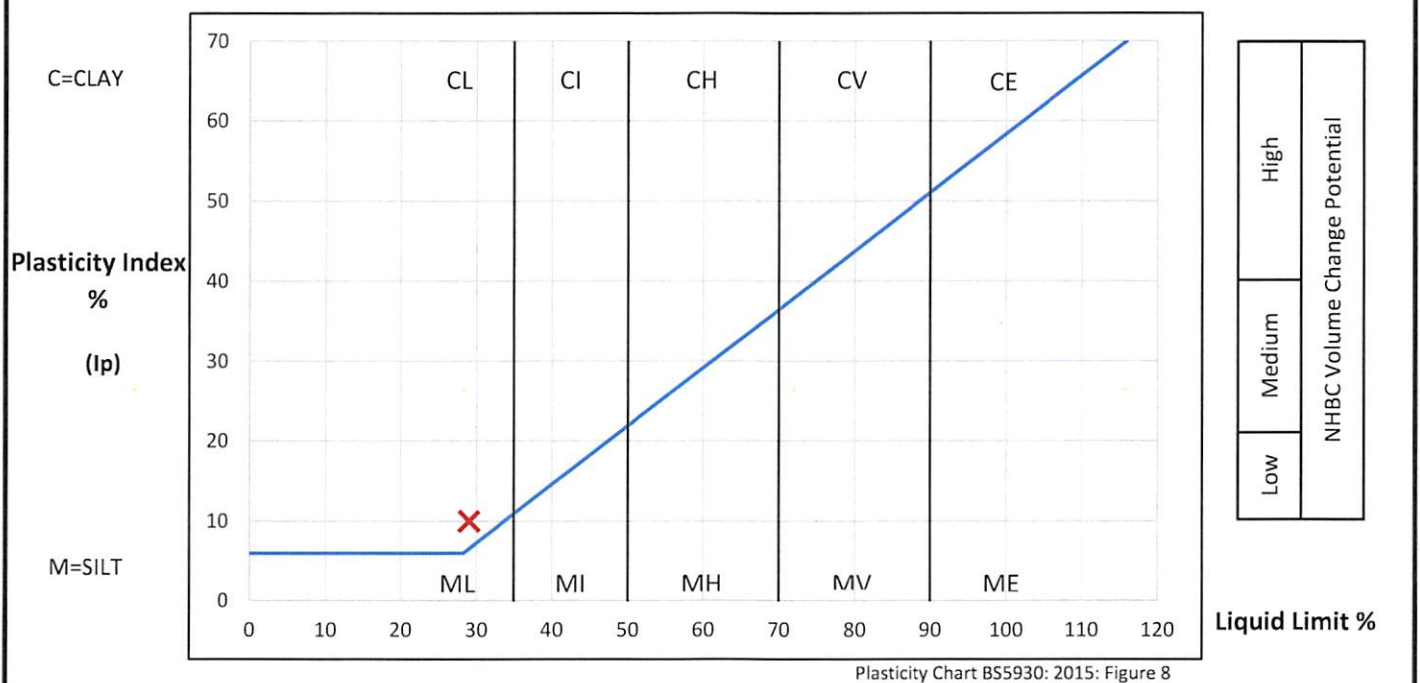
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|-------------------|------------------------------|
| Contract | Trinity Pumping House |
| Serial No. | 40462_1 |

DETERMINATION OF WATER CONTENT, LIQUID LIMIT AND PLASTIC LIMIT AND DERIVATION OF PLASTICITY INDEX AND LIQUIDITY INDEX

| Borehole / Pit No. | Depth m | Sample | | Water Content (W) % | Description | Remarks |
|--------------------|-------------|--------|-----------|---------------------|---|---------|
| | | Type | Reference | | | |
| CP101 | 6.00 - 6.45 | D | 8 | 34.7 | Very soft olive and very dark grey slightly gravelly slightly sandy silty organic CLAY. Gravel is fine and medium chert and quartzite | |

| | | | | | |
|--|-------------------------------|--------------|---------------------|------------------|--------------|
| PREPARATION | | | Liquid Limit | 29 % | |
| Method of preparation | Wet sieved over 0.425mm sieve | | Plastic Limit | 19 % | |
| Sample retained 0.425mm sieve | (Measured) | 22 % | Plasticity Index | 10 % | |
| Corrected water content for material passing 0.425mm | Not reported | | Liquidity Index | 1.57 | |
| Sample retained 2mm sieve | (Measured) | 15 % | NHBC Modified (I'p) | 8 % | |
| Curing time | 29 hrs | Clay Content | Not analysed | Derived Activity | Not analysed |



Method of Preparation: BS EN ISO: 17892-1: 2014 & BS 1377: Part 2: 1990: 4.2
 Method of Test: BS EN ISO: 17892-1: 2014 & BS 1377: Part 2: 1990: 3.2, 4.4, 5.3, 5.4
 Type of Sample Key: U=Undisturbed, B=Bulk, D=Disturbed, J=Jar, W=Water, SPT=Split Spoon Sample, C=Core Cutter
 Comments: Corrected water content not reported due to material type.
 Corrected water content assume material greater than 0.425mm non-porous. See BS1377: Part2: 1990 Clause 3 Note 1
 Volume Change Potential: NHBC Standards Chapter 4.2 Unmodified Plasticity Index
 Note: Modified Plasticity Index I'p = Ip x (% less than 425microns/100)



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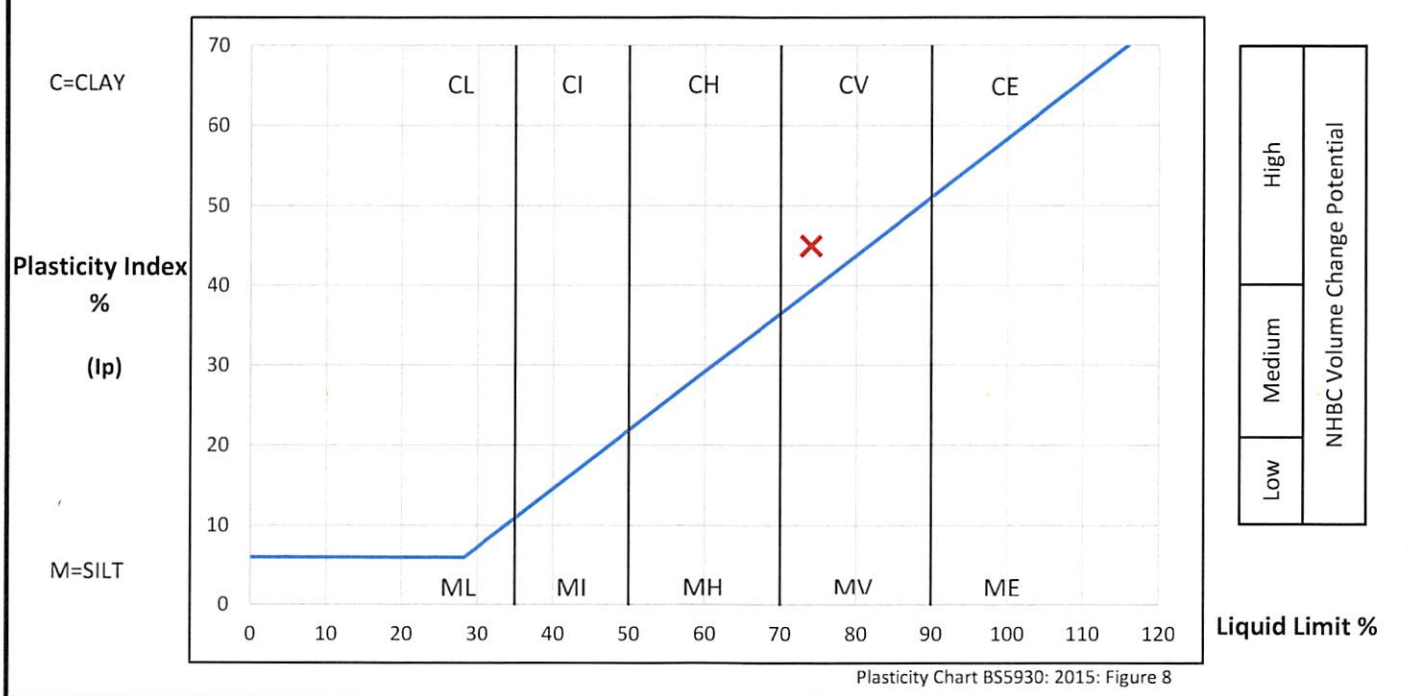
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|-------------------|------------------------------|
| Contract | Trinity Pumping House |
| Serial No. | 40462_1 |

**DETERMINATION OF WATER CONTENT, LIQUID LIMIT AND PLASTIC LIMIT AND
DERIVATION OF PLASTICITY INDEX AND LIQUIDITY INDEX**

| Borehole / Pit No. | Depth m | Sample | | Water Content (W) % | Description | Remarks |
|--------------------|------------|--------|-----------|---------------------------|---|---------|
| | | Type | Reference | | | |
| HDP101 | 1.00 | D | 1 | 37.2 | Firm closely fissured yellowish brown CLAY with rare shell debris and recently active roots | |

| | | | | | | |
|--|--|--------|--------------|--------------|---------------------|--------------|
| PREPARATION | | | | Liquid Limit | 74 % | |
| Method of preparation | | | | From natural | Plastic Limit | 29 % |
| Sample retained 0.425mm sieve (Assumed) | | | | 0 % | Plasticity Index | 45 % |
| Corrected water content for material passing 0.425mm | | | | | Liquidity Index | 0.18 |
| Sample retained 2mm sieve (Assumed) | | | | 0 % | NHBC Modified (I'p) | n/a |
| Curing time | | 26 hrs | Clay Content | Not analysed | Derived Activity | Not analysed |



Method of Preparation: BS EN ISO: 17892-1: 2014 & BS 1377: Part 2: 1990: 4.2
 Method of Test: BS EN ISO: 17892-1: 2014 & BS 1377: Part 2: 1990: 3.2, 4.4, 5.3, 5.4
 Type of Sample Key: U=Undisturbed, B=Bulk, D=Disturbed, J=Jar, W=Water, SPT=Split Spoon Sample, C=Core Cutter
 Comments:



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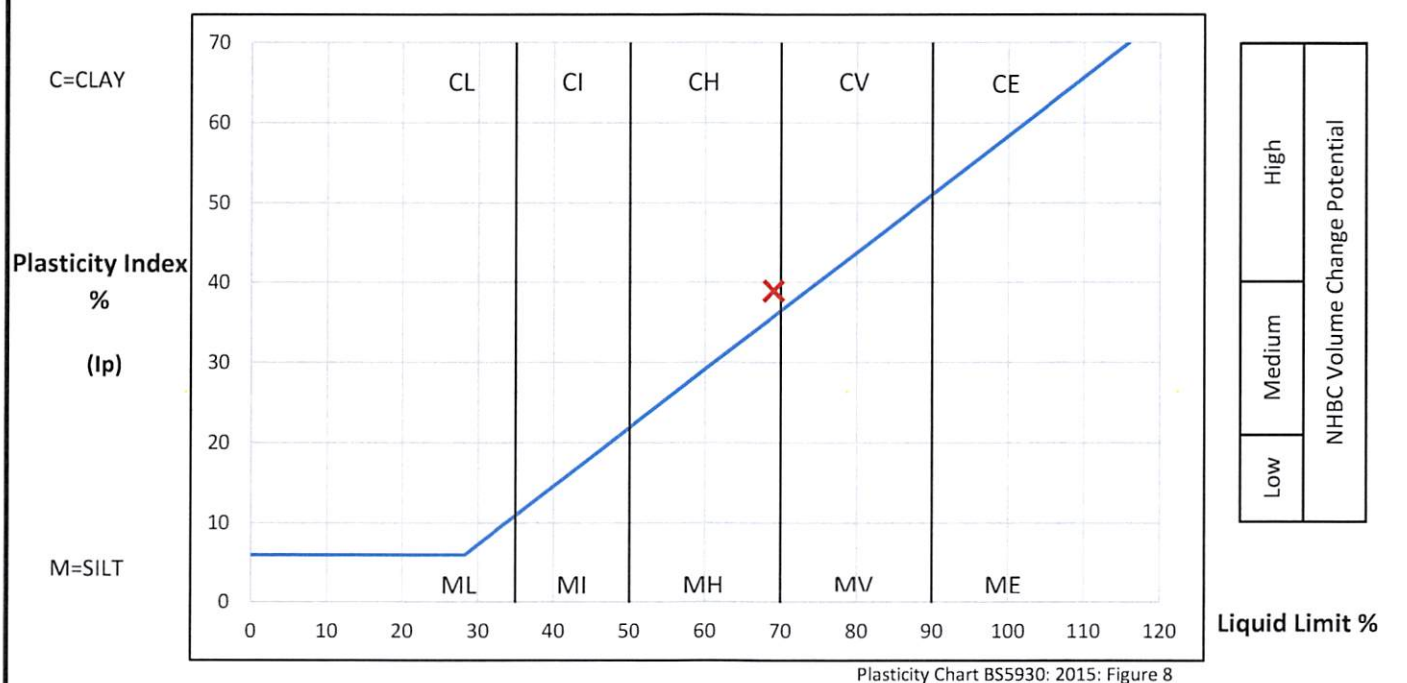
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|-------------------|------------------------------|
| Contract | Trinity Pumping House |
| Serial No. | 40462_1 |

DETERMINATION OF WATER CONTENT, LIQUID LIMIT AND PLASTIC LIMIT AND DERIVATION OF PLASTICITY INDEX AND LIQUIDITY INDEX

| Borehole / Pit No. | Depth m | Sample | | Water Content (W) % | Description | Remarks |
|--------------------|---------|--------|-----------|---------------------|--|---------|
| | | Type | Reference | | | |
| HDP102 | 1.10 | D | 1 | 37.3 | Firm yellowish brown CLAY with rare shell debris | |

| | | | | | |
|--|--------|--------------|--------------|---------------------|--------------|
| PREPARATION | | | Liquid Limit | 69 % | |
| Method of preparation | | | From natural | Plastic Limit | 30 % |
| Sample retained 0.425mm sieve (Assumed) | | | 0 % | Plasticity Index | 39 % |
| Corrected water content for material passing 0.425mm | | | | Liquidity Index | 0.19 |
| Sample retained 2mm sieve (Assumed) | | | 0 % | NHBC Modified (I'p) | n/a |
| Curing time | 26 hrs | Clay Content | Not analysed | Derived Activity | Not analysed |



Method of Preparation: BS EN ISO: 17892-1: 2014 & BS 1377: Part 2: 1990: 4.2
 Method of Test: BS EN ISO: 17892-1: 2014 & BS 1377: Part 2: 1990: 3.2, 4.4, 5.3, 5.4
 Type of Sample Key: U=Undisturbed, B=Bulk, D=Disturbed, J=Jar, W=Water, SPT=Split Spoon Sample, C=Core Cutter
 Comments:



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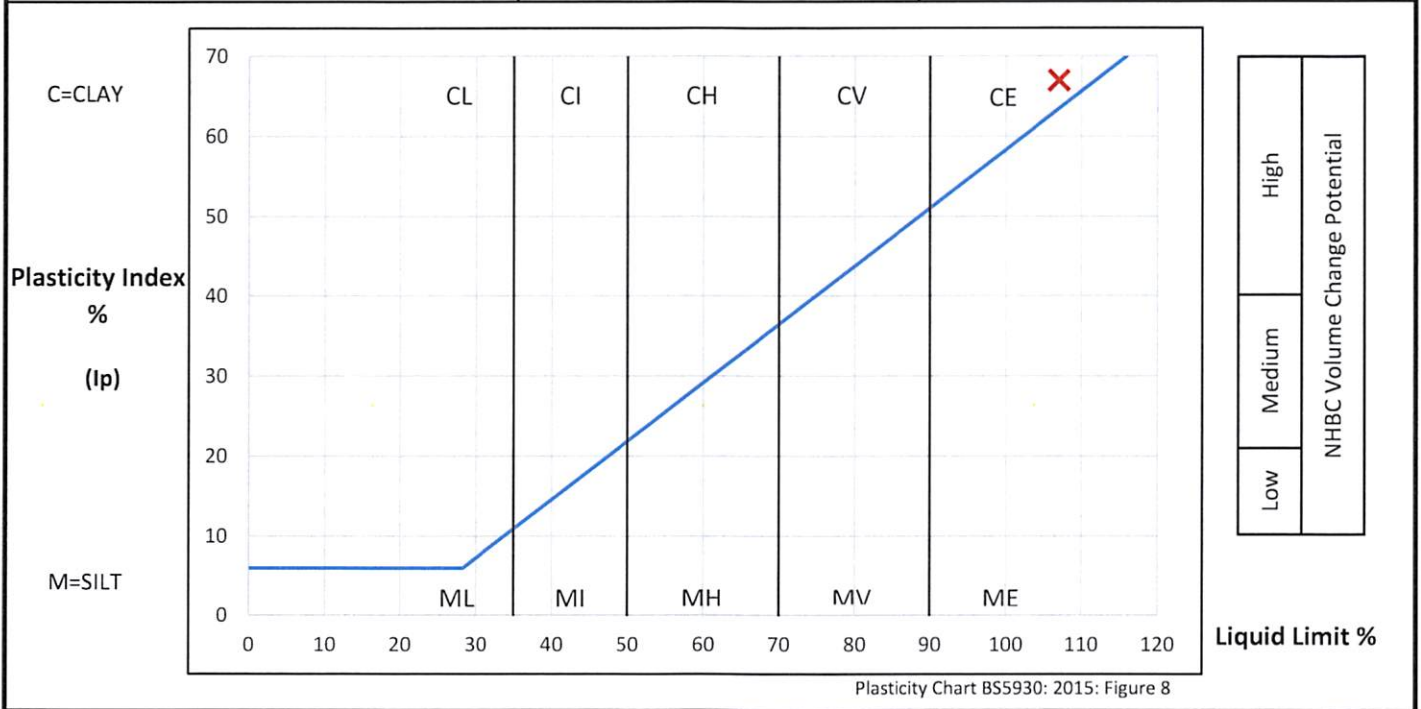
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|-------------------|------------------------------|
| Contract | Trinity Pumping House |
| Serial No. | 40462_1 |

**DETERMINATION OF WATER CONTENT, LIQUID LIMIT AND PLASTIC LIMIT AND
DERIVATION OF PLASTICITY INDEX AND LIQUIDITY INDEX**

| Borehole / Pit No. | Depth m | Sample | | Water Content (W) % | Description | Remarks |
|--------------------|---------|--------|-----------|---------------------|---|---------|
| | | Type | Reference | | | |
| WS101 | 4.50 | D | 5 | 81.0 | Very soft brownish grey organic CLAY with occasional decayed roots and plant material | |

| | | | | | |
|--|--------|--------------|---------------------|------------------|--------------|
| PREPARATION | | | Liquid Limit | 107 % | |
| Method of preparation | | From natural | Plastic Limit | 40 % | |
| Sample retained 0.425mm sieve | | (Assumed) | Plasticity Index | 67 % | |
| Corrected water content for material passing 0.425mm | | | Liquidity Index | 0.61 | |
| Sample retained 2mm sieve | | (Assumed) | NHBC Modified (I'p) | n/a | |
| Curing time | 26 hrs | Clay Content | Not analysed | Derived Activity | Not analysed |



Method of Preparation: BS EN ISO: 17892-1: 2014 & BS 1377: Part 2: 1990: 4.2
 Method of Test: BS EN ISO: 17892-1: 2014 & BS 1377: Part 2: 1990: 3.2, 4.4, 5.3, 5.4
 Type of Sample Key: U=Undisturbed, B=Bulk, D=Disturbed, J=Jar, W=Water, SPT=Split Spoon Sample, C=Core Cutter
 Comments:



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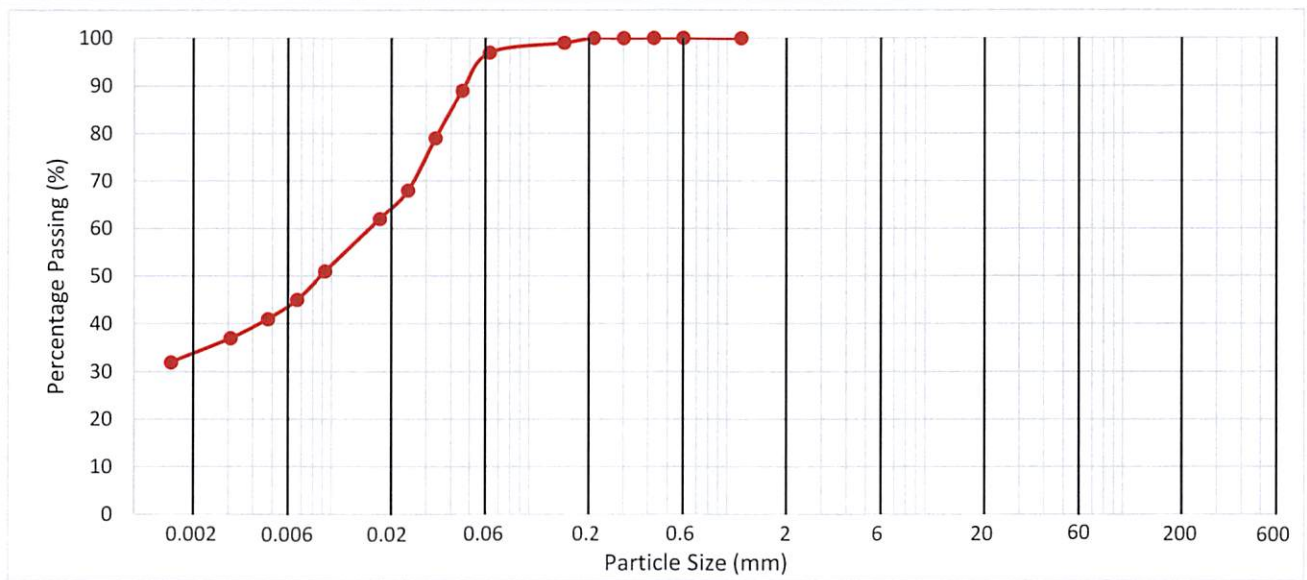
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| | |
|-------------------|------------------------------|
| Contract | Trinity Pumping House |
| Serial No. | 40462_1 |

DETERMINATION OF PARTICLE SIZE DISTRIBUTION

| Borehole / Pit No. | Depth (m) | Sample | | Description | Remarks |
|--------------------|-----------|--------|-----------|---|---------|
| | | Type | Reference | | |
| CP101 | 2.20 | D | 4 | Soft brown silty CLAY with rare orange staining, shell debris and selenite crystals | |

| | | |
|---|-------------------------|---------------------|
| Method of Test: Hydrometer + Pre-sieve | Method of Pretreatment: | Not required |
|---|-------------------------|---------------------|



| | | | | | | | | | | | |
|------|------|--------|--------|------|--------|--------|--------|--------|--------|---------|----------|
| CLAY | Fine | Medium | Coarse | Fine | Medium | Coarse | Fine | Medium | Coarse | COBBLES | BOULDERS |
| | SILT | | | SAND | | | GRAVEL | | | | |

| Hydrometer | Particle Size (mm) | Passing (%) | Silt by Dry Mass (%) |
|------------|--------------------|-------------|-----------------------------|
| | 0.0458 | 89 | 64 |
| | 0.0334 | 79 | |
| | 0.0243 | 68 | |
| | 0.0175 | 62 | Clay by Dry Mass (%) |
| | 0.0093 | 51 | |
| | 0.0067 | 45 | |
| | 0.0048 | 41 | |
| | 0.0031 | 37 | |
| 0.0015 | 32 | 33 | |

| Sieve Size (mm) | Passing (%) | Sand By Dry Mass (%) |
|-----------------|-------------|----------------------|
| 2.00 | | 3 |
| 1.18 | 100 | |
| 0.600 | 100 | |
| 0.425 | 100 | |
| 0.300 | 100 | |
| 0.212 | 100 | |
| 0.150 | 99 | |
| 0.063 | 97 | |

| Sieve Size (mm) | Passing (%) | 2mm+ By Dry Mass (%) |
|-----------------|-------------|----------------------|
| 300 | | 0 |
| 125 | | |
| 90 | | |
| 63 | | |
| 50 | | |
| 37.5 | | |
| 28 | | |
| 20 | | |
| 14 | | |
| 10 | | |
| 6.3 | | |
| 5 | | |

| Fines By Dry Mass (%) | |
|-----------------------|-----------|
| <0.063mm | 97 |

Method of Preparation: BS1377: Part 1: 2016: 8.3 & 8.4.5
 Method of test: BS1377: Part 2: 1990: 9.2,9.5
 Type of Sample Key: U=Undisturbed, B=Bulk, D=Disturbed, J=Jar, W=Water, SPT=Split Spoon Sample, C=Core Cutter
 Comments:



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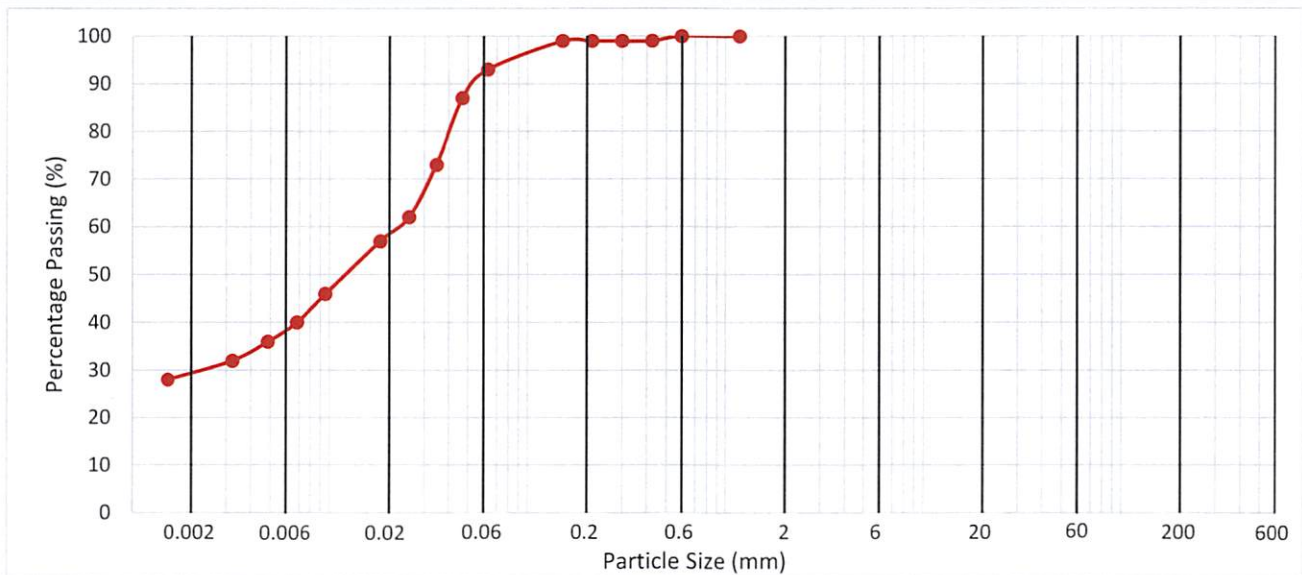
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|-------------------|------------------------------|
| Contract | Trinity Pumping House |
| Serial No. | 40462_1 |

DETERMINATION OF PARTICLE SIZE DISTRIBUTION

| Borehole / Pit No. | Depth (m) | Sample | | Description | Remarks |
|--------------------|-------------|--------|-----------|--|---------|
| | | Type | Reference | | |
| CP101 | 4.50 - 4.95 | UT | 2 | Soft very dark grey organic silty CLAY | |

Method of Test: **Hydrometer + Pre-sieve** Method of Pretreatment: **Tested from natural - pretreatment for organics not carried out**



| | | | | | | | | | | | |
|------|------|--------|--------|------|--------|--------|--------|--------|--------|---------|----------|
| CLAY | Fine | Medium | Coarse | Fine | Medium | Coarse | Fine | Medium | Coarse | COBBLES | BOULDERS |
| | SILT | | | SAND | | | GRAVEL | | | | |

| Hydrometer | Particle Size (mm) | Passing (%) | Silt by Dry Mass (%) |
|------------|--------------------|-------------|----------------------|
| | 0.0469 | 87 | 64 |
| | 0.0345 | 73 | |
| | 0.0251 | 62 | |
| | 0.0180 | 57 | Clay by Dry Mass (%) |
| | 0.0095 | 46 | |
| | 0.0068 | 40 | |
| | 0.0049 | 36 | |
| | 0.0032 | 32 | 29 |
| | 0.0015 | 28 | |

| Sieve Size (mm) | Passing (%) | Sand By Dry Mass (%) |
|-----------------|-------------|----------------------|
| 2.00 | | 7 |
| 1.18 | 100 | |
| 0.600 | 100 | |
| 0.425 | 99 | |
| 0.300 | 99 | |
| 0.212 | 99 | |
| 0.150 | 99 | |
| 0.063 | 93 | |

| Sieve Size (mm) | Passing (%) | 2mm+ By Dry Mass (%) |
|-----------------|-------------|----------------------|
| 300 | | 0 |
| 125 | | |
| 90 | | |
| 63 | | |
| 50 | | |
| 37.5 | | |
| 28 | | |
| 20 | | |
| 14 | | |
| 10 | | |
| 6.3 | | |
| 5 | | |

| Fines By Dry Mass (%) | |
|-----------------------|-----------|
| <0.063mm | 93 |

Method of Preparation: BS1377: Part 1: 2016: 8.3 & 8.4.5
 Method of test: BS1377: Part 2: 1990: 9.2,9.5
 Type of Sample Key: U=Undisturbed, B=Bulk, D=Disturbed, J=Jar, W=Water, SPT=Split Spoon Sample, C=Core Cutter
 Comments:



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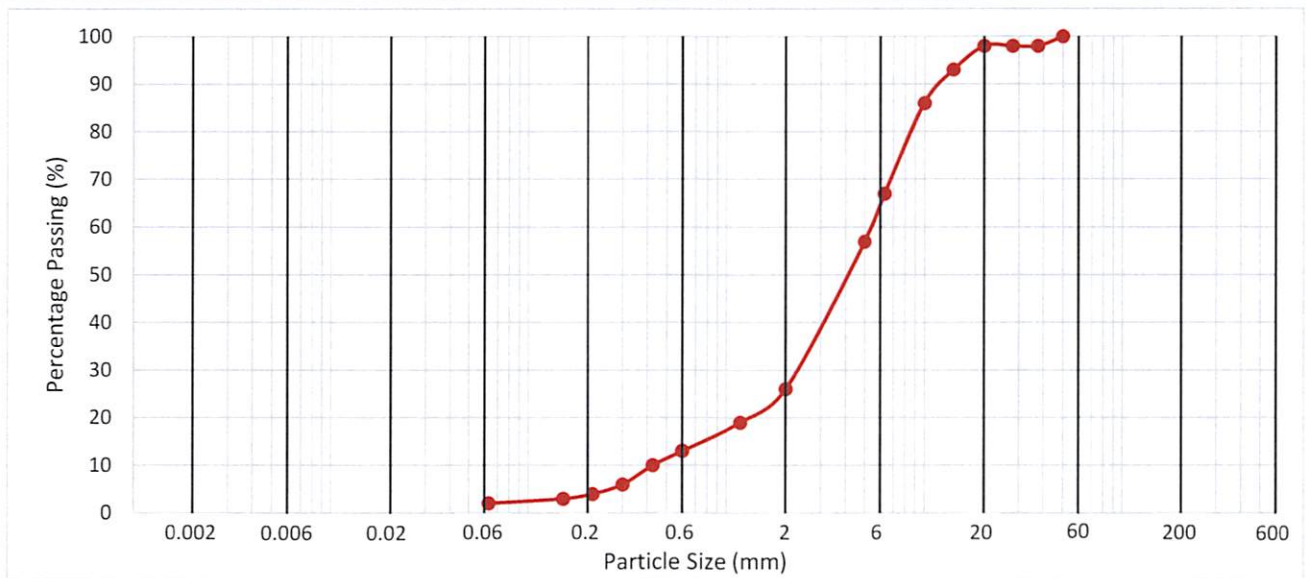
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|-------------------|------------------------------|
| Contract | Trinity Pumping House |
| Serial No. | 40462_1 |

DETERMINATION OF PARTICLE SIZE DISTRIBUTION

| Borehole / Pit No. | Depth (m) | Sample | | Description | Remarks |
|--------------------|-------------|--------|-----------|---|---------|
| | | Type | Reference | | |
| CP101 | 7.50 - 7.95 | B | 3 | Black, brown and white angular to subrounded chert and rare yellowish brown quartzite slightly silty very sandy GRAVEL. Sand is dark olive grey | |

| | |
|----------------------------------|---|
| Method of Test: Wet Sieve | Method of Pretreatment: Not required |
|----------------------------------|---|



| | | | | | | | | | | | |
|------|------|--------|--------|------|--------|--------|--------|--------|--------|---------|----------|
| CLAY | Fine | Medium | Coarse | Fine | Medium | Coarse | Fine | Medium | Coarse | COBBLES | BOULDERS |
| | SILT | | | SAND | | | GRAVEL | | | | |

| Hydrometer | Particle Size (mm) | Passing (%) | Silt by Dry Mass (%) |
|------------|--------------------|-------------|----------------------|
| | | | |
| | | | Clay by Dry Mass (%) |
| | | | |

| Sieve Size (mm) | Passing (%) | Sand By Dry Mass (%) |
|-----------------|-------------|----------------------|
| 2.00 | 26 | 24 |
| 1.18 | 19 | |
| 0.600 | 13 | |
| 0.425 | 10 | |
| 0.300 | 6 | |
| 0.212 | 4 | |
| 0.150 | 3 | |
| 0.063 | 2 | |

| Sieve Size (mm) | Passing (%) | 2mm+ By Dry Mass (%) |
|-----------------|-------------|----------------------|
| 300 | | 74 |
| 125 | | |
| 90 | | |
| 63 | | |
| 50 | 100 | |
| 37.5 | 98 | |
| 28 | 98 | |
| 20 | 98 | |
| 14 | 93 | |
| 10 | 86 | |
| 6.3 | 67 | |
| 5 | 57 | |

| Fines By Dry Mass (%) | |
|-----------------------|----------|
| <0.063mm | 2 |

Method of Preparation: BS1377: Part 1: 2016: 8.3 & 8.4.5
 Method of test: BS1377: Part 2: 1990: 9.2
 Type of Sample Key: U=Undisturbed, B=Bulk, D=Disturbed, J=Jar, W=Water, SPT=Split Spoon Sample, C=Core Cutter
 Comments:



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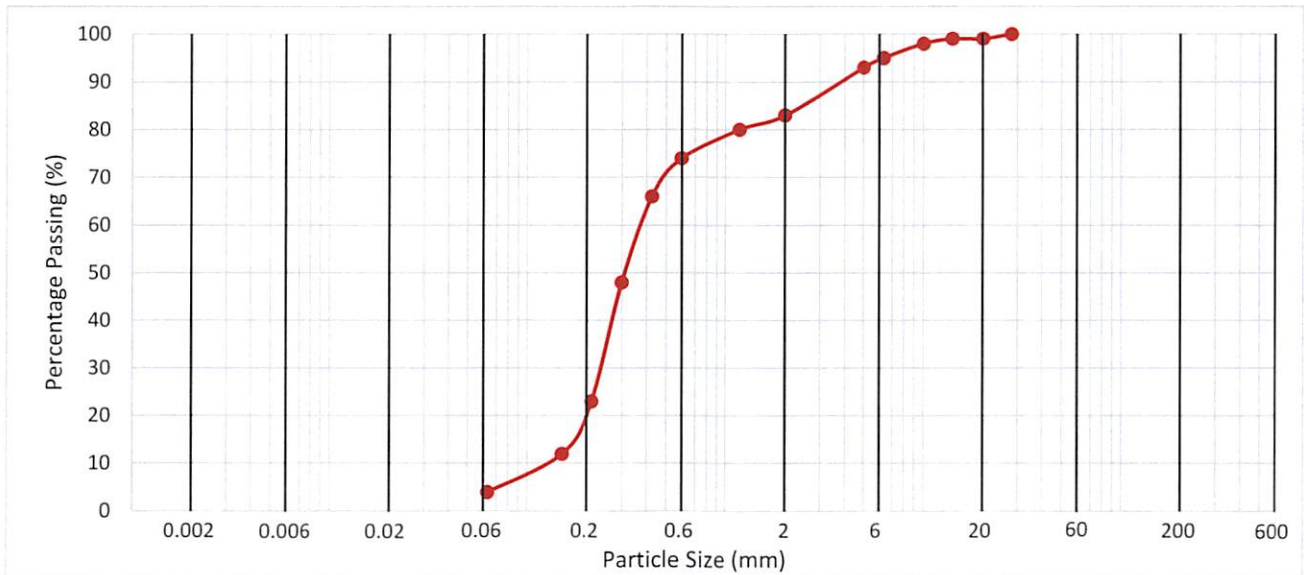
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|-------------------|------------------------------|
| Contract | Trinity Pumping House |
| Serial No. | 40462_1 |

DETERMINATION OF PARTICLE SIZE DISTRIBUTION

| Borehole / Pit No. | Depth (m) | Sample | | Description | Remarks |
|--------------------|---------------|--------|-----------|--|---------|
| | | Type | Reference | | |
| CP101 | 10.00 - 10.45 | B | 5 | Olive grey slightly silty gravelly SAND. Gravel is black, brown and white angular to subrounded chert and rare yellowish brown quartzite | |

| | |
|----------------------------------|---|
| Method of Test: Wet Sieve | Method of Pretreatment: Not required |
|----------------------------------|---|



| | | | | | | | | | | | |
|------|------|--------|--------|------|--------|--------|--------|--------|--------|---------|----------|
| CLAY | Fine | Medium | Coarse | Fine | Medium | Coarse | Fine | Medium | Coarse | COBBLES | BOULDERS |
| | SILT | | | SAND | | | GRAVEL | | | | |

| Hydrometer | Particle Size (mm) | Passing (%) | Silt by Dry Mass (%) |
|------------|--------------------|-------------|----------------------|
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | Clay by Dry Mass (%) |
| | | | |

| Sieve Size (mm) | Passing (%) | 79 |
|-----------------|-------------|-----------|
| 2.00 | 83 | |
| 1.18 | 80 | |
| 0.600 | 74 | |
| 0.425 | 66 | |
| 0.300 | 48 | |
| 0.212 | 23 | |
| 0.150 | 12 | |
| 0.063 | 4 | |

| Sieve Size (mm) | Passing (%) | 17 |
|-----------------|-------------|-----------|
| 300 | | |
| 125 | | |
| 90 | | |
| 63 | | |
| 50 | | |
| 37.5 | | |
| 28 | 100 | |
| 20 | 99 | |
| 14 | 99 | |
| 10 | 98 | |
| 6.3 | 95 | |
| 5 | 93 | |

| Fines By Dry Mass (%) | |
|-----------------------|----------|
| <0.063mm | 4 |

Method of Preparation: BS1377: Part 1: 2016: 8.3 & 8.4.5
 Method of test: BS1377: Part 2: 1990: 9.2
 Type of Sample Key: U=Undisturbed, B=Bulk, D=Disturbed, J=Jar, W=Water, SPT=Split Spoon Sample, C=Core Cutter
 Comments:



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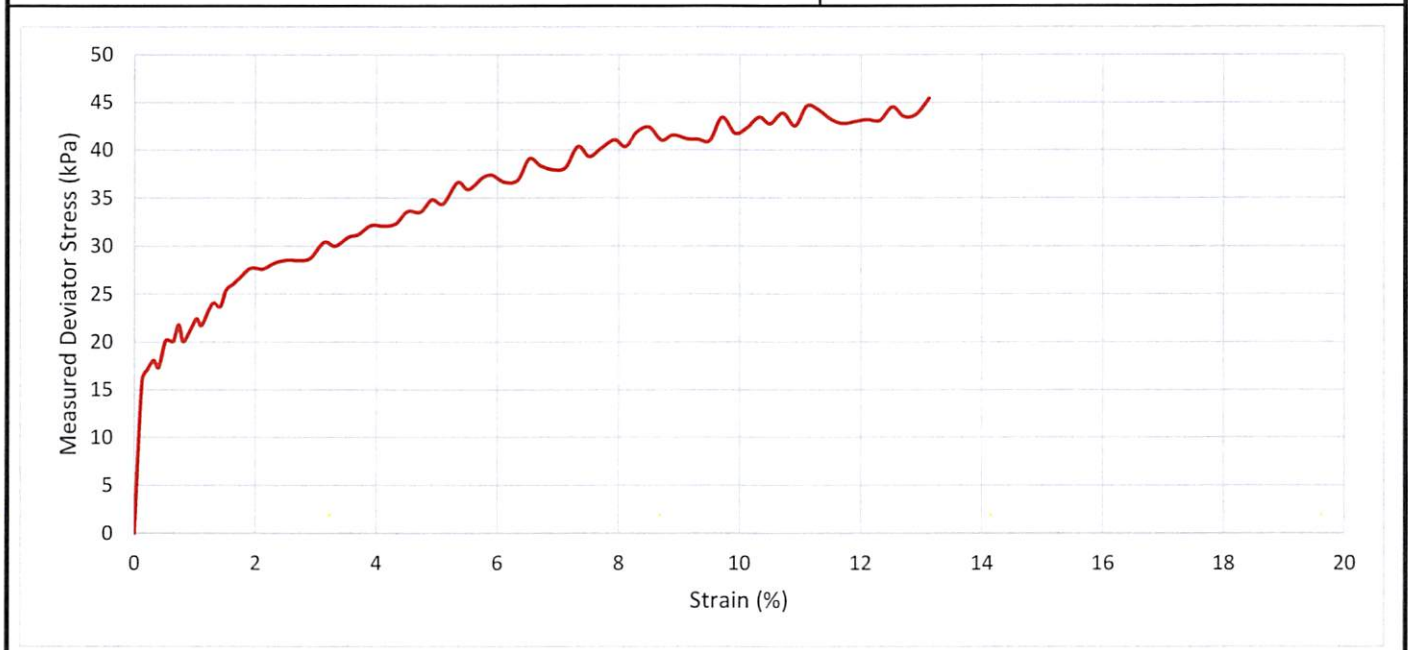
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|-------------------|------------------------------|
| Contract | Trinity Pumping House |
| Serial No. | 40462_1 |


DETERMINATION OF UNDRAINED SHEAR STRENGTH IN TRIAXIAL COMPRESSION WITHOUT MEASUREMENT OF PORE PRESSURE

| Borehole /Pit No. | Depth (m) | Type | Reference | Description | Remarks |
|-------------------|-------------|------|-----------|--|---------|
| CP101 | 4.50 - 4.95 | UT | 2 | Soft very dark grey organic silty CLAY | |

| Initial Specimen | Height (mm) | Diameter (mm) | Weight (g) | Water Content (%) | Bulk Density (Mg/m ³) | Dry Density (Mg/m ³) |
|--|-------------|---------------|------------|-------------------|-----------------------------------|----------------------------------|
|  Depth of Top of Specimen (m) 4.55 | 201.1 | 102.1 | 2979 | 42.6 | 1.81 | 1.27 |

| | | | | | | |
|------------------|----------------|------------|-----------|---------------------------|------------|----|
| TEST INFORMATION | Rate of Strain | 1.0 | % per Min | Rubber Membrane Thickness | 0.3 | mm |
|------------------|----------------|------------|-----------|---------------------------|------------|----|



| Specimen at failure | Measured Cell Pressure, σ_3 (kPa) | Strain at Failure (%) | Stress Corrections (kPa) | | Corrected Max. Deviator Stress, $(\sigma_1 - \sigma_3)_f$ (kPa) | Shear Stress C_u , $\frac{1}{2}(\sigma_1 - \sigma_3)_f$ (kPa) | Mohr's Circle Analysis | |
|---|--|-----------------------|--------------------------|-----------------|---|---|------------------------|---------------|
| | | | Rubber Membrane | Piston Friction | | | Cu (kPa) | PHI (degrees) |
|  | 94 | 13.1 | 0.8 | \ | 44 | 22 | | |

Method of Preparation: BS 1377: Part 1: 1990
 Method of Test: BS 1377: Part 7: 1990: 8 Definitive Method, 1990: 9 Multi-stage loading
 Type of Sample Key: U = Undisturbed, B = Bulk, D = Disturbed, J = Jar, W = Water, SPT = Split Spoon Sample, C = Core Cutter
 Comments: Tested in Vertical Condition
 UKAS Calibration - loads from 0.2 to 10kN
 Remarks to Include: Sample disturbance, loss of moisture, variation from test procedure, location and origin of test specimen within original sample, oven drying temperature if not 105-110°C



TEST REPORT

ISSUED BY SOIL PROPERTY TESTING LTD
DATE ISSUED: 26/04/2022

| | |
|-------------------|------------------------------|
| Contract: | Trinity Pumping House |
| Serial No: | 40462_1 |

DETERMINATION OF THE SULPHATE CONTENT AND pH OF SOIL AND GROUNDWATER

| Borehole / Pit No. | Depth (m) | Sample | | Conc. of Soluble SO ₃ | | Calc'd Conc. Of SO ₄ (g/L) | pH Value | % Sample Passing 2mm Sieve | Description | Remarks |
|--------------------|-------------|--------|------|----------------------------------|--------------------|---------------------------------------|----------|----------------------------|--|---------|
| | | Type | Ref. | Water Soluble 2:1 (g/L) | Ground Water (g/L) | | | | | |
| WS101 | 1.50 | D | 2 | 0.34 | | 0.41 | 6.5 | 100 | Very soft greyish brown organic silty CLAY with occasional dark grey speckling, orange staining and rare recently active and decayed roots | |
| WS101 | 4.50 | D | 5 | 0.85 | | 1.01 | 6.9 | 100 | Very soft brownish grey organic CLAY with occasional decayed roots and plant material | |
| WS101 | 6.20 - 7.00 | B | - | 0.19 | | 0.22 | 7.0 | 62 | Greyish brown slightly silty very gravelly SAND. Gravel is brown, black and white angular to rounded chert and quartzite | |
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Method of Preparation: BS1377: Part 1: 2016: 8.5, BS1377: Part 3: 1990: 5.3 Soil/Water Extract, 5.4 Groundwater
 Method of Test: BS1377: Part 3: 1990: 5.5
 Type of Sample Key: U= Undisturbed, B= Bulk, D= Disturbed, J= Jar, W= Water, SPT= Split Spoon Sample, C= Core Cutter
 Comments: **Test not UKAS accredited**
 Remarks to Include: Sample disturbance, loss of moisture, variation from test procedure, location, and origin of test specimen within original sample. Oven drying temperature if not 105-110C.