The Crichton Trust

The Crichton Quarter

Local Heat Energy Network Project

Drilling & Testing of Boreholes for Open-loop GSHP system

UK Government

Contents

1. INTRODUCTION & SCOPE OF WORKS

The Crichton Trust are carrying out a feasibility study to develop a Local Heat Network for The Crichton Quarter, Dumfries.

Previously, a Desk Study report (Crichton Geotechnical Desk Study) has been carried out by Natural Power Consultants for the project. The Desk Study is reported separately and contains all available background geological data on the project and has been used to develop this specification.

This document details the works required as part of a proposed hydrogeological assessment to further evaluate the feasibility of the project. Ultimately a two-borehole open-loop ground source heat pump (GSHP) system is anticipated on the site.

This project stage involves:

- Design of extraction, injection and monitoring boreholes.
- CDM Principal Contractor site management.
- Drilling of boreholes
- Installation of well completions for each purpose
- Test pumping exercises to ascertain measurements hydrogeological parameters and observation of well behavior
- Analysis of thermal, physical and chemical characteristics of extracted water
- Characterization of the aquifer potential, well efficiency and operational considerations,
- Re-injection tests to simulate the operational conditions
- Analysis of results to inform the feasibility study and make recommendations for the working system

Once the design and planning is complete it is proposed that the drilling is completed in two phases.

1.1. Phase 1

The objective of the first stage will be to drill and test one monitoring well followed by the main abstraction borehole (BH1). BH1 will be of a proven design to provide the predicted peak groundwater flow rate and ascertain sustainable groundwater yield. In order to make the design of BH1 specific to the ground conditions the first monitoring well, BH2, will be drilled logged and tested in advance. The scope of BH2 includes rotary coring of the formation to ascertain the detailed ground model. Thereafter the production well design will be checked against BH2 results and drilled.

If successful, this borehole is intended to be reused in the future as the main abstraction borehole and thus the design will take this into account.

The outcome of Phase 1 will dictate whether Phase 2 is progressed.

1.2. Phase 2

The second stage will be to drill 2 x further monitoring wells (BH3 and BH4) to be used to provide data on drawdown during the production well testing, and to enable testing of injectivity. If successful, one of these wells (BH4) is intended to be reused in the future as a re-injection borehole. This reinjection & monitoring well will be of the same or similar diameter and construction to the test well, albeit with well screen design and pressure control well head suited to injection.

Outline designs criteria for the borehole system are provided later in this document, but the contractor shall specify in detail in their proposal

The third stage will be a campaign of static condition monitoring, test pumping, sampling and injection.

1.3. Guiding principles of two well systems

The contractor will work with the engineer and client collaboratively to achieve the best possible outcome. In doing so the following guiding principles must be understood in relation to well design and long-term performance.

The efficiency of the systems depends on whether the following are met:

- The abstraction and injection wells are designed to the highest standard specific to the intended use.
- The wells are spaced adequately based on discharge rates and aquifer parameters and incorporate sufficient conservatism.
- Production and injection wells are not placed within the same stratigraphic horizon.
- The injection well screen is at least twice as long as the abstraction well.
- Maintenance schedules are established and followed where necessary to maintain reasonable rates of injection.

1.4. Site Details

Note that the borehole locations are within a landscaped area where pedestrians may access. The contractor shall allow for visiting site to accurately ascertain accessibility, extent of the works involved and shall make due allowance in his tender accordingly.

Acting as Principal Contractor, they will be responsible for site security and safety, particularly in relation to public interfaces.

The proposed borehole locations are likely to be within the central / southern areas of the Crichton Campus (e.g., areas B, C & D on the below figure) but are provisional at this time. The Desk Study has identified that the geology is expected to be consistent below the whole site, therefore the main driver for borehole siting will be the most practical locations logistically, and not geologically driven. Several potential open ground locations have been identified by the Desk Study information, however the final borehole locations will be selected and agreed in consultation with The Crichton Trust. It is generally advisable to maximise borehole spacing, to mitigate against unwanted hydraulic and thermal interference. As such, minimum spacings of 115m will likely be required. However, the areas available for the works are constrained by existing buildings and associated services, which must be considered. This is to be confirmed during a site walkaround upon the award of the contracted works.

Figure 1.1: Potential Site Development Areas

Suitable drilling setup, fencing and security will be required during all works. Similarly, the route between boreholes will have to be fenced to accommodate an injection pipeline for the injection testing.

The contractor shall prepare detailed risk assessments, method statements and program detailing the proposed drilling and testing before undertaking the works. This should include a survey of existing services within the area of works. The contractor will be liable for any costs resulting from avoidable services strikes as a result of these works.

It is important that risk of downward vertical migration of contaminants is eliminated. The contractor shall set out a detailed methodology for 'clean' drilling to manage this risk for consideration.

1.5 Scope of Works

The outline scope of works consists of:

- Site visit during tender period to familiarise with location of boreholes and all site services and constraints.
- The successful contractor will need to provide all RAMS and paperwork for review/ approval a minimum of two weeks prior to the agreed mobilisation date and undertake the role of Principal contractor under CDM 2015.
- Complete design and planning activities taking into consideration the availability of well completion materials and any long lead times (e.g. for well screen)
- Mobilisation of drilling rig suited to drilling the abstraction, monitoring and injection boreholes.
- Drill the monitoring borehole (BH2) closest to the production well position utilizing temporary casing in overburden and coring of the formation to final depth with on-site logging of core and formation analysis.
- Undertake downhole geophysical surveys including acoustic image, natural gamma, temperature and conductivity in BH2.
- Complete variable head tests to gauge hydraulic conductivity in BH2.
- Based on the above formation data and well criteria verify the tender design, an example of which would be:
- Drill superficial deposits at approximately 350mm diameter from ground surface through overburden to rockhead with a minimum 3m penetration below rock head. Install suitable new steel, 270-300mm welded casing (assumed depth 12 m) and grout to surface. The precise casing depth will depend on the condition and competence of the upper section of the aquifer. Drill to full depth of approximately 150m, taking samples every 2m for logging of geology.
- Initial well flushing and development to remove debris / residues.
- A geophysical survey will be run prior to installing the completion comprising a verticality / caliper log acoustic image, natural gamma, temperature and conductivity.

- Install selected well screen (ND 200mm) at designed depths to achieve the expected yield efficiently with respect to well hydraulic parameters.
- Install selected filter pack and upper annular sanitary seal
- Terminate with flanged well head.
- Casing size shall allow for pumping with a submersible pump to provide a flow of up to circa 15l/s, 50.4m3/h. The borehole diameter, casing and completion will be specified to accommodate the likely choice of submersible pump and satisfy the specified well flow efficiency criteria. The most likely submersible pump diameter will be 150mm.
- The rig is expected to be a minimum 10t track mounted rotary top drive rig suited to the drilling loads and installation process. Drilling tools will be selected to suite the geology and as far is reasonably practicable prevent uncontrolled mess or flow of groundwater at surface during drilling operations. The drill site will be designed to accommodate security, materials handlings, ground protection, arisings discharge and groundwater flow control.
- Drill 2 x additional monitoring boreholes to full depth of 50m giving three monitoring wells in total. Two of the monitoring holes (BH3 & BH4) will be open hole drilled and sampled every 2m for logging of geology.
- BH4 will be furthest away down gradient from the production well and this will be designed as an injection well. Final positions of boreholes will look to achieve recommended distance and take into account the formation porosity and other relevant factors.
- Development by airlift and pumping sufficient to clear all drilling mud and drill cuttings from the boreholes and develop the aquifer. The air lift method will be used to move water back and forth across the borehole / formation interface through the full depth of screened borehole until satisfactory results are achieved (i.e. a marked reduction in solids and coloration)
- Development pumping will follow this using a ramping procedure to be at a rate of up to the intended production rate or as limited by the well itself.
- Note that significant volumes of groundwater and sediment will be produced. This will require desanding to remove suspended solids prior to pumping to sewer (if this can be agreed) or to another suitable receptor. Measurement of suspended solids to be by Imhoff cone.
- Test-pumping of the production borehole is to include:
- A stepped-rate test to waste consisting of 5 steps of 80 minutes up to a maximum of 15l/s.

- A constant rate test of a duration to be agreed. Potentially this could be120 hours at a rate determined via the step test (but in the region of 14l/s.)
- All hardware for on-site monitoring of water level, flow rate, water sampling and suspended solids measurement is to be provided.
- Settled, pumped water is to be directed to the nearest possible sewer or storm drain to the borehole. The contractor is to obtain a suitable discharge consent for wastewater.
- Once complete, the injection borehole will be tested. Testing will include:
- A stepped-rate test to waste consisting of 5 steps of 80 minutes up to a maximum of circa 15l/s.
- An injection test with water pumped from the abstraction well to the injection well at a nominal rate determined as above but intended to be similar to the production rate of 15l/s. Note that the injection test might require pumping under pressure. The pipeline and wellhead should be suitable for this.
- Samples collected from the aquifer will be analysed for chemical and bacterial composition.
- Reporting of all aspects of the project in PDF format with provision of AGS data is required.

2. PREDICTED GEOLOGY AND HYDROGEOLOGY

Refer to Desk Study Report.

3. SPECIFICATION – BOREHOLE CONSTRUCTION

3.1 Abstraction borehole depth and diameter

- The borehole design shall be undertaken after contract award and verified after coring the initial monitoring well and updating the ground model.
- For the purpose of the tender the abstraction well shall meet the following criteria:
- To provide sufficient yield for the heating system, estimated to be 15l/sec
- Designed to maximise well hydraulic efficiency
- To maintain entrance velocity below 3.3cm/sec by ensuring total open area of screen is sufficient.
- Thus, the successful contractor will need to demonstrate that their design provides sufficient open area, distributed correctly to avoid convergence and sufficient aquifer penetration that vertical components of hydraulic conductivity do not limit performance. The filter pack must be sized appropriately to the formation and that construction factors (e.g. well development and screen placement) are appropriate.

- For the tender assume the following design features
- The proposal should be based on a borehole depth of 150m to be completed within Doweel Formation, with a surface casing depth of approximately 15-20m at 270mm diameter.
- The borehole drill diameter will allow for installation of a secondary casing and well screen with a gravel pack in the annulus. The diameter should accommodate a 150mm diameter submersible pump, controls and dip tube and may be either stainless steel, UPVC or a combination of both provided that the above criteria can be met.
- Drill and casing diameters are suggested above and in the BOQ. The minimum completed internal borehole diameter shall be agreed with the Engineer before drilling commences but should allow installation of a pump capable of providing a peak flow rate of up to 15l/s with estimated pumping head of 60m*.
- The drilling diameters required to achieve the final borehole design will be proposed by the Contractor and approved by the client. The Contractor must ensure that there is a minimum of 50mm annular space for grout between the borehole wall and the OD of surface casing, and, if required, well-screen, with a formation stabiliser between it and the borehole wall.
- *This peak flow is an estimate for the purposes of producing a fair bid and may vary dependent on the results of the feasibility works being performed independent to this bid. This will be confirmed before plant is mobilised.

3.2 Injection Well considerations

Many of the principals from the extraction well also apply to the injection well however the following should be considered in the drilling and design.

Whilst the materials and construction methods are similar to the main abstraction well it should be noted that the entrance velocities and should be lower with approximately twice the screened area as the abstraction well.

The long-term performance is very susceptible to water chemistry which may lead to incrustation and sediment (<0.1mg/l) which will partially block pathways resulting in lower permeability and increased pressure.

The formation itself will be susceptible to increased pressures which can ultimately hydro fracture the formation rock.

Pressure control and gauges will be necessary in the delivery pipework and as a rule of thumb the injection pressure should not exceed 0.2 times the head taken at the top of the well screen section.

Injection tubing should be specified to provide full flow which will reduce the risk of air entrainment.

Finally, the location of the injection well should be proposed at a distance and depth to avoid the warmer injected water having a negative impact on the performance of the heat pump system.

3.3 Monitoring well considerations

The two standard monitoring wells shall be drilled to accommodate 50mm piezometer pie and filter pack. These shall also be purged after drilling and developed but their primary purpose is water level monitoring via manual dip tape and data logger. If necessary, water samples can also be taken and temperature variance monitored during injection.

3.4 Techniques & drilling media

The Contractor will use their skill and judgement to proposed drilling technique(s) and media which they feel are applicable to achieve the depths and diameters required, providing that the details of the techniques to be used are submitted to and approved by the Engineer (TBC) prior to site works commencing. The contractor should take into account the nature of the drilling location and the need for cleanliness, tidiness and absolute need for prevention of groundwater flooding.

The techniques and media must not permit formation collapse, excessive borehole erosion or involve the use of lost circulation agents, sawdust or any form of plugging that may ultimately affect the production capacity of the water bearing strata intersected. The Contractor shall make every effort to keep the drilling area tidy and well drained during operations. Approval must be gained from the Engineer should the drilling technique or media be changed once works have commenced and no additional work can be undertaken until approval is granted.

The Contractor shall notify the Engineer as soon as possible of any intention to vary the drilling technique and/or media and will not charge for any standing time whilst awaiting approval or additional mobilisation charge associated with the change in technique. The Engineer will review and approve any variation as quickly as is reasonably practicable.

3.5 Artesian water

The contractor shall provide details of measures they intend to put in place in the event of encountering artesian water during drilling, prior to site works commencing.

3.6 Proposed drilling and construction of boreholes

The final borehole constructions shall be agreed with the Engineer on site. The boreholes must be drilled at sufficient diameter to allow the installation of the necessary casing, centralisers, grout, and screen.

3.7 Sampling

Representative samples of the strata intersected shall be collected every 2m or significant change in material recovered, by whatever method is standard for the drilling technique in use and approved by the Engineer. The sample should be bagged, labelled with the borehole number and depth increment and stored in a position where they will not be contaminated by site conditions or drilling operations and will not interfere with any other site operations. The Contractor shall supply strong sample bags and labels as required.

One of the monitoring boreholes (BH2) shall be rotary cored for the full depth to obtain continuous rock core samples.

3.8 Casing

Casing types can be specified by the Contractor. However, all casing shall be new and conform to BS879. Steel surface casing shall be butt end welded.

3.9 Setting Casing in Position

All casing strings shall be lowered into position. Under no circumstances will it be permitted to drop casing into position. All casing strings shall be installed with centralisers at not less than 5 m intervals.

3.10 Grouting

All surface casings are to be grouted in place. The minimum grout thickness shall be 50 mm. The Contractor is to specify the placement technique, which shall ensure that the casing is securely grouted through the full thickness of any superficial deposits and formations above the target aquifer.

The borehole must be drilled at sufficient diameter to allow effective grouting. Should the grouting be deemed to be ineffective, then all costs relating to rehabilitation and/or re-drilling and construction of an alternative borehole will be at the expense of the Contractor.

3.11 Screens/Casing string

The secondary casing and screen will comprise either stainless steel, uPVC or a combination of the two at a nominal diameter to accommodate a submersible pump capable of a yield of at least 15l/s and at a head of about 6bar. Casing and screen will conform to BS879. Casing will be screwed.

The Contractor should confirm that the product being used will be strong enough for the designed installation. Details of the screen and casing must be submitted within the Tender. Screen slot opening is to be specified following the drilling of cored monitoring borehole 2.

3.12 Plumbness and alignment

The borehole shall be drilled and cased straight and vertical and all casings and liners shall be set round, plumb and true to line. The drillers shall employ a bottom hole assembly (BHA) intended to reduce well deviation and will manage rate of penetration (ROP) accordingly.

The Engineer shall have the right to reject any or all drilling or casing which fails to meet this specification and work and casing rejected will be replaced at the Contractor's expense.

It should be noted that the above should be considered as a target and will not be unreasonably applied by the Engineer. Any delays or losses encountered in running casing, considered to be due to poor borehole alignment shall be at the Contractor's expense.

3.13 Protection of boreholes

During the Contract period when work is not in progress, the boreholes shall be kept capped in such a manner as to prevent vandalism and the entrance of foreign material. The Contractor shall remove any such foreign matter at his own expense. On completion of drilling the borehole, the Contractor shall supply and fit a temporary flange and facing plate below ground level. One hole will be cut through the plate with a dip tube to allow entry of a standard dip meter probe. The hole shall be threaded and a bolt inserted to prevent debris being placed in the borehole.

3.14 Development

On the completion of construction, abstraction boreholes shall be developed by airlift (and submersible pump) to a maximum yield. This must be done to the satisfaction of the Engineer, the duration of which is dictated by the well properties. The objective is to result in minimum sediment load.

Suitable settlement tanks and de-sander units should be used to settle suspended solids during airlifting and pumping. The sediment load will have a bearing on water discharge agreements and re-use for injection tests. If a submersible pump is used for development, a suitable means of continuously measuring sand/suspended solids should be provided; for example an Imhoff cone and Rossum sand tester.

3.15 Discharge

Following settlement of any solids, the contractor must make available approximately 50m of suitable discharge pipe of sufficient diameter to take all water discharged during development away from the test site to a sewer entry (to be identified and agreed). The exact route is to be agreed with the Engineer and determined during site visit. The contractor is to obtain permission from water/wastewater company to discharge drilling water and test-pumping water to sewer.

Sufficient valves, taps and pipe work must be available to ensure the necessary level of flow control can be achieved, that water samples can be collected at the well head and that any in-line flow meters are at the manufacturers recommended distances from bends or valves.

3.16 Borehole geophysics

Following the drilling of BH2 and 1 downhole geophysical logging is required. The contractor will be responsible for these works will comprise verticality and caliper logs, acoustic imaging / CCTV, temperature (thermal log), gamma and fluid conductivity.

3.17 Supply and installation of submersible pump for test pumping

Following successful development, a temporary submersible pump shall be supplied to supply a flow rate of at nominal 15l/s - at an assumed maximum pumping head of 6bar. The pump is to be installed on temporary rising main and the system calibration tested to the satisfaction of the Engineer prior to test pumping.

Power for the submersible pump will be supplied by quiet-running 24hr generator with standby generator and automatic switching controls - to be supplied by the contractor.

The discharge water shall be passed through a suitable flow gauge and monitoring system prior to discharge.

3.18 Temporary Borehole headworks

On completion, the borehole will be finished below ground level. A manhole is to be constructed around the wellhead with a temporary sealed manhole cover. The borehole casing will be completed with a flange and facing plate and finished with a suitable paint (Hammerite or similar).

A temporary wellhead is to be constructed of suitably painted mild steel. The wellhead flange shall be sealed and incorporate one dip tube.

3.19 Acceptance of Borehole

The boreholes shall only be accepted once the Engineer is satisfied with the borehole construction and that the pump and wellhead have been tested and commissioned to the satisfaction of the Engineer.

3.20 Reports

The Contractor shall provide report in his own standard forms for approval by the Engineer. The type of records necessary are listed below.

Log	Description
Strata Log	An accurate record of strata passed through and the depths at which the strata intersected, also progressive measured air lifted yields when drilling with air, air developing or air lift pumping.
Construction log	An accurate record of all drill bit sizes, casing and grouting details including grout volumes, used in the hole.
Time Log	An accurate record of time spent on all phases of drilling.
Waste Disposal	Copies of all waste transfer certificates / consignment notes.
Core log	Engineering logs to BS930 standard including photos of all rock cores taken.

4. TEST PUMPING

It is essential that sufficient airlifting and development pumping has been performed to verify the borehole is producing water with low suspended solids, as measured by Imhoff cone and/or Rossum tester. Sand production target nominal 1 -2ppm to prevent long-term pump impeller erosion.

Test pumping of the first borehole will consist of short 'calibration' tests, step and constant rate test each with full recovery. Duration of constant rate test is likely to be a minimum of 48h and up to 120 hrs depending on the response of the borehole.

Data loggers will be used in all monitoring boreholes in addition to manual dipped readings

4.1 Types of Tests

Pumping tests shall be carried out as directed by the Engineer and any SEPA consent. These shall include:

- Test-pumping of the first borehole is to include:
- A stepped-rate test to waste consisting of 5 steps of 80 minutes up to a maximum of 15l/s.
- A constant rate test of 48-120 hours at a rate of 14l/s.
- All hardware for on-site monitoring of water level, flow rate, water sampling and suspended solids measurement is to be provided.

- Settled, pumped water is to be directed to the nearest suitable sewer or storm drain to the borehole. The contractor is to obtain a suitable discharge consent for wastewater.
- Suitable fencing and security will be required for the duration of testing
- Subject to results of the first borehole, the second borehole (the injection borehole) will be drilled and developed.
- Once complete, BH4 will be tested. Testing will include:
- A stepped-rate test to waste consisting of 5 steps of 80 minutes up to a maximum of circa 15l/s
- An injection test with water pumped from ABs1 to INj1 at a nominal rate of 14l/s. Note that the injection test will require pumping under pressure. The pipeline and wellhead should be suitable for this.

4.2 Equipment

Suitable fencing and security will be required for the duration of testing. The Contractor shall have available on site a pump and all necessary ancillary equipment, capable of setting a pump to nominal 60m depth with a maximum yield of 15l/s.

The Contractor should note that ancillary equipment refers to, but is not limited to: power sources, rising main, discharge line, flow measurement devices, water level measuring devices, accurate stop watches, personnel and back up equipment.

The pump will be installed with 2 x 32mm (minimum) dip tubes. The tubes must allow installation of data logging equipment (OD 22mm, 154mm long) to the pump installation depth. Failure of installation and consequential costs will be at the Contractors expense.

4.3 Discharge

The contractor must make available at least 50m of suitable discharge pipe of sufficient diameter to take all water discharged during testing away from the test site to a suitable site drainage entry. The exact route is to be agreed with the Engineer.

Sufficient valves, taps and pipe work must be available at the well head to ensure the necessary level of flow control can be achieved, that water samples can be collected at the well head and that any in line flow meters are at the manufacturers recommended distances from bends or valves.

An injection test with water pumped from BH1 to BH4 at a nominal rate of 15l/s. Note that the injection test might require pumping under pressure. The pipeline and wellhead should be suitable for this with appropriate safety valves and gauges

4.4 Measurement

The contractor will be responsible for making and recording accurate measurements of time, pump discharge and water level. All information collected shall be neatly recorded, to the Engineers satisfaction, by the contractor, and submitted to the Engineer at the end of each test.

The information recorded by the contractor shall include the following:

- Date and time when the test starts
- The rest water level before pump installed (and time)
- The rest water levels before the test starts
- The description of the reference datum at each monitoring point from which drawdown is measured
- The height in mm of the reference datum above ground level
- The pumping rate in m3/hour and the times specified by the Engineer
- The type of pump
- The pump setting in metres below the ground level
- The type and serial number of the Discharge measurement devices
- Water levels, including monitoring wells, at the times specified by the Engineer

4.5 Measurement of the pumping rate

The pumping rate will be measured by an approved method e.g. v notch weir tank and cumulative flow meter. The contractor shall measure discharge to an accuracy of 0.1 m3/hour.

During the total time taken to complete a step or constant rate discharge test, any variation in the discharge rate shall be kept within 10%.

If, during a test, the contractor fails to maintain the minimum specified levels of accuracy in measurement the test will be aborted, the water levels allowed to recover and the test re-run. Any such aborted test and standing time awaiting recovery will be at the expense of the contractor.

4.6 Measurement of water levels

The contractor will supply, install and remove electronic measurement equipment as required by the Engineer.

Water levels will also be measured using an electric tape measuring device inserted into one of two 32mm diameter conduit tubing strapped to the side of the pump column. The instrument must be in good working order and shall produce a clear signal when the probe touches the water. The water level shall be measured to the nearest 10mm division.

Water levels shall also be collected from the three monitoring wells via data loggers and manual readings.

The Contractor must have sufficient working instruments and back up devices to allow all the required monitoring to take place as defined by the Engineer.

4.7 Measurement of water temperature

The contractor will measure water temperature hourly during each pump test, and for an additional period of 48 hours after completion of each test.

4.8 Measurement of water quality

The risk of scaling needs to be taken in to account when designing an open loop system. Groundwater samples shall be taken from the test borehole for measurement of water chemistry/ water quality. Samples should be taken immediately prior to and immediately following each test. Samples will be taken to a testing laboratory within 24 hours and be tested for mineral content, pH and hardness. Minimum sample volume of 5 litres per sample in appropriate bottles supplied by the testing facility. A provisional sum is allowed for testing, the test schedule will be agreed with the contractor prior to commencement.

4.9 Pump failure during pumping

In certain circumstances, it may not be necessary to repeat the test. This will be dependent on the length of time that the test has run, the quality of the data obtained and the importance of the late data. The decision whether to repeat the test will be the Engineer's.

If the test is repeated, the aborted test and standing time awaiting recovery will be at the expense of the contractor.

4.10 Protection of existing services

Information on the location of site services will be provided by the client, however the Contractor shall, during the execution of the Contract, take care that existing services, e.g., cables, pipelines, sewers, etc., are not damaged or interfered with and should hand excavate to a depth of 1.2m prior to drilling.

The Contractor will take full responsibility and indemnify the Client from any responsibility for damage to services and delays caused by such damage.

A permit to work will be issued prior to undertaking the works which will include the location and identification of all known services in the proposed work area.

The Contractor shall have no claim in regard to delays occasioned by alterations to any such services other than a claim for extension of the completion date of the Contract Works.

4.11 Supervision and Engineer's instructions

During the execution of the Contract Works and until completion thereof, the Contractor shall keep on the site one competent head representative, who shall superintend the work, receive on behalf of the Contractor instructions from the Client and/or Engineer and be responsible for the behavior of the Contractor's employees and subcontractors.

The Contractor shall carry out and maintain the works to the satisfaction of the Engineer and shall comply with and adhere to the Engineer's instructions on any matter within the scope of the contract, (whether mentioned in the contract or not), who may, in his absolute discretion, and from time to time, issue further drawings, details and/or written instructions and/or directions and/or written explanations.

4.12 Waste Disposal

All waste is to be disposed of off-site. All liquid and solid waste disposed of off-site must be removed by a licensed waste carrier and the appropriate documentation retained by the Contractor for submission with invoices. It is the contractor’s responsibility to ensure that waste disposal is carried out according to current legislative requirements.

4.13 Contractors Facilities

Water supply options will be discussed with the successful tenderer prior to commencement of works and any additional costs confirmed.

4.14 Electrical Power and Water

The Client will provide access to a suitable water supply for use by the contractor, if available. The contractor will be responsible for providing an electrical supply. All generating equipment to be used is to be as quiet as possible.

4.15 Watching and lighting

The Contractor must arrange his work in such a way that the working area is secure at all times and that the area cannot easily be entered by unauthorised people. The Client reserves the right to suspend work if, in his opinion, this requirement is not being complied with and, further, to make secure the area and recover any costs involved in labour and materials from monies due to the Contractor.

The Contractor shall make provision in the nature of temporary works as may be required for the purpose of ensuring the safety of adjoining property and for the protection of all persons or animals. He shall be responsible for and indemnify the Client from, all damage, injuries and accidents that may occur through the omission of the Contractor of any necessary provision in this respect.

The Contractor shall make full provision for all watching and lighting necessary for the protection of all persons, animals, vehicles, etc., from injury by reason of the Works. He shall provide ample warning signs, guard rails, etc., around static plant, stacks of material, excavated materials, debris or the like. The Contractor shall provide and maintain all necessary temporary protection of finished and/or existing work liable to be damaged during the progress of the works by properly covering up, isolating, etc., as required. The Contractor shall be responsible for any damage which may occur and shall make good the same at his own expense.

Fires will NOT be allowed. The working area will be kept as clean and tidy as practicably possible.

4.16 Site Access and Egress

The contractor shall provide with their tender a plan detailing their proposals for plant and pedestrian access and egress from the site, including deliveries.

4.17 Standing and Waiting Time

Standing and waiting time will only be paid on the written instruction of the Engineer. All normal work (non-drilling) time must be accounted for in the rates provided.

4.18 Advance payments on materials

"Materials on Site" are not paid for prior to installation.

4.19 Abandonment

The Engineer shall have the right, at any time during the progress of the work, to order the abandonment of a borehole whilst acting reasonably. The Contractor thereupon shall withdraw the casing and screens, if applicable, and salvage or attempt to salvage all such materials as the Engineer may direct and/or up until the Engineer revokes such direction, and shall fill or leave the borehole to the satisfaction of the Engineer.

Payment shall be made for such abandoned boreholes at the rate of drilling and other rates as are appropriate or as detailed in this specification.

4.20 Lost Borehole

Should accident to the plant, behavior of the ground, jamming of the tools, or casing or any other cause prevent the satisfactory completion of the works, the borehole shall be deemed to be lost. Lost boreholes resulting from unstable conditions where the Driller does not notify the Engineer and agree a mitigating course of action will not be reimbursed. In this situation the driller has not acted with due care and attention and no payment shall be made for that borehole nor for any materials not recovered there from, nor for any time.

Any material provided by the Employer which is not recovered from the lost borehole in good condition, may be at the Contractor's expense, and may be deducted from the Contractor's payment.

In the event of a lost borehole, the Contractor shall construct a borehole at a suitable location adjacent to the lost borehole or at a site indicated by the Engineer. The option of declaring any borehole lost shall rest with the Contractor subject to direction from the Engineer.

If the Engineer directs that the new borehole be re-drilled close to the lost borehole and the Contractor is concerned regarding the possible loss of air or other media the Contractor shall backfill the lost borehole with approved material and to SEPA guidelines. The top 20 m of the borehole shall be cement grouted to provide a complete seal. All work and material shall be at the Contractor's expense.

4.21 Expertise

The Contractor under this contract is considered to be an expert water well driller and test pumping contractor and is expected to organise and carry out the work specified herein in an expert manner. Drilling problems encountered will be overcome entirely within the framework of the specification and Bill of Quantities and rates and no claim for extra payments will be entertained for problems not given in the specification or due to limitations of this specification.

4.22 Contractor's plant and tools

The Contractor's plant and tools shall be of modern design and construction, suitable for the duties required of them and subject to regular inspection and maintenance. They shall be in sound working condition and shall be sufficiently ample in capacity or number to enable the work to be carried out efficiently and expeditiously. All drilling and lifting plant will be governed by PUMER and LOLR with record of in-date inspections spanning the duration of works.

Should the Engineer be of the opinion that the plant used by the Contractor is insufficient or in any way unsuitable for carrying out the Works in a manner or at a rate commensurate with his requirements, he shall have the right to call upon the Contractor to provide such additional or approved plant and tools as may, in his opinion, be necessary to attain these requirements. The Contractor shall make available, on request, all relevant inspection and maintenance records and certificates and demonstrate that the Contractors staff are trained/licensed in the correct use of the plant and tools.

4.23 Local acts and regulations

The Contractor shall at all times conform with any acts, regulations or permits relevant to this Contract, and to such amendments as may be promulgated during the period of construction.

The Engineer will provide the Contractor with a copy of the relevant SEPA consents prior to works commencing.

4.24 Cleaning of site on completion

On completion of each section of the Works, or if directed by the Engineer on Completion of any portion of the works, the Contractor shall remove surplus materials, construction plant and equipment not being used at or near the same location during later stages of the work.

In the event of the Contractor's failure to comply with the above the same may be accomplished by the Client at the Contractor's expense.

5. CONTRACT ITEMS

5.1 Applicable standards and particular specifications

For the purpose of the Contract the following particular Specifications that may or may not be bound into the document shall apply:

- Specification for the drilling of groundwater boreholes (Section 2 above)
- Specification for test pumping (Section 3 above)
- British Standards Institute (2003) Hydrometric determinations. Pumping tests for water wells. Considerations and guidelines for design and use. BS ISO 14686:2003
- British Standards Institute Water Well Casings BS879 Parts 1 and 2
- In the event of an ambiguity or conflict between specifications the following order of precedence will apply to the above Specifications:
- This Specification
- British Standards

5.2 Method Statements and risk assessments

Contractors will supply Method Statement and Risk Assessment for permitting requirements. The contractor will also be required to submit a detailed program of work.

The contractor shall include details of measures proposed for limiting noise and disturbance and dealing with pedestrians and any potential public interface.

5.3 Construction Design Management (CDM) Regulations

The Contractor will be appointed as Principal Contractor under CDM regulations, and as such will be responsible for managing site safety and organizing adequate welfare facilities for the site workers amongst other normal PC duties.

The location of temporary welfare facilities shall be agreed with The Crichton Trust.

5.4 Maintenance period

12 months.

6 BILL OF QUANTITIES (BOQ)

A bill of quantities (BOQ) is to be completed and returned for the works based on the specification provided above.

PROJECT DELIVERY SCHEDULE:

Tender Invitation Launched: Monday 24th October
Submission Deadline: Extended to 9th Nov 9am (Was Monday 7th Nov (12noon)
Contract Awarded: Wednesday 9th November
Works Commence: Monday 14th November
Works Completed By: 18th December 2022

QUALITY SUBMISSION (50)	
Criteria	**Weighting**
1) Can you meet the required programme dates as listed within the 'Key Dates' under the Contract Data Part One. Please note achieving a pass in respect of this question is a mandatory requirement. Tenderers who do not achieve a pass in respect of this question will have their proposal rejected and further assessment of their tender submission will not occur.	Pass / Fail
2) Gant chart programme - Detailed programme based on the envisaged work (to be more detailed than the activity schedule).	5%
3) Please provide a detailed explanation as to the amount of resource you shall be using on the project during each phase, and whether they are external or not. This should be linked to the programme and Key Persons listed within the contract.	15%
4) Please provide a detailed assessment of the process you shall undertake to identify all permitting, permissions etc. required to undertake the borehole construction, including the relevance of each approval, as well as obtaining them within the required key dates and programme.	30%

PRICE ELEMENT (50)	
Tender value	**50%**
The Tenderer whose tender results in the lowest Total Cost as submitted in Schedule 3 will be given the maximum possible weighted price score (50). The other Tenderer's Total Costs are then calculated pro rata to the lowest Total Cost using the following equation: (Lowest Total Cost/Other Total Cost) x Price Weighting (50) = Price Element score	

This project is funded by the UK Government through the UK Community Renewal Fund.
The UK Community Renewal Fund is a UK Government programme for 2021/22. This aims to support people and communities most in need across the UK to pilot programmes and new approaches to prepare for the UK Shared Prosperity, it invests in skills, community and place, local business and supporting people into employment.
For more information, visit https://www.gov.uk/government/publications/uk-community-renewal-fund-prospectus

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