HILLINGDON WATER SPORTS FACILITY AND ACTIVITY CENTRE

UTILITIES REPORT

for

LONDON BOROUGH OF HILLINGDON

STUART McCURRY & PARTNERS LTD
11 Chiltern Court
Asheridge Road
Chesham
Buckinghamshire
HP5 2PX

Tel: (01296) 696780
Email: engineers@smpengineering.co.uk
Website: www.stuart-mccurry-partners.co.uk

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SMP

REPORT

ISSUE AND AMENDMENT RECORD SHEET

REVISION	DATE	DETAILS	AUTHOR	CHECKED BY
-	30/06/23	Draft Issue	CS	
A	30/06/23	Amended following Client Comments	CS	
B	06/07/23	Re-issued with naming changes following HWSFAC feedback	CS	
C	07/08/23	Utilities Survey added at Appendix A	CS	
D	12/09/23	Gantry crossing details added	CS	

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EXECUTIVE SUMMARY

Stuart McCurry & Partners Limited were appointed by the London Borough of Hillingdon to carry out a study of the current utilities available at Broadwater Lake and to investigate the best possible ways of serving the site to support proposals for the proposed Hillingdon Water Sports Facility and Activity Centre.

All buildings will be operated on the Net Zero and Carbon Neutral model and onsite renewable generation will have a significant part to play in their day-to-day operations.

The report will explain the potential for solar energy to mitigate carbon emissions by replacing carbon intensive sources of heat and power with clean renewable energy.

The scope of the report includes how any generated energy could be used, stored onsite as well as how best it could be exported and distributed to surrounding users via the DNO's existing 6.6kV HV system, for example local schools and hospitals.

Ecological design as well as flora and fauna considerations are contained in other reports.
SMP carried out a non-intrusive electrical survey of the electrical systems supplying the areas noted above. Some record drawings and test certification records, where applicable, were made available for inspection.

The report will highlight the following recommendations and a potential path to progress them.

Recommendations:

- To keep the existing HV electrical supply at its rated 500kVA
- Bring the new water supply across the canal on a gantry in from the Broadwater Lane mains network.
- Connecting a fire hydrant to the Broadwater Lane supply.
- Bring the telecoms and data services from the Broadwater Lane DP across the Canal.
- Install a suitably rated solar PV generator with battery energy storage system.
- Install a lake water source heat pumps.
- Install a pumped sewage system with attenuation buffer and impervious containment.

1. EXISTING DEPOT INFASTRUCTURE

1.1. Terms of Reference

Stuart McCurry & Partners Ltd were commissioned by the London Borough of Hillingdon to carry out an assessment of the existing utilities installations at the Broadwater sailing club site in Harefield Uxbridge.

The report has been based on an initial non-intrusive inspection of the area.

Existing report drawings and current site information was consulted in the preparation of this report.

A recent Utilities survey, prepared by LandScope Engineering Ltd, of the area's underground electrical, telecoms and water services was issued to SMP, and this was consulted in the preparation of this report. A copy of this is contained in Appendix A at the end of this report.

This report has been prepared exclusively for the instructing client and we do not accept any liability or responsibility for its use by other parties.

Whilst every effort has been made to ensure the submission of an accurate report, it should be understood that it can only be based upon visual evidence. The survey contains no testing, dismantling or intrusive checks. It is also confirmed that the estimation of the adequacies of the existing services is based on a broad overview with no detailed calculations or analysis of the property being undertaken at this stage.

The term 'Time Served' or 'unserviceable' is used within this report which indicates that an item of plant or component has reached the end of its useful and reliable or maintainable life expectancy, and that replacement should be considered. Such plant is most likely no longer produced by its original manufacturer and effectively obsolete from a maintenance standpoint due to parts no longer being available.

Due to the age of the plant onsite it is known that asbestos is present as well as equipment containing PCBs. Both these materials will require management under a separate hazardous materials plan. The presence of asbestos in older plant must always be considered and its very presence effectively makes that piece of equipment unserviceable.

1.2. Scope of Report

This report is to examine the current utilities strategy with regards to the future development of the Hillingdon Water Sports Facility and Activity Centre at the disused quarry site in Broadwater Lake, Moorhall Road, Harefield, UB9 6PE.

The study will also examine the opportunity of providing, efficient cheap, clean and renewable energy to the adventure centre development.

Electricity generation is responsible for 42.5% of global CO_2 emissions. Most of this CO_2 is from the burning of fossil fuels, but a very small proportion comes from the manufacture of the components of renewable technologies such as PV panels.

2. EXISTING ELECTRICAL SUPPLY - OVERVIEW

2.1. Existing Electrical Infrastructure

The existing electrical infrastructure consists of a 6.6kV HV supply terminated in a 500 kVA transformer.

The transformer dates from the mid 1960’s and is understood to be the original quarry’s HV/LV intake equipment.

Due to its age, it will most likely need to be replaced by a modern unit filled with a more environmentally friendly cooling oil such as Midel.

Attached to the quarry’s original electrical switchgear are a number of large electrical capacitors, originally manufactured by the Telegraph Condenser Company of Acton London, each containing a dielectric which is most likely of a PCB makeup which is considered a hazardous material. When these capacitors are disposed of they must fall under the hazardous waste disposal plan.

As the supply to the surrounding area is limited to the 6.6kV level, it is most likely that there will be strict limitations on obtaining a supply increase from the DNO SSEN.

2.2. Projected Onsite Electrical Demand

The proposed development is an outdoor adventure centre. The development is required to be zero carbon under current GLA requirements. This precludes the use of natural gas as an energy source. There is currently no onsite natural gas supply and it is not proposed to connect the site to the grid. Heating, domestic hot water and power provision will be by electricity and electrically powered water heat pump systems.

It is proposed to install a number of green smart energy technologies to provide for the site’s electrical demand, for example energy storage and recovery systems.

The space heating and domestic hot water will be provided by modern water source heat pump technologies.

3. BROADWATER LANE - CANAL CROSSING – OPTION 1

Currently the HV electrical intake crosses the Grand Union Canal on a utilities gantry from the Broadwater Lane substation at the Western end of Broadwater lane. It is recommended that this is retained as the the access route to the new site’s electrical intake as it is the closest point of connection to the SSE HV network.

The potential here is to re-develop the canal bridge as a utilities gantry and also provide a route for the site’s water main, telecoms and fire hydrant across the canal via this gantry.

A canal and bridge and navigation specialist will be appointed to provide a technical solution for the refurbishment of this council owned bridge.

If the canal bridge is used to carry the water, hydrant and telecoms, it would create a secure umbilical access to the site, mostly across private land currently owned by the council.

This route would have the least impact on road traffic, the aggregate business and the local residents. This is a dedicated utilities gantry with no public access.

Apart from the proposed centre, only one other supply is served from this supply which is the bungalow at the entrance to the site.

Figure 1 Current Services Gantry

4. MOORHALL ROAD ACCESS – OPTION 2

This option is the least preferred option for a number of reasons, the main one being the potential disruption to local residents as well as businesses.

A HV supply enters the access road from the Moorhall Road to supply a pole mounted transformer serving the aggregates site.

A mains water supply runs along the eastern boundary of this road to supply a number of dwellings and a cottage near the entrance to the new adventure centre.

An Openreach telecoms cable runs along the same route serving the same dwellings and cottage.

It is not apparent what size the existing water main is, but it is believed that if is a reduced branch emanating from the 4" main on Moorhall Road.

Trying to service the centre from the Moorhall Road access point would be extremely difficult with much disruption to the existing business and properties. The water mains and telecoms would need to be laid along a narrow access road. This road is a narrow single access road that is in constant use and required to be kept open at all times for access by emergency services.

5. EMBEDDED PV GENERATION

The PV generator will require the construction of a dedicated Energy Centre, in the form of a specially constructed plantroom, designed to receive, store, control, manage and distribute the generated electricity.

As discussed earlier, the existing site's electrical substation and associated switchgear will have the installed capacity of around 500kVA. This would limit the installed capacity of any embedded PV generator to around 400kW taking into account a margin of safety for any power factor present.

There may be scope to increase the size of any embedded PV generator if the energy is collected and stored within a battery storage and Uninterruptible Power Supply system or UPS. However, there would need to be an automatic load monitoring system to prevent any level of power above the main intake switchgear's capacity reaching the capacity of the main intake.

The proposed installed PV generator could be in the region of around 400-500kWp.

The new solar PV generator and supporting energy centre can be divided into the following components as follows:-

1. The building mounted solar PV arrays. This would most likely be a number of individual arrays each feeding into the main LV system and the supporting battery storage and energy centre.

2. The LV Switch room which would connect the solar PV Generator to the centre's electrical system and hence to the HV system. The system should be sized to be capable of absorbing all the array's generated energy and distributing it to the battery or the grid, depending on need and usage.

3. The Battery Energy Storage and UPS system, which would store any excess generated energy for use during periods of high demand or when the PV generator's output is reduced due to overcast conditions. This battery could be called upon in periods of high network demand to effectively take the centre "off grid" and power the centre's operations during these peak periods.

4. The array and its supporting energy centre could be installed with the capacity for future expansion – with the limitations of the main intake in mind. The energy centre in particular would be sized to have the capacity to expand the array by a factor of 100%, which would allow the array to be extended and higher rated panels to be installed in future years as this technology becomes more mainstream in this type of urban environment, and as demand for renewable electricity grows.

5.1. The HV Substation

A suitably new sized HV transformer substation will be installed along with a new LV electrical intake switchgear arrangement.

It is hoped that the size of the photovoltaic generator would render the centre largely self-sufficient from an energy standpoint. This could be achieved with the careful management of the PV's energy centre.

The coupling of this with a Battery Energy Storage system (BES) could allow the centre to remove itself from the local SSEN HV network during periods of high demand.

Figure 1: Typical Transformer Substation

Above is a picture of a typical transformer substation of the type and rating that would be around the proposed installed 500kW level.

5.2. Battery Energy Storage

The major component of the energy centre is the battery energy storage and Uninterruptible Power Supply system. Such a system would be designed to capture and store any excess generated electricity and could be used in a number of ways.

During times of peak demand on the surrounding HV network, the centre would operate independently from the network and use the battery to provide its requirements. Network operators could potentially pay for this facility, which would effectively take pressure off the network during periods of excessive demand or periods when there is low capacity on the national grid.

The Distribution Network Operators have in recent years increasingly availed themselves of large renewable generators to provide electrical stability during times of peak demand, and there could be a financial benefit to the depot here that would need to be negotiated with the DNO SSEN.

Various scenarios exist for the operation of the array during times of peak demand on the network. With a suitably sized battery storage system the centre could automatically disconnect from the network and run on its stored power. The advantage to the Borough is that it would be paid by the network operator to provide its own power during times of peak demand. Such times would most likely coincide with periods of low depot activity.

A suitably sized battery storage system could provide up to 12-36 hours of resilience and back-up during times of outage or voluntary disconnection from the grid, without having to switch to fossil fuel based back-up (diesel generated electricity). With careful energy management in place the above endurance could be further extended.

In any case, it is anticipated that the array would be providing all of the centre's electrical requirements at any one time, either from directly generated power from sunshine, or from utilisation of on-site stored energy from the battery.

The other use of the battery storage system would be for use by the centres electric boat fleet and sites e-bike vehicle fleet. The stored energy could be used during night-time to provide a charging power supply to the fleet.

During periods of high output and long hours of sunshine during the summer months when the PV generator operation is at a relatively high level, the battery would effectively be at capacity during daylight hours, with its demand being called on during the hours of darkness for electrical charging.

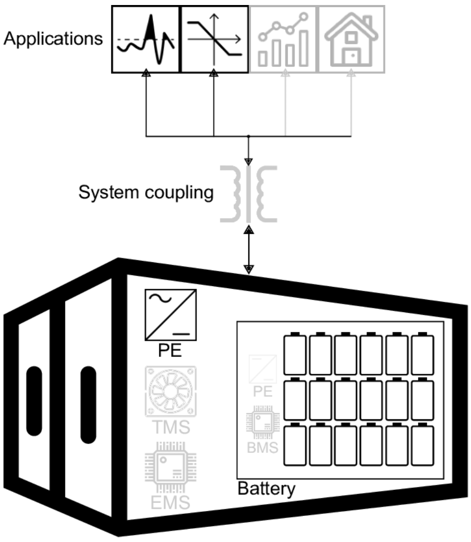


Figure 2: Battery Energy Storage Architecture

The type and chemical make-up of the individual battery cells is beyond the scope of this report, but in recent years the industry has seen the rise in Lithium-Ion (Li-Iron) battery cells for such PV and Hybrid energy storage systems.

No matter what battery system is installed, such battery storage would require proper management and maintenance.

It is also worth noting that such systems have a useful service life, with typical VRLA (lead acid cells) batteries lasting in the region of six to eight years.

Modern solid-state cells such as Lithium-Iron (Li-Iron) batteries can potentially increase this to approximately ten years or more, depending on usage and daily demand.

Also available as a battery technology are Lithium Iron battery cells. Although these cells currently have less capacity than the above Ion cells, their technology is improving all the time. The chief advantage of installing Lithium Iron over Lithium Ion or cobalt is safety, with Lithium Iron phosphate having excellent thermal and chemical stability. This lends them to situations where fire risk and fire mitigation are a concern to the owners of energy centres. That, along with their cheaper cost makes them ideal for such energy storage systems where space requirements are not an issue.

Battery cycle life is affected by many different stress factors including temperature, discharge current demand, charge current availability, state of charge ranges (depth of discharge) and propulsion systems' coupling set ups.

In all situations an effective battery storage system would require temperature and environmental controls and monitoring as well as fire detection and suppression systems.

The battery needs to be housed in an environmentally controlled housing to maintain an effective operating condition and help to prolong its useful service life.

The modern operation of such Battery Storage Systems is a developing technology. The opportunity exists here for technical training and development programmes to be developed for depot maintenance staff and operations teams.

The use and management of targeted training programmes in renewable technologies could open the door and present opportunities for the Borough to invest in their personnel with the view to personal development and career advancement. With modern education moving over to more technological and apprentice- based vocational training, such training programmes could even be expanded to become a fully developed and supported apprenticeship scheme leading to a recognised qualification in renewable energy technologies management.

6. TELECOMS

The new site will need to be served by telecoms and data services. The centre will require reliable landline telephones for emergency calls as well as high speed internet ASDL services. The facility will have a number of specialist systems that require off site remote monitoring such as CCTV, Fire alarms, Energy management, pump monitoring, weather stations, nature cams, intruder alarms etc. All of these monitored systems will require a reliable connection to high speed, high bandwidth fibre internet connection.

As mentioned above a BT Openreach connection will be routed in from the Broadwater Lane side, across the canal. Like the required water connections this route would pose less of an impact on the residents, and the aggregates business.

7. BOAT & VEHICLE BATTERY CHARGING

A substantial proportion of the stored battery energy will be used to charge the batteries of the onsite electric craft motors as well as a number of electric road vehicle chargers.

The facility will have four active and four passive electric vehicle chargers installed onsite.

In addition there will be thirty charging stations installed to charge the electric batteries of the electric boat motors.

The side will also be providing charging points for personal mobility scooters and electric wheelchairs.

8. WATER SOURCE HEAT PUMP

A water source heat pump system will be installed drawing water from the lake as an energy source. This is a green smart technology which is a self-contained system which is ecologically safe and non-polluting as well providing full replenishment, and water aeriation to the lake water.

The chief advantages and benefits of a water source heat pump system are:

1. No deep bore holes are required which could pose a risk to any aquifers.
2. It is powered by free onsite generated electricity from the PV generator.
3. Free heating and domestic hot water.
4. Circulation: the heat pump should help prevent lake water stagnation by introducing water circulation to relatively still sections of the lake, such as the lagoon.
5. Aeration: as above, the pump would provide beneficial aeration to these sections of lake water.
6. Cooling: In the summer months cooled water from the system is returned to the lake.

From such a system there is a potential to drive a proposed self-contained micro pumped stored hydro generator which could potentially be used at time of peak demand to generate additional electrical power while releasing water harmlessly back into the lake without any adverse impact on its ecosystems.

9. ENERGY PROVIDER

9.1. Current and Forecast Unit Electricity Costs

Up until the recent energy increases in mid to early 2022, the average cost of a unit of electricity to commercial businesses, based on a variable rate, was approximately 18.9 pence per kilowatt hour.

In the last few months this rate has risen to around 36 pence.

Area	Average variable unit price in 2021 (p/kWh)	April - Sept 2022 (p/kWh)	Current average electrical buy in rates 2023 (p/kWh)
London	18.9	28.2	36
South East	19.5	26.5	36
United Kingdom average (including VAT)	**18.9**	**28**	**36**
https://www.nimblefins.co.uk/average-cost-electricity-kwh-uk#nogo			

Table 1: Variable Unit Price

Based on the rates quoted in the above table and the potential forecast yield of a 400kW generator, the table below shows the current and forecast potential revenue that could be generated.

400 kW Array Estimated Annual Yield (kWh)	Average variable unit price in 2021 (p/kWh)	April – Sept 2022 (p/kWh)	Current average electrical buy in rates 2023 (p/kWh)
	18.9	28.2	36
Potential 400kW Generator Annual Yield	379,680	£107,069.76	£135,684.80

Table 2: Potential Revenue

A 400kW sized generator, with a suitable and well managed energy centre, would effectively replace the monthly electrical cost and could become an additional income source as well as effectively rendering the Depot self-sufficient from an electricity perspective.

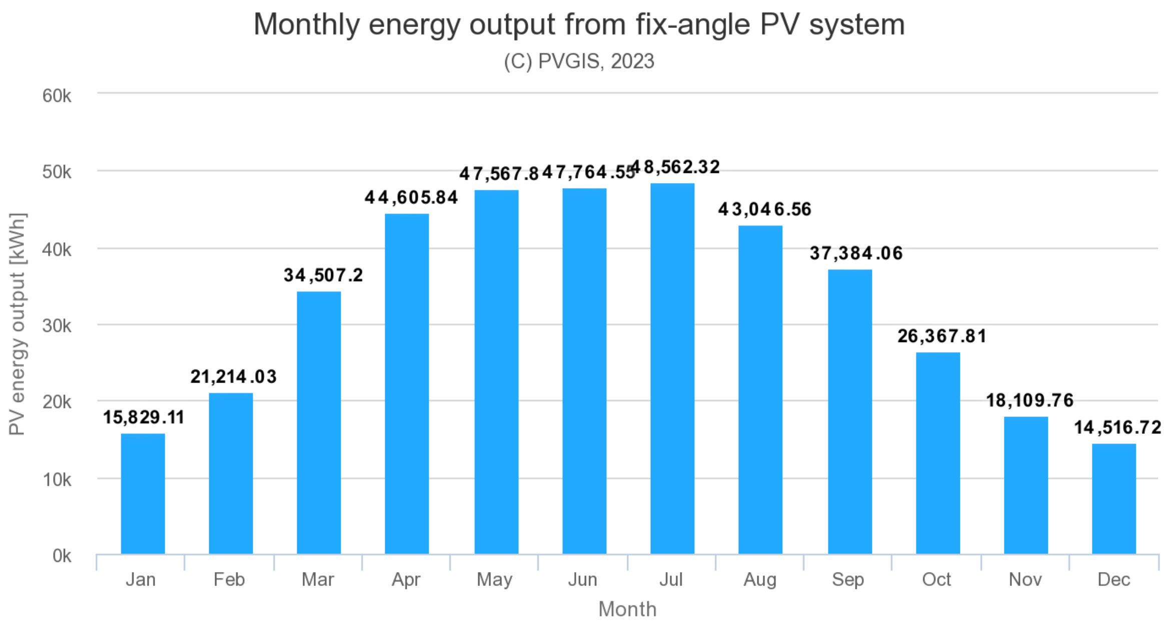
9.2. A Source of Income

The table below shows a representation of electrical Energy generated by the array compared with the estimated current electrical consumption for the depot.

	400kW Array Estimated Annual Yield (kWh)	Average 2022 28.2 (p/kWh)	Forecast 2023 36 (p/kWh)	Homes @ 3,829kWH
		28.2	36	
Potential 400kW Generator Annual Yield	379,680	£107,069.76	£135,684.80	99.15

Table 3: Potential Income v Consumption

The table above shows a figure for the potential yield from the PV array of 379,680kWh.



10. ZERO CARBON SITE

The site will be operated as a carbon neutral site with the site's energy demands being met from onsite embedded generation. A battery storage system would be a key element here, allowing energy to be captured and utilised for boat and vehicle charging.

A number of additional onsite micro generation systems can also be explored such as micro pumped stored hydro generation which could add additional power and energy value to the other on-site renewables.

This is an opportunity to create a flag ship self-sufficient renewables based development capable of operation off grid providing its own power requirements as well as possibly exporting excess green energy to local users.

11. SEWAGE PUMPING AND BUFFER STORAGE

The site sewage containment system will be carefully designed, given its location and proximity to the lake and its eco system. This system will be an impervious pumped buffer storage system. The system will contain all the sites foul water and sewage, hold it, and prevent it from any accidental discharge into the lake or water courses.

Such an approach will be on the principle of "contain and removal" with all sewage being held in a suitably sized buffer tank until it can be pumped off site during periods of capacity on the local system. The storage tank will be sized with the capacity to hold all the sewage, in the event of pump failure, for a period of at least 24 hours until the system can be repaired. During peak periods of high demand on the main local network the sewage will be held safely until it can be discharged to the sewer system during a period of lesser demand.

There will no sewage treatment plant on site due to the volumes and usage profiles of the site's system and the delicate environment of the SSSI.

Any form of natural filter bed method, such as reed beds would most likely not be allowed due to the risk of chemical pollution to the surrounding lake waters. Due to the toxic chemical make-up of modern foul water (sewage) natural reed bed systems have not been found suitable as a modern treatment method. Such treatment is best carried out at a modern treatment facility.

12. CONCLUSION

The opportunity exists on the Broadwater site for PV generation in the region of around 400kW based on the potential size of the electrical. This array could not only provide for the centre's energy needs, but any excess energy could be distributed to local users under a power purchase agreement arrangement.

The least disruptive option for serving the site with utilities is to follow the route across the canal on the existing utilities gantry. This would be much less disruptive to the existing properties to the south of the site where a dig along their only access road would be quite disruptive.

Any energy generated could be seen as a potential income source for the Borough as well as removing its dependence on fossil fuels. With the current and future predictions of volatility in the global energy supply market, such a Power Purchase Agreement, PPA, or similar, development would be a stable, secure source of revenue. This income would offset the Borough's current energy costs, and help protect the Borough from exposure to the global energy market increases.

The potential to generate clean, renewable green energy and help offset the Borough's carbon footprint should be pursued. The best use of Council assets is to generate green energy which would be an effective use of this type of green belt environment that is surrounded by potential electrical users.

In an increasingly volatile energy market, all avenues should by explored with the view of provision of reliable clean energy from a smart renewable source.

The development of a Power Purchase Agreement (PPA) development arm of the Borough should be investigated. Such an arm could have the potential to sell the excess generated electrical energy for the Borough and reduce its reliance on bought-in grid generated energy. A PPA development could provide a secure source of green energy that is protected from the current volatility of the energy markets. Going forward the potential green and carbon reduction benefits of such a development could go a long way towards the Borough meeting its carbon offsetting targets. Potential electrical users of such green exported electrical energy would be Harefield hospital for example.

One of the chief advantages to the type of renewables discussed in this report is the low cost of owner ship and op-ex. The above systems are designed to be low maintenance with the service intervals and parts replacement timescale running in tens of years. Modern renewables are designed to be remotely monitored with out the need to maintenance technicians to attend site until such a time as a component has failed.

Below is a brief bullet point capture of the report's main recommendations:-

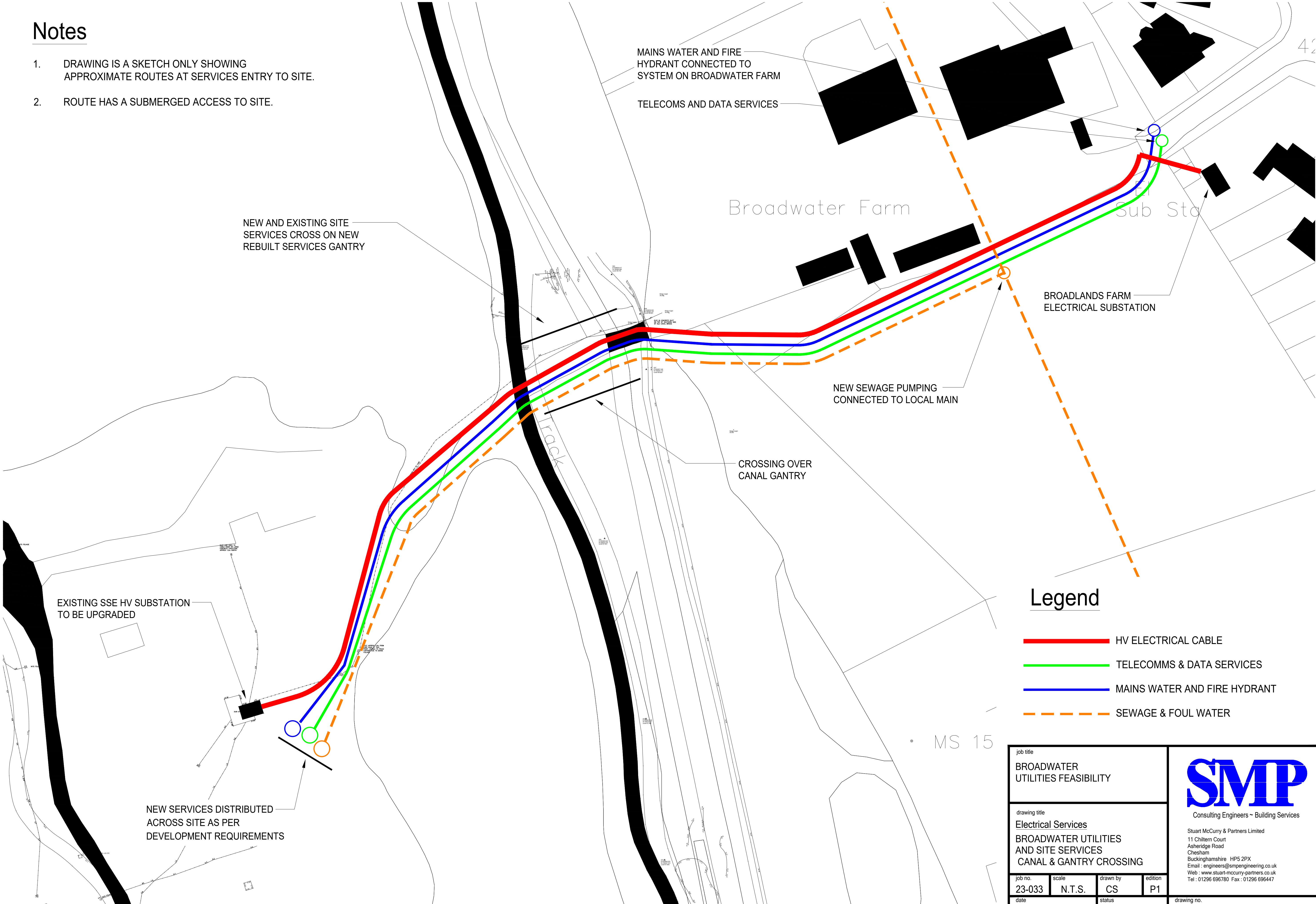
- The creation of a canal crossing for the utilities to enter the site over a canal gantry and into the Northern portion of the site.
- Avoid the Southern route due to congestion.
- Install a suitably sized PV generator based on the Electrical intake size.
- Install an energy centre with battery storage.
- Install a water source heat pump.

- Install a pumped sewage system with storage vessel.

13. APPENDIX A – UTILITIES SURVEY

Notes

1. DRAWING IS A SKETCH ONLY SHOWING APPROXIMATE ROUTES AT SERVICES ENTRY TO SITE.
2. ROUTE HAS A SUBMERGED ACCESS TO SITE.



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drawing title: Electrical Services
BROADWATER UTILITIES AND SITE SERVICES CANAL & GANTRY CROSSING

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SMP
Consulting Engineers ~ Building Services
Stuart McCurry & Partners Limited
11 Chiltern Court
Asheridge Road
Chesham
Buckinghamshire HP5 2PX
Email : engineers@smpengineering.co.uk
Web : www.stuart-mccurry-partners.co.uk
Tel : 01296 696780 Fax : 01296 696447