

Caversham Weir

Hydrogeological Desk Study and Risk Assessment

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Introduction

Reading Hydro is a community project to build a sustainable energy power source on the River Thames at Caversham Weir, Reading. This project is based on the environmental principles of sustainability and minimising our impact on the natural environment. The project also aims to provide a focus for and funding of sustainability education in the area. Thus it is important to all involved to ensure that the building and maintenance of the scheme will not be to the detriment of the river system nor of the aquifer below.

The associated fish pass, the plans for which Environment Agency approval has already been received, will help enhance the biodiversity of the river. The Environment Agency has also already granted abstraction and return licences for the micro hydroelectricity project.

The local bedrock geology is that of undifferentiated Seaford Chalk Formation and Newhaven Chalk Formation, overlain by Quaternary deposits of mainly dense sand and gravel, with some finer alluvial deposits.

The aim of this report is to assess the level of possible risk to the Chalk aquifer and lays out how they will be minimised if impacted by the hydro scheme.

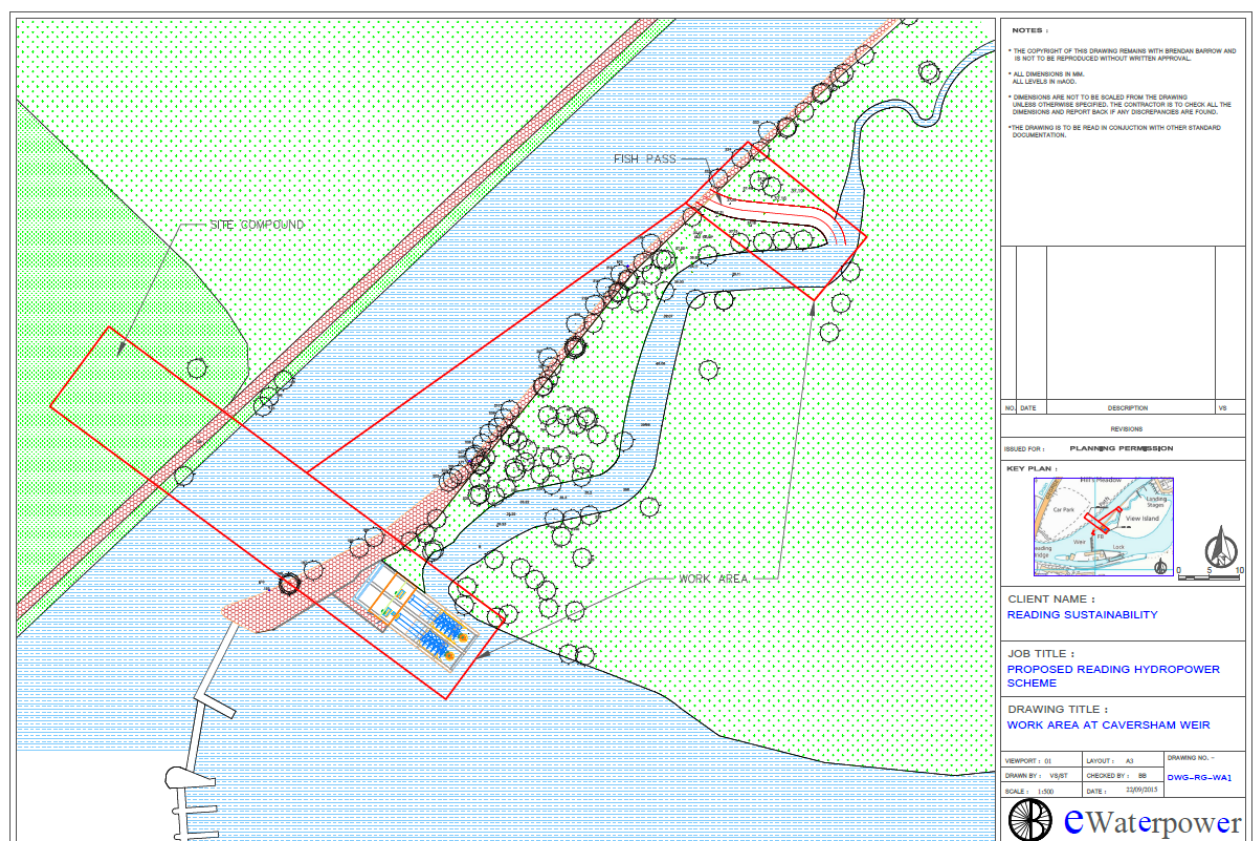
Any risks to the Chalk aquifer will be minimised by:

- Strong understanding of the local topography, historic land use, hydrology and geology, including access to a geotechnical surveys in the vicinity carried out in 1993 and 2002
- Further understanding and confirmation of the site conditions by the contractors prior to construction
- Lack of proximity to, connection with or disturbance of contaminated land during construction

- Well-proven low-impact construction materials and techniques, similar to those used at Windsor and Mapledurham, where the geological context is almost identical
- using existing piling for some of the vertical foundation sections
- Existing and new piling together forming both the cofferdam for construction and the foundations of the completed structure, so that any piling penetration of the bedrock will be rapid and immediately seal itself.
- Horizontal concrete foundations between the piling walls will immediately be lain to form a strong seal against penetration of any contaminants from the river into the substrata during or after construction.
- Any options for minimising the construction impact and size are being continuously researched.

Site Boundaries, Location and Topography

The Reading Hydro Community Benefit Society project has a proposed site at the eastern end of Caversham Weir, shown below with the work areas and site compound outlined in red. The Reading Hydro scheme will be inserted into an existing abutment to the weir, between the main weir and View Island. The associated proposed fish pass is shown cutting into View Island from the mill stream, to the east, where there will be a sluice.



Once building works are complete the turbines or tubes will be surrounded by water and fenced off from the public footpath with access being provided via a locked gate.

Permission has already been granted for the fish pass, which will run through View Island and exit adjacent to the hydro site. The head of the fish pass will be visible from the footpath which it will pass under and into the technical section which will run gently downhill to the existing

streambed where the water will flow towards the hydro scheme, eventually joining the river immediately adjacent to them creating an attraction flow for fish. It will be as it is today, a natural and unbounded area forming part of View Island which is itself already made up of a variety of natural habitats.

View Island is a low lying area of land, the entire area of which save that taken up by the public footpath lies below the level of the river above the weir and hence it floods regularly. The island is heavily wooded, mostly being covered by sycamore trees. There are remnants of Caversham House that used to be on the island, which was demolished and the most visible remaining feature is the old tennis court surface.

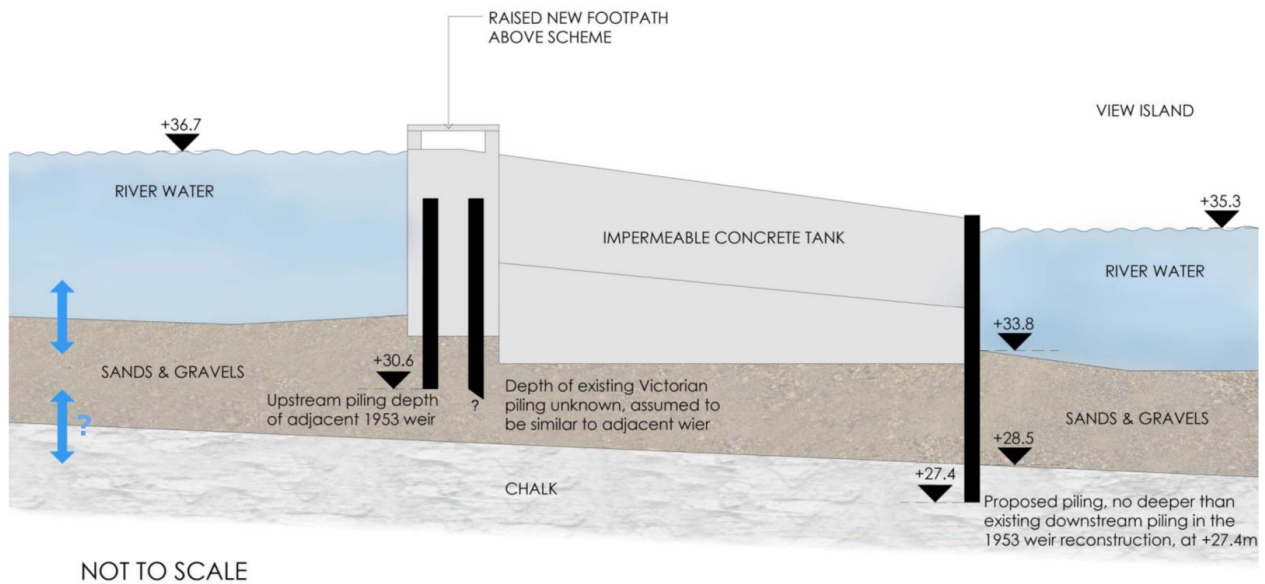
Access to the island is gained by means of a wooden bridge across the mill stream or by making use of the walkway over the weir structures. There are two further small wooden bridges that cross the old stream bed on the island, which can contain water when the river level is high.

The hydro scheme itself will be inserted only in the existing abutment and adjacent river bed, between the weir and View Island.



Conceptual Model

The conceptual model developed for this desk study of the Reading Hydro scheme is shown in the diagram below. This is not to scale, and simply indicates under water and subsurface relationships.



The water of the River Thames is in contact with the underlying Quaternary sands and gravels where its banks or bed are free of overlying low permeability clays and silts or artificial constructions.

The existing upstream piling at Caversham Weir does not penetrate to the known depth of the Chalk (c. 28.5maOD), however the downstream piling probably does, having been sunk to a depth of 27.4maOD in 1953. As this piling is continuous across the weir, it would also obstruct groundwater flow through the gravels under the weir. Thus it is flow of water over the weir that would most readily transport any water-borne contaminants.

The hydro power generating structure will be cut into an existing Victorian embankment, which has no historic contamination potential. Sheet piling will be driven no deeper than existing weir piling, and due to its compressive insertion will not create new groundwater pathways and will self-seal against the bedrock.

The construction of the Reading Hydro scheme will create a coffer dam within the piling, lined with cement from the beginning, effectively shutting off any downward percolation of fluids during and after construction, as the piling and cement lining will remain in place to support the hydro power generating machinery and form the sides of the associated new sluice channel. Additionally, the construction materials, as well as ongoing maintenance materials, such as biodegradable lubricants, will be low impact by design and avoid contamination risks.

The research and background for this conceptual model is described and referenced in more detail below.

Local Geology

Bedrock and Quaternary Deposits

The local bedrock geology is that of the undifferentiated Seaford Chalk Formation and Newhaven Chalk Formation, overlain by Quaternary deposits of mainly dense sand and gravel, with variable

finer alluvial deposits and/or made ground overlying these.

Local borehole records show the upper surface of the Chalk bedrock to be between 30.2 and 28.1maOD. They confirm that this is overlain by Quaternary deposits of medium dense to dense fine to coarse sand and sub-angular to sub-rounded fine to coarse gravel. In turn on land these are overlain by up to 5m of made ground, and/or alluvial silts and clays. The ground levels around the upper side of the weir and lock are over 37maOD.

The River Thames is incised into the sand and gravel deposits, so that they underlie and adjoin the river bed. This is demonstrated by the fact that the top surface of the gravels, as found in adjacent boreholes, ranges between 34.7 and 36.9maOD, whereas the river bed lies between 34.5 and 26.9maOD. There are publicly available records of two boreholes directly into the river bed by Reading Bridge, approximately 200m upstream of Caversham Weir, which both show 0.6m of silty or clayey gravels above an approximately 5m thickness of sand and gravels overlying the Chalk. The continuity of these river bed deposits is unknown, but is likely to be variable in thickness and composition.

Hydraulic Connection

The river bed of the Thames above and below the weir and lock contains some transient silt and mud, as well as sands and gravels. Boreholes under Reading Bridge directly into the river bed show that the sand and gravel deposits lie below 0.6m of silty or clayey gravel [BGS ID: 428690 & 428691].

Where river banks or the clayey river bed deposits are eroded, the Quaternary sands and gravels will be exposed and allow two way flow between the river and groundwater. Boreholes in the vicinity show these sands and gravels are deposited directly upon soft to firm blocky to rubbly Chalk. Thus the river water is potentially able to permeate directly to the Chalk aquifer along much of the river bed in this area, if there is significant permeability in the top of the Chalk.

The Cretaceous Chalk aquifer is known to have more developed secondary permeability in valley bottoms such as this, as bedding planes and fissures tend to be more widened than at interfluvies. However, two borehole records 325m from the site that recorded groundwater levels as drilling progressed show a drop in groundwater level of 1 to 1.5m between the sands and gravels and the Chalk aquifer, which implies limited hydraulic connection between the two [1970, BGS ID: 428363 & 428364].

Detailed river water depths are available from the 1951 weir rebuilding study and an Environment Agency survey in 2004. Above the weir the normal river water level is close to 37maOD, with water depths of 0-4m. It is deepest behind the main weir gates and close to Lock Island, and shallowest behind the proposed Reading Hydro site. Thus the Chalk will be overlain by a significant depth of sands and gravels upstream, given the Chalk's upper surface ranging between 28 and 30maOD in the area.

The river bed is of more uneven depth downstream of the weir. The water level is variable, with normal levels around 35.5maOD. The river is less than 2m deep close to View Island, the bed being around 33.8maOD where the tail end of the hydro scheme will be sited. However, the river bed is locally as low as 28.9maOD 20m downstream of the hydro site, and 26.9maOD in the

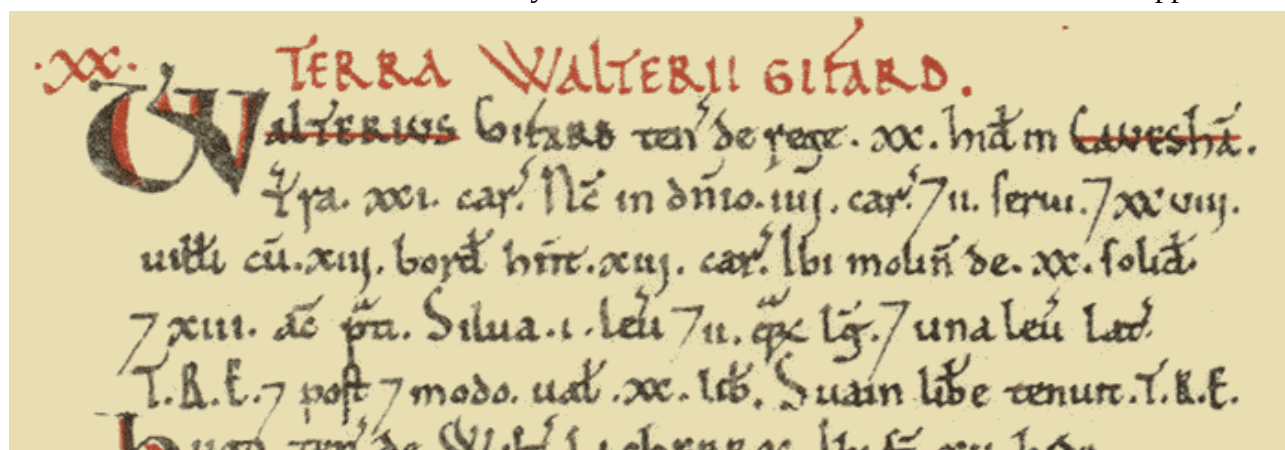
deepest part of the weir pool with 8.4m water depth there. This implies scouring through the sands and gravels into the Chalk, the upper surface of which is normally in the region of 28-29maOD, as indicated by the nearest borehole logs available. Any overlying sands and gravels in the deeper parts of the weir pool downstream of Caversham Weir will therefore be reworked and thin.

Clearly, if there is any contamination in the waters of the River Thames or the surrounding sand and gravel deposits, only the lack of permeability of the Chalk would stop waterborne pollutants permeating into this aquifer. The proposed hydro project will neither reduce nor add to this connectivity. Thus the potential contamination risks of any works in the area would only result if they disturbed contaminated land or releasing contaminants into the river water or sands and gravels. To assess this, we will look at the history of the site and proposed construction.

Historical Land Use

Summary of History of the Site

The weir and mill stream at Caversham have 1000 years of known history. The major episodes of more recent river management construction occurred in 1778, 1877, 1884 and 1953. A timeline of historical construction activity and records has been created and added as an appendix.



Mill, Lock and Weir Construction History

A mill stream and weir system has been built up by human action for a thousand years or more at Caversham, making use of an islanded section of the river. Caversham Mill was first referenced in the Domesday Book [above].

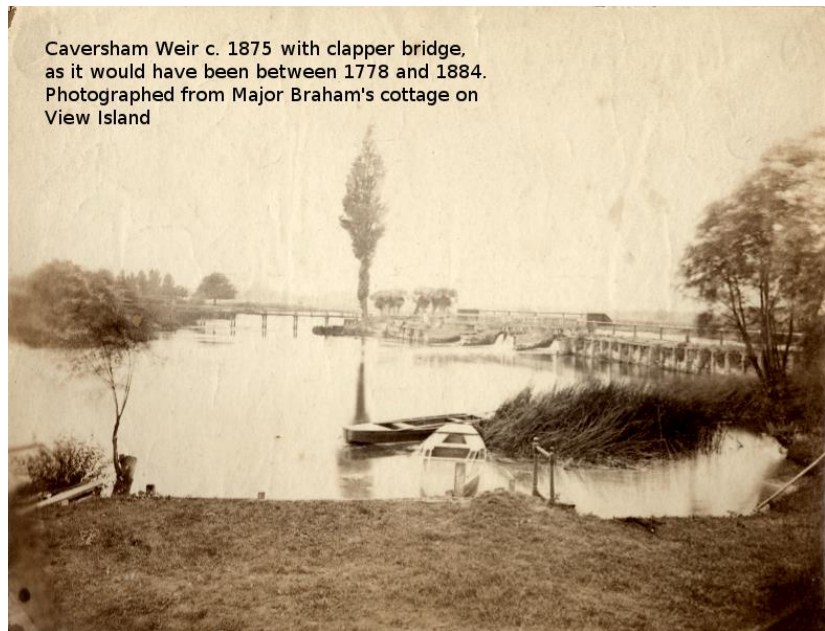
By 1219 a weir, flash lock and ferries were recorded as part of the landholdings here of William, Earl Marshall. The flash lock was roughly where weir C currently is, right next to the proposed Reading Hydro site. A flash lock is one that barges can float down over or be winched upstream over when a burst of water is released by removing the lock paddles (manually removed sluice gates).

When a salaried Thames Navigation Commission was set up in 1771 it had the power to buy land and make river improvements. One of the most important works was to replace the problematic flash locks with pound locks. These are those we know today with two sets of lock gates and an intermediate narrow basin where the water is raised and lowered.

The Caversham pound lock was built in 1778 on the southern side of the river, with the former flash lock site becoming a weir. There was a clapper bridge (wooden walkway) across the weirs to Lock Island from this time.

Rebuilding of the lock occurred in 1875, with weir reconstruction happening in 1884 [both seen in 1890 photo right, Reading Libraries]. By 1954 the weir was reconstructed again, with Weir D at the eastern end of View

Island reconstructed in 1960, and a salmon pass inserted in Weir C in 1993. These are the structures still seen today.



Caversham Weir c. 1875 with clapper bridge, as it would have been between 1778 and 1884. Photographed from Major Braham's cottage on View Island



The Proposed Reading Hydro Site

The site of the proposed Reading Hydro electricity generating scheme is a two-sided made ground embankment above the Quaternary sand and gravel deposits. It forms a narrow tract where the former mill stream has been divided off from the Thames to channel water behind View Island from above the weir. The embankment forms the eastern abutment to Weir C and supports a footpath.

The site's last period of significant construction would have been during the 1884 Caversham Weir reconstruction. Some superficial reinforcement, resurfacing, repair and vegetative overgrowth have occurred since.

The made ground is likely to consist of reinforced concrete, disturbed alluvium and sand and

gravel deposits and perhaps some broken building materials. The upper surface is currently tarmac, with fencing either side.



The difference in water level from the mill stream side to the weir tail side averages 1.4m, varying with river flow. This narrow strip of concrete-sided abutment is a public right of way, and has served no other purposes.

View Island and Heron Island

View Island is currently a public parkland area, which was bequeathed to Reading Borough Council in 1935. Before this time it was private land with a large mid-Victorian house at the western end.



View Island can be seen as open land and a different shape in the 1830 OS map (pictured above). Here Lock Island looks much wider and shorter than currently, although this map may not be entirely accurate.

By the time of the 1877 map (see below) the island had altered much to its present shape, even before the 1875 lock reconstruction. Some artificial and natural soil redistribution will have occurred. By 1877 a house had been built at the western end of the island, with a mix of formal and informal grounds, and lasting from the late 19th century until at least 1935.

By 1871 the Knight family lived on View Island, as osiers and willow-rod growers for

basket making, as well as gardeners. By 1891, now at Caversham Mill Fishery, they were bankrupt and left the site. At the same time (1875), Major Braham's cottage was on the island, which is likely to have been the site of the main house. This was improved in 1889 by Frank Attwells, the then owner, with living rooms and a verandah, and accommodation for his steam launch.

A boatbuilder called Adams and Gygells was in business by 1891 and had boathouse somewhere in the locality. There is no direct record of its location but from descriptions it is thought to be associated with the View Island house. Maps from 1877 onwards mark a boathouse on what is now Heron Island, which was then probably considered part of View Island. This boathouse can be seen to the

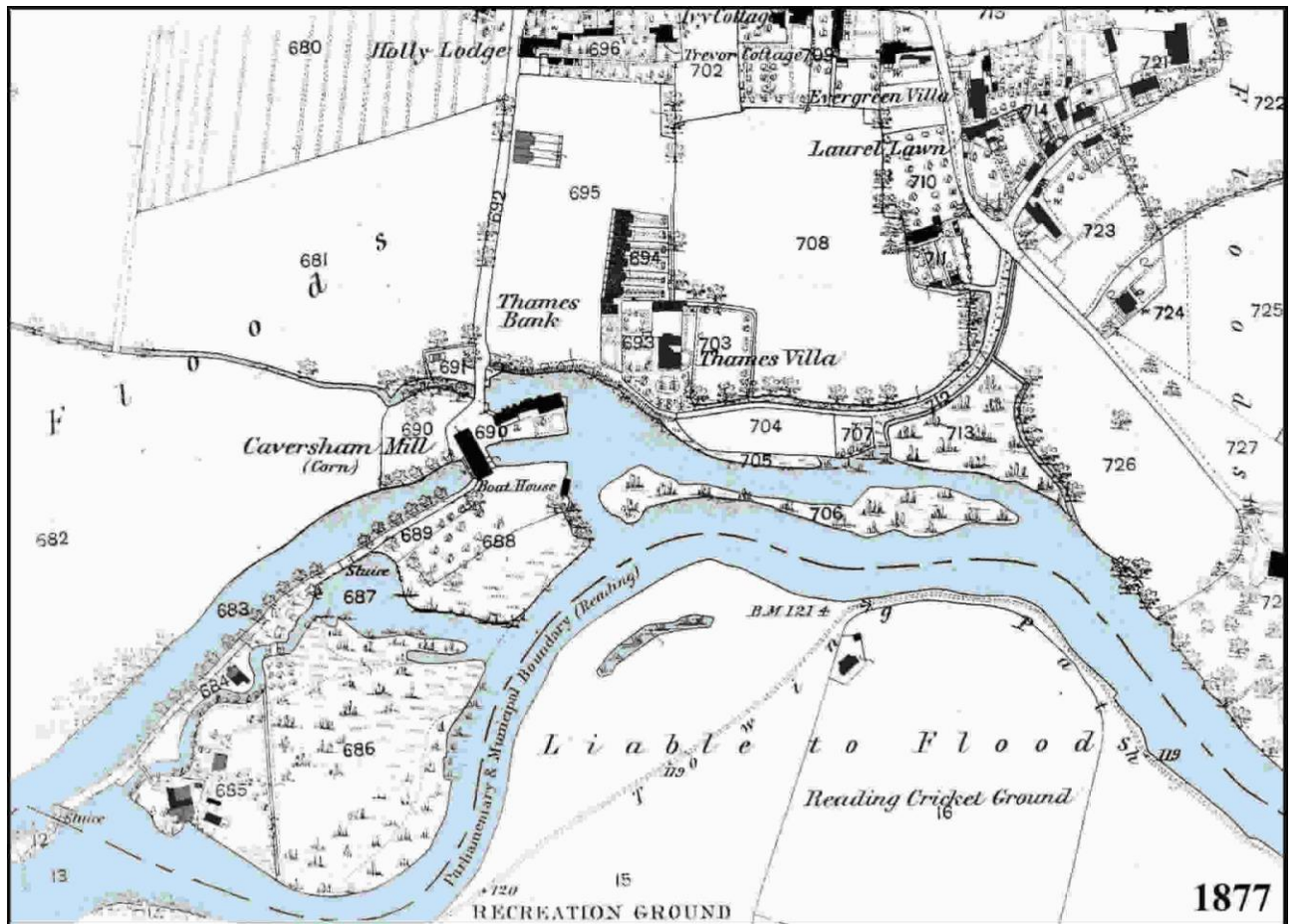
left in an 1890 photo of Caversham Mill and looks significant enough to have been a boat building and hire facility [Francis Frith via Reading Libraries]. The main purpose of the boat business appears to have been pleasure boats for hire. Construction would have been of mainly small wooden boats that would have been built and hired from the boathouse, and some larger boats may have been built or kept here.



By 1901, the main house and land of View Island had become a private dwelling called Caversham House, which was occupied by a stockbroker called James Watts, who was likely to have been the JH Watts who bequeathed View Island to the Council upon his death in 1935. In 1914 some land was trimmed from View Island to improve flow.

After this time, the house was demolished and the land became overgrown. In 1998 View Island was opened as a public park after being overhauled. All that remains of the former house is the tarmac of the tennis courts.

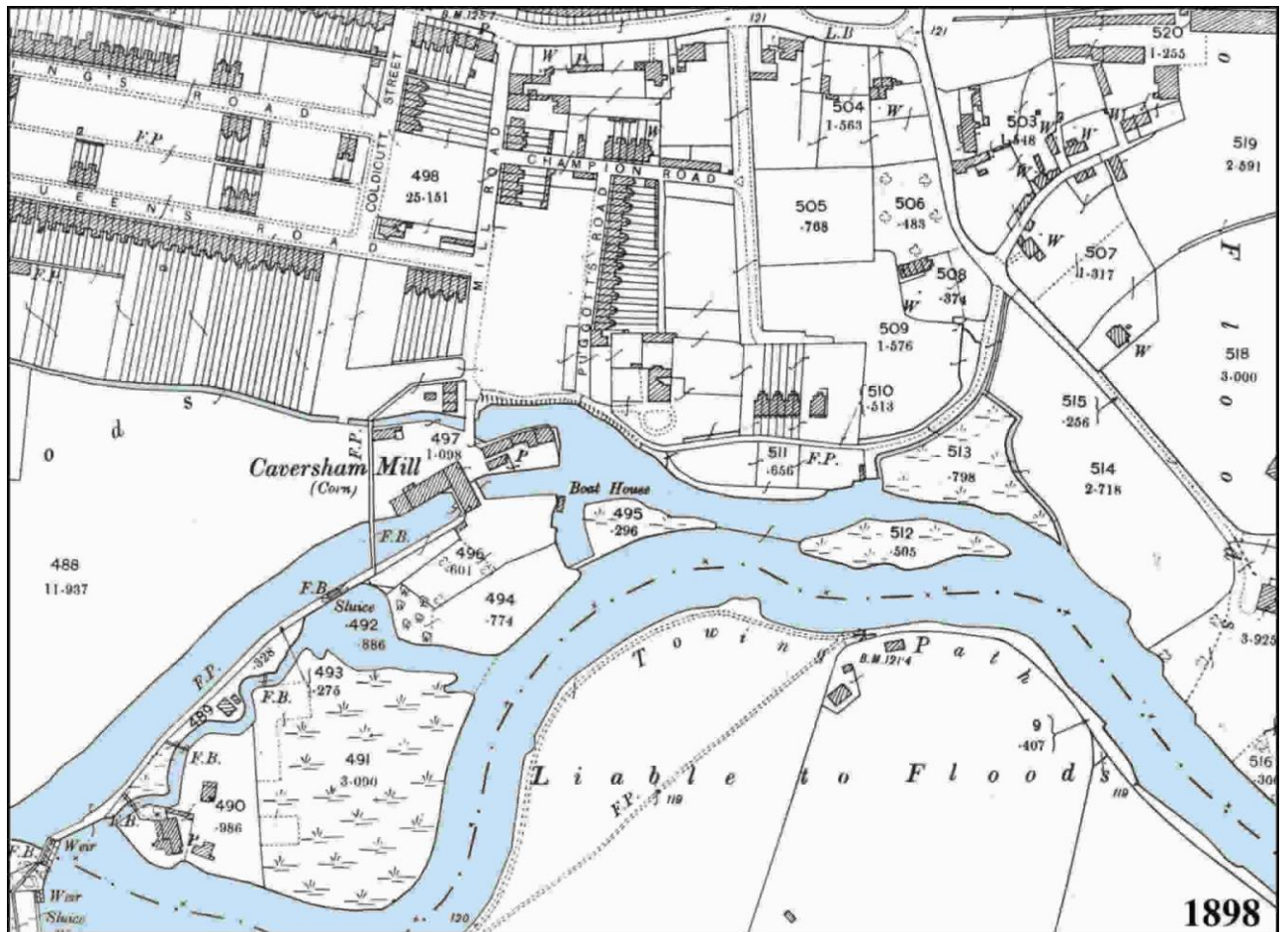
1877 map showing View Island to be in part flood land and in part occupied by the large house, thought to have been a hotel.



The western end of View Island in 1877 (Reading Library archives
<http://readingimages.epixtech.co.uk/loc/1204148.PDF>)



1898 map showing View Island showing little change in 21 years, though much housebuilding beyond



Aerial view of Caversham Weir and View Island, with the mill to the left, c.1920 (Reading Library images <http://readingimages.epixtech.co.uk/loc/1205083.PDF>)



1932 map showing View Island house/hotel grounds now covering the whole island.

Southern Side of Caversham Lock

On the Reading town side of Caversham Lock, opposite view Island, lies a strip of land that is raised to the upper lock level along its length, with a significant drop into a ditch on its south side, reflecting the change in level through the weir and lock. Beyond this lies the open floodplain park area known as Kings Meadows, where a Victorian lido is now being renovated. A little way upstream,



just east of Reading Bridge is some modern housing, which in a 1924 photograph was clearly the site of a rowing club, with boat houses and boat builders known in this vicinity.

The southern bank of the lock was subject to a geotechnical survey in 2002, providing useful data on its composition and underlying geology. As this area was last built up in the late Victorian reconstruction of the lock and weir, and its function was simply to hold back the water, it is likely that its composition bears similarity to that at the proposed Reading Hydro project site, which has had a similar role.

Contamination Potential in the Vicinity

Contamination in the immediate area has been shown by the history to be that of river management and scattered residential buildings. Any potential ground contamination is likely to be low urban and residential Normal Background Contamination (NBC) levels, as demonstrated by soil samples at the lock. However a few historic sites of heavier industry were once located 400m upstream on the Reading side, which have influenced river water chemistry.

Hills Meadows

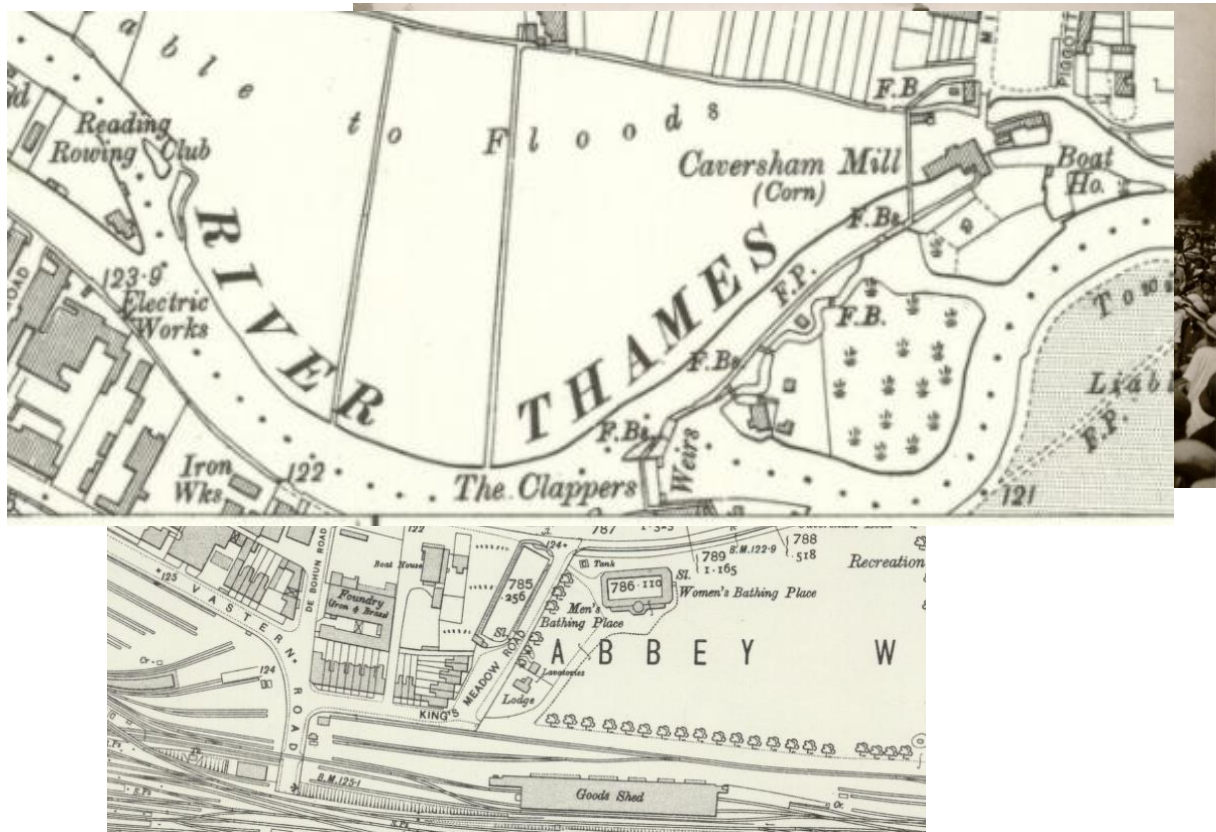
This car park and recreational facility to the north of the Thames close to the weir system may have some light pollution runoff due to a large car park and occasional fairground use. Any such runoff is likely to enter the Thames down or through its banks, leaking storm drains, and by permeating through the soils.

Historic Industrial Land Use

We have not found any registered contaminated land in the vicinity, despite the significant development of the area over the past century.

From the pre 1900 until the 1960's a coal-fired power station operated on the present Scottish and Southern Energy Power Distribution office site between Vastern Road and the River Thames, supplying power to Reading and demolished in 1970 [pictured in 1926, and OS 6 inch maps 1912/14] . The Coronium Metal Company Ltd, non-ferrous founders, were located at the site of what is now Reading Bridge House. Historic maps of 1912 also show an iron works, and in 1934

also show paint works, a cod store and ice factory. All industries along this bank have long since been replaced by office space and housing.



Boat Building and Hire

Boating along the river were popular from the 18th century to the mid 20th century. Steam powered boats appeared in the 19th century, for both passengers and commodity transport, the latter reducing with the introduction of the railway in the 1850's. Thus there were several boatbuilders and boat houses during this time, including East Ltd just upstream of the lock, where the Environment Agency building and some modern housing are now sited. Electric boats were recharged by the power plant. There was also thought to have been some brief boat building and boat hire before 1910 at View Island or Heron Island, as detailed previously.

There were also outdoor swimming pools at the Thames Lido, in Kings Meadow by Caversham Lock. The former womens bathing place is currently being renovated after many years of dereliction.

Soil Samples at the Lock

The soil samples taken in the boreholes beside the lock in 2002 demonstrate below NBC levels of PAH, arsenic, cadmium, lead, mercury, copper and nickel, yet these soils are on the side of the river closest to Reading town centre, the railway and more intensive land uses. Since the make up of this area is closer to potential contamination sources than the proposed Reading Hydro site and of similar construction, yet raises no concerns, there is no anticipated contamination above NBCs at the proposed Reading Hydro site.

Hydrology

River Water Chemistry

The River Thames in Reading is subject to runoff from urban and residential areas, as well as treated wastewater. It will also suffer from agricultural run-off further upstream, including ammonia and nitrates.

Whilst water quality data for the catchment sections above Caversham Lock show good water quality in respect to organic pollutants, it frequently contains high levels of ammonia, arsenic, copper, iron and zinc, and occasionally nickel, whilst having a high temperature and pH. A high pH is anticipated in an hydrological system so closely associated with the Chalk. This will be a reflection of the urbanisation of Reading and the catchment further upstream.

During flooding episodes in 2014 there was evidence of significantly elevated faecal content in Thames flood waters. However, due to the relatively rapid deterioration of such contaminants over time combined with lowered downward permeation of groundwater during flooding episodes, this may not pose a significant Chalk aquifer contamination threat.

Flood Risk

Being sited in the middle of a major river of the UK, although local flood management is excellent, there is significant flood risk. However, being sited on a weir, historic flood levels on the upstream side has a relatively low range. On the downstream side, the water level has a higher range. The head at the weir is normally about 1.4m, but is significantly less during flood conditions as the downstream levels rise more than upstream.

The highest floods in recent history were in 1947, before the 1954 electric weir operating system with far greater flow capacity was put in place. The photograph to the right shows workmen clearing debris at Caversham Weir in March 1947, with water over-running the abutments and with only a small difference in river level above and below the weir [Photograph via Reading Museum, from the Reading Chronicle Collection].

Due to current river management systems at Caversham and all along the Thames, the risk of such an extreme flooding has been significantly reduced. A 1988 study predicted that computer automation of the weir gates could keep the levels even, whatever the inputs. However in 2003 and 2014 there was significant flooding (37.5maOD January 2003 upstream; 37.4maOD in March 2014 upstream and 37.0maOD downstream).



Construction

Existing Weir Construction

The existing weir was last reconstructed in the 1950's, at which time sheet piles were driven down

into the bedrock both at the upstream and tail end of the weir. The concrete abutments date to a much earlier time, most likely the 1884 rebuild of the weir. This includes the raised path section where the Reading Hydro site is proposed, just west of View Island.

On the 1950's plans this abutment is shown to contain 'existing universal piling', but it is not stated of what material this is constructed. The whole abutment construction is covered in concrete. A photo from the early 1900's shows the site looking in very good condition, as further evidence that it would have only been a couple of decades old [pictured below left in a relatively newly built state, c. 1890; Reading Libraries archive].



The 1951 weir reconstruction plans show the upstream piling to a depth of 100.29ftaOD, equalling 30.6maOD. Since local boreholes show the Chalk upper surface being between 28.1 and 30.2maOD, it is unlikely that the upstream piling penetrated the Chalk, particularly since the closer boreholes to the site are at the lower end of this range [ref borehole table]. However, the downstream piling was planned to penetrate to 90ftaOD, equalling 27.4maOD, and thus will probably have penetrated the Chalk.

Made ground is anticipated in the fill of the current weir and abutment construction, as detected by the geotechnical survey in 1993 at the adjacent weir, and the lock bank geotechnical survey of 2002. The soil sample analyses show the lock bank to be constructed of disturbed superficial deposits, with below normal background limits of key contaminants. The same situation is anticipated at the Reading Hydro scheme site, with even lower potential for soil contamination, being further from historic or current sources.

Proposed Hydro Generation Construction

The proposed construction will drive in sheet piling to abut against existing piling, and close off the tail end of the construction area. If there is any deficiency in existing piling in the Victorian structure, further piling can be driven in to compensate. The complete boxing in by piling of the construction area will both form a cofferdam to hold out the river water, and will also act as the final boundaries of the construction. Thus piling will only occur once. It will not need to penetrate any deeper than the piling used in the 1954 weir reconstruction.

Piling, being a compressive process, will not open up pathways that boring would, and will rapidly self-seal against the bedrock. The Chalk bedrock will be no more exposed than it already is by the nature of the overlying sands and gravels.

Construction of the Reading Hydro project will only commence when flood risk is considered to be low. The inside of the coffer dammed construction area will be excavated down into the sand and gravel deposits and immediately lined with concrete. Thus the interior of the construction area will be sealed from the sand and gravels and thus the underlying aquifer. In the unlikely event that flooding occurs during construction, this precaution of sealing the base from the start will avoid any risk of contamination of the sands and gravels or Chalk aquifer below through this route. The existing managed sluice system run by the Environment Agency will be undisturbed and in operation throughout construction.

The completed construction will be resistant to flood damage by design, and have its own overflow channel which will increase the maximum flow capacity of the whole weir. It will become part of the existing managed weir and sluice system.

The construction methods will be using well-understood low impact techniques, as used elsewhere on the Thames where the substrata are almost identical, such as at Windsor.

All the engineered power-generating apparatus will be inserted after the base of the construction site has been sealed with concrete.

Materials used for construction and maintenance of the scheme are selected for low environmental impact, including the use of biodegradable grease.

Thus the construction and existence of the scheme is not expected to increase contamination risk to the river or underlying strata, nor increase pathways into the Chalk aquifer. The scheme will increase the maximum flow capacity of the weir, thus assisting with flood alleviation and reducing related river water contamination events.

Similar Hydro Schemes on the Thames and their Geology

A number of other such schemes in similar geological contexts either exist on the Thames or have already gained planning approval. For none of these have contamination concerns been raised, due to the low impact nature of such schemes and lack of industrial history at their construction sites.

The proposed scheme at Goring is underlain by the Zig Zag Chalk Formation, beneath about 5m of Quaternary alluvium and sands and gravels.

The micro hydroelectricity generation scheme at Mapledurham has been in place since 2011. It is sited in a pre-existing mill race, with the adjacent ground being underlain by a thickness of about 4.3m of Quaternary alluvial deposits, particularly terrace gravels, underlain by the Seaford Chalk Formation and Newhaven Chalk Formation.

The first micro hydro scheme on the Thames was built at Sonning Mill. This is underlain by about 5m of Quaternary sands and gravels lying directly above the Seaford Chalk Formation and Newhaven Chalk Formation.

The hydro scheme at Romney Weir, Windsor, supplying power to Windsor Castle since 2013, is

similarly located in terms of the adjacent ground being underlain by about 11.6m of Quaternary sands and gravels above the Chalk aquifer.

In comparison, the Chalk aquifer is around 8m below ground level in the area of Caversham Weir. Thus the situation of the Chalk aquifer below Quaternary sands and gravels is similar at all these locations.

Conclusion

The River Thames in the vicinity of Caversham Lock is in direct hydrological contact with the underlying sands and gravels, which in turn directly overlie the Chalk aquifer. In the deeper parts of the weir pool below the lock, the full thickness of the Quaternary sands and gravels will be eroded away, leaving only a thin redeposited layer of sand, gravel and silt. This is a similar situation to other hydro schemes in this section of the Thames. Thus in this whole region of the Thames contamination threats need to be taken seriously.

The site geology and location is very similar to that of the existing micro hydro generation schemes on the Thames at Windsor, Sonning and Mapledurham, and that granted planning permission at Goring. Due to the low impact nature of such schemes, those proposed on the Thames to date are not known to have been required to provide a risk assessment desk study such as this. However, the Reading Hydro community benefit project has been pleased to do so for the peace of mind of all concerned, and because it is so near a large town.

Whilst artificial river management construction has taken place at the site for over a thousand years, the proposed site is only a Victorian weir abutment made of piling and concrete, most likely filled with reworked sands and gravels, built up over the centuries. Nearby land has only been used for scattered housing, boating, a car park and river management.

The construction of the proposed micro hydro electricity generating scheme at Caversham Weir will be low-impact by design. It will not increase pathways into the Chalk aquifer of any contaminants already in the river water. It will not release contaminants nor expose sources of contamination, for there are no indications of any at its proposed location. Thus the Reading Hydro scheme is not expected to result in an increase in contamination risk to the Chalk aquifer, nor the river, either during or after construction, in line with this community benefit project's purpose of environmental sustainability and enhancement.



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3. Atkinson, Walker & Peters 1988, Electronic automation of the weir gates on the River Thames, <http://digital-library.theiet.org/content/journals/10.1049/jiere.1988.0003>

Contamination

1. Environment Agency Catchment Data Explorer <http://environment.data.gov.uk/catchment-planning/WaterBody/GB106039030331>
2. George Street Allotments - only entry in the Reading Borough Council register of contaminated land. <http://old.reading.gov.uk/article/2568/Contaminated-Land> and <http://old.reading.gov.uk/media/1287/Contaminated-Land-Register/pdf/Contaminated-Land-Register.pdf>
3. Normal background concentrations (NBCs) of contaminants in English and Welsh soils <http://www.bgs.ac.uk/gbase/NBCDefraProject.html>
4. Polycyclic aromatic hydrocarbons (PAH) and polychlorinated biphenyls (PCB) in urban soils of Greater London, UK <http://nora.nerc.ac.uk/508789/>
5. Methodology for the determination of normal background concentrations of contaminants in English soil <http://www.sciencedirect.com/science/article/pii/S0048969713002878>
6. Normal background concentrations (NBCs) of contaminants in English soils: Final project report, British Geological Survey <http://nora.nerc.ac.uk/19946/1/CR12035N.pdf>
7. Fertiliser pollution lives on in the River Thames <http://planetearth.nerc.ac.uk/news/story.aspx?id=1125&cookieConsent=A>
8. Dr Ben Neuman of University of Reading - Heavily contaminated water found in the Thames Valley <https://www.reading.ac.uk/news-and-events/releases/PR563656.aspx>

Hydro Power Schemes

12. Mapledurham mill hydro power scheme: <http://www.bbc.co.uk/news/uk-england-oxfordshire-15434914> <http://www.mapledurhamwatermill.co.uk/page2.html>
13. Romney Weir hydro power scheme, Windsor: <http://www.bbc.co.uk/news/uk-england-berkshire-24771303>
14. Goring hydro power scheme: <http://www.bbc.co.uk/news/uk-england-35771054>
15. Sonning Mill hydro power scheme <http://www.millatsonning.com/about/green>

Appendices

Timeline

This table of key dates has been constructed to clarify the history of the site. Fuller detail is available in a spreadsheet, including references for each point.

Year	Construction	Details
1086	Mill (and thus mill race)	existed in Domesday book at Caversham
1219	Flash lock existed	By 1219 a weir, flash lock and ferries were recorded as part of the landholdings here of William, Earl Marshall. The flash lock was roughly where weir C currently is, right next to the proposed Reading Hydro site.
1493	Existing weir, mill, flash lock and ferry granted to Notley Abbey	weir, mill, ferry and flash lock on the site were referenced in 1493 when granted to Notley Abbey
1771	Thames Navigation Commission	When a salaried Thames Navigation Commission was set up in 1771 it had the power to buy land and make river improvements.
1778	Lock constructed	A pound lock was constructed.
1819	Lock House built	
1871	View Island osier and willow rod growing	William and Eliza Knight were osier or willow rod growers, and their son was a basket maker. William also gardened..
1875	Lock reconstructed	
1875	photo of pre-1884 weir	The weir, with The Clappers footpath over it, between Caversham and Reading, c. 1875. Photograph taken from Major Braham's cottage on View Island. A boat and a punt are moored in the foreground. 1870-1879.
1877	Map of large house / hotel and View Island	View Island shown as a hotel and marshland, with a stream running through it (which will become the Reading Hydro fish pass). A small boat house is shown at the eastern end of Heron island, beyond the mill.
1877	Photos of View Island	Smart hotel/house shown
1884	Main weir construction, along current lines	from diagram drawn during a 1973 reconstruction based on an 1884 plan.
1889	View Island House improved	the main house on View Island was improved in 1889 by Frank Attwells with living rooms and a verandah, and accommodation for his steam launch.
1890	Photo of lock and weir	Shows newly rebuilt weir
1891	Adams and Gyngells boatmaker set up	A boatbuilder called Adams and Gyngells set up in business in 1891 and had boathouse somewhere in the locality. There is no direct record of its location but from descriptions it is thought to be associated with the View Island house.

1898	Map of large house / hotel and View Island	Much as 1877, but the angle of the weirs has changed, and there are more houses in Caversham. View Island shown as a hotel and grassland.
1901	View Island and house became a private dwelling known as Caversham House	the house and land occupied by a stockbroker called James Watts
early 1900's	Photo of Reading Hydro site	Shows concrete structure, path and iron fencing, looking quite smart, with pollarded trees behind.
1914	Cutting away of part of View Island	Also campshedding of the new frontage to improve the approach to the lock and facilitate flow from the weir.
c. 1920	Large house / Hotel existed on View Island	Hotel and ornamental grounds shown on aerial photo, as well as a large mill on what is now the Heron Island housing development
1924	Rowing club photo by lock	
1932	Map of hotel and View Island	Much as 1898, and the hotel is still shown.
1934	Map of Thames side industry	Showing ice works, cold store and paint works either side of the power station and iron foundry, upstream of Reading Bridge on the south bank.
1935	View Island bequeathed to Reading Borough Council, who demolished house/hotel at some later point	Conveyancing document
1947	Highest flood in recent history	Much of lower Caversham was in flood after snow melt and rain. The lock and weir overflowed
1951-54	Caversham Weir Reconstruction - the first electrically operated weir	Steel piling and mechanised weir sluices, abutting existing concrete pillars and abutments
1950's	The British Technical Cork Company	Factory on Mill Island (now Heron Island)
1960	Improvements to Weir D	Small sluice gated weir at eastern end of View Island.
1970	Power station demolished	At current SSE office site by the Thames
1993	Fish Pass (Ladder)	Most recent construction at the weir, at southern end of Weir C

1998	View Island opened to public	View island renovated from its overgrown state and turned into a public park
2001 to 02	Ground investigation at Lock	Carried out due to proposed bank protection measures.

Borehole Records

BGS ID: 428364 : BGS Reference: SU77SW212	http://scans.bgs.ac.uk/sobi_scans/boreholes/428364/images/10761808.html	Thames Water building, Reading Bridge
BGS ID: 428363 : BGS Reference: SU77SW211	http://scans.bgs.ac.uk/sobi_scans/boreholes/428363/images/10761806.html	Thames Water building, Reading Bridge
BGS ID: 428453 : BGS Reference: SU77SW301	http://scans.bgs.ac.uk/sobi_scans/boreholes/428453/images/10761931.html	Cross Town Route, start of Napier Road
BGS ID: 428454 : BGS Reference: SU77SW302	http://scans.bgs.ac.uk/sobi_scans/boreholes/428454/images/10761934.html	Cross Town Route, start of Napier Road
BGS ID: 428455 : BGS Reference: SU77SW303	http://scans.bgs.ac.uk/sobi_scans/boreholes/428455/images/10761936.html	Cross Town Route, start of Napier Road
BGS ID: 428456 : BGS Reference: SU77SW304	http://scans.bgs.ac.uk/sobi_scans/boreholes/428456/images/10761939.html	Cross Town Route, start of Napier Road
BGS ID: 428457 : BGS Reference: SU77SW305	http://scans.bgs.ac.uk/sobi_scans/boreholes/428457/images/10761942.html	Cross Town Route, start of Napier Road
BHC1 (abandoned in made ground)		2002 Ground investigation
BHC1A		2002 Ground investigation
BHC2		2002 Ground investigation
BHC3		2002 Ground investigation
TPC1		2002 Ground investigation
TPC2		2002 Ground investigation

Without ordnance datum but in river bed		
BGS ID: 428691 : BGS Reference: SU77SW539	http://scans.bgs.ac.uk/sobi_scans/boreholes/428691/images/10762229.html	Reading Bridge, in river bed
BGS ID: 428690 : BGS Reference: SU77SW538	http://scans.bgs.ac.uk/sobi_scans/boreholes/428690/images/10762228.html	Reading Bridge, in river bed