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SUMMARY

Introduction

The National Rivers Authority is obliged under Statutory Instrument 1217, The Land Drainage Improvement Works (Assessment of Environmental Effects) Regulations 1988, to prepare an Environmental Statement if the environmental effects of proposed land drainage works are deemed to be significant.

This Statement details the environmental impacts and mitigation measures for the Contract C1 improvement works to the River Wandle. It includes information on the purpose of the project, descriptions of alternative options and the proposed option, the existing environment and analysis of the predicted environmental effects and mitigation measures.

These proposals form part of the wider Beddington and Mitcham Area of Opportunity Scheme (BMAO) designed to provide a 1:100 year level of protection by combining river works with flood storage areas. Contract C1 described here, involves interim works to the River Wandle from Beddington Park to Richmond Green. These will provide a 1:10 year level of flood protection for the immediate area. The works include the removal of restrictions, some channel and bank work, the creation of a flood relief channel and the replacement of a number of crossings. Alternative options such as major diversion channels and extensive enlargement of the existing channel were rejected both on environmental and engineering grounds.

There is presently insufficient capacity for flood flows at bridges and service crossings. In places the banks of the Wandle are in a dilapidated condition with piecemeal bank protection. Although the Wandle is generally of limited ecological value an Environmental Statement is considered necessary as a significant number of trees will be lost, particularly in Length 5 where a two-stage channel is to be created. The location of the trees which will be lost are detailed in Appendix 2, "Landscape Drawings". There is also a short section of concrete-lined channel to be constructed in addition to the existing lengths. Due to the urban location of the river a key issue has been to preserve the more natural sections of the Wandle and to pursue enhancements opportunities where possible.

Predicted Impacts and Mitigation Measures

Construction Impacts

* archaeology: the site to the north of the Wandle at the sewage treatment works is a Scheduled Ancient Monument. Where the scheme impinges on this site permission is needed from English Heritage to carry out any works. An Archaeological Watching Brief will be issued and an archaeological specialist employed to monitor the works

* **human impact:** this will include direct and indirect disturbance to local residents and property due to the movement of plant and material. Disruption will also occur as a result of the temporary closure of a number of footpaths and access routes and the closure of the Wandle Road Bridge during reconstruction. The impacts will be minimised by limiting the hours of use of plant and material and by fully informing local residents about the nature and the timing of the works

* **wildlife:** the proposals will lead to the loss of some 74 trees (including 36 sycamore and 22 willow). However the removal of trees has been avoided where at all possible, a full tree survey undertaken, and a plan for replanting of appropriate species drawn up. Working areas will be minimised to reduce disruption and the sites fully reinstated after work has been completed. The additional concrete section will be lined with gravels to encourage habitat diversity.

End-State Impacts

* **channel morphology:** the scheme will lead to loss of the existing morphology of the channel. However the proposals avoid extensive channel works where possible and incorporate more acceptable designs, such as two-stage channels. Gravels exposed by excavation will be left to form a new substrate and a more natural channel morphology incorporated where possible to provide a diverse range of habitats for fisheries, aquatic and terrestrial plants and animals.

* **landscape:** the general impact of the works (eg new flood walls and bank protection) and the loss of trees will result in a considerable impact on the existing landscape. To minimise this, full landscape plans have been drawn up. The proposals have been designed to blend in with the existing environment and a tree replanting programme will be implemented.

* **wildlife:** the impact of the loss of trees will be minimised by replacement planting and the full reinstatement of ground cover and shrubs. However there will be a considerable period before the replanted species reach maturity. Bird and bat boxes will also be installed where appropriate. Gravels will be reinstated over concrete lined section where appropriate.

Enhancement Opportunities

The proposals should lead to a general improvement of the riverside environment in the area. Specific enhancement measures include the provision of a pond dipping platform and conservation area on the relief channel at Carew Manor School. Slightly downstream a kingfisher bank will be incorporated into the channel design.

Consultation and Monitoring

Consultation with riparian owners, statutory bodies and interested parties will continue. Negotiations are under way to engage an environmental specialist (in addition to an archaeological specialist) to monitor the works as they are carried out to ensure environmental requirements are fulfilled.

1.0 INTRODUCTION

The Land Drainage Improvement Works (Assessment of Environmental Effects) Regulations 1988 (Statutory Instrument 1217) places an obligation on any drainage body proposing to carry out certain land drainage improvement works to consider whether they are likely to have significant environmental effects and therefore require the preparation of an Environmental Statement.

This report details the key environmental issues that necessitate the preparation of an Environmental Statement and also defines the problems, alternative solutions considered, the proposed works and associated measures intended to minimise the impacts, undertake mitigation works and enhance the surrounding environment.

2.0 PURPOSE OF PROJECT

This scheme involves proposed improvement works to be carried out on the River Wandle from Beddington Park to Richmond Green Contract C1, (see figures 1 and 2). These are interim works, extending over a distance of 1375m, which will eventually form part of the scheme known as the Beddington and Mitcham Area of Opportunity (BMAO). This wider BMAO scheme has been proposed for linking Beddington Park to the playing fields and golf course of Mitcham Common by an area containing a series of lakes to be used for recreational purposes.

The BMAO is intended to provide a 1:100 year level of protection when completed. At present the area of concern is in poor condition with piecemeal bank protection and inadequate capacity at bridge openings, with service crossings restricting flow. In several reaches the restrained, narrow channel has insufficient capacity for flood flows.

A 1:100 year level of protection between Mill Green and Richmond Green can be achieved by combining works to the river channel with flood storage on the site of the Beddington Sewage Treatment Works. This storage will eventually be provided in lakes created as a result of proposed gravel extraction as part of the BMAO.

However the gravel extraction is a long-term project and therefore interim works are necessary to gain a 1:10 year level of protection for the area. The total length of the river eventually affected under the BMAO scheme will be 5000 metres, but the proposed interim works (Contract C1) described here will affect only 1375m of river from Beddington Park to Richmond Green.

The BMAO presents an ideal opportunity to obtain a large flood storage area in what is otherwise a highly urbanised catchment. The storage will provide protection to the area from Mill Green to Richmond Green and will therefore reduce the scale of channel works required. In the longer term this storage will also reduce

the scale of any future work required on the Wandle downstream of Mill Green where the existing largely rigid channel is heavily constrained. The area eventually protected by the River Wandle Flood Alleviation Scheme include Mill Green, Beddington Corner, Camarthen Works, Hackbridge Road and Richmond Green.

3.0 ALTERNATIVES CONSIDERED

Alternative proposals were considered for individual lengths of channel but rejected, either because they were less environmentally acceptable, or because they were impracticable in engineering terms. In the upstream length through Richmond Green one alternative considered was to construct a diversion channel parallel with the left-bank. However this would have entailed considerable land-take and severe disruption to the public open space. In addition underground electricity cables run through the site and would have been severely disrupted by a diversion channel. Along several reaches through Beddington Park the necessary capacity required to contain the floodwaters could have been achieved by extensive widening and deepening of the channel. However such drastic engineering measures are now considered to be environmentally unacceptable because a channel is often created which is unstable during the normal range of flows, and which provides a uniform habitat.

4.0 DESCRIPTION OF PROPOSED ALTERNATIVE

The proposed interim works under Contract C1 have been divided into a number of lengths. Many of the impacts are similar for each length but have been listed separately for each length for ease of reference:-

Length 1: Downstream limit to Church Road Bridge

The works (figure 3) extend over a distance of approximately 85 metres and involve removing the existing weir, limited regrading to the river bed upstream of the weir, and the creation of a two-stage channel along both banks. The low-flow channel will be slightly narrower, thereby avoiding the problems of siltation associated with overwide channels. As a consequence of the regrading in this length it is inevitable that some service facilities will be disrupted. Gravels exposed by excavation will be retained to form the new substrate.

The bridge itself will be unaffected by the works and access across it will be maintained throughout the duration of the works. A temporary fence will be erected around the site of the works.

Access for machinery and other vehicles will be gained from Church Road via the paths to the east and west of the Lodge (figure 3). These access routes through the park will be reinstated after the works are complete. The pillar in the park will be temporarily removed and replaced after the works have been completed (figure 3).

A working strip of 14 metres will be required along the left-bank of the channel, thereby ensuring enough room for machinery to avoid trees. A narrower strip of land is also required along the right-bank as working room.

Length 2: Church Road Bridge to Carew Manor Bridge

The total length of works in this reach is about 350 metres (figure 3). A short section of concreted channel will be constructed immediately upstream of the bridge in the vicinity of the flood diversion channel and electromagnetic flow gauging station. The river will be realigned slightly northwards making it deeper and wider (figure 3). The footpath adjacent to this length of river will be relocated slightly and will be closed for the duration of the works.

Within the realigned length of channel a reed bed and kingfisher bank will be created (figure 3). The majority of length 2 will be a two-stage channel, the gravels as excavated will be left to form the new bed. A number of trees will be lost due to the nature of the works.

Since a flood relief channel has been created as part of the wider BMAO scheme to divert flood flows into a series of lakes, these interim works include a flow control structure and side weir on the existing channel to take these flows. A new footbridge will be constructed across the flood relief channel. The existing gauge weir in this length will be demolished, as will the retaining brick wall on the right-bank. Carew Manor Bridge will be rebuilt but with pedestrian access maintained at all times. A working strip is required along both banks; along the left-bank it will need to be sufficiently wide so that trees are not affected by the works. The site will be fenced with chain-link fencing.

Access for plant and machinery will be gained from Church Road as in Length 1. All access routes will be maintained and reinstated after the works are completed.

The main disruption will be to the footpaths to Crispin Crescent and to the residents of the cottages adjacent to the flow control structure.

Length 3: Carew Manor Bridge to upstream of Beddington Park

The works in this length extend over a distance of 225 metres and involve some deepening of the channel at the downstream end. Where excavation is necessary then the gravels exposed will be left to form a natural substrate (figure 4). Short reaches of channel at the Carew Manor Bridge and weir will have a concrete bed, backfilled with gravel. The channel will otherwise remain largely untouched since flood capacity will be provided by a new relief channel which will be constructed across adjacent land. A new drop weir will be constructed along the existing channel to compensate for the difference in slope caused by the localised

deepening and an offtake built along the left-bank to carry flood flows into the relief channel described below as Length 3a (figure 4).

Access for machinery and plant will be from Mallinson Road (figure 4). A working strip is required along both banks affected by the two-stage design. This area will be fenced with chain-link fencing.

Length 3a: Flood Relief Channel, Carew Manor School

The flood relief channel extends over a distance of 170 metres and crosses through land owned by the Carew Manor School (figure 4). The relief channel will be widened and deepened to create a pond which will be fed by a sweetening flow piped through the upstream weir. The overflow weir to the pond will be designed to take flood flows in excess of a 1 in 2 year frequency. A weir is also required within the relief channel to create the pond (figure 4). The surrounding area will be landscaped to create a conservation area for the school and a dipping platform will be constructed adjacent to the pond.

Length 4: Upstream of Beddington Park to Riverside Walk

Over a distance of 185 metres between Beddington Park and Riverside Walk the existing channel is to remain unaltered. However along the north branch of the river at Riverside Walk, approximately 85 metres of channel will be concrete-faced with granite setts. Up to 500mm of gravels are to be backfilled over the new concrete bed. The invert level under Millstream bridge is to be lowered. A temporary footbridge will be provided whilst the existing one is replaced with a new timber bridge.

Access for machinery and plant will be gained from Beddington Lane and from both north and south of the bridge. Pedestrian access will be maintained to Beddington Park (figure 4). Working strips will be required and the site fenced with chain-link fencing.

A compound for plant and materials will be sited at the Goose Green allotments with access from Beddington Lane (figure 4).

Length 4a: Millstream Bridge to Wandle Road Bridge

The bed is to be substantially regraded to a maximum depth of 900mm. A new drop weir will be built and the banks and bed locally concreted (figure 4). Part of a garage adjacent to the river will be demolished and reconstructed and a number of garden sheds will be temporarily relocated during the works. Avaries and a greenhouse to the south of the river will be temporarily relocated but reinstated after the works are completed. Similarly a car port on the Wandle Road will be moved (figure 4).

The Wandle Road bridge will be reconstructed as part of the scheme. This will involve temporary closure of the road for an estimated six months and major electricity and a foul sewer diversion. The car access to houses in Wandle Road, particularly No's. 11 and 13, will be affected (figure 4).

A 4m working strip along the right-bank and a 3m strip on the left-bank in the gardens between Beddington Lane and the Wandle Road will be required.

Length 5: Wandle Road Bridge to Richmond Green

Along this section of the river the bed will be lowered by up to 1m and a two-stage channel created along the right-bank. This will involve the lowering of the bank by about 1m and widening by about 5m (figure 5). The existing concrete bed will be broken out and removed. The new housing development along the right-bank will be protected by a low brick wall. Both banks will be protected by toeboarding. The creation of the new channel will involve the loss of a number of trees.

Access will be gained from the Wandle Road and along the new road into the housing development adjacent to the right-bank of the river.

Length 6: Richmond Green to end

Along the left-bank at the upstream end of this section approximately 6m of the bank will be lowered to create a two-stage channel to take flood flows (figure 5). About 1m will also be removed from the right-bank. Where the river flows behind the houses along the bridle path the main part of the two-stage channel will be along the right-bank. The original river bed width will remain the same throughout the length. The toeboarding along the left-bank will be lowered by two boards. The bed will remain largely unaltered although some regrading will take place.

Access will be from the Richmond Road to the north and from Salcott Road to the south. A working strip will be required along both sides of the channel. The working strip will be sufficiently wide to avoid unnecessary damage to mature trees, although a number will be lost due to the nature of the work. There will be a temporary loss of access to part of Richmond Green. The site will be fenced with chain link fencing (figure 5).

An Environmental Statement is required for the works as a whole as the environmental effects have been deemed significant due to the number of trees which will be affected. In all approximately 74 trees will be lost, the majority of which are sycamore and willow, together with a number of ash, thorns and wild fruit trees. The Landscape Drawings in Appendix 2 detail the location of trees to be removed and replacement planting plans. In addition a short section of channel will be concreted although a gravel substrate will be placed over the new bed.

The works are scheduled to commence in June 1990 and will last for 18 months.

Note. In order to avoid further disruption to riparian owners those areas of the interim scheme which require major channel or structural works will be carried out to the full 1:100 year standard. Obviously this new level of protection cannot be achieved until the whole scheme, including the gravel pits has been completed.

5.0 EXISTING ENVIRONMENT

Downstream from Beddington Lane bridge the Contract 1 (C1) improvement works are in the Beddington Park area where the river flows through an area of parkland and playing fields (figure 2). Although the river has a concrete bed in places and has been straightened and regulated through a series of weirs, there are a few open and fairly natural sections of the River Wandle still remaining.

Carew Manor gardens were created in the Elizabethan period when the river was realigned for landscaping purposes and a lake created. The gardens were possibly one of the most important in England at that time. Although there are no standing remains of the garden there is evidence that the ground has been raised considerably since the 16th century and there may be significant buried remains. A number of walls and other structures from the 18th century are still standing.

Upstream from Beddington Lane bridge the River Wandle has been substantially regulated in the past to power a mill. From here to Richmond Green the river is more confined flowing through a residential area which includes a new housing estate (figure 2). The bed of the channel has been concreted in places, particularly in reaches adjacent to the Wandle Road bridge. At the upstream end of Contract 1 (C1), through the Richmond Green area, the river flows through public open space.

In general the River Wandle is of poor water quality (Class III) due to urban runoff and of limited instream ecological value. However the remaining bankside vegetation, which includes a large number of trees, is a valuable habitat for wildlife. There is considerable opportunity for improvement and enhancement works.

6.0 PREDICTED ENVIRONMENTAL EFFECTS, MITIGATION MEASURES AND RESIDUAL EFFECTS

For ease of reference these have been divided into construction and end-state impacts. Both adverse and beneficial effects have been included with an indication of the magnitude of the impact where appropriate. The measures that will be used to mitigate these impacts are also detailed below.

Environmental disciplines considered not to be significant issues in the area of the works, namely agriculture, angling and water quality, are omitted from the discussion below. Recreation and amenity issues are covered under human impact. Since potential ecological and landscape impacts are of concern to the local planning authority full consultation has taken place.

6.1 Construction impacts and mitigation measures

Length 1: Downstream Limit to Church Road Bridge (figure 3).

- aquatic biology and fisheries. Temporary fluctuation to water levels during construction may affect instream plants and animals and fisheries. This impact can be minimised by maintaining upstream water levels during construction. The Fisheries Department will be notified well in advance of the works being carried out.

- archaeology. The works along the north bank of the Wandle involve the removal of the fence surrounding the sewage treatment works so the area can be used for working space. Part of this site is a Scheduled Ancient Monument and consent to carry out any works will be required from English Heritage. Full consultation will take place with relevant archaeological specialists before any works are carried out and an Archaeological Watching Brief will be issued.

- geomorphology. The construction works may lead to excess siltation downstream and the loss of the natural channel morphology. It is therefore proposed to minimise the instream working area. The original substrate will be stored and replaced where possible, elsewhere appropriately sized gravels will be reinstated. A natural channel morphology will be recreated where possible.

- human impact. Direct and indirect disturbance to local residents and property and to the park area will occur as a result of construction activity and the movement of plant and material. The main impact will be temporary disruption to footpaths and disturbance to residents of the cottages in Beddington Park.

These impacts can be substantially mitigated against by limiting the use of plant and machinery to the period 0730-1800 hours from Monday through Friday and 0730-1300 hours on Saturdays. No working shall be allowed on Sundays or Bank Holidays except in emergencies. Pile driving shall only be permitted between 0900-1700 hours, Mondays to Fridays.

- **landscape.** A number of mature trees fringe the river and are important wildlife/ landscape features. Due to the extent of the works a number of trees will be affected. By working around bankside trees and carrying out tree surgery unnecessary damage can be avoided.

- **maintenance.** Downstream siltation could result during construction, although works will be carried out at low-flow to reduce this potential impact.

- **wildlife.** The construction works may lead to the damage of bankside vegetation, particularly trees. To avoid this the working area will be kept to a minimum. An arboricultural survey has been carried out to make specific recommendations. Tree surgery will only be undertaken with specialist supervision and all trees will be checked for bats beforehand

Length 2: Church Road Bridge to Carew Manor Bridge (figure 3)

- **aquatic biology and fisheries.** Temporary fluctuation to water levels may affect instream plants and animals and fisheries during construction. This impact can be minimised by maintaining upstream water levels during construction. The Fisheries Department will be notified well in advance of the works being carried out.

- **archaeology.** The area is of special significance being located on a remnant Tudor garden possibly with older historic connections. Therefore an Archaeological Watching Brief will be issued and where it is not possible to avoid sites, excavations will be carried out before works begin.

- **geomorphology.** The construction works may lead to excess siltation downstream and the loss of the natural channel morphology. It is therefore proposed to minimise the instream working area. The original substrate will be stored and replaced where possible, elsewhere appropriately sized gravels will be reinstated. A two-stage channel will be created to ensure habitat diversity.

- **human impact.** Impacts in Length 2 include direct and indirect disturbance to local residents and property and to the sports ground at the Carew Manor School. Footpaths in the area will also be disrupted and those leading to Crispin Crescent temporarily closed. The path along the right-bank of the river will be realigned to the north. The residents in the cottages in Beddington Park adjacent to the site of the flow gauging station may also be disturbed during its replacement.

These impacts can be substantially mitigated against by limiting the use of plant and machinery to the period 0730-1800 hours from Monday through Friday and 0730-1300 hours on Saturdays. No working shall be allowed on Sundays or Bank Holidays except in emergencies. Pile driving shall only be permitted between 0900-1700 hours, Mondays to Fridays. Residents will be fully informed of the works.

- **landscape.** A number of mature trees fringe the river and are important wildlife/ landscape features. Due to the extent of the works a considerable number of trees will be affected. By working around bankside trees and carrying out tree surgery unnecessary damage and loss can be avoided.

- **maintenance.** Downstream siltation could result during construction, although works will be carried out at low-flow to reduce this potential impact.

- **wildlife.** The construction works will lead to the damage of bankside vegetation, particularly trees. To avoid unnecessary loss and damage the working areas will be minimised and full replacement planting will take place. An arboricultural survey has been carried out to make specific recommendations. Tree surgery will only be undertaken with specialist supervision and all trees will be checked for bats beforehand.

Length 3/3a: Carew Manor Bridge to Upstream of Beddington Park (fig.4)

- **aquatic biology and fisheries.** Temporary fluctuation to water levels may affect instream plants and animals and fisheries during construction. However this impact can be minimised by maintaining upstream water levels during construction. The Fisheries Department will be notified well in advance of the works being carried out.

- **geomorphology.** The construction works may lead to excess siltation downstream and loss of the natural channel morphology. It is therefore proposed to minimise the instream working area. The original substrate will be stored and replaced where possible, elsewhere appropriately sized gravels will be reinstated.

- **human impact.** Direct and indirect disturbance to local residents and to property adjacent to the new flood relief channel and to the playing field due to construction activity. The movement of plant and material may also be disruptive, particularly along the Mallinson Road access route. Footpaths through the area will also be temporarily disrupted.

These impacts can be substantially mitigated against by limiting the use of plant and machinery to the period 0730-1800 hours from Monday through Friday and 0730-1300 hours on Saturdays. No

working shall be allowed on Sundays or Bank Holidays except in emergencies. Pile driving shall only be permitted between 0900-1700 hours, Mondays to Fridays.

- **landscape.** A number of mature trees fringe the river and are important wildlife/ landscape features. Due to the extent and nature of the works a number of trees will be affected. By working around bankside trees and carrying out tree surgery unnecessary losses can be avoided.

- **maintenance.** Downstream siltation could result during construction, although works will be carried out at low-flow to reduce this potential impact.

- **wildlife.** The construction works will lead to the damage of bankside vegetation, particularly trees. To avoid this trees will be retained where possible, the working area will be kept to a minimum and full replacement planting will take place where necessary. An arboricultural survey has been carried out to make specific recommendations. Tree surgery will only be undertaken with specialist supervision and all trees will be checked for bats if surgery is required.

Length 4: Upstream of Beddington Park to Riverside Walk (figure 4).

- **aquatic biology and fisheries.** Temporary fluctuation to water levels may affect instream plants and animals and fisheries during construction. However this impact can be minimised by maintaining upstream water levels during construction. The Fisheries Department will be notified well in advance of the works being carried out.

- **geomorphology.** The construction works may lead to excess siltation downstream and the loss of the existing channel morphology. It is therefore proposed to minimise the instream working area. The original substrate will be stored and replaced where possible, elsewhere appropriately sized gravels will be reinstated

- **human impact.** Direct and indirect disturbance to local residents and property due to construction activity and noise and the movement of plant and material particularly along Beddington Lane and Guy Road.

The use of plant and machinery will be limited to the period 0730-1800 hours from Monday through Friday and 0730-1300 hours on Saturdays. No working shall be allowed on Sundays or Bank Holidays except in emergencies. Pile driving shall only be permitted between 0900-1700 hours, Mondays to Fridays. More specifically construction activity will affect the grounds and footpaths of the Park Farm School and Wandle Gardens, Guy Road and Beddington Lane. A temporary footbridge will be provided during reconstruction of the existing bridge.

- **landscape.** A number of mature trees fringe the river and are important wildlife/ landscape features. Due to the extent of the works a number of trees will be affected. By working around bankside trees and carrying out tree surgery unnecessary losses can be avoided.

- **maintenance.** Downstream siltation could result during construction, although works will be carried out at low-flow to reduce this potential impact.

- **wildlife.** The construction works will lead to the damage of bankside vegetation, particularly trees. To avoid this all trees will be retained along the banks where possible and the working area will be kept to a minimum. An arboricultural survey has been carried out to make specific recommendations. Tree surgery will only be undertaken with specialist supervision and all trees will be checked for bats if surgery is required.

Length 4a: Millstream Bridge to Wandle Road Bridge (figure 4).

- **aquatic biology and fisheries.** Temporary fluctuation to water levels may affect instream plants and animals and fisheries during construction. However this impact can be minimised by maintaining upstream water levels during construction. The Fisheries Department will be notified well in advance of the works being carried out.

- **geomorphology.** The construction works may lead to excess siltation downstream and the loss of the existing channel morphology due to the regrading. It is therefore proposed to minimise the instream working area. However as the works mainly involve replacement of the existing concrete bed, morphological impacts are likely to be minimal.

- **human impact.** Direct and indirect disturbance to local residents and property, due to construction activity and noise and the movement of plant and material along the narrow streets, particularly Beddington Lane, Richmond Road, Wandle Road.

In general these impacts will be mitigated against by limiting the use of plant and machinery to the period 0730-1800 hours from Monday through Friday and 0730-1300 hours on Saturdays. No working shall be allowed on Sundays or Bank Holidays except in emergencies. Pile driving shall only be permitted between 0900-1700 hours, Mondays to Fridays.

The walls will be constructed from within the channel and from a working strip designated in the gardens of adjacent properties. Landowners will be fully consulted before and during the works and any land affected by the works will be fully reinstated afterwards.

More specifically construction activity will lead to the replacement of several buildings in the gardens of riverside properties including an aviary, a number of sheds, a carport and

a garage. All will be carefully dismantled and replaced after negotiations with individual owners. Several fences will also be replaced.

The major disruption in this reach will be the temporary closure of the road whilst the Wandle Road bridge is rebuilt (estimated to take 6 months) and major electricity and foul sewer diversions are completed. This will mean car access to the houses in Wandle Road will be restricted, particularly to No's. 11 & 13 adjacent to the bridge. Pile driving will be carried out by the most practical means to limit noise and vibration, taking into account the ground conditions.

- landscape. A number of mature trees fringe the river and are important wildlife/ landscape features. Due to the extent of the works a number of trees will be affected. By working around bankside trees and carrying out tree surgery unnecessary losses can be avoided.

- maintenance. Downstream siltation could result during construction, although works will be carried out at low-flow to reduce this potential impact.

- wildlife. The construction works will lead to the damage of bankside vegetation, particularly trees (eg. sycamore and crack willow) and shrubs. To avoid this the working area will be kept to a minimum. Replacement planting will take place where necessary. An arboricultural survey has been carried out to make specific recommendations. Tree surgery will only be undertaken with specialist supervision and all trees will be checked for bats if surgery is required.

Length 5: Wandle Road Bridge to Richmond Green (figure 5)

- aquatic biology and fisheries. Temporary fluctuation to water levels may affect instream plants and animals and fisheries during construction. However this impact can be minimised by maintaining upstream water levels during construction. The Fisheries Department will be notified well in advance of the works being carried out.

- geomorphology. To avoid excess siltation downstream the instream working area will be minimised. By creating a two-stage channel and breaking out the concrete bed the channel morphology can be improved. The exposed gravel bed will form the new substrate.

- human impact. Direct and indirect disturbance to local residents and property, particularly those in the new housing adjacent to the river, due to construction activity, noise and the movement of plant and materials.

These impacts can be substantially mitigated against by limiting the use of plant and machinery to the period 0730-1800 hours from Monday through Friday and 0730-1300 hours on Saturdays. No

working shall be allowed on Sundays or Bank Holidays except in emergencies. Pile driving shall only be permitted between 0900-1700 hours, Mondays to Fridays.

In general works will be constructed from within the channel but a working strip will need to be designated on the north side of the channel. Landowners will be fully consulted before and during the works and any land affected by the works will be fully reinstated

- landscape. A number of mature trees fringe the river and are important wildlife/ landscape features. Due to the extent and nature of the works a number of trees will be affected. By working around bankside trees and carrying out tree surgery unnecessary losses will be avoided.

- maintenance. Downstream siltation could result during construction, although works will be carried out at low-flow to reduce this potential impact.

- wildlife. The construction works will lead to the damage of bankside vegetation, particularly trees. To mitigate this all trees will be retained along the banks where possible and the working area will be kept to a minimum. Replacement planting will take place where necessary. An arboricultural survey has been carried out to make specific recommendations. Tree surgery will only be undertaken with specialist supervision

Length 6: Richmond Green to end of contract

- geomorphology. To avoid excess siltation downstream the working area instream will be minimised. By creating a two-stage channel major impacts on channel morphology can be minimised. Existing morphological features (pools, riffles and gravels) will be retained.

- human impact. Direct and indirect disturbance to local residents and property and to the park area due to construction activity, noise and the movement of plant and material. Particularly affected will be Richmond Green and the bridle path.

These can be substantially mitigated against by limiting the use of plant and machinery to the period 0730-1800 hours from Monday through Friday and 0730-1300 hours on Saturdays. No working shall be allowed on Sundays or Bank Holidays except in emergencies. Pile driving shall only be permitted between 0900-1700 hours, Mondays to Fridays.

In general works will be constructed from within the channel but a working strip will need to be designated on Richmond Green. Landowners will be fully consulted before and during the works and any land affected by the works will be fully reinstated.

- landscape. A number of mature trees fringe the river and are important wildlife/ landscape features. Due to the extent and nature of the works a number of trees will be affected. By working around bankside trees and carrying out tree surgery unnecessary losses can be avoided.

- maintenance. Downstream siltation could result during construction, although works will be carried out at low-flow to reduce this potential impact

- wildlife. The construction works will lead to the damage of bankside vegetation, particularly trees. To avoid this trees will be retained where possible and the working area will be kept to a minimum. Full replacement planting will take place where necessary. An arboricultural survey has been carried out to make specific recommendations. Tree surgery will only be undertaken with specialist supervision and all trees will be checked for bats if surgery is required.

6.2 End-State Impacts and mitigation measures

The works are not considered to have any long-term human impacts, apart from the loss of land at the school. There are also unlikely to be any long-term effects on recreation and amenity, planning, water quality or fisheries. Angling is not considered to be a significant issue in the area of the works.

Length 1: Downstream limit to Church Road Bridge (figure 3)

- aquatic biology and fisheries. Impacts will result if the dry-weather flow channel dimensions are altered; if the shading affecting instream plants and animals is lost; or if pool-riffle sequences and natural substrates are destroyed. These adverse impacts will be reduced by minimising alterations to the dry-weather channel and by avoiding damage to trees and natural banks. A natural channel morphology will be retained or recreated.

- geomorphology. A two-stage channel will be created to minimise any impact on the existing channel. However regrading of the bed will lead to loss of the original substrate and channel morphology which will be mitigated by the placement of gravels and sympathetically designed channel cross-sections.

- landscape. Impacts are likely as the work will lead to the need for tree surgery which will be carried out under supervision. Ground cover will be fully reinstated.

- maintenance. Siltation may occur in reaches which have been regraded, although the intention is to offset this by minimising any reduction in channel grade.

- **wildlife.** Impacts are likely as the work will result in some damage to vegetation along the river banks. Trees will be avoided where possible and marginal vegetation will be avoided or removed and replaced after the works have been completed.

Length 2: Church Road Bridge to Carew Manor Bridge (figure 3).

- **aquatic biology and fisheries.** Impacts will result if the dry-weather flow channel dimensions are altered; if the shading affecting instream plants and animals is lost; or if pool-riffle sequences and natural substrates are destroyed. These adverse impacts will be reduced by minimising alterations to the dry-weather channel and by avoiding damage to trees and natural banks. A natural channel morphology will be retained/ recreated.

- **archaeology.** There is a potential loss of part of a Scheduled Ancient Monument. Any finds recovered during excavation may be beneficial.

- **geomorphology.** A two-stage channel will be created to minimise any impact on the existing channel. However regrading of the bed will lead to loss of the original substrate and channel morphology which will be mitigated by the placement of gravels and sympathetically designed channel cross-sections.

- **landscape.** Impacts are likely as the work will lead to the need for tree surgery and to the loss of a considerable number of mature trees along the river banks. Any permanent loss of trees will be mitigated against by replacement planting and full reinstatement of the ground cover.

The flow control structure will be brick-faced to blend with adjacent cottages to ensure minimal visual impact.

- **maintenance.** Siltation may occur in reaches which have been regraded, although the intention is to offset this by minimising any reduction in channel grade.

- **wildlife.** Impacts are likely as the work will result in some damage to and the loss of mature trees along the river banks. Trees will be avoided where possible and replacement planting will take place. Marginal vegetation will be avoided or removed and replaced after the works have been completed.

Length 3/3a: Carew Manor Bridge to upstream of Beddington Park (fig 4)

- **aquatic biology and fisheries.** The weirs built as part of the flood relief channel will be set at heights which maintain the dry-weather flows in the River Wandle. Other potential adverse impacts will be reduced by minimising alterations to the dry-weather channel and by avoiding damage to trees and natural banks. A natural channel morphology will be retained/ recreated wherever possible.

- geomorphology. Where the reach is proposed to be deepened and concreted then gravels will be reinstated over the new bed.

- human impact. The loss of land to the school will be compensated for by the creation of a pond and conservation area.

- landscape. Impacts are likely as the work will lead to the need for tree surgery and to the loss of a number of mature trees along the river banks. Any permanent loss of trees will be mitigated against by replacement planting and full reinstatement of the ground cover.

- wildlife. Impacts are likely as the work will result in some damage to and the loss of mature trees along the river banks. Trees will be avoided where possible and replacement planting will take place. Marginal vegetation will be avoided or removed and replaced after the works have been completed.

Length 4: Upstream of Beddington Park to Riverside Walk (figure 4).

- aquatic biology and fisheries. Impacts will result if the dry-weather flow channel dimensions are altered; if the shading affecting instream plants and animals is lost; or if pool-riffle sequences and natural substrates are destroyed. These adverse impacts will be reduced by avoiding damage to trees.

- geomorphology. Regrading of the bed will lead to loss of the original substrate and channel morphology which will be mitigated by the placement of gravels.

- landscape. Impacts are likely as the work will lead to the need for tree surgery and to the loss of a number of mature trees along the river banks. Any permanent loss of trees will be mitigated against by replacement planting and full reinstatement of the ground cover, particularly in the affected gardens. The channel sides will be concrete lined but faced with granite setts to match those already existing.

- wildlife. Impacts are likely as the work will result in some damage to and the loss of mature trees along the river banks. Trees will be avoided where possible and replacement planting will take place. Marginal vegetation will be avoided or removed and replaced after the works have been completed.

Length 4a: Millstream Bridge to Wandle Road Bridge (figure 4).

- aquatic biology and fisheries. Impacts will result if the dry-weather flow channel dimensions are altered; if the shading affecting instream plants and animals is lost; or if pool-riffle sequences and natural substrates are destroyed. The existing channel is already partially concreted. Any adverse impacts will be reduced by minimising alteration to the existing channel morphology and by avoiding damage to trees.

- geomorphology. In places the regrading of the bed will lead to the loss of the original substrate and channel morphology. However as the works mainly involve replacement of the existing concrete bed, morphological impacts are likely to be minimal.

- human impact. Chains and ladders will be placed at the lower end of the lined channel to facilitate escape in an emergency.

- landscape. Impacts are likely as the work will lead to the need for tree surgery and to the loss of a number of mature trees along the river banks. Any permanent loss of trees will be mitigated against by replacement planting and full reinstatement of the ground cover, particularly in the affected gardens. The channel sides will be concrete lined with an exposed aggregate finish.

- wildlife. Impacts are likely as the work will result in some damage to and the loss of mature trees (eg. crack willow/sycamore) along the river banks. Trees will be avoided where possible and replacement planting will take place. Marginal vegetation will be avoided or removed and replaced after the works have been completed.

Length 5: Wandle Road Bridge to Richmond Green (figure 5)

- aquatic biology and fisheries. Impacts will result if the dry-weather flow channel dimensions are altered; if the shading affecting instream plants and animals is lost; or if pool-riffle sequences and natural substrates are destroyed. These adverse impacts will be avoided by creating a two-stage channel which maintains the existing low-flow channel width and by avoiding damage to and loss of trees.

- geomorphology. Impacts will largely be avoided by the construction of a two-stage channel. The channel morphology will be improved as the concrete bed is to be broken out and the exposed gravels left to form a new substrate with the re-creation of pools and riffles.

- landscape. Impacts are likely as the work will lead to the need for tree surgery and the loss of a considerable number of mature trees along the river banks. Any permanent loss of trees will be mitigated against by replacement planting and full reinstatement of the ground cover.

- wildlife. Impacts are likely as the work will result in damage to and the loss of some mature trees (including crack willow and sycamore) along the river banks. Trees will be avoided where possible and replacement planting take place. Marginal vegetation will be avoided or removed and replaced after the works have been completed.

Length 6: Richmond Green to end of contract (figure 5).

- aquatic biology and fisheries. Impacts will result if the dry-weather flow channel dimensions are altered; if the shading affecting instream plants and animals is lost; or if pool-riffle sequences and natural substrates are destroyed. These adverse impacts will be avoided by creating a two-stage channel which maintains the existing low-flow channel width and by avoiding damage to and loss of trees.

- geomorphology. Impacts will largely be avoided by the construction of a two-stage channel. The invert level will not be affected so existing pools, riffles and gravel substrate will be retained.

- landscape. Impacts are likely as the work will lead to the need for tree surgery and to the loss of a number of mature trees along the river banks. Any permanent loss of trees will be mitigated against by replacement planting and full reinstatement of the ground cover.

- wildlife. Impacts are likely as the work will result in some damage to and the loss of mature trees along the river banks. Trees will be avoided where possible and replacement planting will take place. Marginal vegetation will be avoided or removed and replaced after the works have been completed.

6.3 ENHANCEMENT MEASURES.

In general the works should lead to an overall improvement of the built area, particularly to derelict fences and bank protection. A number of gardens may suffer temporary disruption but old sheds will be replaced and all the gardens will be reinstated to the original condition.

Reinstatement plans have been drawn up by the Authority's landscape architect (see Landscape Drawings LA/RIV/10/1-4, see Appendix 2) and appropriate landscaping will be carried out along river lengths where there is sufficient land available.

In Beddington Park a flood relief channel is to be constructed on the open land belonging to the Carew Manor school. The channel will be widened and deepened to create a pond, a significant environmental enhancement. A platform for pond dipping will be built. The area will be landscaped for the school and managed as a conservation area.

At the downstream end of the works on the last sharp bend of the river the channel will be widened on the left-bank (figure 3). This will enable a wetland area to be created and reed bed to be planted. The inside of the bend will be steepened to form a cliff and artificial kingfisher holes will be created. Bird and bat boxes will be fixed to walls or structures where

appropriate. In places the substrate will be enhanced by retaining the gravels exposed by excavation. A more natural channel morphology will be created where possible.

7.0 EXTERNAL INTEREST AND CONSULTATIONS

Consultations with the Authority's environmental specialists have formed an integral part of the design procedure, including the landscape architect, the conservation officer, biology and fisheries staff, pollution and archaeological officers.

The riparian owners have been given the opportunity to highlight matters they felt relevant in a questionnaire, dated 17 November 1988, and have been given the opportunity to discuss the proposals at meetings held in November 1986 and March 1990.

Additional consultees have included:-

- Nature Conservancy Council
- English Heritage
- London Borough of Sutton Planning Department
- London Borough of Sutton Parks Department
- London Wildlife Trust
- Surrey Archaeological Society
- Wandle Industrial Museum
- Merton Historical Society
- the Wandle Group
- the Carew Manor Group

8.0 MONITORING ARRANGEMENTS

On-site supervision of working practices by environmental specialists will be arranged, particularly for the more sensitive mitigation and enhancement works such as tree surgery, placement of gravel, creation of natural morphology, formation of the kingfisher bank and works to the pond. The implementation of these works will be carefully monitored to ensure complete success.

9.0 SUPPORTING DOCUMENTATION

The following documents and copies of the detailed engineering and full landscape drawings (which detail which trees are to be removed) are available for inspection during working hours at the Authority's London Office (address overleaf):-

- * London Wildlife Trust (1988) River Wandle Ecological Survey
- * National Rivers Authority, Thames Region (1989) River Wandle Fisheries Report

Mr A. Wright, Project Manager, National Rivers Authority, Thames Region, Howard House, 10/11 Albert Embankment, London, SE1 7TG.

10.0 APPENDICES

Appendix 1 - Engineering Drawings (Figures 1-5)

Appendix 2 - Landscape Drawings (LA/RIV/10/1-40)

REF: EG/WANDES/01

AB/HJL. 02/90