Firs Farm Wetlands, Whinchmore Hill, Enfield

SuDS used

- De-culverting
- Bioretention channel
- Wetlands
- Pond
- Permeable surfaces

Benefits

- Reduction in local and wider flood risk.
- Amelioration of air pollution and water pollution.
- Noticeable increases in wildlife (particularly bird-life).
- Promotion of community cohesion.

1. Location

Firs Farm Playing Fields and Wetlands, Firs Lane, Winchmore Hill, N21 2PJ.

2. Description

Firs Farm Wetlands is a combined wetlands and flood storage area that mitigates the impact of surface water flooding and diffuse urban pollution in the local area and the wider downstream catchment, it does this by:

- Storing up to 30,000m³ of flood water during extreme rainfall events;
- Filtering and cleaning surface water runoff that flows through the wetlands.

The scheme also enhances the site for both people and wildlife. Several amenity features have been included as part of the works including a cycleway and network of footpaths, an outdoor classroom, dipping platform and several seating areas.

The scheme involved restoring 500m of the Moore Brook, a 'lost' tributary of Pymmes Brook which is itself a tributary of the River Lee. The spoil from the newly excavated channel was used to create a 200 metre long flood defence that forms the eastern boundary of the site.

Prior to the works, this area of Firs Farm Playing Fields was an underused open space that offered little value to local residents. Now it offers:

- 3,300m² wetlands;
- 1,000m² pond;
- 500m de-culverted watercourse;
- 30,000m³ overall flood storage provided on site for extreme events;
- 2.4ha habitat enhancements;
- 600m cycleway;
- Outdoor classroom.

3. Main SuDS components used

- De-culverting;
- Bioretention channel;
- Wetlands;
- Pond;
- Permeable surfaces.

4. Status

- Phase 1 - Excavation of watercourse and preliminary improvements to existing flood defences – Autumn 2014
- Phase 2/3 - Construction of Wetland Cells 1-4 (with associated footpaths) – Summer 2015
- Phase 4 - Construction of combined footpath-cycleway – Winter 2015
- Phase 5 - Excavation of woodland watercourse – Autumn 2016
- Phase 6 - Connection of Moore Brook southern branch to wetlands – Spring 2017.

5. How it works

The scheme is a combined wetland and flood storage area that reduces the risk of surface water flooding and diffuses urban pollution across a wide urban area. There was a known issue of poor water quality within the surface water sewer network due to misconnections. Samples taken at the untreated upstream end of the system were exhibiting a detection of phosphates in the region of 3 mg/l which is classed as 'poor' in Water Framework Directive (WFD) classification and indicative of misconnections.

The scheme diverts a surface water runoff through a series of integrated wetland cells which flow out to an open watercourse before re-entering the underground drainage system.

The flow from two surface water sewers – which include the culverted Moore Brook - is diverted to an outfall at the north-west of the site into wetland cell 1. A third diverted sewer in the south outfalls into a newly created woodland watercourse prior to draining into wetland cell 2, which is not hydraulically linked to cell 1. Both cells then link to wetland cell 3, which is the largest cell.

In total the wetlands accept surface water from a 216ha catchment area which is densely built up and includes over 4,700 properties. The wetland cells, open watercourse and ponds have been planted with a variety of reed species and marginal aquatic plants in order to provide water quality cleansing benefits. The outfalls linking the various wetland cells are placed in such a way as to maximise the filtering and cleansing of the surface water passing though the wetlands.

At the downstream end of the site near to where the water re-enters the culvert, a flood bund provides flood protection by impounding water during extreme rainfall events. Up to 30,000m³ can be stored on site due to the wetlands, flood bund and modified outfalls working in combination. Over 100 nearby properties and the A10 Great Cambridge Road have their flood risk reduced by the scheme. The flood bund has been designed to retain volumes for events up to a 1 in 100 year (1% annual probability). The outfall to the culvert at the downstream end of the scheme has been designed accordingly, however the design of many of the other features are designed to accommodate the everyday low flows.

The wetland cells have been designed to incorporate different slope gradients, depths and levels of planting. Some areas around the wetland margins have been densely planted whereas others have been left to regenerate naturally. Water depths within the wetlands are typically 0.2-0.3m for dry weather flow. Some open water pond features have also been created by increasing the depth to 1.0m at selected locations to collect silt and allow for a change in planting.

Amenity features including benches, an outdoor classroom, an open bird-hide, a dipping platform, boardwalks and stepping stones have also been provided.

6. Specific project details

6.1. A wider description framed from the aspect of design and construction

Firs Farm Playing Fields is permanently open to the public. Prior to the wetland works the site was used for sports pitches, none of which have been removed as the design of the scheme sits outside their boundaries. The other main users of the site were dog walkers, with the only formal path in the site being located some distance to the south. All of the pedestrian entrances to the site were unwelcoming and even unsafe. The site was not realising its potential given its size and location. The only ecological variances across the site other than open grass were some wooded copses.

Figure 1 Firs Farm Site prior to implementation

Given that the presence of the scheme was likely to attract a greater number of users to the site a wider consideration of the public health and safety was required during the design. The gradients of the slopes of the wetland cells are designed to have a maximum fall of 1 in 3 for example.

Phase 1 of the scheme involved excavating the footprint of a new 500m long open watercourse with an average depth of 1.5m. Excavated spoil from the new channel was used to create a natural earth flood bund along the eastern boundary of the site. This ensures that flood water is stored on the playing fields during extreme rainfall events, increasing protection to nearby houses. The new flood storage area is below the threshold of a statutory reservoir (25,000m³). Nevertheless it was constructed to the required standard for an asset of this status in strict accordance with a methodology approved by a Qualified Reservoir Engineer; this included the appropriate degree of compaction and testing of the suitability of the material. This was to ensure that the new feature is safe for local residents.

Figure 2 Firs Farm Site after completion of Phase 1

Phases 2 and 3 were implemented the following summer. The spoil from these areas was retained on site and used to create a varied landscape with different habitat types including woodland, grassland and low scrub vegetation.

Figure 3 Montage of construction pictures

6.2. Sewer diversion and outfalls

An essential aspect of the project was to connect or “plumb-in” surface water from existing sewers to the new wetlands. The following diagram shows the existing surface water sewers around the site and where their diversions were constructed.

The connection to wetland cell 1 was designed to capture flow from two sewer lines. Work was carried out to form a diversion from an existing chamber on the north branch by connecting a new 300mm diameter pipe. Where this diversion pipe intersected the western branch it was engineered to accept flow from this culvert by gravity and subsequently outfall to wetland cell 1.

Wetland cell 2 is directed from a surface water sewer which flows more than 400m to the south of the site. Levels of the wetlands were set so that it was achievable to divert flow from the southern branch over this distance. The outfall of this pipe was into a newly constructed channel in a woodland area of the site which connects into wetland cell 2 from the south.

It was also necessary to construct an outfall structure at the downstream end which directs the above ground flows back into the original culvert. This outfall is an in-situ concrete headwall, with the connecting pipes sized appropriately to discharge flood water held back by the bund.

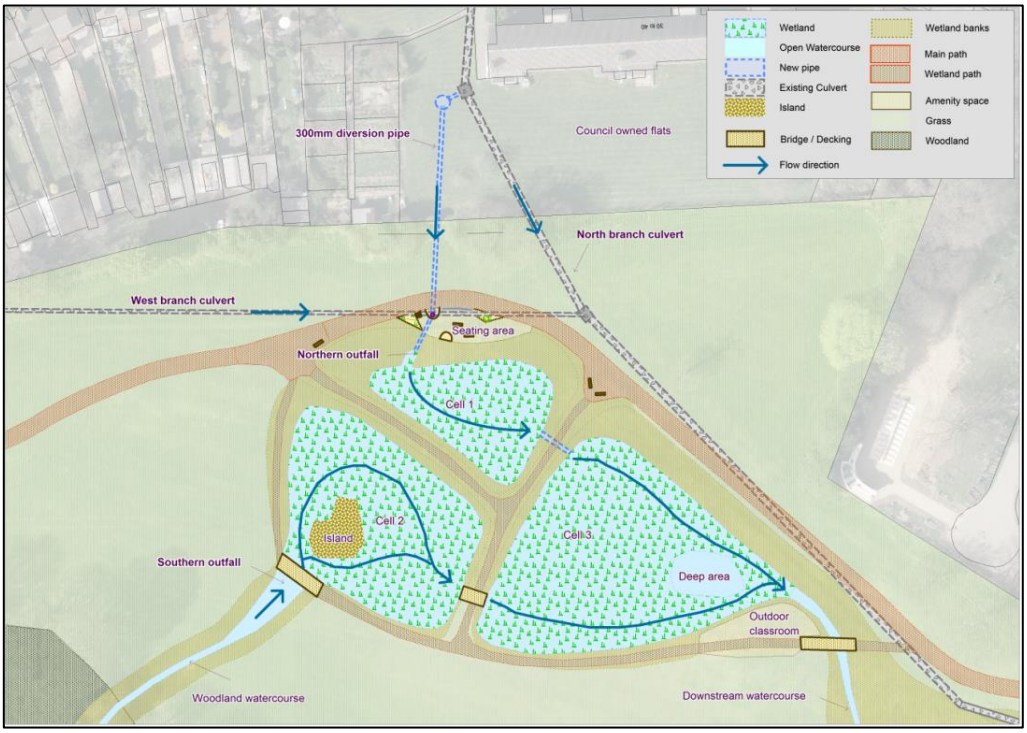

Figure 4 Plan of the scheme

Phase 4 focused on the construction of a combined footpath / cycleway through the site which took place through the winter of 2015. Further work involved the formation of landscaped viewing and seating areas with associated planting, the modification of entrances from Firs Lane, footbridges and decking, an outdoor classroom, a bird-hide and a dipping platform.

Phases 5 & 6 involve the construction of the woodland watercourse and the connection of the south branch to this watercourse and ultimately the wetlands.

6.3. Comparison with traditional drainage of a culverted watercourse

Historic maps show the presence of a watercourse known as the Moore Brook. It was culverted in stages through the first half of the 20th century resulting in a 'lost watercourse'. The site became used principally for sports pitches and the presence of a watercourse would have remained unknown to most of the park users.

The culvert had an input from a combined catchment area of 129ha with 2,525 properties (the north and west branches). These flows passed through the site untreated and un-attenuated, passing through further urban areas before outfalling into Pymmes Park Lake in Edmonton. Prior to the wetland scheme this lake suffered from severe pollution issues, these are described in a separate case study for Pymmes Park Wetlands.

The diversion of the southern branch directs flows from an 87ha catchment which also flowed to Pymmes Park Lake through a different outfall. The addition of the diversion from this catchment results in treatment of further flows through Firs Farm Wetlands before joining the downstream culvert to Pymmes Park Lake.

The scheme also provides attenuation of storm flows and a reduction in flood risk in the wider catchment as well as water quality benefits.

The implementation of the scheme has greatly improved the area in ways which conventional drainage would not be able to, resulting in much improved community engagement activities, wildlife presence and biodiversity.

6.4. Community Engagement – Thames21 & Friends of Firs Farm

At the time of the projects initial inception, events where held at the site with the input of the newly formed Friends group to engage on some of the details of the scheme.

Thames21, a waterways charity, organised corporate and public volunteers for wetland planting events and other activities. They have also been involved in interpretation, education events and initiatives.

A "Friends of the Park" group is comprised of local residents and businesses which carry out various activities in the park. In relation to the wetland project they have assisted in vegetation planting, woodland path networks, litter picking, a tree adoption scheme and even organised a community festival focussed around the wetland that was attended by 2,000 local residents.

Both groups are essential for the future success of the scheme.

6.5. Disciplines

The project was devised and advanced within the councils internal functions and as such drew expertise from a range of disciplines from across the organisation wherever possible.

The project brought together disciplines from a range of backgrounds:

Discipline	Internal / External	Stage	Detail
Civil Engineering	Internal	Construction	The design and implementation of earthworks
Drainage Engineering / Hydrology	Internal	Construction and on-going	The design and implementation of the connection of surface water sewers
Landscape Architect	Internal	Construction	The design and implementation of amenity areas around the site including planting of trees and plants
Reservoir Engineer	External	Advisory	To provide guidance and approval of the flood bund

Arboricultural officer	Internal	Advisory	To provide assistance in the removal of trees in certain areas of the site to accommodate the watercourse
Parks management	Internal	Advisory and on-going	To approve certain aspects of the design
Transportation	Internal	Advisory	To assist in the delivery of the pathway / cycleway
Housing	Internal	Approval	In allowing access for manhole modifications
Highways	Internal	Approval	In allowing modification to entrances and footway crossovers
Planning	Internal	Approval	Considering and conditioning phases of the scheme
Charity / Voluntary	External	Construction and on-going	In harnessing the site for educational and corporate activities

The main drivers for the scheme were to provide flood defence and improve water quality benefits to the catchment. However the interaction of other disciplines into the project enabled the maximum utilisation of the opportunities to improve the parks environment, wildlife spaces and social areas.

Various contractors needed to be commissioned to deliver the project including:

- Earthworks;
- Civils - pipes and drainage;
- Tree removal;
- Path construction;
- Bridge construction;
- Vegetative planting.

7. Maintenance & operation

The site is classed as a public open space and park and is owned and managed by Enfield Council.

A management plan for the site was developed which includes cutting of wetland cells vegetation; inspection of inlets and outlets to check for blockages caused by silt, vegetation, litter and other debris; inspection of manhole diversion chambers and grilles; inspection of boardwalks, seating areas and interpretation signs.

The scheme sits within a public park which requires routine maintenance. Thames21 and the Friends group organises supplementary activities such as litter picking and vegetation management.

Parts of the scheme which are considered flood defence assets are to be inspected as part of a formal flood asset management programme.

8. Monitoring & evaluation

A long term monitoring programme comparing parameters between the inflow and the outfall has been implemented by Enfield Council and is conducted by Thames21 to test and observe data on a monthly basis. Testing for parameters of phosphate, nitrogen, BOD5, total coliforms and heavy metals have shown a significant drop in mean concentrations of all, showing an improvement in the water quality classification status in three of the parameters.

9. Achievements

The following results refer to the "Water sampling, analysis and report - Interim" by Dr. Nathalie Gilbert, Thames21 (September 2016).

Comparisons between inflow and outflow:

- Mean decrease of 91.85% in ammonia, improving the WFD classification from "moderate" to "very good".
- Decrease of 77.86% in phosphate, improving the WFD classification from "poor" to "moderate".
- Mean decrease of 29.99% in BOD (Biological Oxygen Demand), improving WFD classification from "poor" to "moderate".

Beyond the ecological improvements cited in the on-going monitoring and evaluation, there have been noticeable increases in wildlife and particularly bird-life.

The project has dramatically altered the landscape and environment of the area. Previously there were very few features of note, entrances to the park were undefined and there were limited reasons to visit the site. The transformation of the site has given members of the public a reason to use the site and enjoy the new environment, bringing the community together in contributing to a common project.

In 2017 London Borough of Enfield was announced winner in the Canal & Rivers Trust Living Waterway Awards for the Natural Environment category. The awards aim to recognise the achievements of those who are working together to unlock the benefits of canals and rivers by making them exciting places to live, learn and spend time. The assessment panel are drawn from a range of professions across the industry and made the following comments: *"The highly integrated nature of this scheme, involving very active partners and close co-operation between different professional disciplines, is truly inspiring. The revealing of a hidden watercourse is not unique, but pursuing this aim to fulfil so many different goals is highly noteworthy, and this project has already demonstrated its value as a catalyst for future work."*

Figure 5 Wetland

Figure 6: Overlooking downstream wetland

10. Challenges or lessons learnt

Challenges for a scheme of this size with a phased approach and multiple disciplines and contractors operating on site are inevitable and range from significant to trivial:

- Establishing initial drainage conditions in the site and veracity of existing plans;
- A part of the open watercourse required routing through a line of woodland, a suitable point was chosen due to a natural gap, however excavating around tree roots still presented a problem;
- A part of the design for the watercourse required very close interaction with football pitches, which needed moving part way through the playing season;
- Across such a large site, with dramatic levels changes, in places it was important to gain an understanding of the differences in sight-lines, particularly around adjacent houses;
- Incorporating several sewers and various inlets and outlets can require design and subsequent adjustments of levels;
- The challenge of misconnections from the foul sewer system upstream can become evident in the wetlands. Therefore it is crucial to work in partnership with water companies on schemes such as this to advance a programme of identifying and tackling misconnections upstream of the outfall.

10.1. Budget & funding

The overall cost of the delivered scheme was £1M with funding from a range of project partners and sources, highlighting the importance and opportunities that can be realised through securing a range of funding streams.

Approximately 95% of the total secured budget went towards construction of the various elements with the remaining 5% covering design and interpretation.

10.2. Project partners

Enfield Council: Funding; overall delivery; project management

Environment Agency: Funding (Flood Risk Management)

Thames Water: Funding (Community Investment Fund); volunteers

TfL: Funding (cycleway links infrastructure)

GLA: Funding (Big Green Fund)

Thames21: Public and corporate engagement; water quality testing

Friends of Firs Farm: Community engagement and maintenance; fund-raising

Turfdry Ltd: Contractor

AH Nicholls: Contractor