# Hydrological Statement

Proposed Storm Water Swale & Ponds at Churchdown Park

Churchdown Parish Council

Parton Road Churchdown

GLOUCESTER GL3 2JH

OS Grid Reference SO 885 206

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# Hydrological Statement

## 1.0 Introduction

Churchdown Parish Council proposes enhancing Churchdown Park with the creation of a stormwater storage swale with an associated landscaping and chain of small wildlife ponds. There are useful benefits associated with this proposal that would provide an important flood water storage buffer, promote biodiversity and also improve amenity.


Fig 1. Aerial photograph of Churchdown Park and location of proposed swale & ponds.

The system of swale and ponds would be located in the north east area of the Churchdown Park Playing Fields, close by the A40 and Normans Brook. Water for recharging the new pond is to be taken from the existing surface water drainage from the Parish Council premises, car park and hard amenity area, as well as the wider playing field area.

The Parish of Churchdown has undergone significant development and land use change during the past century with a large increase in paved area, and loss of some farmland with its accompanying biodiversity, together with numerous ponds previously in this area. Thus accelerating run-off and contributing to raised local flood risk. This proposal seeks to demonstrate, in hydrological terms, a useful counter to this development by moderating flood and also benefitting biodiversity by providing new habitat.

Consideration of the close proximity to Gloucestershire Airport is incorporated into this proposal by way of designing small ponds so that they will not be favourable to water fowl and other bird species will be discouraged by frequent visitors to the park, those regularly walking dogs etc.

## 2.0 Hydrogeology

A Ground Investigation, Survey and further research has identified the following:

### 2.1 Site Description

The proposed swale & ponds site is located on a gently north sloping grass playing field. An existing stormwater sewer runs from the direction of Parton Road along the western side of the site before discharging into Normans Brook, which bounds the site along its northern perimeter.

The remainder of the site is soft turfed playing fields together with hard standing car parking and council offices. The car parking area and offices surface drainage are presently drained via storm sewer to Normans Brook at times of rainfall. The playing field area also drains into Normans Brook owing to the landform and gradient.

It has been noted that the area of the proposed pond often remains water-logged and unusable for sports or other purposes for long periods following rainfall.

### 2.2 Geology - Ground Conditions

Fieldwork investigations of the proposed pond area have been carried out in general accordance with BS5930:1999 comprising six trial pits and two soakaway tests.

Beneath a thin layer of topsoil an area of Made Up Ground extends (at depths between 0.5 - 1.9m) across the area for the proposed pond. The investigation confirmed the presence of Lower (Blue) Lias Clay, as indicated by the geological records, underlying the site. There are small sedimentary Head deposits present locally over the Lias.

The material within the Made Up Ground comprises soft & firm, locally stiff, orange/brown and/or grey slightly to locally very sandy clay with occasional gravel sized fragments of brick and tile. (This material would be excavated from the swale area and used for landscaping).

### 2.3 Hydrogeological Conclusion

Soakaway tests here resulted in very little water infiltration during a two hour test. The feasibility of constructing a competent swale and reedbed here within, and puddled by, the Blue Lias Clay underlying the site appears very good.

The remaining 5 small ponds and reedbed will be excavated within the Made Up Ground and will require butyl linings or similar.

There are no negative Aquifer, or other Ground Water recharge issues relating to this pond proposal.

## 3.0 Hydraulic Operation

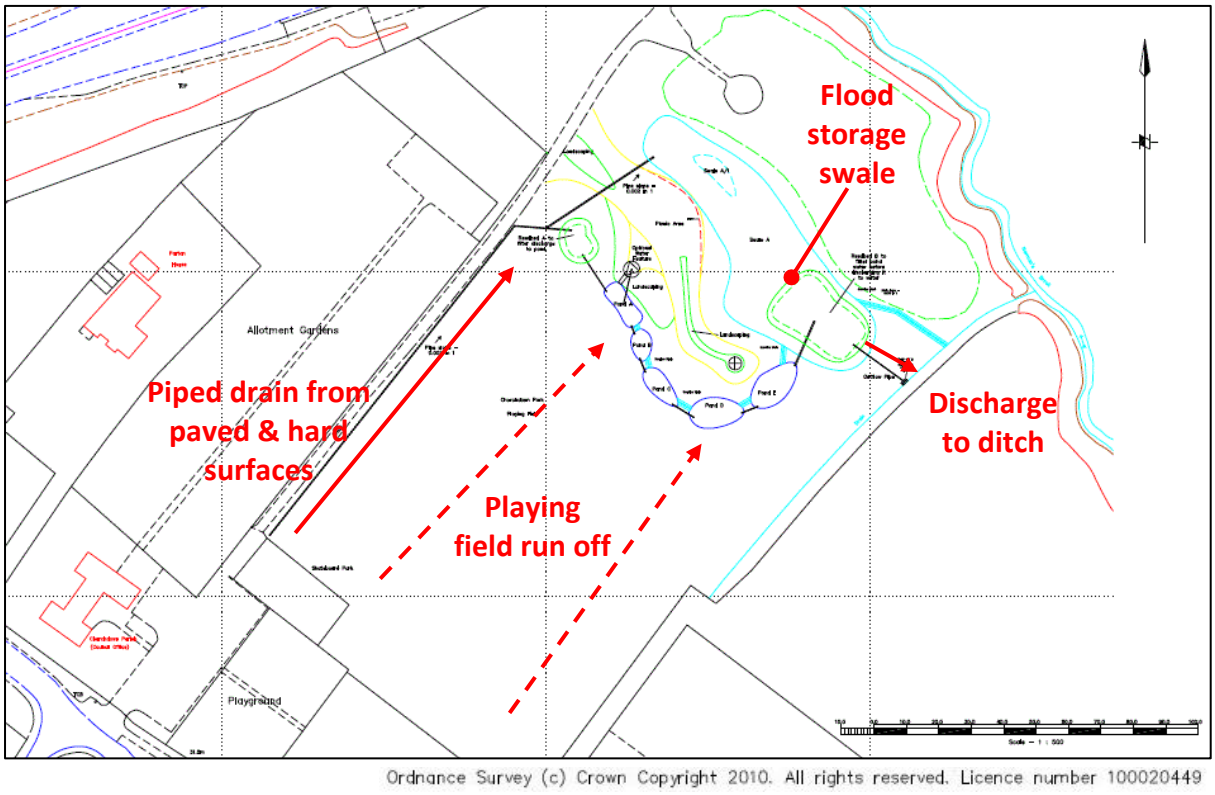




Fig 2. The swale and ponds system features reedbeds to cleanse water prior to storage and before discharge to brook.

Water for recharging the new system will be provided by the rainfall/storm water falling on the remainder of the Churchdown Park site. The proposed pond area lies, by way of the prevailing site gradient, at the lowest area of the site, enabling collection of rainfall here by gravity.

The new water storage system and its associated landscaping will occupy an area measuring approximately 0.6 ha, with a permanent water area about 0.031 ha (312 $m^2$) contained within a chain of five small ponds. During major storm events, when all of the swale capacity is used, the water area here will be temporarily 0.240 ha (2401.7 $m^2$).

The drainage from the hard standing area (office building, car park and hard play area) presently drains from the site via public sewer and enters Normans Brook by way of a storm drain that bounds this site, (thus, by way of this direct run-off contributing to raised local flood risk in the brook at times of heavy rainfall). This will now be intercepted and redirected by sub-surface drain to the pond area, along with any other surface drainage entering from the green playing field area of the site.

Reedbeds provide water treatment prior to entry to small ponds, and again on discharging from swale prior to the overflow into the existing ditch bounding the Eastern site perimeter, which discharges into Normans Brook. A bypass diverts major rainfall to direct to swale. A

coarse sand planting medium is recommended and the reedbeds are sized according to anticipated treatment required.

(An optional refinement to the system design for severe drought conditions is the ability to divert 'grey water', from the washing and kitchen facilities at the Parish Office via the drain and reedbed in order to maintain pond levels).

(See accompanying layout plans)

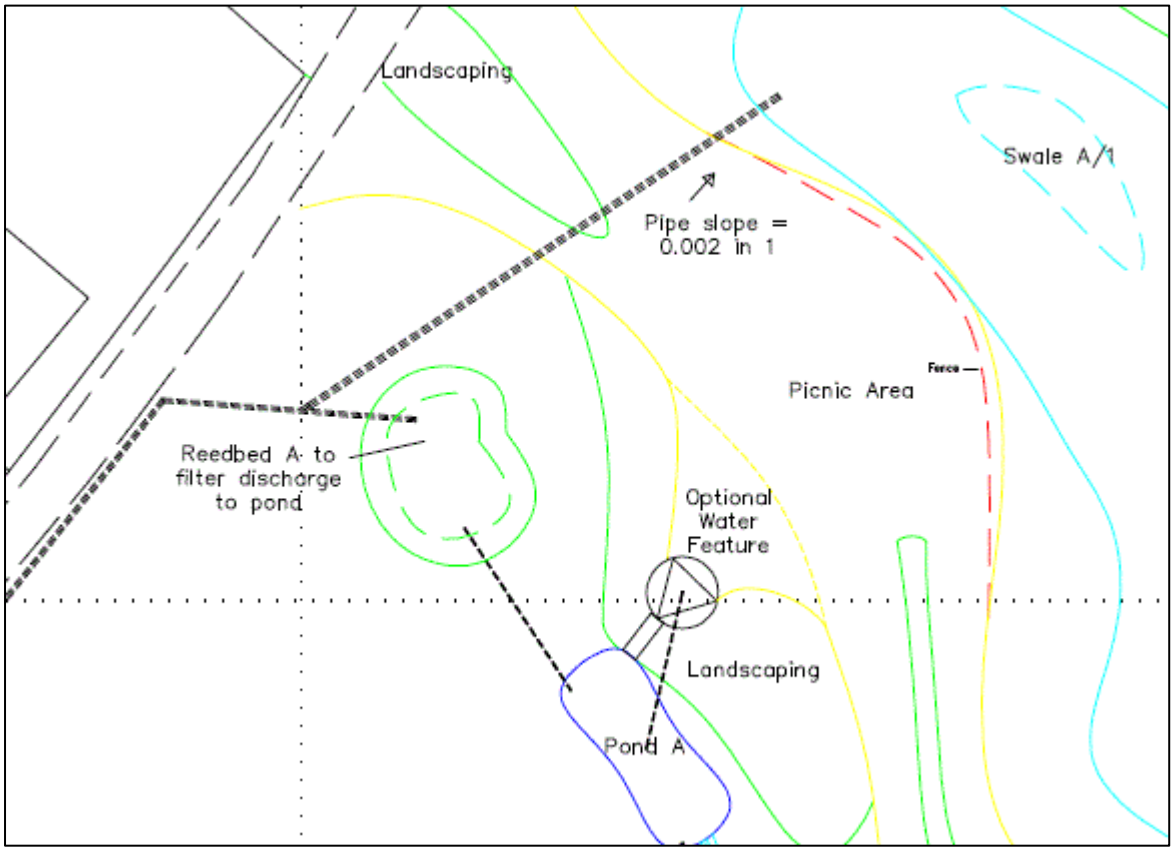


Fig 3. Detail from plan, showing reedbed for treatment of influent regular rainfall from drain that conveys hard surface run-off, prior to discharge into pond – a bypass diverts major rainfall to swale.

The ponds, swale and associated structures (reedbeds, drain & discharge to ditch) are all positioned at distances exceeding 8 metres from Normans brook. Normans Brook at this location is designated a 'main river' and hence any works within 8 metres of the top of bank of the watercourse would require formal EA permission in the form of a Flood Defence Consent. As no works are proposed within 8 metres of the Normans Brook or within any floodplain areas and hence any such permissions as set out above will not be required in this instance.

The drain outlet to the ditch is specified as a hard construction on the recommendation of Robert Nightingale, Tewkesbury BC, Land Drainage and Design Consultancy Manager, comprising a block built headwall mounted upon a concrete plinth with apron, discharging in a downstream direction.

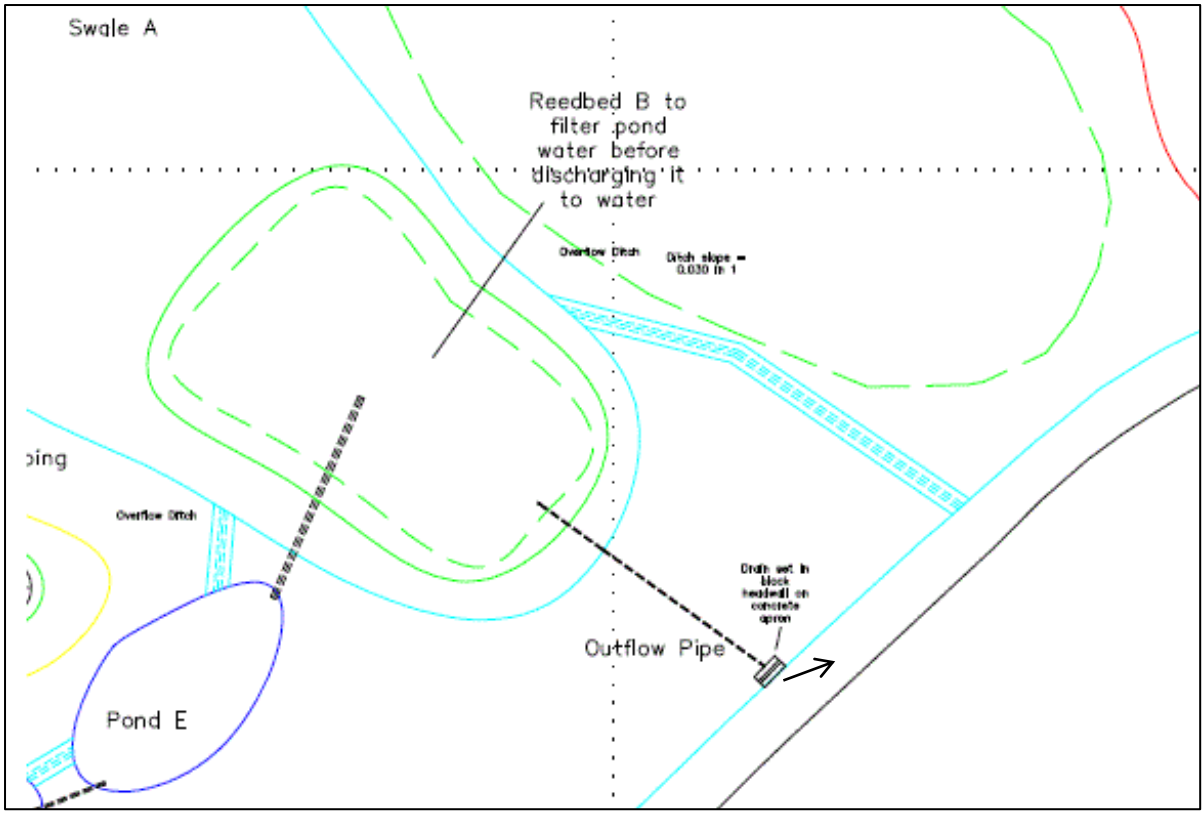


Fig 4. Detail from plan, showing reedbed for treatment of all outflows from swale, prior to discharge into ditch (and then into Normans Brook).

### 3.1 Water storage

The design contains five small ponds for wildlife and recreational functions and a large swale for storm water retention.

(See Appendix for Table 1.3 Estimation of ponds and swales volume).

Water storage within the swale is determined by size of construction and depth. The normal swale depth will be approximately 1m across the majority of the water storage area approximating to 2600m$^3$ of water stored. The total water storage capacity is approximately 2900m$^3$, though this storage capacity exceeds any estimated capacity required.

The opportunity provided by this site, of the gently sloping gradient for collecting rainwater in the pond area, is further enhanced by the lower level of the adjacent Normans Brook, whose normal base flow level lies below the intended bed of the pond.

The main swale is surrounded by a bund to provide the required storm water storage capacity. A restricted diameter discharge pipe (100mm) set into the bund at the intended normal pond water will allow storm surcharges to slowly drain down to the adjacent ditch (which discharges into Normans Brook), via a reedbed treatment system.

The water from the paved and playfield area is drained down to the main Swale (Swale A) by the chain of ponds as it was designed to this function. The connection between the ponds is

provided by pipes (200mm) and an overflow ditch system is incorporated between the individual ponds to drain down extreme storm water volumes directly into the swale.

A key demonstration aspect of this system is to show the benefits of retaining rainfall run-off from paved areas and specifically here this will be conducted by way of disconnection of existing drainage and diversion into the system. The paved area here comprising the offices, car park and hard play area, amounts to 2550.00 m2.

The total potential receiving catchment for any stored rainfall comprises the hard and soft areas of Churchdown Park, this covers an area of 3ha (30,000m2).

Other than water logging of the proposed storage area following rainfall, the Churchdown Park site offers poor flood resilience owing to the impervious nature of the clay soils here and the significant paved area - either by way of surface run-off, or sub surface drainage, the majority of any rainfall here will quickly enter Normans Brook which bounds the site.

Normans Brook, though small, does suffer significant occasional flooding and a small flood plain area subject to high flood risk is immediately adjacent to Churchdown Park, along the course of the Brook - though the park and proposed pond area stands well above the flood risk area. The site of the pond is located in an area of low flood risk (Flood Zone 1) as defined in table D1 of PPS25 and hence the EA suggests that it would be at the discretion of the local planning authority as to whether they should be consulted as part of the planning process.

The EA (John Foulds, Development & Flood Risk, Midlands Region) has been consulted during feasibility planning stage of this proposal and informally agreed that the proposals will provide some benefits in relation to managing discharge rates and will more importantly contribute to improving the quality of the discharges from this area.

**3.2 Local rainfall and pond recharge**

Annual rainfall is around 700mm per annum (Gloucester Airport).
Annual water volumes available for periodic pond recharge will approximate to :
Annual run-off for paved area of Churchdown Park – 2550 $m^2$ x 700mm = 1820 $m^3$

- 100 % of this run-off will be directed to pond/swale system.

Annual run-off for total area of Churchdown Park - 30,000 $m^2$ x 700mm = 21,000 $m^3$

- 50% or less of this run-off will be available to pond/swale system.

### 3.3 Peak flows

The maximum flow rates from the surface drainage of the paved area can be estimated from the duration and intensity of any likely storm event. Rainfall intensity for various return period storms can be derived from rainfall data in the Flood Estimation Handbook (FEH) for the nearest rainfall recording station to this site, given in Table 1.1 below.
Table 1.1 FEH rainfall totals (mm) for Gloucester Airport

| **Return Period (years)** | **Storm Duration** | | | | |
|---|---|---|---|---|---|
| | **30 min** | **1 hr** | **3 hr** | **6 hr** | **12 hr** |
| **2** | 8.2 | 10.5 | 15.3 | 19.4 | 24.7 |
| **5** | 12.9 | 15.9 | 22.3 | 27.7 | 34.2 |
| **10** | 16.8 | 20.4 | 27.9 | 34.0 | 41.4 |
| **25** | 23.0 | 27.5 | 36.5 | 43.6 | 52.1 |
| **50** | 29.0 | 34.2 | 44.3 | 52.2 | 61.6 |
| **100** | 36.4 | 42.3 | 53.7 | 62.4 | 72.6 |

Table 1.2 Peak Flows and Storage Volumes for paved and total grass area of Churchdown Park

| **Churchdown Park** | | | | |
|---|---|---|---|---|
| Return Period 100 years | Paved area 2550 m2 | | Playing Field area 30,000 m2 | |
| Storm Duration (hrs) | Peak Flow (l/s) | Volume (m3) | Peak Flow (l/s) | Volume (m3) |
| 0.5 | 51.57 | 92.82 | 606.67 | 1092 |
| 1 | 29.96 | 107.87 | 352.50 | 1269 |
| 3 | 12.68 | 136.94 | 149.17 | 1611 |
| 6 | 7.37 | 159.12 | 86.67 | 1872 |
| 12 | 4.29 | 185.13 | 50.42 | 2178 |

The estimation of likely peak flows to be drained from the paved area inform a recommended sizing of 300mm diameter drain pipe to convey the run-off, via small treatment reedbed, to the pond/swale system.

Run-off from the remainder of the playing field area will be by surface flow into pond/swale system, but by way of existing drainage here and the surface gradients and landform the ponds and swale will not capture and store all the theoretical run-off here.

The flood storage capacity of the main swale, 2600m$^3$, is therefore adequate to meet likely major storm rainfall events and receive sufficient regular recharge to maintain a good volume of standing water.

Slow drain down of the swale via reedbed to the ditch and on into Normans Brook is determined by the use of a restricted diameter (100mm) pipe. With this size of the pipe all stored capacity from the biggest likely storm events is drained down by 9.8 days (if the slope is 0.002 in 1).

## 4.0 Landscaping features

The landscaping is intended not only to provide the land profiles to enable water storage but also create an area that is rich in biodiversity and amenity interest for the visitors to the park.

An optional refinement to the design is the installation of a Flowform water feature. This provides an additional point of interest to visitors as well as providing useful aeration and recirculation to the ponds. An electric pump and recirculating subsurface pipe work would be required.

A range of Flowform cascades are available and the 'Sevenfold' model has been suggested as appropriate here. This would be securely mounted onto a stepped concrete plinth.

Fig 5 Sevenfold Flowform (courtesy Ebb & Flow Ltd).

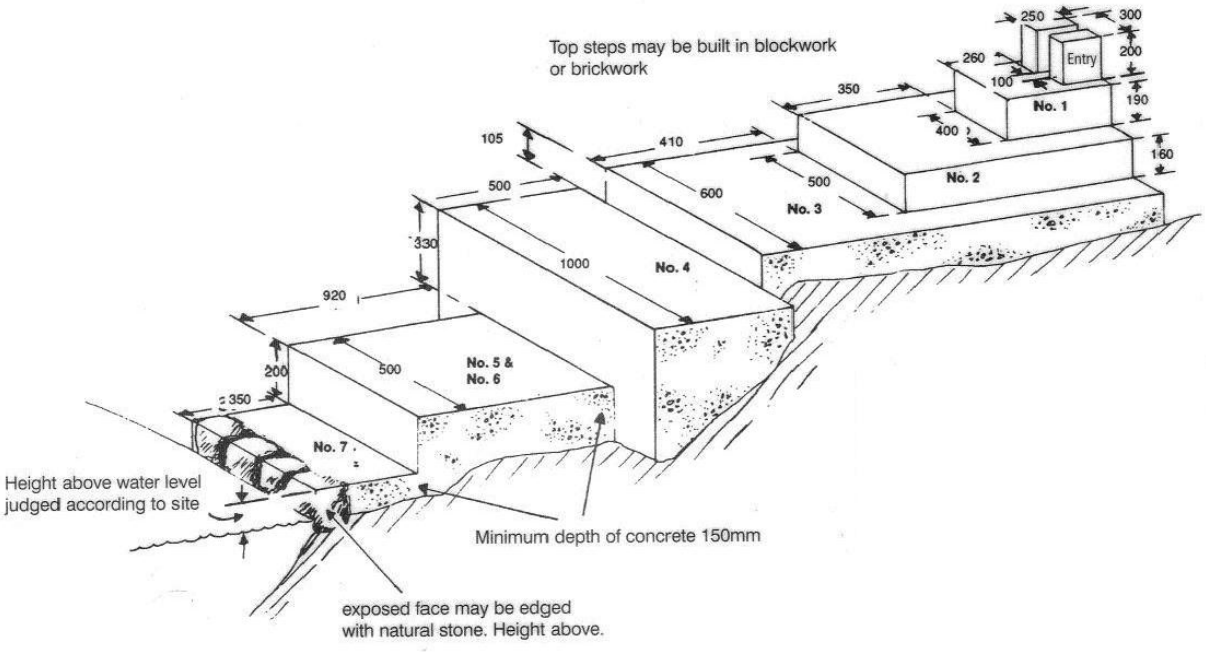


Fig 6 Sevenfold Flowform installation details (courtesy Ebb & Flow Ltd).

## 5.0 Appendix

Table 1.3

| **Churchdown Pond Plan v4.3.1<br>Estimation of ponds and swales volume** | | | | | | |
|---|---|---|---|---|---|---|
| Pond/Swale name | Length - water level - (Radius) $R_1$ <m> | Width - water level - (Radius) $R_2$ <m> | Length - bed - (Radius) $r_1$ <m> | Width - bed - (Radius) $r_2$ <m> | Depth (m) <m> | Volume (V) <$m^3$> |
| Pond A | 7.50 | 2.50 | 4.80 | 0.70 | 0.90 | 28.32 |
| Pond B | 5.00 | 3.00 | 3.20 | 1.20 | 0.90 | 24.91 |
| Pond C | 7.50 | 3.00 | 5.70 | 1.20 | 0.90 | 39.34 |
| Pond D | 8.50 | 4.50 | 5.80 | 1.80 | 0.90 | 64.72 |
| Pond E | 9.00 | 5.00 | 6.30 | 2.30 | 0.90 | 80.13 |
| Swale A | 48.50 | 42.50 | 12.00 | 6.00 | 1.00 | 2637.36 |
| Swale A/1 | 9.00 | 2.50 | 8.00 | 2.00 | 0.90 | 54.17 |
| TOTAL PONDS | | | | | | 237.43 |
| TOTAL SWALES | | | | | | 2691.52 |
| TOTAL | | | | | | **2928.95** |

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