Almondbank Flood Mitigation Scheme

Surface Water Flooding Solutions

August 2012

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Executive Summary

The Mouchel report 'Almondbank Flood Mitigation Scheme, Impacts on Drainage Infrastructure' (April 2010), investigates the relationship between the proposed Almondbank fluvial flood mitigation scheme and the existing surface drainage in the area that the scheme is intended to protect.

The report highlighted key areas where;

- Ground levels are at or below the top design water level of the proposed flood defences, therefore unable to drain to the river during the design flood,

- Surface drainage is considered to be insufficient and may be perceived as a failure of the flood mitigation scheme.

This report summarises the areas where a risk of surface water flooding has been assessed, and proposes three outline solutions to mitigate the most likely problems of excess surface water runoff and flooding in Almondbank, these are as follows;

- A combined kerb and drainage system at Bridgeton Brae,
- A combined kerb and drainage system at Lower Main Street,
- A surface water pumping system at the Vector Aerospace site.

Other areas were highlighted for discussion due to being below the top design water level of the proposed flood defences. These have been investigated, but found to pose little or no risk of significant flooding from surface water runoff, these areas are;

- Huntingtowerfield,
- Ministry of Agriculture Site,
- Deer Park,
- Low's Work Cottages,
- Lochty Industrial Estate,
- Waterside Cottages.

Contents

List of Appendices

1 Introduction

1.1 Background

Almondbank is at risk from fluvial flooding. Development has occurred on the floodplain of the River Almond, around the area of Low's Work Weir and the confluence of the River Almond and the East Pow Burn.

Perth & Kinross Council employed Mouchel to develop a flood mitigation scheme. The aim of the scheme is to protect the town from events up to and including the 1 in 200 year flood, plus freeboard (hereafter referred to as 'flood level').

An analysis of the effect of the proposed scheme on the existing drainage infrastructure[1] found that fluvial floodwater could backflow up the system from some drainage outfalls, and pond on the protected 'dry' side of the proposed defences.

Backflow protection (e.g. flap valves) could prevent this. However, these would also prevent surface water runoff from reaching the river. A risk of flooding on the 'dry' side of the defences would remain.

1.2 Purpose of this Report

This report summarises the areas where a risk of surface water flooding has been assessed, and proposes outline solutions for areas where the flooding risk is significant.

[1] 'Almondbank Flood Mitigation Scheme: Impacts on Drainage Infrastructure' (Mouchel, April 2010)

2 Analysis

2.1 'High', 'Low' and 'Margin' Areas

Initial assessments demonstrated that raised flood levels would not significantly increase flood risk from drainage infrastructure in areas more than a few metres above flood level.

Subsequently, Almondbank and surrounding areas were assessed in terms of ground levels and assigned to one of three groups: 'high areas' (e.g. where ground levels are more than 10m above the 200yr flood level - a conservatively set limit), 'low areas' (below flood level) and 'margin areas' (between 0m and 10m above flood level).

High areas were discounted from further analyses of the effect of fluvial floods.

2.2 Analysis of Surface Water Flood Volumes and Extents

Low and Margin Areas were subjected to an analysis of the likelihood of the following scenarios;

- Spills from the existing drainage infrastructure resulting from incapacity,
- Areas and extents of resulting surface water flooding.

Sewer capacity and the likelihood and location of spills were estimated from steady state backwater calculations[2].

Surface water flooding extents were estimated by calculating the 1 in 30 year (in accordance with Sewers for Scotland) event runoff volume from each contributing catchment, and applying this to an electronic contour map of the catchment (contours were derived from a spot level survey).

Surface water flowpaths were also assessed from the contour map, and determined to be either 'safe' (freely draining to the river without significant risk of internal flooding) or 'unsafe' (not freely draining, or at risk of causing internal flooding). A map of the indicative flowpaths is provided in Appendix A.

2.3 Results Summary

The analysis concluded that the combined sewer serving the majority of Almondbank suffers from a lack of capacity to handle the potential runoff from the areas it serves, at least in terms of the modern design standard of a 1 in 30yr level of service. This is regardless of water levels in the river (i.e. 'free outfall' conditions).

[2] Refer 'Almondbank Flood Mitigation Scheme: Impacts on Drainage Infrastructure' (Mouchel, April 2010), section 3.2.

3 Discussions with Scottish Water

A telephone meeting was held between Mouchel, Perth & Kinross Council and Scottish Water on 16 June 2010. The analyses of the areas summarised in section 2 above were discussed with Scottish Water, and their comments sought.

Scottish Water stated that they had no records of sewer flooding incidents in Almondbank, but accepted that the analysis was reasonable.

A lack of official records is not unexpected, given that the analysis deals with extreme events (e.g. 1 in 200yr Average Recurrence Interval), or with short duration ‘flash’ flooding, which - provided it is short-lived and no internal property damage occurs - is often tolerated by the public and not reported. Alternatively, the flooding may be reported to the ‘wrong’ authority.

Without the evidence to signify a need, Scottish Water could not justify investment in improving the performance of their assets. It was therefore agreed that ‘off-line’ solutions - which work independently of the combined sewer network - would be developed by Perth & Kinross Council within the remit of the proposed flood mitigation scheme.

All parties agreed that the solution designs should ignore the presence and action of the combined sewer, and deal with surface runoff as if it was all discharged to the road. This makes little difference to the required capacity of the solutions, since the combined sewer offers very little storage and will quickly overflow in the type of events being considered.

The risk of 'backflow overflows' was discussed – i.e. foul water spilling from the combined systems and finding its way to the river via the proposed surface interceptors.

All parties agreed that, should such an event be viewed by the Scottish Environmental Protection Agency as an un-consented discharge and an offence, the spill would have first occurred from Scottish Water’s assets, therefore Perth & Kinross Council would not be responsible if their interceptor diverted the spill to the river. The issue of sewage discharge via new interceptors during a flood event will be discussed with SEPA as the scheme is taken forward.

4 Problems and Proposed Solutions

This section describes the extent of predicted surface water drainage problems in nine areas identified by the analysis. Of these, solutions are recommended for three of the areas;

- A combined kerb and drainage system at **Bridgeton Brae**,
- A combined kerb and drainage system at **Lower Main Street**,
- A surface water pumping system at the **Vector Aerospace** site.

The solutions for these three areas are discussed in sections 4.1 to 5.3 below and the remaining areas are discussed in Sections 5.4 and 4.5.

Specific surveys were undertaken in order to ensure that the problems could be accurately defined. The results of these surveys, key manholes, outfalls and Vector Aerospace surface water network are included in Appendix B.

4.1 Bridgeton Brae Surface Water Interceptor

4.1.1 The Problem

The existing combined sewer system serving the "Bridgeton North" catchment (north of Kirkhall Rd) has been shown to have insufficient capacity to meet the Sewers for Scotland standard[3].

Excess runoff will flow down the kerb and channel of Bridgeton Brae and across the Bridgeton Road Bridge, where our analysis[4] and statements from residents suggest it will collect on its west side at a low point in the road. Indicative extents are shown in Figure 1 below.

The flooding described will eventually spill across the pavement to the river, therefore significant action may not be necessary.

A gully exists at the low point. This is thought to discharge to the combined sewer. This could alleviate the problem (draining any ponded water when capacity is available downstream), or it could make it worse (overflowing from surcharging in the system downstream). Determining the behaviour response of the system at this gully would require dynamic hydraulic modelling, which is outside the scope of the analysis.

The flooding on the west side of the bridge (estimated to be around 200-300mm deep before spilling) is likely to impede pedestrians and vehicles. The bridge is only one lane wide, and the ponding occurs on a 'semi-blind' corner, where it may not be

[3] Refer 'Almondbank Flood Mitigation Scheme: Impacts on Drainage Infrastructure' (Mouchel, April 2010), section 5.3.

[4] Refer 'Almondbank Flood Mitigation Scheme: Impacts on Drainage Infrastructure' (Mouchel, April 2010), section 5.4.

seen by drivers crossing from Bridgeton. The road has a significant slope across the bridge, meaning that runoff velocity across it would be fairly high. Erosive damage to the road surface and bridge structure is a possibility.

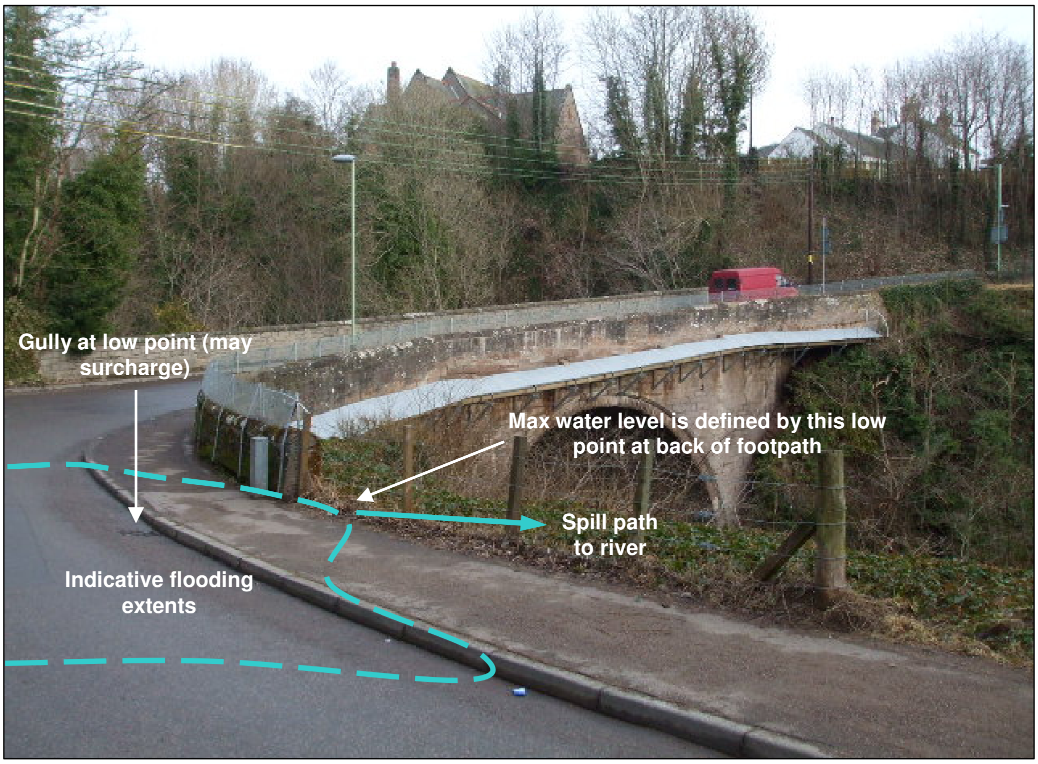


Figure 1: Indicative flooding extents from surface runoff

4.1.2 The Solution

4.1.2.1 Option A: Do Nothing

If this option is selected, the problems described above will remain.

4.1.2.2 Option B: Drop Kerb and Flow Routing

A drop kerb could be installed and the footpath locally lowered at the low point of the carriageway adjacent to the river. The flood water would be directed across the lowered footpath and down the bank to the river.

Benefits

- Surface water flooding will be reduced,
- The works are low cost and low technology,
- Utility diversions are not required.

Other Considerations

- The works will require traffic management,
- The proposed works will mean that flows are directed across the footway,

- Surface water continues to flow with high velocities along Bridgeton Brae and over the bridge with no improvement across the bridge for either pedestrians or vehicles.

4.1.2.3 Option C: Combined Kerb and Drainage Interceptor (recommended)

Combined kerb and drainage installed in Bridgeton Brae immediately above the bridge will collect surface runoff and overflows from the street, and discharge it to the river before it can flow across the bridge.

Figure 2, Figure 3 and Figure 4 demonstrate the concept. A sketch plan of the outline design is provided in Appendix C.

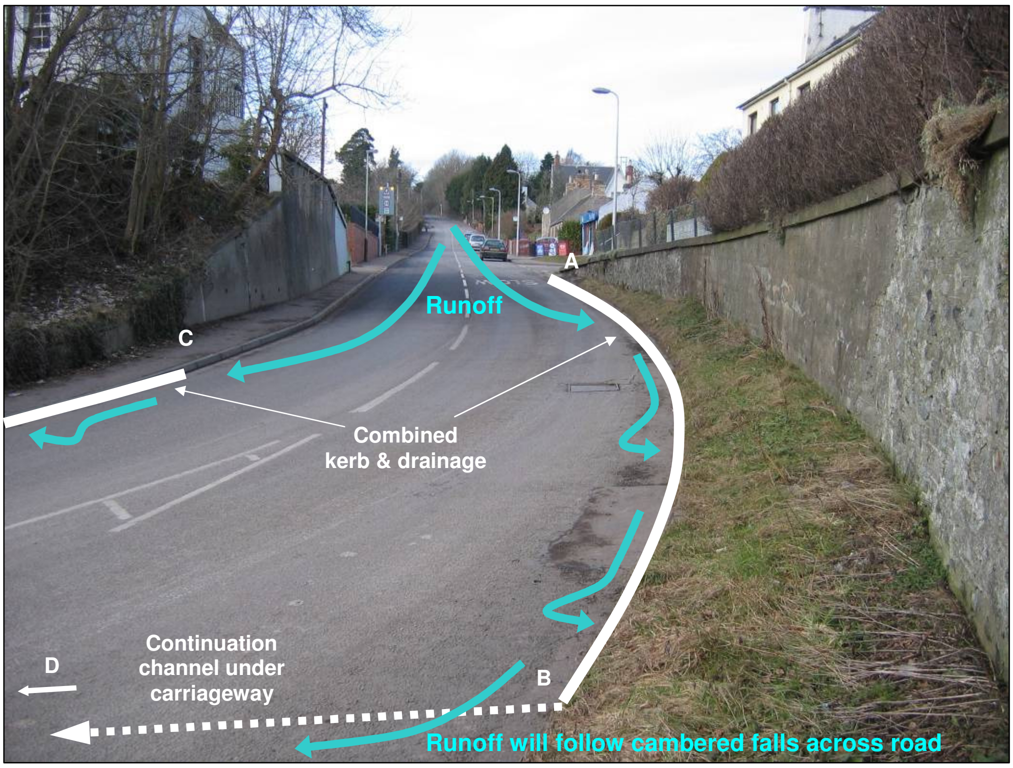


Figure 2: Indicative proposed solution on Bridgeton Brae (1)

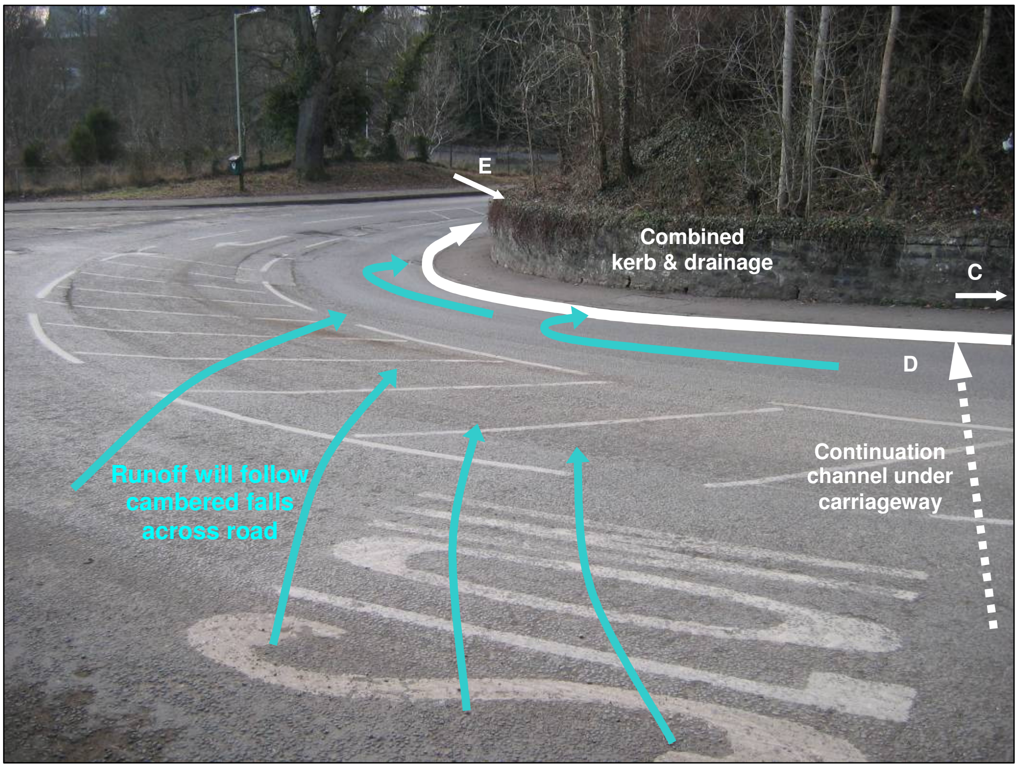


Figure 3: Indicative proposed solution on Bridgeton Brae (2)

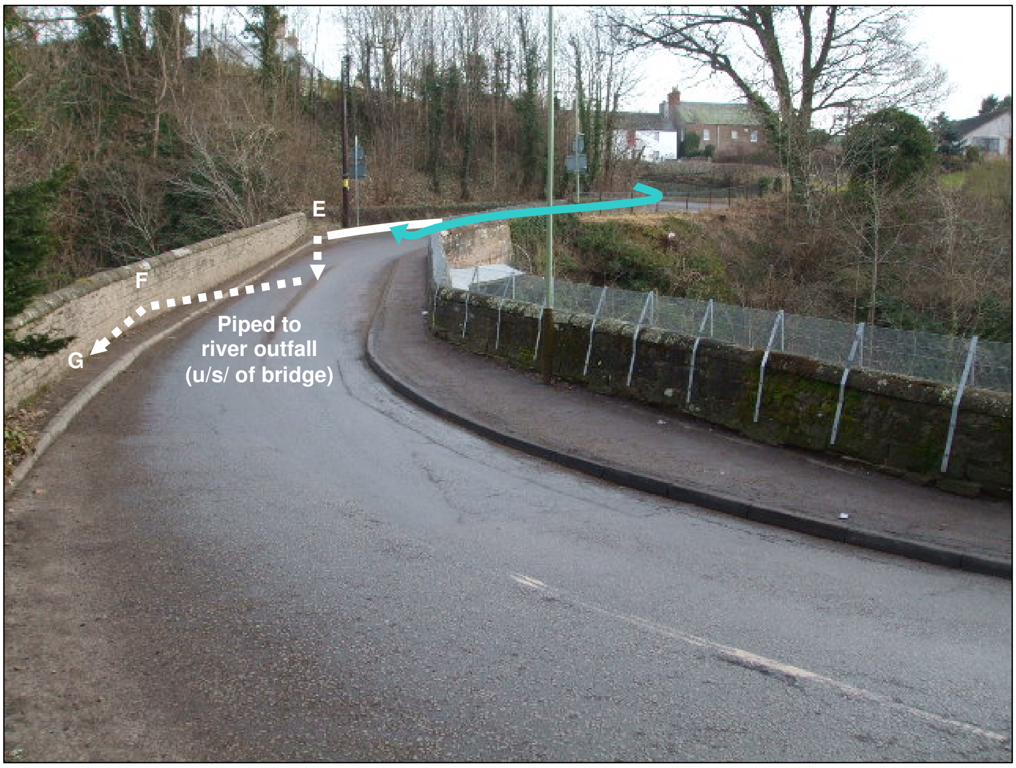


Figure 4: Indicative proposed solution on Bridgeton Brae (3)

Benefits

- Surface water flooding will be reduced,
- The proposed solution will improve safe passage across the bridge for both pedestrians and vehicles,
- Kerb drainage is generally less expensive to install than traditional gully and pipe drainage, as it permits shallower excavations.

Other Considerations

- Utility diversions (including existing sewers) may be required;
  - The 225mm diameter combined sewer on the corner of Bridgeton Brae may need to be diverted unless the interceptor can be laid clear above it,
  - The indicative layout of the potable water network is known, but accurate positions and depths are unknown,
  - The location of other utilities (telecoms, electricity, gas, etc) would also need to be accurately determined.
- Ground conditions at this exact location are unknown. Trial holes will be required,
- The works will require traffic management,
- The proposed outfall is in a steep bank and appropriate consideration must be applied to its design and construction (note that a CSO outfall has been successfully installed in similar conditions downstream of the bridge).

4.1.3 Validity of the Recommended Solution

The flooding described here does not directly pose a threat to property (buildings). Furthermore, the point where water collects near the bridge is still significantly above the river level for the 200yr fluvial event. As such, it could be argued that this solution is not justified as part of this scheme, as its mechanism is not influenced by the recommended scheme.

However, the flooding does impede access across the bridge and, being on a partially blind corner potentially introduces dangerous conditions to traffic and pedestrians. It could also still be publicly perceived as a failure of the flood mitigation scheme, despite it being relatively clear that this flooding is not caused or influenced by the action of the river. This may not be an important distinction in the eyes of those whose lives we wish to improve.

We therefore recommend that this Recommended Solution is discussed with the appropriate divisions of Perth & Kinross Council, i.e. those with a stake in highways, public structures (the bridge) and general public safety.

4.2 Lower Main Street Surface Water Interceptor

4.2.1 The Problem

The existing combined sewer system serving Main Street and residential areas above has been shown to have insufficient capacity to meet the Sewers for Scotland standard. Excess runoff will flow down the kerb and channel of Main Street towards the bottom of the catchment and the Vector Aerospace entrance.

Vector Aerospace has been demonstrated to be at risk from surface flooding from Main Street and other areas as well as fluvial flooding from the watercourses.

During a sufficiently high flood event, the water levels in the adjacent watercourses will prevent the surface water drains in Vector Aerospace from functioning, and surface water will collect in the site. The proposal to prevent flooding at Vector Aerospace, which incorporates the Main Street solution, is set out in Section 5.3.

4.2.2 The Solution

4.2.2.1 Option A: Do Nothing

The problem described will remain: excess surface runoff will flow down Main Street and collect at the Vector Aerospace site. A solution for this flooding problem is discussed in Section 4.3. However, limited storage is available within the Vector Aerospace site. Therefore, any practicable measures that can prevent runoff from reaching the site should be implemented.

4.2.2.2 Option B: Combined Kerb and Drainage Interceptor (recommended)

A plan of the outline design is provided in Appendix D.

Kerb drainage interceptors on Main Street (between East Drive and Mackenzie Drive) will collect surface runoff and overflows from the street and discharge it to the river (via the playing fields).

Flows that are intercepted from Main Street will be piped beneath the playing fields, passing beneath the proposed earth embankment and discharging into the River Almond, upstream of the steel footbridge.

Benefits

- The interceptor will reduce the surface runoff catchment area contributing to Vector Aerospace, therefore reducing the extent of flooding within the site,
- The proposed solution will improve safe passage for both pedestrians and vehicles along Main Street,
- The road surface of lower Main Street will be better protected from any damage that the flooding could cause.

Other Considerations

- Utility diversions may be required;

  - The indicative layout of the potable water network is known, but accurate positions and depths are unknown,
  - The location of other utilities (telecoms, electricity, gas etc) would also need to be accurately determined.
- Ground conditions at this exact location are unknown. Trial holes will be required,
- The works will require traffic management.

4.3 Vector Aerospace Flood Mitigation

4.3.1 The Problem:

The Vector Aerospace site is vulnerable to fluvial and surface flooding. During a sufficiently high flood event, the water levels in the adjacent watercourses will prevent the surface water drains in Vector Aerospace from functioning, and surface water will collect within the site.

The extents of surface water flooding from the 200yr design event (approx 100mm of rainfall), and with the proposed defences in place, have been estimated[5] for two scenarios - assuming that the Main St interceptor has, or has not, been installed. These result in the following flooding extents.

Main Street interceptor installed?	Approx Flooding Volume, m^3	Approx Flooded Area, m^2	Approx Average depth, m	Approx Max depth, m
Yes	7100	36,500	0.19	0.50
No	9900	48,200	0.21	0.60

Table 1 : Vector Aerospace flooding volumes and depths

The extents of these are shown below. Note that negligible storage available in the existing drainage system (circa 50-100m^3) is not taken into account.

[5] Volumes were estimated using the New UK Runoff Model, as described in WaPUG User Note 28: http://www.ciwem.org/knowledge-networks/groups/wapug/publications/full-list-of-user-notes.aspx

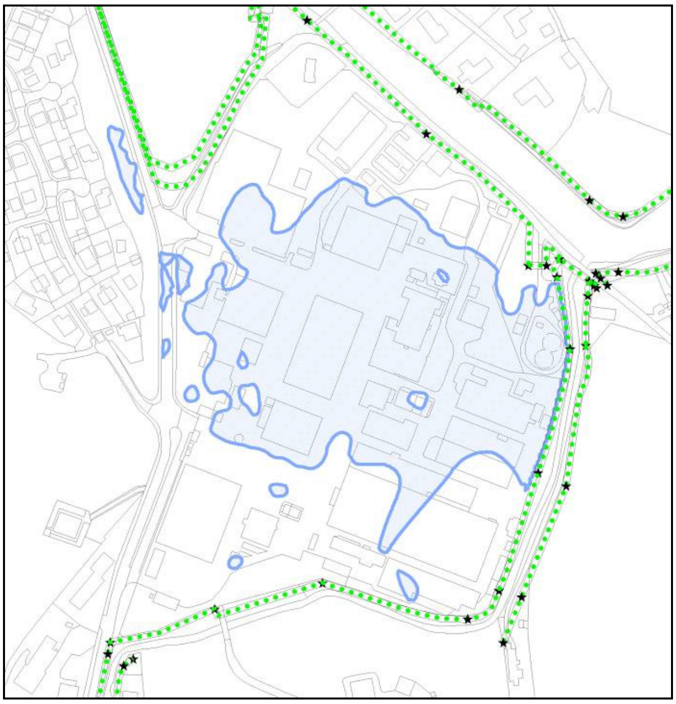


Figure 5: 1 in 200yr surface water flooding, Vector Aerospace (assuming surface water interceptor installed on Main Street)

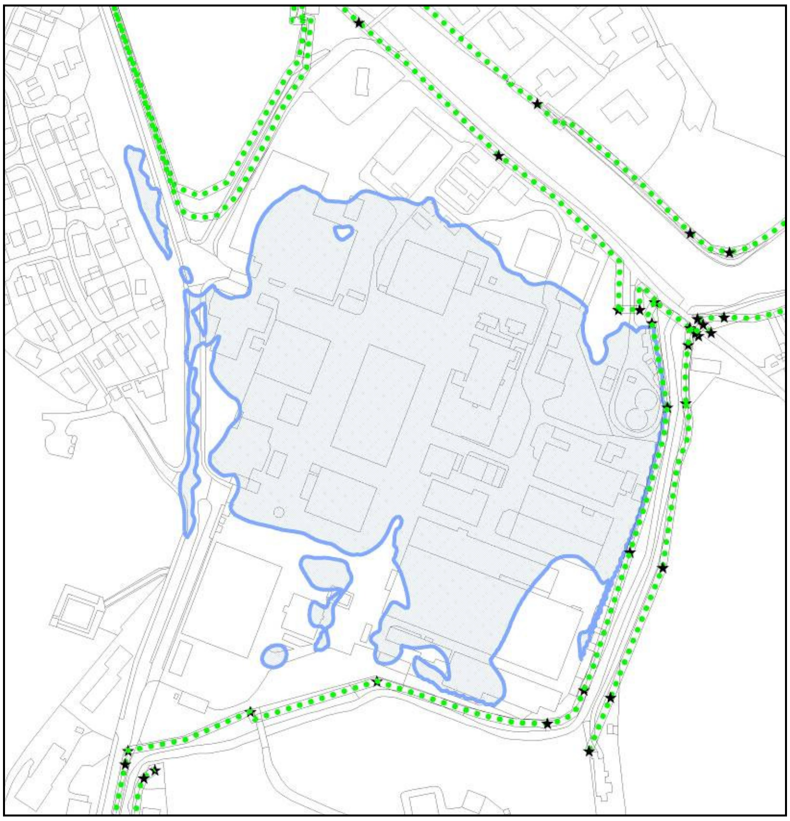


Figure 6: 1 in 200yr surface water flooding, Vector Aerospace (assuming no surface water interceptor on Main Street)

The construction of the fluvial defences may produce localised ponding behind them; localised drainage works would need to be considered in these areas.

4.3.2 The Solution

4.3.2.1 Option A: Do Nothing

The extent of the effects from surface water flooding on the operation of the Vector Aerospace site has not been part of this scheme. It is likely that flooding to depths of 0.5 – 0.6m will occur and will present a major disruption to the operation of the site.

External flooding may be such that manufacturing work can continue, but the analysis suggests that the best case scenario is one where surface water flooding will pond around buildings, preventing or hindering access to a significant proportion of the site.

We therefore recommend that measures are implemented to ensure that the raised water levels in the river do not adversely affect the drainage network within the site.

4.3.2.2 Option B: Surface Water Storage

In addition to the proposed Main St surface runoff interceptor, a storage tank is constructed in the Vector Aerospace site.

When the raised river levels prevent runoff in the drainage system from discharging to the river, water will spill into the storage tank. The stored water will be released when the fluvial flood passes and the river level drops, allowing the system to drain freely again. If levels permit, the tank could have its own dedicated outfall to the river.

Improvements to the existing site drainage have not been considered as part of this scheme. If the existing system is insufficient due to hydraulic or operational issues, new site specific drainage systems may be required.

The least cost solution is a tank of modular construction, comprising interlocking plastic units (capable of withstanding the crushing loads from traffic above) with a waterproof membrane outer wrap.

The volume of the tank (and therefore its level of service) will be constrained by the available area, groundwater levels, outfall levels and the depth of the existing sewers.

Benefits

- The proposed solution will reduce the risk of external flooding in the Vector Aerospace site when the flood mitigation measures are constructed,
- Lower operating expenditure than a standalone emergency pump station,
- ‘Passive’ system with lower risk of failure than a standalone emergency pump station,
- Does not require a power connection.

Risks and Other Considerations

- Larger footprint than a standalone emergency pump station,
- Requires maintenance and checking,
- The required storage volume is based on a 'best estimate' of runoff volume,
- The available storage volume for a 'drained by gravity' system is unknown, this would be determined at the detail design stage,
- The available storage volume may not be enough to contain the estimated flood volume. The capacity of the tank is dependent on the tank being able to drain between storm events and have sufficient capacity for the critical events,
- New or extended surface collection systems may be required,
- Further optioneering and investigation will be required;
    - The exact location, depth and type of the existing drainage infrastructure will have to be confirmed for the design to be confirmed,
    - The location of other utilities (telecoms, power, gas etc) will need to be determined,
    - Ground investigations will be required.

4.3.2.3 Option C: Surface Water Pumps (recommended)

In addition to the proposed Main St surface runoff interceptor, a pumping system could be provided to remove the risk of flooding. This would intercept the surface water from the outfall to the site, but instead of storing the runoff and waiting for the river levels to subside, it would collect the water within a wetwell and pump it into the river.

The initial consideration was that the pumps would be designed to mimic the current outfall system; the flows above the pipe surcharge level would spill into a new drainage network to the pumping station. The pumps would be sized at the same flow rate to discharge against the top river level and as such they would have no negative impact on the network.

Improvements to the existing site drainage have not been considered as part of this scheme. If the existing system is insufficient due to hydraulic or operational issues, new site specific drainage systems may be required.

The pumps have been sized at this stage, the Outline Design Stage, to provide protection for a 1 in 30 year event.

Stormwater pumping arrangements are generally comprised of a series of duty/assist/assist (as required) pumps, such that smaller flows are handled by a single pump, larger flows by two pumps, then three, etc. The number of pumps and their exact capacity would be finalised in detail design. A plan of the outline design is provided in Appendix E.

Benefits

- The proposed solution will reduce the risk of external flooding in the Vector Aerospace site when the flood mitigation measures are constructed,
- Smaller footprint than a storage solution,
- Not constrained by the depths of existing sewers.

Risks and Other Considerations

- Higher operating expenditure than a storage solution,
- Requires a power connection,
- ‘Active’ system with higher risk of failure than a storage solution,
- Requires maintenance and testing – more often and more extensive than for a storage solution,
- The required pump capacity is based on a ‘best estimate’ of runoff rate,
- New or extended surface collection systems may be required,
- Further optioneering and investigation will be required;
  - The exact location, depth and type of the existing drainage infrastructure will have to be confirmed for the design to be confirmed,
  - The location of other utilities (telecoms, electricity, gas etc) will need to be determined,
  - Ground investigations will be required.

4.3.2.4 *Option D: Combined Storage and Pumping*

In addition to the proposed Main St surface runoff interceptor, a combined or ‘balanced’ solution could be considered with both a storage facility and a pumping station constructed, but each is smaller than its standalone alternative.

Smaller events (where the river still rises enough to ‘shut off’ the normal drainage network) would be handled by the storage tank. Larger events would fill up the storage tank, at which point the pumps would start up to discharge any remaining inflow to the river.

This solution balances the risks between the initial expense and large footprint of a storage tank, and the higher cost and operation & maintenance expense of a pumping station.

Although having the benefits of each system it also has both sets of risks too.

4.3.3 Required Level of Service

Section 2.6.1 of Sewers for Scotland calls for surface water systems to be designed “so that flooding does not occur in any part of the site in a 1-in-30 year return period design storm flood frequency”.

Section 2.8 of the same document states that “checks should be made for the 1-in-100 year return period and the 1-in-200 year return period to ensure that properties on and off site are protected against flooding for all these scenarios.

Taken at first value, this implies that the solution implemented for Vector Aerospace must have a level of service of 1 in 200 years, since surface water flooding from this event will not be able to escape the site if flood defences are put in place.

However, two important facts must be considered first;

- Vector Aerospace is currently at risk from both fluvial and surface water flooding. Of these, fluvial flooding is the greater risk, and addressing it is the primary purpose of the flood mitigation scheme. Therefore, even if no surface water measures are implemented, the scheme will still significantly reduce the overall risk of flooding to Vector Aerospace, and hence provide an improved overall level of service.

- Sewers for Scotland is primarily a design guide for new developments. Development on floodplains is now constrained to a much higher degree than in the past, to the extent that an application made now to build Vector Aerospace on its current site would probably be declined.

4.3.4 Recommendations

Our opinion is that a surface water solution designed to a 1 in 30 year level of service is reasonable, achievable and practicable.

We note that of our estimate of the 200yr event flood volume, only half of this can be stored within the footprint of the car park (assuming 1m deep). If Vector Aerospace require a greater level of protection than afforded by the 1 in 30 year level of service as offered by the recommended scheme, discussions would need to be held as to how this goal could be achieved through additional contribution by Vector Aerospace.

Of the options proposed, the standalone pumping station is the recommended option as it can be designed to be independent of the need for storage. Storage cannot be guaranteed and the consequence of not having sufficient is considerable in this site. The pumping station detail will be refined through the detail design process. Discussions with Vector Aerospace have been undertaken and a site has been identified for the Pumping Station, see Appendix E.

4.4 Backflow Prevention

4.4.1 Huntingtowerfield and Ministry of Agriculture Site

Flap valves or other method of backflow prevention should be installed on stormwater outlets from Huntingtowerfield and the Ministry of Agriculture site. Ground levels behind the defences are lower that the design flood level, so a risk of backflow from the river exists.

When water levels in the river are high, excess surface runoff from these areas can escape downstream along the line of the proposed flood defences, with minimal ponding. The identified flowpath will be further assisted by drains along the foot of the proposed defences.

4.5 Areas where Solutions are not required

Refer to Appendix A for further details of excess surface runoff flow paths.

4.5.1 Deer Park and Low's Work Cottages

An analysis of the surface flow paths in these two areas, demonstrates that surface runoff can escape downstream along the line of the proposed flood defences, with minimal ponding. The identified flowpaths will be further assisted by drains along the foot of the proposed defences.

4.5.2 Lochty Industrial Estate

An analysis of the contributing area; existing drainage infrastructure; existing ground levels and the proposed regrading of Main Street along the Pow Burn; and the resulting surface flow paths indicates that surface water ponding in this site will be minor.

According to Scottish Water plans, Lochty Industrial Estate is served by a combined sewer pumping station at the north end of the site, near to 'The Honey Pot' children's nursery.

If the existing drains block or prove to be under capacity, or the pumping station fails, the likely spill path is to Main Street via the entrances to The Honey Pot car park, from where runoff will flow north along the road towards Vector Aerospace.

Properties and ground levels in Lochty Park (on the right bank of the Pow Burn) are generally 0.2 - 0.5m higher than adjacent levels in Lochty Industrial Estate, and therefore not at risk of collecting surface water.

4.5.3 Waterside Cottages

Analysis at Waterside Cottages, as part of the flood mitigation scheme, has shown this location not to be at risk of fluvial flooding although the risk of surface water flooding may remain. The properties at Waterside Cottages have no surface drainage infrastructure, and rely on septic tanks for foul drainage.

Runoff from the field to the southwest will flow towards Waterside Cottages. Ground levels around the properties are slightly raised, but the path behind the properties appears to be lower than the fields. Runoff reaching this path could threaten the properties from the east end.

Ground levels have been surveyed in the immediate area of Waterside Cottages, but are unknown in the field behind the properties. There may be enough depression storage available to prevent any runoff from collecting at the cottages, or a safe flow path may exist.

As this location is not at risk of fluvial flooding and the surface water flooding is not exacerbated by the modelled water levels for the fluvial design event, it is not recommended that any works to the surface water drainage are included in the flood mitigation scheme.

5 Conclusions and Recommendations

The recommended solutions described in this report are considered to be a justifiable inclusion to the proposed flood mitigation scheme. They address any secondary surface water flooding that may occur as a consequence of raised water levels in the constrained watercourses during a 1:200 year return period flood event.

We have applied a proactive approach that seeks to ensure the actual and perceived success of the flood mitigation scheme by eliminating any flooding mechanism that may result in surface water flooding on the 'dry' side of the proposed fluvial defences.

The need for each solution has been carefully assessed by a combination of desktop study, site visits, discussion with the public, Perth & Kinross Council and Scottish Water.

Modifications to Scottish Water assets have been considered, but have not been considered as viable options. This is due primarily to Scottish Water having no record of any flooding issues in this area and therefore they are unable to commit funds to address the predicted incapacities. Regardless, we consider that the solutions proposed here will generally be less disruptive, less expensive, and more effective than any measures that could be practicably undertaken on Scottish Water's assets.

Current cost estimates indicate that the combined cost of surface drainage solutions represents less that 10% of the overall cost of the flood mitigation scheme if implemented 'up front' as part of an integrated flood mitigation scheme. This will realise significant cost savings and avoid the scenario (as is likely to be perceived by the public) of 'fixing' a 'failed' system at a later date.

We recommend that these proposals are included in the outline design of the flood mitigation scheme and incorporated into the Flood Risk Management (Scotland) Act 2009 submission.

We have used our reasonable endeavours to provide information that is correct and accurate and have discussed above the reasonable conclusions that can be reached on the basis of the information available.

6 Appendices

Appendix A: Excess Surface Runoff Flow Paths

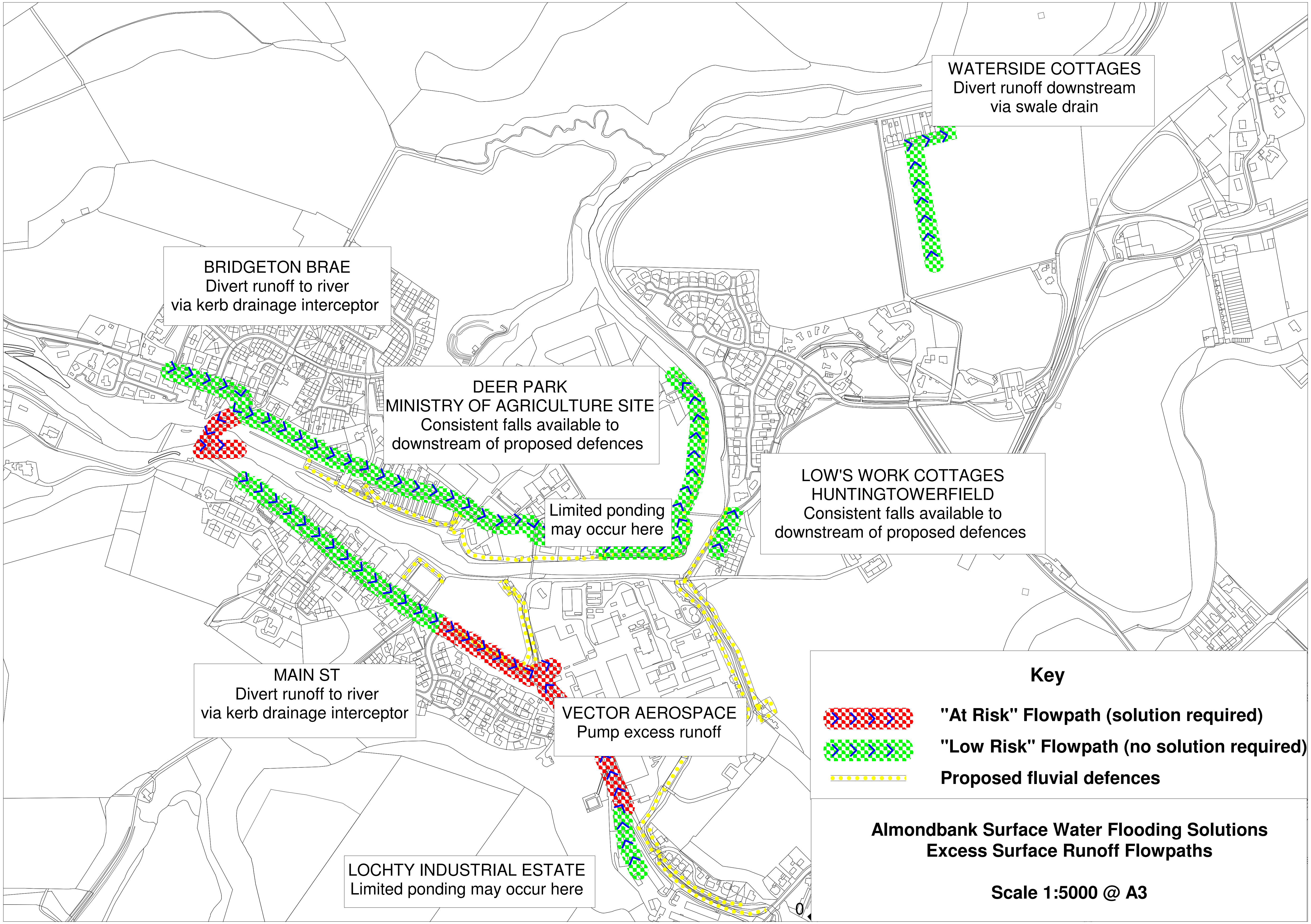
Appendix B: Drainage Surveys

Appendix C: Bridgeton Brae Surface Water Interceptor

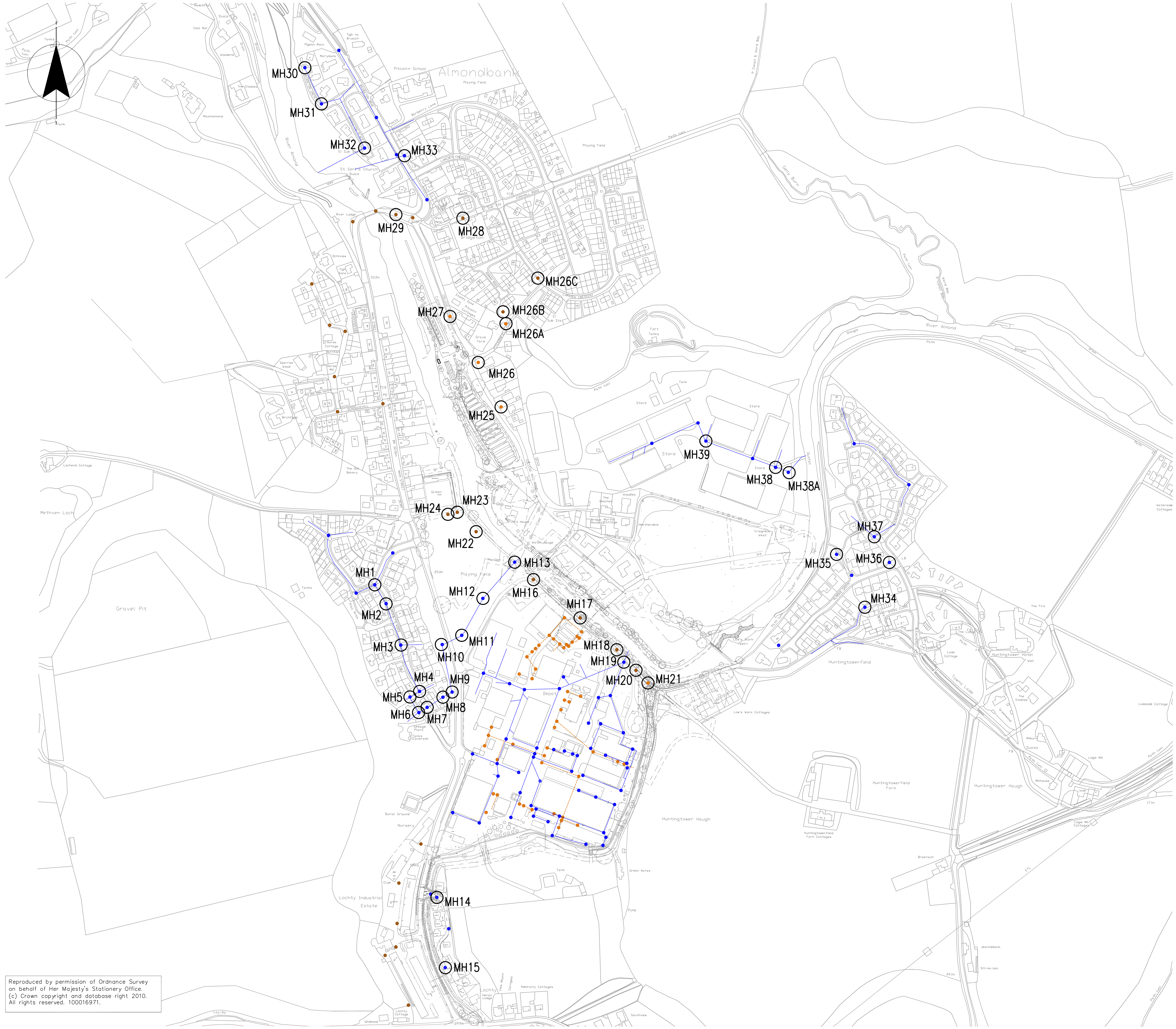
Appendix D: Main St Surface Water Interceptor

Appendix E: Vector Aerospace Pumping Station Solution

Appendix A: Excess Surface Runoff Flow Paths


WATERSIDE COTTAGES
Divert runoff downstream
via swale drain
BRIDGETON BRAE
Divert runoff to river
via kerb drainage interceptor
DEER PARK
MINISTRY OF AGRICULTURE SITE
Consistent falls available to
downstream of proposed defences
Limited ponding
may occur here
LOW'S WORK COTTAGES
HUNTINGTOWERFIELD
Consistent falls available to
downstream of proposed defences
MAIN ST
Divert runoff to river
via kerb drainage interceptor
VECTOR AEROSPACE
Pump excess runoff
LOCHTY INDUSTRIAL ESTATE
Limited ponding may occur here
Key
"At Risk" Flowpath (solution required)
"Low Risk" Flowpath (no solution required)
Proposed fluvial defences
Almondbank Surface Water Flooding Solutions
Excess Surface Runoff Flowpaths
Scale 1:5000 @ A3

Appendix B: Drainage Surveys



At original drawing size (A1) this line measures 100mm

PLAN
SCALE: NTS

LEGEND

MHXX — MANHOLE SURVEYED AS PART OF CCTV SURVEY CONTRACT, DEC 2008

SERVICES

FOUL WATER

SURFACE WATER

COMBINED SEWER

SUMMARY OF DEC 2008 MANHOLE SURVEY

MH Ref No.	Chamber size	Depth
1	Ø1200	2.10
2	Ø1200	1.98
3	Ø1200	2.04
4	Ø1200	2.16
5	Ø1200	2.57
6	Ø1200	2.21
7	Ø1200	2.58
8	Ø1200	2.98
9	Ø1200	1.77
10	Ø1200	1.78
11	Ø1200	1.57
12	Ø1200	1.78
13	Ø1350	2.69
14	Ø1050	1.08
15	Ø1050	1.50
16	Ø900	2.26
17	Ø900	2.09
18	Ø900	2.04
19	Ø900	2.24
20	Ø1200	3.05
21	580x800	0.62
22	Ø1000	1.01
23	960x1270	2.03
24	920x1400	1.99
25	900x630	1.25
26	840x840	1.78
26A	870x880	1.51
27	950x890	1.10
28	960x730	3.10
29	Ø1200	1.44
30	Ø900	1.20
31	Ø900	1.29
32	Ø900	1.37
33	810x810	1.37
34	Ø1200	1.44
* 34A	Ø1200	2.46
35	Ø1200	3.61
36	Ø1200	1.75
37	Ø1200	1.96
38	Ø1050	1.28
38A	Ø1050	1.45
39	Ø1050	1.45
* 40	Ø1200	2.02
* 41	Ø1200	1.93
* 42	Ø1200	1.64

* MANHOLES NOT FOUND ON CCTV SURVEY PLANS PROVIDED

Version	Amendment	Drawn Date	Checked Date	Approved Date
A	FIRST ISSUE	SMCCULLOCH 24.04.12	M.CHAMBERS 24.04.12	R.SHARPE 24.04.12

Project: ALMONDBANK FLOOD MITIGATION SCHEME

Client: PERTH & KINROSS COUNCIL — The Environment Service

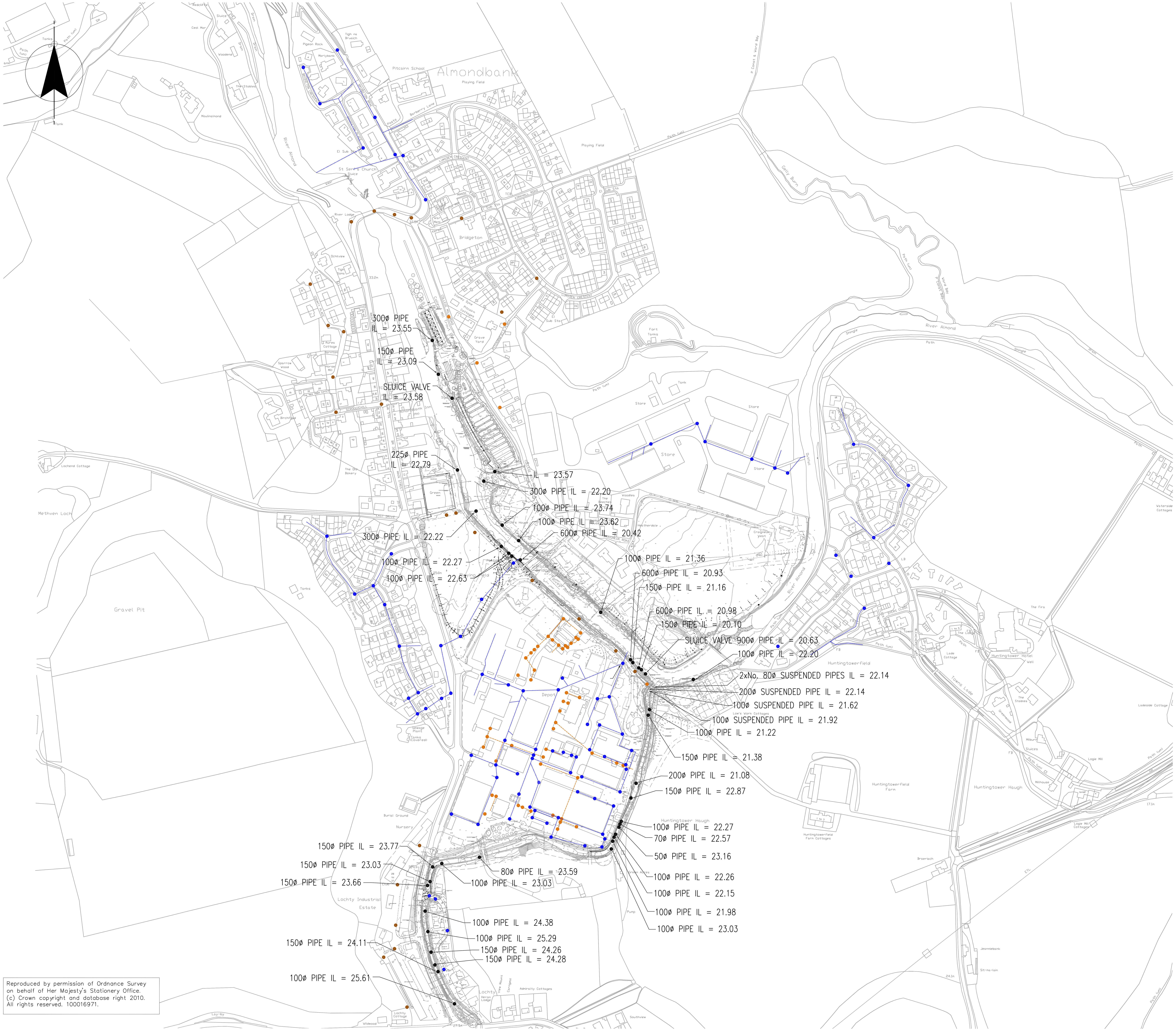
Drawing Title: SURFACE WATER FLOODING INVESTIGATIONS PLAN DEC 2008 SURVEY

mouchel

Scales (at A1 size): AS SHOWN

Purpose of Issue: INFORMATION

Office	Tel No	Drawing No	Version
LIVERPOOL	0151 237 4200	716516/A/501	A



At original drawing size (A1) this line measures 100mm

PLAN

SCALE: NTS

LEGEND

● EXISTING OUTFALL LOCATIONS

SERVICES

- FOUL WATER
- SURFACE WATER
- COMBINED SEWER

Version	Amendment	Drawn / Date	Checked / Date	Approved / Date
A	FIRST ISSUE	S.MCCULLOCH 24.04.12	M.CHAMBERS 24.04.12	R.SHARPE 24.04.12

Project: ALMONDBANK FLOOD MITIGATION SCHEME

Client: PERTH & KINROSS COUNCIL – The Environment Service

Drawing Title: SURFACE WATER FLOODING INVESTIGATIONS PLAN OUTFALLS

mouchel

Scales (at A1 size): AS SHOWN

Purpose of Issue: INFORMATION

Office	Tel No	Drawing No	Version
LIVERPOOL	0151 237 4200	716516/A/502	A

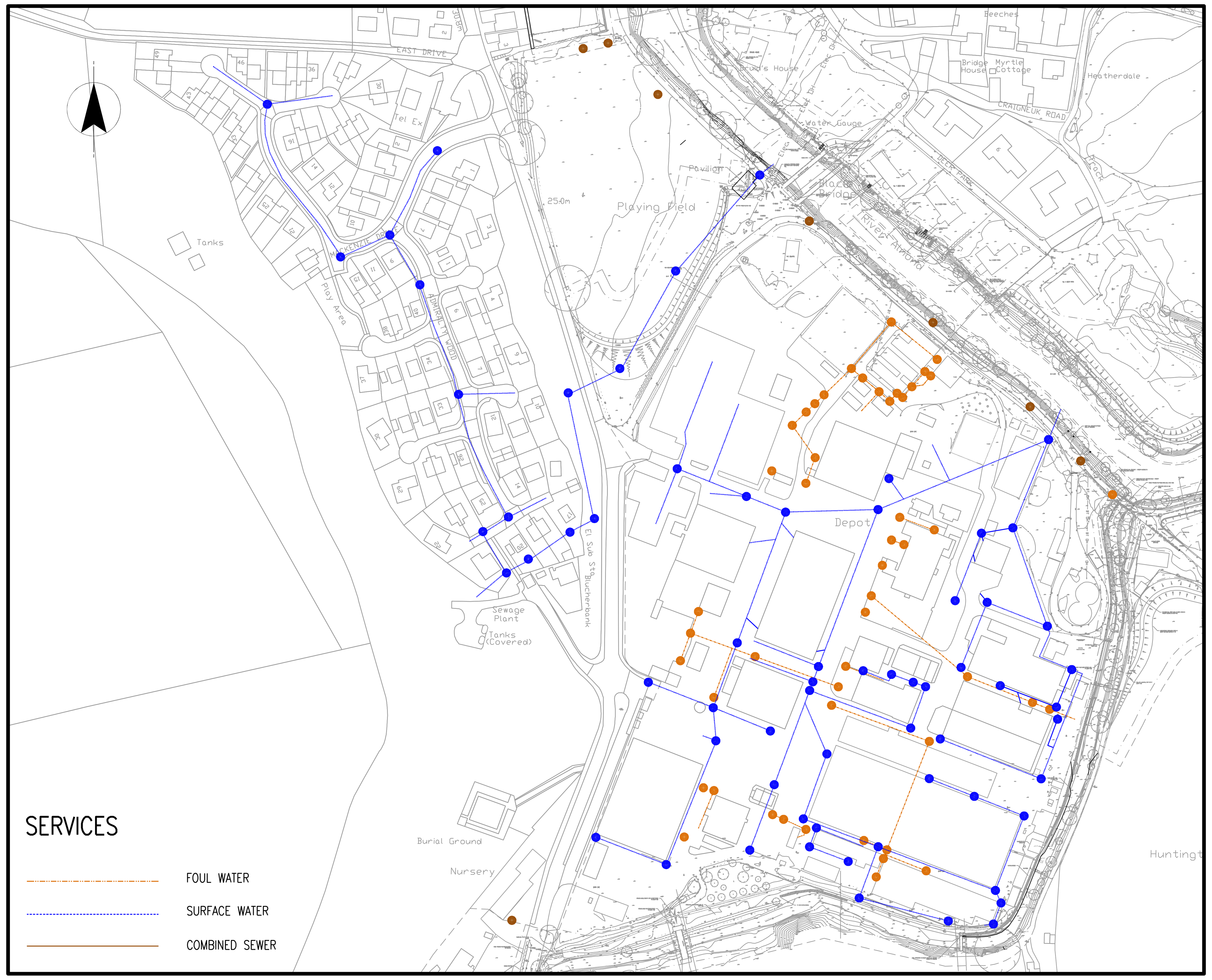
MANHOLES

MH Reference	Cover Level (mAOD)	Level Flag	No. of Incoming Connections	No. of Outgoing Connections	Depth to Invert Level (m)	Comments
MH2	23.343		1	1	0.73	Connections coming in is start of line.
MH3	23.2		2	1	1.32	Connection from car park is blocked.
MH4	22.966		5	1	1.15	Constant inflow from tank overflow.
MH6	23.168		2	1	1.33	Connection from downpipe.
MH7	22.938		2	1	1.17	Connection from RE and downpipes.
MH11	23.021		2	1	1.39	Connection from gully / slot drain
MH12	23.011		3	1	1.39	
MH13	22.982		2	1	1.38	
MH14	23.013		2	1	1.34	Connection from RE and downpipes.
MH28	22.943					Unable to raise cover. Likely to be start of line, 1 connection from gully next to manhole.
MH29	22.9966					Unable to raise cover. Likely 1 connection from US, 1 connections from gully nearby.
MH30	22.995	Level recorded twice - poor signal. Other level was 23.0279.	1	1	0.77	Drawing in EEC survey sheet is incorrect. Bend is in other direction.
MH31	22.9735	Levelled manually - no GPS signal	3	1	0.71	Connections from gully and bunded area.
MH32	23.0075	Levelled manually - no GPS signal	2	1	0.62	Connection from gully.
MH33	23.0642	Levelled manually - no GPS signal	1	1	0.62	Upstream of this is a rodding eye.
MH34	23.243		1	1	1.57	
MH35	22.9079	Levelled manually - no GPS signal	1	1	1.27	
MH35A	22.986		2	1	1.57	
MH36	22.671		4	1	1.44	
MH36A	22.585					UTR. Doesn't appear to be connected to system, most likely to be on combined sewer.
MH39 (INT)	22.674					UTR - two covers. Interceptor
MH39 (INT)	22.704					UTR - two covers. Interceptor
MH40	22.965		2	1	1.72	Connection from gully.
MH37	22.981		3	1	1.44	Connection from gully nearby.
MH37A	23.33		1	1	1.6	Connection coming from off-site. No flow at time of survey.
MH38	22.988		3	1	0.94	Connections coming from buried chamber and car park drainage. This is the only manhole collecting runoff from car park.
MH41	23.256		1	1	1.87	
MH40A (INT)	23.072		1	1		Interceptor - inverts / dimensions not measured
MH40B (INT)	22.97					Interceptor - inverts / dimensions not measured
MH52	23.1384	Levellled manually - no GPS signal	3	1	2.21	Key confluence of site drainage. Connection from water tank overflow or downpipe.
MH51	22.848	Cover is broken concrete slab laying across open hole.	3	1	1.45	Connection from downpipe
MH47	23.005		4	1	1.33	Connections from trap and rain water pipe.
MH48	23.061		2	1	1	Connection from nearby gully.
MH50	22.7221	Manhole under container. Used offset to calculate position and level. Manual level.	3	1	1.03	Connections from nearby gully and downpipe.
MH45	22.991		1	1		UTR - concrete cover. Upstream connection is start of line (downpipe).
MH43	23.068		1	1	0.75	
MH42 (Valve chamber)	22.926					Not surveyed - valve chamber
MH44 (UTR)	22.955					Not surveyed - could be rodding eye, could be separate connection at end of pipe from MH43
MH29A	23.018					UTR - not surveyed. Likely to be on line but could not be confirmed.
G001	22.8726					Doesn't appear to be connected to system, may be on combined sewer line.
G002	22.7892					
G003	22.6954					Possibly connects to pipe 37-35A. Certainly not 35-35A, no connections on this side of pipe.
G004	22.7946					
G005	22.8497					Uncertain where this connects to, probably combined sewer.
G006	22.8832					Uncertain where this connects to, probably INT
G007	22.4763					May connect to combined system
G008	22.897					
G009	22.932					
G010	23.196					
G011	23.078					
G012	22.95					
G013	22.865					
G014	22.832					
G015	22.607					Doesn't seem to be connected to system. Probably on combined sewer line.
G016	22.673					Doesn't seem to be connected to system. Probably on combined sewer line.
G017	22.465					Doesn't seem to be connected to system. Probably on combined sewer line.
G018	22.512					
G019	22.667					
G020	22.731					
G021	22.548					
G022	22.792					
G023	22.778					
G024	22.835					May connect to MH28, doesn't appear to connect anywhere else.
G025	22.877					May connect to MH28, doesn't appear to connect anywhere else.
G026	22.941					
INT-A	22.987					3 covers on interceptor
INT-B	22.928					3 covers on interceptor
INT-C	22.874					3 covers on interceptor
MH1	23.75	Not surveyed. Located by eye and level interpolated from previous survey nearby. Level accurate to within 0.06m	1	1	1.11	Connection from off-site. Had flow in it at time of survey
MH9	23.21	Not surveyed (contamination). Located by eye and level interpolated from previous survey nearby. Level accurate to within 0.05m.	3	1	1.07	Contamination - no CCTV
MH10	23.13	Not surveyed (contamination). Located by eye and level interpolated from previous survey nearby. Level should be very accurate.	2	1	1.25	
MH15	23.167	Not surveyed (contamination). Located by eye and level interpolated from previous survey nearby. Level accurate to within 0.09m.	2	1	0.84	
MH16	23.21	Not surveyed (contamination). Located by eye and level interpolated from previous survey nearby. Level accurate to within 0.05m.	1	1	0.82	
MH17	23.24	Not surveyed (contamination). Located by eye and level interpolated from previous survey nearby. Level not accurate - perhaps within 0.1m.	1	1	0.8	
MH18	23.1	Not surveyed (contamination). Located by eye and level interpolated from previous survey nearby. Level accurate to within 0.05m.	2	1	0.92	
MH19	23.14	Not surveyed (contamination). Located by eye and level interpolated from previous survey nearby. Level not accurate due to banking, maybe within 0.5m	2	1	0.86	Connection from gully.
MH20	24.17	Not surveyed (contamination). Located by eye and level interpolated from previous survey nearby. Level not accurate due to banking, maybe within 0.5m	1	1	0.38	
MH21	23.131	Not surveyed (contamination). Located by eye and level interpolated from previous survey nearby. Level not accurate due to banking, maybe within 0.3m	1	1	0.66	
MH22	23.1	Not surveyed (contamination). Located by eye and level interpolated from previous survey nearby. Level not accurate, probably within 0.3m	3	1	0.9	Connections coming in from gully and downpipe
MH23	23.257	Not surveyed (contamination). Located by eye and level interpolated from previous survey nearby. Level not accurate, perhaps within 0.3m				Unable to raise cover. Connectivity is assumed.
MH24	23.257	Not surveyed (contamination). Located by eye and level interpolated from previous survey nearby. Level not accurate, perhaps within 0.3m	2	1	0.55	Connection from down pipe.
MH25	23.5	Not surveyed (contamination). Located by eye. Not certain of level. Best guess is 23.5.	1	1	0.61	
MH26	23.26	Not surveyed (contamination). Located by eye and level interpolated from previous survey nearby. Level accurate to within 0.2m	2	1	0.95	Connection from gully. Upstream pipe is probably to buried manhole at start of line.
MH27	23.26	Not surveyed (contamination). Located by eye but only to within 20m. Level is best guess - no survey points nearby, could be +/- 0.5m	1	1	1.03	There are multiple connections from gully and downpipe into pipe in this area. Not surveyed as no CCTV access due to contamination.
MH41A	23.02	Not surveyed - buried. Located by eye but only to within 20m. Level accurate to within 0.1m	1	1	0	MH is buried - unable to survey
MH46	22.8	Not surveyed as no access. Location is by eye to within 10m. Level is approximated from previous survey, accurate to within 0.4m	3	1	1	Connection from drains within compound. Manhole appears to be in bunded area and cover is raised above ground ~10-20cm.
MH49	22.9	MH is buried, location is approximate. Level interpolated from previous survey, accurate to within 0.2m				
MH1A		Buried - not surveyed. Location within 30m				Buried - not surveyed
MH5		Buried - not surveyed. Location within 30m				Buried - not surveyed
Buried chamber		Location is very approx - within 30m. No nearby level available				

At original drawing size (A1) this line measures 100mm

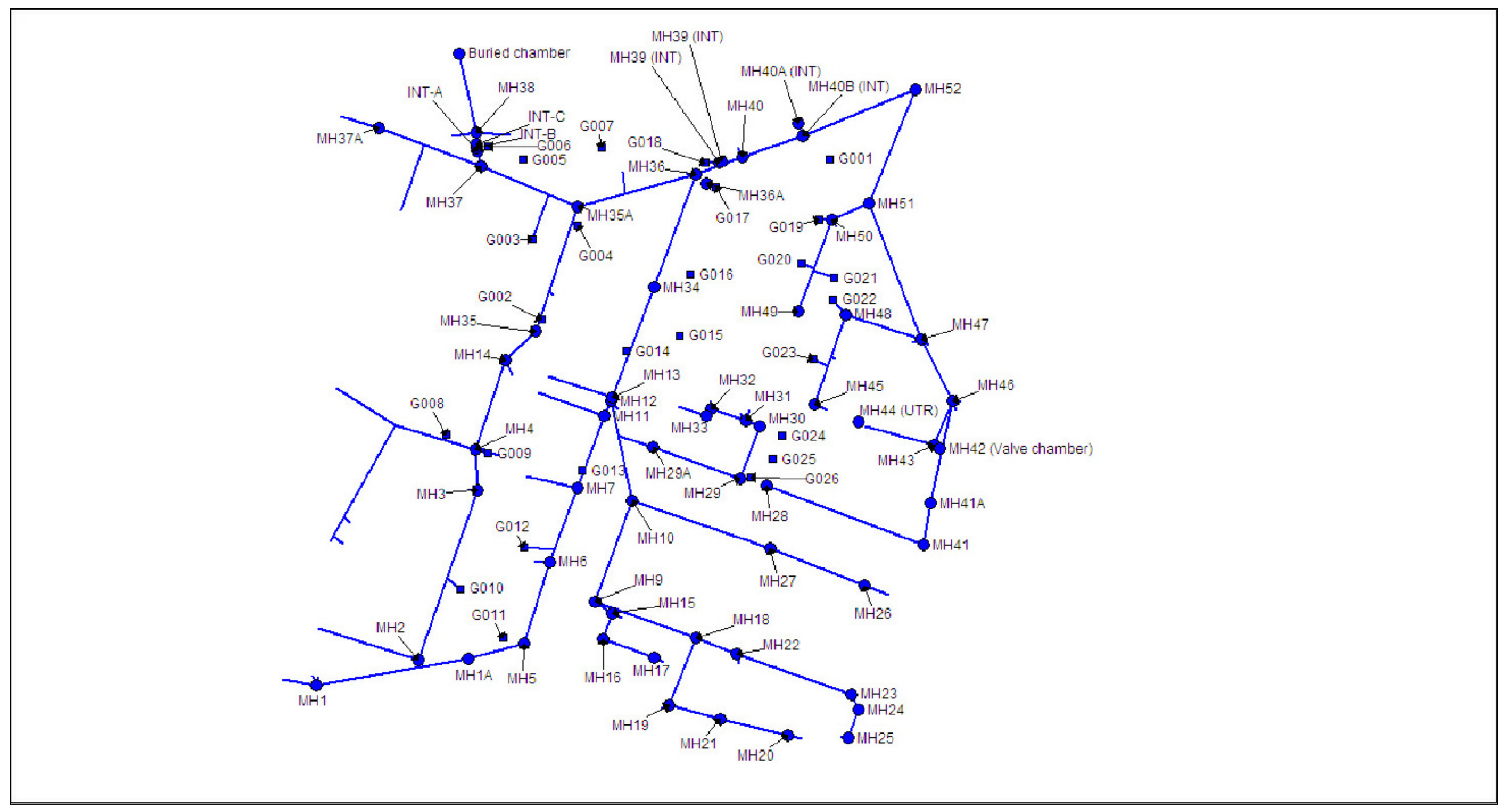
PIPEWORK

Upstream Connection	U/S Invert Level (mAOD)	Downstream Connection	D/S Invert Level (mAOD)	Diameter (mm)	Connections	Comments
Off-site		MH1	22.65	225		
MH1	22.64	MH1A - buried		225		DS invert not known as manhole is buried
MH1A - buried		MH5 - buried		225		No inverts as both manholes are buried
MH5 - buried		MH6	21.868	300	Multiple connections from downpipes and gully.	No inverts as both manholes are buried
Start of line		MH2	22.633	150		US invert not known as start of line.
MH2	22.613	MH3	21.9	150	Four downpipes and one gully in road	
MH3	21.88	MH4	21.836	150		
MH4	21.816	MH14		21	One connection from downpipe	
MH6	21.838	MH7	21.778	375	One from gully in car park.	
MH7	21.768	MH11	21.681	375	One from gully, one from downpipe.	
MH11	21.631	MH12	21.671	375		
MH12	21.621	MH13	21.592	450		
MH25	22.89	MH24	22.707	150		
Possibly downpipe		MH25	22.95	100		
Downpipe		MH24		150		
MH24	22.707	MH23				MH23 UTR - no invert
MH23		MH22	22.22	225	Likely connections from drains, gullies and down pipes.	MH23 UTR - no invert
Gully		MH22		100		
Downpipe		MH22		100		
Start of line		MH20	23.82	100		
MH20	23.79	MH21	22.481	100		
MH21	22.471	MH19	22.28	150		
Gully	0	MH19		100		
MH22	22.2	MH18	22.25	225		
MH19	22.28	MH18	22.2	150		
MH18	22.18	MH9	22.14	225	Likely connections from downpipes / gullies	
MH17	22.44	MH16	22.4	100		
Start of line - down		MH17	22.46	100		
MH16	22.39	MH15	22.417	100		
Gully		MH15		100		
MH15	22.327	MH9	22.24	100		
Gully		MH9		100		
MH9	22.14	MH10	21.9	225		
MH26	22.31	MH27	22.21	225		
Gully		MH26		100		
Start of line, unkno		MH26	22.31	225		No manhole visible upstream, upstream connection cannot be confirmed but suspected start of line.
MH27	22.23	MH10	21.9	225		Under building. Not certain if there are connections / manholes on line.
MH10	21.88	MH12	21.861	300	Connection coming in from MH29A. Confirmed using dye test at MH 30.	
Rodding eye - start		MH33	22.484	100		
MH33	22.474	MH32	22.408	100		
Gully		MH32		100		
MH32	22.388	MH31	22.2635	100		
Gully		MH31		100		
Bunded area - drain		MH31		100		
MH31	22.264	MH30	22.225			
MH30	22.225	MH29		100		MH29 buried - downstream invert unknown
MH29		MH29A		150	Probably gullies / downpipes	Manholes UTR so no inverts / CCTV
MH29A		Pipe between MH10 an		150	Possibly gully	No CCTV access - no inverts.
Building		MH1		100		
Building		MH1		150		
Start of line		MH3		100		Connection not active - blocked.
Site entrance/offsit		MH4	21.846	225		
Gully		Pipe between MH4 and		150		
Gullies		Site entrance - conn		150		
Gully		Pipe				
Gully		Pipe				
Offsite		Site entrance / MH4		225		
Possibly downpipe		MH14		100		
Downpipe		MH6		100		
Gully		Pipe between MH2 and		100		
Rodding eye / downpi		MH7	150			
Gully		Pipe between MH7 and		150		
Gully		MH4		150		
Tank overflow		MH4		150		
Downpipe		MH4		150		
Gully / slot drain		MH11		150		
Head of line		MH12		100		Connection not active - head of line
Gully / slot drain		MH13		150		
Gully - likely		MH29				
MH28	0	MH41	21.416	150	Number of downpipe / gully connections	There are a number of material changes in this pipe
MH41	21.386	MH41A		150		MH41A is buried - no inverts
MH41A		MH46		150		Significant debris build up which could not be jetted due to buried manhole.
Drain		MH46		100		
Drain		MH46		150		
Rodding eye		MH43		100	Number of downpipes and one connection at end. Possibly MH44??	
MH43	22.318	MH46	21.65	100		
MH46	21.62	MH47	21.705	150		
Probably DP / RE		MH45				MH45 UTR - no dimensions available
MH45		MH48	22.081	100	Downpipe and likely gully	
Gully		MH48		100		
Gully		Pipe MH45 - MH48		100		
Downpipe		Pipe MH45 - MH48		100		
MH48	22.061	MH47	21.705	100		
Trap		MH47		150		
Downpipe		MH47		100		
MH47	21.675	MH51	21.408	225		
MH50	21.692	MH51	21.448	100		
Gully		MH50		100		
Down pipe		MH50		100		
MH49		MH50	21.722	100		MH49 buried - not visible, no inverts at US end
Gully		Pipe MH49 - MH50				ASSUMED - NO CCTV
Gully		Pipe MH49 - MH50				ASSUMED - NO CCTV
MH13	21.602	MH34	21.683	450	Gully and multiple down pipes	
Gully		Pipe MH13 - MH34				
MH34	21.673	MH36	21.271	450	Two downpipes	
MH35A	21.416	MH36	21.271	450	Channel / drain	
Channel		Pipe MH35A - MH36		100		
Downpipe		MH36		100		
Downpipe		MH36		100		
MH14	21.673	MH35	21.658	300		
MH35	21.638	MH35A	21.436	300		
Gully		Pipe MH35 - MH35A		150		
Gully		Pipe MH35 - MH35A		150		
Gully		Pipe MH35 - MH35A		150		
MH37	21.541	MH35A	21.436	300	Connection coming in at top. Could be downpipe or G003, would assume both.	
MH37A	21.73	MH37	21.581	300		
Offsite		MH37A	21.76	300		
INT-A		MH37	21.851	225		
INT-B		INT-A		225		
INT-C		INT-B		225		
MH38	22.048	INT-C		225		
Buried chamber		MH38	22.068	225		
Drains		Pipe 37 - 37A				
Start of line		MH38		150		
Slot drain		MH38		150		
Gully		INT				Connection assumed.
MH36	21.231	MH40	21.275	525		
Gully		MH40		150		
INT		Pipe MH36 - MH40				
MH40	21.245	MH40B		600		Interceptor not surveyed so inverts at interceptor unknown. It is assumed incoming pipe goes through here.
MH40A		MH40B				This pipe connection is assumed
MH40B		MH52	20.938	600	No connections	Uncertain exactly what the US manhole is. It is one of the interceptors.
MH51	21.398	MH52	21.138	225	No connections	
Gully		Pipe MH6 - MH7				
Gully		Pipe MH37 - MH35A				Connection is likely, may be combined with downpipe.



PLAN OF VECTOR AEROSPACE SW AND FOUL NETWORKS

SCALE: NTS



SCHEMATIC OF SURVEY DATA - SW SYSTEM ONLY SURVEYED

Version	Amendment	Drawn / Date	Checked / Date	Approved / Date
A	FIRST ISSUE	S.MCCULLOCH 24.04.12	M.CHAMBERS 24.04.12	R.SHARPE 24.04.12

Project: ALMONDBANK FLOOD MITIGATION SCHEME

Client: PERTH & KINROSS COUNCIL — The Environment Service

Drawing Title: SURFACE WATER FLOODING INVESTIGATIONS PLAN VECTOR AEROSPACE CCTV SURVEY

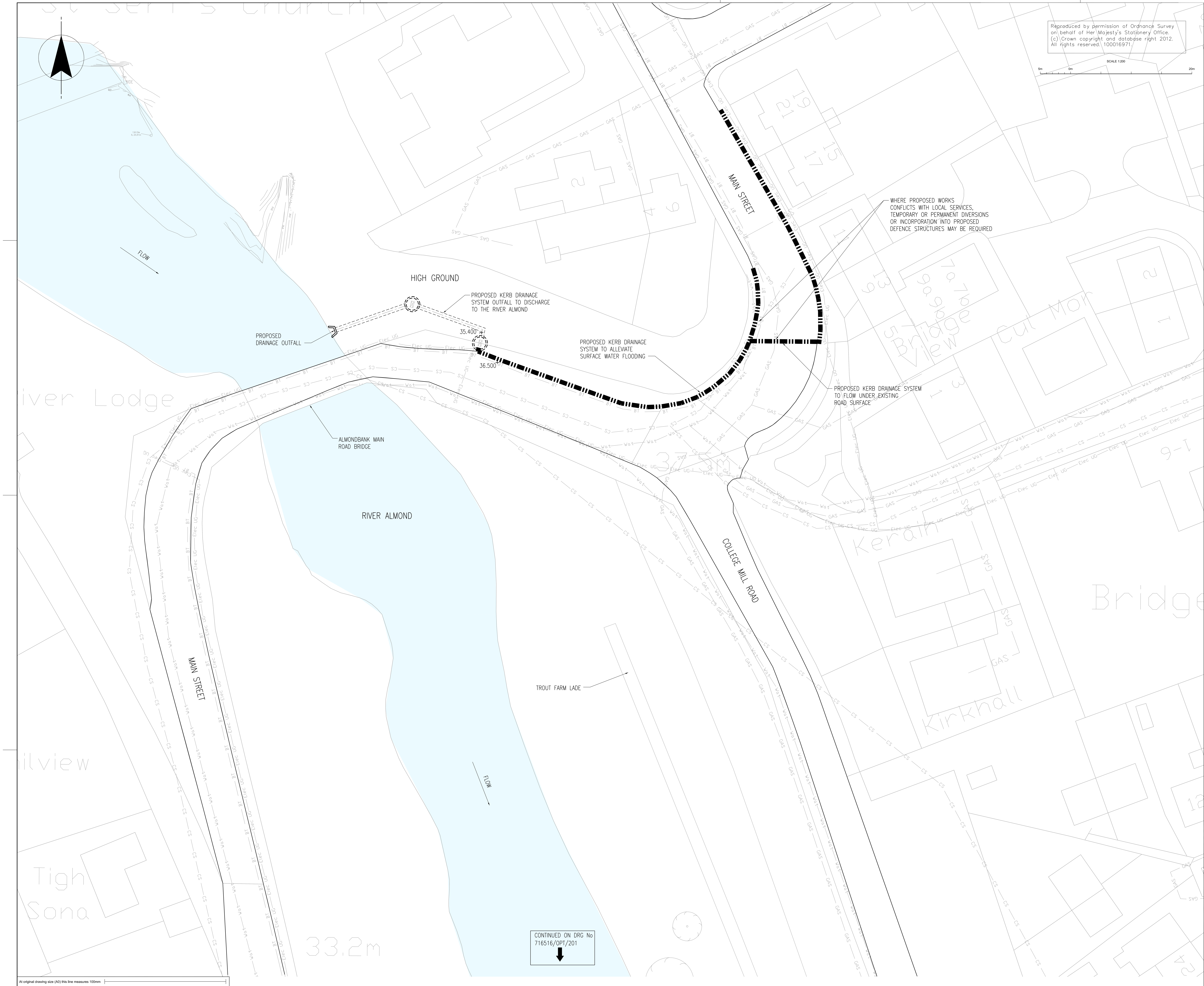
mouchel

Scales (at A1 size): AS SHOWN

Purpose of Issue: INFORMATION

Office	Tel No	Drawing No	Version
LIVERPOOL	0151 237 4200	716516/A/503	A

Appendix C: Bridgeton Brae Surface Water Interceptor



NOTES

1. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE STATED.
2. ALL LEVELS ARE IN METRES ABOVE ORDNANCE DATUM.
3. + 23.000 PROPOSED GROUND LEVELS (TO 3 DECIMAL PLACES).
4. INFORMATION RECEIVED FROM STATUTORY UNDERTAKERS HAS BEEN USED TO IDENTIFY LOCATIONS OF SERVICES. EXACT LOCATIONS OF THESE SERVICES ARE TO BE CONFIRMED DURING DETAIL DESIGN.
5. REINFORCED CONCRETE WALLS AND SHEET PILE WALLS IN CERTAIN LOCATIONS ARE TO BE CLAD IN A SUITABLE MATERIAL.
6. MAINTAIN ALL EXISTING OUTFALLS THROUGH PROPOSED STRUCTURES. APPROPRIATE DRAINAGE TO BE INCORPORATED INTO FLOOD DEFENCE AND RETAINING WALL STRUCTURES.
7. MINIMUM WALL HEIGHT TO BE 500mm ABOVE EXISTING GROUND LEVEL (MINIMUM DEFENCE HEIGHT REQUIREMENT MAY BE SHOWN AS LESS).
8. VEGETATION TO BE PRESERVED WHERE POSSIBLE.
9. TOP WATER LEVEL (T.W.L) IS DEFINED AS MODELLED WATER LEVELS WITHOUT FREEBOARD ALLOWANCE.
10. FREEBOARD ALLOWANCES OF 300mm ABOVE TOP WATER LEVEL FOR FLOOD WALLS AND 600mm ABOVE TOP WATER LEVELS FOR EMBANKMENTS.

LEGEND

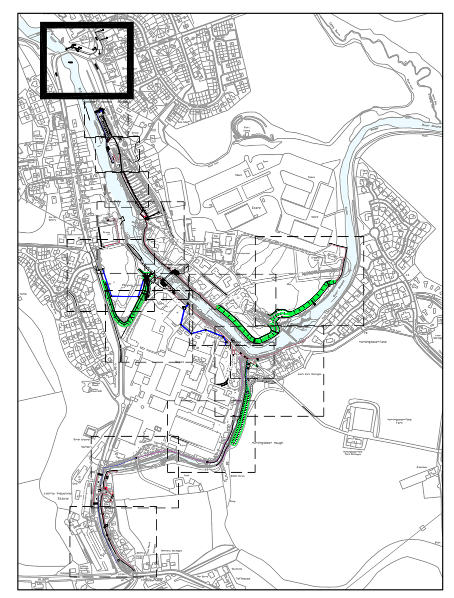
REINFORCED CONCRETE FLOOD WALL
RETAINING WALL
SHEET PILE WALL
SHEET PILE WALL WITH CLADDING
KERB DRAINAGE SYSTEM
PROPOSED SECURITY FENCING
EMBANKMENT (WITH IMPERMEABLE CORE WHERE REQUIRED)
PROPOSED EROSION PROTECTION (EXACT EXTENTS TO BE DETERMINED AT DETAIL DESIGN)
EXISTING EROSION PROTECTION
COMPACTED GRAVEL
SOIL BACKFILL
RAISED ROAD/ ACCESS TRACK
CONCRETE
SURFACE WATER DRAINAGE CHANNEL
SECTION MARKERS

SERVICES

BT — BT	TELECOMS
Elec OH — Elec OH	OVERHEAD ELECTRICITY
Elec UG — Elec UG	UNDERGROUND ELECTRICITY
GAS — GAS	GAS
FW — FW — FW	FOUL WATER
SW — SW	SURFACE WATER
Wat — Wat — Wat	WATER MAIN
CS — CS — CS	COMBINED SEWER
	OUTFALL
+ 25.250 EXISTING LEVEL	25.250 PROPOSED LEVEL

DRAWING REFERENCES

716516/OPT/199	OVERALL LAYOUT
716516/OPT/201	FLOOD MITIGATION PROPOSALS SHEET 2 OF 17 COLLEGE MILL TROUT FARM



Version	Amendment	Drawn Date	Checked Date	Approved Date
C	TEXT EDITS	M.CHAMBERS 07.02.012	N.COOKE 09.03.012	P.SWIFT 09.03.012
B	ADDITIONAL SERVICES ADDED	M.CHAMBERS 28.10.11	P.LAMBERT 28.10.11	N.COOKE 28.10.11
A	FOR INFORMATION	M.CHAMBERS 04.04.11	P.LAMBERT 21.04.11	N.COOKE 26.04.11

Project: ALMONDBANK FLOOD MITIGATION SCHEME

Client: PERTH & KINROSS COUNCIL — The Environment Service

Drawing Title: FLOOD MITIGATION PROPOSALS
SHEET 1 OF 17
COMBINED KERB & DRAINAGE SYSTEM

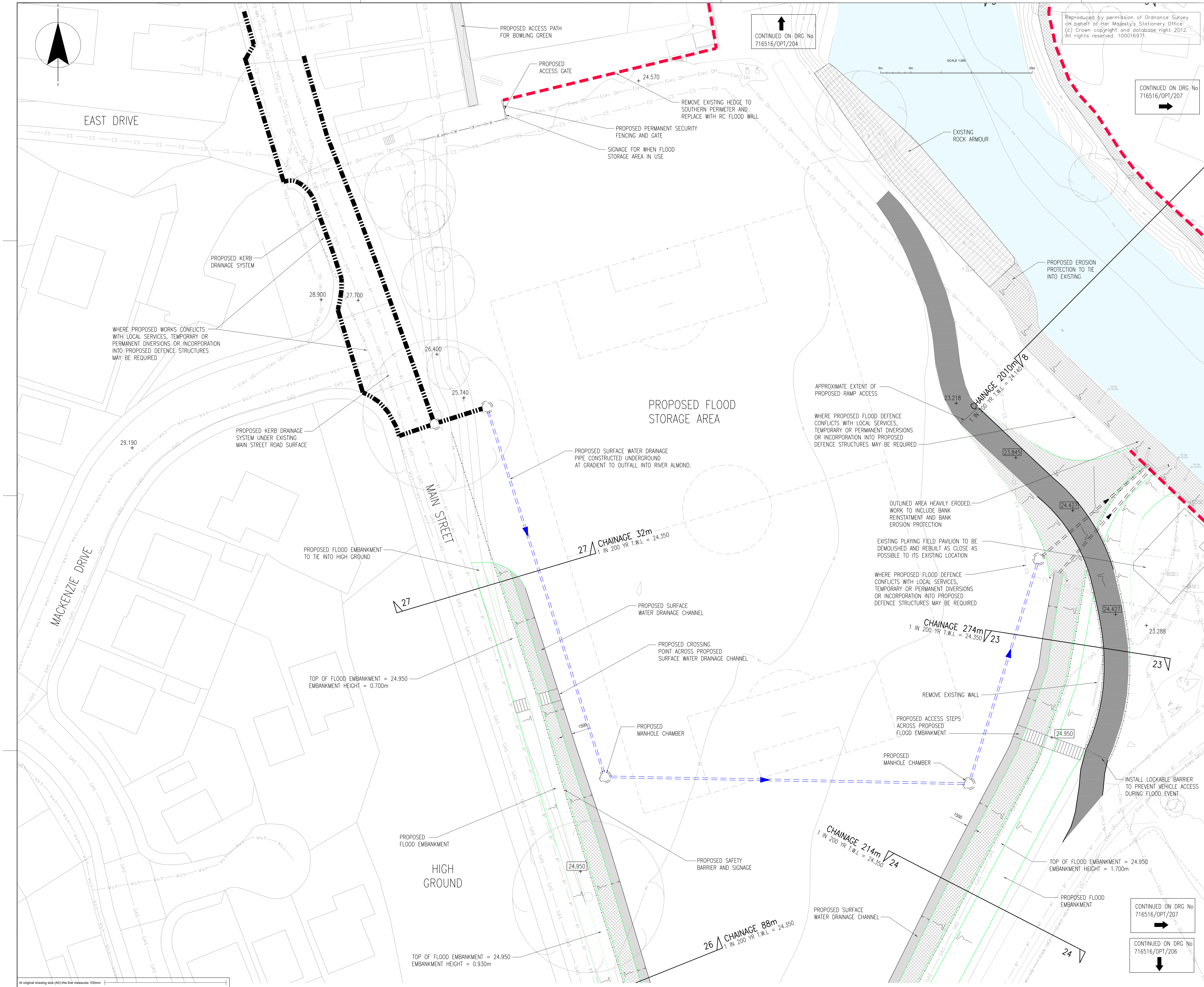
mouchel

Scales (at A0 size): 1:200

Purpose of Issue: FINAL OUTLINE DESIGN

Office	Tel No	Drawing No	Version
LIVERPOOL	0151 237-4200	716516/OPT/200	C

Appendix D: Main St Surface Water Interceptor



NOTES

1. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE STATED.
2. ALL LEVELS ARE IN METRES ABOVE ORDNANCE DATUM.
3. + 23.000 PROPOSED GROUND LEVELS (TO 3 DECIMAL PLACES).
4. INFORMATION RECEIVED FROM STATUTORY UNDERTAKERS HAS BEEN USED TO IDENTIFY LOCATIONS OF SERVICES. EXACT LOCATIONS OF THESE SERVICES ARE TO BE CONFIRMED DURING DETAIL DESIGN.
5. REINFORCED CONCRETE WALLS AND SHEET PILE WALLS IN CERTAIN LOCATIONS ARE TO BE CLAD IN A SUITABLE MATERIAL.
6. MAINTAIN ALL EXISTING OUTFALLS THROUGH PROPOSED STRUCTURES. APPROPRIATE DRAINAGE TO BE INCORPORATED INTO FLOOD DEFENCE AND RETAINING WALL STRUCTURES.
7. MINIMUM WALL HEIGHT TO BE 500mm ABOVE EXISTING GROUND LEVEL (MINIMUM DEFENCE HEIGHT REQUIREMENT MAY BE SHOWN AS LESS).
8. VEGETATION TO BE PRESERVED WHERE POSSIBLE.
9. TOP WATER LEVEL (T.W.L) IS DEFINED AS MODELLED WATER LEVELS WITHOUT FREEBOARD ALLOWANCE.
10. FREEBOARD ALLOWANCES OF 300mm ABOVE TOP WATER LEVEL FOR FLOOD WALLS AND 600mm ABOVE TOP WATER LEVELS FOR EMBANKMENTS.

LEGEND

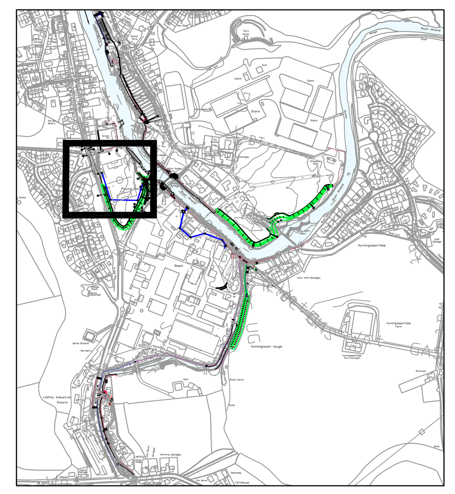
- REINFORCED CONCRETE FLOOD WALL
- RETAINING WALL
- SHEET PILE WALL
- SHEET PILE WALL WITH CLADDING
- KERB DRAINAGE SYSTEM
- PROPOSED SECURITY FENCING
- EMBANKMENT (WITH IMPERMEABLE CORE WHERE REQUIRED)
- PROPOSED EROSION PROTECTION (EXACT EXTENTS TO BE DETERMINED AT DETAIL DESIGN)
- EXISTING EROSION PROTECTION
- COMPACTED GRAVEL
- SOIL BACKFILL
- RAISED ROAD/ ACCESS TRACK
- CONCRETE
- SURFACE WATER DRAINAGE CHANNEL
- SECTION MARKERS

SERVICES

- BT — TELECOMS
- Elec OH — OVERHEAD ELECTRICITY
- Elec UG — UNDERGROUND ELECTRICITY
- GAS — GAS
- FW — FOUL WATER
- SW — SURFACE WATER
- Wat — WATER MAIN
- CS — COMBINED SEWER
- OUTFALL
- + 25.250 EXISTING LEVEL
- 25.250 PROPOSED LEVEL

DRAWING REFERENCES

716516/OPT/199	OVERALL LAYOUT
716516/OPT/204	FLOOD MITIGATION PROPOSALS SHEET 5 OF 17 TROUT FARM, BOWLING GREEN, RHOURKTON HOUSE
716516/OPT/206	FLOOD MITIGATION PROPOSALS SHEET 7 OF 17 VECTOR AEROSPACE
716516/OPT/302	FLOOD MITIGATION PROPOSALS CROSS SECTIONS - SHEET 2 OF 12
716516/OPT/308	FLOOD MITIGATION PROPOSALS CROSS SECTIONS - SHEET 8 OF 12
716516/OPT/309	FLOOD MITIGATION PROPOSALS CROSS SECTIONS - SHEET 9 OF 12



Version	Amendment	Drawn Date	Checked Date	Approved Date
C	CHANGES TO BOWLING GREEN AND PAVILION LOCATION	M.CHAMBERS 07.02.012	N.COOKE 09.03.012	P.SWIFT 09.03.012
B	ADDITIONAL SERVICES ADDED	L. NEALEY 24.10.11	P.LAMBERT 24.10.11	N.COOKE 24.10.11
A	FOR INFORMATION	M.CHAMBESR 04.04.11	P.LAMBERT 21.04.11	N.COOKE 26.04.11

Project: ALMONDBANK FLOOD MITIGATION SCHEME

Client: PERTH & KINROSS COUNCIL — The Environment Service

Drawing Title: FLOOD MITIGATION PROPOSALS SHEET 6 OF 17 PLAYING FIELD FLOOD STORAGE AREA

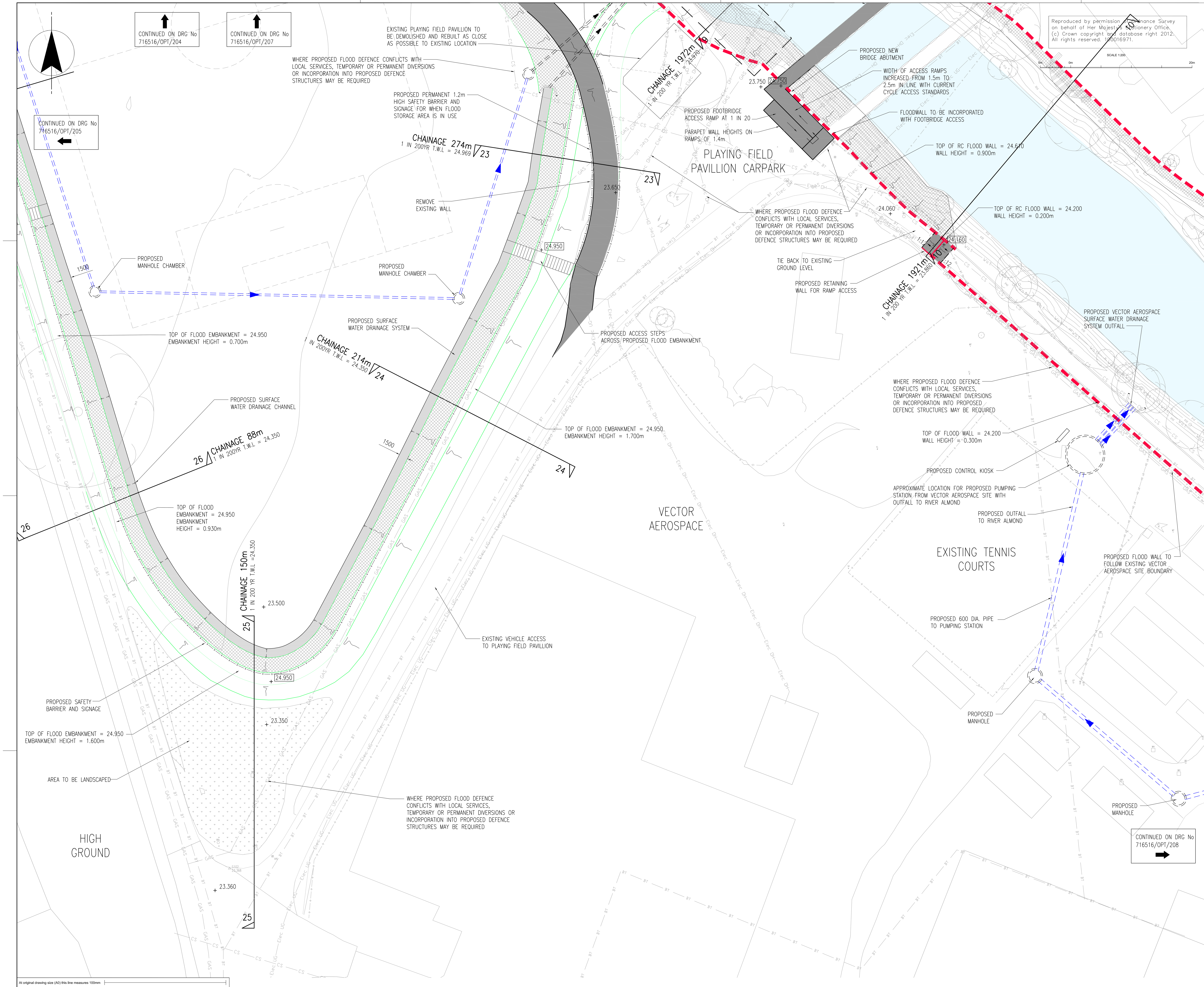
mouchel

Scales (at A0 size): 1:200

Purpose of Issue: FINAL OUTLINE DESIGN

Office	Tel No	Drawing No	Version
LIVERPOOL	0151 242-4200	716516/OPT/205	C

Appendix E: Vector Aerospace Pumping Station Solution



NOTES

1. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE STATED.
2. ALL LEVELS ARE IN METRES ABOVE ORDNANCE DATUM.
3. + 23.000 PROPOSED GROUND LEVELS (TO 3 DECIMAL PLACES).
4. INFORMATION RECEIVED FROM STATUTORY UNDERTAKERS HAS BEEN USED TO IDENTIFY LOCATIONS OF SERVICES. EXACT LOCATIONS OF THESE SERVICES ARE TO BE CONFIRMED DURING DETAIL DESIGN.
5. REINFORCED CONCRETE WALLS AND SHEET PILE WALLS IN CERTAIN LOCATIONS ARE TO BE CLAD IN A SUITABLE MATERIAL.
6. MAINTAIN ALL EXISTING OUTFALLS THROUGH PROPOSED STRUCTURES. APPROPRIATE DRAINAGE TO BE INCORPORATED INTO FLOOD DEFENCE AND RETAINING WALL STRUCTURES.
7. MINIMUM WALL HEIGHT TO BE 500mm ABOVE EXISTING GROUND LEVEL (MINIMUM DEFENCE HEIGHT REQUIREMENT MAY BE SHOWN AS LESS).
8. VEGETATION TO BE PRESERVED WHERE POSSIBLE.
9. TOP WATER LEVEL (T.W.L) IS DEFINED AS MODELLED WATER LEVELS WITHOUT FREEBOARD ALLOWANCE.
10. FREEBOARD ALLOWANCES OF 300mm ABOVE TOP WATER LEVEL FOR FLOOD WALLS AND 600mm ABOVE TOP WATER LEVELS FOR EMBANKMENTS.

LEGEND

- REINFORCED CONCRETE FLOOD WALL
- RETAINING WALL
- SHEET PILE WALL
- SHEET PILE WALL WITH CLADDING
- KERB DRAINAGE SYSTEM
- PROPOSED SECURITY FENCING
- EMBANKMENT (WITH IMPERMEABLE CORE WHERE REQUIRED)
- PROPOSED EROSION PROTECTION (EXACT EXTENTS TO BE DETERMINED AT DETAIL DESIGN)
- EXISTING EROSION PROTECTION
- COMPACTED GRAVEL
- LANDSCAPED AREA
- SOIL BACKFILL
- RAISED ROAD/ ACCESS TRACK
- CONCRETE
- SURFACE WATER DRAINAGE CHANNEL
- SECTION MARKERS

SERVICES

- BT — TELECOMS
- Elec OH — OVERHEAD ELECTRICITY
- Elec UG — UNDERGROUND ELECTRICITY
- GAS — GAS
- FW — FOUL WATER
- SW — SURFACE WATER
- Wat — WATER MAIN
- CS — COMBINED SEWER
- OUTFALL
- 25.250 EXISTING LEVEL
- 25.250 PROPOSED LEVEL

DRAWING REFERENCES

716516/OPT/199	OVERALL PLAN
716516/OPT/205	FLOOD MITIGATION PROPOSALS SHEET 6 OF 17 PLAYING FIELD STORAGE AREA
716516/OPT/207	FLOOD MITIGATION PROPOSALS SHEET 8 OF 17 RIVER ALMOND FOOTBRIDGE
716516/OPT/303	FLOOD MITIGATION PROPOSALS CROSS SECTIONS - SHEET 3 OF 12
716516/OPT/309	FLOOD MITIGATION PROPOSALS CROSS SECTIONS - SHEET 9 OF 12

Version	Amendment	Drawn Date	Checked Date	Approved Date
C	CHANGES TO VECTOR AEROSPACE SURFACE WATER DRAINAGE	W.CHAMBERS 07.02.012	N.COOKE 09.03.012	P.SWIFT 09.03.012
B	ADDITIONAL SERVICES ADDED	L. NEALEY 24.10.11	P.LAMBERT 24.10.11	N.COOKE 24.10.11
A	FOR INFORMATION	W.CHAMBERS 04.04.11	P.LAMBERT 21.04.11	N.COOKE 26.04.11

Project: ALMONDBANK FLOOD MITIGATION SCHEME

Client: PERTH & KINROSS COUNCIL — The Environment Service

Drawing Title: FLOOD MITIGATION PROPOSALS SHEET 7 OF 17 VECTOR AEROSPACE AND PLAYING FIELD STORAGE AREA

Scales (at A0 size): 1:200

Purpose of Issue: FINAL OUTLINE DESIGN

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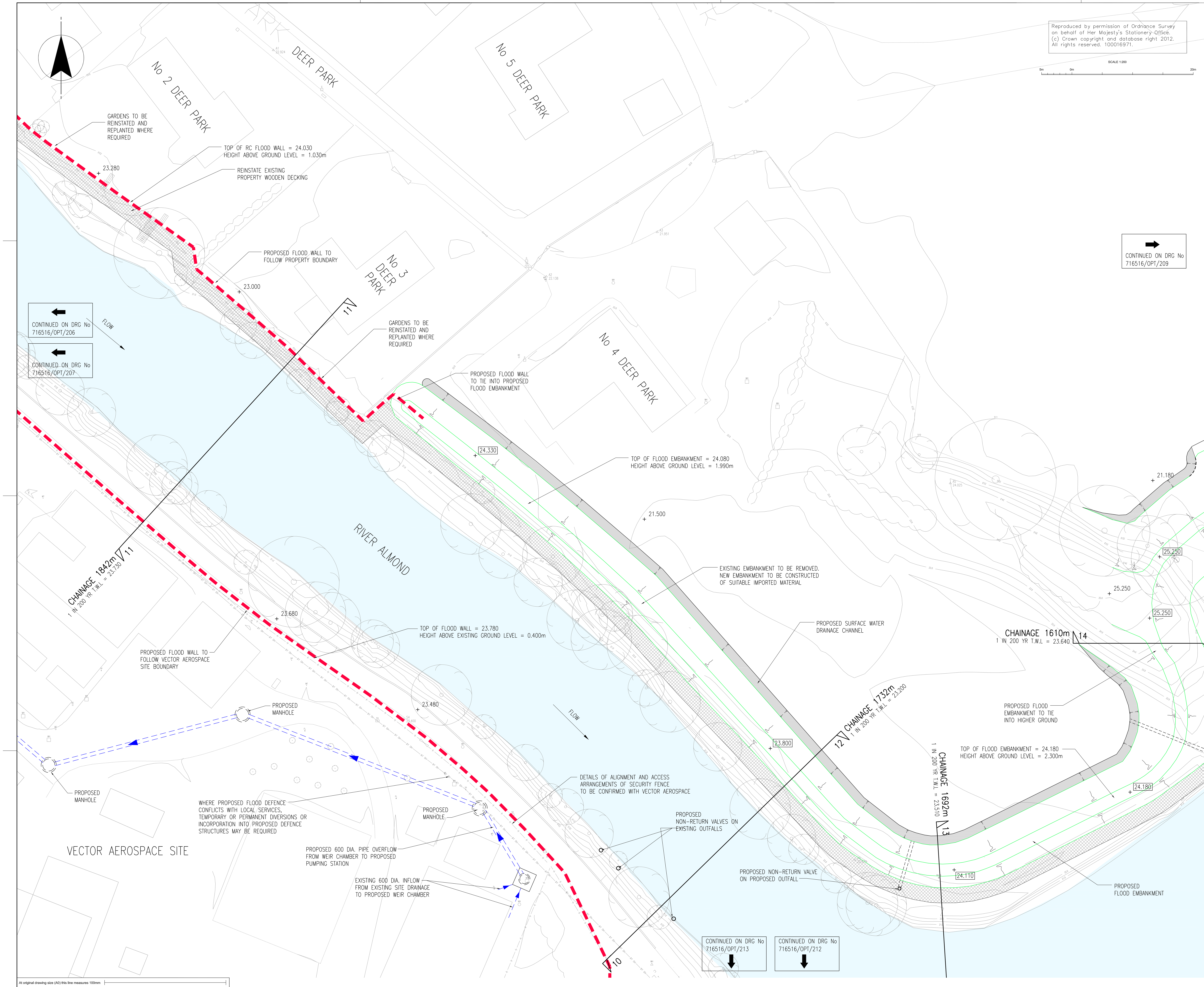
Office: LIVERPOOL | Tel No: 0151 237-4200 | Drawing No: 716516/OPT/206 | Version: C



NOTES

1. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE STATED.
2. ALL LEVELS ARE IN METRES ABOVE ORDNANCE DATUM.
3. + 23.000 PROPOSED GROUND LEVELS (TO 3 DECIMAL PLACES).
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LEGEND

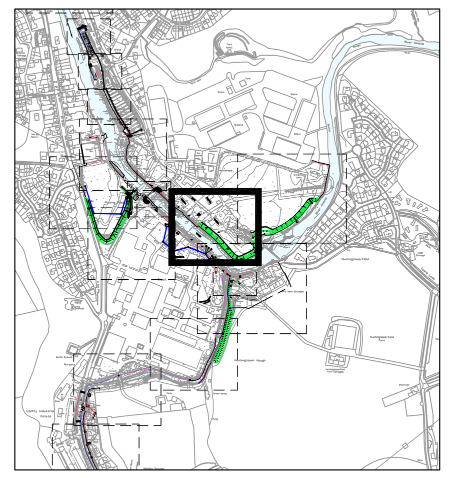
- REINFORCED CONCRETE FLOOD WALL
- RETAINING WALL
- SHEET PILE WALL
- SHEET PILE WALL WITH CLADDING
- KERB DRAINAGE SYSTEM
- —x—x—x—x— PROPOSED SECURITY FENCING
- EMBANKMENT (WITH IMPERMEABLE CORE WHERE REQUIRED)
- PROPOSED EROSION PROTECTION (EXACT EXTENTS TO BE DETERMINED AT DETAIL DESIGN)
- EXISTING EROSION PROTECTION
- COMPACTED GRAVEL
- SOIL BACKFILL
- RAISED ROAD/ ACCESS TRACK
- CONCRETE
- SURFACE WATER DRAINAGE CHANNEL
- 1 1 SECTION MARKERS

SERVICES

- — BT — BT — TELECOMS
- — Elec OH — Elec OH — OVERHEAD ELECTRICITY
- — Elec UG — Elec UG — UNDERGROUND ELECTRICITY
- — GAS — GAS — GAS
- — FW — FW — FW — FOUL WATER
- — SW — SW — SURFACE WATER
- — Wat — Wat — Wat — WATER MAIN
- — CS — CS — CS — COMBINED SEWER
- OUTFALL
- + 25.250 EXISTING LEVEL
- 25.250 PROPOSED LEVEL

DRAWING REFERENCES

716516/OPT/199	OVERALL LAYOUT
716516/OPT/206	FLOOD MITIGATION PROPOSALS SHEET 7 OF 17 VECTOR AEROSPACE
716516/OPT/210	FLOOD MITIGATION PROPOSALS SHEET 11 OF 17 MINISTRY OF AGRICULTURE STORE
716516/OPT/213	FLOOD MITIGATION PROPOSALS SHEET 14 OF 17 CONFLUENCE OF RIVER ALMOND & EAST POW BURN
716516/OPT/303	FLOOD MITIGATION PROPOSALS CROSS SECTIONS - SHEET 3 OF 12
716516/OPT/304	FLOOD MITIGATION PROPOSALS CROSS SECTIONS - SHEET 4 OF 12
716516/OPT/305	FLOOD MITIGATION PROPOSALS CROSS SECTIONS - SHEET 5 OF 12



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A	FOR INFORMATION	M.CHAMBERS 04.04.11	P.LAMBERT 21.04.11	N.COOKE 26.04.11

Project: ALMONDBANK FLOOD MITIGATION SCHEME

Client: PERTH & KINROSS COUNCIL The Environment Service

Drawing Title: FLOOD MITIGATION PROPOSALS SHEET 9 OF 17 DEER PARK & VECTOR AEROSPACE

mouchel

Scales (at A0 size): 1:200

Purpose of Issue: FINAL OUTLINE DESIGN

Office	Tel No	Drawing No	Version
LIVERPOOL	0151 237-4200	716516/OPT/208	C