west sussex county council

DRAINAGE REVIEW

Project: **Drainage Review - Bell Lane & Bookers Lane, Earnley**
Reference: 12DRA
Revision:
Date: 29th October 2014

Contents:

1 Summary

1.1 Instructions were received to investigate historic flooding problems in vicinity of Bell Lane & Bookers Lane, Earnley. It is understood that surface water run-off from the surrounding land overwhelms the existing infrastructure for some events at two existing highway culverts:

1.1.1 Culvert No.6 – Just south of the Bell Lane/Somerley Lane junction.

1.1.2 Culvert No.5 – Just west of the Bracklsham Lane/Bookers Lane junction.

1.2 The purpose of this drainage review is to:

1.2.1 Identify the reasons for the flooding problems.

1.2.2 To advise on potential methods/solutions with a view to allev iate the flooding problem.

1.3 This report is intended to form recommendations that can be taken forward as a detailed design and may be subject to further investigation prior to implementation or acquisition of funding.

Fig.1 Site Location Plan

2 Investigations & Sources of Information:

Historical Evidence:

2.1 There is a significant ongoing issue as local residents have reported the flooding problems on a number of occasions. Flooding observations have been collated from a number of residents along Bell Lane, Somerley Lane and Bookers Lane.

Southern Water:

2.2 Southern Water has a minimal public foul water sewer network serving the area. This is sparse and appears dependant on the density of the urban pockets; at the location of the 2 No. aforementioned culverts there are no foul water public sewers. Southern Water has confirmed there has been occasional overloading of Pinks Lane pump station which occurs during periods of prolonged rainfall thus is likely to be due to surface water ingress.

Environment Agency:

2.3 The EA have recently completed the Medmerry coastal flood defence scheme. A main arterial element of this starts at the southern end of Bookers Lane approximately 1.0 km south of the aforementioned 2 No. culverts.

2.4 The majority of the watercourses within the catchment are classified as ordinary, however the ultimate section of watercourse is designated as Main River.

2.5 At this time there is no new coastal and/or fluvial modelling to appraise the potential benefits for the upstream catchment, however the recent works are expected to afford some benefit to the local area.

Geotechnical Mapping:

2.6 The BGS website has been reviewed to appraise the existing geology and potential groundwater impacts.

Lidar:

2.7 Lidar is a remote sensing technology that measures distance by illuminating a target with a laser and analysing the reflected distance. This data has been utilised to assess the local topography.

Site Inspections:

2.8 A detailed site inspection has been undertaken by Opus to identify any additional features/factors and ultimately define the area of interest by better understanding the catchment and existing drainage infrastructure.

CCTV/Maintenance:

2.9 West Sussex County Council has undertaken routine maintenance to clear the 2 No. aforementioned culverts. Where necessary existing drains have been jetted and cleaned removing any silt and debris.

2.10 It is understood that, following the June 2012 rainfall events, a number of the land owners have now undertaken maintenance to watercourses local to this area.

Future Appraisal:

2.11 West Sussex County Council has commissioned CH2MHILL to undertake a drainage appraisal for the Manhood peninsula.

3 Discussion:

Catchment & Topography:

3.1 The Lidar data has been modelled to illustrate contours by colour banding to enable the extent of the global surface morphological catchment to be determined.

3.2 This has been explored further by consideration of features such as roads and watercourses which could indirectly impact over the overall catchment in terms of surface water run-off flow.

3.3 There appears to be 2 No. catchments flowing south either side of Bell Lane. These converge just downstream of Culvert No.6 (Bell Lane/Somerley Lane junction). The head of west catchment appears to start just north of the 82179 carriageway. This portion is rural and discharges under the 82179 (Public Highway) to an ordinary watercourse. The head of the east catchment appears to start in line with the A286 . Both networks are predominately open ditch (ordinary watercourse) and pass through a number of piped culverts for field accesses or other strategic crossings. Downstream of Culvert No.2 a number of other sub-catchments converge as the network continues as open ditch (Main River) parallel with Bookers Lane where it discharges to the newly enlarged EA conduit. The network continues south through the Medmerry scheme and ultimately out to sea.

3.4 Catchment 1 merges with the Main River running parallel with Bookers Lane at a number of locations. The catchment is predominantly downstream of the 2 No. culverts being appraised.

3.5 There are a few parcels of catchment which are unverified and may require further investigations to be undertaken dependant on the consultations to follow from Earnley Parish Council.

3.6 The total verified catchment measures to be of the order of 2.664km^2.

3.7 Please refer to drawing 100 & 101 for further details.

Geotechnical Mapping:

Superficial Geology	River Terrace Deposits (undifferentiated) - Sand, Silt And Clay. Superficial Deposits formed up to 3 million years ago in the Quaternary Period. Local environment previously dominated by rivers. *(majority of catchment)* Raised Marine Deposits - Clay, Silt, Sand And Gravel. Superficial Deposits formed up to 3 million years ago in the Quaternary Period. Local environment previously dominated by shallow seas. *(locally to Bookers Lane)*
Bedrock Geology	London Clay Formation - Clay, Silt And Sand. Sedimentary Bedrock formed approximately 34 to 56 million years ago in the Palaeogene Period. Local environment previously dominated by deep seas.

3.8 The EA have advised that part of the stratum locally to Bell Lane is likely to be impermeable. Groundwater levels in this area are known to be high all year round and tidally influenced.

3.9 The existence of numerous ditches serving the catchment corroborates the high groundwater observations whereby the ground will not readily accept run-off and needs to be conveyed to an outfall.

Tidal Defences:

3.10 On review of the topographical LIDAR data it is evident that ground levels along Bookers Lane south of Culvert No.5 and continuation downstream lay below 4.5m AOD. Invert levels of watercourses are nominally lower and of the order of 3.5m AOD therefore there is potential for tidal impact.

3.11 The ground levels north of Culvert No.5 rise slightly to 5.0m AOD and above, therefore falls outside of the tidal impact zones. This appears to correspond with current Environment Agency flood risk mapping predictions (see fig.3). However, as aforementioned, there is no new coastal and/or fluvial modelling to appraise the potential benefits of the Medmerry scheme and as to whether this area is afforded betterment.

Ditches &Watercourses:

3.12 The main focus has been to identify and map a number of primary ditches/watercourses which form the arterial network for the overall catchment. The majority of the catchment appears to be open ditch.

3.13 Secondary branches and lateral drains have not been explored in detail and may require further investigations at detailed design stage.

3.14 It is understood the EA currently undertake annual maintenance of the watercourses designated as Main River which extends up through Bookers Lane due along the west boundary of Somerley .

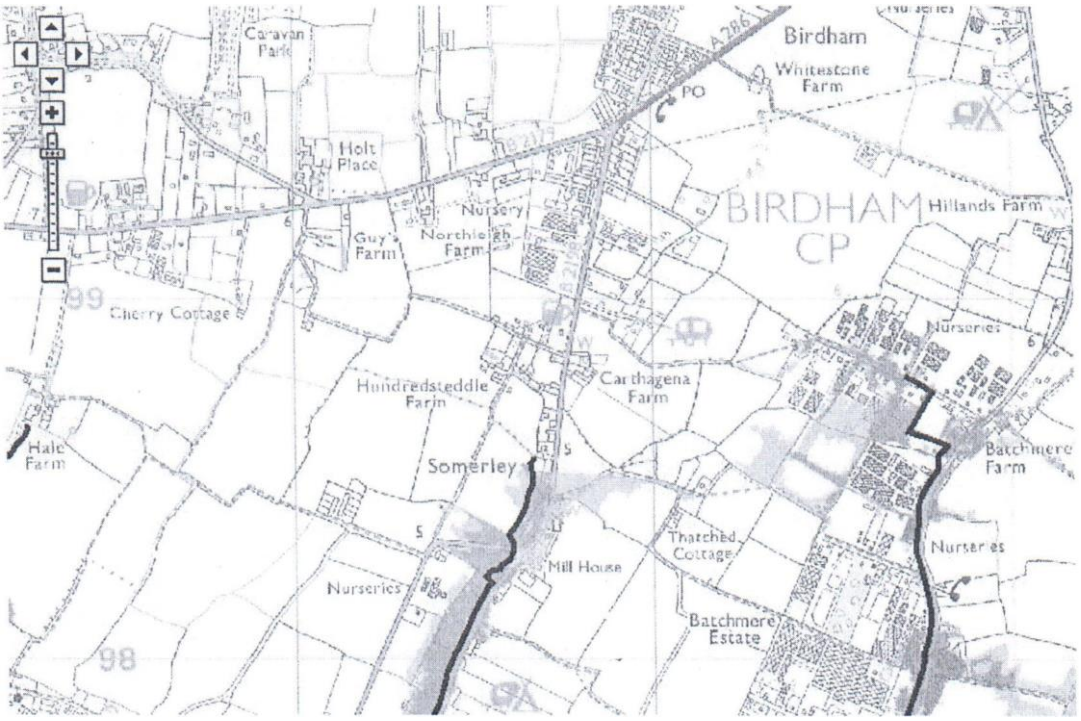


Fig.3 Extract from EA Website

Culvert Assessment:

3.15 At main roads and vehicular crossovers the ditch/watercourses are culverted with a pipe.

3.16 The culvert sizes have been appraised to determine their ability to convey flows and/or retain flows and the impacts to the upstream and downstream catchment. (Refer to Appendix B)

3.17 For the purposes of this exercise culverts 1A-1F have been amalgamated to a single item under culvert No.2 as these are all of a similar size.

3.18 At the start of the newly enlarged EA conduit it is assumed that the drainage network is now fully functional and has been increased from of the order of 1.2cumecs to a little above 4cumecs immediately downstream of catchment 1.

Highway Drainage:

3.19 The highway catchment amounts to a relatively small portion of the overall catchment.

3.20 The highway run-off is currently collected via two methods 1) traditional road gullies 2) over the edge run-off; in most instances both appear to drain into the aforementioned ditch/watercourses.

4 Surface Water Run-off:

Run-off From Catchments :

4.1 Unconfirmed areas of catchment have been excluded from the analysis.

4.2 It is evident that surface water run-off from the surrounding area is predominantly rural (Greenfield) however there is a small portion of urban catchment amounting to of the order of 10%. For the purposes of this assessment this has been ignored in the calculations.

4.3 Culvert No.1 would appear to be adequate for events up to approximately a 1:1Oyr event. This is the governing culvert prior to entering the EA scheme.

4.4 Culvert No.2 (1A-1 F & 2) would appear to be adequate for events up to approximately a 1: 2yr event.

4.5 Culvert No3 & 4 would appear to be adequate for events up to approximately a 1:1OOOyr event and are not consider to be impacting flow conveyance .

4.6 Culvert 5 would appear to be adequate for events up to approximately a 1:25yr event.

4.7 Culvert 6 would appear to be adequate for events up to approximately a 1:5yr event.

4.8 Culvert 7 would appear to be adequate for events f.or less than a 1:1yr event. This would imply that the current situation suffers from ponding created by the throttling effect.

4.9 Culvert 8 would annR::ir tn hR ::irlP.r,11::itP. *fr,r* P.1/Pntc: I I f"' tn C>f"'rrnvime>to l , ci 1,l;yr ovont.

4.10 Culvert 9 would appear to be adequate for events for less than a 1:1yr event. This would imply that the current situation suffers from ponding created by the throttling effect, however is positively holding volume upstream within lower lying field areas.

4.11 Culvert 1O would appear to be adequate for events up to approximately a 1:30yr event.

4.12 Culvert 9 would appear to be adequate for events for less than a 1:1yr event. This would imply that the current situation suffers from ponding created by the throttling effect, however is positively holding volume upstream of the 82179.

Volume From Catchments:

4.13 It is evident that there are numerous ditches forming the majority of the rural field boundary divisions. Many of these ditches are notably large in width with depths of the order of 0.6m-2.0m. This implies that there is already a significant storage volume available to collect and store run-off in-line (due to the flow rate lag effect).

4.14 Review of the Lidar data confirms a very flat catchment with vast areas with a range of less than 250mm variance in vicinity of the arterial ditch routes. When ditch storage capacity is exceeded during prolonged rainfall periods these areas will provide a significant buffer storage.

4.15 The overall catchment ditch storage is not known however we have given some initial considerations on the basis that the lengths of functional ditch are of the order of 16,000m:

- Average ditch cross sectional area of $1m^2$ = $16,000m^3$
- Average ditch cross sectional area of $3m^2$ = 48,000m3

2 .6km2 catchment with M100, 6hr rainfall of 55mm and a 40% SPR (Surface Percentage Run-off) equates to a run-off volume of about $57,000m^3$. The estimated likely system storage volume, is about 30,000m3. During the 6hr storm event and using a total discharge rate of 1.2cumecs/second the total discharge of around $25,000m^3$ could be expected . Therefore the storage limit of the system is estimated to be around 1:100yr return period. There will however be local variations within the system and a more frequent return period should be expected in the future commensurate with climate change effects. Based on the 1.2cumecs flow rate the theoretical residual drain down time for the rest would be about 18hrs, however there would be a further lag effect as the flow rates diminish hence the total drain down time will be in excess of one day.

5 Identification of Problems & Limitations:

5.1 In overview the fundamental concern of the residents is one of sluggish flow and long drain down times. Making existing culverts larger is only applicable in a small range of circumstances i.e. a culvert of twice the area is perceived to be able to pass twice the flow rate is dictated by the overall gradient available. In the case of an oversized pipe there is simply not enough gradient to propel the flow so the water level will not rise up to fill the pipe as the water level is dictated by land gradient not pipe size. Gradients could only be increased by raising the land upstream of the section requiring a higher flow or pumping out water downstream to lower the level there neither of these is viable or acceptable. Existing gradient therefore dictates flow and there is no benefit in oversized culverts.

5.2 The characteristics of the catchment are clayey with a very flat topography . This dictates that surface water run-off has an inability to drain down quickly. For prolonged rainfall periods this is noted to immerse a number of existing culverts.

5.3 The residential properties at the greatest risk of flooding lay along Somerley Lane, Bell Lane and Bookers Lane where ground levels fall below 5.0m AOD.

5.4 Culverts No.2 (1A-1F & 2) could be upsized to improve flow conveyance , thus aid in draining down the run-off to the newly enlarge EA conduit reducing the impact to Bell Lane.

5.5 Culverts No.5 is considered capable of dealing with up to a 1:25yr rainfall event and thus is considered unnecessary to upsize/upgrade. The existing entry taper and bag work arrangement to the eastern most pipe does appear to be slightly hindering the flow conveyance and could be locally reconstructed.

5.6 Culverts No.6 is considered capable of dealing with up to a 1:5yr rainfall event and thus is considered unnecessary to upsize/upgrade.

5.7 Culverts No.7 could be upsized to improve flow conveyance, thus aid in draining down the run-off which currently collects at Somerley Lane as the local area is seen to be a subtle depression of lower lying ground. This will only have a limited improvement as water levels will continue to weir over the road during more severe rainfall events.

5.8 Additional buffer storage could be provided immediately upstream of culvert No.5. The watercourse could be excavated to form a nominal balancing pond/shelf area providing of the order of 400m^3. In comparison to the aforementioned estimated ditch storage this equates to of the order of 1% (of estimated current storage), which, whilst is providing some benefit, is negligible and thus not considered cost effective.

5.9 Part of the west catchment could be re-directed to an alternative outfall to by-pass culvert No.5. Initial observations of the LIDAR and ditch routing imply it may be possible to excavate new ditch links towards Bookers Lane or Stubcroft Lane alleviating the problem areas. This will first require additional investigatios to determine existing connectivity, catchment and perceived impacts. This would reduce flows arriving at culverts No.5 & 6 but flows to culverts No.1 & 2 would be maintained and would have no impact elsewhere.

5.10 A number of ditches/watercourses within the catchment are heavily silted and in need of maintenance.

5.11 Please refer to drawings 104 for location of the above items.

6 Recommendations:

6.1 1 Culverts No.2 (1A-1F & 2) to be upsized to improve flow conveyance , thus aid in draining down the run-off to the newly enlarge EA conduit reducing the impact to Bell Lane.

6.2 Culverts No.7 to be upsized to 750mm diameter culvert and downstream ditch locally re-graded, thus mimicking the downstream culvert No.6 flow conveyance and improving the drain down lag for this length but not noticeably beyond.

6.3 Culverts No.5 eastern entry taper and bag work arrangement to the reconstructed to improve flow conveyance .

6.4 Providing additional buffer storage at Bell Lane is not considered cost effective however we anticipate could be easily implemented by the community .

6.5 Part of the west catchment could be re-directed to an alternative outfall to by-pass culvert No.5. This will first require additional investigations to determine existing connectivity , catchment and perceived impacts. The Environment Agency will need to be party to any such proposals .

6.6 Ensure annual maintenance is upheld for ordinary watercourses .

6.7 Please refer to drawings 104 for location of the above items.

7 Summary:

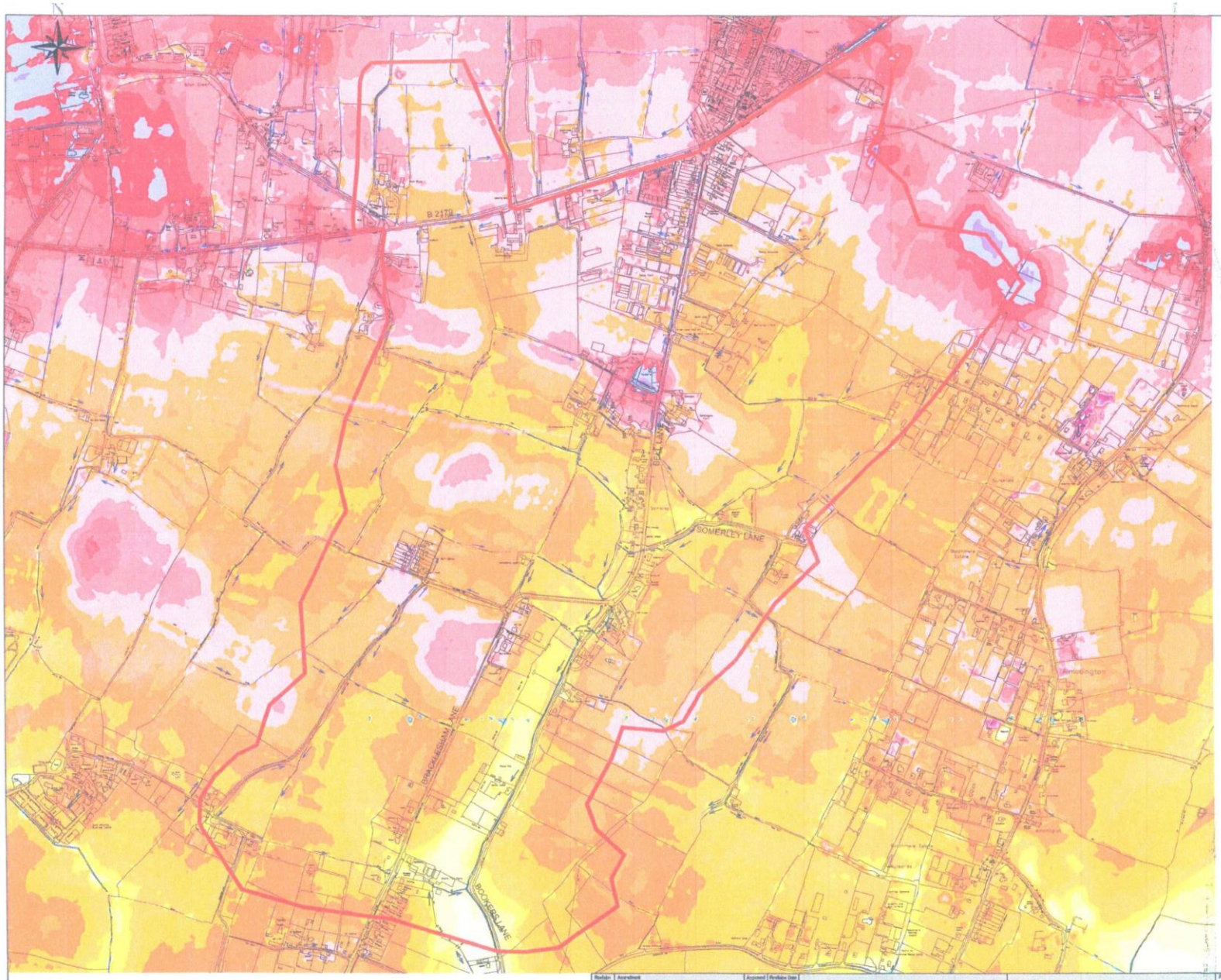
7.1 All the aforementioned potential options are anticipated to remove some of the obvious constraints (Culvert No.7) and improve flow conveyance (Bookers Lane) thus improving the drain down lag, however will not improve on the water levels experienced when the outfall is tide locked.

7.2 Without undertaking further detailed investigations of the existing reticulated network, the available ditch storage provision is unknown; however we would anticipate this is of the order of 30,000m^3 capacity before surface water levels are observed to 'break bank'.

7.3 Even with implementation of the aforementioned proposals the 'ditch'/watercourse system would not be able to hold 1:30yr & 1:1OOyr eturn period volumes and would continue to overspill on to the adjacent field edges which provide buffer storage . As discussed in paragraph 5.1 the rate of drainage is fundamentally determined by the flatness of the catchment not the capacity of the culverts and because the drainage rate is inherently sluggish this mobilises the storage .

7.4 There may be potential for locally rerouting the catchments 3 & 4 . This may net a total reduction of the order of 0.126km^2 (7-8%) flow conveyance betterment at culvert No.5.

7.5 The benefits of the Medmerry scheme recently completed by The Environment Agency are not yet known, however are expected to afford some benefit to the local area. This is likely to be explored further under the CH2MHILL commission to undertake a drainage appraisal for the Manhood peninsula.



Revision	Amendment	Approved	Revision Date
P1	Initial Issue	MJA	07.02.2014

1:5000 @ A1
1:10000 @ A3
0 50 100 150 200 250 300 350 400 450 500 m

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Drawn	Designed	Approved	Revision Date
CGJ	MJA	MJA	07.02.2014

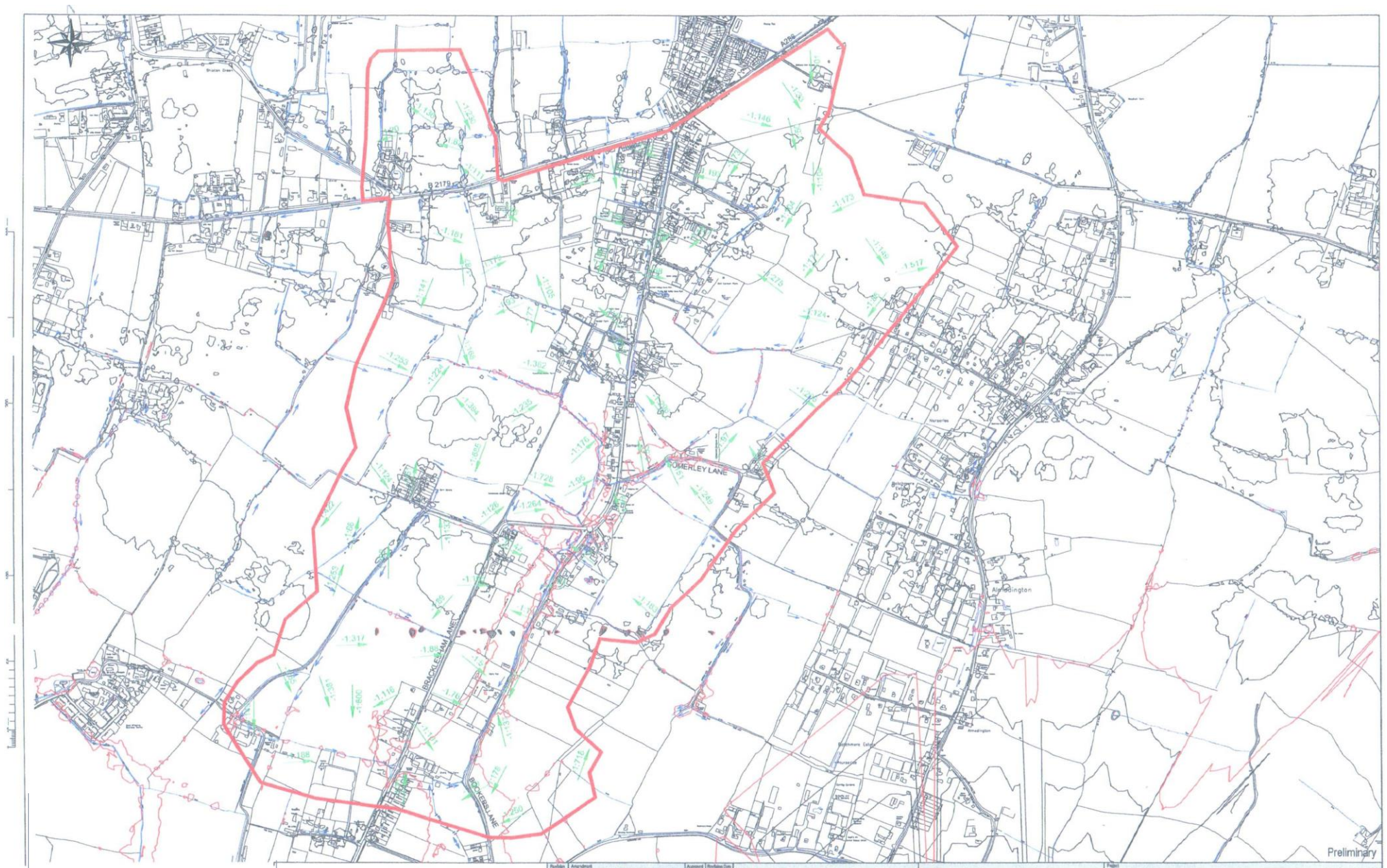
Project No. EF1057 | Scale 1:5000

Project: WSCC Drainage Appraisal Earnley

Sheet: Lidar Colour Banding

Drawing No. 100

Original Sheet Size A1 [841x594] Plot Date 30 Oct 2014 @ 1:20M Path G:\Projects EF\EF1000-EF1999\EF1000-EF1099\EF1057\04 CAD-Current Working Drawings\12DRA (Earnley)\FA E-F-1057_00 100 Lidar.dwg



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Major contor lines

Minor contour lines

Fall Arrows

1:5000 @ A1
1:10000 @ A3
0 50 100 150 200 250 300 350 400 450 500 m

Revision	Amendment	Approved	Revision Date
P1	Initial Issue	MJA	07.02.2014

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Drawn	Designed	Approved	Revision Date
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Project No.: EF1057
Scale: 1:5000

Project: WSCC Drainage Appraisal
Bell Lane and Somerley Lane

Sheet: Contours and Gradients

Original Sheet Size A1 [841x594] Plot Date 30 Oct 2014 @ 1:19 PM Path G:\Projects EF\EF1000-EF1099\EF1000-EF1099\EF1057\04 CAD\Current Working Drawings\12DRA (Eartley\FA E-F-1057_00 10' contours and gradients.dwg 100