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Cambridgeshire County Council

Soil Affected Roads – Review of Sites and Treatment Options Report.

January 2024

Document History

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Executive Summary

This report assesses Soil Affected Roads within Cambridgeshire. Cambridgeshire County Council (CCC) identified the most used 25 roads by road name using their Highways Infrastructure Resilience Assessment Tool (HIRAM). Soil affected roads are those where the foundation and sub-grade of the road is on organic or peat-based soils. This causes seasonal heave which causes undulations, cracking and differential settlement leading to failure of the road construction.

Cambridgeshire Highways were commissioned to review the 25 sites totalling approximately 100km of the CCC network. Surveys were undertaken to determine a hierarchy of the poorest condition roads and advise on potential treatment options for each site.

- The short-term plan for these sites is to utilise the site plans and hierarchy provided below to monitor and assess their condition using existing a network management process to target intervention. This may include ordering asphalt patch repairs, installing temporary speed limits, signage and traffic signals or in the worst-case road closures. This work is ongoing within CCC maintenance team.

- The medium-term proposal is to take forward the findings of this Report to gain funding for the reconstruction work required to treat the worst of these roads. Site investigations and design work will be undertaken as set out in the CCC guidance document '*Guidance specification for stabilisation/recycling of Fenland Roads*' to determine areas requiring deeper treatment etc. This Report compares the costs for treating all of the sections in poor condition at each site, but is subject to further design and development.

- The long-term plan will be to survey, monitor and manage the wider network. This will involve reviewing the reconstruction work undertaken through the previous 'Drought Damaged Roads' (DDR) programme to determine how those roads are performing and to undertake repeatable data led surveys such as the R3 surveys included in this Report to provide objective results. The data set used for these R3 surveys is different from a conventional Pavement Condition Index (PCI) as it scores the level of roughness, undulation and differential settlement rather than overall pavement condition.

The Report proposes several treatment options with their associated cost, carbon impact and indicative works duration, based on typical construction outputs for comparison. To treat the roads which score below 7 on the International Roughness Index (IR) with the same 'double-geogrid' reconstruction method used for the DDR programme would cost in the region of £45.5million (including 23% optimism bias (OB)). To fully reconstruct the roads removing a significant depth of peat would cost around £85million (inc 23% OB). And to use an alternative deep in-situ recycling method would cost around £37.5million (inc 23% OB).

This Report recommends:

- The table and base plans provided should be used to target funding as it becomes available. The Report gives a hierarchy based on the condition of the roads but this will need to be considered against additional factors such as village/town links and the wider network connectivity.

- The other approximately 100+ soil affected roads not captured within this 25 are surveyed using the same scanning process to ensure there are no other sites or sections of road in a worse condition than these and to provide a baseline data set for future monitoring.

- A review of the Drought Damaged Roads and similar recent reconstruction projects is undertaken to provide a comprehensive review and assessment on how well they are performing and whether there are any trends or site conditions which affect the suitability of each treatment option.

Failure to achieve funding will result in continued worsening of the network and may lead to local road closures having significant impact on local communities until such time as funding can be made available.

1.0 Background

CCC have produced a previous report '*Soil Affected Roads Report on Initial Assessment of Risk and Scale of the issue in Cambridgeshire.*' This Report builds on the findings of that and reviews 25 sites within Cambridgeshire.

'Over 1600km of Cambridgeshire road network lies on roads with peat-based soils. These expand and contract significantly across seasons as they become saturated and then dry out. Recent years have seen the extent and frequency of this cycle and the level of damage caused increase, presenting an increasing maintenance burden' SAR report, 2023.

The previous report used the Highways Infrastructure Resilience Assessment Tool (HIRAM) to identify 25 roads as the most used to be reviewed at a network level.

'The traditional methods used to refurbish the roads previously are no longer providing the outcomes in terms of extending life of the roads, halting further decline and providing comfortable and safe surfaces. Longitudinal cracking on routes is posing a particular danger to cycles and motorcycles as well as large lorries. Several roads are constantly requiring extensive localised repairs. More highly used routes now require traffic management; speed limits and safety signing to support safe use.' SAR report, 2023

CCC have maintained this asset over the years by patching and overlaying the affected areas.However, this method has no longevity as it does not address the deeper-seated failures in the foundation layers and subgrade beneath.

A draft guidance note '*Guidance specification for stabilisation/recycling of Fenland Roads*' has been produced by CCC which discusses the issue and talks in detail about treatment selection and methodology. That guidance document discusses three longer term options with regard to traffic loadings, existing road structure and sustainability:

- Regen for lightly trafficked roads: Shallow in-situ recycling 150mm deep with cement binder finished with double surface dressing.
- Double Geogrid for higher levels of HGV traffic: Deep plane-out and process ex-situ existing road; return 300mm of unbound recycled aggregate incorporating two confinement geogrid layers, finished with two layers of asphalt.
- Roads containing failing concrete slabs: Shallow plane-out and process ex-situ asphalt layers; rubbilise existing concrete slabs then return 150mm of unbound recycled aggregate incorporating single confinement geogrid layer, finished with two layers of asphalt.

More recently in mid-2021, since the circulation of CCC's draft guidance note, the Client team have trialled a new method of installing geogrids at Cants Drove. This latest technique allows the incorporation of a geogrid below a bound recycled layer, constructed in-situ in a single operation, this can deliver savings in terms of cost, time and carbon.

These shallow and deeper 'geogrid' treatment options are considered within this report alongside other alternatives. When funding has been confirmed for these sites, this guidance document and recent best practice should be used as the basis for intrusive investigation, design and confirmation of treatment options.

2.0 Introduction

Through the Cambridgeshire Highways contract Milestone Infrastructure Services Ltd have been commissioned by CCC to review the 25 Soil Affected Roads (SAR) sites totalling approximately 100km. Additionally, the existing established and trusted supply chain have collaborated on this project and Report with Milestone's Design and Delivery teams. Stabilised Pavements Limited (SPL) have undertaken a wide range of treatments across the CCC network in recent years. Aggregate Industries (AI) undertake the majority of Cambridgeshire Highways resurfacing work and are innovating new lightweight aggregates, low temperature asphalts and other emerging technologies. CCC and their technical leaders have also shared their learning from the previous Drought Damaged Road programme which has led to the development of several treatment options for roads where the subgrade is poor, or the roads have become 'soil damaged' through seasonal heave.

CCC are developing short-, medium- and long-term aspirations for these roads. The short-term plan is dealt with at a network management level whereby roads are regularly visited and assessed and small areas of patching, temporary traffic lights, signage and road closures are implemented. The medium-term plan is covered by this Report and involves planned interventions to carry out partial reconstruction of the carriageway to provide a safe and economic solution. The longer-term process will be an asset management approach to regularly survey and test the affected areas of network alongside a data led review of the interventions undertaken over recent years to determine how they are performing and learn lessons for improvement.

This Report will present a priority list of sites based on surveys undertaken as part of this work. It will propose treatment options with their comparative cost, carbon impact and outputs.

The method used was to review previously supplied Gaist condition surveys and undertake a visual inspection of each site undertaking a videoed drive-through. In addition, R3 surveys have been commissioned to undertake site scanning surveys to present International Roughness Index (IRI) data to determine appropriate areas of each road requiring treatment.

The priority list and site plans provided can be used as a baseline for the short-, medium- and long-term interventions required. Further work will be required following this Report to intrusively trial the foundation layers of each section of road to confirm suitable treatment options.

3.0 Site List

The 25 sites presented for review are shown below. No.6 already has a treatment proposal and so is omitted from this Report. The scheme has already been developed to a point of target costing the works. No.12 has been omitted as the road extends beyond county boundary, so the section through Tadlow is considered as part of No.10

CCC Top 25 Soil Affected Roads

Rd No.	Rd Type	Road Name
1	A605	Wisbech Rd, Coates
2	A1123	Hill Row Causeway
3	A603	Cambridge Road, Wimpole
4	C134	Padnal Bank Queen Adelaide
5	B1093	Benwick Road, Whittlesey
6	B1050	Shelfords Road Willingham
7	B1049	Twenty Pence Road, Wilburton
8	B1381	Chain Causeway, Sutton
9	B1040	Herne Road, Ramsey St M
10	B1042	Lower Road, Croydon
11	B1040	St Marys Road, Ramsey
12	B1042	Wrestlingworth Road, Tadlow
13	B660	Holme Road, Ramsey St M
14	B1099	Upwell Road, March
15	B1046	High Street, Longstowe
16	B1096	Benwick Rd Ramsey forty foot
17	B660	Long Drove, Holme
18	B1096	Ramsey Road, Benwick
19	B1104	Prickwillow Road, Isleham
20	B1411	Straight Furlong
21	B1098	New Road, Chatteris
22	B1050	Chatteris Road, Somersham
23	B1040	Pidley Sheep Lane, Pidley
24	B1094	Upwell Road, Christchurch
25	B1100	Padgetts Road, Christchurch

4.0 Survey Review

4.1 Gaist survey review

In Spring/Summer 2023 Gaist were commissioned by CCC to undertake a countywide pavement condition survey. This data set was reviewed for the 25 sites. The Gaist mapping shows Yellow and Cyan for serviceable roads and Red and Amber for sections in poor condition with a square metre summary. The survey also has a description of the condition with tags for subsidence, cracking, chip loss, fatting, potholes etc.

The limitation of this data set is that it includes all condition data. Pavement Condition Index (PCI) gives a good overall picture of condition however it includes surface deterioration information and did not provide specific undulation or structural failure areas. The example above at Hill Row Causeway is shown as serviceable, however there are significant undulations captured in the R3 data below. It was agreed at commissioning stage that further surveys would be required to determine the sections of road affected and to give an index to compare sites with.

4.2 Video surveys

To begin the review of the 25 locations a site visit and video were undertaken during October and November 2023. The purpose of this was to filter the sites into a hierarchy based on visual condition, undulations, cracking and other salient features. The videos provided an excellent visual review of each site and were reviewed by the project team with advice being sought from within CCC on their previous DDR programme. The sites were prioritised to determine which should be fully surveyed using R3 Surveys.

4.3 R3 surveys

Videos in isolation do not provide a data set which could be assessed objectively and repeated in future years - they are subjective and comparison between sites becomes difficult with so many to concurrently assess. Therefore, in December 2023 R3 Surveys were commissioned to undertake a detailed survey of the worst sites identified through the video review. Due to time constraints only 16 of the sites were visited and surveyed. This consisted of a photo every 5m and a scan of the road surface.

R3 use an International Roughness Index (IRI) system to assess the rutting and undulations within the road surface producing a site map and identifying the worst areas. This includes for areas where cracking and differential settlement has occurred which is the most common failure observed on these soil affected roads. Typically, IRI ranges from 0-3.5 for new pavements up to 6-7 for older pavements which are due a resurfacing intervention. Unfortunately, the survey results for the sites assessed significantly exceed the typical IRI ranges with the worst sites recording 57+.

As a consequence for the purposes of this Report, it was decided to add additional classifications to determine the areas in poorest condition. Working with R3 additional classification criteria were set as below to enable the very worst sections to be easily communicated.

IRI Project specific classifications	
0 - 3	Good Surface Condition (Major A Road, Motorway Class)
3 - 7	Serviceable (General deterioration, Some rutting and undulations present)
7 – 15	Poor Condition (serious vertical deflection)
15 – 30	Very Poor Condition
30+	Extremely Poor Condition (serious structural failure and/or differential settlement)

Thes survey data was overlaid onto Ordinance Survey base mapping to provide square meterage of the classifications for each site and areas hatched. Yellow and Green sections were omitted for clarity. For the purposes of this Report as of December 2023 anything 7+ is included as requiring an intervention and it may prove cost effective to include areas with a score of 3 – 7 on a site-specific basis. Where short sections (<50m) of acceptable carriageway exist between two very poor areas these have been included as it is not cost effective to stop-start deep treatments.

5.0 Site plan review

The base plans for each site are included in Appendix 1. The areas are based on OS mapping. The R3 data displays the ranges discussed above, where R3 data is not present the Gaist and Video review data have been transferred to the plans giving a much more simplistic treatment area.

These plans can be used for short term assessment and taken as a baseline for future design, intrusive survey and construction work.

The IRI guidance suggests that anything with a score 7+ is in very poor condition. Some of the sites assessed in this Report had a score of 57+. Approximately 100km of the network is covered by this Report and around 40%, 291,000m2 was in a very poor condition with serious undulations and cracking with 20,500m2 being classified as extremely poor condition.

Four of the sites have areas in extremely poor condition. For the purposes of the comparison table in Chapter 8.0 these are not separated out from the overall areas requiring treatment. These sites are:

- Straight Furlong, Pymoor – Approx 60m.
- Benwick Road Whittlesey – approx. 20m.
- Benwick Road, Ramsey Forty Foot – Approx 20m.
- Upwell Road, March – Approx 20m.

These are the areas in the poorest condition and it is recommended that they be visited using the base plans to determine if any short term interventions can be implemented.

6.0 Treatment Options

The treatment options included in this Report are focussed on reconstructing and improving the structure and shape of the road in the medium term. CCC are working with other Local Authorities to continuously develop new innovative solutions and best practice for these roads and so this is not an exhaustive list. In the longer term more innovative and radical alternatives will be needed to provide a network which works for soil affected roads.

Part of the issue with the soil affected roads is the load of the road construction itself. Where the surface is undulating the depressions can be subjected to significant hammering action from axle loading, this deepens the depressions and compounds the issue. Across the world there are many examples where raft solutions have been tried, where the road 'floats' above the poor ground conditions. Many of the sites in Cambridgeshire would not be suitable due to the volume of traffic expected and the cost of constructing and effectively maintaining a bridge structure above the poor subsoils. In its simplest application this could be concrete slabs to spread the load, however this has not been successful long term at Prickwillow road and Longstowe High Street both of which are included in this Report and have slabs with differential settlement and failure.

Alternatively, mini-piling of the road has been used elsewhere using a reinforced raft structure above. This is not included in this Report as it would likely prove prohibitively expensive. It could be worthwhile exploring further or considering trial sites prior to settling on treatment options as a longer-term alternative.

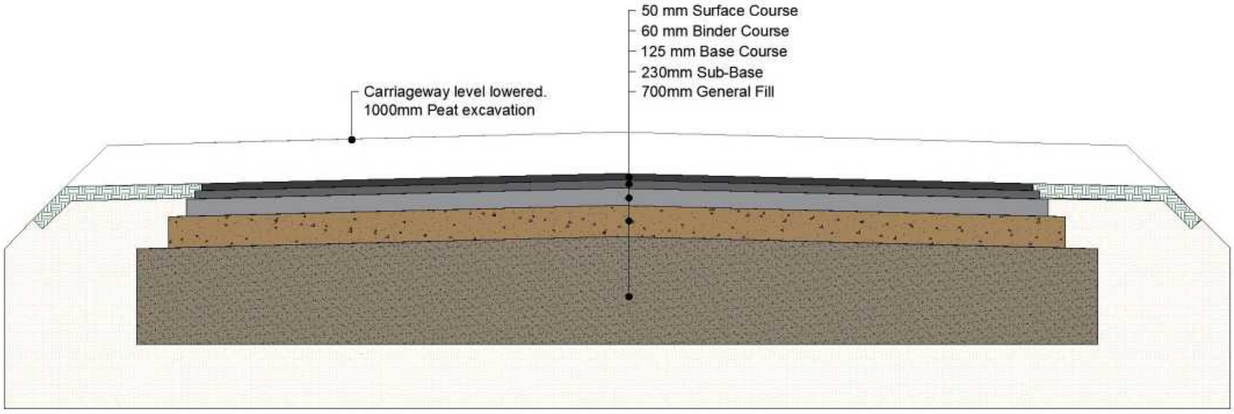
There are examples in Cambridgeshire (Caxton End) where single size sub-base material with cut-off and filter drains have been used to allow groundwater to pass through and under the road. This would likely not be suitable where the peat-based soils swell and contract due to saturation. One option included below which may become economically feasible in the longer term, is the formation stabilisation technique to create a solid formation through binder stabilisation of the existing soil.

Finally, the steep embankments, ditches and causeways found across Cambridgeshire adjacent to the carriageway affect the stability of the road edge. This can lead to slip failure and accelerate the differential settlement. The Strataweb® option included in this Report has been used with some success, however other options include reducing the level of the road, re-cutting or backfilling of ditches, or sheet piling. This would provide a wider stable foundation for the road and should be considered in the design development of these sites.

The treatment options below are presented for comparison and have been used across the county network in recent years. In some of the options where crack seal and surface dressing is indicated, an additional £10/m^2 (£50k in the example 5,000m^2 site) can be added to the treatment cost.

6.1 Treatment A: Full depth 'conventional' reconstruction

The most expensive, carbon intensive but longest lasting option would be where practical to remove the existing carriageway construction and excavate the peat soil down to a suitable load bearing sub-grade. This option has proved prohibitively expensive and due to the amount of works and excavation depths required would lead to long road closures to undertake the work. It is anticipated that alternative innovative solutions for stabilising the peat layer will prove more cost effective in the medium term. The example costed in this Report assumes 400-450mm asphalt construction and 1m of peat soil below the carriageway will be removed, although across the fens these depths varies significantly. A suitable general fill would be used as a capping layer and the carriageway re-built above. At many sites it would be possible to reduce the finished road level and so would not need to import and place the full depth of peat, this would also help with slope stability on roads which are currently on banks or causeways with steep verges and drains adjacent.



Treatment A - Full Depth Reconstruction

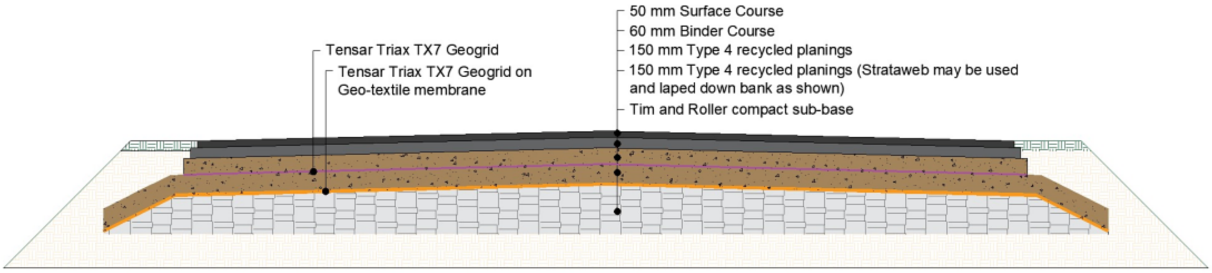
Cost (Example 5000m 2))	Co2e/m^2	Output per shift (Example 5000m^2 duration)	Lifespan (approx.)
£338/m^2 (£1.69mil)	38.1	100m^2 (50 Day)	Average 10-15yrs*

The figures above are based on Cambridgeshire Highways standard estimating tool including 23% optimism bias, including an allowance for Traffic Management and minor vegetation and verge trimming.
*This assumes an interim surface treatment and is based on 5%+ CBR at formation.

6.2 Treatment B: Deep double geogrid through ex-situ processing

This method has been used to mixed but generally positive results on the previous DDR programme in 2018/19. The road is planed and excavated down to circa 400-450mm and disposed of or recycled and re-used. The new construction is built up with two geogrids and Type 4 material to create a stronger foundation layer prior to binder and surface course. The learning from the DDR programme is to use triaxial grids rather than biaxial grids or to consider emerging stronger grid technology such as Tensar Interax. In addition, where steep embankments and verges are an issue Geosynthetics Strataweb has been used to overlap through the formation level and down the verge to increase the slope stability. This is recommended where the site permits.

The guidance document suggests that a design life of 10 years may be achieved although some defects may appear before this, and so crack sealing and surface dressing should be used to extend the life of the pavement further.



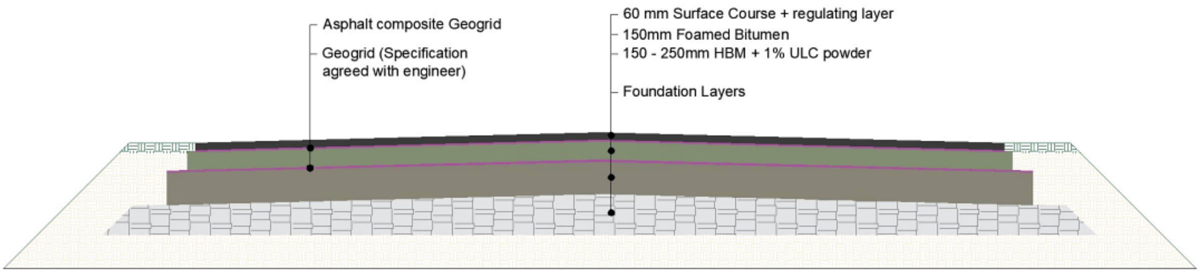
Treatment B - 'Drought Damaged' double grid method

Cost (Example 5000m²)	Co2e/m²	Output per shift (Example 5000m² duration)	Lifespan (approx)
£182/m² (£900k)	19.2	500m² (10 Day)	Average 8-10yrs inc crack seal & surf dressing

The figures above are based on Cambridgeshire Highways standard estimating tool including 23% optimism bias, an allowance for Traffic Management and minor vegetation and verge trimming.
*This assumes based on 5%+ CBR at formation.

6.3 Treatment C: Deep in-situ recycling with geogrid

This method has been used by CCC and other Local Authorities with soil affect roads (Norfolk, Essex and East Riding) with generally good results – Case Studies can be found in the Appendices. A geogrid can be incorporated below the recycled layer during in-situ recycling, all in a single pass. This saves time, money and carbon. When placed deeper in the road layers, geogrid is shown to mitigate the risk of cracking and deformation propagating to the road surface. The trial undertaken by CCC at Cants Drove used cement as the primary binder, but this Report proposes the use of foamed bitumen to provide enhanced flexibility, however savings of up to 50% could be achieved by following the previous cement-based approach. This geogrid approach is five times quicker than the double geogrid treatment thereby minimising the impact on residents, businesses, and the travelling public with lower costs associated with a shortened programme. Although foamed bitumen requires a small amount of cement, trials are underway to use an alternative ‘ultra-low’ carbon binder made from calcined clay.



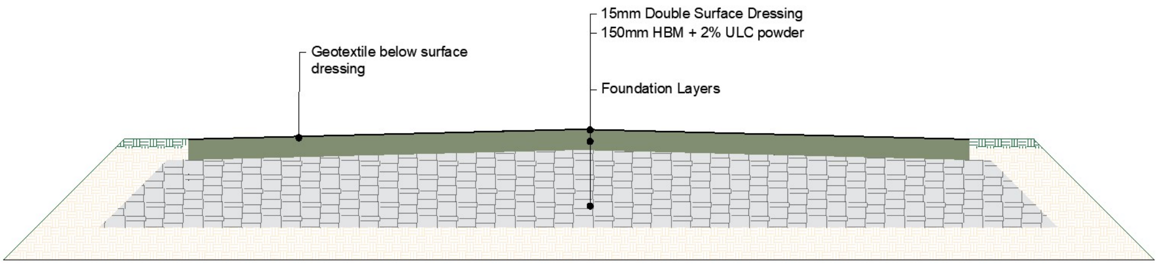
Treatment C - Deep In-situ recycling with Geogrid

Cost (Example 5000m^2)	Co2e/m^2	Output per shift (Example 5000m^2 duration)	Lifespan (approx.)
£150/m^2 (£750k)	16.1	2,500m^2 (2 Day)	Average 8-10 yrs inc crack seal & surf dressing

The figures above are based on Cambridgeshire Highways standard estimating tool including 23% optimism bias, an allowance for Traffic Management and minor vegetation and verge trimming. (example figures do not include mobilisation etc)

6.4 Treatment D: Shallow regen in-situ recycling

Suitable for lightly trafficked roads and Fenland Droves, 'Regen' was developed in Cambridgeshire and has been used with positive results for approaching ten years. This approach stabilises the road structure and restores ride quality by pulverising and recycling 150mm of the existing road materials in-place. It includes a low level of cement addition and is sealed from the weather with skid resistance restored by applying two layers of surface dressing. This option does not incorporate a Geogrid below the recycled layer although, again, following successful results on previous CCC trial sites, a geotextile layer is proposed below the double surface dressing to reduce reflective cracking and extend the life of the treatment. In future treatment locations, as referenced above, the use of the 'ultra-low' carbon calcined clay cement alternative is proposed (reflected in the carbon data).



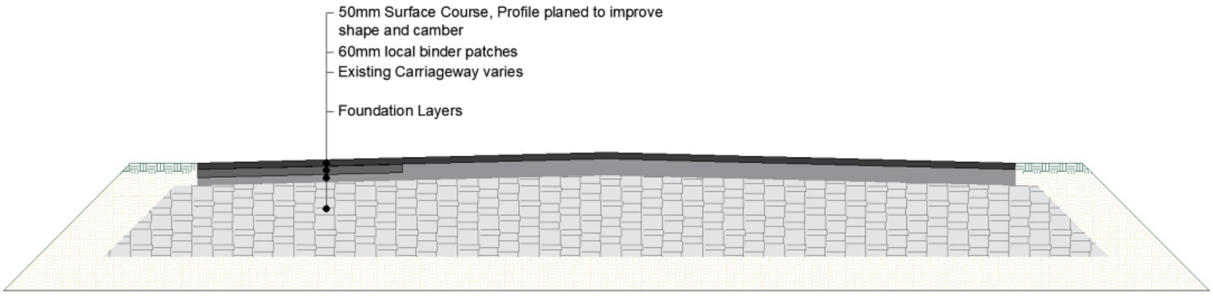
Treatment D - Regen

Cost (Example 5000m^2)	Co2e/m^2	Output per shift (Example 5000m^2 duration)	Lifespan (approx.)
£46/m^2 (£230k)	5.0	2,500m^2 (2 Day)	Average 5yrs+ inc crack seal & surf dressing

The figures above are based on Cambridgeshire Highways standard estimating tool including 23% optimism bias, an allowance for Traffic Management and minor vegetation and verge trimming. (example figures do not include mobilisation etc)

6.5 Treatment E: Resurfacing with profile plane and binder patch repairs.

This option is used extensively on the majority of the network and outside of the soil affected roads sites. Binder patches are used to remedy localised failure areas and the shape of the road can be improved by profile planing and inlaying. This option would prove cheapest and so could cover the widest area however it is only included for comparison as it does not resolve the deep-seated foundation issues associated with the roads covered by this Report. At best it would give 1-2 years before extensive cracking and undulations reappear and there is widespread evidence across the county to support that estimate.



Treatment E - Plane and inlay with Binder patches

Cost (Example 5000m^2)	Co2e/m^2	Output per shift (Example 5000m^2 duration)	Lifespan (approx)
£40/m^2 (£200k)	15.2	1,700m^2 (3 Day)	Average 1-2 yrs

The figures above are based on Cambridgeshire Highways standard estimating tool including 23% optimism bias, an allowance for Traffic Management and minor vegetation and verge trimming. (example figures do not include mobilisation etc)

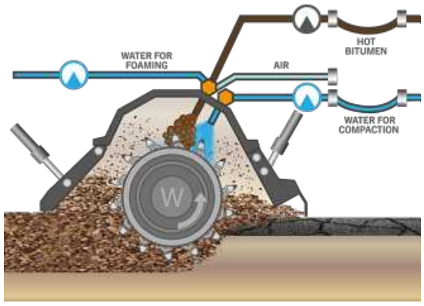
7.0 Emerging Technology and Innovation

The treatment options provided in this Report are some of the current best practice options available which have been used within Cambridgeshire previously.

Emerging technology and innovative products are being trialled in Cambridgeshire and in other Local Authorities dealing with Soil Affected Roads. CCC have technical representation on a joint working group with other Local Authorities to share best practice. As these schemes progress a collaborative approach will be used to assess whether these new solutions are suitable. Some of the options being considered include:

- **Tensar Interax** – Biaxial grids have not performed as well as Triaxial grids at sites which have previously had geogrids incorporated. The type of deformation seen in soil affected roads is not linear and often is a combination of tree roots, edge failures and seasonal heave due to water in the sub-grade. Tensar have recently brought to market their new Interax grid which should improve on the performance of a Triaxial grid by using varying 'openings' to create better interlock and to spread the acting load more efficiently though the grid. Interax could also be installed using the rapid 'one-pass' In-Situ Recycling technique.

- **In-Situ Recycling with foamed bitumen** – Although cement bound layers have proven to be a cost effective and durable treatment, SPL continuously evaluate new materials, techniques and equipment to support the future needs of clients. As the UK has become more familiar with 'foam mix' products, the use of a foamed bitumen when In-situ Recycling has gained wider acceptance. Subject to pre-testing, its use in a variety of highway applications has shown it to be cost effective and comparable in performance to conventional asphalt, offering further carbon savings against alternatives. In the future, even greater carbon savings can be derived from using cement alternatives in the mix, such as Hoffman Green's calcined clay product as detailed below.



- **In-Situ Recycling with an 'ultra-low' carbon binder** – In collaboration with Norfolk County Council (NCC) and Hoffman Green, SPL have undertaken the first highway project in UK to use their H-EVA calcined clay product as an alternative to Portland Cement. Completed in May 2023, saving 55% CO2, the client has already deemed the trial a success based on ongoing monitoring and testing. Confidence and their carbon aspirations has already given rise to NCC supporting its wider adoption in 2024.

- **Lightweight Aggregate (AI)** - Aggregate Industries continue to investigate and trial lightweight aggregate to reduce the carbon intensity of paving processes and to provide a solution where, as seen within the soil affected roads package, carriageway overlay over many years has led to a significant depth and load imposed by the asphalt. This load acts on the formation level of the road exacerbating the effect of poor sub-grade conditions. In some situations, it is not possible to reduce the existing road level and so lightweight aggregate may be an option to reduce the overall loading of the carriageway.

- **Low Temperature and Low Carbon asphalt (AI)** – Warm Mix asphalt with a lower production temperature than conventional asphalt has been specified across Cambridgeshire wherever possible for a number of years. To decarbonise carriageway resurfacing and reduce energy intensity new asphalt mixes are being trialled to determine their performance against conventional mixes.

- **Formation Stabilisation** – Groundwork company ALLU have been testing and undertaking stabilisation of poor subgrades in Soham, Cambridgeshire (although not for CCC) with positive results. The method is to expose and mix the formation layer injecting or mixing in wet or dry binder to solidify the sub-grade. Whilst this method could be trailed it currently costs around £40/m3 so would be an additional approximately £240 per linear 6m wide carriageway to stabilise 1m of peat.

Cambridgeshire Highways

SPL Stabilised Pavements Ltd

MILESTONE INFRASTRUCTURE
A part of MGroupServices

8.0 Summary of Treatment Options

The suitability of each site for respective treatments has been discussed within the project team and where suitable is included below. Cost (Inc 23% optimism bias), carbon and duration of anticipated road closures are given for Comparison

CCC Top 25 Soil Affected Roads

							Profile Plane and inlay with patch repair			Regen			Deep In-situ (300mm) with Geogrid			Double Grid (Tensar Triax or similar) Reconstruction			Full Reconstruction including removal of soil sub-grade (Assumed 1m)		
Priority Order		Original No.		Road Name	Treatment Area (m2)	% Very Poor	Cost	Carbon (Tonnes) 15.2kg/m2	Duration (Wks)	Cost	Carbon (Tonnes) 5.0kg/m2	Duration (Wks)	Cost	Carbon (Tonnes) 16.1kg/m2	Duration (Wks)	Cost	Carbon (Tonnes) 19/2kg/m2	Duration (Wks)	Cost	Carbon (Tonnes) 38.1kg/m2	Duration (Wks)
1		6	B1050	Shelfords Road, Willingham	6,000								£900,000	96.6	5	£1,092,000	115	7	£2,028,000	229	14
2		16	B1096	Benwick Rd Ramsey forty foot	13,433	40							£2,014,950	216	3	£2,444,806	258	6	£4,540,354	512	18
3		4	C134	Branch (Padnal) Bank Q. Adelaide	12,035	24							£1,805,250	194	3	£2,190,370	231	6	£4,067,830	459	16
4		20	B1411	Straight Furlong, Pymoor	10,534	18				£484,564	53	2	£1,580,100	170	3	£1,917,188	202	5	£3,560,492	401	14
5		25	B1100	Padgetts Road, Christchurch	9,330	13							£1,399,500	150	2	£1,698,060	179	4	£3,153,540	355	12
6		18	B1096	Ramsey Road, Benwick	3,342	13							£501,300	54	2	£608,244	64	2	£1,129,596	127	5
7		19	B1104	Prickwillow Road, Isleham	37,311	12							£5,596,650	601	4	£6,790,602	716	15	£12,611,118	1422	36
8	Highest	14	B1099	Upwell Road, March	17,391	5							£2,608,650	280	3	£3,165,162	334	8	£5,878,158	663	23
9		21	B1098	New Road, Chatteris	4,180	5							£627,000	67	2	£760,760	80	2	£1,412,840	159	7
10		9	B1040	Herne Road, Ramsey St M	11,826	4							£1,773,900	190	4	£2,152,332	227	6	£3,997,188	451	16
11		22	B1050	Chatteris Road, Somersham	21,990	4							£3,298,500	354	4	£4,002,180	422	9	£7,432,620	838	29
12		5	B1093	Benwick Road, Whittlesey	35,663	3							£5,349,450	574	4	£6,490,666	685	14	£12,054,094	1359	34
13		2	A1123	Hill Row Causeway	12,985	3							£1,947,750	209	3	£2,363,270	249	6	£4,388,930	495	17
14		17	B660	Long Drove, Holme	6,941	3							£1,041,150	112	2	£1,263,262	133	3	£2,346,058	264	11
15		8	B1381	Chain Causeway, Sutton	19,613	1							£2,941,950	316	4	£3,569,566	377	9	£6,629,194	747	26
16		11	B1040	St Marys Road, Ramsey	10,859								£1,628,850	175	3	£1,976,338	208	5	£3,670,342	414	14
17	Medium	10	B1042	Lower Road, Croydon	11,849								£1,777,350	191	3	£2,156,518	228	6	£4,004,962	451	16
18		13	B660	Holme Road, Ramsey St M	16,968								£2,545,200	273	3	£3,088,176	326	8	£5,735,184	646	23
19		24	B1094	Upwell Road, Christchurch	5,606								£840,900	90	2	£1,020,292	108	3	£1,894,828	214	9
20		1	A605	Wisbech Rd, Coates	10,015								£1,502,250	161							
21		3	A603	Cambridge Road, Wimpole	12,476		£499,040	190	1				£1,871,400	201							
22	Lower	7	B1049	Twenty Pence Road, Wilburton	3,113		£124,520	47	1												
23		15	B1046	High Street, Longstowe	8,271		£330,840	126	1												
24		23	B1040	Pidley Sheep Lane, Pidley	800		£32,000	12	1												

Duration factor x1.2 added to Double grid and Reconstruction for sites under 10wks to reflect mobilisation and efficiencies of longer treatments. Shelfords rd was found to have very thick asphalt layers with additional duration.

9.0 Conclusion

The survey data collected during this project found that 14 of the sites assessed fall well below the International Roughness Index guidance with sections of Very Poor Condition road. These sites are highlighted pink in the '% very poor' column of the table. All sites have a poor road surface with undulations, cracking and differential settlement present.

It is noted that the sites continue to deteriorate day by day and it is unlikely that patching and repair will halt this deterioration through Winter 2023/24. In the short term, network management processes are in place and the list and base plans can be used as a hierarchy of sites to be monitored.

The Gaist and R3 surveys are hosted on web-based platforms and will be a significant data set to use going forward to assess and monitor sites. These will be passed to CCC client officers to hold. The Video surveys will also be provided for future reference.

Recommendations

- It is recommended that this Report is used to target funding as it becomes available. The table gives a hierarchy based on condition of the roads currently. CCC will also need to consider additional factors around village/town connectivity and wider network and asset performance to determine the best approach.

- The HIRAM tool was used to determine the 25 most used sites but it is recommended that R3 surveys are commissioned to survey and categorise the other 100+ sites identified to ensure there are no other sites or sections of road in a worse condition than these and to provide a baseline data set for future monitoring.

- It is recommended that a review of the DDR and similar recent reconstruction projects is undertaken to provide a comprehensive review and assessment on how well they are performing and whether there are any trends or site conditions which affect the suitability of each treatment option.

Appendix 1 – Site Plans

KEY:

No R3 Survey data available. Treatment areas determined from Gaist pavement condition survey and visual inspection from video footage. .

Poor Condition
8343m²

Very Poor Condition
1672m²

Total treatment area: 10015m²

Rev	Date	Description	Drn	Chkd	App
-	-	-	-	-	-

Revisions

Client

Cambridgeshire **Highways**

Cambridgeshire County Council

Drawing Originator

MILESTONE

A part of MGroupServices

Drawing Status

PRELIMINARY DESIGN

Project Name

SOIL AFFECTED ROADS

Title

WISBECH ROAD - COATES AREA OF INTEREST 001

Sheet Size	Scale	Drawn by	Checked by	Approved by
A1	1:5000	SC	NT	
		Drawn Date	Checked Date	Approved Date
		19/12/2023	04/01/2024	

Drawing Number	Status	Rev

File Plotted: 04 January 2024 ... Wisbech Rd_Coates.dwg Printed by: Thompson, Neil

NOTES:

KEY:

International Roughness Index (IRI) 7+ is categorised as poor to very poor requiring intervention.

IRI 7-15
12641m²

IRI15-30
344m²

IRI 30+ Extremely Poor Condition
0m²

Total treatment area: 12985m²

Rev	Date	Description	Drn	Chkd	App
-	-	-	-	-	-

Revisions

Client

Cambridgeshire Highways

Drawing Originator

MILESTONE

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Drawing Status

PRELIMINARY DESIGN

Project Name

SOIL AFFECTED ROADS

Title

HILL ROW CAUSEWAY AREA OF INTEREST 002

Sheet Size	Scale	Drawn by	Checked by	Approved by
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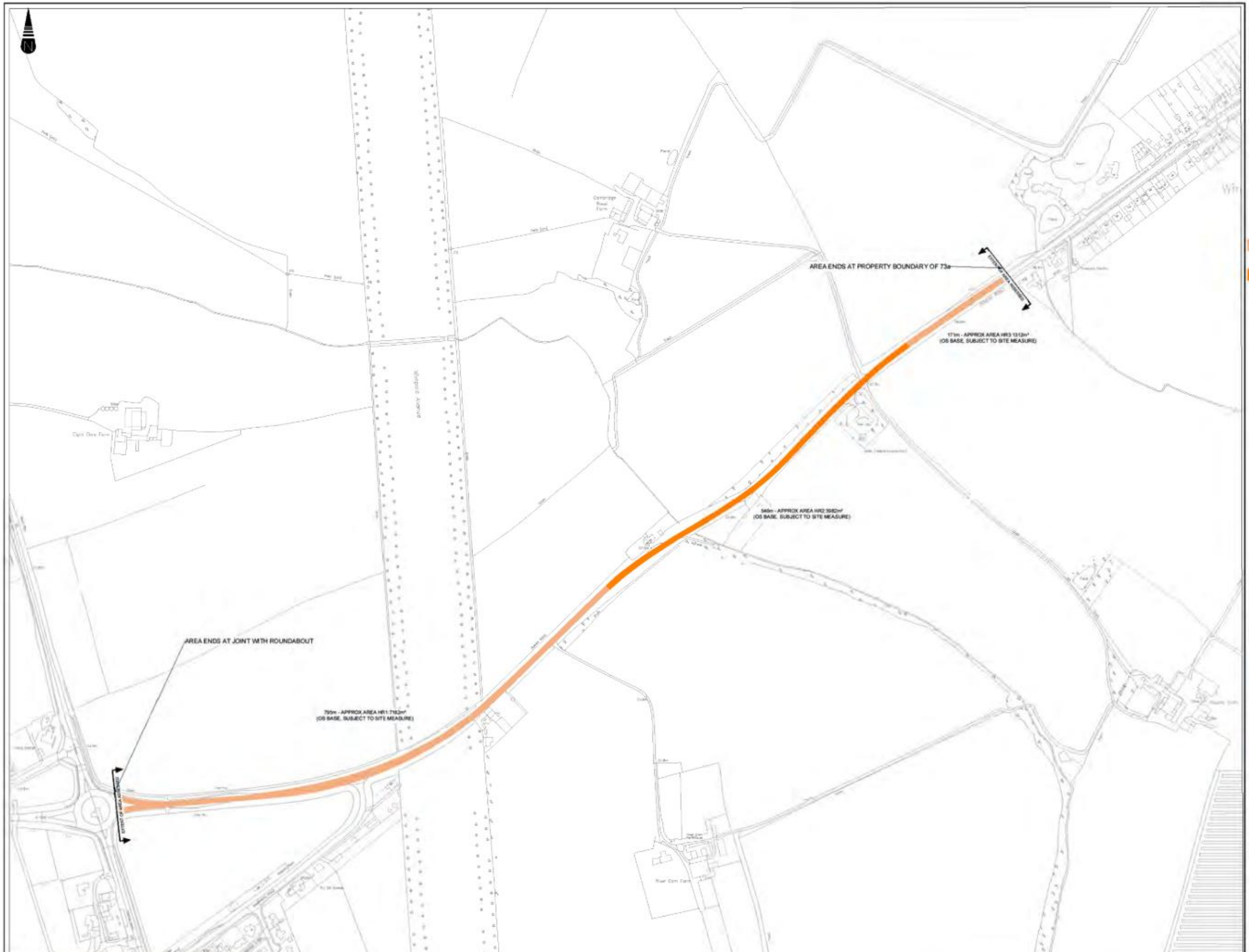
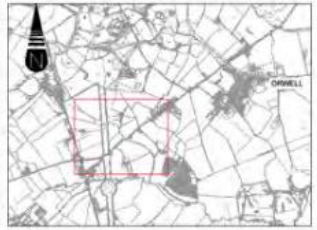
Drawing Number	Status	Rev





KEY:

No R3 Survey data available. Treatment areas determined from Gaist pavement condition survey and visual inspection from video footage. .

Poor Condition
8494m²

Very Poor Condition
3982m²

Total treatment area: 12476m²

Rev	Date	Description	Drn	Chkd	App
-	-	-	-	-	-

Revisions

Client

Cambridgeshire Highways

Cambridgeshire County Council

Drawing Originator

MILESTONE

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Drawing Status

PRELIMINARY DESIGN

Project Name

SOIL AFFECTED ROADS

Title

CAMBRIDGE ROAD WIMPOLE AREA OF INTEREST 003

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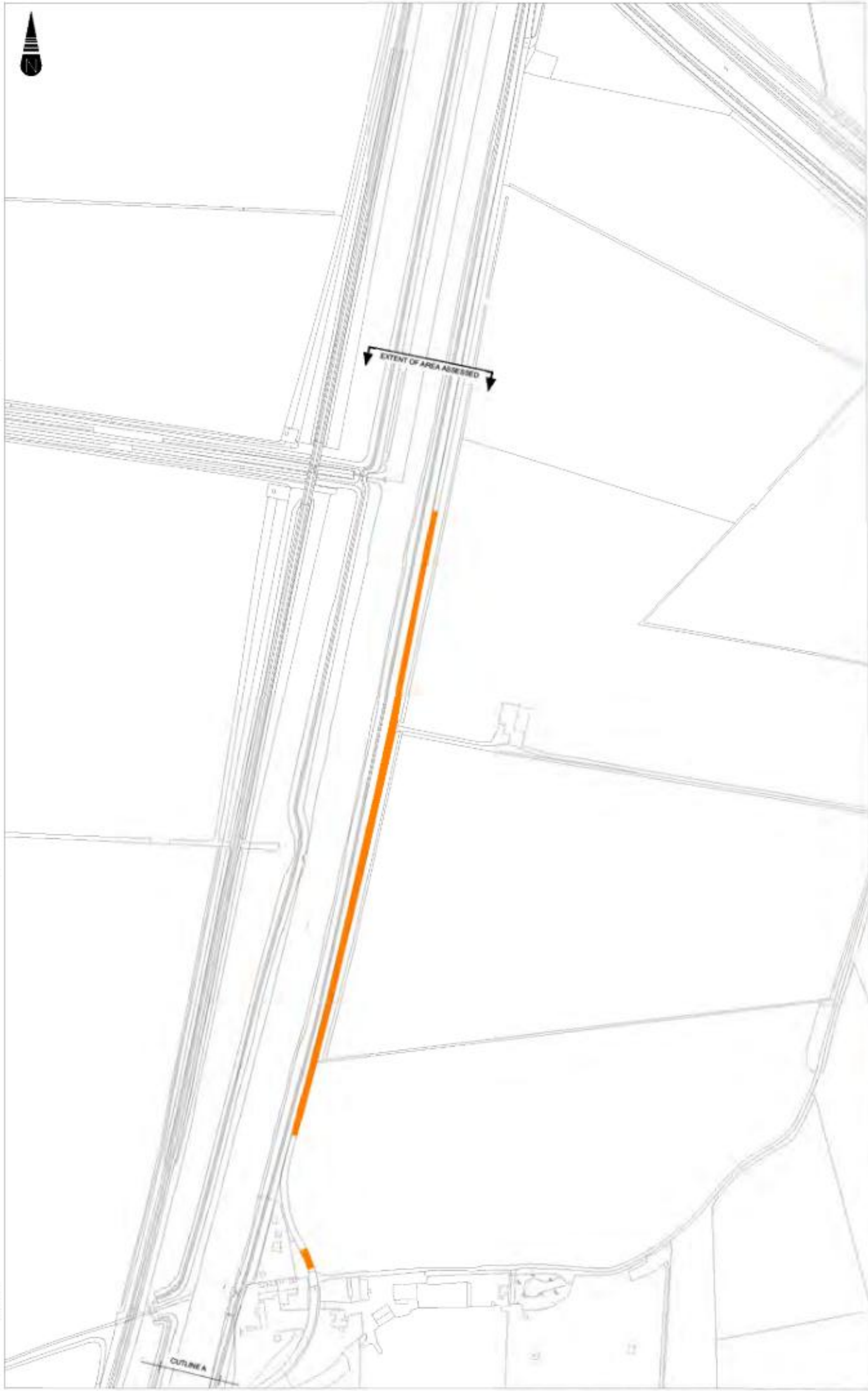
		Drawn Date	Checked Date	Approved Date
		15/12/2023	04/01/2024	

Drawing Number	Status	Rev



KEY:

International Roughness Index (IRI) 7+ is categorised as poor to very poor requiring intervention.

IRI 7-15	9193m²
IRI15-30	2842m²
IRI 30+ Extremely Poor Condition	0m²

Total treatment area: 12035m²

Rev	Date	Description	Drn	Chkd	App
-	-	-	-	-	-

Revisions

Client

Cambridgeshire Highways

Cambridgeshire County Council

Drawing Originator

MILESTONE

A part of MGroupServices

Drawing Status

PRELIMINARY DESIGN

Project Name

SOIL AFFECTED ROADS

Title

PADNAL BANK QUEEN ADELAIDE AREA OF INTEREST 004

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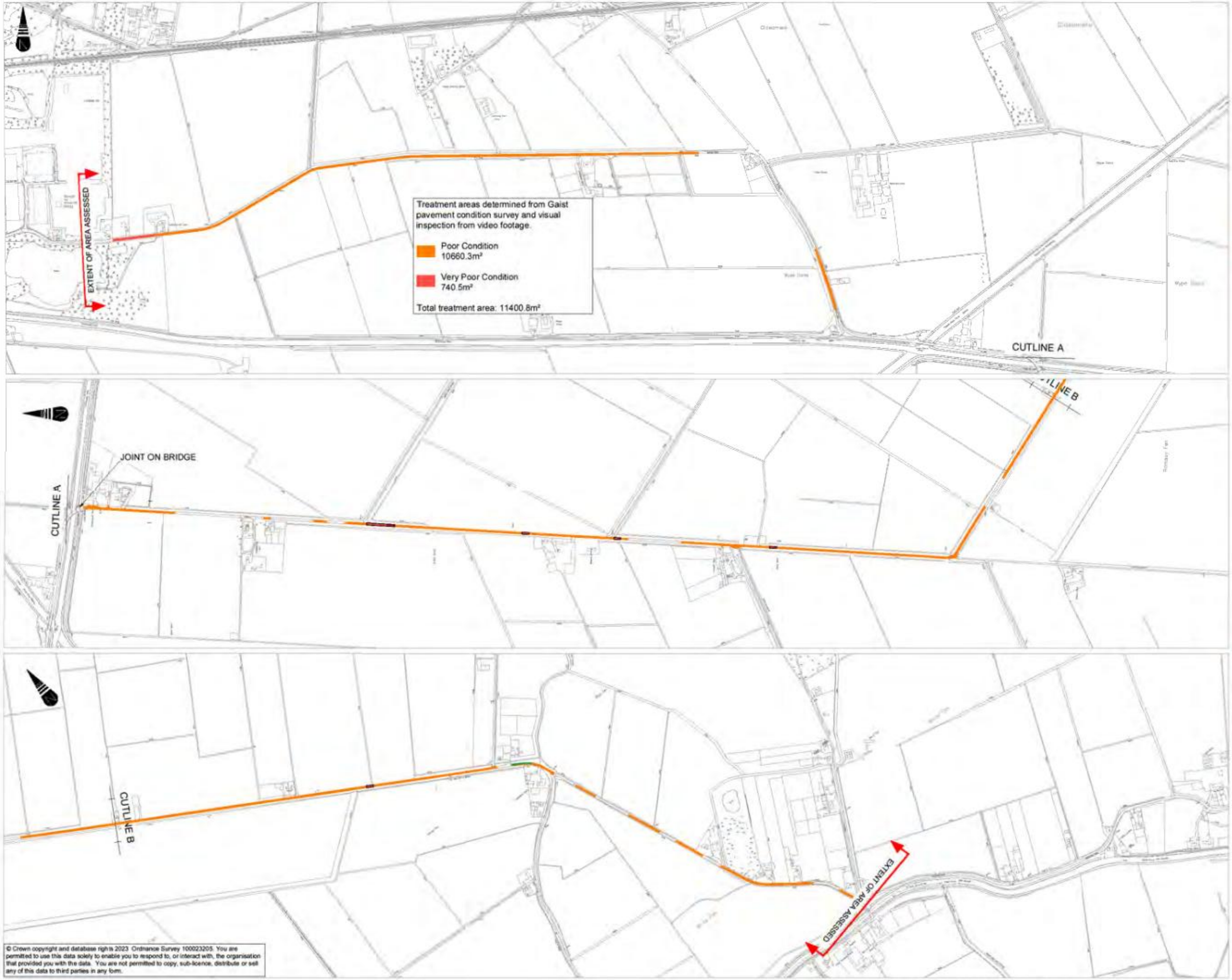
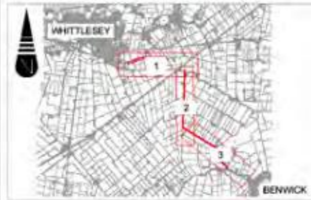
		Drawn Date	Checked Date	Approved Date
		01/12/2023	04/01/2024	

Drawing Number	Status	Rev





KEY:

International Roughness Index (IRI) 7+ is categorised as poor to very poor requiring intervention:

- IRI 7-15
23,326.9m²
- IRI 15-30
813.2m²
- IRI 30+ Extremely Poor Condition
120.9m²

Total treatment area: 24,261m²

Rev	Date	Description	Drn	Chkd	App
-	-	-	-	-	-

Revisions

Client

Cambridgeshire Highways

Drawing Originator

MILESTONE

A part of MGroupServices

Drawing Status

PRELIMINARY DESIGN

Project Name

SOIL AFFECTED ROADS

Title

BENWICK ROAD WHITTLESEY
AREA OF INTEREST 005

Sheet Size	Scale	Drawn by	Checked by	Approved by
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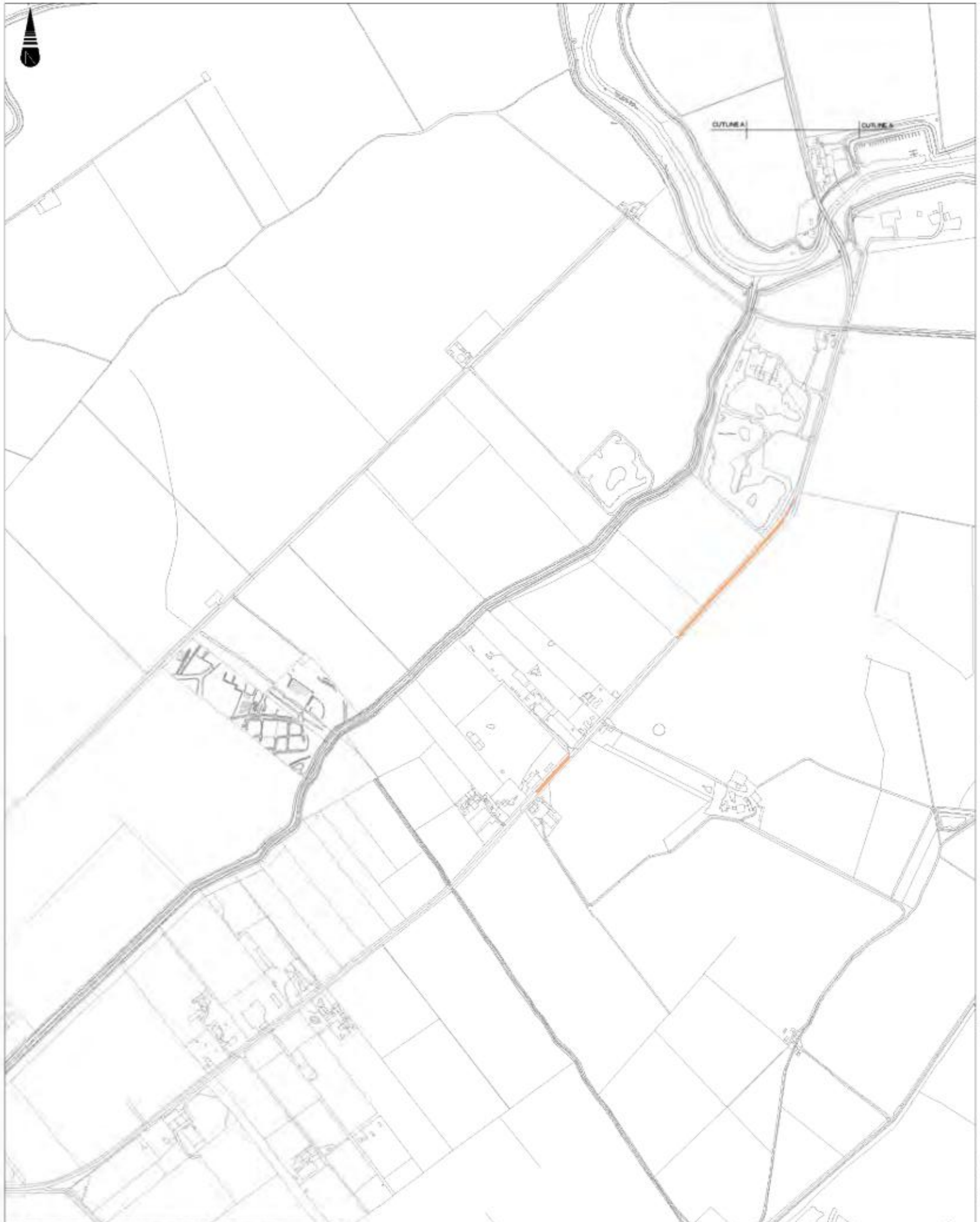
		Drawn Date	Checked Date	Approved Date
		02/01/2024	04/01/2024	

Drawing Number	Status	Rev



KEY:

No R3 Survey data available. Treatment areas determined from Gaist pavement condition survey and visual inspection from video footage. .

Poor Condition
3113m²

Very Poor Condition
0m²

Total treatment area: 3113m²

Rev	Date	Description	Drn	Chkd	App
-	-	-	-	-	-

Revisions

Client

Cambridgeshire Highways

Drawing Originator

MILESTONE

A part of MGroupServices

Drawing Status

PRELIMINARY DESIGN

Project Name

SOIL AFFECTED ROADS

Title

TWENTY PENCE - WILBURTON
AREA OF INTEREST 007

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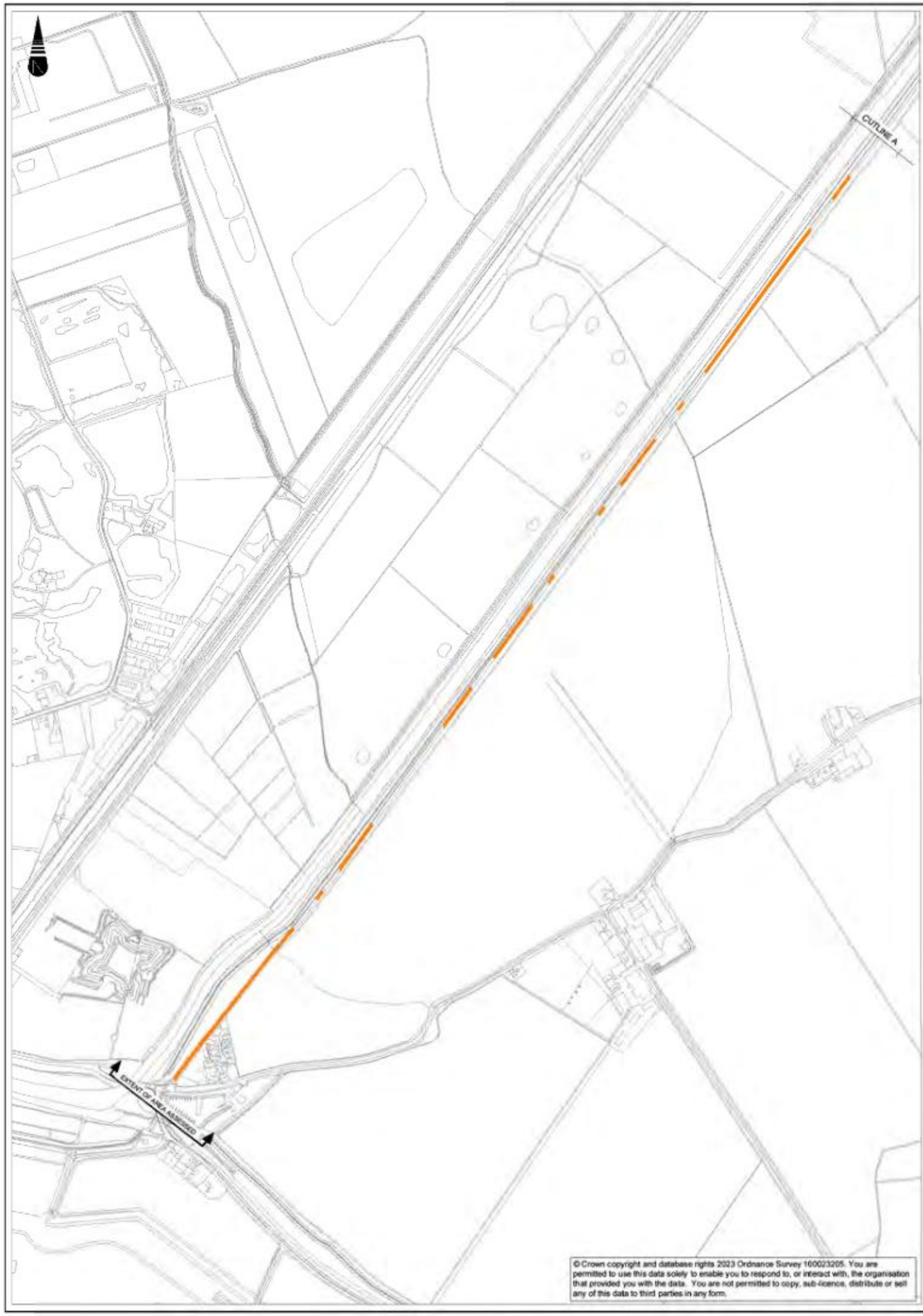
		Drawn Date 14/12/2023	Checked Date 04/01/2024	Approved Date

Drawing Number	Status	Rev

Printed by: Thompson, Neil



KEY:

International Roughness Index (IRI) 7+ is categorised as poor to very poor requiring intervention.

- IRI 7-15 19400m²
- IRI15-30 213m²
- IRI 30+ Extremely Poor Condition 0m²

Total treatment area: 10534m²

Rev	Date	Description	Drn	Chkd	App
-	-	-	-	-	-

Revisions

Client

Cambridgeshire Highways

Drawing Originator

MILESTONE

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Drawing Status

PRELIMINARY DESIGN

Project Name

SOIL AFFECTED ROADS

Title

CHAIN CAUSEWAY - SUTTON AREA OF INTEREST 008

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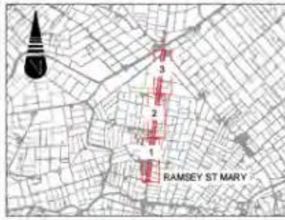
Drawing Number	Status	Rev



KEY:

International Roughness Index (IRI) 7+ is categorised as poor to very poor requiring intervention:

- IRI 7-15 11,324.1m²
- IRI 15-30 501.9m²
- IRI 30+ Extremely Poor Condition 0m²

Total treatment area: 11,826m²

Rev	Date	Description	Drn	Chkd	App
-	-	-	-	-	-

Revisions

Client

Cambridgeshire Highways

Cambridgeshire County Council

Vantage House, Vantage Park, Washingley Road, Huntingdon, PE29 6SR.

Drawing Originator

MILESTONE

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Drawing Status

PRELIMINARY DESIGN

Project Name

SOIL AFFECTED ROADS

Title

HERNE RD - RAMSEY ST MARY AREA OF INTEREST 009

Sheet Size	Scale	Drawn by	Checked by	Approved by
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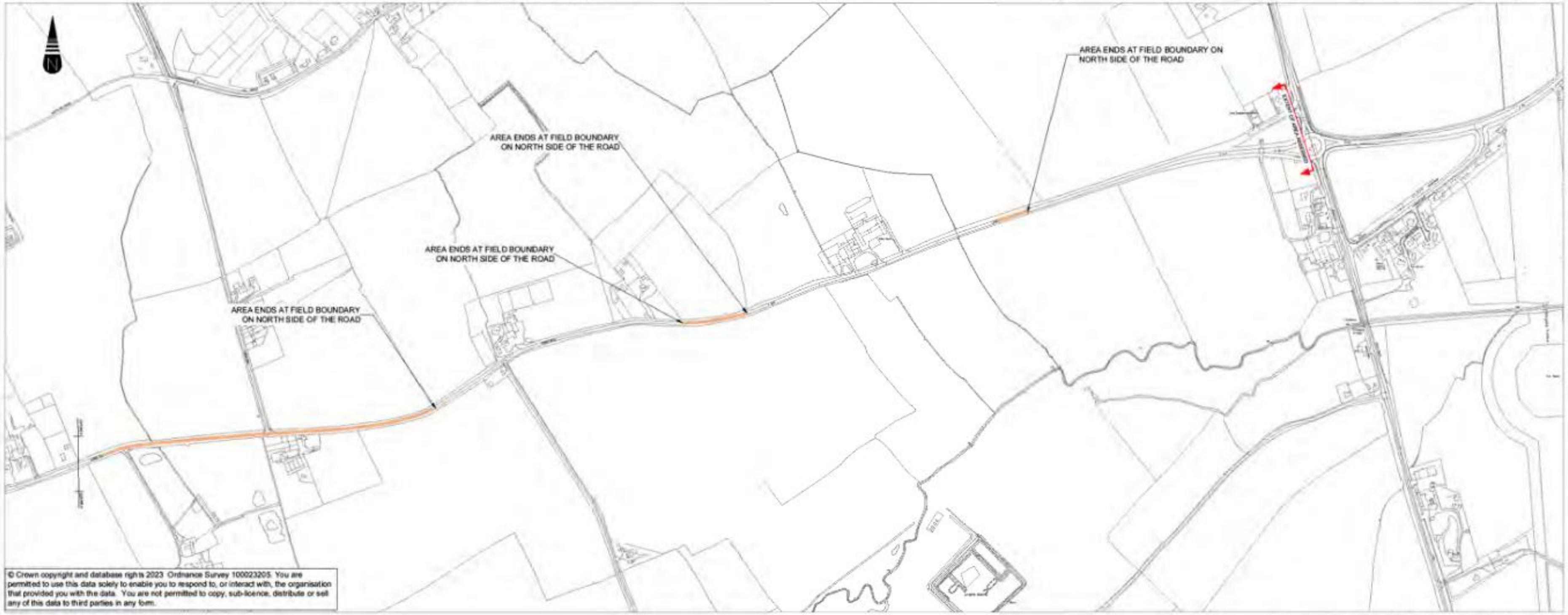
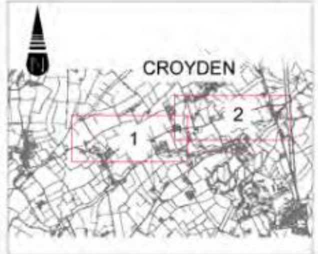
		Drawn Date 03/01/2024	Checked Date 04/01/2024	Approved Date

Drawing Number	Status	Rev





KEY:

No R3 Survey data available. Treatment areas determined from Gaist pavement condition survey and visual inspection from video footage.

Poor Condition
9616m²

Very Poor Condition
2233m²

Total treatment area: 11849m²

Rev	Date	Description	Drn	Chkd	App
-	-	-	-	-	-

Revisions

Client

Cambridgeshire Highways

Drawing Originator

MILESTONE

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Drawing Status

PRELIMINARY DESIGN

Project Name

SOIL AFFECTED ROADS

Title

LOWER RD CROYDEN
AREA OF INTEREST 010

Sheet Size	Scale	Drawn by	Checked by	Approved by
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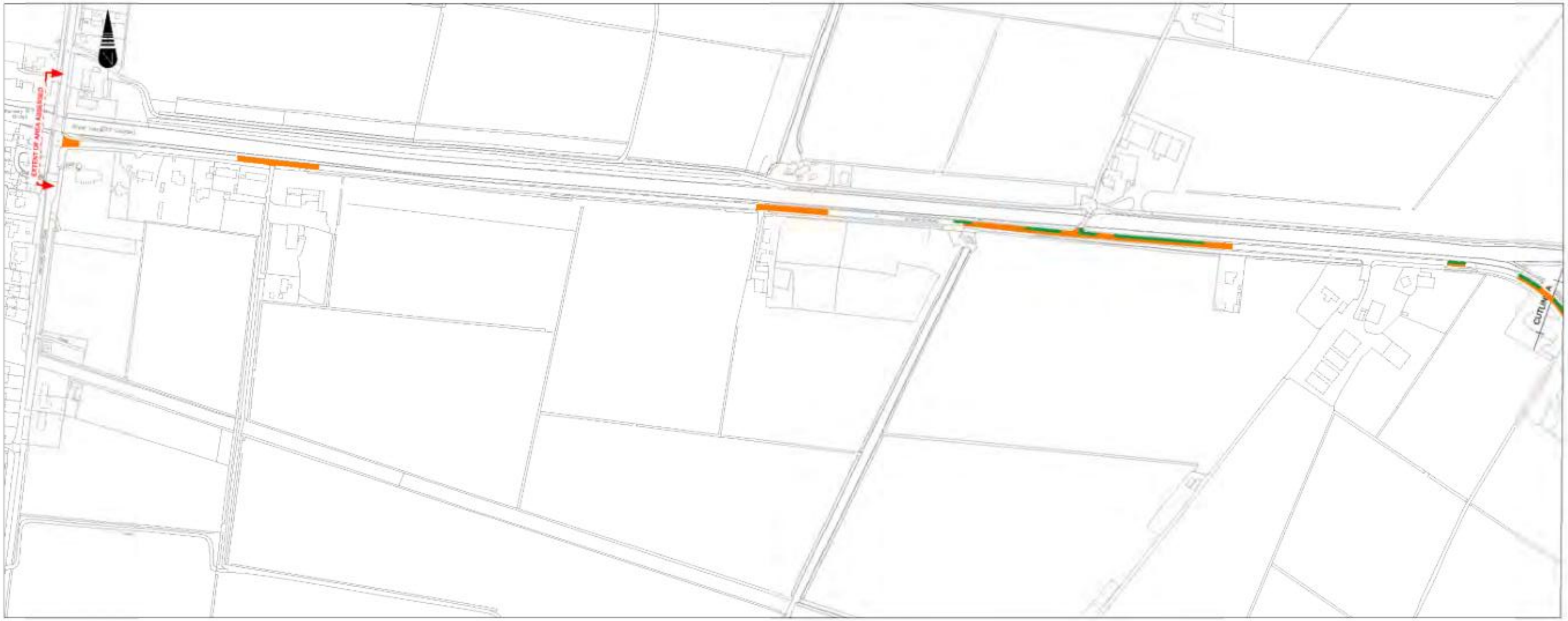
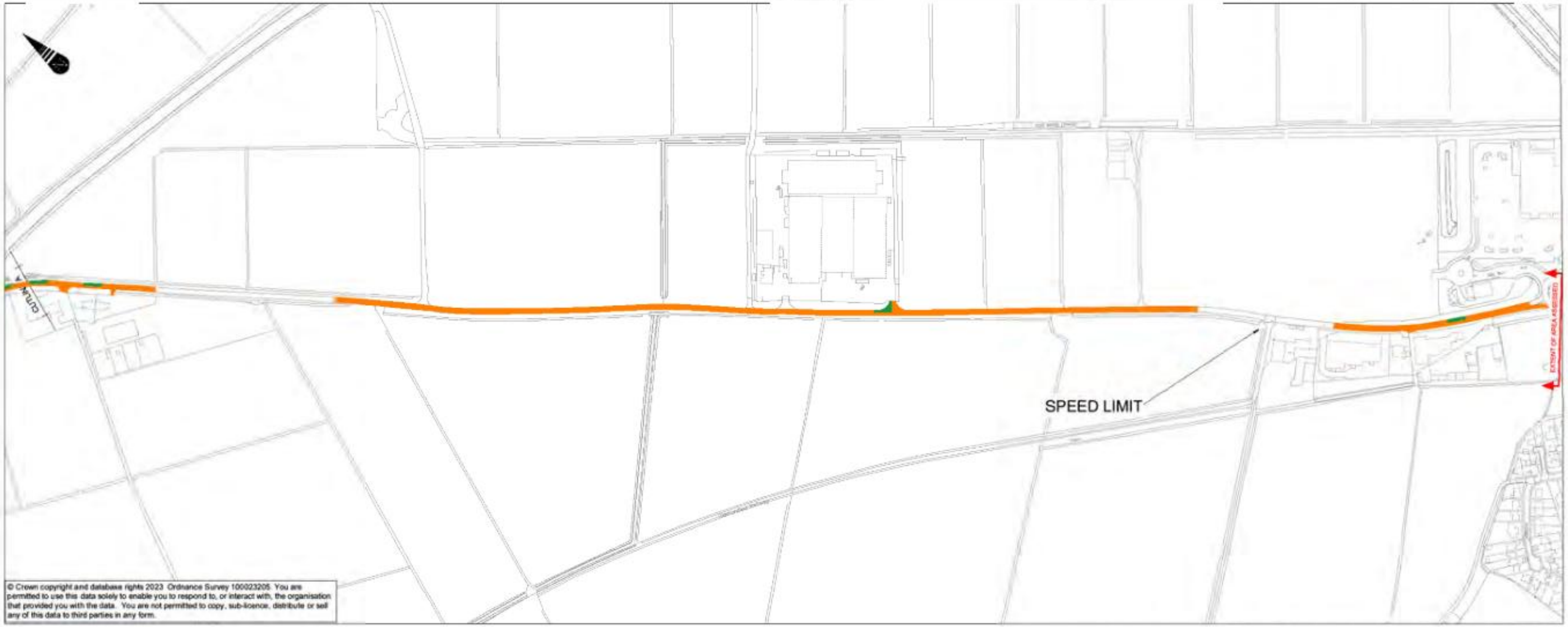
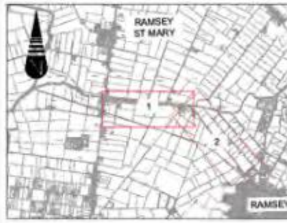
		Drawn Date 13/12/2023	Checked Date 04/01/2024	Approved Date

Drawing Number	Status	Rev

Printed by: Thompson, Neil







KEY:

International Roughness Index (IRI) 7+ is categorised as poor to very poor requiring intervention:

- IRI 7-15 10,858.6m²
- IRI 15-30 0m²
- IRI 30+ Extremely Poor Condition 0m²

Total treatment area: 10,858.6m²

Rev	Date	Description	Drn	Chkd	App
-	-	-	-	-	-

Revisions

Client

Cambridgeshire Highways

Drawing Originator

MILESTONE

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Drawing Status

PRELIMINARY DESIGN

Project Name

SOIL AFFECTED ROADS

Title

ST MARYS RD RAMSEY
AREA OF INTEREST 011

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		Drawn Date	Checked Date	Approved Date
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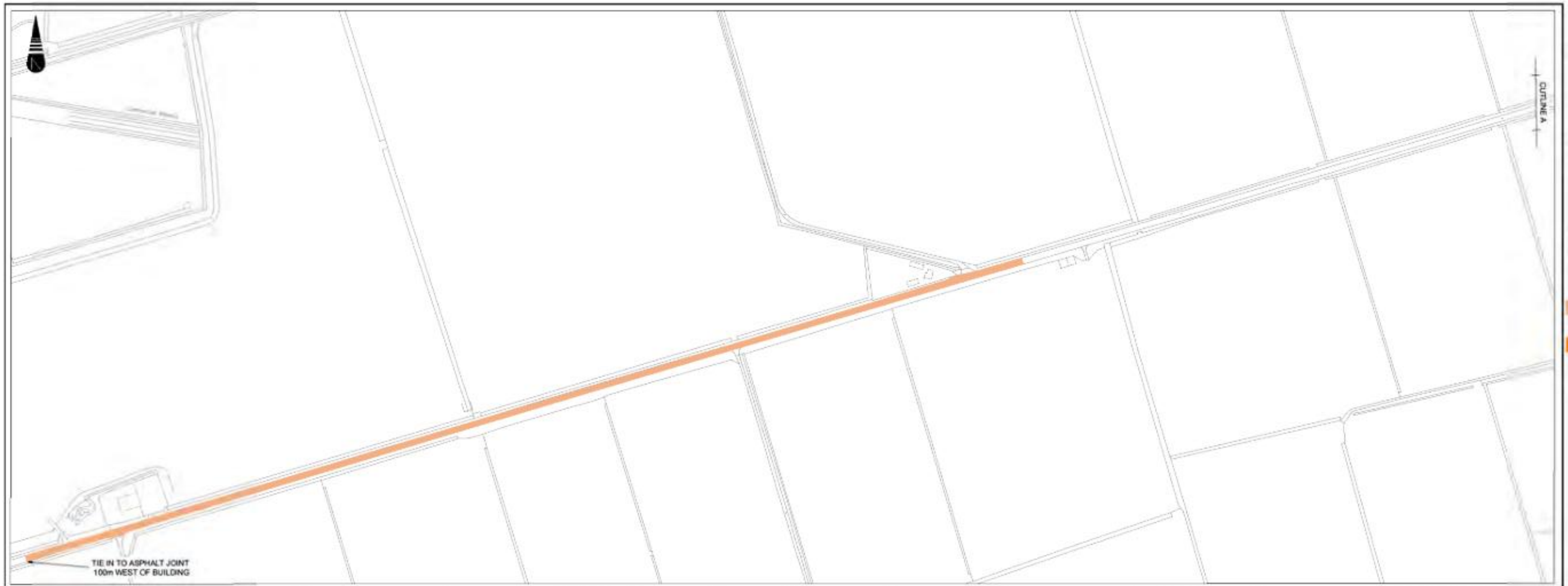
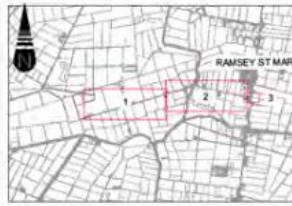
Drawing Number	Status	Rev

File Plotted: 04 January 2024 10:29:16 File location: P:\Highways\Cambridgeshire Highways\Projects\00 Pipeline\Soil Affected Roads\XREF\XREF OS Heme Rd Ramsey St Mary.dwg Printed by: Thompson, Neil





KEY:

No R3 Survey data available. Treatment areas determined from Gaist pavement condition survey and visual inspection from video footage.

Poor Condition
13706m²

Very Poor Condition
3262m²

Total treatment area: 16968m²

Rev	Date	Description	Drn	Chkd	App
-	-	-	-	-	-

Revisions

Client

Cambridgeshire Highways

Drawing Originator

MILESTONE

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Drawing Status

PRELIMINARY DESIGN

Project Name

SOIL AFFECTED ROADS

Title

HOLME RD - RAMSEY ST MARY
AREA OF INTEREST - 013

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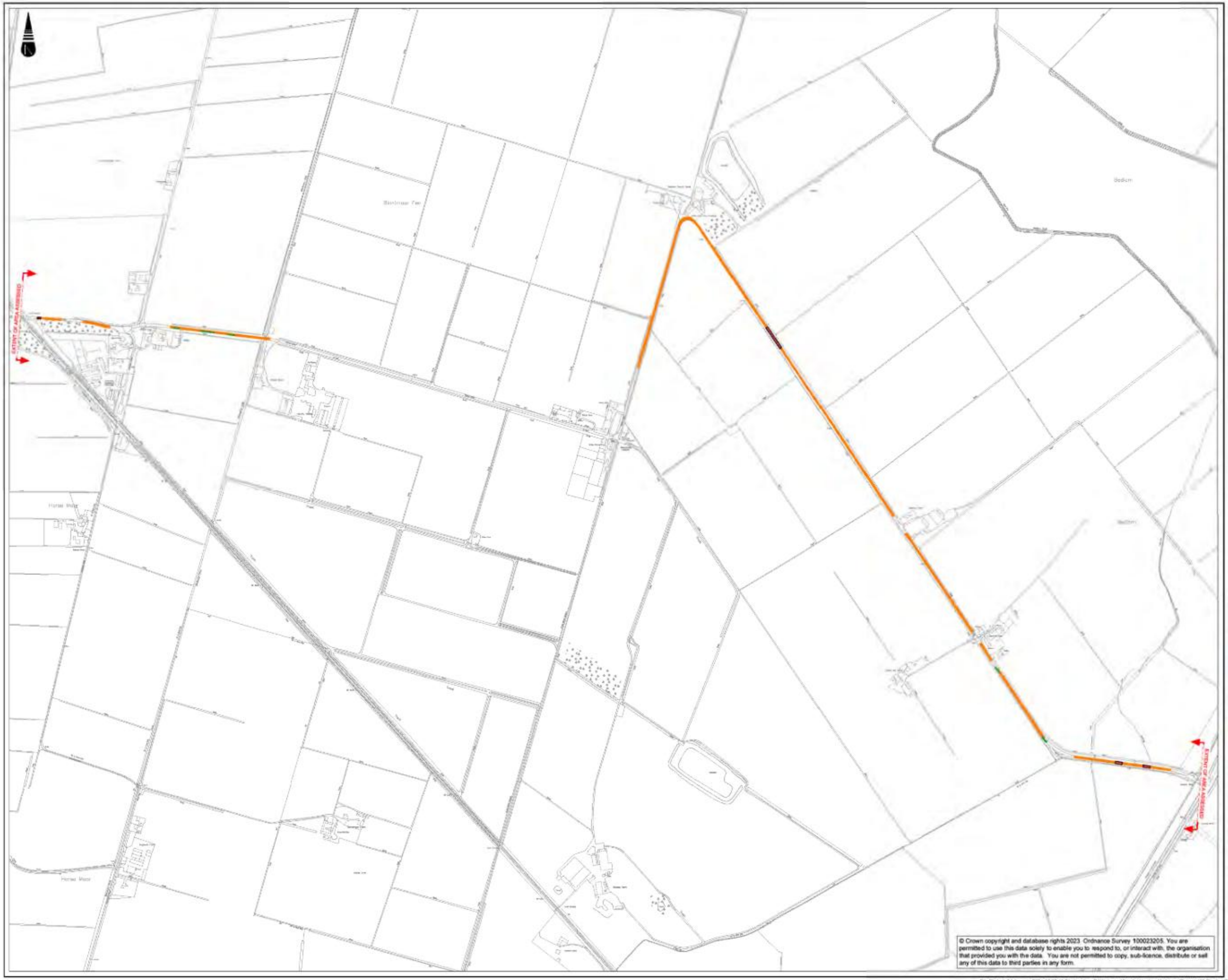
Drawing Number	Status	Rev



KEY:

International Roughness Index (IRI) 7+ is categorised as poor to very poor requiring intervention:

- IRI 7-15 16,640.5m²
- IRI 15-30 695.7m²
- IRI 30+ Extremely Poor Condition 55.2m²

Total treatment area: 17,391.4m²

Rev	Date	Description	Drn	Chkd	App
-	-	-	-	-	-

Revisions

Client

Cambridgeshire Highways

Drawing Originator

MILESTONE

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Drawing Status

PRELIMINARY DESIGN

Project Name

SOIL AFFECTED ROADS

Title

UPWELL RD MARCH
AREA OF INTEREST 014

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		Drawn Date 03/01/2024	Checked Date 04/01/2024	Approved Date

Drawing Number	Status	Rev

KEY:

No R3 Survey data available. Treatment areas determined from Gaist pavement condition survey and visual inspection from video footage. .

Poor Condition
8271m²

Total treatment area: 8271m²

Rev	Date	Description	Drn	Chkd	App
-	-	-	-	-	-

Revisions

Client

Cambridgeshire Highways

Drawing Originator

MILESTONE

A part of MGroupServices

Drawing Status

PRELIMINARY DESIGN

Project Name

SOIL AFFECTED ROADS

Title

HIGH STREET LONGSTOWE AREA OF INTEREST 015

Sheet Size	Scale	Drawn by	Checked by	Approved by
A1	1:2500	SC	NT	
		Drawn Date 18/12/2023	Checked Date 04/01/2024	Approved Date

Drawing Number	Status	Rev

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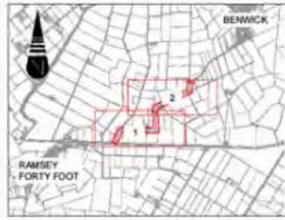

KEY:

International Roughness Index (IRI) 7+ is categorised as poor to very poor requiring intervention:

- IRI 7-15 8,019.7m²
- IRI 15-30 5,238m²
- IRI 30+ Extremely Poor Condition 175.3m²

Total treatment area: 13,433m²

Rev	Date	Description	Drn	Chkd	App
-	-	-	-	-	-

Revisions

Client

Cambridgeshire Highways

Cambridgeshire County Council

Drawing Originator

MILESTONE

A part of MGroupServices

Drawing Status

PRELIMINARY DESIGN

Project Name

SOIL AFFECTED ROADS

Title

BENWICK RD RAMSEY FORTY FOOT AREA OF INTEREST 016

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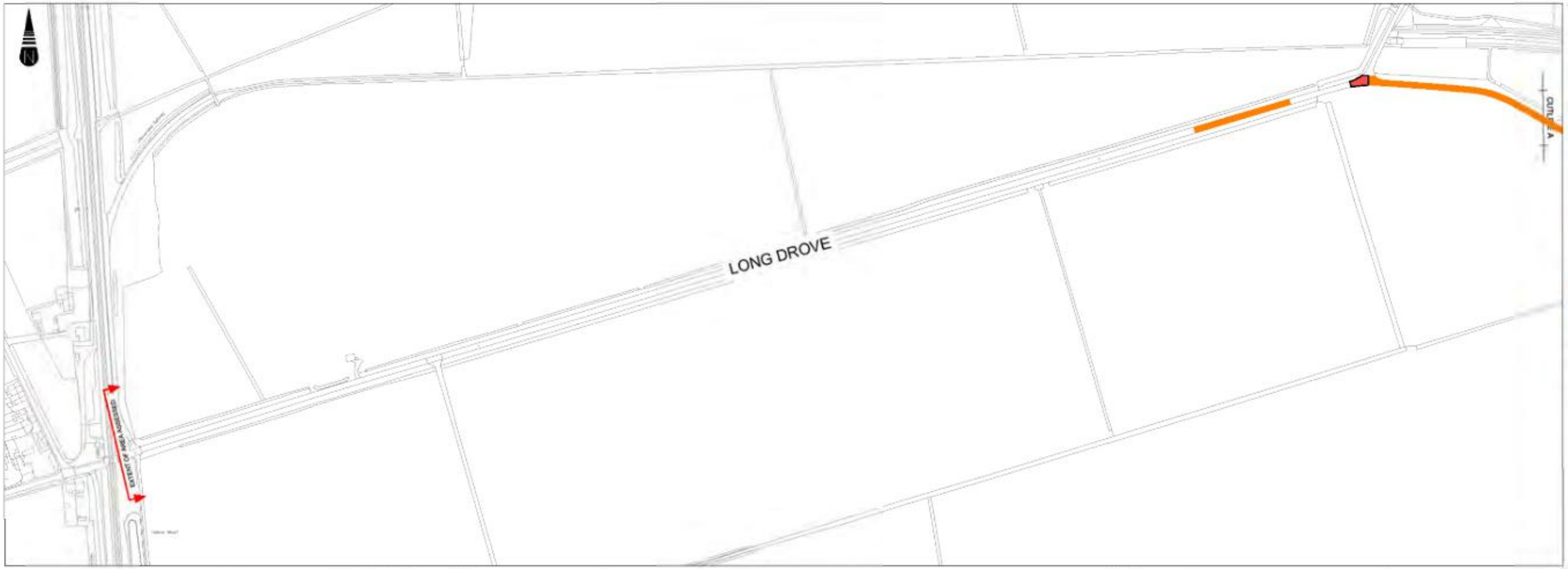
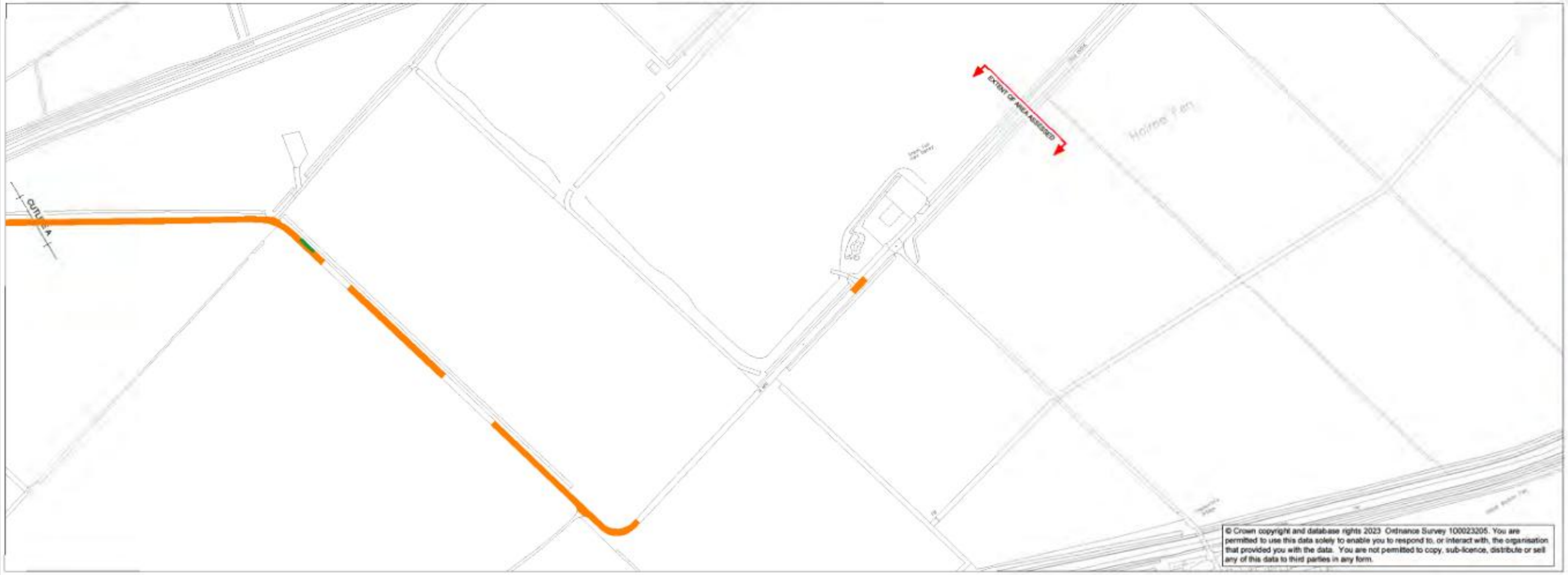
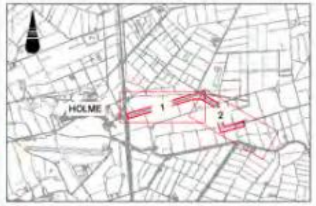
Drawing Number	Status	Rev

Treatment Detail Drawings\RD - 016 Benwick Rd Ramsey Forty Foot.dwg Printed by: Thompson, Neil







KEY:

International Roughness Index (IRI) 7+ is categorised as poor to very poor requiring intervention:

- IRI 7-15
  6758.1m²
- IRI 15-30
  183.1m²
- IRI 30+ Extremely Poor Condition
  0m²

Total treatment area: 6941.2m²

Rev	Date	Description	Drn	Chk'd	App
-	-	-	-	-	-

Revisions

Client

Cambridgeshire Highways

Cambridgeshire County Council

Drawing Originator

MILESTONE

A part of MGroupServices

Drawing Status

PRELIMINARY DESIGN

Project Name

SOIL AFFECTED ROADS

Title

LONG DROVE HOLME
AREA OF INTEREST - 017

Sheet Size	Scale	Drawn by	Checked by	Approved by
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		Drawn Date 03/01/2024	Checked Date 04/01/2024	Approved Date

Drawing Number	Status	Rev

KEY:

International Roughness Index (IRI) 7+ is categorised as poor to very poor requiring intervention:

- IRI 7-15 2913.5m²
- IRI 15-30 428.5m²
- IRI 30+ Extremely Poor Condition 0m²

Total treatment area: 3342m²

Rev	Date	Description	Drn	Chkd	App
-	-	-	-	-	-

Revisions

Client

Cambridgeshire **Highways**

Cambridgeshire County Council

Drawing Originator

MILESTONE

A part of MGroupServices

Drawing Status

PRELIMINARY DESIGN

Project Name

SOIL AFFECTED ROADS

Title

RAMSEY RD BENWICK
AREA OF INTEREST 018

Sheet Size	Scale	Drawn by	Checked by	Approved by
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		Drawn Date: 03/01/2024	Checked Date: 04/01/2024	Approved Date:

Drawing Number	Status	Rev

File Plotted: 04 January 2024 10:53:43 File location: P:\Highways\Cambridgeshire Highways\Projects\00 Pipeline\Soil Affected Roads\DWG\700 Treatment Detail Drawings\RD - 018 Ramsey Rd Benwick.dwg Printed by: Thompson, Neil

KEY:

International Roughness Index (IRI) 7+ is categorised as poor to very poor requiring intervention.

- IRI 7-15 32969m²
- IRI15-30 4342m²
- IRI 30+ Extremely Poor Condition 0m²

Total treatment area: 37311m²

Rev	Date	Description	Drn	Chkd	App
-	-	-	-	-	-

Revisions

Client

Cambridgeshire Highways

Drawing Originator

MILESTONE

A part of MGroupServices

Drawing Status

PRELIMINARY DESIGN

Project Name

SOIL AFFECTED ROADS

Title

PRICKWILLOW RD ISLEHAM AREA OF INTEREST 019

Sheet Size	Scale	Drawn by	Checked by	Approved by
A1	1:5000	SC	NT	
		Drawn Date 14/12/2023	Checked Date 04/01/2024	Approved Date

Drawing Number	Status	Rev

KEY:

International Roughness Index (IRI) 7+ is categorised as poor to very poor requiring intervention.

- IRI 7-15 8241m²
- IRI15-30 1860m²
- IRI 30+ Extremely Poor Condition 433m²

Total treatment area: 10534m²

Rev	Date	Description	Drn	Chkd	App

Revisions

Client

Cambridgeshire Highways

Cambridgeshire County Council

Drawing Originator

MILESTONE

A part of MGroupServices

Drawing Status

PRELIMINARY DESIGN

Project Name

SOIL AFFECTED ROADS

Title

STRAIGHT FURLONG PYMOOR AREA OF INTEREST 020

Sheet Size	Scale	Drawn by	Checked by	Approved by
A1	1:2500	SC	NT	
		Drawn Date 18/12/2023	Checked Date 04/01/2024	Approved Date

Drawing Number	Status	Rev

KEY:

International Roughness Index (IRI) 7+ is categorised as poor to very poor requiring intervention:

- IRI 7-15 3970m²
- IRI 15-30 210.7m²
- IRI 30+ Extremely Poor Condition 0m²

Total treatment area: 4180.7m²

Rev	Date	Description	Drn	Chkd	App
-	-	-	-	-	-

Revisions

Client

Cambridgeshire Highways

Drawing Originator

MILESTONE

A part of MGroupServices

Drawing Status

PRELIMINARY DESIGN

Project Name

SOIL AFFECTED ROADS

Title

NEW RD CHATTERIS
AREA OF INTEREST 021

Sheet Size	Scale	Drawn by	Checked by	Approved by
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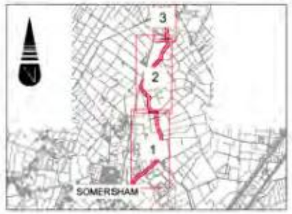
		Drawn Date	Checked Date	Approved Date
		03/01/2024	04/01/2024	

Drawing Number	Status	Rev



KEY:

International Roughness Index (IRI) 7+ is categorised as poor to very poor requiring intervention:

- IRI 7-15 28,314m²
- IRI 15-30 881.3m²
- IRI 30+ Extremely Poor Condition 0m²

Total treatment area: 29,195.3m²

Rev	Date	Description	Drn	Chkd	App

Revisions

Client

Cambridgeshire **Highways**

Drawing Originator

MILESTONE

A part of MGroupServices

Drawing Status

PRELIMINARY DESIGN

Project Name

SOIL AFFECTED ROADS

Title

CHATTERIS RD SOMERSHAM
AREA OF INTEREST 022

Sheet Size	Scale	Drawn by	Checked by	Approved by
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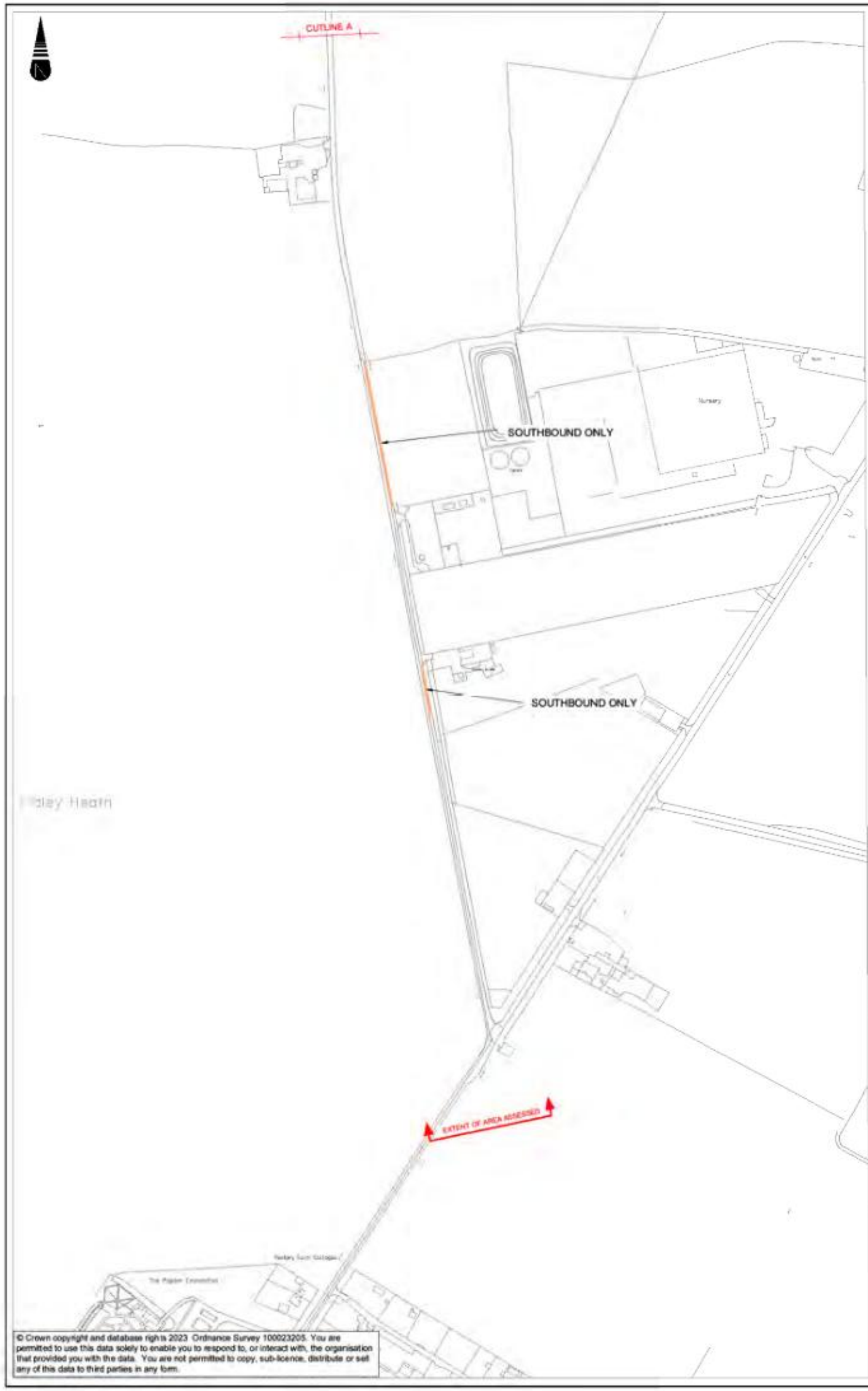
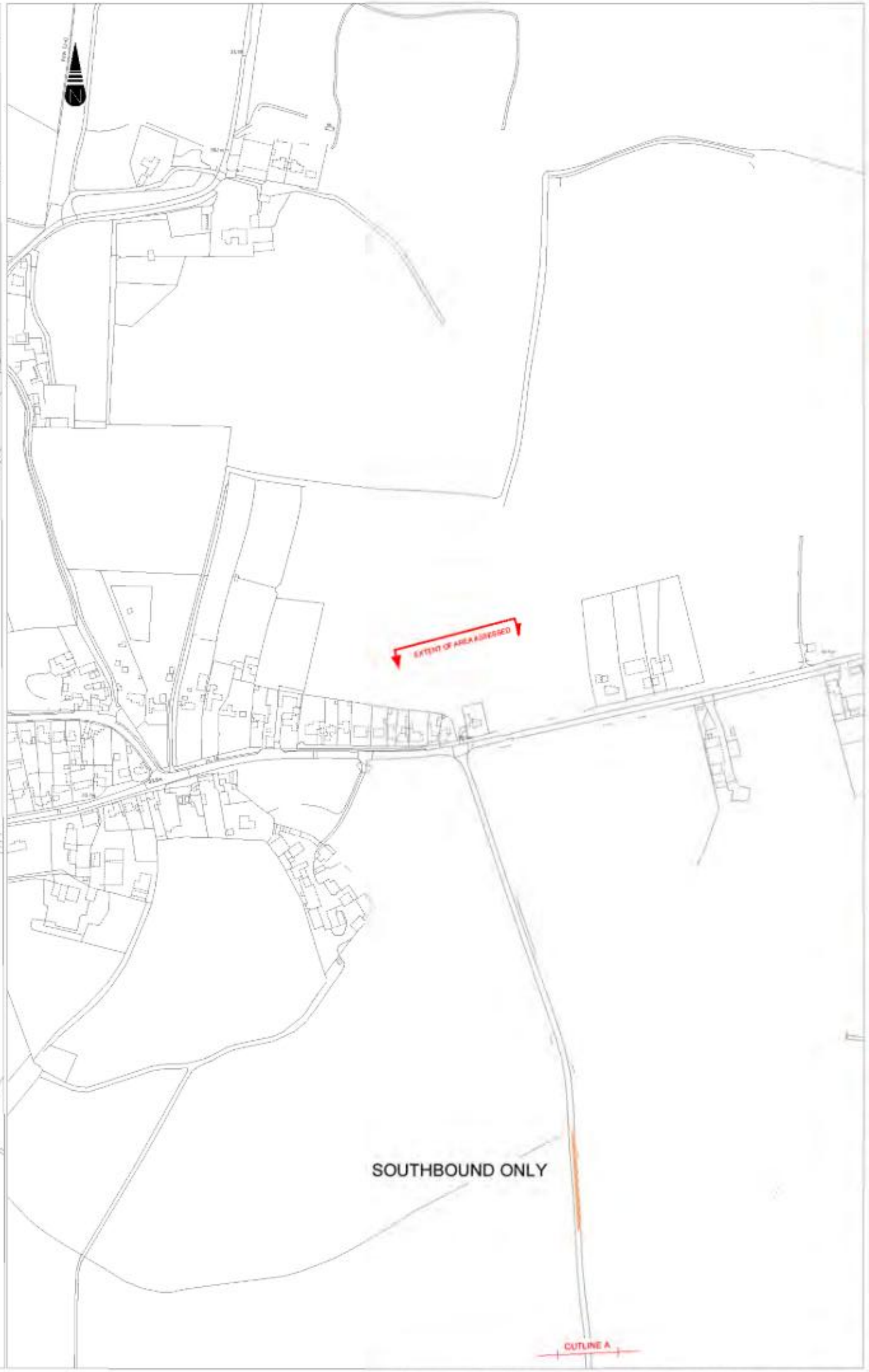
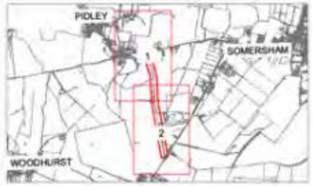
		Drawn Date 03/01/2024	Checked Date 04/01/2024	Approved Date

Drawing Number	Status	Rev







KEY:

No R3 Survey data available. Treatment areas determined from Gaist pavement condition survey and visual inspection from video footage. .

Poor Condition
800m²

Total treatment area: 800m²

Rev	Date	Description	Drn	Chkd	App
-	-	-	-	-	-

Revisions

Client

Cambridgeshire Highways

Cambridgeshire County Council

Vantage House, Vantage Park, Washingley Road, Huntingdon, PE29 6SR.

Drawing Originator

MILESTONE INFRASTRUCTURE

A part of MGroupServices

Woodlands Court, Burnham Road, Beaconsfield, Buckinghamshire, HP9 2SF

Drawing Status

PRELIMINARY DESIGN

Project Name

SOIL AFFECTED ROADS

Title

PIDLEY SHEEP LANE PIDLEY
AREA OF INTEREST 023

Sheet Size	Scale	Drawn by	Checked by	Approved by
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		Drawn Date	Checked Date	Approved Date
		29/11/2023	04/01/2024	

Drawing Number	Status	Rev

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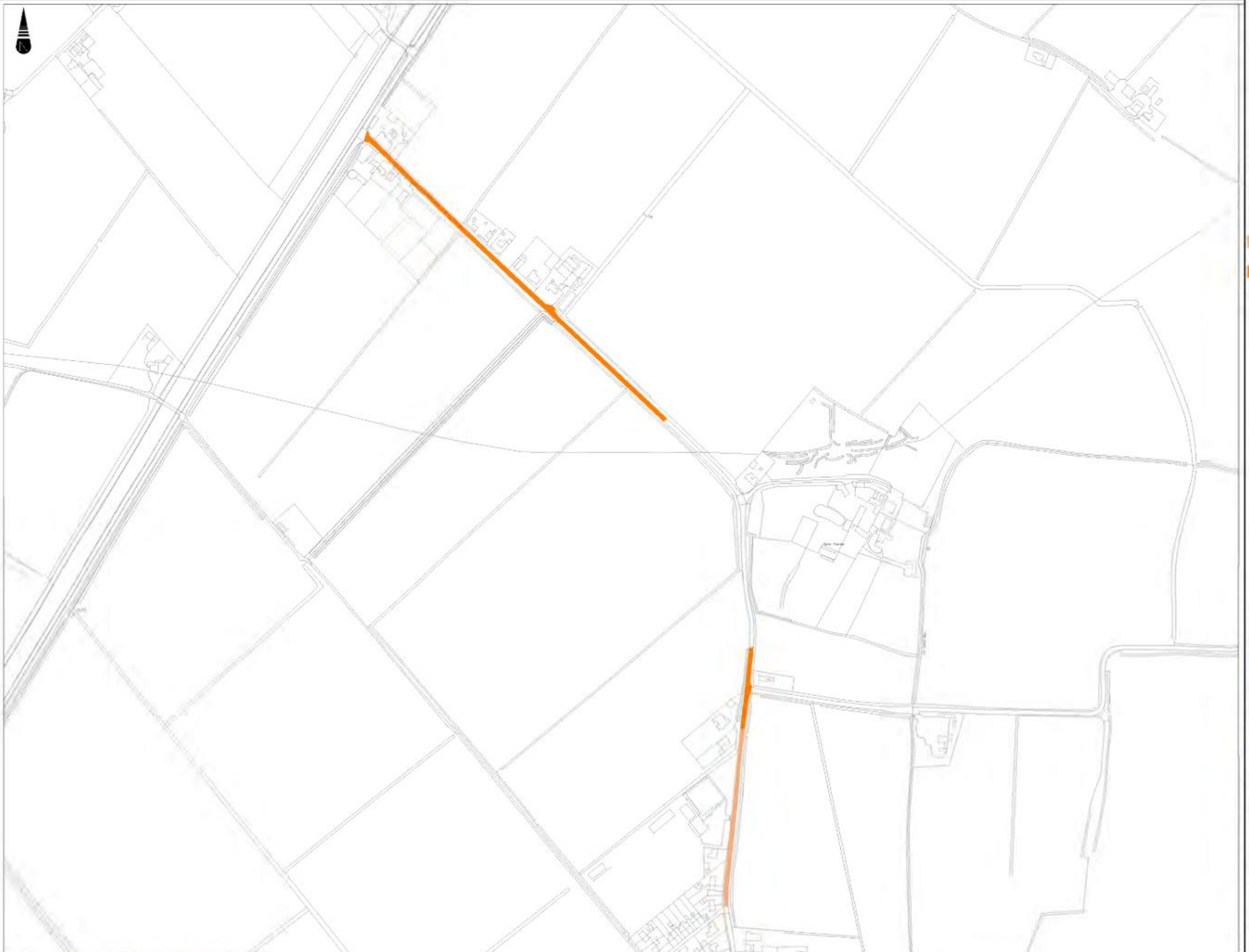

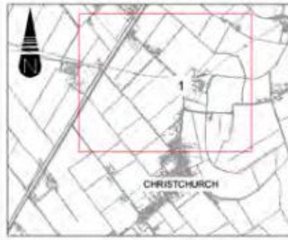

KEY:

No R3 Survey data available. Treatment areas determined from Gaist pavement condition survey and visual inspection from video footage. .

Poor Condition
1452m²

Very Poor Condition
4154m²

Total treatment area: 5606m²

Rev	Date	Description	Drn	Chkd	App
-	-	-	-	-	-

Revisions

Client

Cambridgeshire Highways

Drawing Originator

MILESTONE

A part of MGroupServices

Drawing Status

PRELIMINARY DESIGN

Project Name

SOIL AFFECTED ROADS

Title

UPWELL RD CHRISTCHURCH AREA OF INTEREST 024

Sheet Size	Scale	Drawn by	Checked by	Approved by
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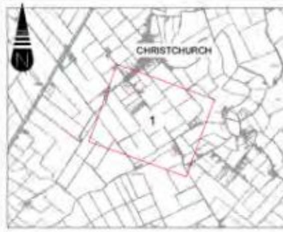
		Drawn Date 13/12/2023	Checked Date 04/01/2024	Approved Date

Drawing Number	Status	Rev



KEY:

International Roughness Index (IRI) 7+ is categorised as poor to very poor requiring intervention.

IRI 7-15
8143m²

IRI15-30
1187m²

IRI 30+ Extremely Poor Condition
0m²

Total treatment area: 9330m²

Rev	Date	Description	Drn	Chkd	App
-	-	-	-	-	-

Revisions

Client

Cambridgeshire **Highways**

Drawing Originator

MILESTONE

A part of MGroupServices

Drawing Status

PRELIMINARY DESIGN

Project Name

SOIL AFFECTED ROADS

Title

PADGETTS RD CHRISTCHURCH
AREA OF INTEREST 025

Sheet Size	Scale	Drawn by	Checked by	Approved by
A1	1:2500	SC	NT	
		Drawn Date: 18/12/2023	Checked Date: 04/01/2024	Approved Date:

Drawing Number	Status	Rev

File Plotted: 04 January 2024 11:40:24 File location: P:\Highways\Cambridgeshire Highways\Projects\00 Pipeline\Soil Affected Roads\DWG\700 Treatment Detail Drawings\R3 - 025 Padgetts Rd Christchurch.dwg Printed by: Thompson, Neil

Appendix 2 – Case Studies

CASE STUDY

REGEN with Geogrid

‘SPL & Milestone provide sustainable maintenance solution for Green Energy access road’

Scheme:	Cant’s Drove, Murrow
Principal Client:	Cambridgeshire County Council
Client:	Milestone Infrastructure
Date:	October 2021
Area:	3,500m^2
In-Situ Process:	REGEN with Geogrid
Tar Bound Import:	850 Tonnes
Surface:	AC20 Binder 40/60 - 60mm thick CA Surface Course PSV60 - 50mm thick
CO_2 Saving:	Over similar depth recon 47 Tonnes

Adapt Biogas, located at the Western end of the Cant’s Drove site takes in vegetative waste and Feedstock to create a green sustainable energy, for heating local homes and businesses.

In addition to local farms sending this material into the Somerset Farm site, the anaerobic digestion plant also produces a high level of nutrients and minerals to be recycled back to the land, in the form of solid or liquid digestate transported out of the plant.

Excessive wear from heavy agricultural vehicles and tankers running to and from the Somerset Farm site had taken its toll on the section of Cant’s Drove between Adapt’s Plant and the B1187 (Murrow Bank) and as such, resolving the damaged road was a priority in addition to enhancing the structural properties to aid future performance under this increasing workload.

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www.roadrecycling.co.uk

SPL's recycling with a Surface Dressing often used in this kind of rural location would require some adaption for this environment, so following technical analysis of the ground properties and the traffic impact the following enhancements were put forward.

Due to a lack of formal, granular construction and the evolved nature of the road some 850 Tonnes of planings were imported to be recycled within the existing structural layers. Due to the presence of coal tar in the road, this allowed Cambridge to use tar bound arisings from elsewhere in the county which could be encapsulated within the Cant's Drove recycling. This structural benefit also helped to avoid any costly disposal of tar bound carriageway material.

Having imported the additional material, SPL's Wirtgen 380 would not only recycle and create a structural Hydraulically Bound Material to a depth of 150mm with the addition of 2% Cementitious Binder, but also would install simultaneously a layer of geotextile and a layer of geogrid – both would sit below the recycled layer with the grid providing more structural stability and the textile separation layer preventing any clay migration from below when re-opened to traffic.

In order to recycle and install grid and textile in one pass, the Blended Cement was spread and a planer gave an addition 1 metre width so that the 380 could pick up and mix all of the material, feed the paver, which in turn could be set to place the recycling to the required width of the carriageway.

The recycled layer was completed with a K1-40 emulsion and sealing grit – applied to protect the recycled layer prior to surfacing and prevent the top of the HBM drying out too quickly to prevent any aggregate loss.

Following a light sweep of the carriageway Surfacing was carried out – unlike the usual Surface Dressing application for REGEN, due to the weight of traffic the recycling was capped off with a 60mm thick AC20 Binder course and a 50mm thick Cambridge Asphalt Surface Course. In turn providing a more robust construction over the enhanced recycling.

Due to the pace of installation the site preparation, including excavation of soft areas, the import and spread of planings and recycling complete with Geogrid and textile was complete within 3 days ready for surfacing thereby minimising disruption to the valuable work carried out by the Green Energy provider Adapt Biogas at Somerset Farm.

In addition to the re-use of 850 Tonnes of tar bound arisings the project achieved a Carbon saving of 47 Tonnes over a more traditional reconstruction of the same depth.

CASE STUDY

Norfolk Trials Low Carbon Cement Alternative

‘Norfolk cut the Carbon with cement free binder trial’

Scheme:	Eau Brink Road, Wiggenhall
Authority:	Norfolk County Council
Term Contractor:	Tarmac
Date:	June 2023
Area:	8,872 m^2
In-Situ Process:	Regen
CO_2 Saving:	141 Tonnes using CEM 2 161 Tonnes using H-EVA

Norfolk Partnership Laboratory
Part of the Norse Group

The OPC in our blended cement binder used for recycling comes with a high embodied Carbon figure of around 604Kg.CO_2eq/T. This is a result of its highly emissive production involving quarrying, transport, fossil fuel firing and grinding.
On this site an alternative has been trialled – based on Ettringite technology.

Using alkaline activation H-EVA is a “Clinker Free” cement produced in France by Hoffman Green approximately 60km from Dover in their Dunkirk.

- H-EVA cement has a mechanical strength of up to 60 MPa within 28 days.
- H-EVA cement has a formulation that does not contain one gram of clinker and a carbon footprint divided by 5 compared to the traditional cement.
- This cement comes in the form of a powder that can be stored in a silo and is perfectly compatible with existing manufacturing processes.
- H-EVA is a cement intended for the market of mortar and coating formulators, building site concretes and road binders.

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CASE STUDY

Norfolk Trials Low Carbon Cement Alternative

Using Cem 2, our Carbon Footprint was at 56 tonnes, which, whilst representing a significant 141 tonne saving over a traditional asphalt alternative, amounted to 17.7kg.CO_2eq/tonne.

The H-EVA embodied carbon at 272Kg.CO_2eq/t, reduced our footprint further to 35 tonnes, saving 161 tonne over a traditional asphalt approach and amounted to 11.2kg.CO_2eq/tonne – a decrease of 43%.

Product	Embodied Carbon (kg/tonne)	Project Footprint (kg/tonne)	Saving over traditional asphalt (kg/tonne)
CEM 2	604	17.7	41.7
H-EVA	272	11.2	48.1

As a trial, SPL and Norse Laboratories will be monitoring the H-EVA performance which will determine the longer-term use of the product across the UK as a low Carbon alternative to Blended Cement products containing OPC.

Eau Brink Road in Wiggenhall near Kings Lynn was well suited for Stabilised Pavement's Regen process due to suitable material within the road as well as appropriate levels of traffic.

Our trial hole and coring analysis determined the material suitability as well as understanding the roads characteristics in terms of drainage and edge restraint.
Our Ground Penetrating Radar Survey also provided information around services and apparatus which again provided confidence around the in situ works.

Norfolk Trials Low Carbon Cement Alternative

As an alternative to formal reconstruction or extensive patch repairs, the recycling of the existing carriageway material with a surface dressing represents a cost appropriate approach to highways maintenance.

Recycling to a depth of 150mm, the existing road layers were pulverised, compacted and re-shaped before the introduction of a cementitious binder (CEM 2 – a blend of 70% OPC and 30% PFA). The binder was spread at 2% by volume before the 150mm layer was mixed through with the blended cement and water to create our hydraulically bound material (HBM) which was once again compacted and shaped to ensure consistent depth of construction.

The profiling of the HBM also allows the smoothing out of high and low points in the existing carriageway, which cannot always be achieved through patch repairs alone. There are several benefits to this re-shaping:

- Road users experience a vastly improved ride quality.
- Falls are created to allow water to be vacated from the running surface.
- The removal of bumps and troughs reduces the impact of dynamic loadings thereby extending the durability and life of the road structure.

In addition to the physical benefits the process is certainly one of the more sustainable approaches available since the re-engineering of the existing road layers does not involve importing virgin aggregates as with traditional asphalt reconstruction.

The recycled content sits at approximately 98% of the materials used – this amounts to 3061 Tonnes of granular material which is kept on site and recycled rather than transported and either treated for re-use or replaced. In turn this vastly reduces associated lorry movements which will not only avoid wear and tear on the surrounding network but also potentially decrease traffic disruption since around 300 lorry movements have been avoided.

Finally, the outputs are impressive. The works were completed in 4 shifts and included the double dressing of 10 & 6mm stone. Less time on site, less disruption and lower costs resulting in Environmental and commercial successes.

Deep Recycling & Grid Installation

'Innovation leads the one pass foam, cement and low layer grid trials in Norfolk'

Scheme:	B1160 College Road, Wissington
Authority:	Norfolk County Council
Term Contractor:	Tarmac
Date:	June 2021
Area:	10,230m^2
In-Situ Process:	Deep Recycling using Down Cut W380CRi CIR machine
Pavement Treatments:	Recycled HBM & Foamed Asphalt laid onto geogrid foundation, surfaced with asphalt overlay
CO_2 Saving:	206 Tonnes

Wissington in Norfolk is the site of British Sugar's largest refinery in the UK, indeed the largest in Europe, and the local highway network certainly takes the strain. Sitting on peat and soft ground, alongside deep drainage ditches, the client required a deeper solution than simple asphalt patching.

The reconstruction of this section of College Road involved in situ recycling the existing carriageway materials using cementitious binder placed onto the road prior to mixing, to create a Hydraulic Bound Material as well as a section of Foamed Bitumen binder injected into the mixing chamber of the recycler to create Bituminous bound cold recycled material.

The recycled layers in both sections received an Asphalt Binder course and an Asphalt Surface course.

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In addition, stabilisation was to be enhanced mechanically using a polypropylene grid below the recycled platform.

The grid installation and both the foamed and cementitious recycling was carried out trialling the unique “one pass” approach developed by Stabilised Pavements using the latest generation Wirtgen 380CRi Recycler adapted with a new Grid dispensing attachment.

The extent of the works is a little under 2km of the B1160, heading South from British Sugar’s Wissington Sugar Factory on College Road. Providing access and egress for lorries into and out of the factory in addition to agricultural use and local traffic between West Dereham, Southery and Methwold.

The road condition prior to intervention was cracked and undulating, largely recognised as a result of the underlying ground conditions consisting of black peat and variable moistures. The impact of the peat and moisture has meant the structural integrity of the carriageway above has been compromised and consequently limiting its ability to carry the levels of traffic using it.

The proposed design solution in line with TRL 611 involved reconstruction using an in-situ recycled foundation layer with a structural stiffness sufficient to provide a sound platform for an asphalt binder and surface layer collectively appropriate for the 7.1 Million Standard Axles capacity of the road.

Analysis of this proposal validates the capacity in theory; however, the impact of the sub-grade may be a detrimental influence on the outcome in the longer term. Therefore, the incorporation of a grid was considered a further enhancement to retain the roads performance and condition.

CASE STUDY

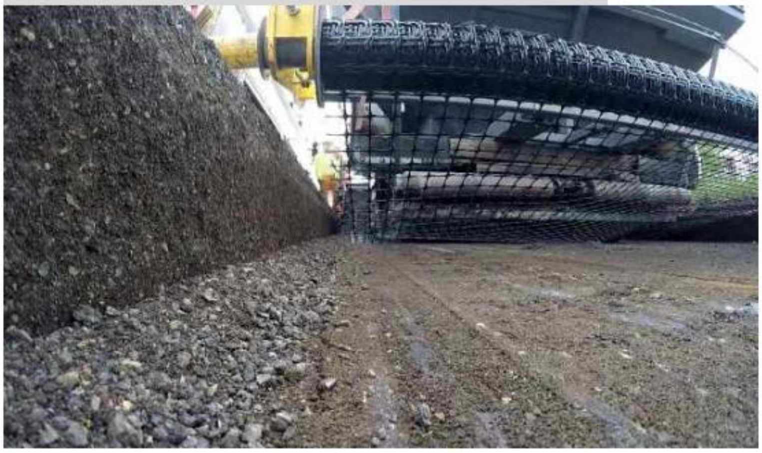
Deep Recycling & Grid Installation

A polypropylene geogrid, incorporated into the reconstruction below the recycled layer and above the subgrade had been proposed, which historically would have meant excavation of the carriageway to lay the grid before covering and recycling.

SPL have now developed a pioneering “one pass” technique by using the Wirtgen 380CRi.
As the recycling takes place, this state-of-the-art recycler exposes a section of subgrade below the material conveyor for a brief period, presenting the opportunity to roll out the grid before the recycled layer is placed back onto this grid in the road through the following paver.

This installation technique has minimal impact on the delivery of the recycling in terms of productivity yet benefits the construction by acting as a spring constraint preventing the development of micro cracks through crack recovery when loads are applied within the grid layer. This mitigation of the development of cracking preserves the structural benefits and life of the hydraulically and bitumen bound recycled layers therefore preserving the integrity as a supporting layer to the Asphalt above.

In addition to the successful trial of this installation technique, a trial section using Foamed Bitumen to create a Bituminous bound cold recycled material was also carried out as an alternative to the cementitious Hydraulically Bound Material. Creation of the product in Phase 2 of the works (B1160 East West) was achieved utilising the Wirtgen 380Cri, recycling the existing carriageway aggregate using bitumen with good foaming characteristics and additions of cement and Pulverised Fuel Ash (PFA). This section will be monitored closely to evaluate the impact of moisture and sub-grade to establish performance compared to the HBM.



At SPL it is our firm belief that measuring and managing our environmental performance in turn gives rise to innovation and efficiencies that lead to real commercial benefits. With improved efficiency around the grid installation, the high outputs of the W380Cri and the re-engineering of existing carriageway aggregates comes inevitable Carbon benefits. Using the CO2 calculator for this scheme, which considers industry recognised embodied material Carbon numbers as well as variables around travel we can demonstrate a Carbon saving of more than 200 Tonnes over traditional construction techniques. 200 Tonnes of Carbon being the equivalent to Greenhouse Gas Emissions from an average car driving 525,000 miles.