Condition Surveys

Alex Wright
Director of Technology

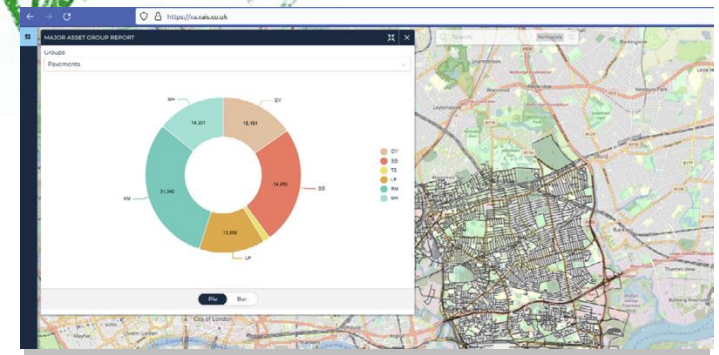
XAIS-PTS
INFRASTRUCTURE ASSET AND PAVEMENT SOLUTIONS
A PHENNA GROUP COMPANY

XAIS-PTS
INFRASTRUCTURE ASSET AND PAVEMENT SOLUTIONS
A PHENNA GROUP COMPANY

Surface Condition (SCANNER, PAS)

Structural assessment (FWD/DFG)

Structure (GPR)



Asset Management and Decision Support

Established in 2002, XAIS-PTS Limited are the UK's leading provider of infrastructure surveying technology, infrastructure asset management software and Asset Management Services

Safety (SCRIM and Griptester)

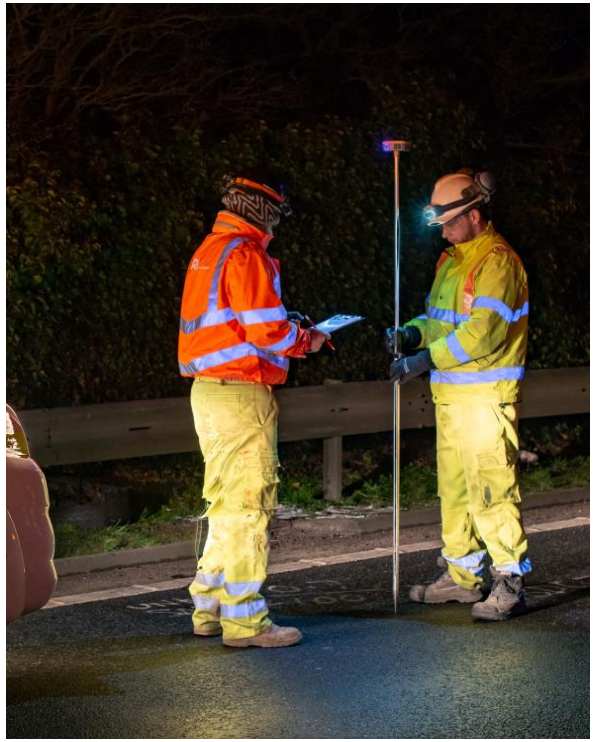
Visual inspection (CVI, AEI, DVI)

UKAS TESTING
4076

Materials testing

XAIS-PTS
INFRASTRUCTURE ASSET AND PAVEMENT SOLUTIONS
A PHENNA GROUP COMPANY

Typical condition surveys….



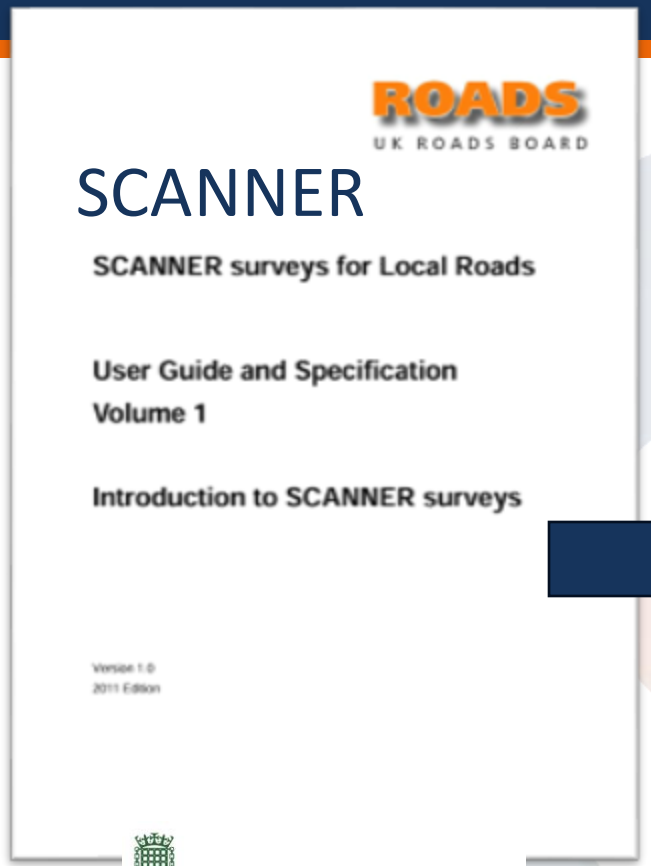
- Walked Inspections
- Manual inspections (DVI)
- Safety inspections / RMMS
- Watchman reports

- Network driven surveys,
- “Video vans”
- CVI

- Commissioned traffic-speed surveys to formal data requirements:
  - **Surface: SCANNER**
  - Structural: Deflectograph
  - Safety: SCRIM

2025 - Step-change in network condition surveys

- Some LAs not seeing value in SCANNER data – want data that better matches their assessments
- New providers offering alternative tech.
- Tight specification preventing innovation
- Transport Select Committee enquiry in 2018/19, recommend a new approach that:
  - Is flexible and allows LAs to access a wider choice of data/technologies
  - Is defined in a way that does not lead to (enforce) the adoption of certain types of technology
- PAS – Publicly Available Specification from BSI
  - A sponsored standard from DfT
  - Fast Track – (developed within 9 – 12 months)
  - Drafted in line with BSI and ISO



PAS2161

Step-change in network condition surveys

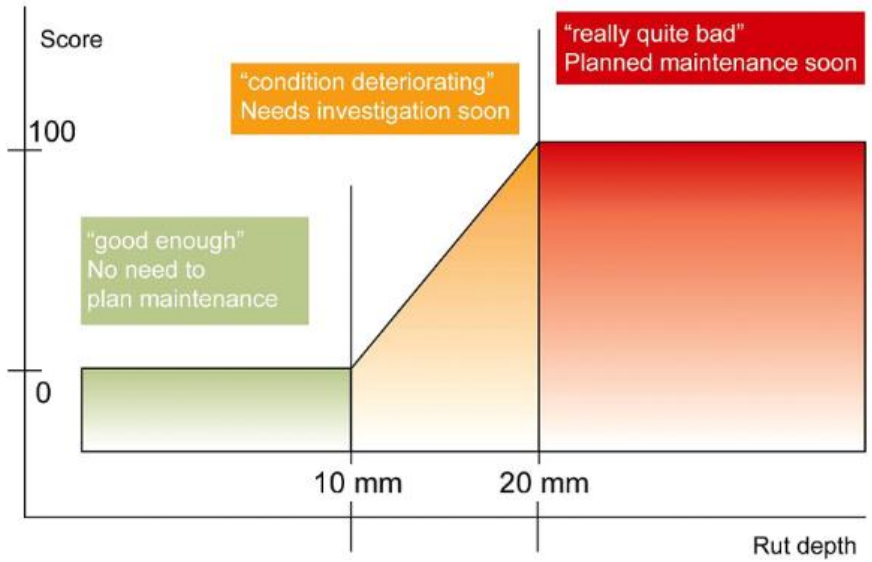


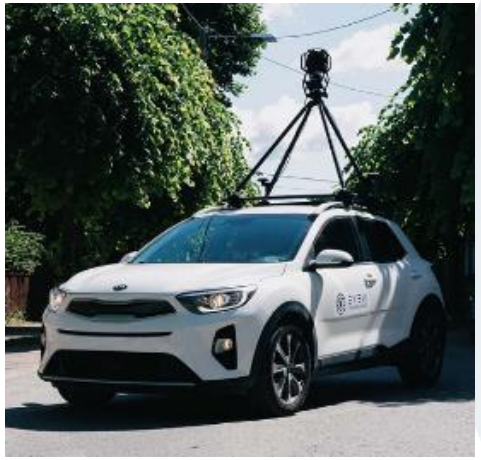
Table 2 – Road condition categories

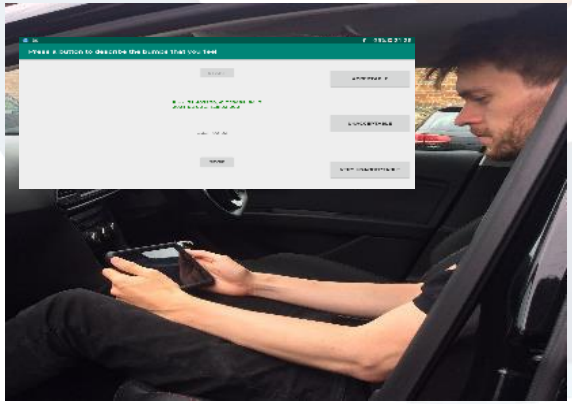
Category	Description	Potential maintenance treatment option
1	No deterioration	Pavement is not considered for maintenance
2	Minor (and/or aesthetic) deterioration	Light maintenance (e.g. minor patching)
3	Moderate deterioration	Localized intervention or mid-life preventative maintenance (e.g. surface dressing, patching, crack sealing)
4	Moderate to severe deterioration	Rehabilitative maintenance, perhaps full carriageway (e.g. resurfacing with thin overlay/surface dressing and multiple patching, edge haunching)
5	Severe deterioration	Structural maintenance (e.g. full carriageway resurfacing or reconstruction)

NOTE The examples of maintenance treatment options provide general, not definitive, descriptions of some of the maintenance treatments that might be considered by a typical Highway Authority engineer to restore a length in that RCM condition category to a condition that does not require maintenance. They are provided for guidance only and are non-exhaustive. Benchmarking of categories, and the ability of RCM devices to report them, is established through comparison with consensus assessments of highway engineers (see Annex C).

Step-change in network condition surveys

- SCANNER





PAS2161 examples:

- Dedicated mobile technologies
- Dedicated survey vehicles (SCANNER)
- Crowdsourcing
- Human visual inspections
- Other…?

PAS2161 – An opportunity to get better value from data

XAIS-PTS
INFRASTRUCTURE ASSET AND PAVEMENT SOLUTIONS
A PHENNA GROUP COMPANY

Table 2 – Road condition categories

Category	Description	Potential maintenance treatment option
1	No deterioration	Pavement is not considered for maintenance
2	Minor (and/or aesthetic) deterioration	Light maintenance (e.g. minor patching)
3	Moderate deterioration	Localized intervention or mid-life preventative maintenance (e.g. surface dressing, patching, crack sealing)
4	Moderate to severe deterioration	Rehabilitative maintenance, perhaps full carriageway (e.g. resurfacing with thin overlay/surface dressing and multiple patching, edge haunching)
5	Severe deterioration	Structural maintenance (e.g. full carriageway resurfacing or reconstruction)

NOTE The examples of maintenance treatment options provide general, not definitive, descriptions of some of the maintenance treatments that might be considered by a typical Highway Authority engineer to restore a length in that RCM condition category to a condition that does not require maintenance. They are provided for guidance only and are non-exhaustive. Benchmarking of categories, and the ability of RCM devices to report them, is established through comparison with consensus assessments of highway engineers (see Annex C).

PAS 2161:2024

Annex B (informative) Additional RCM data

B.1 General

The UK Roads Leadership Group provides guidance [8] to Highway Authorities on the establishment of integrated asset management principles for highway management and a risk-based approach to managing highway assets. The guidance provides several recommendations for Highway Authorities, with specific emphasis on the development and application of asset data collection regimes that provide comprehensive information on the physical condition of the network, the types and extent of damage or risks present and the application of data to support scheme identification, estimate deterioration and to prioritize risk-based asset management. Additional RCM data can be used to support these goals.

When planning the collection of RCM data for the purposes of national reporting of condition, the Highway Authority should take into account the potential for the application of the RCM data in the wider management of highway assets, through the collection of additional data. While additional data are not required by national government for national reporting, the collection and application of additional data should be taken into account by Highway Authorities and reflects good practice.

NOTE 1 The additional data covered in this Annex includes both categories and parameters that might be provided by some RCM technologies (but might not be provided by all RCM technologies). The availability of additional data might also evolve over time as RCM technologies further develop.

The Highway Authority should:

a) discuss the availability of additional data with potential RCM providers prior to commissioning any data collection on its network;

b) take into account the value that additional data might add to its local asset management process, when selecting a particular RCM technology;

c) make an assessment of value that takes into account the potential benefits provided by additional data, including (but not limited to):

1) reduction in the need to undertake other inspections;

2) providing support to wider asset management decisions;

3) determining treatment needs; and

4) assisting in prioritization of maintenance;

d) identify any additional data that are to be provided, prior to commencement of data collection;

e) specify the requirements for the additional data, including:

1) additional categories that are to be provided (five general categories of condition with specific definitions in **5.1**);

*NOTE 2 The Highway Authority might request additional categories for local asset management (see **B.2**), e.g. categories that rate different components of condition, such as safety or structural robustness.*

2) condition parameters that are to be provided;

32

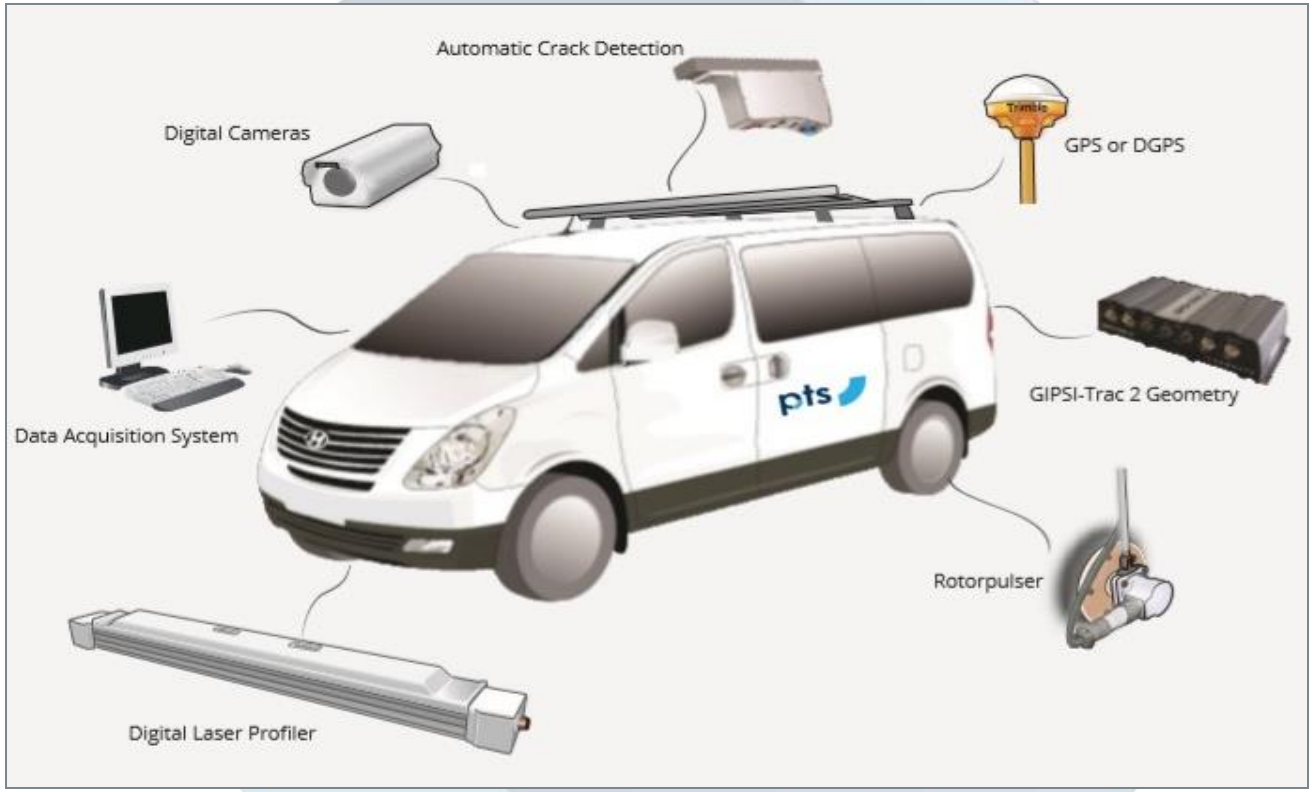
© The British Standards Institution 2024 – ALL RIGHTS RESERVED

Technology options opened by the new approach

- ***A data specification not a survey specification***
- Chose your technology based on the asset strategy / application for the data and the value required
- You can select *different* data sources (“surveys”) for the *same or different* roads
  - Technology-based automated surveys and manual surveys are both options
- Need to consider the value of **additional** data
  - Local road condition categories for local asset management
    - Functional, structural, safety?
  - Additional Data to support decisions on treatment and the type of treatment
    - Inventory, Visual Defects, Shape
    - Safety, Raw data (images)
- *Including data to support policies that either aim to, or will facilitate, the use of recycling*

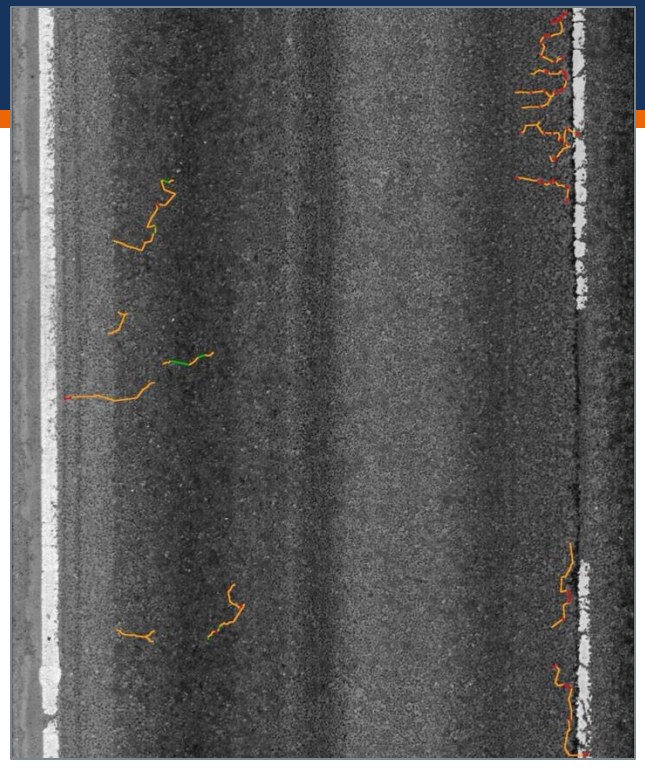
Beyond condition categories with…
Advanced dedicated survey vehicles (e.g. XAIS MFV – SCANNER+)

- Whilst SCANNER has focussed on RCI using 4 core defects, advanced dedicated survey vehicles now deploy
  - High resolution pavement imaging
  - All round image collection of the surrounding environment
  - High resolution 3D shape measurements of the road surface
  - Extremely accurate location referencing with dGPS and inertial sensors
  - Measurement of the raw surface texture and shape
  - Automated analysis to report a wide range of condition parameters

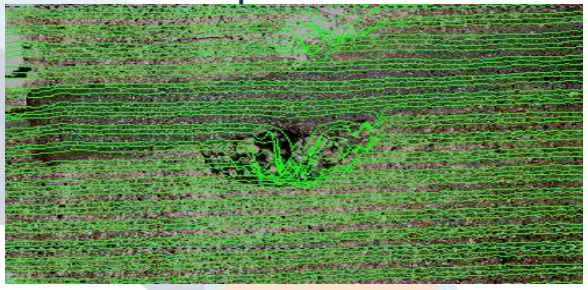


Beyond condition categories with… Advanced dedicated survey vehicles (e.g. XAIS MFV – SCANNER+)

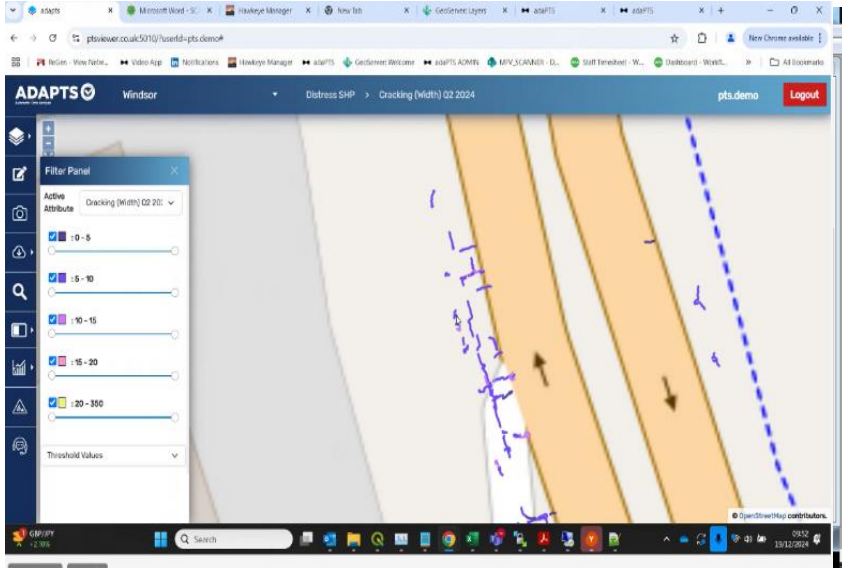
XAIS-PTS
INFRASTRUCTURE ASSET AND PAVEMENT SOLUTIONS
A PHENNA GROUP COMPANY

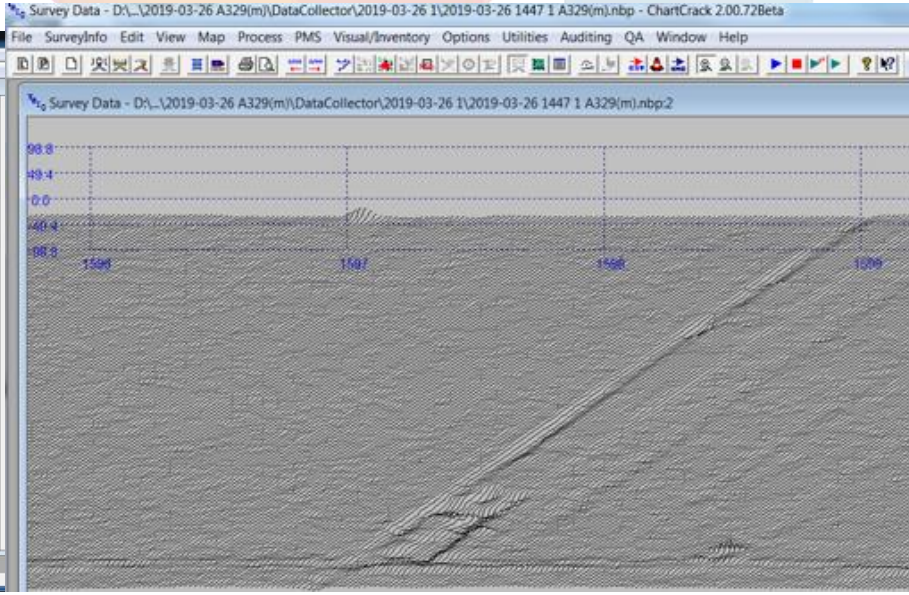


- Detailed defect data (type, extents - depth, width, severity) and condition parameters
  - Detailed crack maps
  - Major Fretting, Ravelling
  - Patching, Fatting, Joints
  - Roughness, texture and geometry

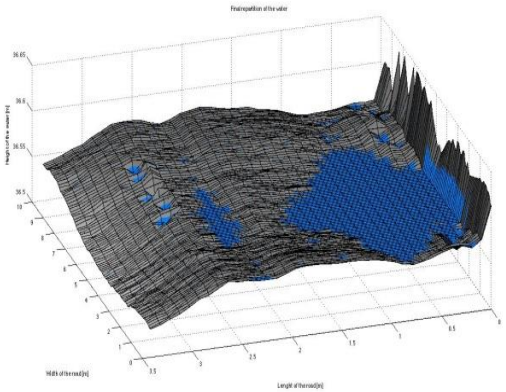


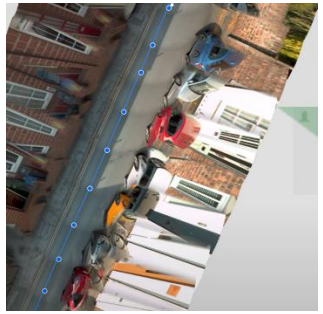
- Data can be processed in Asset Management Systems (e.g. XA) to:
  - Report custom parameters and indices (functional, structural, safety, edge)
  - Derived treatment designs
    - Including localised information to help define specifics (e.g. edge deterioration)

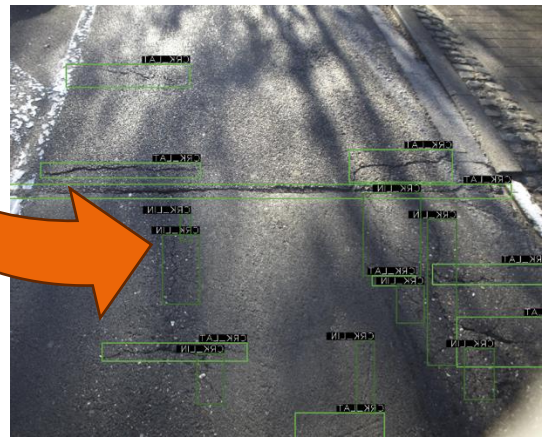




A note on AI and ML

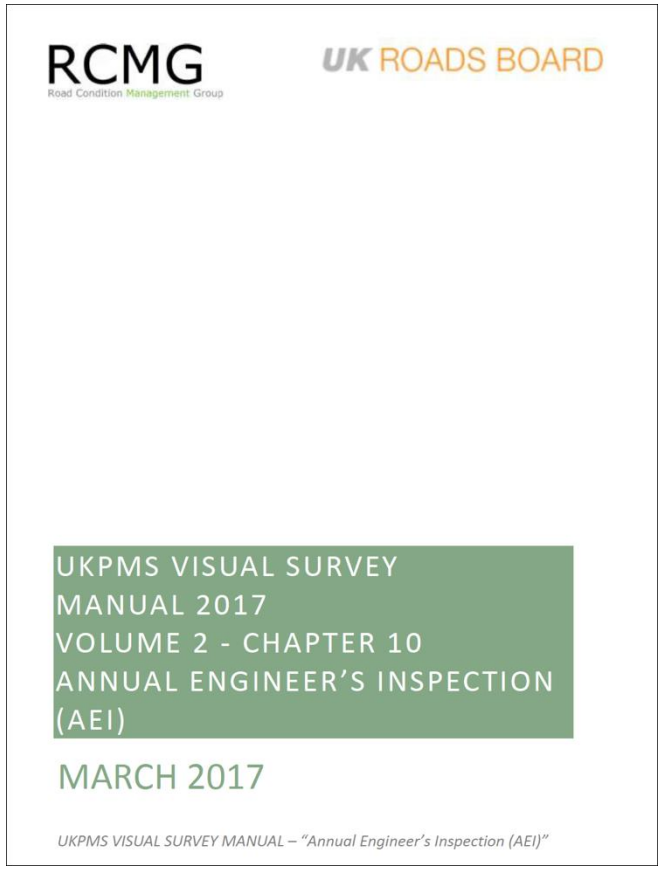






- Contributing to the step change in tools and data
- Typically, defect detection will be based on Machine Learning
- Has expanded the range of defects detectable
- Many providers use image analysis
  - Image sensors are low cost and easily deployed
  - Pavement defect detection is hard
  - Tools are trained to detect defects based on libraries of labelled images
  - Performance linked to effort expended on training
- Image analysis will not fully replace road shape data
  - Rutting (structural deterioration, ponding, flooding)
  - Texture depth (high speed skidding)
  - Roughness (user satisfaction)
  - Edge fall off (treatment design)
- “New” technologies not always a step forward

Beyond condition categories with…
Annual Engineering Inspection (AEI)



- Dedicated Survey Vehicles (SCANNER+) provide PAS condition categories plus additional data parameters (which can be used to determine treatments),
- AEI can provide PAS categories plus treatments directly
  - An engineer-driven survey
  - Treatment Selection not raw defects
  - Surveyors have experience in highways, treatments and materials
  - Engineers experience visual and shape components of road condition
  - No processing required

New AEI manual

Beyond condition categories with…
Annual Engineering Inspection (AEI)

- AEI – can use UKPMS standard and locally defined treatments
  - As New
  - Up to standard
  - Maintenance Patch
  - Rejuvenators
  - Joint Seal
  - Surface Dress (minimal patching)
  - Surface Dress (10% patching)
  - Micro-Asphalt
  - In-situ recycling
  - Resurfacing
  - Resurface with binder
  - Reconstruction
  - Concrete milling etc.

As New

Resurfacing (40mm or 100mm etc.)

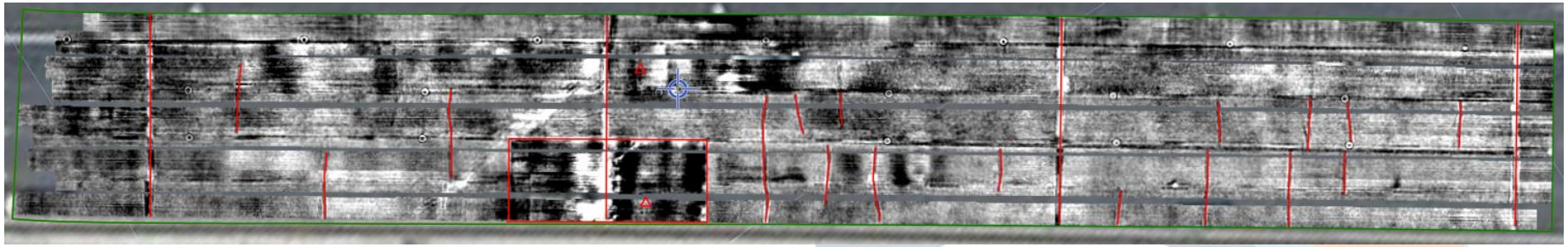
Material types are recorded – important for decisions on performance

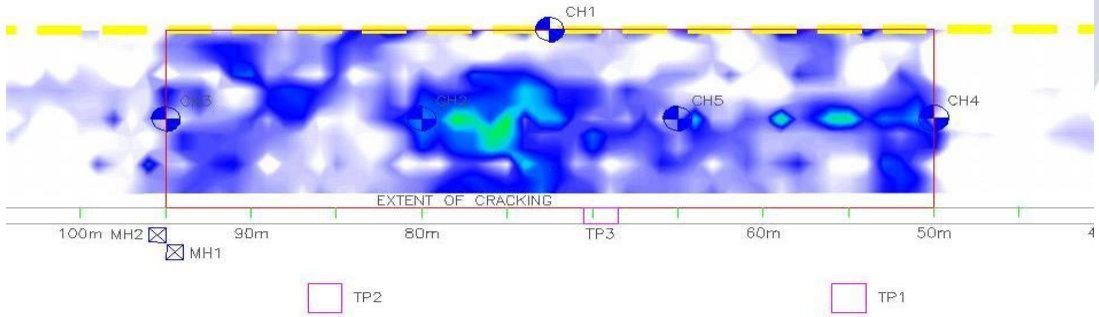
Beyond PAS2162
Further data to support decisions on treatments – 3D GPR

- 3D GPR equipment
  - An array of GPR antenna using swept frequency to optimise resolution across penetration depths
  - Multiple longitudinal lines provide depth information continuously along and across the carriageway
  - Integration with inertial GPS provides a real-world 3D model of the pavement substructure

Beyond PAS2162
Further data to support decisions on treatments – 3D GPR

Mapping of joints, discontinuities and delamination





Mapping of voids and moisture within and beneath the layers

Integration with map-based visualisation – alignment and comparison with other data sources

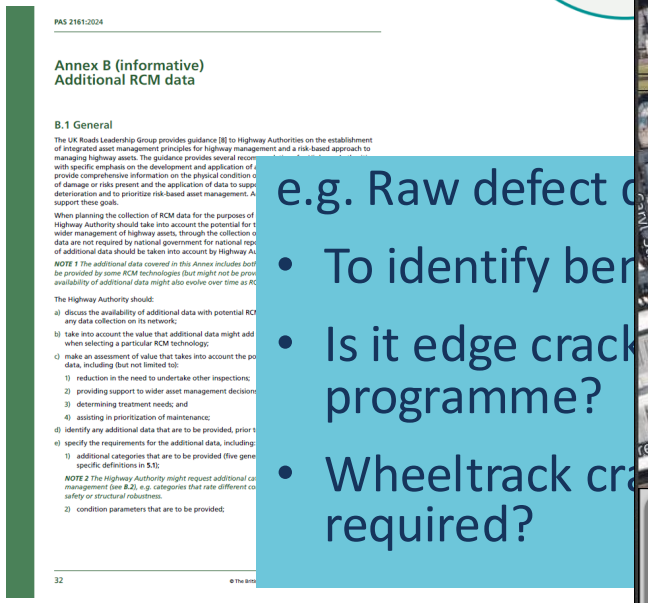
Beyond PAS2162
Further data to support decisions on treatments – Traffic-speed deflection

- PAS2161 surveys primarily consider the surface
- Network wide assessment of structural condition has been impractical to date on local roads
- On strategic roads this is being solved by the Traffic-speed Deflectometer
- TSD deploys doppler sensors to measure the velocity of pavement deflection, at 80km/h
- Several annual surveys undertaken
- TSD assists in
  - Targeting of maintenance budget
  - Improving condition projection
  - Long term planning
  - Asset valuation
- Local principal road applications?

What does this mean for asset owners? ….In the context of asset management

XAIS-PTS
INFRASTRUCTURE ASSET AND PAVEMENT SOLUTIONS
A PHENNA GROUP COMPANY

Accurate assessment of the pavement and surface distress can provide a consistent and rational method for allocating limited resources.


PAS 2161:2024

Annex B (informative)
Additional RCM data

B.1 General

The UK Roads Leadership Group provides guidance [8] to Highway Authorities on the establishment of integrated asset management principles for highway management and a risk-based approach to managing highway assets. The guidance provides several recom… with specific emphasis on the development and application of … provide comprehensive information on the physical condition o… of damage or risks present and the application of data to suppo… deterioration and to prioritize risk-based asset management. A… support these goals.

When planning the collection of RCM data for the purposes of … Highway Authority should take into account the potential for t… wider management of highway assets, through the collection o… data are not required by national government for national repo… of additional data should be taken into account by Highway Au…

NOTE 1 The additional data covered in this Annex includes both … be provided by some RCM technologies (but might not be provi… availability of additional data might also evolve over time as RC…

The Highway Authority should:

a) discuss the availability of additional data with potential RCM … any data collection on its network;

b) take into account the value that additional data might add … when selecting a particular RCM technology;

c) make an assessment of value that takes into account the po… data, including (but not limited to):

1) reduction in the need to undertake other inspections;

2) providing support to wider asset management decisions;

3) determining treatment needs; and

4) assisting in prioritization of maintenance;

d) identify any additional data that are to be provided, prior t…

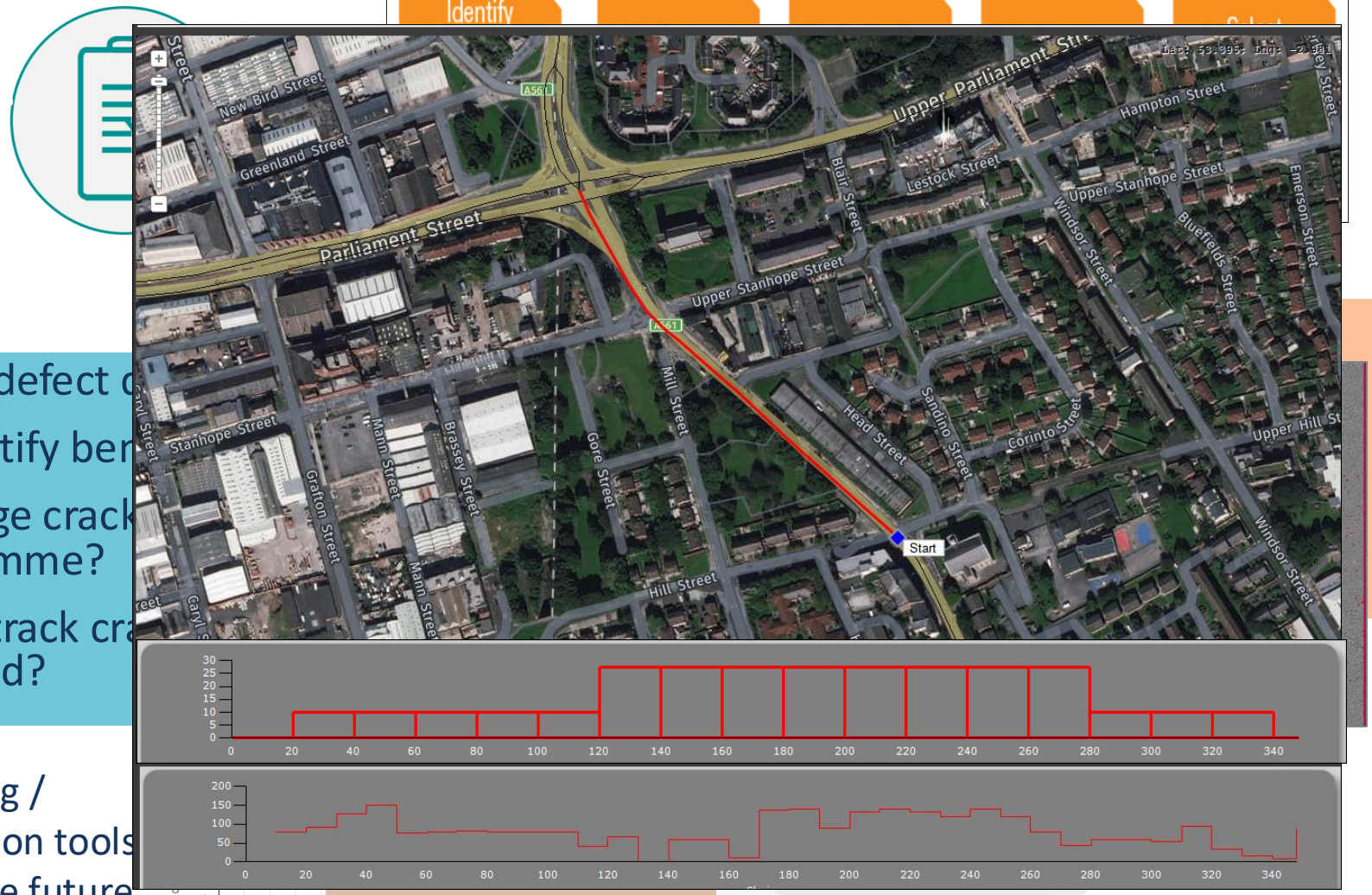
e) specify the requirements for the additional data, including:

1) additional categories that are to be provided (five gene… specific definitions in 5.1);

NOTE 2 The Highway Authority might request additional ca… management (see B.2), e.g. categories that rate different co… safety or structural robustness.

2) condition parameters that are to be provided;

32

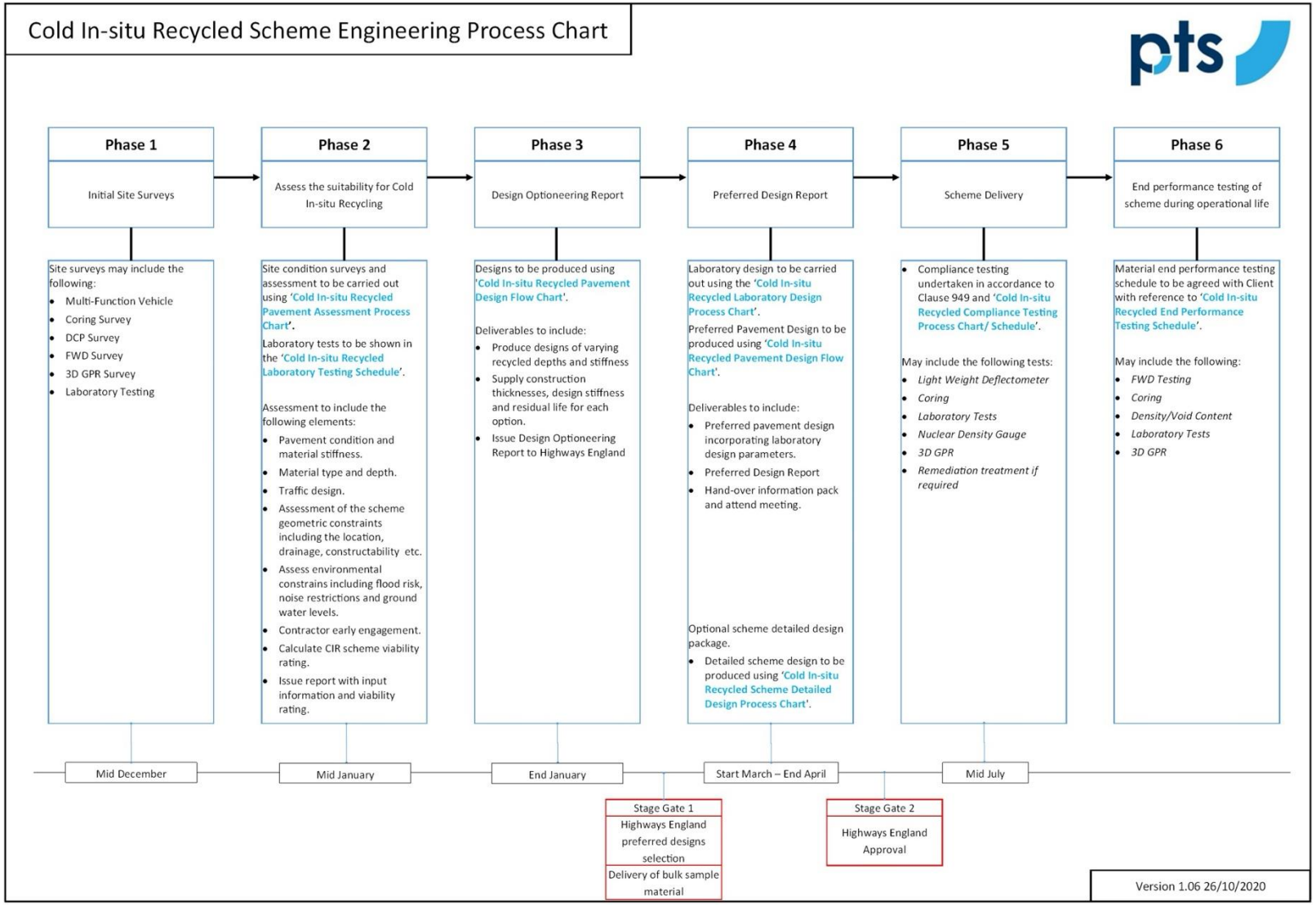


e.g. Raw defect d…

- To identify ber…
- Is it edge crack… programme?
- Wheeltrack cra… required?

Trending / prediction tools estimate future condition and treatment need

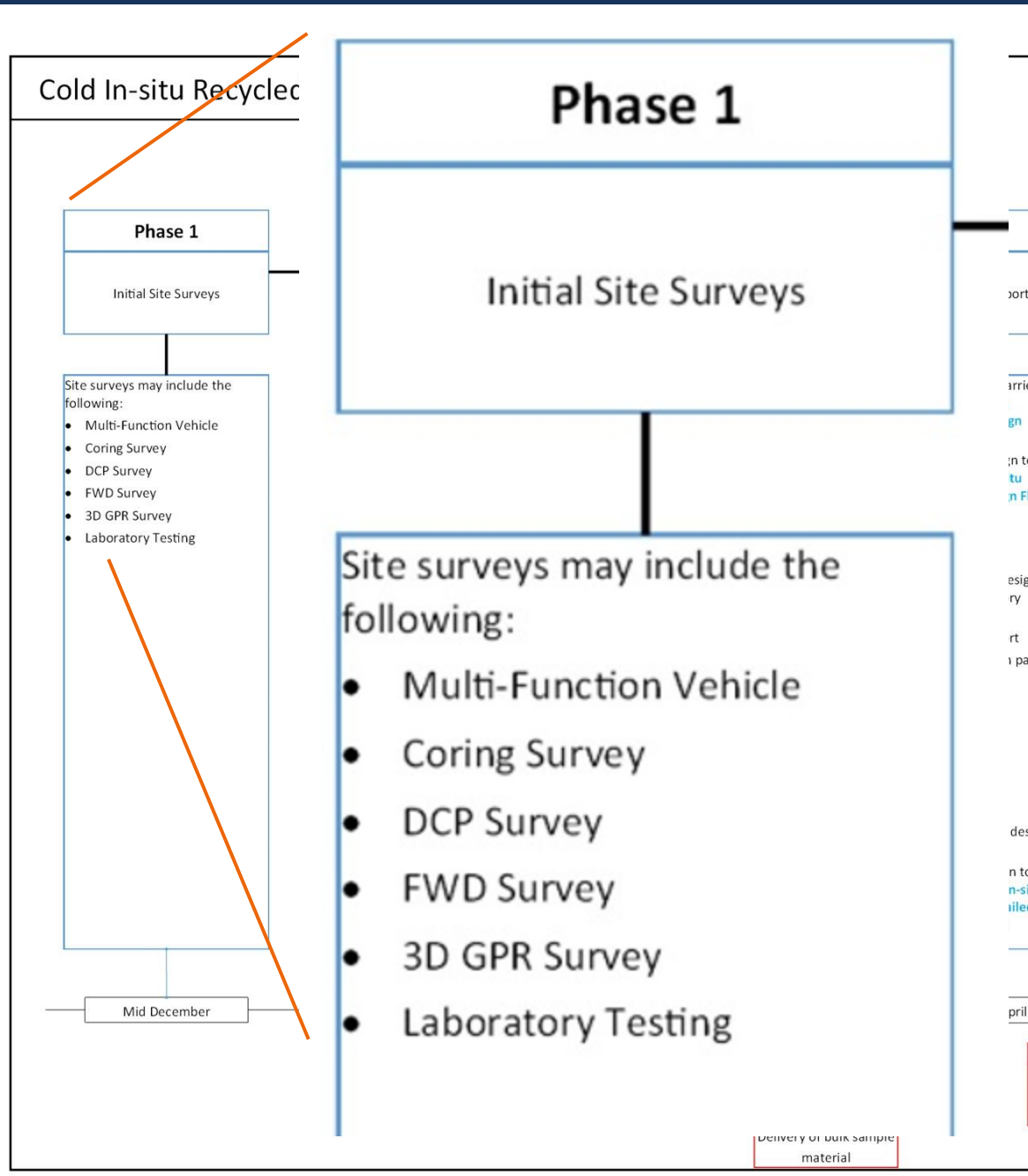
What does this mean for asset owners? In the context of a recycling policy?



XAIS-PTS
INFRASTRUCTURE ASSET AND PAVEMENT SOLUTIONS
A PHENNA GROUP COMPANY

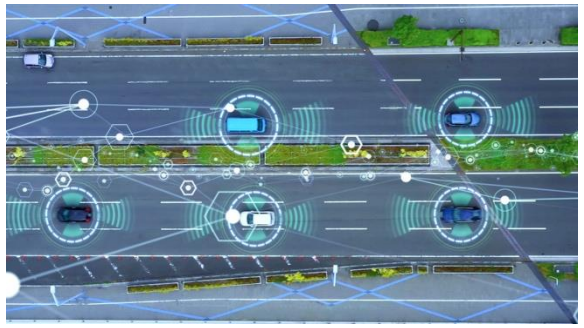
What does this mean for asset owners? In the context of a recycling policy?

- Additional / advanced data to support tactical decisions
  - Can this site be recycled (AEI data)
  - Network level structure/structural condition data to better define where recycling is viable and cost effective
- Additional / advanced data to support strategic decisions
- E.g.:
  - Rut data, poor longitudinal profile
    - Evidence of poor foundation performance may assist in deciding on suitability
  - Cracking data
    - Recycling schemes more effective when targeted at long lengths - monitoring detailed crack information may allow you to “sweat the asset” to decide on optimum interventions
- And knowing that the data is available to support strategies that include recycling policy



XAIS-PTS
INFRASTRUCTURE ASSET AND PAVEMENT SOLUTIONS
A PHENNA GROUP COMPANY

Further thoughts - emerging condition data - crowdsourcing



- Fleets - distributed image collection eqpt or ADAS sensors (e.g. Exeros, Mobileye)
- Edge processing for asset/feature extraction and automated alerts across the network.

Crowd Sourcing

waze

Pothole Tracker

ClearMotion

FixMyStreet

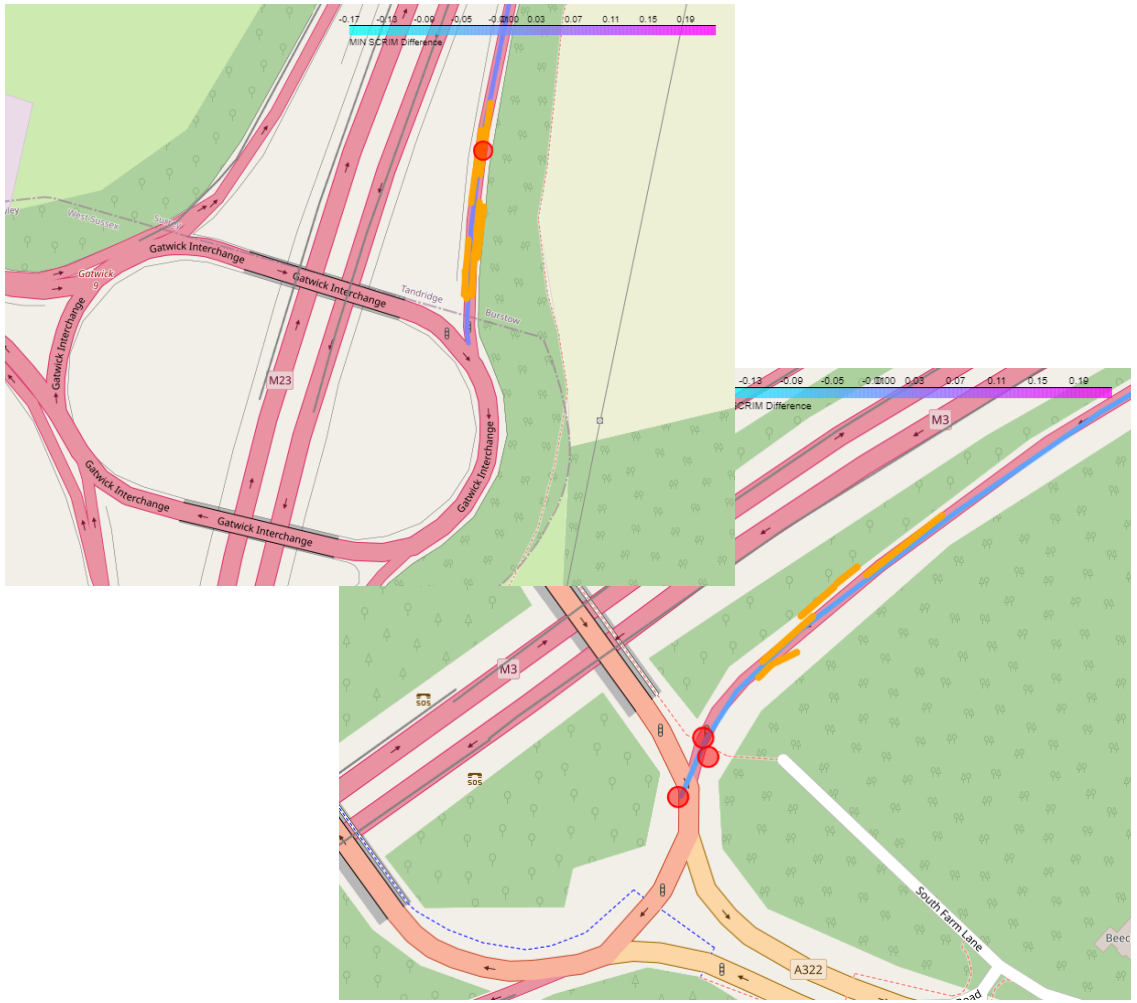
- User deployed in-vehicle or phone Apps
- Cloud data mining extracts asset pertinent data
- DST integrates with other sources to improve decisions

(Hyundai)

- Evolving Sensor systems within semi-autonomous systems in vehicles

XAIS-PTS
INFRASTRUCTURE ASSET AND PAVEMENT SOLUTIONS
A PHENNA GROUP COMPANY

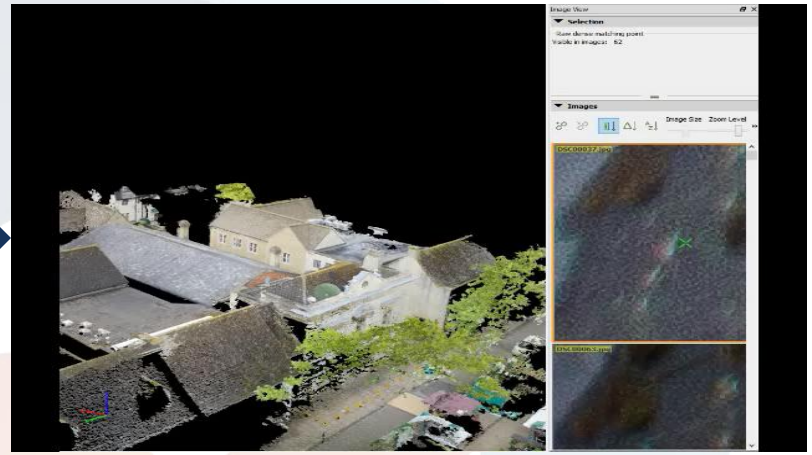
Further thoughts - emerging condition data – crowdsourcing for safety



- For example, TRL research investigated where crowdsourced data reported harsh braking and compared with accident data
  - Data may indicate where risks are higher, *before accidents happen*
  - Data could be used to support focussed site investigations
  - Data might be used to challenge Investigatory Levels

XAIS-PTS
INFRASTRUCTURE ASSET AND PAVEMENT SOLUTIONS
A PHENNA GROUP COMPANY

Further thoughts - remote sensing



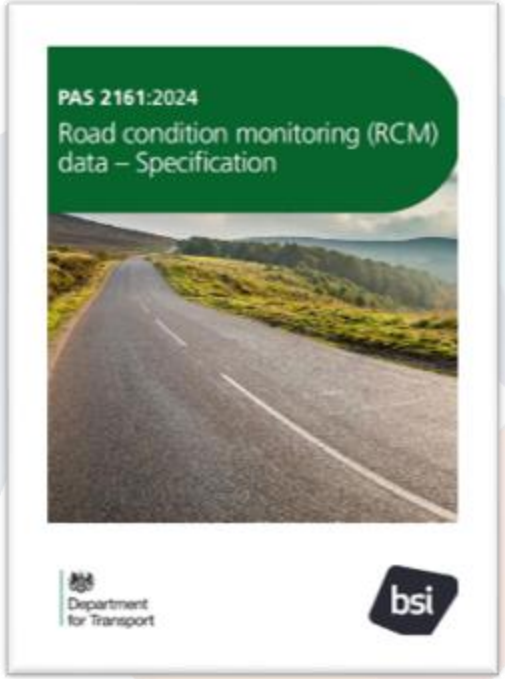
- Passive Satellite Earth Observation achieving resolutions of better than 0.5m
- Spectral reflectance and hyperspectral imagery
- Active sensing (SAR, LIDAR)

- Drone imagery deploying stable, maneuverable platforms
- Deploying imaging, LIDAR, SAR, photogrammetry
- Delivering high resolution data to focused sites

Could these ultimately be an"other" PAS2161 data collection tool?

Summary

- 2025 sees the introduction of a change in approach to network condition assessment, with PAS2161
- This is an opportunity to deploy the right technologies in the right place
- Authorities could get value from the Additional Data to support Asset Management, Treatment selection and to identify recycling options
- Sophisticated non-PAS technologies are available to support this
- Technology is still moving forward
- An even wider range of options will become available in the coming years



Questions

Thank you for your time. Any questions?