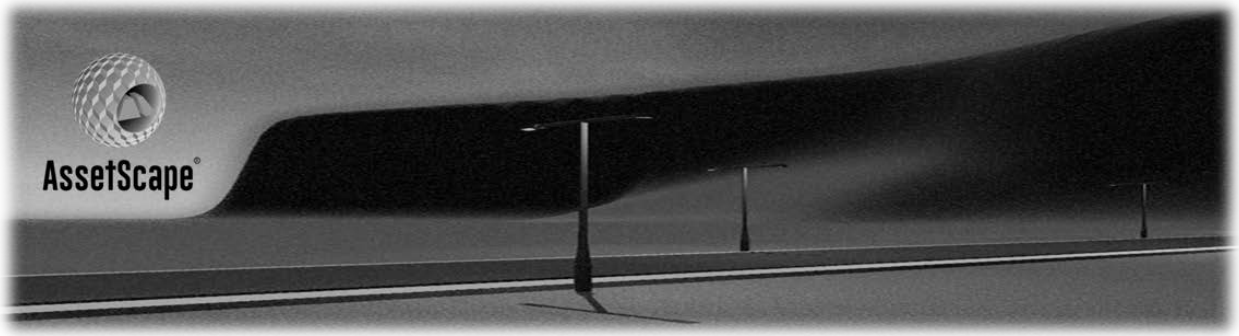


AssetScape® Capability (General)

AssetScape®

Prepared by AssetScape®

Title:	AssetScape® Capability (General)	Reference:		AS/D/02	
Date:	21/7/2015	Version:	1.0	Status:	F

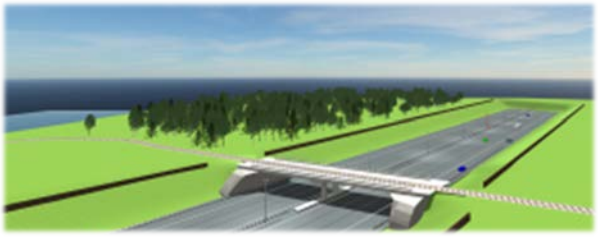
Contents

1 Overview and key points

1.1 Background to AssetScape®

AssetScape® is an asset management solution with a difference.

By combining our 3 dimensional data management approach with a 3 dimensional geographical engine, we have come up with a unique product that finally brings asset management into the 21st century. AssetScape® is much more than an asset management system - it's a "**World Management System**" (WMS).



AssetScape runs automated processes that merge user-supplied and publicly-available datasets to build its environment.

AssetScape® is amazingly easy to use.

Unlike conventional systems, newcomers to AssetScape® can be up and running very quickly with little or no training, performing tasks that would traditionally need far more experience to carry out. This is because working in AssetScape® is just like working in the real world BUT much, much easier!

AssetScape® brings your data to life.

From flora to fauna, bridges to buildings, roads to rail, planning to pavement-management, rivers to routes, weather to wilderness, works to warnings, coast to coast, past to future. Regardless of how little or how much data you have, AssetScape® will allow you to visualise, manage and interact with it all through its unique, fully-navigable, first-person-perspective 3D interfaces. These interfaces depict accurately-scaled virtualisations of customers' territories, properties and regions of governance.

AssetScape® integrates.

With its "**World Management System**" concept, AssetScape® not only interacts with data from your existing systems but also reads and projects publicly-available information live into its world-view. Elements such as weather, traffic flow, 3rd-party works, natural and tidal levels, are just a small sample of the widely-available data that can be linked AssetScape® to add further context to your experience.

AssetScape® allows you to travel in time.

By using one of AssetScape's many innovative features "The Time Slider™", users can easily navigate backwards and forwards through historical system events, instantly viewing details of these as they go. Whilst doing this, AssetScape's 3D worldscape changes dynamically to reflect all the information, geometry, inventory and live data available at the selected moment in time. Unbelievably, AssetScape's "Time Slider™" also allows the user to "slide" into the future, projecting future-modelled scenarios and overlays onto the world-view!

1.2 Quality of source data

The level of accuracy of any world that is generated by the AssetScape software is dependent on the quality and type of data sources that the user makes available to it. For example a world that looks and feels like the one in the demonstration **can** be automatically generated from just open source mapping, some road shape files and geo-coded asset inventory. AssetScape will position embankments, road-markings, general infill etc. automatically to its own advanced rule sets. However, a scenario like this, although having the appearance of the real world, will not contain

accurate enough dimensions to make precise measurement-based judgments and design engineering decisions. It would, however, be suitable for strategic usage and very generalised measurements.

To achieve a truly-accurate environment, AssetScape requires LiDAR point-cloud and/or as-built data sources made available to it. AssetScape can then merge these with the other less-precise data sources to create a scene whose dimensions can be used for any purpose.

2 Explore the scene

2.1 Overview of the scene

AssetScape has an in-built scene generator that can accept topographical maps, LiDAR and asset inventories to build the scene.

The scene captured here in Figure 1 is a combination of all three data sets. The generator was developed to create seamless scenes that retain the source data for analytical purposes. So where are the joins? We can't tell you everything, but the scene was built with the individual datasets and then merged or blended providing the user with a realistic scene. If the scene is built from data such as LiDAR, AssetScape will then provide geometrical interrogations based on how the world really looks – bringing a massively-enhanced level of spatial calculation with it.

Figure1: AssetScape Scene

So what about the scene shown in figure 1 above. What data sources were used?

Landscape – Ordnance survey open source topo maps. AssetScape automatically builds terrain from differing formats of GIS data.

Left verge – **LiDAR** point cloud data. The verge was created using TIN principles and then merged into the scene.

Right verge – **no data supplied**. The verge was auto-created by AssetScape and merged from the top of the embankment down to the carriageway.

Carriageway – LiDAR point cloud data. The carriageway was created using TIN principles and then merged into the scene**. If LiDAR point cloud data is not available then the carriageway would still be generated from GIS base road plans.**

White lines – LiDAR point cloud data. The whites lines where extracted from the point cloud and then overlaid onto the carriageway. **If LiDAR point cloud data is not available then road markings would be positioned automatically according to AssetScape engineering algorithms**

VRS - LiDAR point cloud data. The VRS was (critical points) extracted from the point cloud and then positioned in the correct WCS position. The posts were then overlaid and driven into the ground to the correct depth. **If LiDAR point cloud data is not available then barriers would be positioned automatically according to AssetScape engineering algorithms.**

Lighting points - LiDAR point cloud data. The lighting point base position was extracted from the point cloud and then positioned in the correct WCS position. The base of each column was then overlaid and driven into the ground to the correct depth. **If LiDAR point cloud data is not available then the units would still be generated automatically from inventory positions, with a column model overlaid vertically.**

Bridge – As-built data and LiDAR point cloud data. The critical points of the bridge, which are the underside and internal surfaces have been morphed onto the as-built model of the bridge. The processed bridge model is then loaded and merged into the scene to sit correctly alongside the verge and carriageway. **If LiDAR point cloud data or as-built data is not available then the bridge would still be generated automatically from inventory positions, with a bridge model overlaid to AssetScape's engineering and layout algorithms.**

AssetScape is set up to enable the user to develop any model into a fully functioning asset that can be managed in the maintenance manager module.

We have illustrated a few of AssetScape's capabilities which can be applied to any infrastructure asset such as coastal management and so on.

2.2 LiDAR feature extraction

The following features have been extracted and placed in the scene:

- VRS
- Lines
- Lighting columns
- Road
- Right verge

Each feature has been extracted from LiDAR in different ways and this depends on whether the asset is linear, point or area and in some cases the level of accuracy required to represent the asset within the scene. For instance, the user will require a good level of accuracy extracted for VRS alignment but not be too concerned about the detail of each post. Another example is lighting columns, we can record the planted position of the column and its angle, but other dimensions or shape data is taken from a combination of the inventory and model attributes that are held in the AssetScape library.

The right verge or for that matter any assets based on topography such as the road are developed using TIN calculation principles. A wire frame (mesh) is created from the LiDAR points to create the surfaces. We can also provide cross-sectional wire frames of the carriageway which are used to provide detailed analysis tools to report and analyse cross-sections and longitudinal profiles on the carriageway.

The accuracy of the models created from LiDAR can be a difficult to validate due to the quality of the source LiDAR data provided. We have carried out a series of validations between the source data (analysed in 3 different LiDAR viewers) and the processed data held within AssetScape (validation paper is available on request). We are confident that the accuracy of the data processed by AssetScape is comparable in terms of tolerances to all other LiDAR viewers on the market and represents the measurement calculated from the LiDAR viewers.

2.3 Overlay assets onto the landscape

This function can be used in two different ways:

1) The first function automatically lays any processed model to follow the topography of the landscape (land, rivers, road or structures), each model snaps to the scape at "ground level".

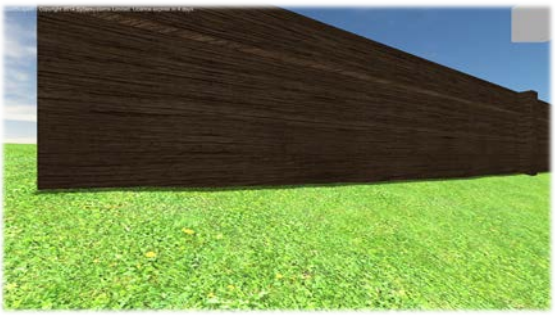
This feature is used when the initial scene is developed from raw data such as LiDAR that holds assets or features within the dataset.

2) The second function enables the user to load their own assets from GIS shapefiles. Assets are loaded and transformed into 3D models from the model library, where they are then positioned (laid) onto the landscape. Any GIS shapefiles can be handled (2D or 3D) comprising of points, lines or polygons.

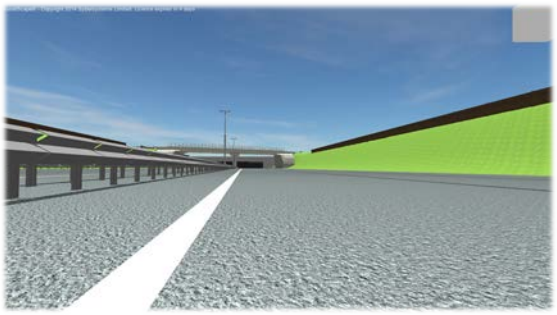
The assets or models overlaid in the scene and they include; white lines, VRS, lighting columns, sign, and boundary fence. Please note: the railtrack will also be developed to overlay and follow the land.

How does the overlay feature work? AssetScape holds all positional data for the base landscape, road and so on (base layer). So, when a model is positioned on top of the base layer it forms itself by either selecting the correct sized objects to follow the base layer as it would in the real world or literally adopts the same height data.

The illustration below shows boundary fence and white lines in action.



Boundary fence – as you can see, the fence panel follows the landscape until it gets to the end where it goes into the ground.



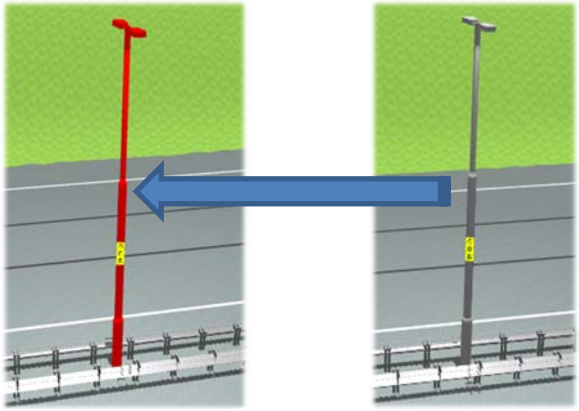
White lines – the lines are overlaid directly onto the carriageway spot heights.

2.4 Time Slider™

The Time Slider™ is registered to AssetScape as a product which forms the keystone to ease your access to data as **AssetScape® allows you to travel in time.**

By using one of AssetScape's many innovative features "The Time Slider™", users can easily navigate backwards and forwards through historical system events, instantly viewing details of these as they go. Whilst doing this, AssetScape's 3D worldscape changes dynamically to reflect all the information, geometry, inventory and live data available at the selected moment in time. Unbelievably, AssetScape's "Time Slider™" also allows the user to "slide" into the future, projecting future-modelled scenarios and overlays onto the world-view!

Maintenance activities



Before – Review History (defects and works issued “Door Broken”)

Now – No reported actions

Figure 2: Time Slider™ – review works history

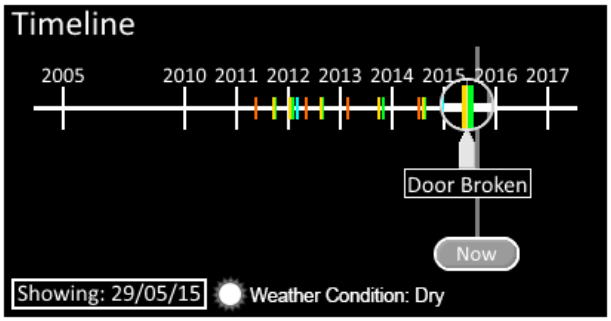
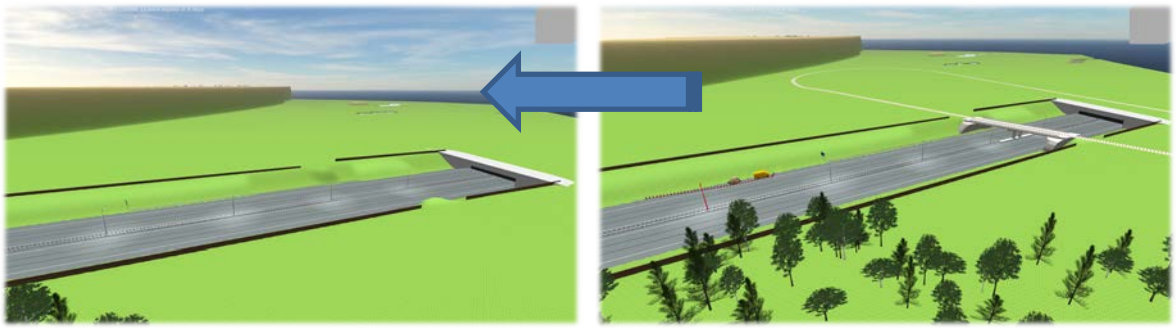


Figure 3: Timeline for defect

Construction



Before – Sliding back prior to building the bridge and railway infrastructure

Now – Bridge and railway built and loaded as the present day view

Figure 4: Time Slider™ – Pre / post scheme build

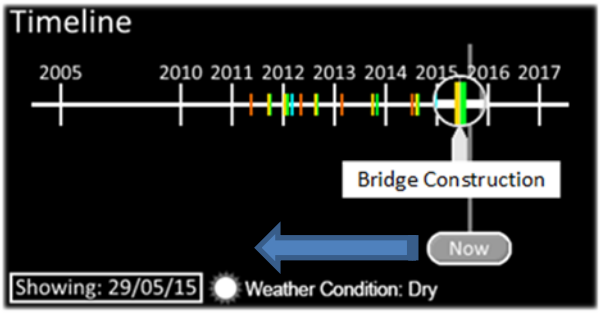


Figure 5: Timeline for bridge construction

2.5 Maintenance management

2.5.1 Summary

The maintenance management module is built around AssetScape's Time Slider™ feature. The data is structured to enable the user to review assets through the Time Slider™ window. What can be viewed? The window has a default layout that includes the main elements such as defects, works and inspections. The user can configure the window to include asset attribution, condition, basically anything that's held in the database that's time based. It also links to the BIM module, retrieving archive BIM data.

The user can manage defects interactively in the "control room" environment. The control room enables the user to manage works seamlessly, where data coming from site is compiled for the user to review and action by various means.

2.5.2 Scenarios

We have included a number of scenarios that demonstrate the potential benefits and highlight what could be achieved.

<u>Scenario 1 – All at your finger tips</u>

AssetScape has redefined the way we can manage the world's infrastructure by putting everything at the user's finger tips. You can break the system's functional benefits up into two areas, data and navigation.

Data is presented to the user without them even thinking about it consciously. This could be open source data that enriches the experience and provides useful background information such as the weather conditions, location of staff, travel data, live events (including twitter analysis) and so on. All the data can be recorded, stored and replayed via the Time Slider™ feature at any time. AssetScape's philosophy is to build functionality and features that are easy to use and just as important, easy to configure.

Navigation is where AssetScape excels and brings the most benefit to the user. We have worked on and even developed asset management systems in the traditional sense. Traditional systems are all constructed in a 2D world in terms of operation and for viewing data. AssetScape is truly 3D in both data management and viewing capability, enabling users to grasp and understand the data very quickly.

In summary, AssetScape will enable the user to see more, do more and cover more operations in one system. If you were to put a phrase to capture this point it would probably be **"EASE OF USE"**.

It would be difficult to put a cost saving or defined benefit to your specific solution. But, in our experience the key benefits that can be achieved from adopting AssetScape are listed below:

- 20% increased productivity (ops) – Streamlined operations
- 20% increased staff retention – More interest in working on the system
- 50% decrease in configuration costs – More included in the blackbox
- 100% increase in being informed – "visualise"

Scenario 2 – Find and fix (inc. alerts)

Clients wishing to adopt a find and fix operation can set this function up in AssetScape. How? Just purchase AssetScape and it will work straight out of the box. The service includes tracking, mobile asset solution to manage works onsite, find and fix functionality that ties into the maintenance manager module.

This function is covered in the demo software and highlights how a lamp out defect is sent to the works gang that is capable of fixing the defect. The system can be configured to suit your operation whether that be an inspector or gang find and fix solution. All defects can be reviewed and selected for pre-approval back in the office prior to auctioning the works – if required, or be automatically issued by the system.

The key benefit of AssetScape is the way that the find and fix works are managed between the office and site staff. There is a seamless transfer of data that may have been sent directly to the asset owner to review prior to actioning or a more holistic view of all defects in the vicinity are reviewed as part of find and fix.

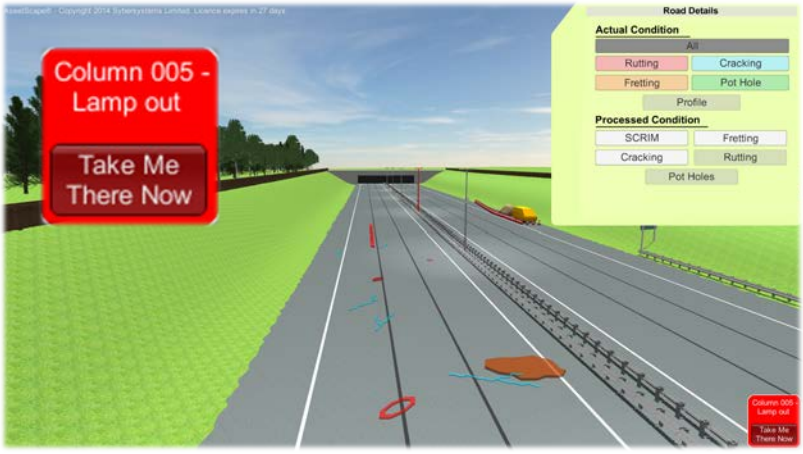


Figure 6: Find and fix alert sent to nominated asset owner

Figure 6 shows off the alert system. The nominated asset owner is alerted to a defect on site. The user has a number actions, open up a dialogue box to talk to the gang on site about the defect, or, allocate the defect to a defect basket for scheduled repair (collated), or, select defect for immediate repair. You can pull all asset defects for that location (past and present) to make an informed decision, such as whether to bulk order several different defect types under one traffic management order.

Key benefits:

- Communication between office and site
- Analyse all your data in one place
- Simplifies a complex operation

2.5.3 Route watcher

The user can set up routes and proceed along any one of these watching and evaluating the data that appears in the form of pop ups. The pop ups are defined by the user and can include a selection of defect types, conditions, attributed notes for any asset and so on.

Route watcher can be set up for real time movement to ensure the user picks up on the information on display and can pause, fast forward or rewind. The user can click on the pop up to review the data, carry out actions such order works, collate works or enter a stage comment for the asset management team.

A clever feature included in the route watcher is the jump button. The jump button will enable the user to literally jump to the next pop up along the route being viewed. This feature reduces the time taken to review a route.

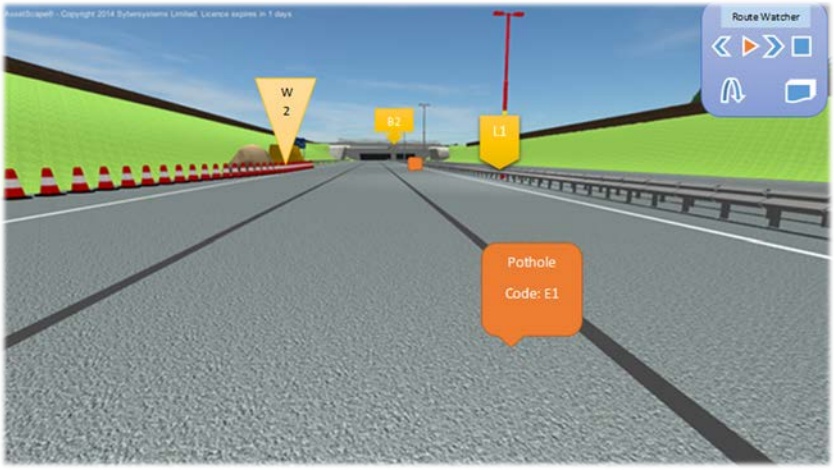


Figure 7: Route watcher illustration

Other features included are a search facility, listing all pop ups on the route which is planned to be developed to include more strategic tools such as risk evaluation and auto prioritisation of works.

2.5.4 Drag and Drop

This feature increases productivity and also improves on the quality of the service by dispensing with the need to do lots of typing and perform detailed lookups to carry out tasks - unlike traditional systems. For example, allocating reactive works to a gang is as simple as dragging the damaged (highlighted) asset onto them! AssetScape discreetly performs background validations as part of all its drag and drop routines and “fills in” the detailed supporting data as it goes.

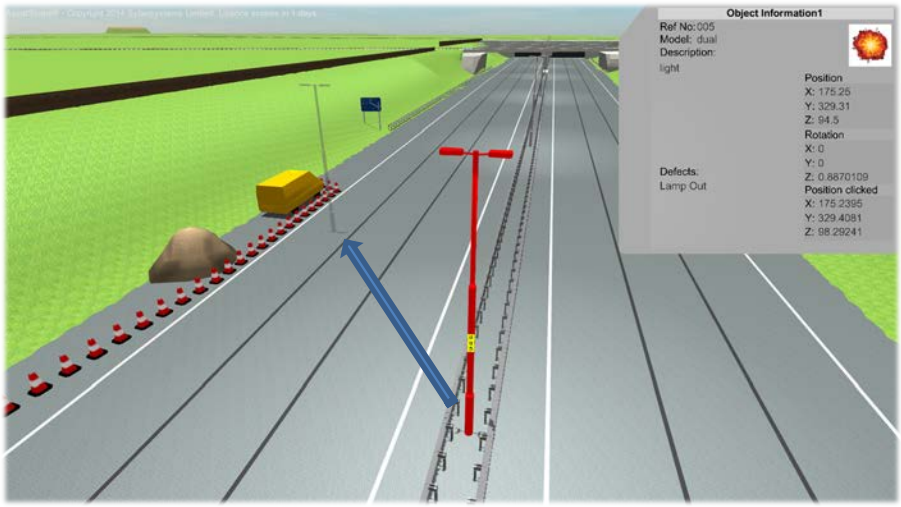


Figure 8: Drag and drop illustration

The user can create shopping baskets that are linked to gangs, defect repair types, work schedules and programmes. The baskets appear in the top left hand side of the screen as another cube. This feature enables the user to quickly drag and drop defects into as many work order schedules without the need to navigate through a number of works order screens. The works selected in each basket can be reviewed in the maintenance manager module.

2.6 Images

Images can be loaded and stored in the system. This function is used (for example) to load images of direction signs onto the asset in situ. The image could be the actual photo of the image or a standard detail from the traffic signs manual – for instance.

Images can also be stored of key assets such as a structure. The 2D photo can be overlaid onto the model to provide a real face of the structure.

Figure 9: Load sign image (auto snap to location / position)

2.7 Pavement management

AssetScape has three key pavement management functions:

- Prioritisation tool used in conjunction with Asset Risk Manager™
- Condition and defect visualisation
- Pavement management

All three are plugin functions that can be configured when the raw condition data from scanner or visual surveys is uploaded.

The cross section of any pavement can be displayed by the route watcher feature. Figure 10 illustrates how route watcher runs along the lane selected and highlights the defects and profile at each cross section interval. Route watcher can be set to a cross section interval (every 100mm or every 10m) and will also display any defects including user defined flags or alerts for data that are out of the desired limits. A similar set-up is available for the profile variance for any lane set.

“Set route watcher to roll through thousands of kilometres of network without stopping to load data files”

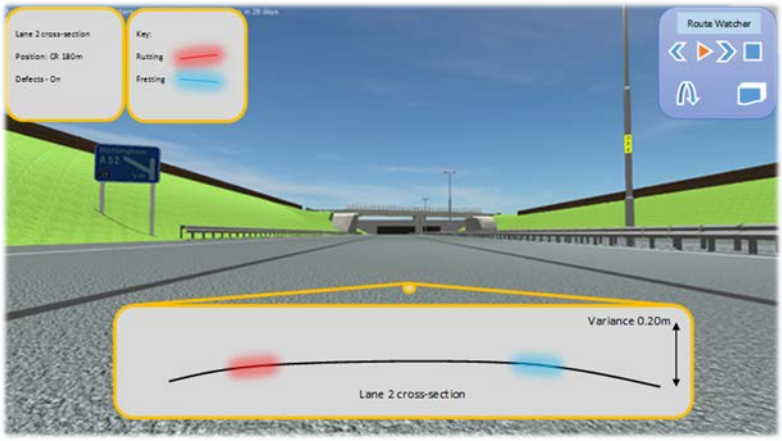


Figure 10: Route watcher – Pavement analysis

AssetScape has a mobile solution that can be configured for detailed visual condition surveys, defect management and works ordering. The mobile solution builds on 4 years of experience in providing easy to use mobile solutions working with infrastructure. The mobile solution continues to build on the philosophy of **AssetScape®, being amazingly easy to use.** Users can be up and running very quickly with little or no training, performing tasks that would traditionally need far more experience to carry out. This is because working in AssetScape® is just like working in the real world BUT much, much easier!

The following sections summarise each function:

2.7.1 Prioritisation tool

Many clients strive to develop cross asset prioritisation tools that can identify the need based on underlying engineering decisions. We have experience in developing cross asset prioritisation tools for highways infrastructure clients, and find that they all see the carriageway as the main influencing factor.

So, the carriageway is the key asset and becomes the platform for building the prioritisation process around. The pavement condition indices are used as the starting point and are incorporated into the prioritisation process used in Asset Risk Manager™.

2.7.2 Condition and defect visualisation

AssetScape can display condition and defect data in a way that encourages users to combine complex datasets to view like never before. Condition data, particularly from machine based surveys will always be percentage-deterioration, section based outputs; but… users can also load actual defects and detailed visual condition data which is plotted alongside the section based data.

This methodology needs users to adopt a new way of thinking. They will be collecting the real defect or condition state on site. E.g. plotting the cracking, rutting, fretting etc. geometrically and sending this to AssetScape, which automatically processes this into section based data. With the latest mobile data collection software, collection on site is fairly easy to do and will bring savings and benefits when you need to re-inspect. No need to start again, just amend what you collected last time. This process improves on the quality of the data collected, enables the user to re-use the data for planning, business cases etc.

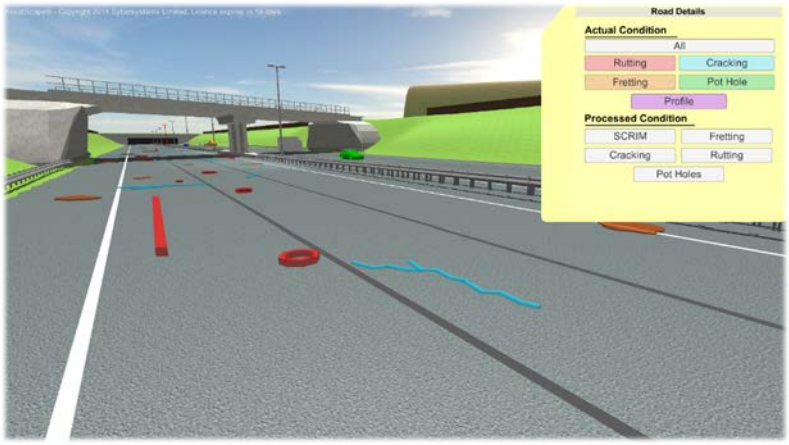


Figure 11: Visualise real pavement data

2.7.3 Pavement management

AssetScape has the potential become a pavement management system (PMS). The client may have a preferred PMS solution that they are more than happy to interface with in terms of overlaying the results. Our consultancy partners have many years' experience in configuring and operating PMS solutions and would be able to provide pavement engineering support.

2.8 Line of sight

AssetScape is a perfect tool for positioning the user to locate targets that in the real world are inaccessible or would require a model to be built specifically to measure line of sight, on site.

Simply load the open source TOPO data, insert any specific models such as trees, houses, landmarks and then navigate around the scene. Any measurements taken are stored in the .dat file to be recalled and used for reporting purposes.

Please use the measurement point to point functions to establish line of sight examples.

2.9 3D vertical management

AssetScape offers users a unique solution that unlocks the power of managing infrastructure from a world view perspective. Traditional systems based on 2D GIS can restrict how complex 3D features are managed - if at all. AssetScape is just as effective at operating in either 2D or 3D environments and can open up a new way of thinking. Firstly, you can see and explore the infrastructure in a 3D context, and secondly, you manage the infrastructure by collecting inventory, developing works and inspection programmes.

The main focal point for this solution is geo-type assets such as coastline, embankments, cuttings, and mining.

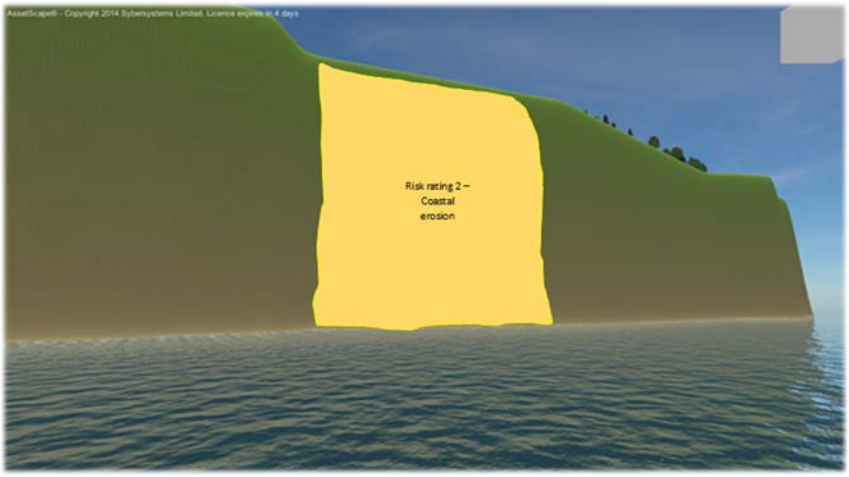


Figure 12: 3D overlay of information

2.10 Covered assets

AssetScape includes functionality to uncover assets and components such as underground assets and tunnel systems that the user can manage within AssetScape. The main benefit of AssetScape is that it removes the need to navigate through form-based data-entry screens (which are considered boring and long-winded) to manage the core assets. A tunnel is a great example, where users can peel back the structure to expose key components and elements to enable clear asset management.

All assets are placed in their real world positions and are linked to the hierarchies and schemas for each asset. The user is able to see the asset or component in its true environment for the purposes of planning works, inspections etc. The real benefits come from the way assets are managed within AssetScape.

2.11 Water

AssetScape can be used predominantly to visualise the general impact from flooding events on a local scale. Yes, you could raise the sea level across the topography of the whole nation and see what happens but this wouldn't serve any real purpose. However, there are two useful functions; 1) localised risk profiling and scenario modelling for river systems, and 2) Tidal impacts for coastal erosion. We are also sure that it has many other uses when it comes to assessing water flows.

1) River impact models (3D)

   AssetScape can be used as a 3D river flood model for high intensity rainfall, evaluating flood risk and catchment area collection due to rising water levels in the river system. The model is visually interactive, turn the flow up and see it happening in front of your eyes with realistic effects.

   The model simulates overtopping of river systems and the subsequent effects across urban flooding due to climate change events. These events can be due to heavy localised rainfall, insufficient flow capacity of storm inlets or the drainage network.

   The simulation can be started at any point along the river system and can include actual embankment data (based on as-built or LiDAR scanned data). This will highlight high risk or hotspots along the river system and will identify infrastructure, housing and other assets that may be at risk.

   The simulation will also enable users to test out designs and concepts as part of the flood defence analysis. This will also include the validation and testing of existing flood planes that are part of existing fold defence systems.

"Turn the tap on upstream and see what impact it has on the river system downstream!"

2) Tidal impact models

AssetScape offers an innovative and accurate solution to visualise coastal flooding as part of a flooding risk assessment, which can be associated to flooding of coastal towns / cities, infrastructure and low lying areas.

It can be configured to model complex and dynamic events such as storm surges, and the influences from estuaries, rivers and drainage ditches as well as sewerage systems.

It can be easily configured to assess real coastline and then gives the users the possibility to investigate the effects of coastal protection, such as dikes/polders and tidal gates or other operational structures in high risk areas.

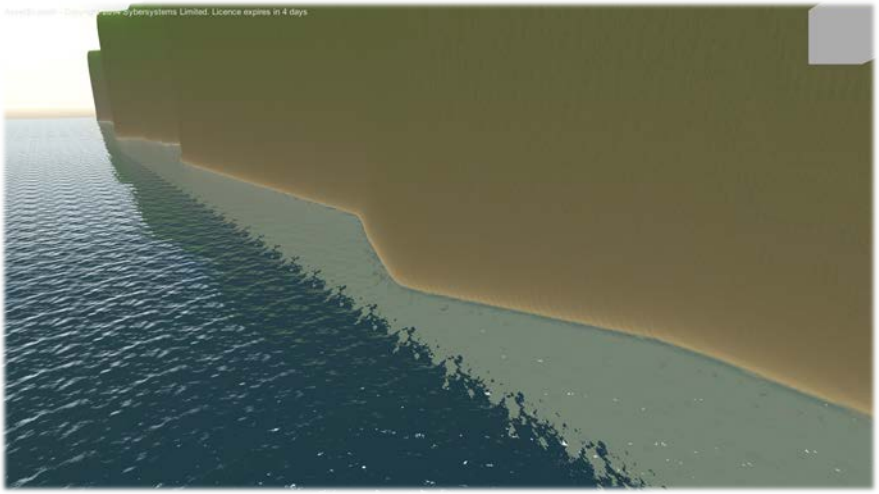


Figure 13: Coastal tidal visualisation

2.12 Traffic

AssetScape enables users to visualise various states of traffic flow on the network, no traffic, normal, heavy and congestion. AssetScape can be interfaced with any other system to display live traffic flows as part of the head up display. Users can navigate between different locations or even set alerts that will zoom to the location to show the stats and visual display.

Traffic flow data is recorded and can be used in several ways:

2.12.1 Time Slider™

The user can go back in time to review traffic flow data for any point in the past. Queries can be location or route based.

2.12.2 Traffic flow analysis

All data is recorded and can then be accessed for the purposes of traffic planning, research, modelling etc. If the user loaded traffic stats it would enable them to correlate this with traffic flow data, key assets such as signs, lighting and key risks for any location.

2.12.3 Vehicle emissions (actual)

AssetScape can be set up to provide a powerful visualisation of vehicle emissions in accordance with your particular emissions criteria. This includes some of the following categories:

- Carbon Dioxide
- Hydrocarbons
- NOx
- PM2.5
- PM10
- Air Quality

Each category can be displayed on screen for any vehicle lane and is based on recording the movement of a vehicles every 10m every hour. The visualisation includes various coloured trails of smoke that are graded in colour intensity based on the levels of pollution. Every emission trail's data attributes can be analysed on screen or accessed via the reporting functions (e.g. search and find the highest polluter on a particular day or the highest that year).

The data can be used to highlight hotspots on the network with ease. No need to build complex models as it is already set up to provide key data to enable holistic decisions regarding the movement of traffic on the network.

2.13 Creating asset models

A library of models would be developed to align with the client's asset and scape inventory. Asset models can also be created by the user for any asset including components using either our own model generator or 3D modelling software that generates an FBX format file.

Using the latest 3rd-party 3D software, you can also load 3D photo images, from these, of the asset or component, into AssetScape, as if it was the real thing. We see this as an opportunity to enable manufacturers to provided 3D photo images for planning or asset management purposes.