ESReT

European Safety Review Tool
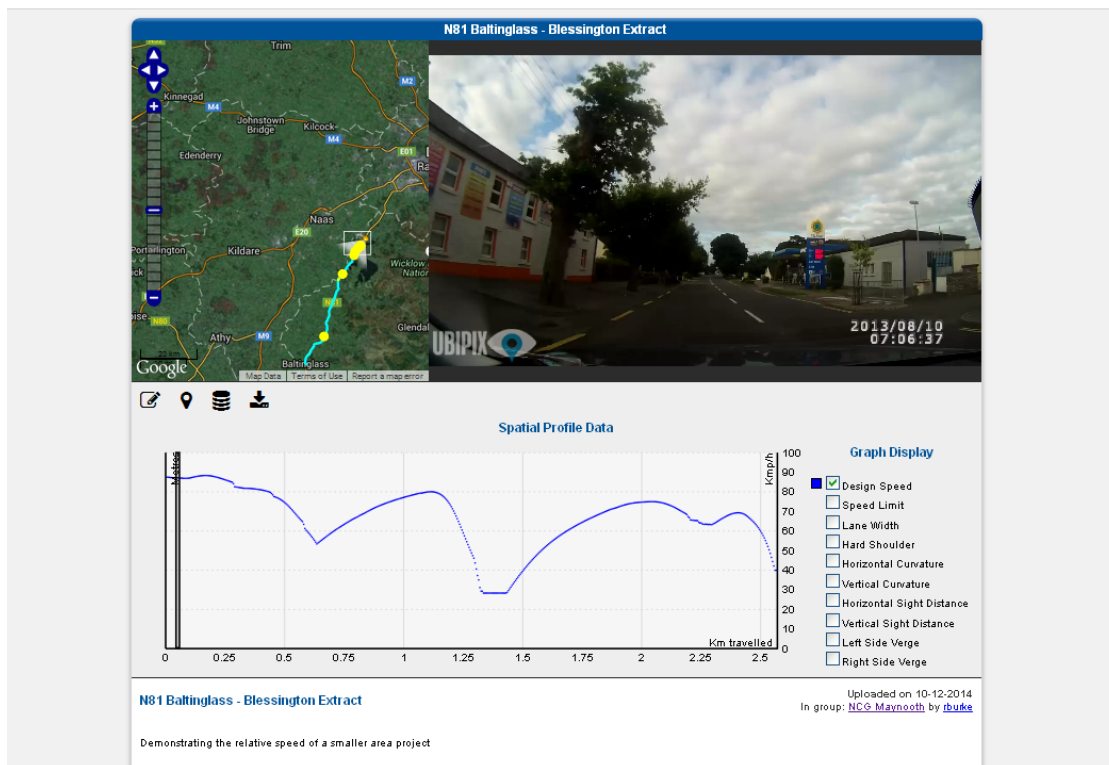
User Guide V1.3

Contents

1 Introduction

This document details the basic steps of working with the ESReT platform. It describes how the user can create projects and upload, display, manage and analyze road survey data and Ubipix tracks.

Please contact Support (support@ubipix.com) for any additional help or queries

2 Getting Started: Register an Account and Log on

To log on to the ESReT system you need an account with Ubipix (app.ubipix.com), you can use those login details to access ESReT. Registration for Ubipix can be done online at https://app.ubipix.com/login.php?action=signup.

Ubipix is a location based multimedia-mapping platform that can be used by anyone to capture, tag, upload and share their multimedia videos and Imagery. Through Ubipix, a user can capture geoSpatially referenced video footage and import this into the ESReT platform.

3 The Dashboard & Header Bar
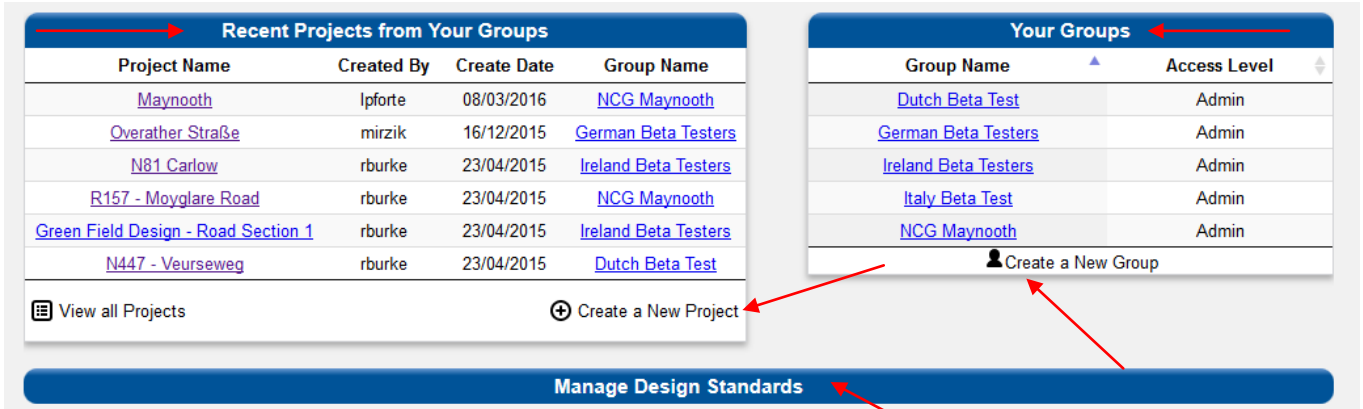
The Dashboard is the homepage of the ESReT platform. Here you can see your groups and selected projects from your groups. Also you can create new groups and new projects and manage existing Design Standards and create new ones.

The Dashboard can be reached from anywhere on the website, by either clicking on the ESReT sign at the top left of the screen or on the Dashboard? link on the right.

In the same top header bar, you can always log out by clicking on the *Log out* link.

You can also click on your full name which will bring you to a page with all your projects, and the option to change your password.

4 Manage and Create Design Standards

To manage existing and create new Design Standards click on *Manage Design Standards* on the dashboard.
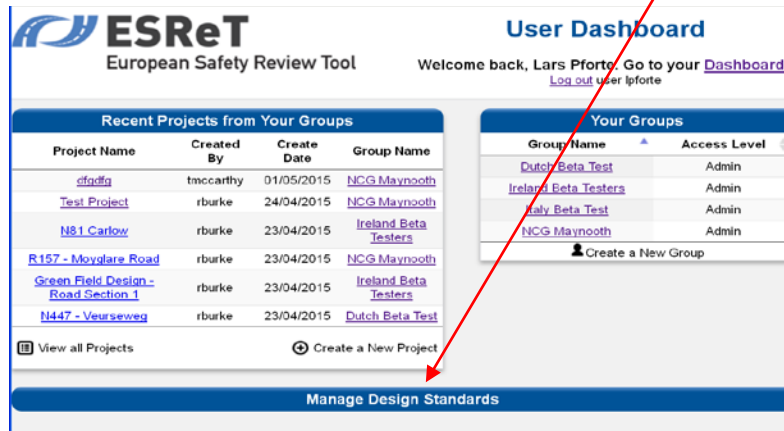
This leads you to the Manage Design Standards page from where you can either view and access existing Design Standards or create new Design Standards.

4.1 Manage existing Design Standards

Under *View Available Design Standards* choose the country whose design standards you would like to access.
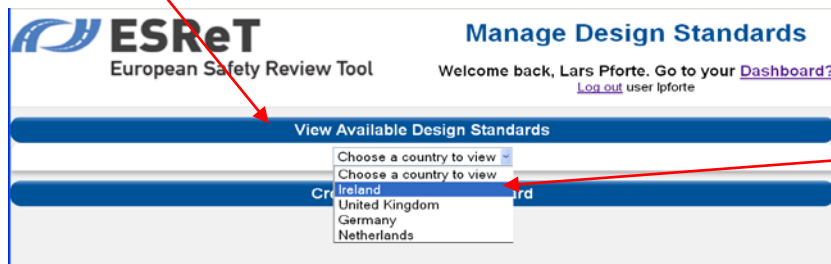
A default 10 entries is shown per page. This can be manually changed to 25, 50 or 100 entries per page. For all available design standards the following information is displayed:

- Road Class Identification
- Cross Section
- Description
- Minimum Design Speed
- Maximum Design Speed

All entries can be ordered according to these features by clicking on the up/down ⬍ button next to the feature name. An option to search for a particular design standard is also available.

You can access any design standard and see all its details by clicking on it. A window appears with all for that country relevant road features, such as, road width, alignment (horizontal/vertical), speed (posted speed limit and design speed), sight distance and others, with their respective values for this particular design standard. Note that not all values may be given.

To edit the value of a feature click on *Edit* to the right of the feature. **This feature is only available to users who have Admin rights for a particular country.** Now you can change the relation sign and/or the given value. If the feature requires an interval of value, click on the symbol ± next to the second box. Two more boxes appear to enter the relation sign and value of the upper bound of the interval. The two boxes disappear if you click on the symbol ± again. Once you have finished your editing press *Submit* to save your changes. **Note** that if you edit several features, then you need to press *Submit* each time after you finished editting a feature.

Edit the relation sign and value of the feature.

Click the plus-sign for a second pair of boxes to appear. Now you can enter the upper bound of an interval. Click on the minus-sign for the interval option to disappear.

Click on *Submit* to save your changes.

Close the window by clicking on X near the top of the page.

4.2   Create new Design Standards

On the Manage Design Standards Homepage click on *Create New Design Standards*.
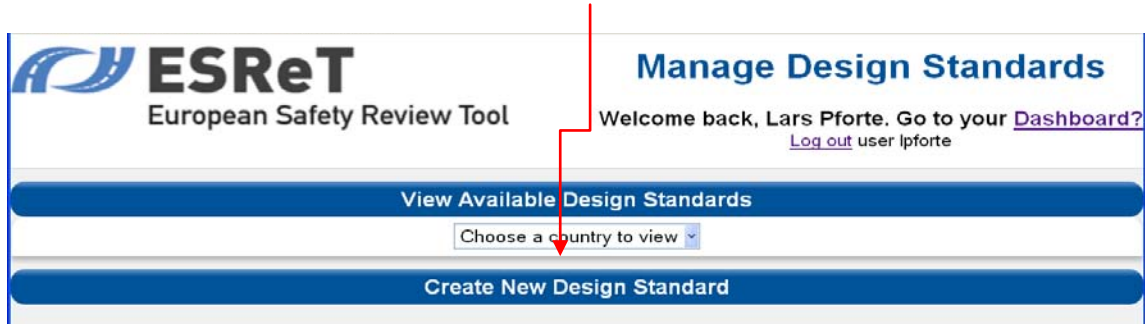
This feature is only available to users who have Admin rights for a particular country.

When creating a new Design Standard you need to choose to which country the standard applies. Next provide the road class identification of the standard, name the cross-section and give a description of the type of road, such as, Single Carriageway, Dual Carriageway or Motorway. Finally state the minimum and maximum design speed that applies to this standard. Finally click on *Add Design Standard* to create the new class.

Start by adding details, such as, country, Road Class ID and minimum and maximum Design Speed.

Create the new class by clicking on *Add Design Standard.*

Next you are prompted to enter data for the various rule categories, such as, road width, alignment (horizontal and vertical), speed and others. For each factor choose a relation sign (you can choose between =, ≤, <, ≥ and >) and a value. The value can be numerical or categorical (eg. you may be asked to specify the 'Shoulder Type' in which case you might enter for instance 'Hard Shoulder' or 'Hard Strip only'). If you want to enter a range instead of a single value click on the and - symbol . Thus a second pair of windows appears (one for the relation sign and one for the upper bound of your interval). Once you are finished press *Save and Continue* to save your inputs and to proceed.

Note that you do not need to fill out all factors during the initial process of creating the new standard. Instead you may leave them empty for now and come back later to complete the rules (point 4.1. Manage Design Standards describes how to complete/change existing design standards.)

Choose a relation sign and enter a value for each rule. Click on *and* to enter a range of values.

Press *Save and Continue* to save your inputs and to proceed.

Once you have completed the creating process the new Design Standard will appear on the country's list of design standards (please refer to point 4.1. Manage Design Standards to see how to access each country's available standards).

5   Your Groups

On the dashboard you find a section containing your groups. From here you can access your groups or create new groups. To access a group, click on the group name, to create a new group, click on *Create a New Group*. You can also list your groups alphabetically in both ascending and descending order, or order them according to the Access Level.

List of your groups. Click on the group you wish to access.

Create a new group by clicking on *Create a New Group.*

5.1   Access your group

As described above you can access a group by clicking on it in the list of your groups. You then see all projects within that group. A default 10 projects is shown per page. This can be manually changed to 25, 50 or 100 projects per page. For all available projects the following information is displayed:

- Project Name
- Description
- Created on
- Created by

List of projects in the group

Search Option

Remove Option

You can order the projects on your list according to these categories by clicking on the up/down button next to the category name. An option to search for a particular project is also available. Finally you can remove a project from your group by clicking on the Remove-button to the right of the project.

5.2   Create a New Group

In order to create a new group click on *Create a New Group*. This option can be found below the list of your existing groups. Enter the Group Name and choose whether your group is *public* or *private*. Click on *Create* to create the group or click on *Cancel* to cancel.

Enter a Group Name

Choose the group as public or private

Create or cancel group

Create a new Group

5.3 Manage Your Group

When you are a group administrator, you can deactivate the group, or add and remove users from your group using the Group Settings icon in the top left corner of the group page:
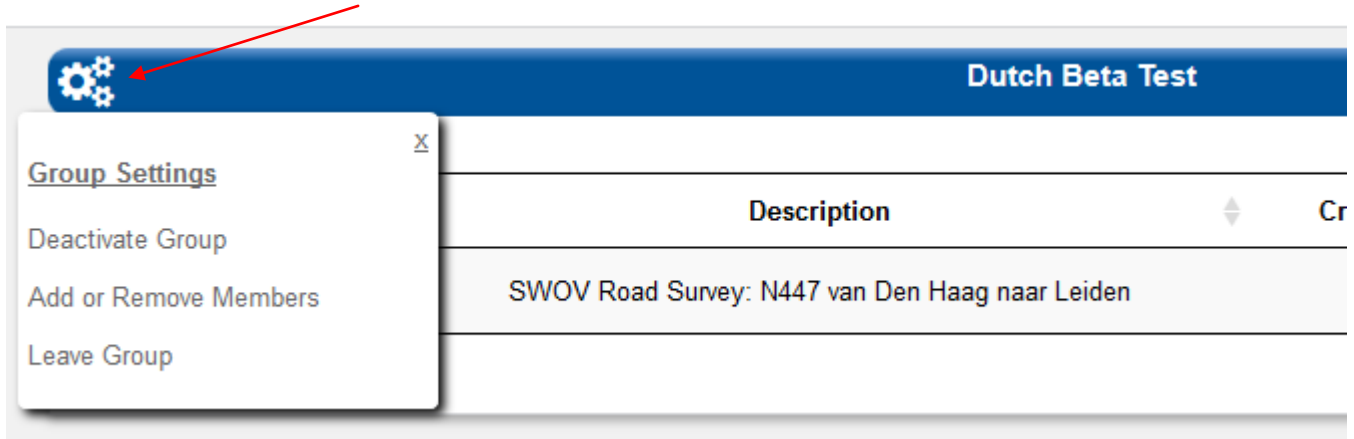
Choosing to **Deactivate the Group** will hide the group all projects that are part of the group. This can only be undone by contacting a system administrator, so proceed with caution.

Choosing to **Add or Remove Members** will bring you to a new user management screen.
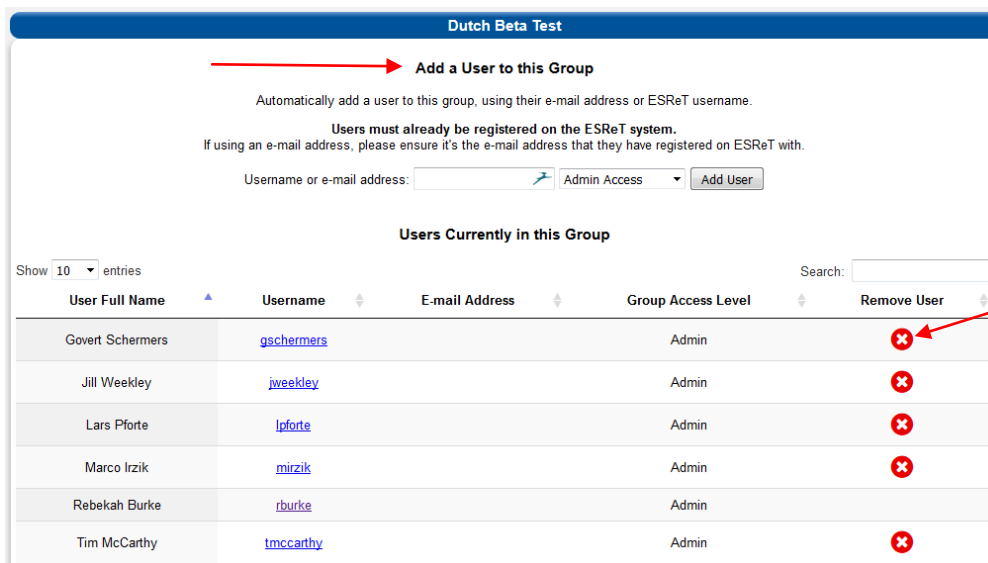
On this screen you can enter the ESReT username of a person you wish to add to a group, select an access level for them, and click "Add User" to automatically make them a member of this group. This will allow them to see the group (if it is private), and to add projects to this group.

Note: The user must be an ESReT user, or a Ubipix user who has logged into ESReT at least once.

Below the Add User section, you can view users in your group, and remove them using the Remove User button. If you would like to change a user's access level, you should use the Remove User button and then re-add them with the new access level.

6 Your Projects

On the dashboard your recent projects are listed. From here you can also view all your projects and create new projects. A project can be accessed by clicking on the project name.

6.1 View all Projects

Click on *View all Projects* to access a complete list of your projects. A default 10 projects is shown per page. This can be manually changed to 25, 50 or 100 projects per page. For each project the following information is displayed: Project Name, Description, Created on, Created by.

You can order the projects on your list according to these categories by clicking on the up/down button next to the category name. An option to search for a particular project is also available. Click on the project for access.

6.2   Access a project

As seen in Point 6.1 View all Projects you can list all your projects. You can also list all projects that belong to a particular group. Through either list you can access a project by clicking on the project name. Depending on the stage of the project the project page consists of three parts:

- Display of the project data (video and graphs)
- Data management (adding road surveys and/ or Ubipix tracks)
- Road testing & Analysis (Design Standard Check and Safety Check)

We discuss each section separately below in chapter 7.

6.3   Create a New Project

Click on *Create a New project*. Next enter a project name, give a brief project description and choose the group to which you want the project to belong (this group must already exist). Also you can associate a country and one of the country's road standards with the project. Finally click on *Create* to create the project or on *Cancel* otherwise.

Next you are asked to define the area of interest for the new project. In the left window above the map you can enter a location and search for it by clicking on *Search Location* to the right of it. Next click on *Start Drawing*. This button is to the right above the map. Drag a box on the map to define the extent of your road. This will be used to find the appropriate map layers in your area of interest. You can move and resize the box. When you are happy with it, click on *Submit area of interest* below the map.
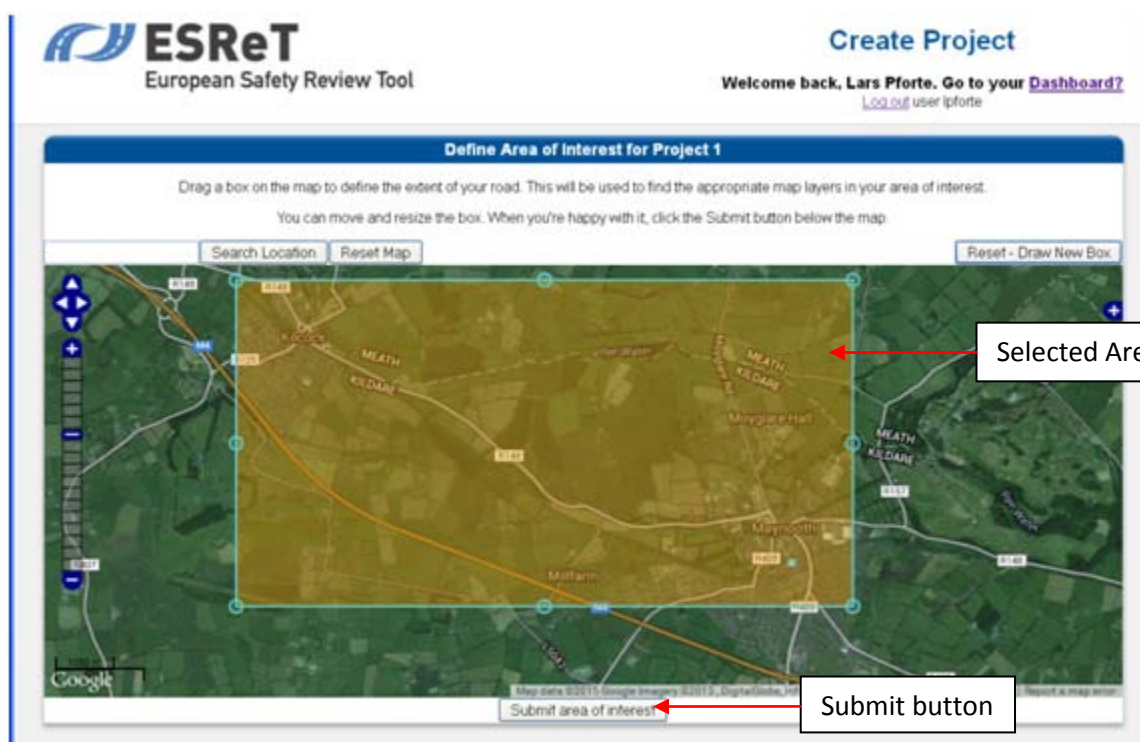
Your project is now created and is available both on the list of all your projects and under the group you have associated your project with. You can now add a survey file or a Ubipix track to your project. Please see Point 7.2 for more information on how to do this.

7   Work with your project

If you access your project you will see up to three sections within your project. They are concerned with data display, data management and data analysis. (Please also see Point 6.2 Access a Project). In the following we describe more closely what you can do within each section.

7.1   Data Display

If your project already contains road survey data, then the first road survey instance on your list is being displayed in this section (see section 7.2 Data Management on how to upload a road survey file and on how to switch between different road survey instances or different Ubipix videos). There are four different elements in this section. They are:

- Ubipix video feed
- Google Maps
- Graph Display
- Working Tools
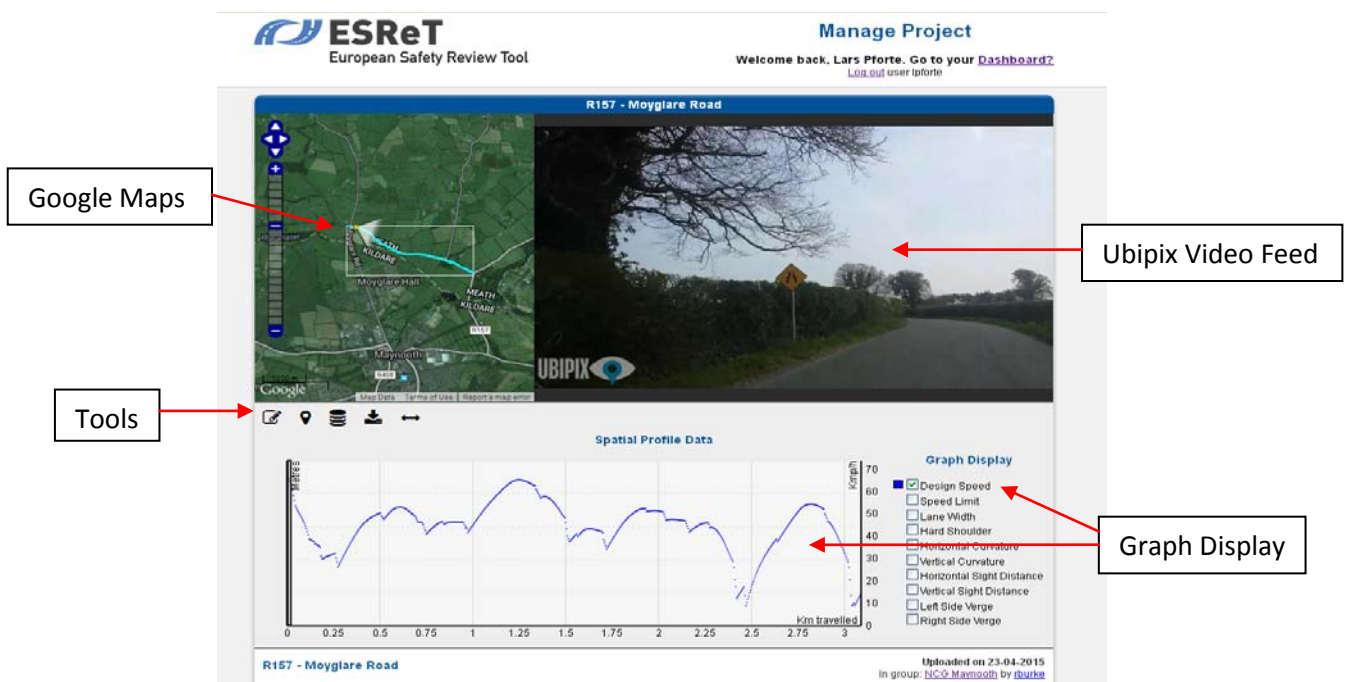
You can explore the recorded journey simultaneously through the Ubipix video, in Google maps and in the displayed graph. All three features are linked and indicate the same location along the journey. You can jump to any location of the journey either by using the streaming bar in the video, clicking on the location in google maps or clicking on the position of interest in the graph.

Location on google maps

Position in the ubipix video

Position on the graph
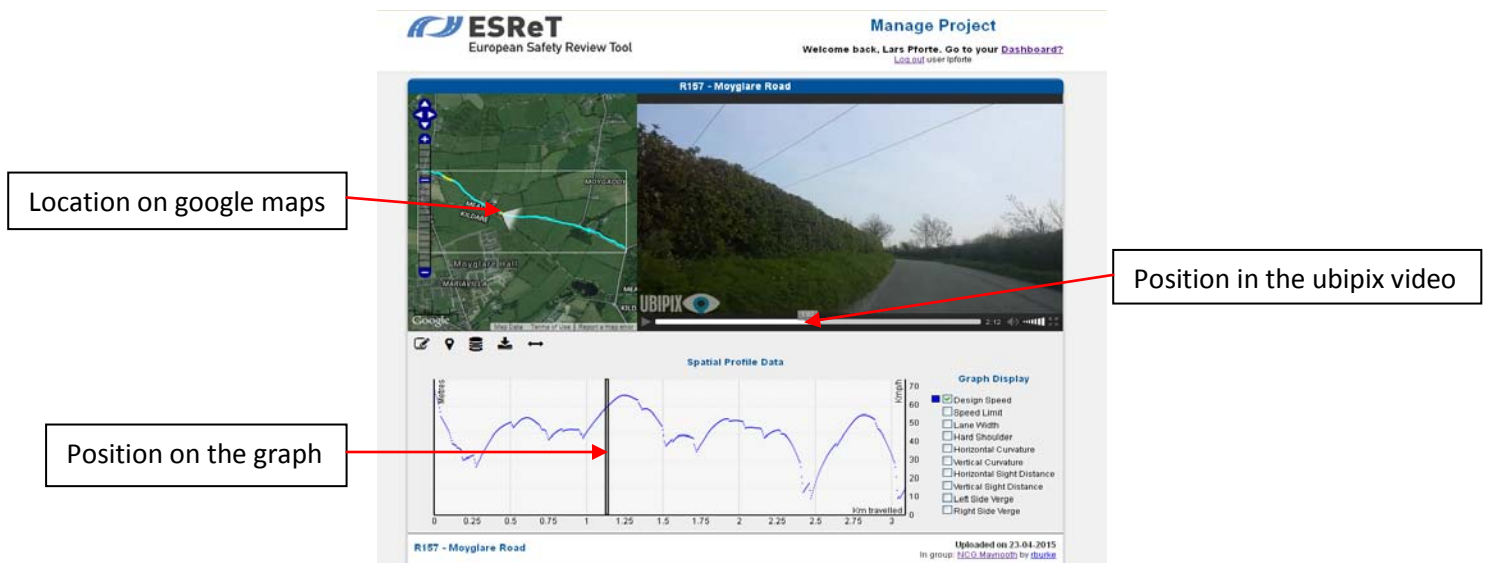
You can choose which road features are displayed in the graph by ticking the box next to the features name. Untick the box to remove the feature from the graph. The following features are available:

- Design Speed
- Speed Limit
- Lane Width
- Hard Shoulder
- Horizontal Curvature
- Sags
- Crests
- Horizontal Sight Distance
- Vertical Sight Distance
- Left Side Verge
- Right Side Verge

Three features are ticked and displayed.
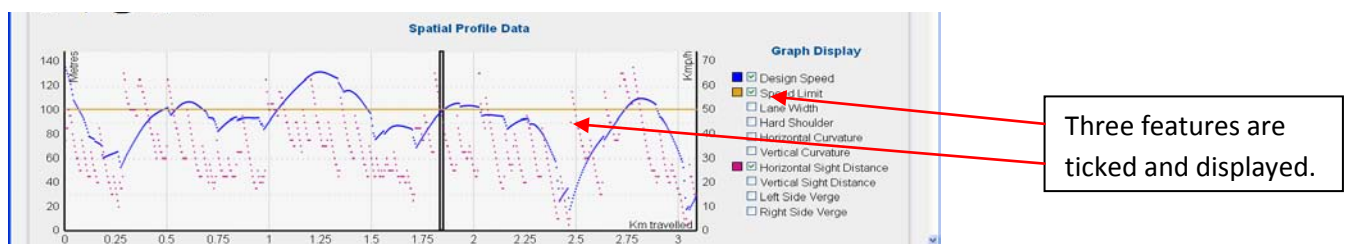
See the appendix for a more detailed explanation how these elements are derived. It is possible to change the colours of the graph lines for ease of viewing; clicking on the small coloured box to the left of the feature name will present you with a colour palette.

7.1.1   The Tools

Below the google maps you can find five tools, which help you to work with and improve the data.
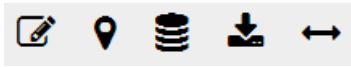
We discuss their functionality in the following.

7.1.1.1   Tool 1 – Draw a continuous road feature, such as a hard shoulder

Click on the symbol ✎ . A blue window opens and you are asked to select a feature type. Here you can choose among a long list of various features that you would like to mark during the journey. Once you have chosen the feature type a drop-down menu appears asking you about feature attributes. The available attributes differ between the various feature types. For instance if you choose *Hard Shoulder* as your feature type, then in then two feature attributes, *Presence* and *Shoulder Width*, occur. If you choose *Slope at Roadside* as your feature type, then one feature attribute, *Type of Slope*, occurs. (See the Appendix for a complete list of all feature types and details about their attributes). Once you have determined Type and Attributes you can either draw the feature, if it occurs only locally, or save the selection for the whole section.

If you click on *Draw Feature* you will be able to draw a path on the map. Click at least two points and double click the final point to finish the drawing. Once you have started you can reset and cancel the drawing. If you are happy with you drawing save the feature.

If you click on *Save for Whole Section*, then your chosen feature is automatically drawn and saved for the entire section, within the area of interest and using the coordinates from the road survey data.

7.1.1.2   Tool 2 – Mark static road feature, such as intersection

Click on the symbol ⦿ . A blue window opens and you are asked to select a feature type. There are six feature types to choose from and for each feature type you need to indicate one or more attributes. See the Appendix for a complete list of all feature types and details about their attributes.

Next click on *Draw Feature* and on the map click at the location of you point feature. Next save the feature or reset or cancel drawing.

7.1.1.3   Tool 3 – Choose the Base Layer and show / hide map layers for area of interest

Click on the symbol ⛁   . A blue window opens and you can choose one of five base layers for the google maps window and select up to four overlays. The base layers are:

- Google Hybrid
- Google Satellite
- Google Physical
- Google Streets
- Open Street Map
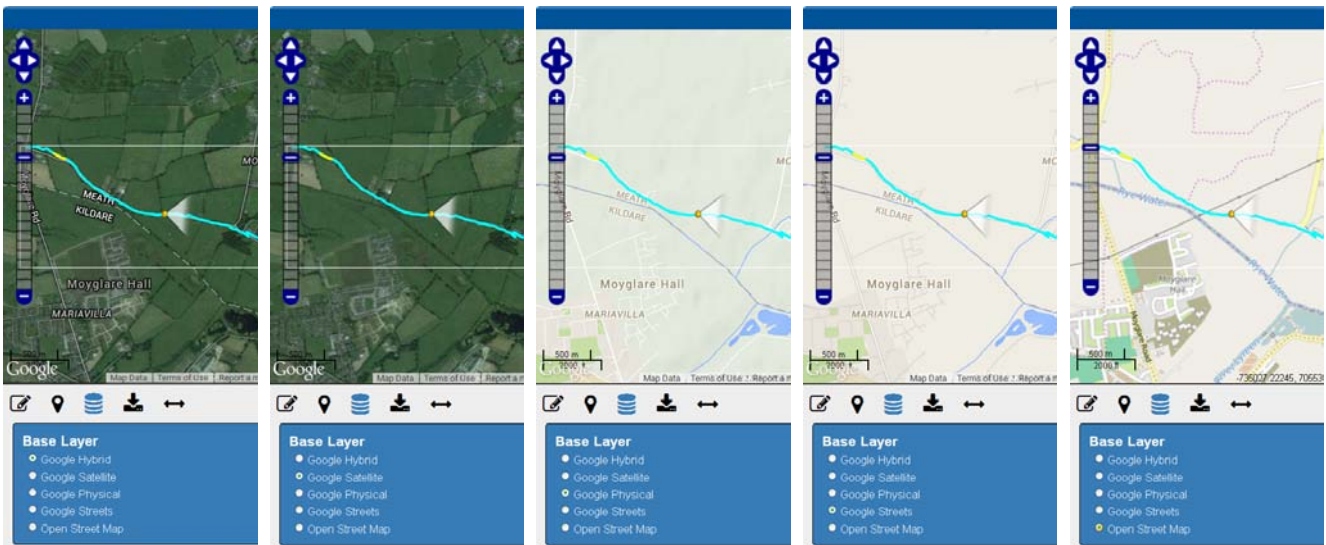
The overlays are:
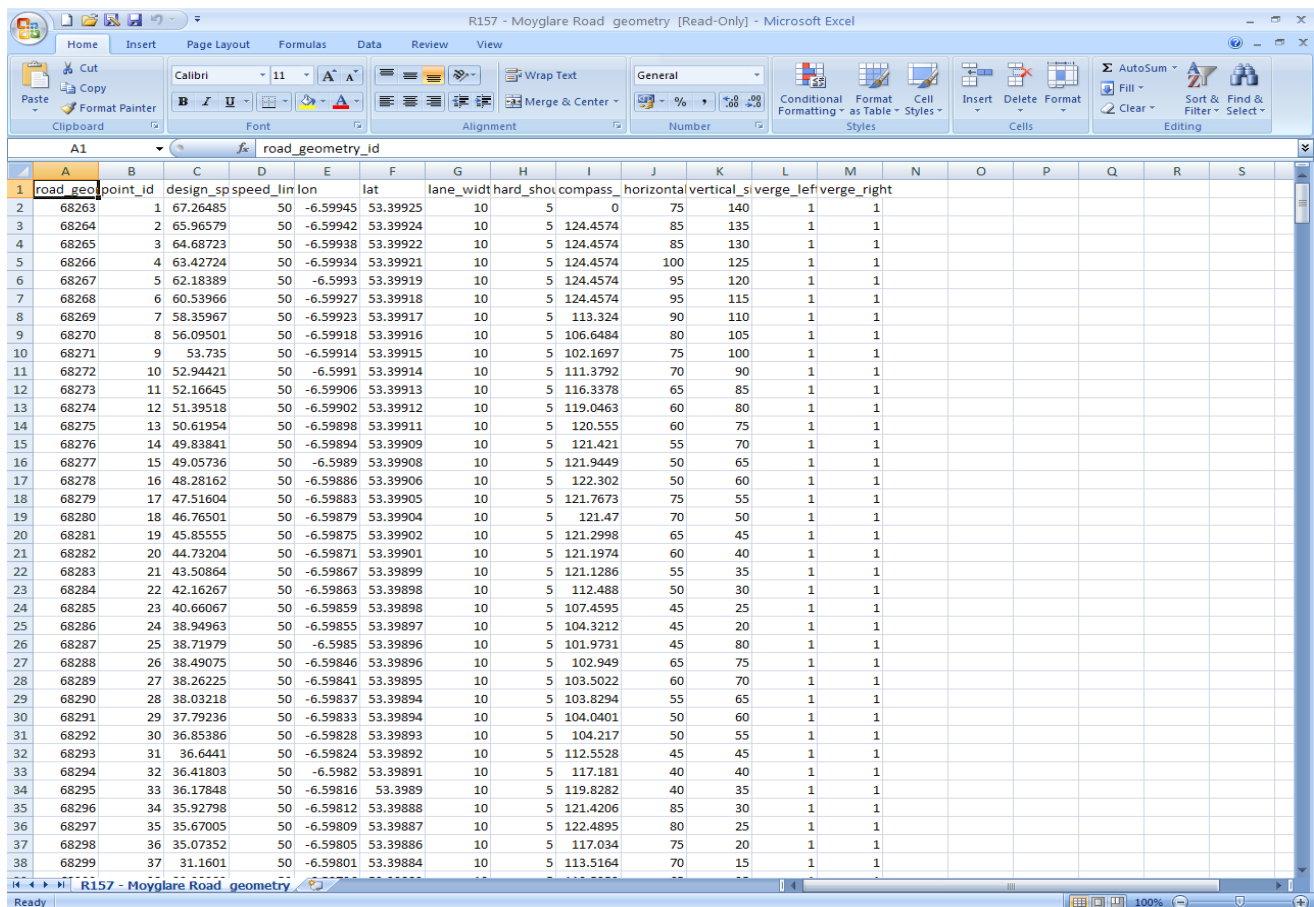
- Road Features (point and line features created by tools 1 and 2)
- Project Area of Interest (rectangular area as outlined during the set-up process of the project)
- Video recording track (curve indicating the road covered in the project)
- Video recording POV (symbol indicating the direction of the journey)
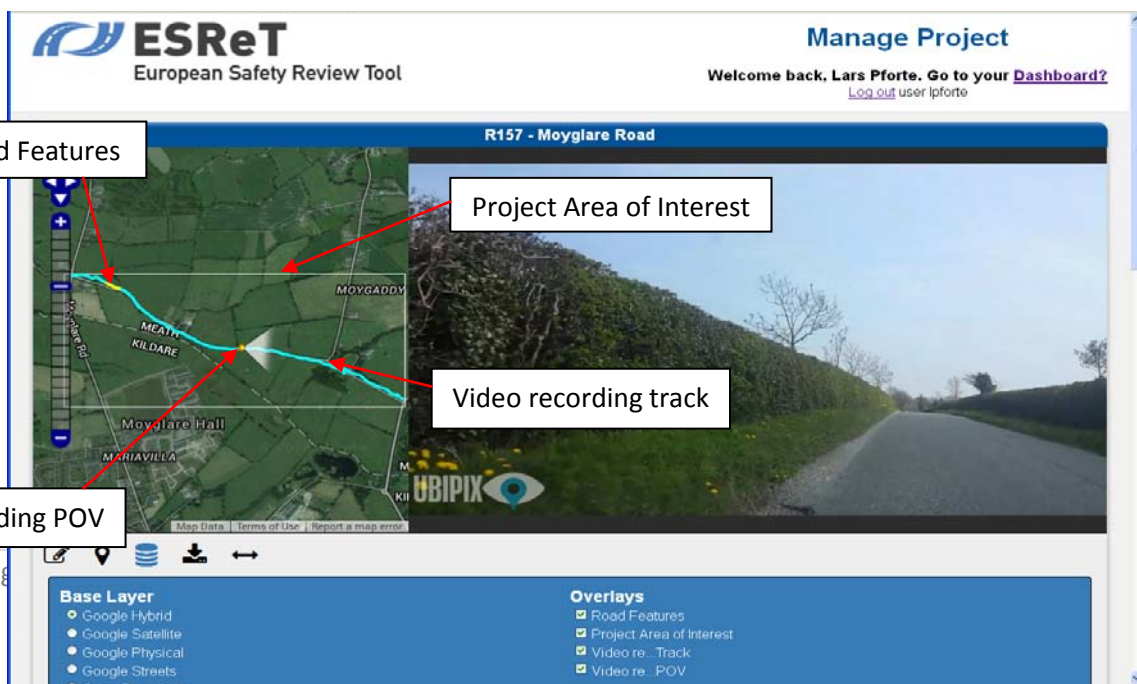
7.1.1.4   Tool 4 – Download data for currently-viewed survey

Click on the symbol ⬇   . A window opens which allows you to open or save a csv-file named after your project. Tick *Open with* to open the csv-file or tick *Save File* to save the csv-file to your computer. You can look at the csv-file in a spreadsheet. It contains the following attributes:

- road_geometry
- point_id
- design_speed
- speed_limit
- longitutde
- latitude
- lane_width
- hard_shoulder
- compass_heading
- horizontal_sight (horizontal sight distance)
- vertical_sight (vertical sight distance)
- verge_left
- verge_right

road_geo	point_id	design_sp	speed_lim	lon	lat	lane_widt	hard_shou	compass_	horizontal	vertical_si	verge_lef	verge_right
68263	1	67.26485	50	-6.59945	53.39925	10	5	0	75	140	1	1
68264	2	65.96579	50	-6.59942	53.39924	10	5	124.4574	85	135	1	1
68265	3	64.68723	50	-6.59938	53.39922	10	5	124.4574	85	130	1	1
68266	4	63.42724	50	-6.59934	53.39921	10	5	124.4574	100	125	1	1
68267	5	62.18389	50	-6.5993	53.39919	10	5	124.4574	95	120	1	1
68268	6	60.53966	50	-6.59927	53.39918	10	5	124.4574	95	115	1	1
68269	7	58.35967	50	-6.59923	53.39917	10	5	113.324	90	110	1	1
68270	8	56.09501	50	-6.59918	53.39916	10	5	106.6484	80	105	1	1
68271	9	53.735	50	-6.59914	53.39915	10	5	102.1697	75	100	1	1
68272	10	52.94421	50	-6.5991	53.39914	10	5	111.3792	70	90	1	1
68273	11	52.16645	50	-6.59906	53.39913	10	5	116.3378	65	85	1	1
68274	12	51.39518	50	-6.59902	53.39912	10	5	119.0463	60	80	1	1
68275	13	50.61954	50	-6.59898	53.39911	10	5	120.555	60	75	1	1
68276	14	49.83841	50	-6.59894	53.39909	10	5	121.421	55	70	1	1
68277	15	49.05736	50	-6.5989	53.39908	10	5	121.9449	50	65	1	1
68278	16	48.28162	50	-6.59886	53.39906	10	5	122.302	50	60	1	1
68279	17	47.51604	50	-6.59883	53.39905	10	5	121.7673	75	55	1	1
68280	18	46.76501	50	-6.59879	53.39904	10	5	121.47	70	50	1	1
68281	19	45.85555	50	-6.59875	53.39902	10	5	121.2998	65	45	1	1
68282	20	44.73204	50	-6.59871	53.39901	10	5	121.1974	60	40	1	1
68283	21	43.50864	50	-6.59867	53.39899	10	5	121.1286	55	35	1	1
68284	22	42.16267	50	-6.59863	53.39898	10	5	112.488	50	30	1	1
68285	23	40.66067	50	-6.59859	53.39898	10	5	107.4595	45	25	1	1
68286	24	38.94963	50	-6.59855	53.39897	10	5	104.3212	45	20	1	1
68287	25	38.71979	50	-6.5985	53.39896	10	5	101.9731	45	80	1	1
68288	26	38.49075	50	-6.59846	53.39896	10	5	102.949	65	75	1	1
68289	27	38.26225	50	-6.59841	53.39895	10	5	103.5022	60	70	1	1
68290	28	38.03218	50	-6.59837	53.39894	10	5	103.8294	55	65	1	1
68291	29	37.79236	50	-6.59833	53.39894	10	5	104.0401	50	60	1	1
68292	30	36.85386	50	-6.59828	53.39893	10	5	104.217	50	55	1	1
68293	31	36.6441	50	-6.59824	53.39892	10	5	112.5528	45	45	1	1
68294	32	36.41803	50	-6.5982	53.39891	10	5	117.181	40	40	1	1
68295	33	36.17848	50	-6.59816	53.3989	10	5	119.8282	40	35	1	1
68296	34	35.92798	50	-6.59812	53.39888	10	5	121.4206	85	30	1	1
68297	35	35.67005	50	-6.59809	53.39887	10	5	122.4895	80	25	1	1
68298	36	35.07352	50	-6.59805	53.39886	10	5	117.034	75	20	1	1
68299	37	31.1601	50	-6.59801	53.39884	10	5	113.5164	70	15	1	1

7.1.1.5   Tool 5 – Measuring distances within the video

Click on the symbol ↔   . The In-Frame Measurement tool can be used to measure road widths within a video frame. To use this tool a monoscopic calibration needs to be performed to define the measure plane, and its size parameters, in which reasonably accurate measurements can be taken. Measurements can be made in any direction of the XY plane allowing for length, width and diagonal measurements to be carried out. When this tool is selected a system check is performed to determine if this video has been calibrated or not. If a video has been calibrated then the user-interface and functionality described below in section 7.1.1.5.1 will load. If however the video needs to be calibrated then the user-interface and functionality described below in section 7.1.1.5.2 will load.

7.1.1.5.1   Measuring road widths
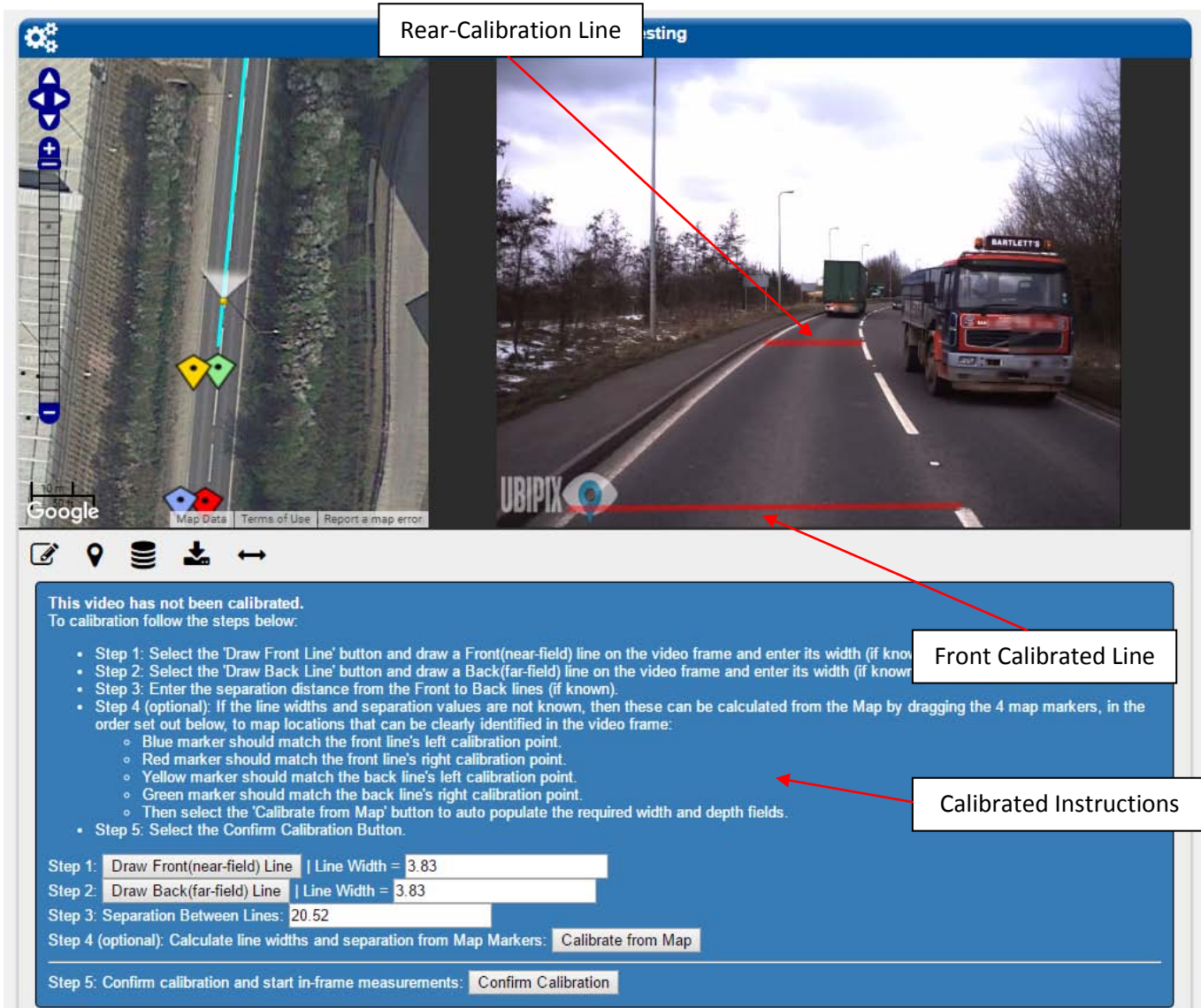
If a video has been calibrated, the measurement user-interface shown below will load. This comprises a green calibration plane overlaid on the video and a measurement output text area below the map. There is also a 'Re-Calibrate this Video' button which will reset a video calibration and load the controls as described in the following section 7.1.1.5.2.

This tool enables the user to click 2 points within the green box overlaid on the video frame. These 2 points will create a red line in the video frame and line's length will be calculated and shown in the line-width output box below the tool-set.
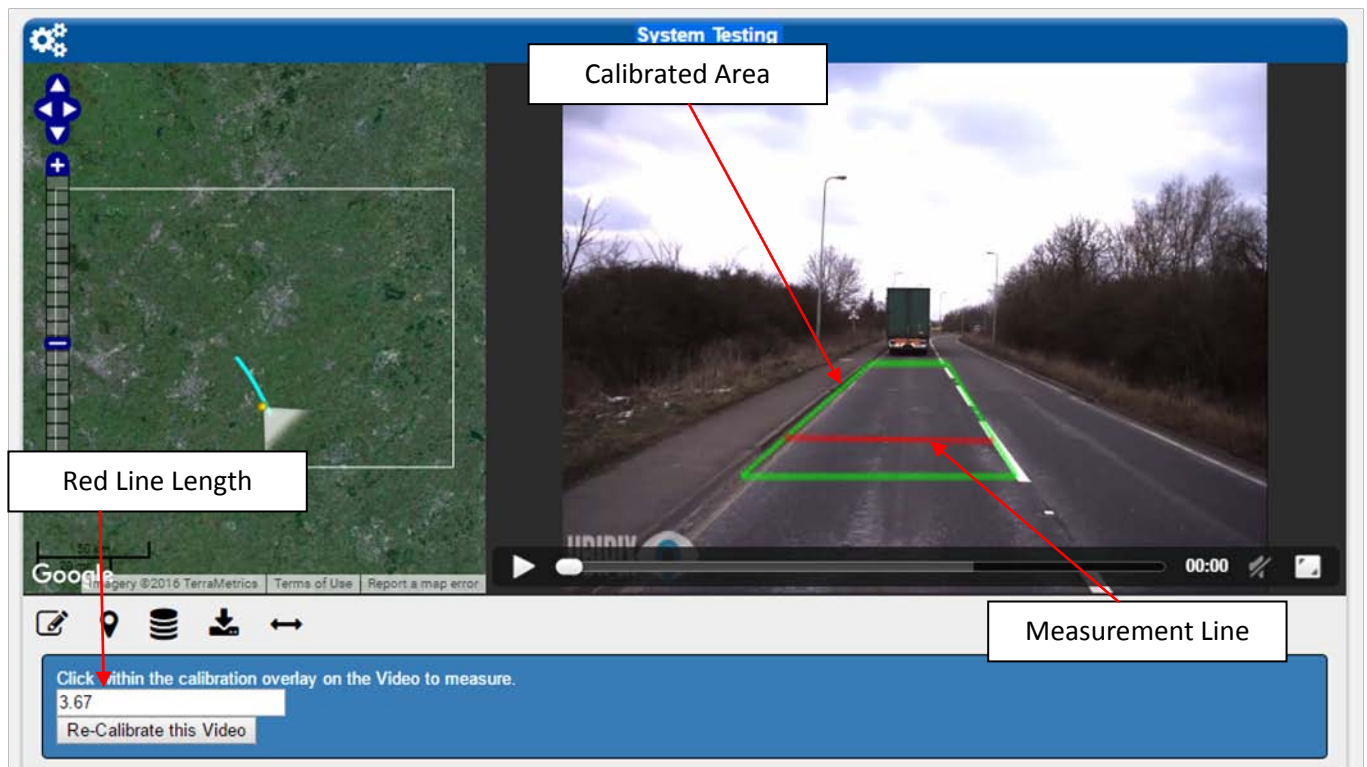
7.1.1.5.2   Calibrating a video

When the measurement tool is selected and a video has no calibration then the system will load the user-interface and functionality, shown below, to enable monoscopic calibration to be performed. The calibration process is clearly described in the on-screen instructions but basically involves, either, defining known measurement units within the video frame or matching clearly identifiable map features within the map to features in the video frame. Based on either calibration operation the necessary calibration information and parameters can be determined and used to load the measurement user-interface and functionality.

Rear-Calibration Line

Front Calibrated Line

Calibrated Instructions

This video has not been calibrated.
To calibration follow the steps below:

- Step 1: Select the 'Draw Front Line' button and draw a Front(near-field) line on the video frame and enter its width (if kno
- Step 2: Select the 'Draw Back Line' button and draw a Back(far-field) line on the video frame and enter its width (if known
- Step 3: Enter the separation distance from the Front to Back lines (if known).
- Step 4 (optional): If the line widths and separation values are not known, then these can be calculated from the Map by dragging the 4 map markers, in the order set out below, to map locations that can be clearly identified in the video frame:
  - Blue marker should match the front line's left calibration point.
  - Red marker should match the front line's right calibration point.
  - Yellow marker should match the back line's left calibration point.
  - Green marker should match the back line's right calibration point.
  - Then select the 'Calibrate from Map' button to auto populate the required width and depth fields.
- Step 5: Select the Confirm Calibration Button.

Step 1: [Draw Front(near-field) Line] | Line Width = 3.83
Step 2: [Draw Back(far-field) Line] | Line Width = 3.83
Step 3: Separation Between Lines: 20.52
Step 4 (optional): Calculate line widths and separation from Map Markers: [Calibrate from Map]

Step 5: Confirm calibration and start in-frame measurements: [Confirm Calibration]

7.2   Data Management

In this section all the data you have added to this project is listed. Each data instance contains a road survey file and (possibly) a certain number of Ubipix files. In the example below there are two surveys in the project, called Eastbound and Westbound. The Eastbound survey has one Ubipix track associated with it, the Westbound survey has two Ubipix tracks associated with it.
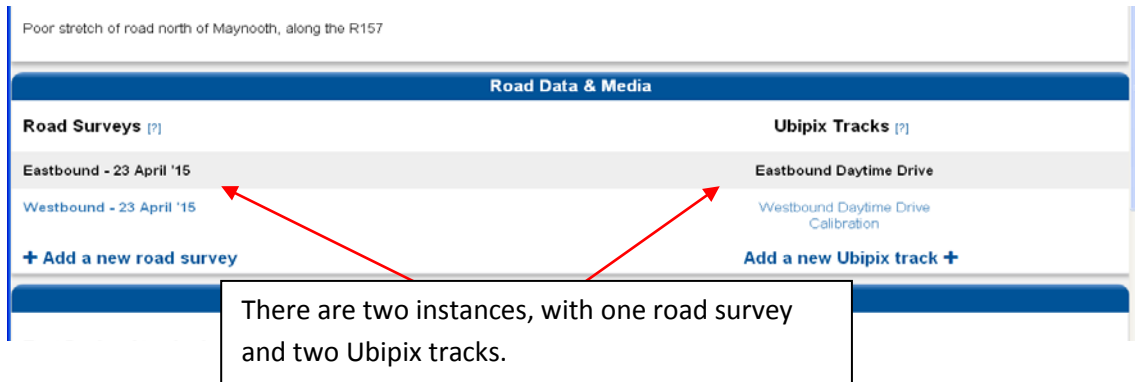
Click on the Ubipix track which you want to appear in the data display section. If you click on a road survey name the first Ubipix track will be loaded in the video screen. Data that is being displayed in shown in black, while blue data is available but momentarily not displayed. You can add a new road survey file or a new Ubipix track to the project by clicking on the respective link.

7.2.1   Add a new road survey file

Click on *Add a new road survey* (Section 8.3 details the file types, their structure and form of the data that can be uploaded). A window appears which prompts you to do the following:
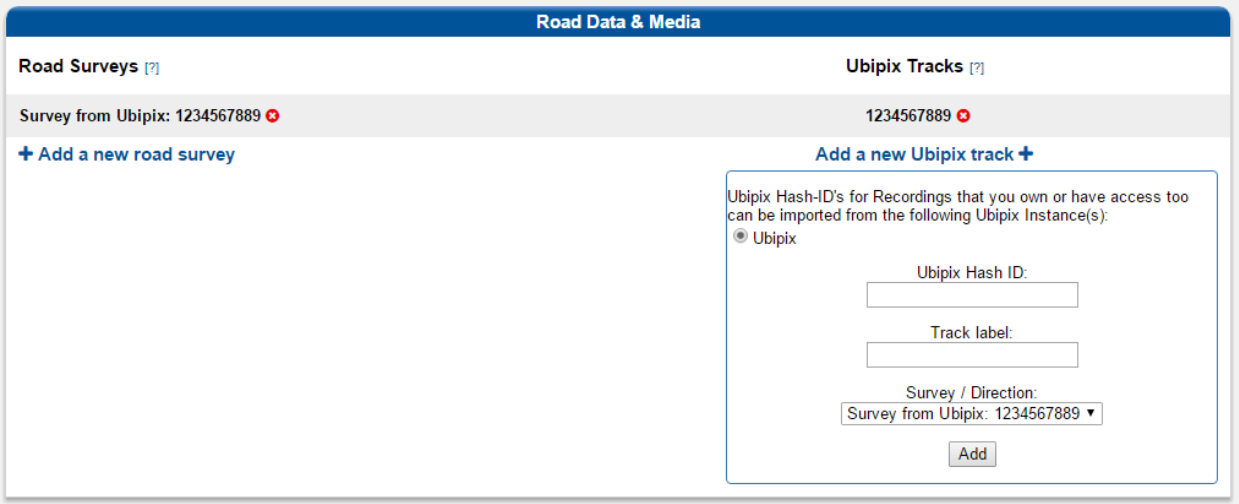
- Enter a survey name
- Click *Choose File* to select a csv-file for this survey from your computer
- You can indicate whether you want to use this survey file to calculate the reverse direction by ticking the respective box
- Click *Upload* to upload the survey file data
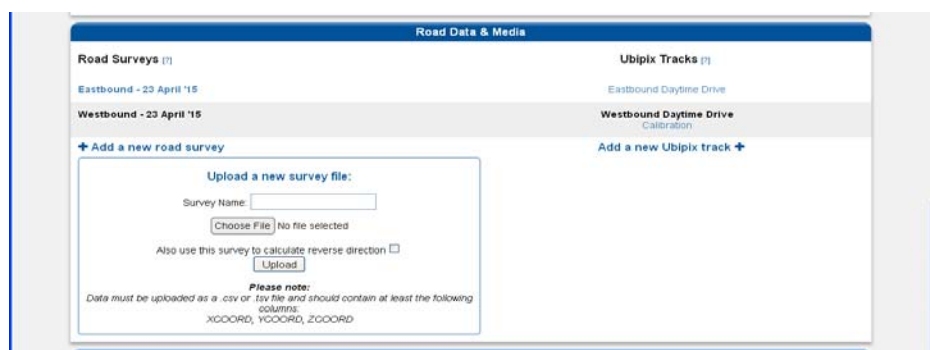
7.2.2   Add a new video track

Video uploads are controlled by Ubipix; the video must be uploaded to Ubipix first, then it can be connected to ESReT. Click on *Add a new ubipix track*. A window appears which prompts you to do the following:

- Select which Ubipix platform you have your recording stored in.
    - o If app.ubipix.com is the only Ubipix Instance you have an account on then this is pre-selected.
- Enter a Ubipix Hash ID (please see below for further details)
- Enter a track label
- Choose the survey to associate the Ubipix track with
- Click *Add* to complete the process

To get the Ubipix Hash ID you need to visit the Ubipix website, go to your video and play it. The ID can then be found in the address name. For instance let https://app.ubipix.com/playvideo.php?id=VtkK23jRjyy be the address of the video. Then the Ubipix Hash ID is VtkK23jRjyy.

Important Note: Any Hash ID's that the logged in user has access to on any Ubipix Instance can be imported here. This means the user can import any Ubipix Instance recordings based on following rules:

- they must own the recording.
- they must own the Channel to import public or private recordings that they don't own.
- they must be a member of the Channel to import public recordings that they don't own.

7.3   Testing & Analysis

7.3.1   Test Design Standards

Test the compatibility of a road section against one or all design standards for a chosen country. This test is directional, that is, you must test one survey at a time. First choose the survey in the project which you want to test. Next pick the country and the design standard you wish to apply. You can test the survey against one or more design standard from a country at a time

Choose the survey you want to test, the country from which to draw the design standards and which standard you want to test the survey against.

Finally click on *Run Design Standard Check* to start the testing process. The results of the test are displayed in table form, indicating which rules have been broken and giving details of the defect.

7.3.1.2   Design Standard Treatments

Relevant treatments relating to the design standards which have failed can be displayed by clicking the green "View Possible Treatments" button below the *Standards Failed* table. This will display a popup table containing suggested treatments for each rule failed; the type of treatment, the estimated cost, and the estimated safety effect.

If there is a particular crash type which is most common on this section of road, you can use the "Filter for crash type" drop-down menu in the top right to display only treatment suggestions which are recommended for roads with this type of crash.

7.3.2   Test Safety Ideal Values

Test this road section against the safety ideal values of a selected country. This test is directional, that is, you must test one survey at a time. First choose the survey in the project which you want to test. Next pick the country whose safety rules you want to test the survey against.

Choose the survey you want to test and the country whose safety rules you want to test the survey against.

Finally click on *Run Safety Check* to start the testing process. The results of the test are displayed in table form, indicating which safety values have been passed/ failed with respect to various speeds at 10 km/h intervals.

Hover with the mouse over Fail to see the reason for the fail.

8 Appendix

8.1 List of Feature Types for Tool 1

Feature Type	Feature Attributes	Choose from / Comment
Street Lighting	Presence	Not Present
		Present
Road Condition	Condition	Sufficient
		Poor
Delineation	Delineation	Sufficient
		Poor
Road Works	Presence	Not Present
		Present
Insufficient Signage	Signage	Sufficient
		Poor
Median Safety Barrier	Presence	Not Present
		Present
Centreline Rumble Strips	Presence	Not Present
		Present
Slope to Roadside	Type of Slope	Flat
		Slight
		Medium
		Steep
Roadside Safety Barrier	Presence	Not Present
		Present
Adjacent Land Use (Driver Side)	Type of Land Use	Undeveloped
		Commercial
		Residential
Adjacent Land Use (Passenger Side)	Type of Land Use	Undeveloped
		Commercial
		Residential
Open / Closed Environment	Feel of Road	Open
		Closed
Shoulder Rumble Strips	Presence	Not Present
		Present

Sidewalk / Footpath (Driver Side)	Type of Sidewalk	Not Present
		Adjacent Facility
		Separated Facility
		Segregated Facility
Sidewalk/Footpath (Passenger Side)	Type of Sidewalk	Not Present
		Adjacent Facility
		Separated Facility
		Segregated Facility
Pedal Cycle Facility	Type of Facility	Not Present
		In Lane Facility
		Segregated Facility
Motorcycle Facility	Type of Facility	Not Present
		Segregated Facility
Speed Management / Traffic Calming	Presence	Not Present
		Present
School Zone – Warning / Signing etc.	Presence	Not Present
		Present

8.2   List of Feature Types for Tool 2

Feature Type	Feature Attributes	Choose from / Comment
Roadside Object	Object Type	Passively Safe Object
		Tree / Tress slump
		Pole / Post
		Bridge / Underpass
		Poor Barrier End
		Other hazardous object
	Distance to Object	State distance to Object
Intersection	Intersection Type	T - Intersection
		X - Intersection
		Roundabout
		Merge / Diverge
		Grade separated
	Intersection Control	Unsignalised
		Signalised
	Turning Pockets	Not Present
		Present

	Intersection Quality	Sufficient
		Poor
VRU intersection Crossing	Road Type	Inspected Road
		Side Road
	Crossing Type	None
		Pedestrian Island
		Zebra Type
		Signalised
		Segregated Facility
Pedestrian Crossing	Crossing Type	None
		Pedestrian Island
		Zebra Type
		Signalised
		Segregated Facility
	Crossing Quality	Sufficient
		Poor
Property Access Point	Presence	Not Present
		Present
Median Object	Object Type	Passively Safe Object
		Tree / Tress slump
		Pole / Post
		Bridge / Underpass
		Poor Barrier End
		Other hazardous object
	Distance to Object	State distance to Object

8.3   Description of Survey File Types

These sections describe the types and form of survey data files that can be uploaded into the ESReT platform. It also describes the computational processes that are applied to these data such that the Graph, Design Standard checks and Data downloads can be completed and made available in the platform.

The survey data import system will only accept Comma or Tab Separated-Value (CSV or TSV) formatted file types with file extensions of .csv or .tsv. Each files data structure must have a header row with the following column headings:

- XCOORD
- YCOORD
- ZCOORD
- LAT
- LONG
- ROADWIDTH
- HARDSHOULDER
- SPEEDLIMIT
- VERGELEFT
- VERGERIGHT

At a minimum XCOORD and YCOORD are required, all other file properties will be filled out by the system based rules described below.

The system will set the following default values for all columns that have not been provided with the original survey file of the road section under investigation. For each (XCOORD, YCOORD) point the following default values will apply if not supplied:

- ZCOORD   (default: 0 meter)
- LAT   (default: 0 degrees)
- LONG   (default: 0 degrees)
- ROADWIDTH   (default: 3 meter)
- HARDSHOULDER   (default: 0 for no)
- SPEEDLIMIT   (default: 50 km/h)
- VERGELEFT   (default: 0 meter)
- VERGERIGHT   (default: 0 meter)

Note that the HARDSHOULDER parameter is not used in the calculation stages described below but is used during the Design Standard and Rules validation stages. It is the presence of the VERGELEFT and VERGERIGHT parameters that control any hard-shoulder type elements that are used in the calculation processes. Thus, the VERGELEFT parameter denotes the width of driveable road to the left of the outer road lane marking. While the VERGERIGHT parameter denotes the width of driveable road to the right of the outer road lane marking.

8.4   Feature Calculations Processes

As a first step the survey-file data trace is translated into a 5 meter interval Master Trace by fitting a sequence of evenly spaced (x,y)-points. This 5 meter interval is currently hardcoded into the calculation process. Next all additional attributes of the original trace, whether they are given explicitly or by default (as described in section 8.3), are interpolated across the Master Trace. The first four attributes in the above list (ZCOORD, LAT, LONG, ROADWIDTH) are interpolated continuously as follows. Given a Master Trace Point P we find its closest data trace points P_1 and P_2 on either side with their respective attribute values a_1 and a_2. Then we assign the attribute value

$$a_P = a_1 + \frac{\text{dist}(P_1, P) \cdot (a_2 - a_1)}{\text{dist}(P_1, P) + \text{dist}(P, P_2)}$$

to the Master Trace Point P. Note that the smaller the distance between P is to P_1, the more the assigned value a_P at P resembles a_1. Likewise if P is closer to P_2, then the value a_P is closer to value a_2. For the remaining four attributes (HARDSHOULDER, SPEEDLIMIT, VERGELEFT, VERGERIGHT) we assign the values based on a closest neighbour principal, that means, if P_1 is the closest data trace point to P, then we assign the attribute value a_1 to P, and a_2 otherwise.

From now on all calculations are done with respect to the Master Trace and ONLY involve the ZCOORD, ROADWIDTH, VERGELEFT and VERGERIGHT attributes. Thus, at every Master Trace Point P the following new attributes are determined:

- Horizontal Sight Distance
- Vertical Sight Distance
- Sight Distance
- Horizontal Curvature
- Vertical Curvature (Sags and Crests)
- Design Speed

Horizontal Sight Distance: In order to determine horizontal sight distance at P we find the first Master Trace Point Q in the direction of travel which cannot be seen by an observer standing at P without the line of sight leaving the boundaries of the road. Here the boundaries of the road are given by road width and left and right verge. We declare the distance of travel between P and the Master Trace Point preceding Q is the horizontal sight distance at P. Furthermore a universal cut off at a sight distance of 600 meters applies.

Vertical Sight Distance: In order to determine vertical sight distance at P we assume an observer of height 1.05m at P and find the first Master Trace Point Q such that an object of height 0.26m at Q cannot be seen by the observe at P. Here the 1.05m represents level above ground of a driver and the 0.26m represents a body lying in the street. We declare the distance of travel between P and the Master Trace Point preceding Q is the vertical sight distance at P. Furthermore a universal cut off at a sight distance of 600 meters applies. Note that if no ZCOORD is submitted, then the vertical sight distance will be 600 meter throughout.

Sight Distance: The overall sight distance at P is now defined as the minimum of its horizontal sight distance and its vertical sight distance. Note that the sight distance at P is at most 600 meters.

Horizontal Curvature: In order to determine horizontal curvature at P we find the circle fitting the most number of Master Trace points before and after P with a margin of error of at most 1m. We declare the radius of this circle as the horizontal curvature at P. Furthermore a universal cut off at a curve radius of 2,000 meters applies.

Vertical Curvature: Vertical Curvature is based on K-values for vertical curves (see the picture below). We scan the entire Master Trace for vertical curves by looking for sufficiently large grade changes, that is, the change between the grade coming into the selection point and the grade going out of the selection point. Based on these grade changes we identify straights, sags and crests; and for each vertical curve the vertical curvature is determined by taking the minimal K-value of all points making up the curve. Furthermore a universal cut off at a curve radius of 10,000 meters applies. Note that if no ZCOORD is submitted, then the entire section will be considered a flat straight and the curve radius will be 10,000 meters throughout.
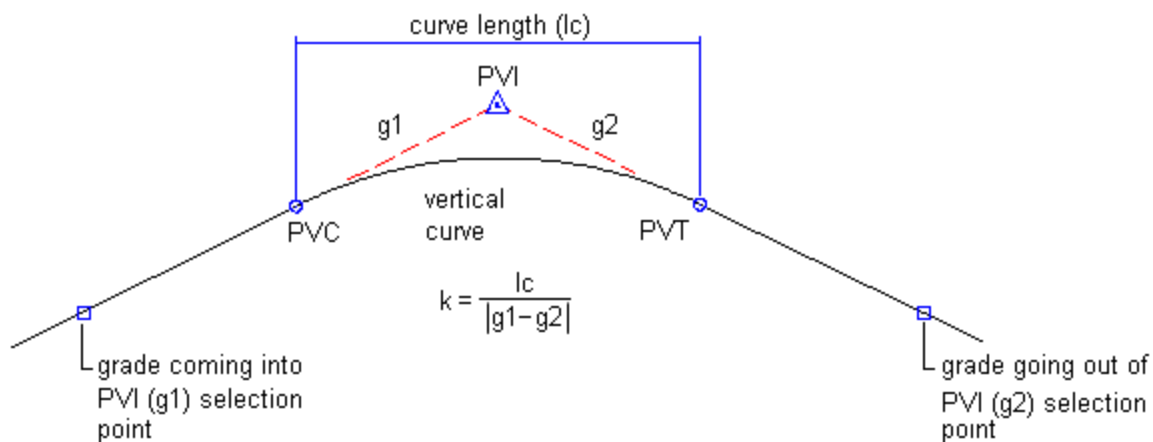
Design Speed: Design Speed at P is determined as follows. First a base speed, denoted by V_B, is calculated at P. The value assigned to V_B is the speed that is considered safe for the given combination of lane width, verge width and sight distance at the point P. In the python code V_B is hard coded to increase steadily with an increasing verge width according to the following table,

Verge width in meter	0	0.3	0.5	1	2	3
V_B in km/h	70	75	80	85	90	95

and an increasing lane width according to the following table,

Lane width in meter	≥3	≥3.5	≥4
V_B in km/h	+5	+10	+15

and an increasing sight distance where V_B is increased by 1km/h for every 50 meter sight distance above 100 meter. These values are up to the expert's discretion and should be changed accordingly. Note that V_B is mostly affected by the total size of the drivable road and only slightly by the sight distance. There the effect of curves on V_B is marginal.

Second a speed based on sight distance, in the following denoted by V_{SD}, is calculated at P. Note that at P the sight distance is the minimum of its horizontal and vertical sight distance. Now we define V_{SD} as the maximal speed value in km/h such that the stopping distance is less than or equal to the sight distance, assuming a reaction time of 1.5sec and a deceleration of 5m/sec². Hence if s_P denotes the sight distance at P in meter, then

$$V_{SD} = 3.6 \cdot (\sqrt{(7.5)^2 + 10 \cdot s_P} - (7.5))$$

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Note that V_{SD} is strongly affected by a low sight distance.

Finally a speed based on the radius at the point P and denoted by V_R is determined. For this the following look-up table has been hard-coded into the python code:
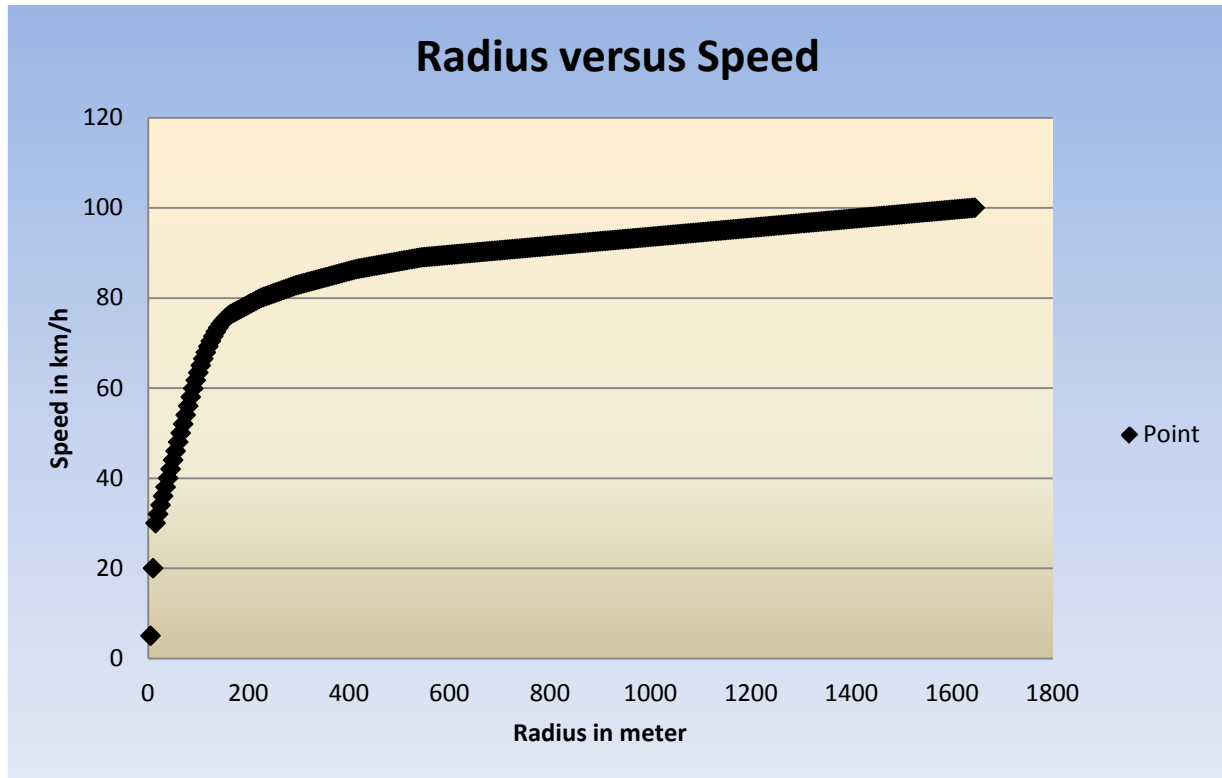
In particular V_R is only affected by the radius of the road section.

Next let V_1 be the minimum of V_B and V_{SD}, and let V_2 be the minimum of V_B and V_R. Finally the design speed V_D, is set as the average of V_1 and V_2 if this average is below 80km/h and as the minimum of V_1 and V_2, otherwise. This is in order to avoid that one artificially low speed profile drags down design speed unnecessarily. Finally as the python code in its present form applies to rural road V_D is capped off at 100km/h.

Finally a speed adjustment script is run on the design speed profile to impose a more realistic acceleration and deceleration process on the profile. For instance let us assume that at the two consecution Master trace point P_1 and P_2 the design speed calculated is 80km/h and 75 km/h. As the points are 5m apart this equates to a deceleration of nearly 6 m/sec^2. Hence in order to facilitate a smooth journey the design speed at P_1 is too high and it is reduced accordingly.