RoadMark: Road and Bridge Inspection App
User Manual

1 Introduction

This document outlines how to install and use the RoadMark application for Android smartphones.

2 What is RoadMark?

RoadMark is designed to be a simple and reliable tool to allow road agencies and road managers[1] to record quickly and simply, the most important aspects of a road network (carriageway, shoulders/verges and longitudinal drainage), associated structures (bridges and culverts) and other street furniture (e.g. signs, posts, access points, intersections). It also allows a basic assessment of the condition of these main items to be made.

The data recorded is automatically stored securely on a Smartphone, and can be transferred easily by email to more permanent and secure locations (such as a desktop or server), for future analysis (through *RoadMark Analysis*). The data collected should allow straightforward network planning and budgeting to be carried out quickly and simply, with the data forming the basis for developing annual programmes of work.

The GPS location of all the data collected is also recorded, allowing this data to be shown on maps in a highly flexible way, using Quantum GIS (QGIS or other GIS software).

RoadMark can be used on any type of road and does not require any referencing system to be in use. However, it is specifically designed to be used on low volume roads, as it has no facility to record traffic levels (usually required for economic evaluations, which is not usually valid for rural roads). Roughness measurements are also not recorded directly (although this can be estimated from the road's condition, as described in this document).

It is also designed to work on any recent Android Smartphone, and requires minimal training. Compared to more sophisticated survey methods, it is also designed to be fast, allowing surveys to cover a substantial length of road each day, at relatively low cost and a very low level of technical expertise.

3 How Does RoadMark Fit in with the Overall Planning & Budget Processes?

Figure 1 shows how RoadMark fits in with the wider planning and budgeting processes provided to the DRRD. As shown, RoadMark forms the first important step in the overall planning and budgeting process, capturing the key data about the network upon which subsequent assessments of the network's needs are based. It is therefore important that this data collection is carried out to a satisfactory standard and extent, as this fundamentally influences the resulting quality and reliability of the plans developed and the subsequent budget estimates.

As also shown in Figure 1, RoadMark produces a series of (small) CSV files that contain all the data collected during the surveys. When the mobile device has an internet or mobile data connection, these files can be sent to a central location as email attachments, where they are loaded into the consolidated database, using RoadMark Analysis (RMA), which can be used to provide a range of reports, either directly or in a way that can be easily transferred into QGIS (to produce maps of the network) or Excel (to allow plans and budgets to be developed).

This document focusses on how to install and use the Android based RoadMark application only. Explanations on the use of the remaining parts of the planning and budgeting system are documented elsewhere.

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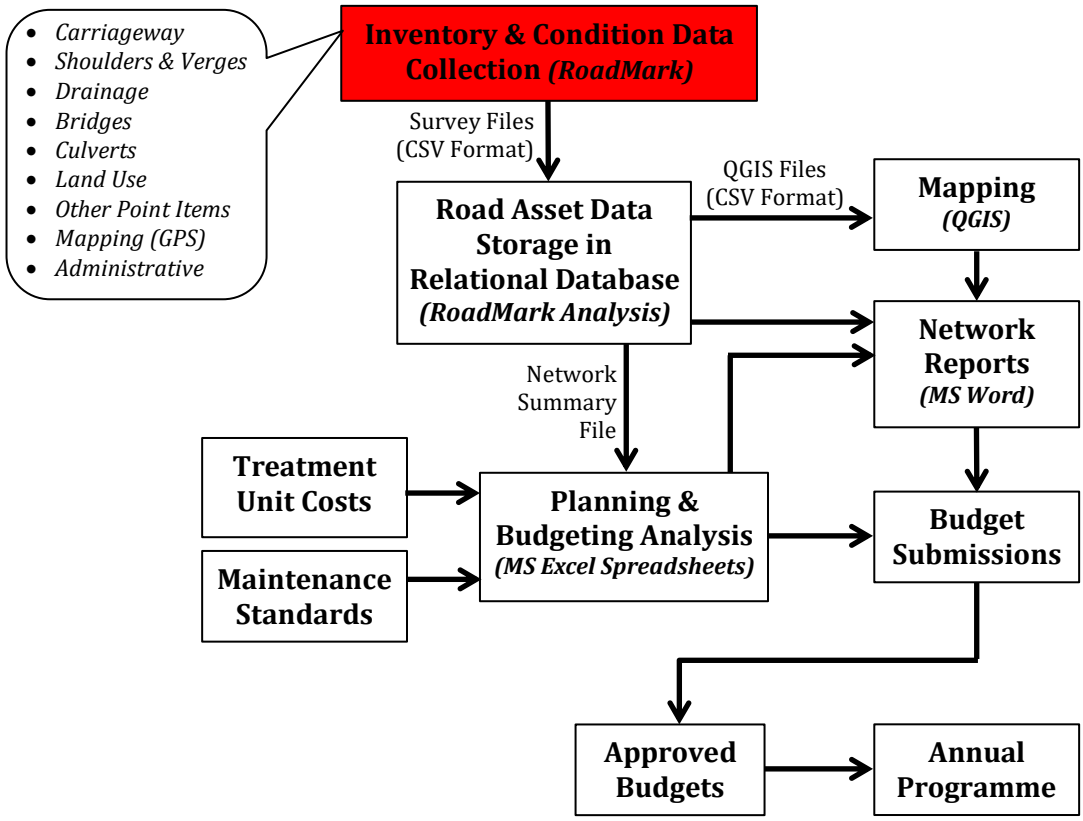
[1] "Road agencies" refers to any institutions responsible for managing a road network. "Road managers" are those individuals with responsibility for this important function.

"Road Assets" refers to any physical items associated with the road, including the carriageway itself, hard shoulders, verges, drainage, culverts, bridges, earthworks, barriers, road markings, signs and other street furniture.

Figure 1: Specific Applications within the Budgeting & Planning System



4 System Requirements

Android Version: RoadMark works on devices running the Android operating system, version 4.2 (Jellybean) or later, which was released in November 2012. It is usually possible to check which version of Android a mobile device is using, although each phone maker will show this in slightly different locations. (On Samsung for example, it is under System – About Device.)

App Size: The App is small, being less than 1.5MB in size.

Data Storage: The amount of space required to store the data depends on the amount of data that has been collected. As a guide, this is approximately 10-15kb per km.

Internet & Email Access: The App requires the phone to have a valid email account and an internet connection, when transmitting the data collected by the App. (These are not required during surveying.)

GPS Signal: The phone must have an active GPS signal to work as this is used to geo-locate all data collected by the RoadMark App. (See below to confirm the quality of this GPS signal.) The App will not start until the phone has detected a GPS signal. It rereads the GPS signal each time a point item, longitudinal bridge or new section is started. If however, the GPS signal fails during a survey, the App will use the last known position.

Locational Accuracy: The accuracy of the locational data collected by the App depends entirely on the accuracy of the GPS system on each phone and the number of satellites visible to the device at any time. As a guide, the App should usually achieve a horizontal accuracy of approximately 5-10 metres. The vertical accuracy is only accurate to within about 20 metres. The App records the phone's GPS location every 10 metres.

Battery: Note that because the phone is constantly recording the GPS signal, the screen needs to be on whilst surveying. This can place quite a demand on the phone's battery (especially if the battery is old). It is therefore recommended to either have a battery booster/backup or if vehicle based, a phone charger in the vehicle. However, if the phone closes down during a survey, no data is lost: the survey will be 'paused' and can be restarted at a later date (as described below).

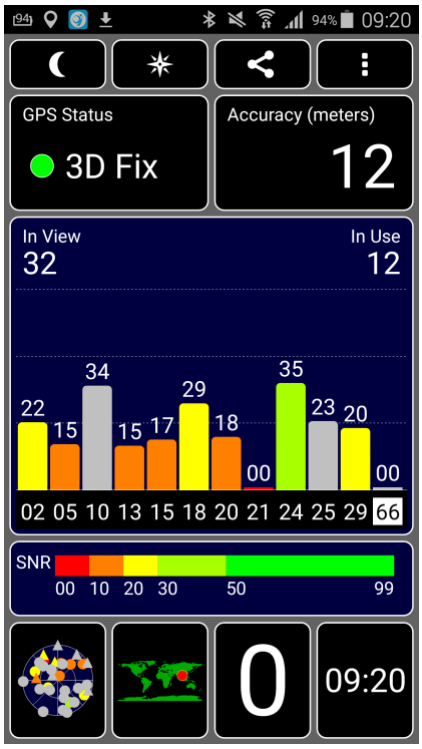
Phone Standby: A conscious decision has been made to pause the survey if the phone goes into 'standby' mode (e.g. the screen turns off). This encourages the user to be actively engaged in the survey and avoids problems if the App is left on accidentally. However, there may be times when the phone enters standby mode before any changes are necessary, (for example for particularly long or monotonous rural roads). It is therefore recommended to turn off the phone's standby mode or increase its activation to a longer period, such as 10 minutes. If the phone does go into standby mode whilst surveying, simply activate the screen again and press the ***Restart Survey*** button.

Running Other Apps Simultaneously: It is common for more than one App to be running at once on Smartphones, but only one can be 'active' at any time. Thus, if the surveyor receives a call (or wishes to use another App) whilst using RoadMark, RoadMark will pause until the user presses the "Restart Survey" button on the main Surveying screen (see below for details).

5 Other Supporting Software Recommended

RoadMark uses the smartphone's GPS function to record the geographical location of all the data that is collected on the road network. RoadMark will not start if the phone is unable to receive a GPS signal, so it is worth checking that it is receiving a GPS signal first.

Many applications are available to check the presence and quality of the GPS signal received by an Android phone. We recommend one called "GPS Test" by Chartcross Ltd (and available via the Google Play Store). It is free and a comprises of a small file (1.2MB). It requires Android version 2.3 or later.



This figure from GPS Test, shows that 32 GPS satellites were visible to the mobile at the time, providing a reading accuracy of approximately 12 metres.

There are many areas in the RoadMark App, where the user is able to add comments. Using an App such as the excellent "SwiftKey" (available for free trial from the Google Play site) makes entering data into these fields much easier and faster, (as well as for all other applications on the mobile device).

6 Installation Procedure

The application is provided as a .APK file, which is a standard format for Android applications. This may be provided as an attachment to an email or as a stand-alone file. The process to install the App onto the phone is simple, as follows:

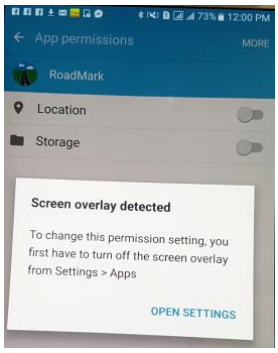
1. Load the .APK file onto your mobile phone (e.g. by email or Bluetooth).
2. Double Click on the file. This will automatically activate the installation process.

3. You may receive a message on your device to say that the installation of software from an unknown source is blocked, with an option to review the phone's security setting. Do this and allow this installation from unknown sources, for this time only. (Ignore the warning message.)

4. The App requires access to the phone's GPS (to record its location when storing data) and to modify or delete the contents of the phone's SD card (necessary in order to store the data collected). Depending on the version of Android, these permissions may be activated automatically, or the user will need to do this manually (see below). Once these permissions are given, the installation is complete and RoadMark is ready to open and use.

   To set (or check) that the App has GPS and storage permissions, open the Apps (or Applications) option under the Settings menu, and select RoadMark. Under "Permissions" ensure that "Locations and Storage" are selected.

   Depending on the version of Android running on the mobile and what other applications are running, a "Screen overlay detected" error message may occur (see figure) when giving RoadMark location and storage permission.



   To overcome this, open the "More" menu (at top in attached photo) and disable all the apps that allow screen overlay. This will then allow the location and storage settings to be activated for RoadMark. You can then open up the "More" menu again and turn back on all the previous overlay apps.

7 Uninstalling the App

To uninstall the App, use the usual method on your smartphone. Note that this will also delete any data files stored on your phone, so it is important to transfer any survey data off the mobile phone first as this action cannot be undone.

8 Other Considerations for Road Inspections

The RoadMark App allows key data about a road network to be recorded, but other items recommended when carrying out a road survey include:

- A tape measure (at least 10m in length);
- A digital camera;
- A torch;
- Safety equipment.

9 Planning the Surveys

RoadMark is designed to collect the important data on a rural road network, including inventory and condition data for roads and all associated structures.

The rate of surveying depends on the amount of road features recorded on the roads. In busy urban areas, the surveys should be done on foot, because of the density of features to record, but in less densely populated rural areas, a slowly moving vehicle can be used to cover greater distances. However, frequent stopping will be required to check specific areas (especially culverts and bridges).

As a guide, one surveyor (plus a driver) should be able to cover approximately 10km of rural road each hour if all features are recorded. However, when planning surveys, additional time needs to be included to cover the time needed to travel to the survey locations.

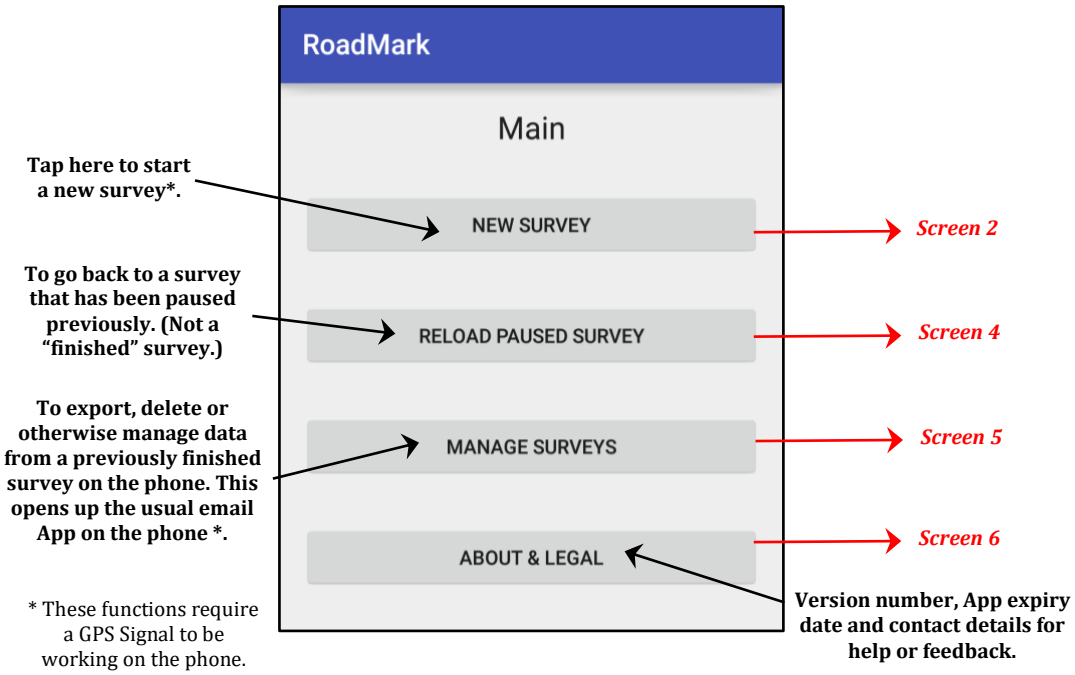
It is important to cover all the roads in a network, if an accurate and up-to-date assessment of needs is to be made. It is recommended that a small team of surveyors is organised to divide up the road network into manageable lengths.

RoadMark enables road managers to check how long it takes to survey each part of the network, allowing better estimates of survey resources to be made in future.

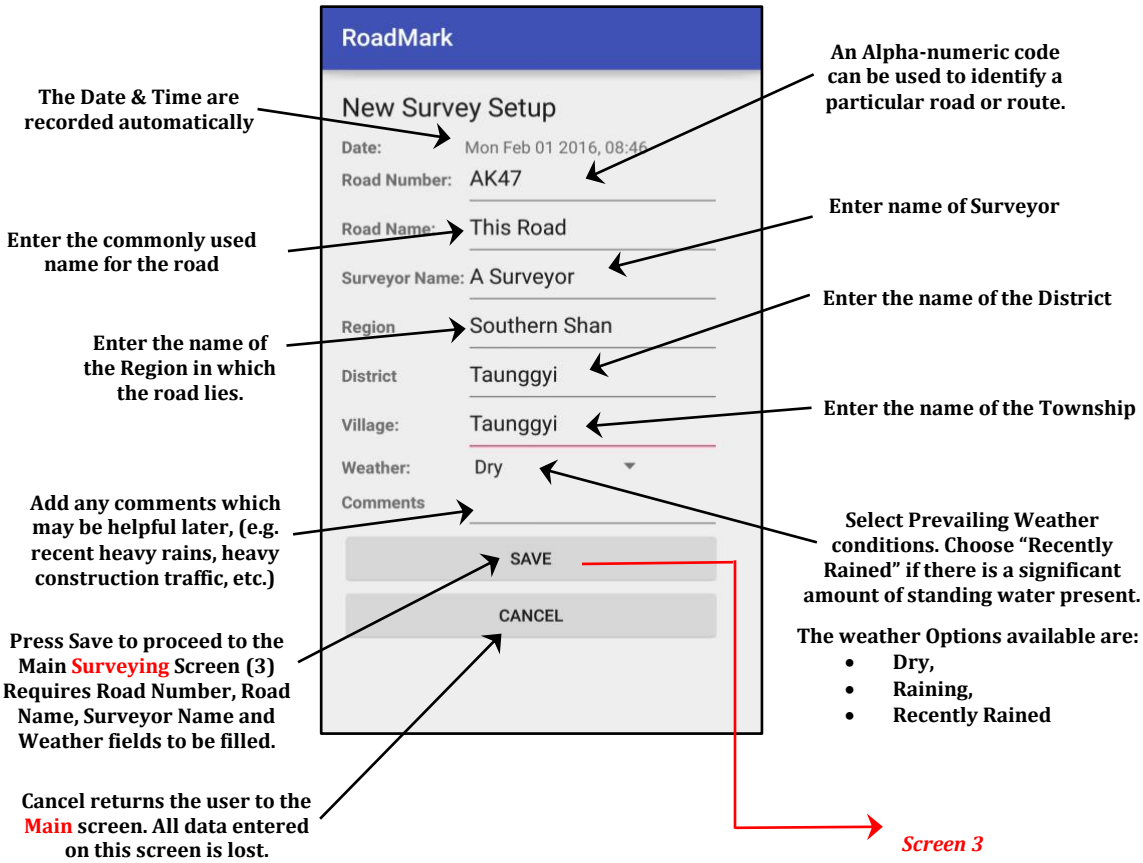
The following sections describe the various screen options available within RoadMark.

10 The Main Screen
(Screen 1)

This is the Main Screen that appears when first starting the App. From this screen, users can start a new survey, restart a paused survey and export or delete completed surveys.

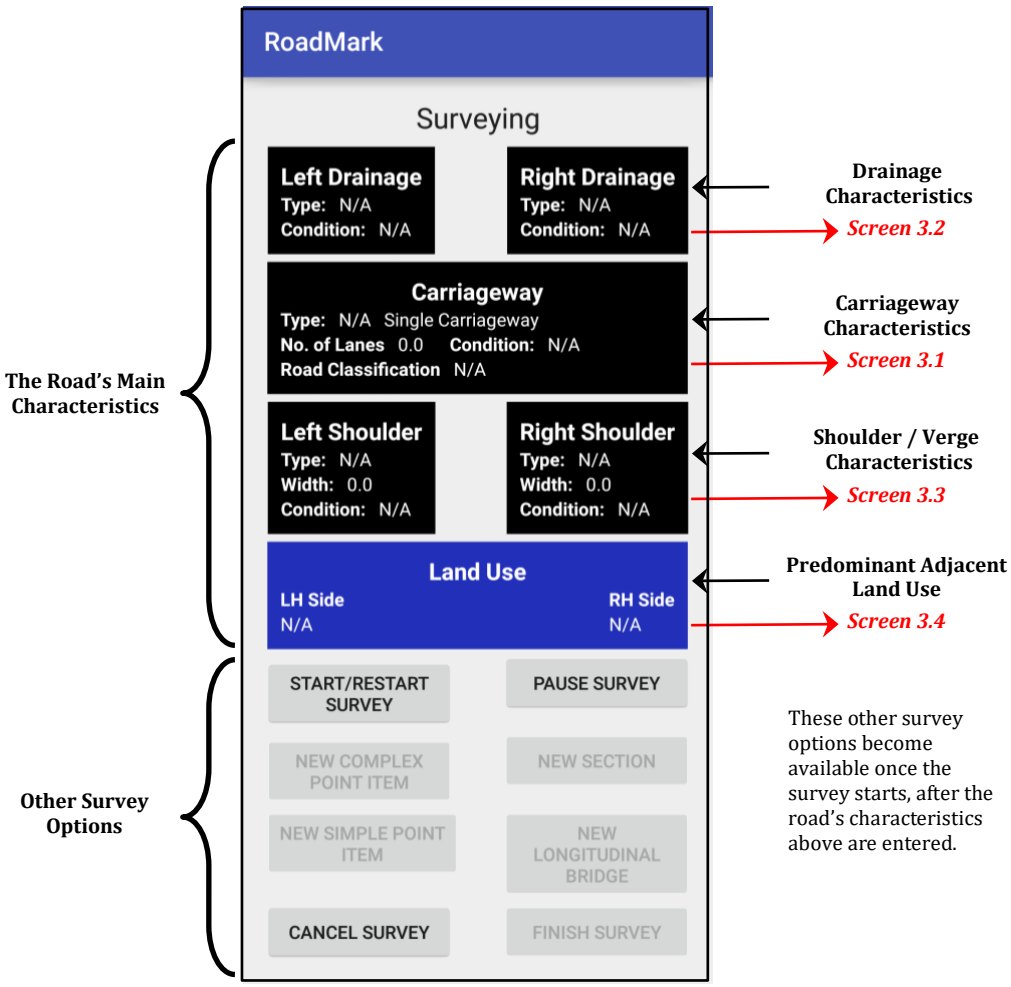


11 New Survey Screen
(Screen 2)



12 Initial Road Surveying Screen
(Screen 3)

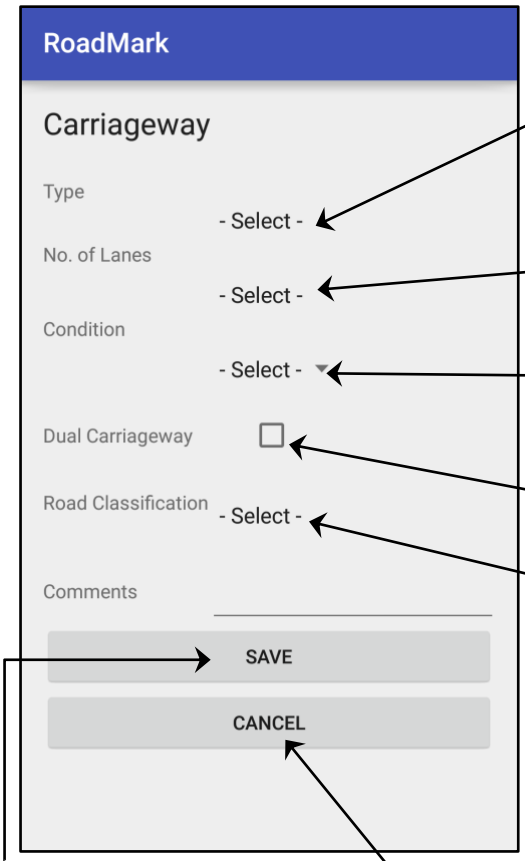
Upon saving a survey's basic setup data, the user is taken to the main surveying screen, on which all the main characteristics of the road can be recorded.



The following figures describe the options and settings available for each of the areas accessed from this main surveying screen.

13 Carriageway Data

Screen 3.1



The following road types are available:
- **Paved (Bitumen)**
- **Paved (Concrete)**
- **Paved (Macadam)**
- **Paved (Sealed)**
- **Gravel / Laterite**
- **Earth**

The width of the road is expressed in the number of lanes. The following options are available: 1, 1½ , 2, 2½ , 3 and 4.

The following road conditions are available: Good, Fair, Poor & Bad.

Tick this box to indicate if the road is a dual carriageway.

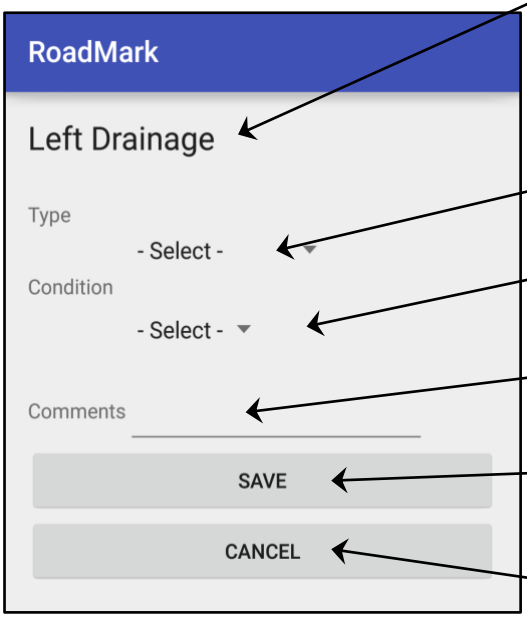
The following road classifications are available:
- **IC: International Communication Road**
- **UR: Union Road**
- **SR: States & Regions Connection Road**
- **DT: District/Township Connection Road**
- **TR: Township Road**
- **NC: No Code**

Press Save to return to the Main Surveying Screen (3/3b). This requires all fields (other than "Comments") to be filled. All the data is saved and shown on the Surveying screen.

Cancel returns the user to the Surveying screen (3/3b). Any data entered on this screen is lost.

14 Drainage Details

Screen 3.2



(This screen is the same for both sides.)

The following drainage types are available:
- **No drainage**
- **Earth (unlined)**
- **Concrete Lined (or brick)**

The following drainage conditions are available: Good, Fair, Poor & Bad. (Not required if "No drainage" selected in option above.)

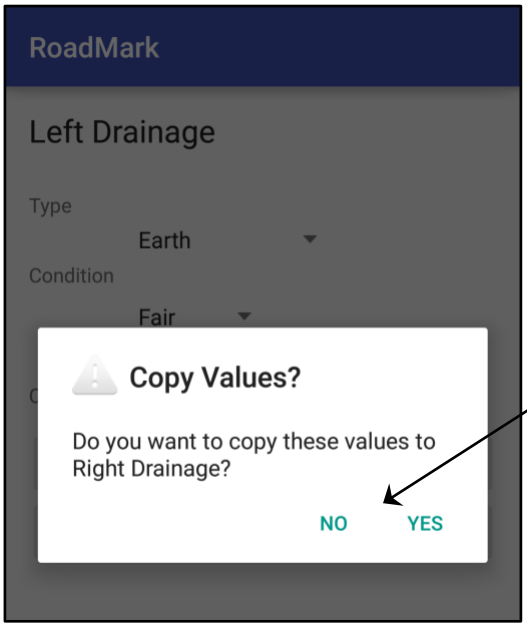
Enter any comments that may be useful for later reference.

Save takes the user to the supplementary dialogue box (3.2a) before returning to the Main Surveying Screen (3). Requires all fields (other than "Comments") to be filled. All the data is saved and shown on the Surveying screen (3/3b).

Cancel returns the user to the Surveying screen (3/3b). Any data entered on this screen is lost.

15 Supplementary Dialogue Box

Screen 3.2a



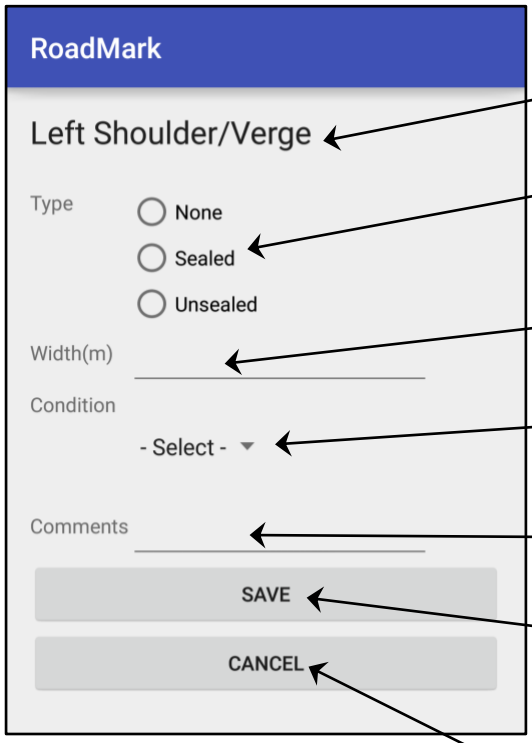
When the Save button is pressed on the Drainage screen, the user is asked whether the opposite side's drainage is the same.

- **Press "yes" to copy the details to the opposite side of the road.**
- **Press "No" if different drainage attributes are to be recorded on the opposite side of the road.**

A similar dialogue box is used for the left and right hand hard shoulders / verges.

16 Hard Shoulder / Verge Data

Screen 3.3



This is the same for both sides.

Select the type of shoulder / verge.

Enter width (in metres) Acceptable Range: 0 – 20m (Not required if "None" selected in option above.)

The following shoulder/Verge conditions are available: Good, Fair, Poor & Bad. Not required if "None" selected in first option above.

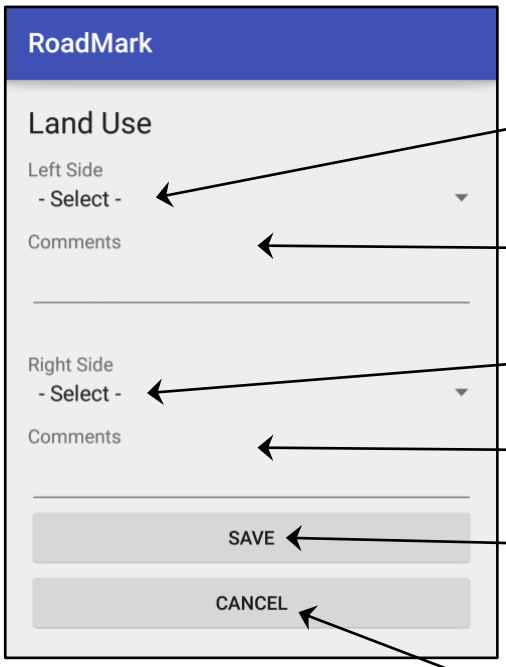
Enter any comments that may be useful for later reference.

Save takes the user to the supplementary dialogue box (3.2a) before returning to the Main Surveying Screen (3). Requires all fields (other than "Comments") to be filled. All the data is saved and shown on the Surveying screen (3/3b).

Cancel returns the user to the Surveying screen (3/3b). Any data entered on this screen is lost.

17 Prevailing Land Use Option

Screen 3.4



Enter the predominant land use on the Left Hand Side of the road. The following options are provided:

Village, Agricultural, Forest, Residential or Urban, Commercial, Mining, Other

Enter any comments about the land use on the LHS, that may be useful for later reference.

Enter the predominant land use on the Right Hand Side of the road. The following options are provided:

Village, Agricultural, Forest, Residential or Urban, Commercial, Mining, Other

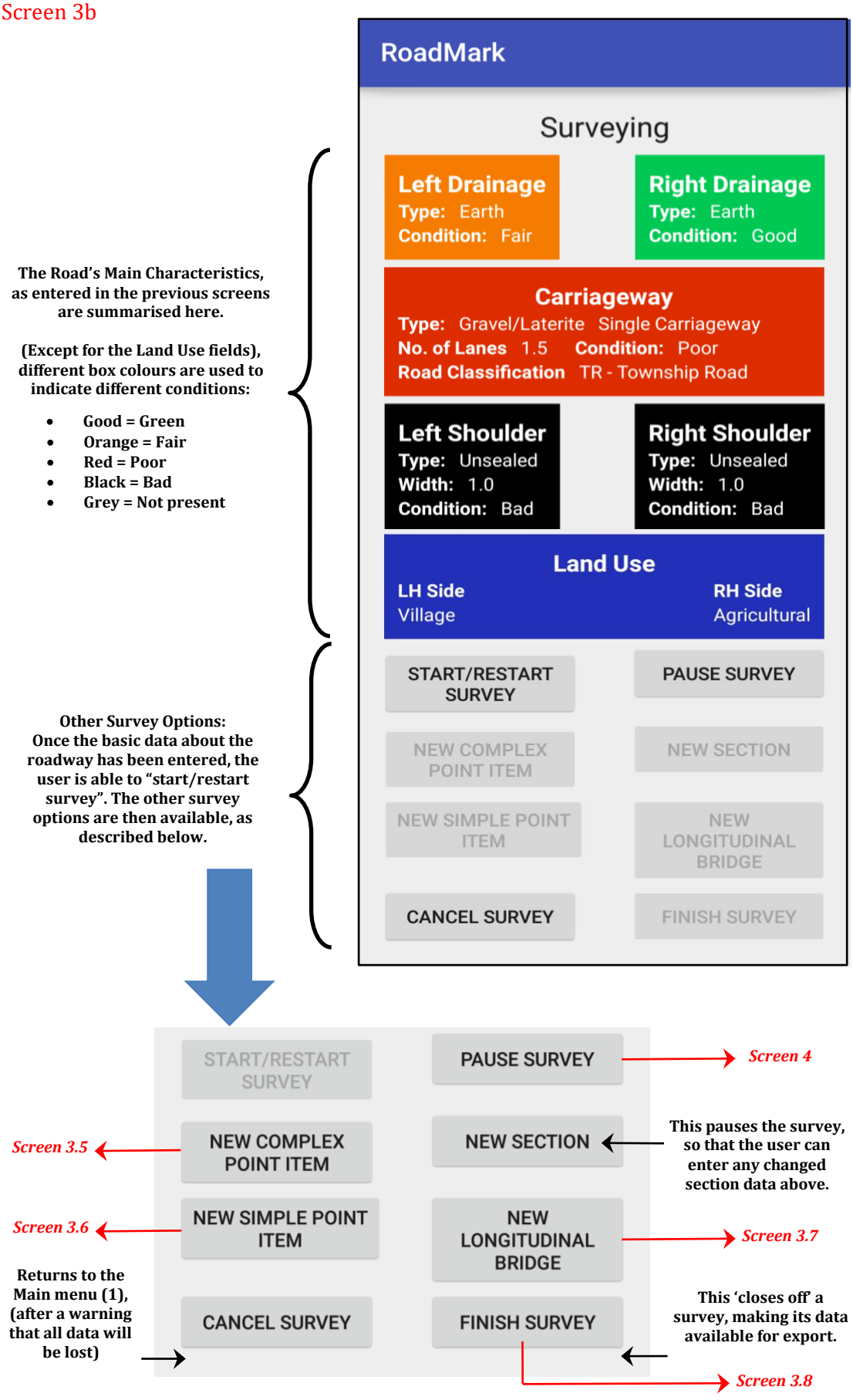
Enter any comments about the land use on the RHS, that may be useful for later reference.

Save returns the user to the Main Surveying Screen (3/3b) . It requires all fields (other than "Comments") to be filled. All the data is saved and shown on the Surveying screen.

Cancel returns the user to the Surveying screen (3/3b). Any data entered on this screen is lost.

18 Completed Road Surveying Screen

Screen 3b



19 Complex Point Items (CPI)

Screen 3.5

A "Complex Point Item" (CPI) is a specific item occurring along the road, with attributes (such as size & condition), which are worth recording (in addition to its location).

The survey is suspended whilst the user enters data about a CPI. Because this data can take some time to record, when returning to the main Surveying screen, the user needs to press the "Start/Restart survey" button.

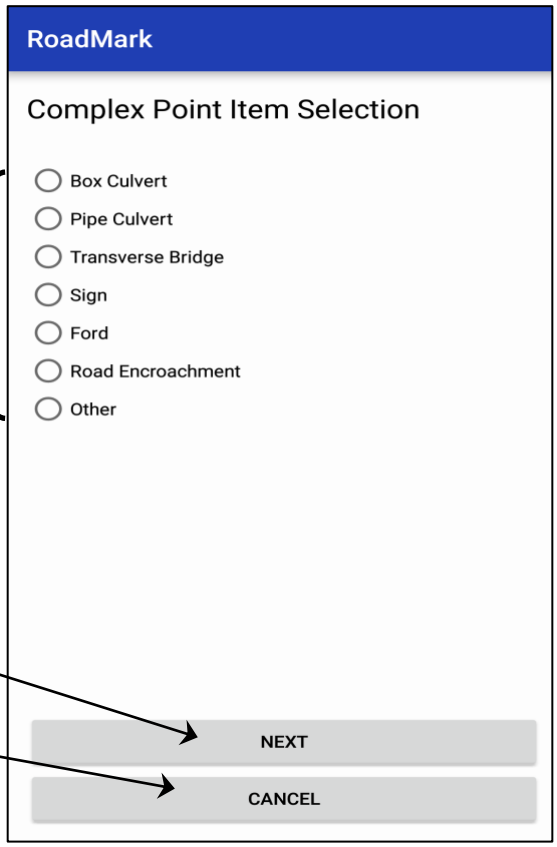
RoadMark can record key attributes about the following CPIs:

- **Box Culverts (see screen 3.5.1)**
- **Pipe Culverts (see screen 3.5.2)**
- **Transverse Bridges (see screen 3.5.3)**
- **Signs (see screen 3.5.4)**
- **Fords / Causeways (see screen 3.5.5)**
- **Road Encroachments (see screen 3.5.6)**
- **Other (see screen 3.5.7)**

The attributes recorded for each of these CPIs is shown in the following screens.

The user is taken to one of the following screens, depending on which CPI is selected above.

The User is taken back to the Surveying Screen (3b) and no data is saved.



20 Box Culvert Data

Screen 3.5.1

Enter the culvert's ID (if available) Any alphanumeric ID is acceptable.

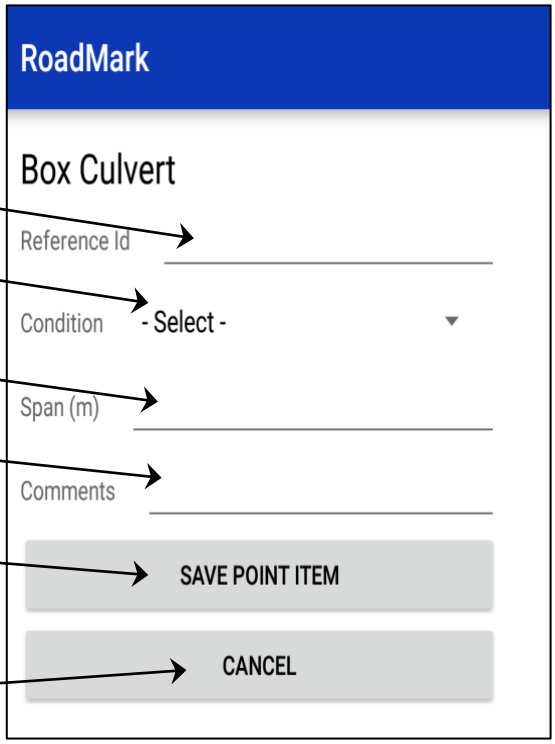
The following Box Culvert conditions are available: Good, Fair, Poor & Failed.

Enter span of culvert (in metres) Acceptable Range: 0 – 20m

Enter any comments that may be useful for later reference.

This saves the data entered & returns the user to the Main Surveying Screen (3b). It requires the condition & Span fields to be filled.

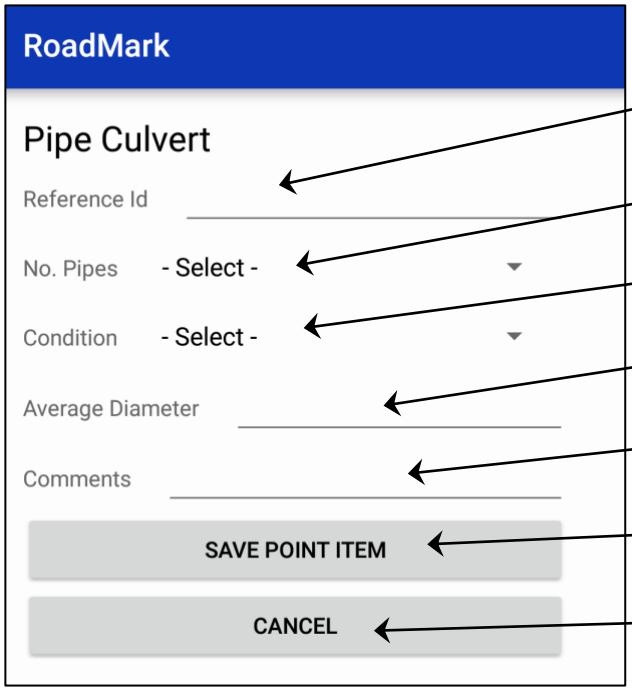
The User is taken back to the Surveying Screen (3b). No data from this screen is saved.



Note: A "Bridge" is a structure that consists of a separate top (superstructure or decking) to the rest of the structure (substructure). They may be made of the same or different materials. If the structure was constructed as a single item, then it should be treated as a "culvert" and not a bridge.

21 Pipe Culvert Data

Screen 3.5.2



Enter the culvert's ID (if available) Any alphanumeric ID is acceptable.

Opens a drop-down box to enter the number of pipes in the culvert Acceptable Range: 1-15

The following Box Culvert conditions are available: Good, Fair, Poor & Failed.

Enter average diameter of <u>each</u> pipe in the culvert (in metres) Acceptable Range: 0 – 5m

Enter any comments that may be useful for later reference.

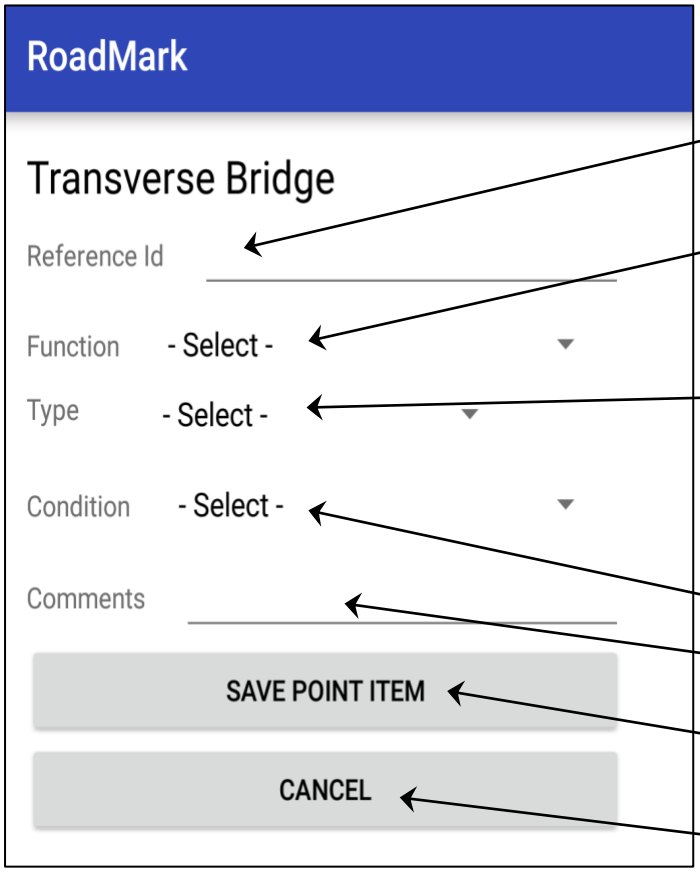
This saves the data entered & returns the user to the Main Surveying Screen (3b). It requires the Condition & No. of Pipes fields to be filled.

The User is taken back to the Surveying (3) screen. No data from this screen is saved.

22 Transverse Bridge Data

Screen 3.5.3

"Transverse Bridges" carry obstacles <u>over</u> the road being surveyed. Whilst these bridges may therefore be the responsibility of another agency, where their presence may influence what actions can be carried out on the relevant road being surveyed, their basic details should be recorded.



Enter the bridge's ID (if available) Any alphanumeric ID is acceptable.

Function records the purpose of the bridge: what is it carrying? Options are:

- **Footpath**
- **Road**
- **Rail**
- **Waterway**
- **Other**

Enter the predominant material of the bridge. Options are:

- **Steel**
- **Reinforced Concrete**
- **Timber**
- **Stone or Masonry**
- **Other**

The following conditions are available: Good, Fair, Poor & Bad.

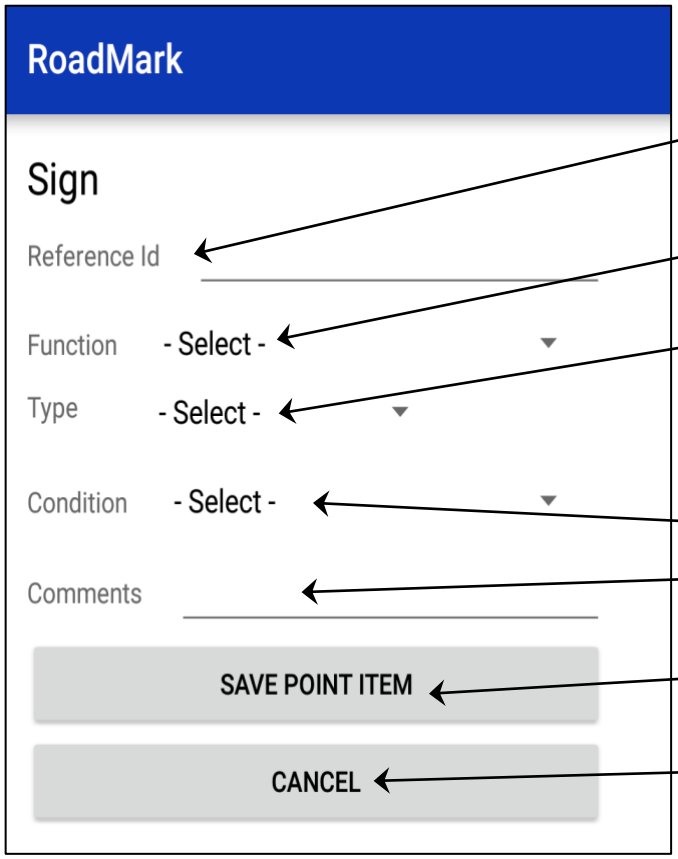
Enter any comments that may be useful for later reference.

Saves the data entered & returns the user to the Main Surveying Screen (3). It requires the preceding fields to be filled (other than Comments).

The User is taken back to the Surveying Screen (3b). No data from this screen is saved.

23 Signs Data

Screen 3.5.4



The Road Agency is often responsible for providing and maintaining road signs along their roads. This screen can be used to record basic data about these road assets.

Enter the sign's ID (if available)
Any alphanumeric ID is acceptable.

Function records the purpose of the sign.
The options available are:

- **Information** (usually rectangular)
- **Warning** (usually triangular)
- **Obligatory** (usually circular)

Enter the predominant material of the sign. Options are:

- **Steel**
- **Timber**
- **Stone or Concrete**
- **Other**

The following conditions are available:
Good, Fair, Poor & Failed.

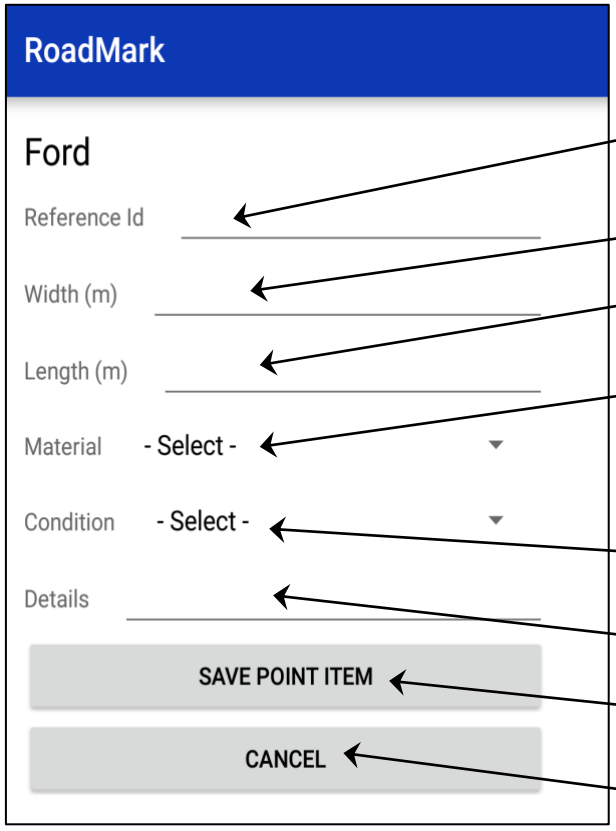
Enter any comments that may be useful for later reference.

Saves the data entered & returns the user to the Main Surveying Screen (3b). It requires the previous fields to be filled (apart from Comments).

The User is taken back to the Surveying Screen (3b). No data from this screen is saved.

24 Ford / Causeway Data

Screen 3.5.5



"Fords" or "Causeways" are structures which carry a road through a river or other watered area. As such, they are usually the responsibility of the road agency to provide and maintain. Key details about each Ford/Causeway can be recorded on this screen.

Enter the ford's ID (if available)
Any alphanumeric ID is acceptable.

Length of the Ford (in metres)
Range: 0 – 25 metres.

Average width of the Ford (in metres)
Range: 0 – 50 metres.

Enter the predominant material of the ford. Options are:

- **Stone**
- **Brick**
- **Concrete**
- **Unformed (none)**

The following conditions are available:
Good, Fair, Poor & Bad.

Enter any comments that may be useful for later reference.

Saves the data entered & returns the user to the Main Surveying Screen (3b). It requires the previous fields to be filled (apart from Details).

The User is taken back to the Surveying Screen (3b). No data from this screen is saved.

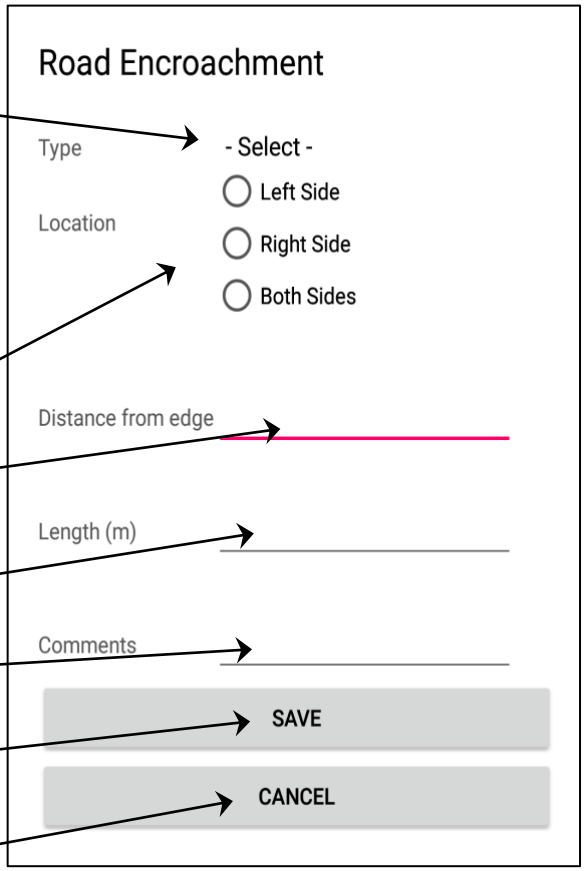
25 Road Encroachments

Screen 3.5.6

Road Encroachments allows the user to record any obstacles that occur on either (or both) sides of the road, that restrict the road corridor. (This is a new option (screen) introduced since Version 1 of RoadMark.)

The following types of Encroachments can be recorded:

- **Pond or Lake**
- **Swamp**
- **Utility Pole**
- **Building**
- **Railway**
- **Water Course** (e.g. River)
- **Land Drop** (adjacent land lower)
- **Cliff** (adjacent land higher)
- **Substantial Tree**



Enter the location of the obstacle on the road.

The closest distance of the obstacle from the edge of the carriageway (in metres) Range: 0 – 25 metres.

Length of the obstacle (in metres) Range: 0 – 500 metres.

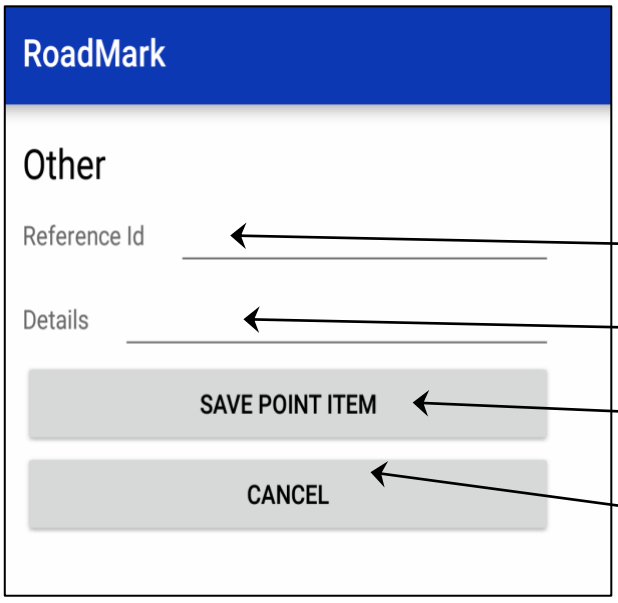
Enter any comments that may be useful for later reference.

Saves the data entered & returns the user to the Main Surveying Screen (3b). It requires the previous fields to be filled (apart from Details).

The User is taken back to the Surveying Screen (3b). No data from this screen is saved.

26 Other Complex Item Data

Screen 3.5.7



This screen allows the user to provide a description of any other items that are located along the road, which may be of relevance when determining what actions to take on a road.

Enter the ford's ID (if available) Any alphanumeric ID is acceptable.

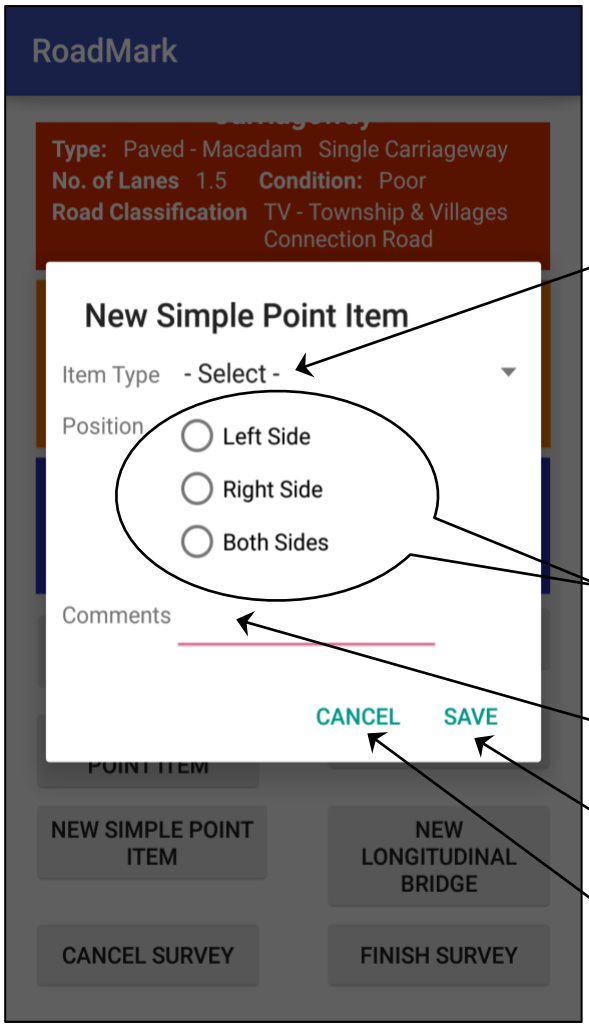
Enter any comments that may be useful for later reference.

Saves the data entered & returns the user to the Main Surveying Screen (3b). It requires the Details fields to be filled.

The User is taken back to the Surveying Screen (3b). No data from this screen is saved.

27 Simple Point Items (SPI) Data

Screen 3.6



This pop-up screen allows the user to record the presence of a range of simple items that are located along the road. These may be of relevance when determining what actions to take on a road.

Type of Point Item. The following options are provided:

- **Intersection**
- **Private Access Point**
- **Health Centre**
- **School**
- **Market**
- **Monastery / Temple**
- **Pond/Lake**
- **Mile or Km Post/Marker**
- **Level Crossing**
- **Other**

The position of the SPI can be recorded here. Select "Both Sides" if the same item is present on both sides of the road, (except for "Intersection" where "Both Sides" indicates the presence of a crossroads).

Enter any comments that may be useful for later reference.

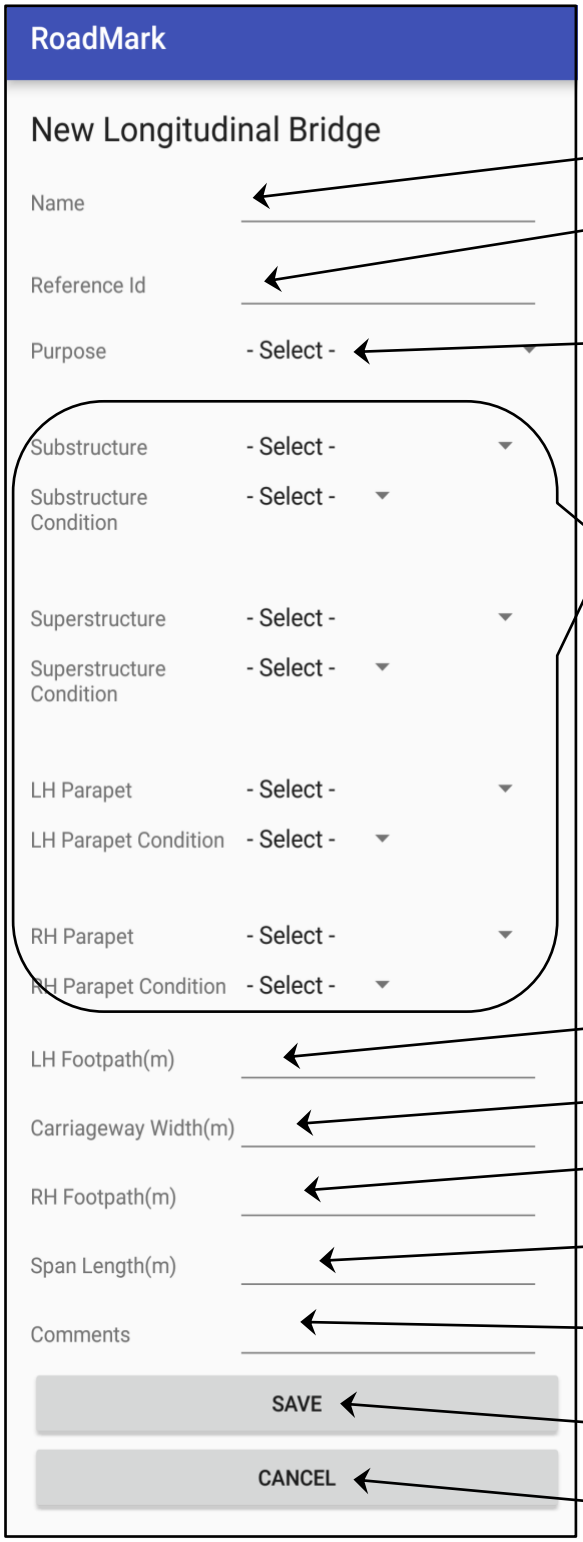
Saves the data entered & returns the user to the Main Surveying Screen (3b). It requires the Item Type & Position fields to be filled.

The User is taken back to the Surveying Screen (3b). No data from this screen is saved.

28 Longitudinal Bridge Data

Screen 3.7

A "longitudinal" bridge is one that carries the road over an obstruction, such as a river or footpath. It is an important link in the road network and is therefore traditionally the responsibility of the road agency along with the road it supports. On this screen, important basic data about each longitudinal bridge can be recorded.



Enter the bridge name (if available)

Enter the Bridge ID (if available) (Must be a digit)

Why is the bridge present? What obstacle is it crossing? The following options are available in RoadMark:

- **Road**
- **River/Water**
- **Footpath**
- **Railway**
- **Other (See comments)**

For the following elements of the bridge, the main materials used can be recorded, together with their condition:

- **Substructure (e.g. abutments)**
- **Superstructure (decking)**
- **Parapets (left & right hand sides)**

The following options are available for the material:

- **Steel**
- **Reinforced Concrete**
- **Timber**
- **Stone or Masonry**
- **Other**

The following condition options are available:

- **Good**
- **Fair**
- **Poor**
- **Bad / Missing**

Width of Footpath (in metres) on LHS (use 0 if no footpath present)

Average width of the road / carriageway (in metres)

Width of Footpath (in metres) on RHS (use 0 if no footpath present)

Length of the bridge's span (in metres), usually considered to be the distance between the abutment faces.

Enter any comments that may be useful for later reference.

Saves the data entered & returns the user to the Main Surveying Screen (3b). It requires the preceding fields to be filled (apart from Comments).

The User is taken back to the Surveying Screen (3b). No data from this screen is saved.

Note: A "Bridge" is a structure that consists of a separate top (superstructure or decking) to the rest of the structure (substructure). They may be made of the same or different materials. If the structure was constructed as a single item, then it should be treated as a "culvert" and not a bridge.

29 Reload Paused Survey

Screen 4

This screen allows the user to reload any previously paused surveys, (but not Finished surveys – see below).

Note: Whilst RoadMark reloads all the previous data, it automatically starts with the phone's new GPS position. In order to avoid spurious network data, it is therefore important that the user returns to the same place where the survey was previously paused.

All previously paused surveys stored on the mobile device are listed here. Pressing the desired survey opens it up from where it was previously paused (after a confirmation screen is shown).

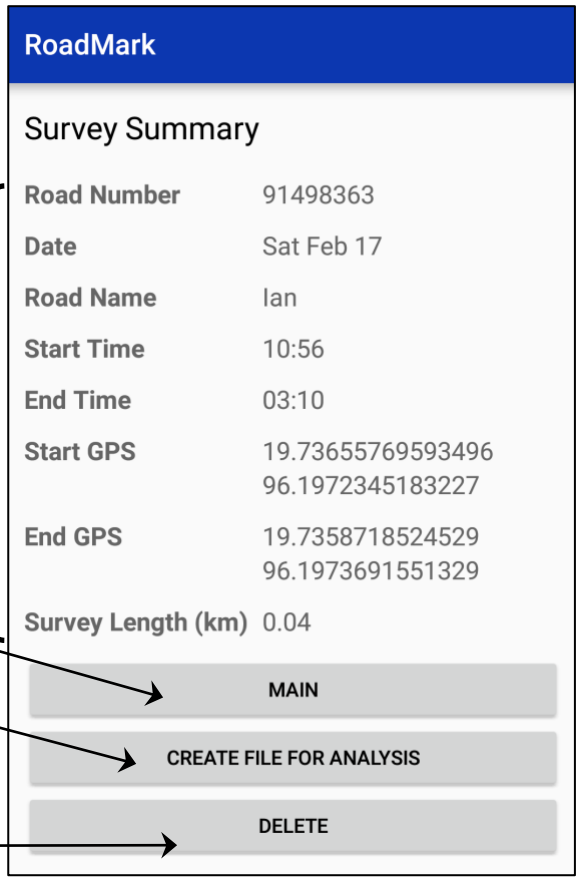
This returns the user to the main screen (1) without loading any previous survey data.

30 Survey Summary Screen

Screen 3.8

This screen is shown when a survey is "Finished" from the Surveying screen (3). It summarises key information about the survey.

From this screen, the user can export or delete the data for the completed survey, or return to the main menu (1).



Summary data for the completed survey.

This return the user to the main screen (1).

This opens up the user's usual emailing app on the device, in order to email a survey's data as an email attachment.
Note that this requires the user to have a valid email account on the device.

This allows the user to delete a survey's data (following acceptance of a warning screen that this action cannot be undone).

31 About & Help Screen

Screen 6

This App has been developed by Penhallow Limited in the UK, to whom any queries about its operation, use or support should be directed.

This version has been specifically tailored to be used at in Myanmar to support the Planning & Budgeting functions in the Department for Rural Road Development (DRRD).

The App contains a number of mechanisms to control its wider use, particularly at this early stage when continual improvements are being made. For this reason, it is important that legitimate users update to the most current version of the software, to avoid compatibility problems and/or data loss with its desktop counterpart program, RoadMark Analysis (RMA).

To protect their data, users should also download the data collected as soon as possible, from their mobile device to a more permanent and secure location, using RMA.