

# POSI Control Strategies and Network Design Examples

## **Introduction**

The POSI Control Strategies and Network Design Examples document has been developed to provide suggested strategies for common scenarios requiring the removal of survey marks, with a focus on appropriate network geometry, control strategy as well as staging and delivery of data to DCS Spatial Services to align with the Surveyor Generals Direction No. 11 (SGD11).

The following document has been developed as an educational resource with examples provided to give applicants a clear understanding of the POSI requirements. It should not be interpreted as a template unless otherwise stipulated. It should also be noted that other public authorities or organisations who administer the POSI process on behalf of the Surveyor-General may require additional information as part of any application.

For further information on how this document fits into the POSI process, consult the POSI Application Support Guide.

## **Example POSI Strategies**

The control component may require a horizontal or vertical control survey (or both). All control work must be carried out in accordance with the Surveyor Generals Direction No.12 (SGD12) and SGD12 Technical Specifications. DCS Spatial Services must consult in aspects of network design, best survey practice, and data submission requirements to ensure all control data meets the standards necessary for eventual ingestion into the Survey Control Information Management System (SCIMS).

For projects requiring the removal of survey marks, there are three common strategies that can be employed:

1. Pre-Project Survey Only
2. Post-Project Survey Only
3. Pre & Post-Project Survey

Depending on the nature of the project, the above strategies may not be appropriate and must be viewed as examples only. The public authority or organisation administering the POSI component of a project may choose to enforce their own POSI strategies.

Please note, users should take into the account the cadastral requirements when preparing a POSI strategy.

### **Pre-Project Survey Only**

A Pre-Project Survey Only strategy is most common when stable replacement marks are able to be placed prior to work and will survive the life of the project. This strategy enables surveyors to use existing State control marks that are to be destroyed as control for any replacement works. This strategy must include a post-construction field audit.

### **Post-Project Survey Only**

A Post-Project Survey Only strategy is most common when the survey marks have already been destroyed and the replacement marks cannot be placed until the completion of works. This might be due to the size or timeframe of the project. The control component will require the applicant to connect their survey into the surrounding State control survey. This may require a more rigorous survey methodology and network design to prove datum and ensure the survey meets the required Class.

DCS Spatial Services does not prefer this strategy and will only accept its use when the other strategies detailed in this document are not applicable.

### **Pre & Post-Project Survey**

A Pre & Post-Project strategy is most common when replacement marks cannot be placed in a safe location until the completion of works. However, the applicant is still able to access the project area to undertake some pre-construction survey work. Both surveys must be submitted to DCS Spatial Services.

The Pre-Project Survey may involve placing recovery marks outside the project area and connecting to survey marks to be destroyed by future works. These recovery marks will act as future control for the Post-Project survey and minimise the amount of survey work that might normally be required in a Post-Project Survey Only strategy. Monumentation for the recovery marks must be stable and survive the life of the project, where possible place approved Permanent Survey Marks (PSMs) as per Surveyor General's Direction No.1 or connect into existing survey marks in SCIMS. A Pre-Project survey can be used to recover cadastral marks in the event that they cannot initially be placed within 30m.

The Post-Project Survey can be carried out at the completion of works when replacement marks can be placed in a safe location using the Pre-Project Survey as control.

# POSI Control Strategies and Network Design Examples

## POSI Control Strategy Examples

For the three previously mentioned POSI strategies, three survey techniques are showcased – GNSS static, total station traversing, and differential levelling. For each strategy and survey technique, example network diagrams and control strategies are shown to provide an indication into the detail DCS Spatial Services expects to accompany a POSI application. These are designed to give applicants an idea on how to approach the control component of a POSI application, depending on which strategy is adopted. Proposed network diagrams must be attached to the POSI Strategy Report to enable DCS Spatial Services to provide immediate feedback.

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## Disclaimer

- Survey marks and associated information, location and survey network used in this document are for example purposes only.
- Additional information or requirements to that shown may be imposed by a public authority for a POSI submission.
- For traverse diagrams, while temporary marks may be required in the connection of two survey marks, they only need to be displayed on the network diagram when used in the closing of a line to prevent radiations, as shown in example diagrams.
- Symbology highlighting the status of a mark (safe, to be destroyed etc) must adopt the convention stipulated in the POSI Strategy Report Template. No standard symbology for temporary marks and replacement marks are stipulated.
- The following diagrams are examples only. Survey Project Plan Drawings, as detailed in SGD11, must include a title block showing additional information including applicant details, project and survey information.
- For large project areas, a 'Key Plan' page should be included depicting the extent of several smaller numbered sections which are shown at larger scale on the following pages. The examples in this document may not show all sheets.
- Where marks are placed before construction, a post construction field audit may be required to verify the status of all replacement marks.
- Users should consider the impact of ancillary works, such as stockpiling, erection of site offices and compounds, utility adjustments, and the impact these activities may have on surrounding survey infrastructure, and this should be incorporated into the POSI strategy if appropriate.





**Legend** **Traverse Example 1: Pre-Project Survey Only Strategy - Key Plan**

- Safe
- Vulnerable
- To Be Destroyed
- Found Destroyed
- Replacement Mark
- ◆ Temporary Station
- ▲ Recovery Mark

This diagram depicts the case where it is possible to safely place replacement marks prior to work and the surveyor is confident that these will not be disturbed by the works. A post construction field audit must be performed to verify the status of all replacement marks.

The traverse connects the newly placed survey marks to Vulnerable and To Be Destroyed survey marks which can be used as control.

Note that temporary stations are used to avoid radiations in some areas.

Given the large extent of the work area, the traverse diagram includes a Key Plan (shown here), followed by several sections at a larger scale (not shown).







**Legend**

- Safe
- Vulnerable
- To Be Destroyed
- Found Destroyed
- Replacement Mark
- ◆ Temporary Station
- ▲ Recovery Mark

The diagram illustrates survey work that could not be carried out until after the destruction of survey marks. Since the survey marks have been destroyed, the traverse must be extended to pick up sufficient survey control.

In some cases a lack of local control may mean that other survey methods, e.g. static GNSS, may be required to establish control for the traverse to connect to, and infill from.

Note that temporary stations are used to avoid radiations in some areas.

Given the large extent of the work area, the traverse diagram includes a Key Plan (shown here), followed by several sections at a larger scale (not shown).

**Traverse Example 2: Post-Project Survey Only Strategy - Key Plan**







**Legend**

**Traverse Example 3: Pre & Post Project Survey Strategy**

- Safe
- Vulnerable
- To Be Destroyed
- Found Destroyed
- Replacement Mark
- ◆ Temporary Station
- ▲ Recovery Mark

**Pre-Project Traverse - Key Plan**

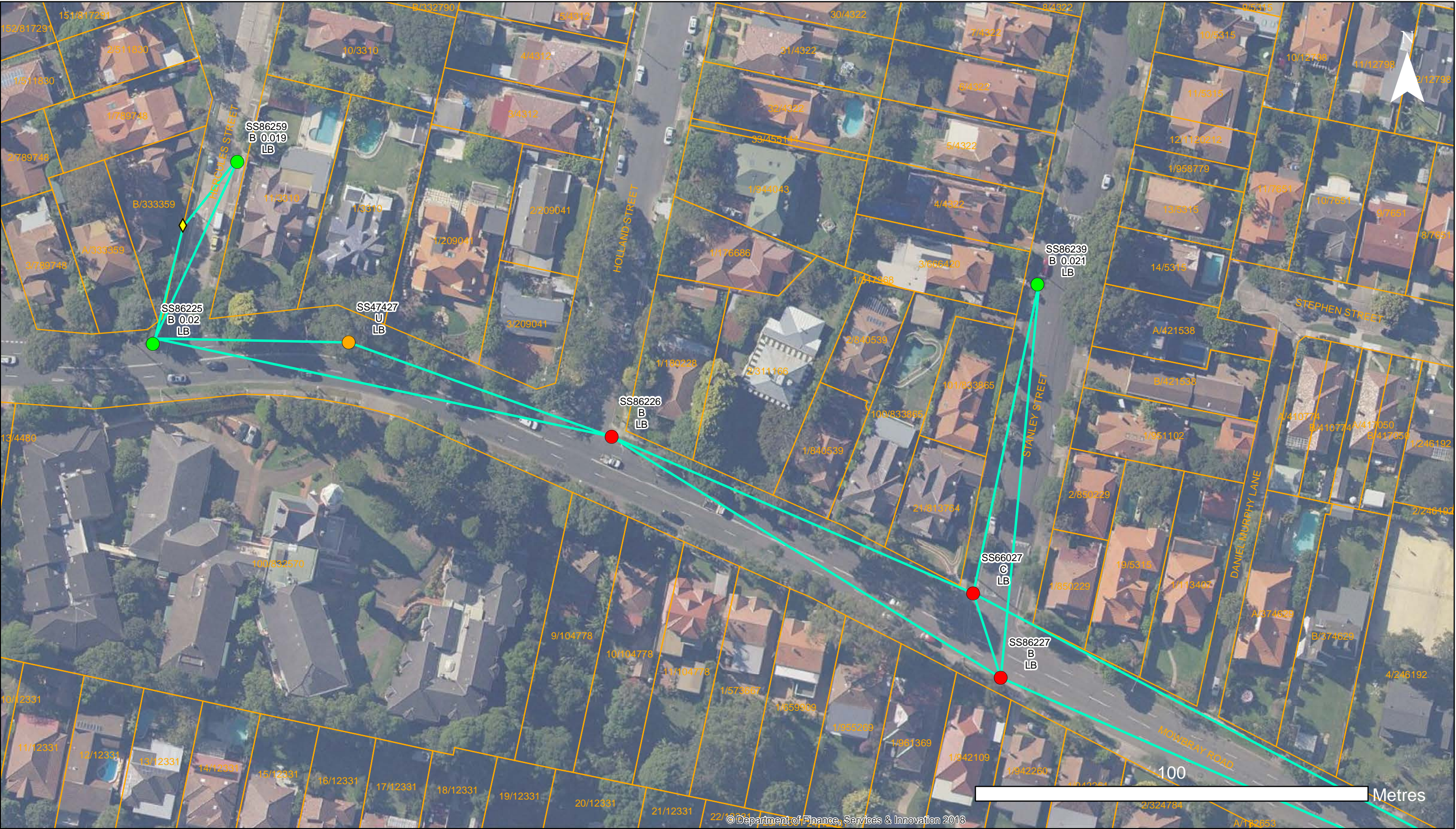
The Pre-Project traverse is designed to illustrate a situation where the extent and nature of the works mean that replacement marks cannot be placed in a safe location until the works are completed. The traverse is designed to assess the fit of local survey control deemed safe and to place and coordinate recovery marks where necessary. These marks will serve as control for the post-project traverse.

Recovery marks must be placed in a safe location away from the works being conducted, and must be stable enough to last the life of the project. In some instances existing survey marks may be appropriate for this purpose, Survey marks can also be placed after discussion and agreement with DCS Spatial Services. Note that temporary stations are used to avoid radiations in some areas. Further recovery marks may be required, for example near SS86318 & SS86226, based on consultation with DCS Spatial Services.

Given the large extent of the work area, the traverse diagram includes a Key Plan (shown here), followed by several sheets showing individual sections at a larger scale (only one section included on the following page as an example).







**Legend**

- Safe
- Vulnerable
- To Be Destroyed
- Found Destroyed
- Replacement Mark
- ◆ Temporary Station
- ▲ Recovery Mark

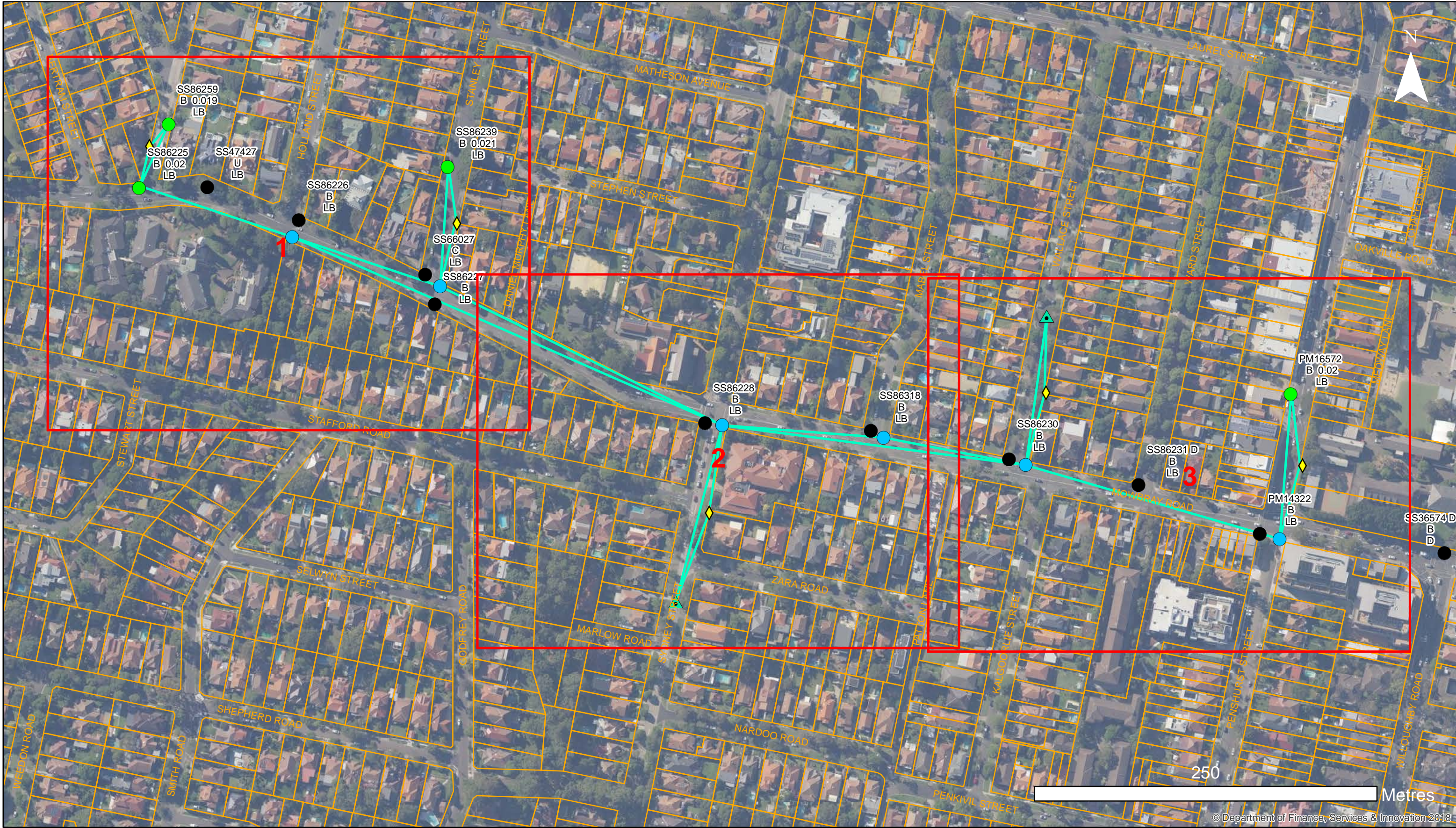
**Traverse Example 3: Pre & Post Project Survey Strategy**  
**Pre-Project Survey**

For large projects, the survey control network should be shown in several sections, at a larger scale. The Key Plan, shown on the previous page, must clearly show the location of these sections over the whole extent of the survey. Sheet 1 of 3 is shown here as an example (Sheets 2 and 3 not shown).

At a larger scale, survey geometry can be viewed clearly and further information, such as DP and lot numbers can be shown.

While temporary marks may be required in the connection of two survey marks, they only need to be displayed on the network diagram when used in the closing of a line to prevent radiations, as demonstrated here.





**Legend**

**Traverse Example 3: Pre & Post Project Survey Strategy**

- Safe
- Vulnerable
- To Be Destroyed
- Found Destroyed
- Replacement Mark
- ◆ Temporary Station
- ▲ Recovery Mark

**Post-Project Traverse - Key Plan**

This diagram depicts the Post-Project traverse. The existing survey control marks with appropriate class deemed safe from the impact of works, along with the recovery marks coordinated in the Pre-Project Survey are used as control.

The traverse includes measurement to the newly placed replacement marks, and the survey marks impacted by the works are now destroyed.

Note that temporary stations are used to avoid radiations in some areas.

Given the large extent of the work area, the traverse diagram includes a Key Plan (shown here), followed by several sheets showing individual sections at a larger scale (not shown).







**Levelling Example 1: Pre-Project Survey Only - Key Plan**

**Legend**

- Safe
- Vulnerable
- To Be Destroyed
- Found Destroyed
- Replacement Mark
- ▲ Recovery Mark

This diagram depicts the case where it is possible to safely place replacement marks before the start of work and the surveyor is confident that these will not be disturbed by the works. A post-construction field audit must be performed to verify the status of all replacement marks.

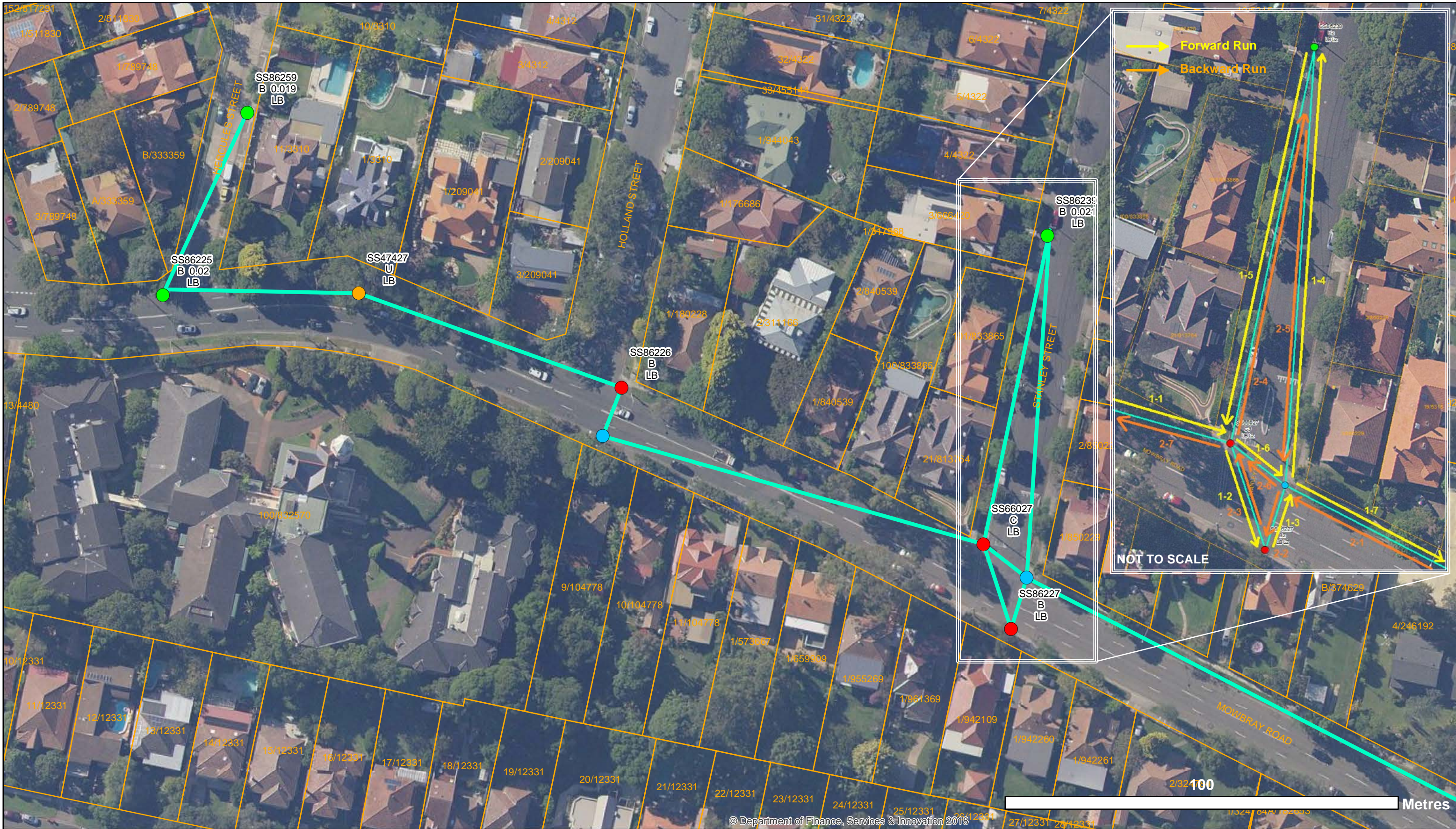
The levelling run connects the newly placed survey marks to Vulnerable and To Be Destroyed survey marks which can be used as control. All survey marks along the path of the levelling run must be included in the levelling control network.

Given the large extent of the work area, the diagram shows a Key Plan (shown here), followed by several sections at a larger scale (Sheet 1 shown on next page, Sheets 2 & 3 not included).

**Note 1:** This survey geometry geometry has been chosen so that a spur is avoided and that direct connections are made between survey marks in close proximity. See Sheet 1 for more detailed information.







**Levelling Example 1: Pre-Project Survey Only Strategy**

**SHEET 1 of 3**

**Legend**

- Safe
- Vulnerable
- To Be Destroyed
- Found Destroyed
- Replacement Mark
- ▲ Recovery Mark

For large projects, the survey network should be shown in several sections at a larger scale. The Key Plan, shown on the previous page, must clearly show the location of these sections over the whole extent of the survey. Sheet 1 of 3 is shown here as an example (Sheets 2 & 3 not included).

At a larger scale, survey geometry can be viewed clearly and further information such as DP and lot numbers, extent of works, location of stockpiles or any other relevant information can be shown.

The expanded section shows the path of the levelling run which allows for a continuous path while avoiding the creation of a spur up to SS86233 and, importantly, provides direct connections between close-by survey marks. Without direct connections, Class calculations may be biased. This is an example only and does not need to be shown in a levelling diagram submission.

Direct connections such as these must be made for survey marks less than 200m apart when avoiding a spur. These connections, however, are not necessary for straight-line levelling.







### Levelling Example 2: Post-Project Survey Only Strategy - Key Plan

#### Legend

- Safe
- Vulnerable
- To Be Destroyed
- Found Destroyed
- Replacement Mark
- ▲ Recovery Mark

Survey work was not able to be undertaken until the marks have been destroyed. The newly placed survey marks will be coordinated by connecting to local undisturbed control marks. A minimum of 3 control marks must be found in agreement, proving datum at both ends.

This example includes the Key Plan only, Sheets 1 to 4 are not included.





**Legend**

**Levelling Example 3: Pre & Post Project Survey Strategy**  
**Pre-Project Survey - Key Plan**

- Safe
- Vulnerable
- To Be Destroyed
- Found Destroyed
- Replacement Mark
- ◆ Temporary Station
- ▲ Recovery Mark

Due to the extent of the works, it is not possible to place replacement marks and connect them to existing control, some of which is to be destroyed. Recovery marks have been placed and levelled to serve as control for the survey of replacement marks upon completion of works.

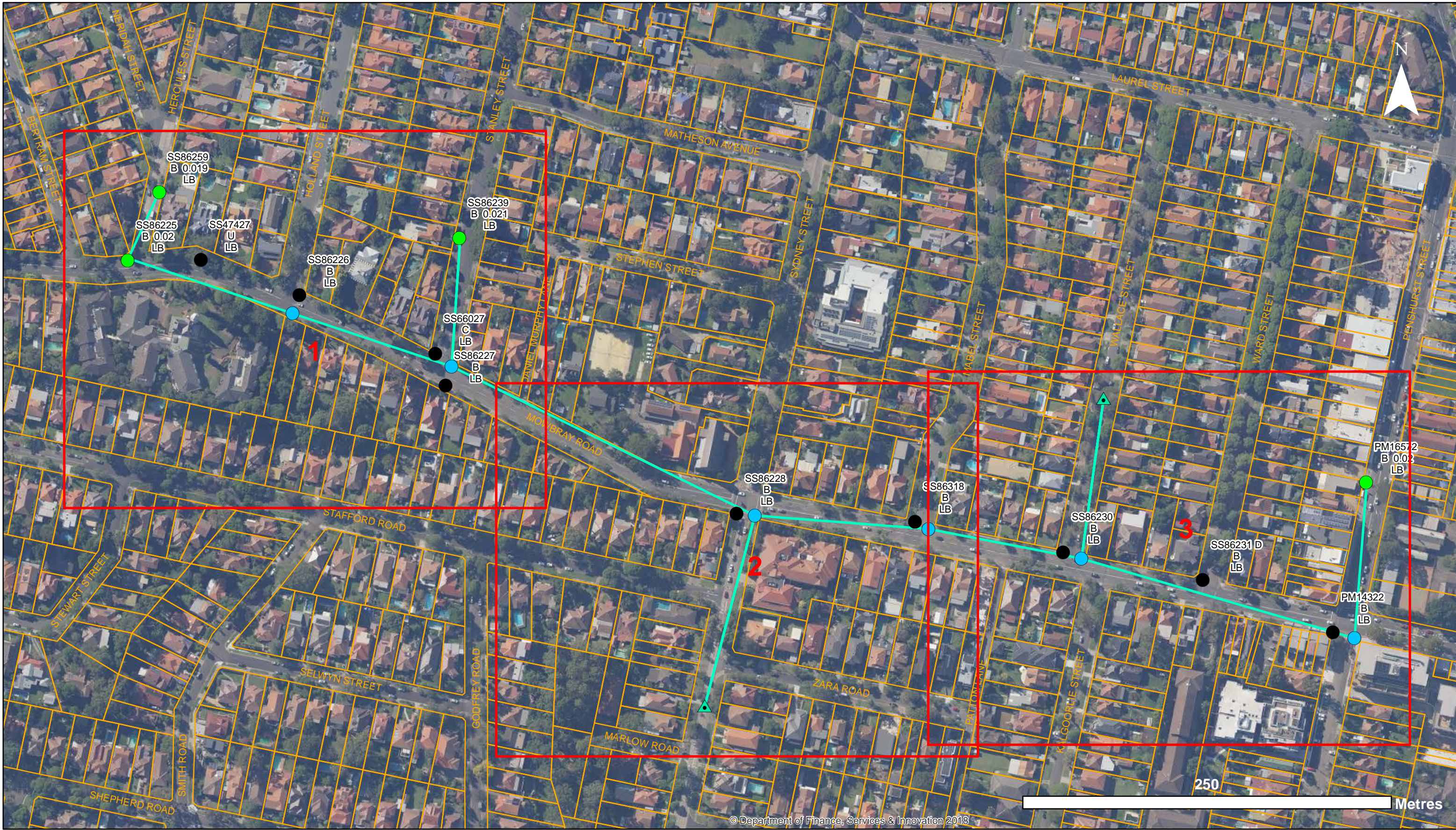
Recovery marks should be placed at sufficient distance from the works so that they will not be disturbed. Stable marks, durable enough to last for the life of the project, must be used.

Given the large extent of the work area, the traverse diagram includes a Key Plan (shown here), followed by several sheets showing individual sections at a larger scale (not shown).

**Note 1:** The path of the levelling run is shown to demonstrate how to avoid a spur. A temporary station is shown here for illustrative purposes. Other temporary stations may be required when measuring between marks which are not shown.

**Note 2:** Spur avoided and direct connection between close-by survey marks. See Levelling Example 1 for more information.





**Levelling Example 3: Pre & Post Project Survey Strategy**  
**Post-Project Survey - Key Plan**

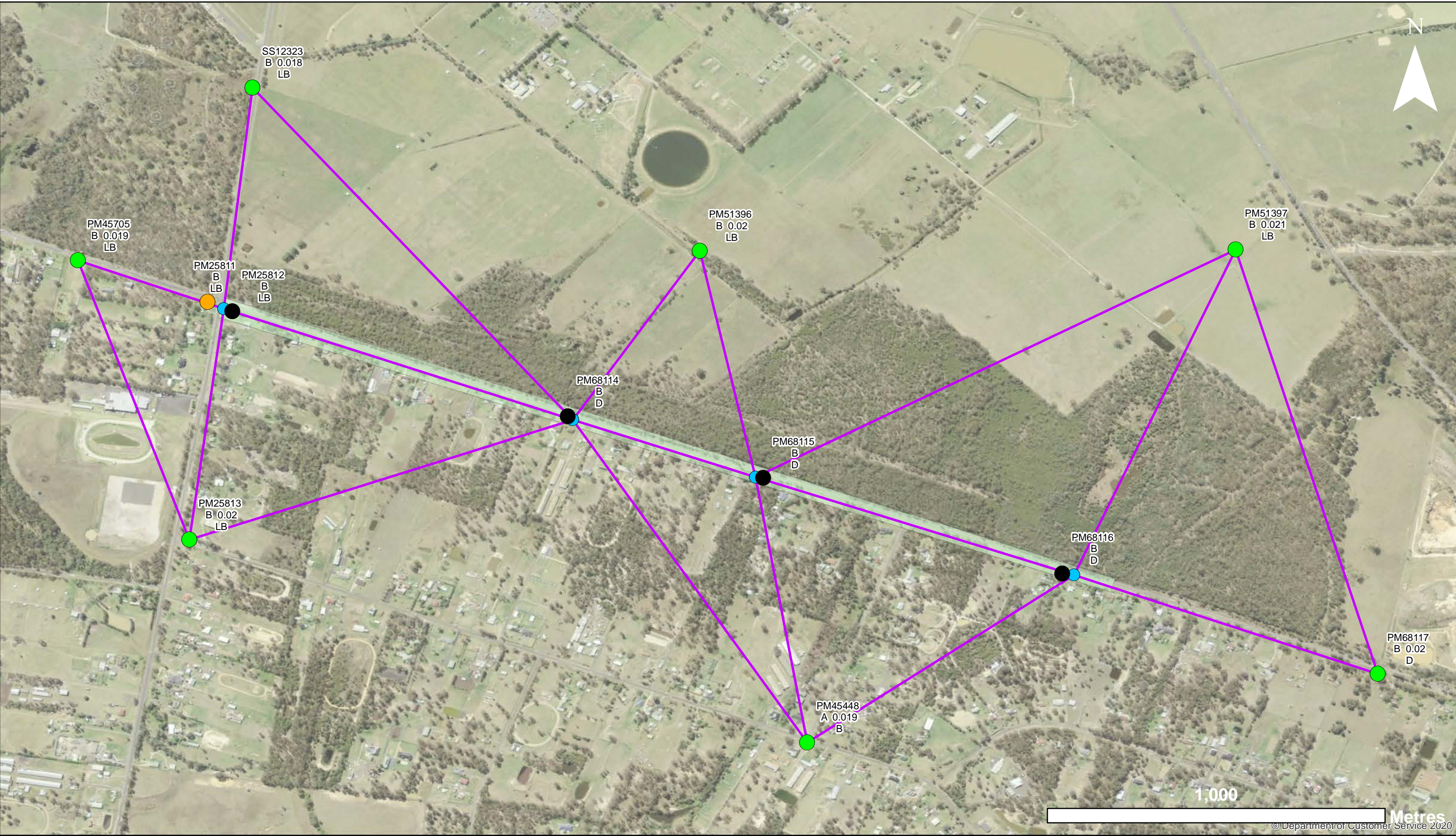
- Legend**
- Safe
  - Vulnerable
  - To Be Destroyed
  - Found Destroyed
  - Replacement Mark
  - ▲ Recovery Mark

Heights have been coordinated for the newly placed survey marks. Survey marks that are safe from destruction, with appropriate class, were used for control, along with the recovery marks placed in the Pre-Project survey which now have accurate heights. A minimum of 3 control marks must be found in agreement, with datum being proven at both ends.

Given the large extent of the work area, the levelling diagram includes a Key Plan (shown here), followed by several sheets showing individual sections at a larger scale (not shown).







**Static GNSS Example Strategy**

SHEET 1 of 1

**Legend**

- Safe
- Vulnerable
- To Be Destroyed
- Found Destroyed
- Replacement Marks

Radiations must be avoided, including to control marks.

Further infill will be performed by terrestrial observations and these are not shown.

Cadastre not shown.

A Key Plan with accompanying sheets at larger scale may be used if necessary.

This is an example only. The public authority/organisation responsible for the works may require the inclusion of additional information.

