Appendix J of the CEMP

Settlement Effects Management Plan

NZ TRANSPORT AGENCY
WAKA KOTAHI

1 MacKays to Peka Peka Expressway

Revision History

Revision Nº	Prepared By	Description	Date
A	Lucy Coe	Draft for Review	17-10-11
B	Lucy Coe	Value Engineering changes and review comments incorporated.	14-11-11
1	Lucy Coe	EPA Completeness Check	07-12-11
2	Lucy Coe	Second issue to EPA	17-02-12

Document Acceptance

Action	Name	Signed	Date
Prepared by	Lucy Coe		17-02-12
Reviewed by	Gavin Alexander		17-02-12
Approved by	Ann Williams		17-02-12
on behalf of	Beca Infrastructure Ltd		

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1 Introduction

1.1 Purpose and scope

The Settlement Effects Management Plan (SEMP) forms part of a comprehensive suite of environmental controls within the Construction Environmental Management Plan (CEMP) for the MacKays to Peka Peka Expressway (the Expressway).

This SEMP addresses the potential ground settlements (settlements) associated with construction and operation of the Expressway, and the effects of these settlements on existing buildings, services and transport infrastructure. For the Assessment of Ground Settlement Effects refer to Technical Report 35, Volume 3.

The settlement effects outside the earthworks footprint have been assessed as being low based on the predicted settlements. Settlements may affect the existing environment in the following ways:

- Aesthetic damage to buildings
- Structural damage to buildings
- Damage to existing services
- Damage to local roads
- Damage to railway

This SEMP proposes a settlement monitoring procedure for the Expressway. The monitoring regime provides a method for measuring the actual settlements and the resulting effects. The settlement predictions and resulting effects assessment will be refined as the Project proceeds based on these measurements.

Measures to mitigate for potential settlement effects are not expected to be required. The potential mitigation measures for settlement effects are described in the operating and management procedures within the SEMP. A variety of mitigation measures are available that may be implemented should the measured settlements or the settlement effects require it.

The SEMP will be updated, with the necessary approval, throughout the course of the Expressway Project, to reflect significant changes associated with construction techniques, to the existing built environment or as a result of actual monitoring results. Approval from the Greater Wellington Regional Council (GWRC) will be required for revisions of a material nature.[1]

[1] Revisions of a material nature would result from adverse changes in settlement predictions as a result of further detailed analyses, changes to buildings identified in schedules, adverse changes to building damage predicted, changes to the arrangement and distribution framework settlement marks proposed.

This report relies in part upon and should be read in conjunction with the Groundwater (Level) Management Plan (Appendix I of the CEMP, Volume 4).

1.2 Project description

For a description of the Project, refer to the Project Description (Construction and Operation) within Part D, Chapters 7 and 8, Volume 2.

1.3 Performance standards

The general performance and legislative standards for the Project are detailed in the CEMP, Volume 4. Guidelines or performance standards do not exist for settlements.

The outcomes of Technical Report 35, Volume 3 are detailed below:

- There is the potential for settlement effects on dwellings and other structures where settlements of 25mm or greater are calculated.
- Building condition assessments for structures and measurement of the settlement and groundwater levels is recommended where predicted settlements exceed 12.5mm and/or predicted groundwater drawdowns exceed 0.2m.

1.4 Environmental plans and maps

The SEMP relies on other management plans within the wider CEMP, Volume 4, in particular the Groundwater (Level) Management Plan (Appendix I of the CEMP, Volume 4). Monitoring of the groundwater drawdown provides advanced warning of settlement during construction. Environmental plans and maps relevant to the management of the settlement effects are summarised in Table 1.

Table 1 – Relevant Environmental Plans and Maps

Plan/ Map	Relevance	Location
Groundwater (level) Management Plan (GMP)	Settlements may result from changes in groundwater level. The groundwater monitoring is an early indicator of settlement.	Appendix I of the CEMP, Volume 4
Construction Noise and Vibration Management Plan (CVMP)	Settlements may result from construction vibrations.	Appendix F of the CEMP, Volume 4
Combined Settlement Contour Plans	Extent and Magnitude of anticipated settlements.	Appendix 35.G, Technical Report 35, Volume 3 (and also in Management Plan

Plan/ Map	Relevance	Location
		Appendices, Report 35, Volume 5)
Effects on Services Plans	Services within the area of anticipated settlement effects.	Appendix 35.I, Technical Report 35, Volume 3 (and also in Management Plan Appendices, Report 35, Volume 5
Peat Thickness Contour Plans	Potential for ground settlement is directly related to peat thickness.	Appendix 35.B, Technical Report 35, Volume 3 (and also in Earthworks Drawings, Volume 5

2 Environmental impacts summary

The construction and operation of the Expressway will result in ground settlements. These settlements have the potential to affect existing buildings, services and transport infrastructure. The assessment of potential settlements and associated effects is presented in Technical Report 35, Volume 3, and is summarised below.

The Expressway traverses dune sands and peat swamps of the Kāpiti Coast Lowlands. Key geotechnical considerations for settlement potential are the presence of peat deposits, and the thickness and nature of these deposits.

The settlement will predominantly result from loading (by earthworks) of the peat deposits that remain beneath the Expressway embankments, and lowering of the groundwater levels in the peat (by excavation or drainage). There are four sources of settlement associated with the construction and operation of the Expressway, as follows:

- Consolidation of the ground due to construction of embankments
- Consolidation of the ground due to lowering of the groundwater
- Mechanical settlement of ground due to movement of the retaining walls
- Mechanical settlement of ground due to vibrations.

The predicted settlements are generally less than 25mm beyond the edge of the earthworks. In areas of thicker peat deposits, the predicted settlements are in the order of 25 to 50mm up to 20m from the earthworks footprint, reducing to less than 25mm beyond this.

The settlements have the potential to affect the existing built environment in close proximity to the Expressway. The main features of the existing environment are the buildings, services and transport infrastructure. These features are described below, along with the predicted effects.

In general, the land adjacent to the Expressway is a mix of urban residential and rural in nature. The urban housing is located close to Paraparaumu and Waikanae town centres. Rural farming and lifestyle properties are located between Otaihanga Road and the Waikanae River, and north of Te Moana Road. The majority of residential buildings have been built over the last 50 years, with a number of newer sub-divisions. The residential buildings are located where settlements are predicted to be less than 25mm, and typically less than 12.5mm. The residential building damage has been assessed as Building Damage Category 'negligible', described as hairline cracks at worst, refer Table 10 of Technical Report 35, Volume 3.

There are some commercial and light industrial buildings in Paraparaumu town centre. These are typically two storey portal frame structures. The settlement effects on the commercial and light industrial buildings, along with the KCDC Wastewater Treatment Plant and the Waikanae Christian Holiday Park (El Rancho), will be further assessed during detailed design and specifically monitored during construction.

There are a number of services crossing or in close proximity to the Expressway Alignment. These services are typical of residential areas and include water, wastewater and stormwater networks, electricity and gas distribution, and telecommunications. The Vector Gas Transmission Pipeline Corridor crosses the Expressway Alignment at several locations within a 1.6 km stretch north of the Waikanae River. The Expressway passes under the Transpower Bunnythorpe to Haywards A and B 220kV Transmission Lines north of Smithfield Road. The services that are located below the footprint and founded above the base of the peat deposits will require relocation or active protection due either to anticipated settlement effects or physical construction works. The services that are located outside the proposed earthworks extents are expected to be subject to relatively small changes in grade and horizontal strain.

The Expressway crosses the existing local road network at nine locations, including several secondary arterials. There are also a number of local roads that are in close proximity to the Expressway within the expected area of effects. The existing local roads are generally two lanes (one lane in each direction) and are finished with a chip-sealed surfacing. The local roads that are located outside the proposed earthworks extents are expected to be subject to relatively small changes in grade.

The North Island Main Trunk (NIMT) Railway line runs roughly parallel with the existing State Highway (SH1). At the southern and northern extents of the Expressway, the NIMT is located on embankment to the east of the exiting SH1. At the southern end, the NIMT is not within the area of predicted settlements. At the northern end, relatively small settlements are predicted. A detailed

assessment of potential effects is proposed at this location, and an approapriate migitgation strategy will be developed with KiwiRail if required.

The settlement effects outside the earthworks footprint have been assessed as being low based on the predicted settlements. Monitoring is required to confirm that ground settlement effects are no worse than outlined in the settlement effects assessment. The settlement assessment is based on the modelled groundwater drawdown, and as such the actual groundwater drawdown must also be confirmed. Monitoring will include building condition assessments for structures, together with measurement and reporting of ground settlement and groundwater levels.

Should settlements result in damage to the built environment, mitigation measures are available that can be implemented.

3 Implementation and operation

3.1 Operating and management procedures

Mitigation measures are not expected to be required based on the Settlement Effects Assessment. There are however mitigation measures available that can be implemented should the measured settlements or their effects require it. This section outlines a variety of mitigation measures that could be used. The Project team[2] will determine the most appropriate measures for each specific case. The measures will be implemented in accordance with the Conditions and in agreement with the Greater Wellington Regional Council.

3.1.1 Road embankment settlement contingency measures

Consolidation settlements of the underlying peat deposits will occur due to increased loading from the road embankments. The road embankment construction, and consequently the modification of the underlying materials, will result in short-term and long-term changes to the shallow groundwater levels. Lowering of groundwater levels beneath the road embankments is expected to result in further consolidation settlements. These settlements are expected to be of relatively large magnitude within the road embankment footprint, with only limited settlement expected beyond it.

If the actual settlements beyond the earthworks footprint are of greater magnitude and/ or extend further beyond the footprint, the following actions may be taken:

[2] This Plan refers to the Project team as carrying out works on behalf of and as contracted by the NZTA. The NZTA is the requiring authority and the consent holder.

- Change the ground improvement approach where the Expressway is constructed over peat deposits. The two proposed treatment methods are 1) Excavate and Replace and 2) Preload and Surcharge. These methods are interchangable.
- Modify the ground improvement approaches, for example:
  - For the Preload and Surcharge method, a more permeable material may be used for the starter/ drainage layer, to reduce the "damming" effect of compressed peat on the groundwater flows across the alignment.
  - For the Excavate and Replace method, the length and drained duration of the temporary excavation may be limited, to reduce the magnitude and extent of groundwater changes.
- Use alternative ground improvement approach for localised areas i.e. a load transfer platform combined with foundations, to avoid excavating or loading the underlying peat.
- Reduce the embankment footprint over localised areas. This may be achieved by using geogrid reinforcement to allow steepening of embankment slopes, to increase the distance between the construction activity and the sensitive items.

3.1.2 Groundwater drawdown settlement contingency measures

Consolidation settlements of the underlying peat deposits will result from groundwater lowering. Lowering of the groundwater level will occur due to construction of the road embankment (as described above) and at unlined stormwater features. In addition, short-term groundwater lowering will occur due to temporary excavations. The groundwater drawdown contingency measures are detailed in Section 5.1 of the GWMP, and summarised below:

- Change to construction methodology i.e.
  - Alternative peat treatment (as described above);
  - Lining (temporary and/ or permanent) of cuts below the groundwater level; or
  - Limit the length and drained duration of temporary excavations.
- Local cut off (clay bund or slurry wall).
- Recharge trenches/ walls.

3.1.3 Retaining wall settlement contingency measures

Lateral movement of embedded retaining walls (as the ground is excavated in front of them) will result in localised settlement of the ground above. These settlements occur relatively quickly, during and immediately following wall construction. If the retaining wall deflections exceed the anticipated limits, a review of the design will be undertaken to assess the increased load in the piles. If required, the following actions may be taken:

- Remove surcharge close to the wall
- Place a berm in front of the wall

- Reduce the extent of temporary over excavation in front of the wall
- Install additional or stiffer structure
- Install props or ground anchors.

3.1.4 Building damage repair measures

a. Non-Structural Effects

If the Expressway works result in building damage, then general repairs may be required. These repairs may include repointing of brickwork, repainting and redecorating. In severe cases, repairs may require some partial re-building work, although this is considered highly unlikely. The timing of such repairs would depend on the stage of construction, the building owner's preference and the degree of damage.

b. Structural Effects

The settlement effects assessment has not identified any buildings with a Building Damage Criteria of greater than 'negligible'. As such, structural building damage is highly unlikely and not envisaged on this Project. However, if any effects of a structural nature are identified during the course of the monitoring programme then a detailed evaluation will be required by a Structural Engineer. Any recommendations for repair and an increased level of monitoring arising from this evaluation will then be implemented. In extreme cases where local repair or re-construction is not sufficient, then additional measures such as underpinning or strengthening may be required.

In the event of a "substantial injurious affection" to a person's land resulting from the construction of the MacKays to Peka Peka Expressway, section 63 of the Public Works Act would entitle that person to compensation.

3.1.5 Services Repair Measures

The services that are located below the footprint and founded above the base of the peat deposits will require relocation or active protection due to either the settlements effects or physical construction works. These works will be agreed with the service providers prior to Project works commencing.

The services located outside the proposed earthworks extents are likely to be subject to relatively small changes in grade and horizontal strain, as indicated on the settlement effects plans. The services outside the earthworks extents will be monitored. If this monitoring indicates damage may have occurred, a detailed investigation of the area and affected services will be promptly carried out. This assessment will include a detailed examination of the site, coordination with the relevant service providers to ascertain what effects their network is experiencing, and an assessment of what remedial action is required. Any remedial works will be carried out as soon as possible. If the

investigation reveals no immediate damage, the services will continue to be monitored closely until all parties are satisfied no damage has occurred.

There are a number of measures available to mitigate damage to services. The specific measures selected would depend on the type of service, location and severity of the damage and agreement with the service provider. If required, the following actions may be taken:

- Permanently divert the service through another nearby service and abandon the original service line (the capacity of the nearby service would need to be checked).
- Temporarily divert the service and repair the original service.
- Expose the service and undertake a repair.
- Replace the service. In cases of severe damage, a length of the service may be replaced.

3.1.6 Transport infrastructure repair measures

The effects on the local roads outside the proposed construction designation are assessed as negligible, with the predicted changes in grade being relatively small. Settlements may result in grade changes and differential movements. If the measured effects are greater than anticipated, the following actions may be taken:

- Overlay the road surface to raise to the previous level and re-shape any differential movements.
- Reconstruct the kerb and channels, and footpaths to mitigate changes in grade and/ or differential settlements.
- Install additional drainage if new areas of ponding are identified.

The effects on the NIMT at the northern end are expected to be able to be remediated by regular maintenance track relevelling. This will be agreed with KiwiRail if necessary once more detailed assessments have been undertaken.

3.2 Monitoring

This section details the proposed settlement monitoring regime. This monitoring regime provides a method for measuring the actual settlements and the resulting effects. Monitoring is required prior to construction, during construction and following construction to provide a comprehensive assessment of effects. The measured settlements and resulting effects will be compared with the predicted values. The settlement predictions will be calibrated as the monitoring results become available, and the assessment of potential effects updated.

The settlement monitoring outlined in this section is proposed to extend beyond the earthworks extent and the expected area of resulting effects. It does not cover settlement monitoring required for the embankment construction control (i.e. to determine the surcharge duration and/ or to predict the long-term pavement performance).

3.2.1 Survey of general monitoring points

A series of survey marks will be installed and regularly monitored to provide information to compare to the settlement estimates. Monitoring will be undertaken using conventional survey monitoring equipment.

The framework marks will extend out from the Expressway and be placed, as far as practical, to match with the cross sections that have been used for the settlement estimates. The number of marks at each cross section will depend on the location of buildings or other features relative to the section (i.e. where there are more buildings there will be more frequent marks and where there is open land the spacing of marks may be increased) and access to those locations for surveying. Marks will be placed at specific stormwater features where groundwater drawdown is predicted (refer Assessment of Groundwater Effects). The marks will be placed to coincide with the groundwater level monitoring where possible.

In addition to the above, survey monitoring marks will be placed on or around building or features that are considered to be particularly sensitive. The number and layout of these marks will be specific to each building or feature.

The framework marks will serve as the main monitoring points. The framework marks will be placed as detailed below:

- Along the cross-sections used for settlement predictions as far as practical. The marks will extend out from the Expressway, where settlements are expected to be greater than 12.5mm. Typically 2 – 4 marks will be installed per cross-section.
- Adjacent to stormwater features where groundwater drawdown of greater than 100mm is predicted.
- KCDC Wastewater Treatment Plant
- At buildings identified in the course of detailed design
- Additional marks will be placed in areas where buildings are located close to the Expressway and in areas where the settlement predictions extend beyond the Expressway footprint.

The proposed framework marks are identified on the Settlement Monitoring Plans, refer Drawings GT-SE-320 to 331, Appendix J.A of this Plan and also Appendix J.A, Management Plan Appendices, Appendix J, Volume 5.

Intermediate marks may be installed between and around the framework marks to provide additional detail as required and to allow level traverses to be undertaken.

If required, a series of datum points will be established for the later surveys. These will be located well outside the area expected to be affected by the settlements and will be protected.

The framework marks will be installed initially and monitored for vertical movement with 13 sets of baseline values taken during the year prior to the Expressway construction commencing. The 13 sets comprise the initial installation survey and the subsequent survey rounds on a monthly basis.

The ongoing frequency of monitoring will then vary depending on the stage of construction. At the start of the Project construction, each framework mark will be monitored for vertical movement on a quarterly basis.

As the active construction stage starts to affect the relevant section, all marks will be monitored monthly for vertical movement. For this Project, 'active construction' can be defined as:

Starting when earthworks commence within 500m of a particular location and ending when pavement construction is complete at that location, and

Starting when excavation in front of a retaining wall comes within 50m of a section and ending when the permanent wall supports are in place beyond a distance of 50m.

Once the active construction for each section is complete, the monitoring can then reduce to the pre-active construction frequency (i.e. quarterly monitoring for all marks) if the results indicate that the settlements and effects are within an acceptable range. Following a six month period of this quarterly monitoring and if results indicate that the settlements and effects are still within an acceptable range, then the framework marks will be monitored on a six month basis for an additional period of at least 2 years.

The survey monitoring is summarised in Table 2.

Table 2 – Survey Monitoring Regime

Project Phase	Vertical Survey Monitoring Frequency of Framework Marks
Preconstruction	Monthly for 12 months
During Construction	Quarterly
During Active Construction	Monthly
Post Active Construction (1)	Quarterly for 6 months, reducing to half yearly

(1) 'active construction' can be defined as:

- Starting when earthworks commence within 500m of a particular location and ending when pavement construction is complete at that location, and
- Starting when excavation in front of a retaining wall comes within 50m of a section and ending when the permanent wall supports are in place beyond a distance of 50m.

If the monitoring results indicate the movements are outside the expected range, or if there are other reasons for concern, then the monitoring frequency and/ or extent can be increased to cover those areas of concern. For example, the quarterly monitoring of framework marks pre and post active construction could be increased to monthly and/ or intermediate marks installed for

monitoring. The number of marks and frequency of monitoring can be modified to address any specific concerns identified.

3.2.2 Building Condition Assessments

Individual structural condition assessments of buildings will be carried out as follows:

- Dwellings within 20m of the proposed peat treatment extents
- Dwellings adjacent to new stormwater features where predicted groundwater drawdown is greater than 0.2m (as identified in Assessment of Groundwater Effects)
- Dwellings in areas where the predicted settlements are greater than 12.5mm, including (as a precautionary measure) 10m beyond the predicted 12.5mm settlement contour shown on the drawings in Appendix J.A of this Plan and also in Management Plan Appendices, Appendix J, Volume 5.
- KCDC Wastewater Treatment Plant
- El Rancho (buildings identified as Type B, refer Table 5 of the Assessment of Settlement Effects)
- Specific buildings identified in the course of detailed design

The initial assessment will comprise an inspection of each building and significant structure on the property to establish and record its condition. Each assessment will produce a written description including photographs of any existing damage and a copy of this report will be provided to the owner. These assessments will be carried out prior to the commencement of the earthworks, excavation and retaining wall construction. These assessments will provide a baseline of the condition of each building.

In addition, monthly visual assessments of the following buildings will be carried out during the 'active construction' phase of the Project ('active construction' is defined above):

- Dwellings where the total settlements are estimated to be greater than 25mm
- Dwellings where the predicted Building Damage Category is greater than 'negligible' (noting that there are none in this category at this stage)
- KCDC Wastewater Treatment Plant
- All other specifically identified buildings.

The purpose of the assessment will be to look for any evidence of effects, with reference to the initial condition (baseline) survey. If mitigation is required, options available are outlined in Section 3.1 above.

Assessments of other buildings, or on a more frequent basis will also be carried out if the monitoring indicates that there may be significant settlement effects. All inspections would be subject to the approval of the owner to enter their property.

It is also proposed that the following dwelling types and specific buildings be the subject of level surveys on a monthly basis during the 'active construction' phase of the Project.

- KCDC Wastewater Treatment Plant
- Specific buildings identified in the course of detailed design.
- The NIMT Railway at the northern end of the Project, if detailed anaylsis indicates it is warranted.

The purpose of the level survey will be to provide a basis for evaluating the rate of any movement and to enable a correlation with the visual survey. If mitigation is required, possible options for action are discussed above.

3.2.3 Retaining wall monitoring

The retaining walls will be specifically monitored for movement using survey monitoring. These values will be compared to the estimated values and if the results indicate movements greater than those anticipated the mitigation measures outlined in Section 3.1 may be implemented. The locations for the instrumentation and trigger levels for action will be determined during detailed design.

3.2.4 Services monitoring

In addition to the survey marks monitoring described above, CCTV inspections of some stormwater and wastewater services will be carried out to assess the effects of the settlements. For stormwater and wastewater services identified as being susceptible to damage or particularly critical, an initial preconstruction CCTV inspection will be carried out to provide a baseline for assessing any future damage. As the construction progresses, additional CCTV inspections may be carried out depending on the results of the survey monitoring and feedback from service providers.

For other services identified as being susceptible to damage or particularly critical, visual inspections may be undertaken by excavating to expose the service if required.

3.3 Reporting

The settlement monitoring and resulting effects will be reported to Greater Wellington Regional Council.

Preconstruction monitoring will be carried out as described above in Section 3.2 and reported following the final set of data, prior to the start of construction. This data will be factual in nature, with assessment only required for anomalous results. The report will form part of the input for the construction phase assessments.

The monitoring data will be processed and compared to the design analyses. Once construction starts, the data will be used to reassess the building damage categories and these categories will then be compared to the results in the settlement assessment report. The effects on services will also be assessed from the settlement gradients. If this reassessment indicates that the damage category has increased by a significant amount then additional analyses or more frequent monitoring may be required and the affected buildings identified for potential mitigation work. Similarly, an increase in estimated effects on the services will require additional review and potentially amended monitoring and mitigation. Consideration may also need to be given modifying the construction approach to reduce ground settlements, if groundwater drawdown is greater than expected due to ground excavation.

Reporting will be determined by the stage of construction and actual results. During the active construction stage it is anticipated that initial internal review of monitoring results will take place shortly after receipt of the processed data. As long as the results show no significant anomalies or assessed significant increased risk to buildings, these monitoring results would be presented on a quarterly basis. If there are any significant anomalies or significantly increased risk to buildings, then following a more detailed review of the data, those parties would be notified and mitigation measures agreed. The results of this more detailed work and the outcomes, along with the agreed way forward will then be reported.

The post active construction stage results (quarterly and six monthly) will be reviewed and reported shortly after receipt of the processed data. Where any significant anomalies or assessed significantly increased risk to buildings occurs, then the reporting will follow the process as described above for active construction.

The settlement monitoring report template is provided in Appendix J.B.

3.4 Training

The Project team (staff and subcontractors) will undergo general environmental awareness training and training about their responsibilities under the SEMP and the CEMP. The site induction programme is described in the CEMP, Volume 4.

The Environmental Induction will include information on the following aspects of the settlement effects management:

- Information about activities and stages of construction that may cause settlements, including excavation and loading from earthworks;
- Consent requirements;
- Settlement monitoring and management procedures;
- Roles and responsibilities for management of settlement on the Project.

3.5 Complaints

The complaints management plan is described in the CEMP, Volume 4.

4 Roles and responsibilities

Roles and responsibilities for the Project are described in the CEMP, Volume 4. Specific roles and responsibilities relating to managing settlements are described below.

The Project team (acting on behalf of NZTA) will manage and monitor the settlement effects on buildings, services and roads.

A Project surveying team will measure the actual settlement and groundwater levels, and an assessment team within the Project team will assess the impacts of the settlement through monitoring the condition of buildings and services. The actual settlements and resulting effects will be compared with the predicted values from the settlement effects assessment.

If the settlement effects have occurred beyond those estimated or if the results indicate that there is the potential for greater settlement effects than estimated, then the team will immediately notify the Project Manager. The Project team will pass on the findings and coordinate any discussions with the affected party. The Project team will implement measures to minimise settlements and carry out remedial actions on affected buildings, services and roads.

All personnel working on the Project (including Project tean employees and subcontractors) have the responsibility for following the requirements of this Plan.

5 Transition phase

The transition phase is the crossover period between construction and operation phases of the Project, where the responsibility of the management is transferred from the Project team to the network operator. The specialist monitoring and assessment team will continue monitoring on a six monthly basis through the post construction stage where practicable, for at least the 2 year period following completion of the Project.

6 SEMP review

This section describes how the Plan will be reviewed, including considering the environmental controls and procedures to make sure that they are still applicable to activities being carried out.

The SEMP will be reviewed by the Project team after confirmation of the resource consent and designation conditions and will be revised in accordance with these conditions. The SEMP will be

updated, with the necessary approval, throughout the course of the Project to reflect material changes associated with changes to construction techniques or the existing environment. Approval from the Greater Wellington Regional Council will be required for any relevant revisions of a material nature.

A management review of the SEMP will be undertaken at least annually by the Alliance Project Management Team. The management review will be organised by the Environmental Manager and the Project team will be informed of any changes to this Plan through the regular Project communications processes. The review will take following items into consideration:

- Any significant changes to construction activities or methods;
- Any significant changes in volume or nature of the groundwater encountered;
- Key changes to roles and responsibilities within the Project;
- Changes in industry best practice standards or recommended pollution controls;
- Changes in legal or other requirements (social and environmental legal requirements, NZTA objectives and relevant policies, plans, standards, specifications and guidelines);
- Results of monitoring, inspection and maintenance programmes, logs of incidents, corrective actions, internal or external assessments; and
- Public complaints.

Reasons for making changes to the SEMP will be documented. A copy of the original SEMP document and subsequent versions will be kept for the Project records, and marked obsolete. Each new/ updated version of the SEMP documentation will be issued with a version number and date to eliminate obsolete SEMP documentation being used.

7 References

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Burland, J.B. (1997), “Assessment of risk of damage to buildings due to tunnelling and excavation”, Earthquake Geotechnical Engineering, Ishihara (ed.), Balkema, Rotterdam, 1997.

Coe, L. Assessment of Ground Settlement Effects: Technical Report 35, Volume 3 of the MacKays to Peka Peka Expressway Project AEE.

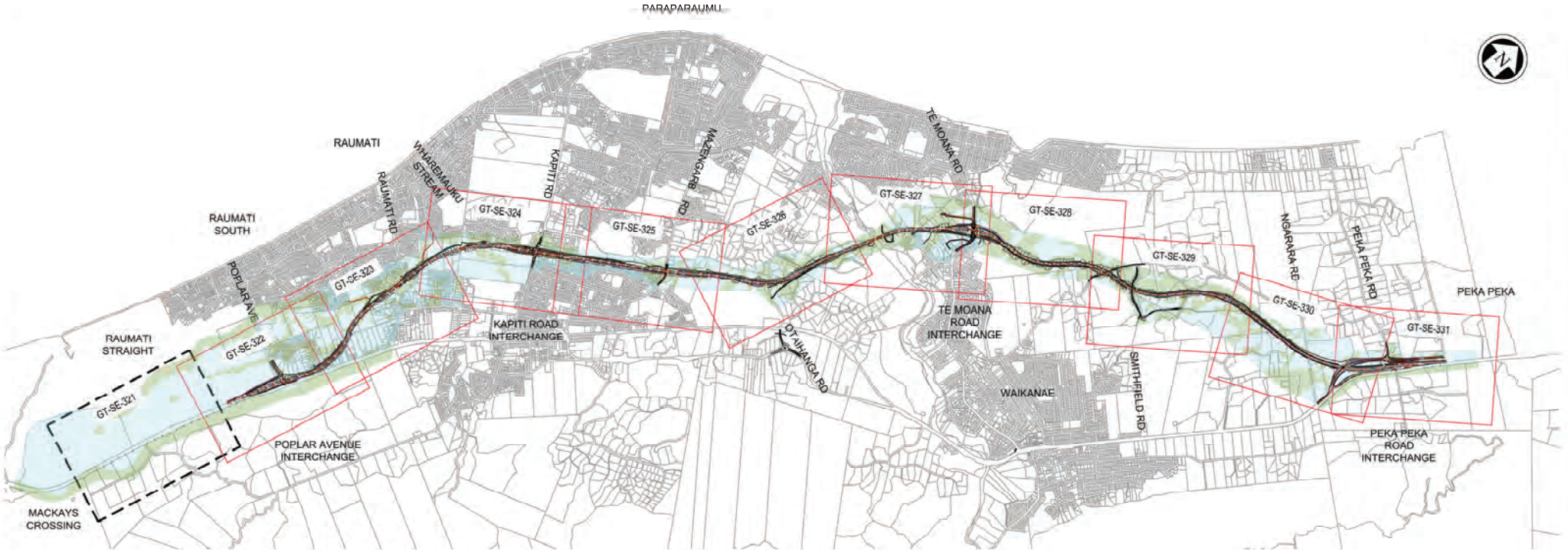
France, S., Goff, P. and Utting, M. Groundwater (Level) Management Plan: Appendix I of the CEMP, Volume 4 of the MacKays to Peka Peka Expressway Project AEE.

France, S. & Michaelsen, J. Assessment of Groundwater Effects: Technical Report 21, Volume 3 of the MacKays to Peka Peka Expressway Project AEE.

Wilkening, S. and Whitlock, J. Construction Noise and Vibration Management Plan: Appendix F of the CEMP, Volume 4 of the MacKays to Peka Peka Expressway Project AEE

Appendix J.A

Settlement Monitoring Location Plans



INDICATES SHEETS NOT USED

NOTE:
GROUNDWATER MONITORING LOCATIONS TO GENERAL BE IN ACCORDANCE WITH THESE DRAWINGS.

Original Scale (A3)

1	AEE LODGEMENT	MRN	15.07.12

NZ TRANSPORT AGENCY
WAKA KOTAHI

MACKAYS TO PEKA PEKA EXPRESSWAY

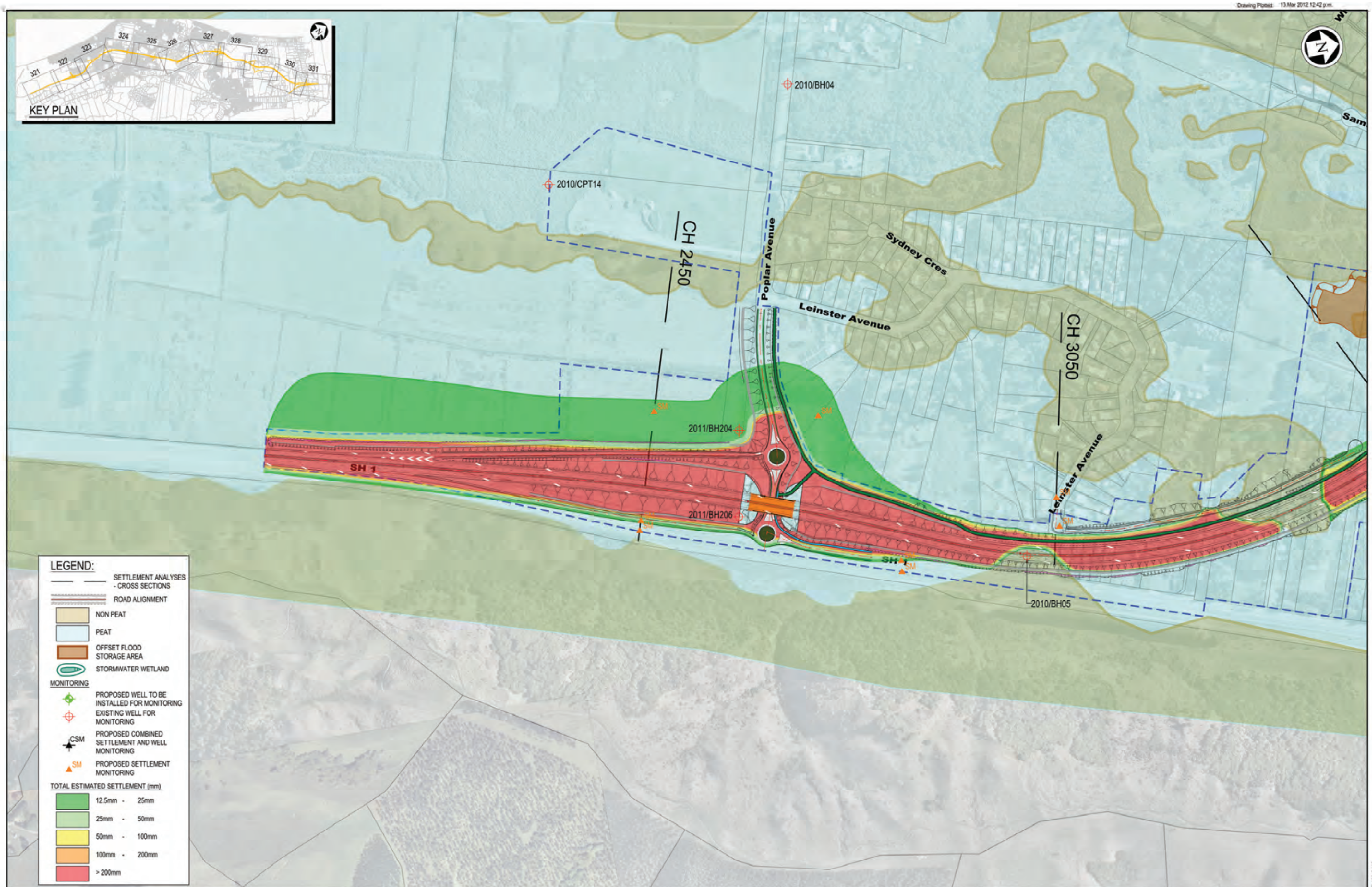
SETTLMENT MONITORING PLANS
SHEET INDEX

FOR CONSENTING

GT-SE-320

1

Drawing Plotted: 13 Mar 2012 12:42 p.m.



NOTES:
SETTLEMENT MONITORING POSITIONS ARE INDICATIVE ONLY

Original Scale (A3)
1:5000

NZ TRANSPORT AGENCY
WAKA KOTAHI

MACKAYS TO PEKA PEKA EXPRESSWAY

SETTLEMENT MONITORING PLANS
SHEET 2 OF 11

FOR CONSENTING

GT-SE-322

Rev. 1

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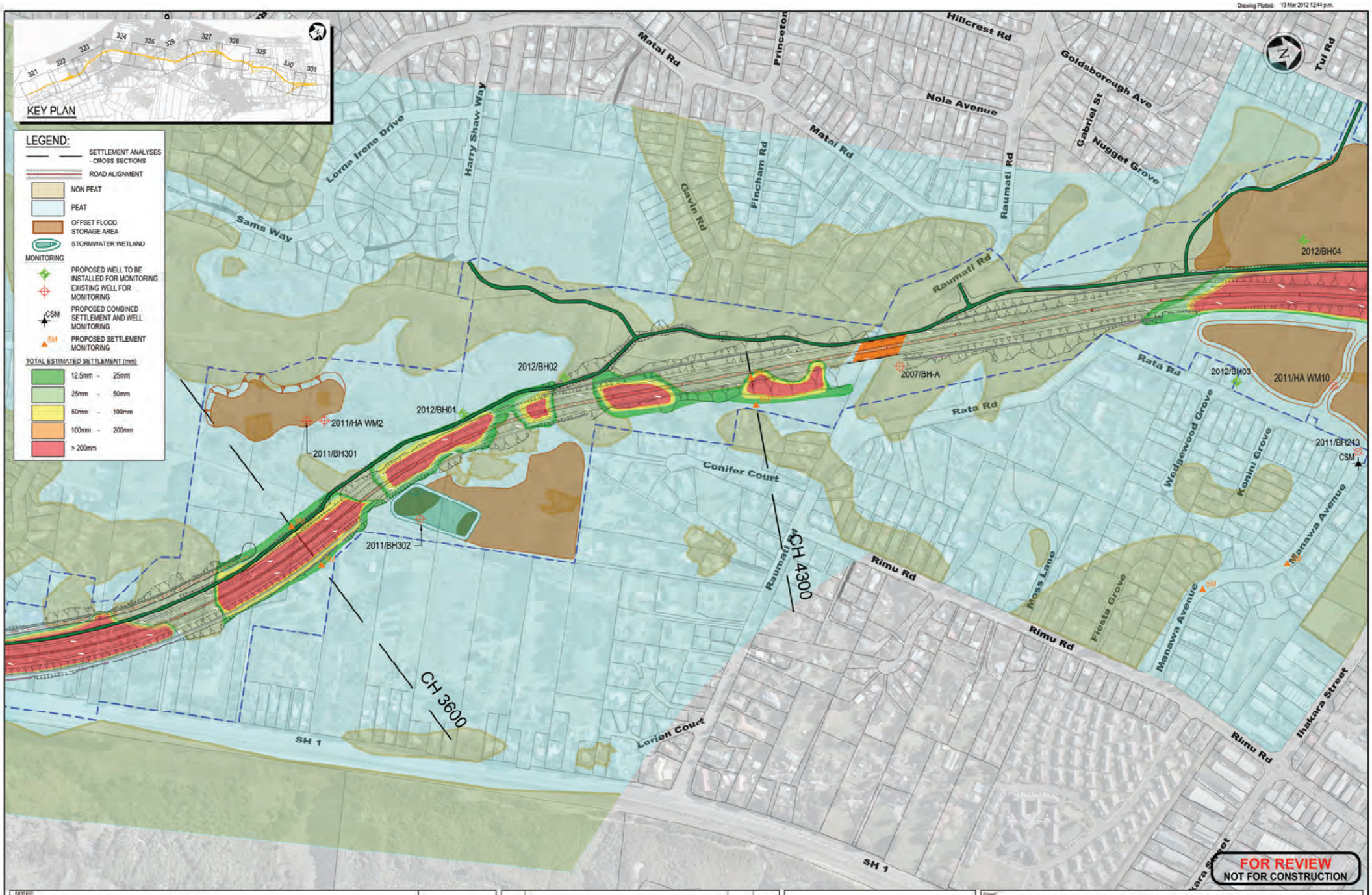


FOR REVIEW
NOT FOR CONSTRUCTION

NOTE:
SETTLEMENT MONITORING POSITIONS ARE INDICATIVE ONLY

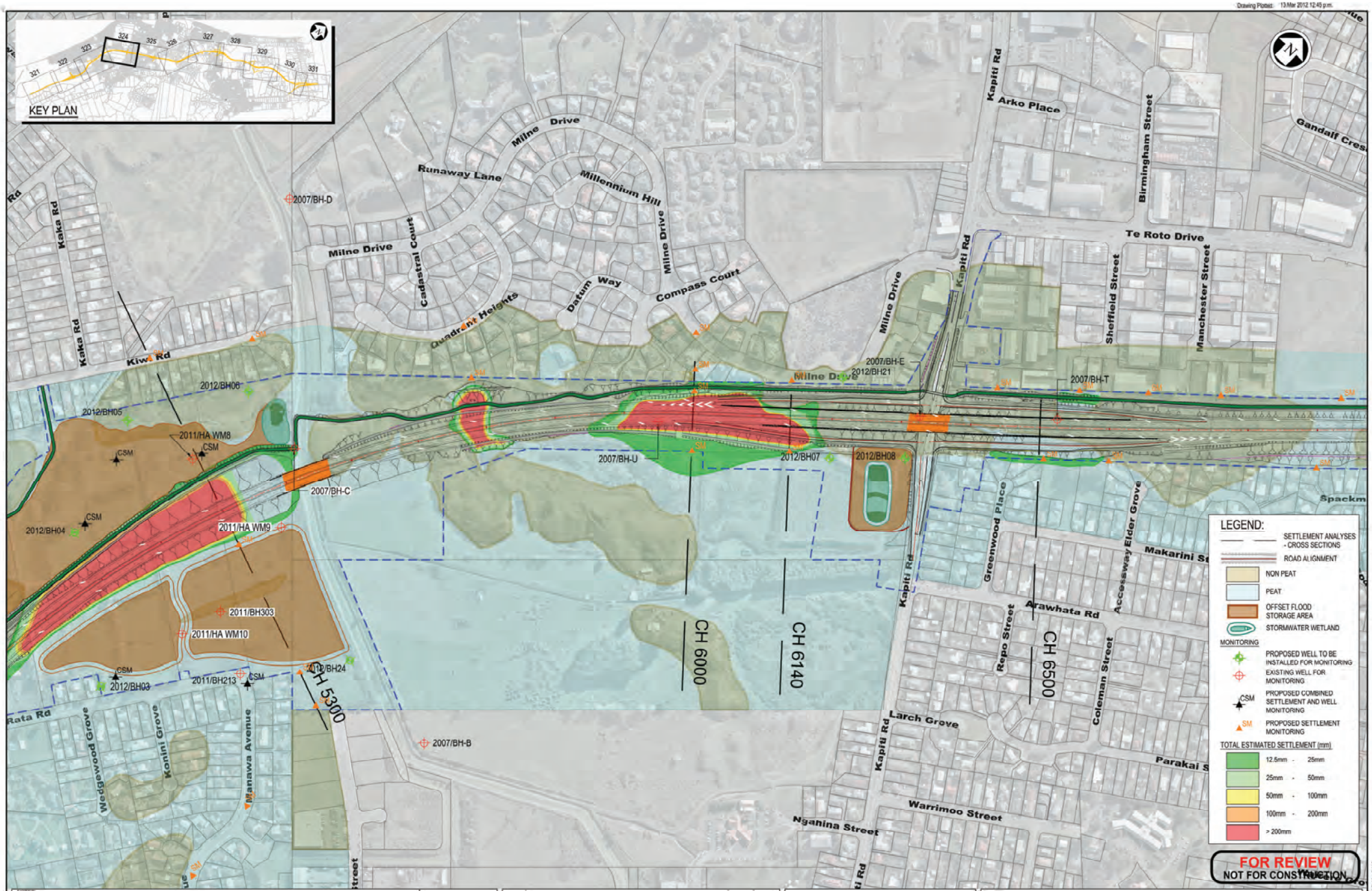
Original Scale (A3)
1:5000

NZ TRANSPORT AGENCY
WAKA KOTAHI

MACKAYS TO PEKA PEKA EXPRESSWAY

SETTLEMENT MONITORING PLANS
SHEET 3 OF 11

GT-SE-323 | A



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Original Scale (A3)
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NZ TRANSPORT AGENCY
WAKA KOTAHI

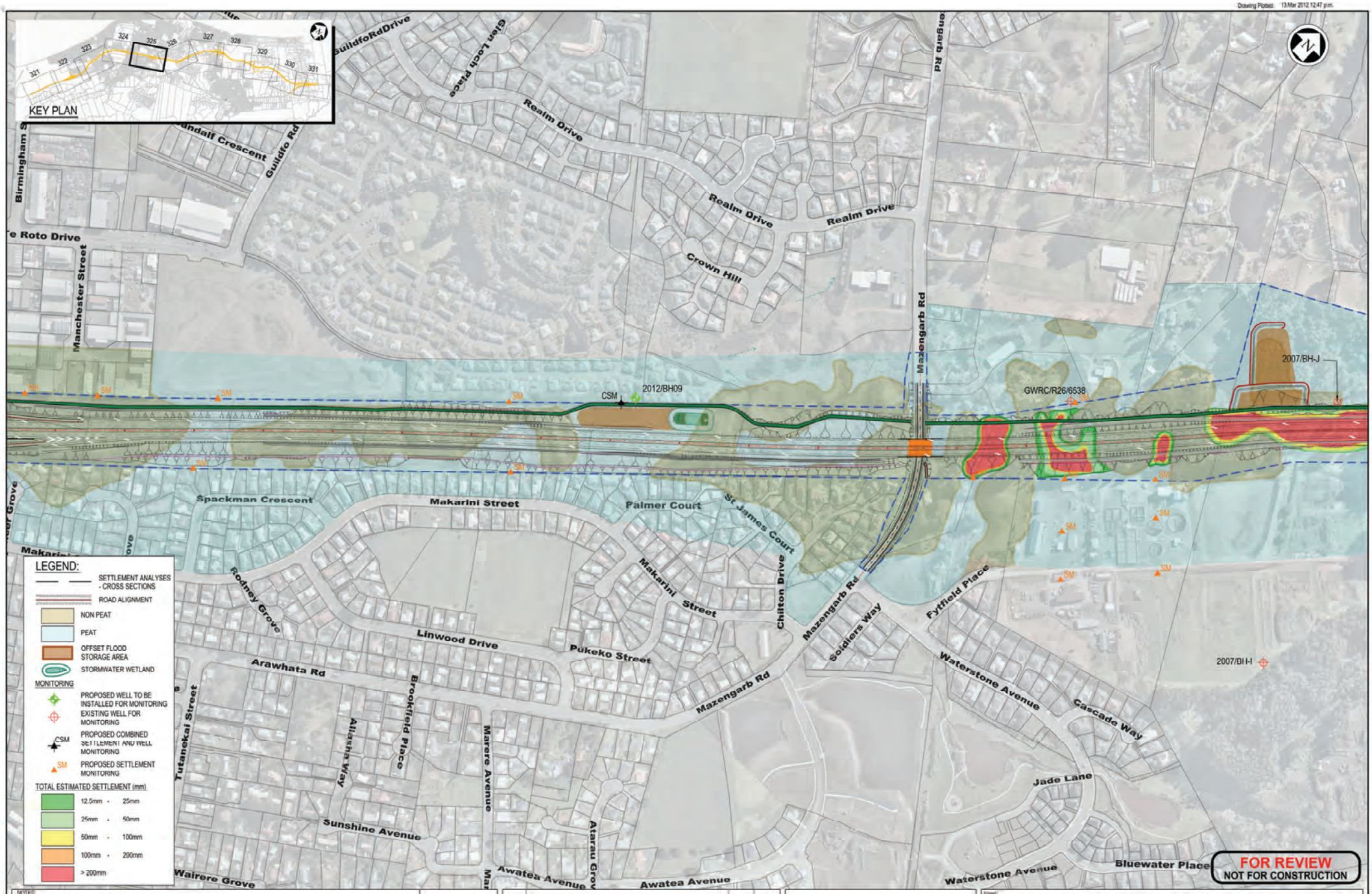
MACKAYS TO PEKA PEKA EXPRESSWAY

SETTLEMENT MONITORING PLANS
SHEET 4 OF 11

GT-SE-324

A

Drawing Plotted: 13 Mar 2012 12:47 p.m.



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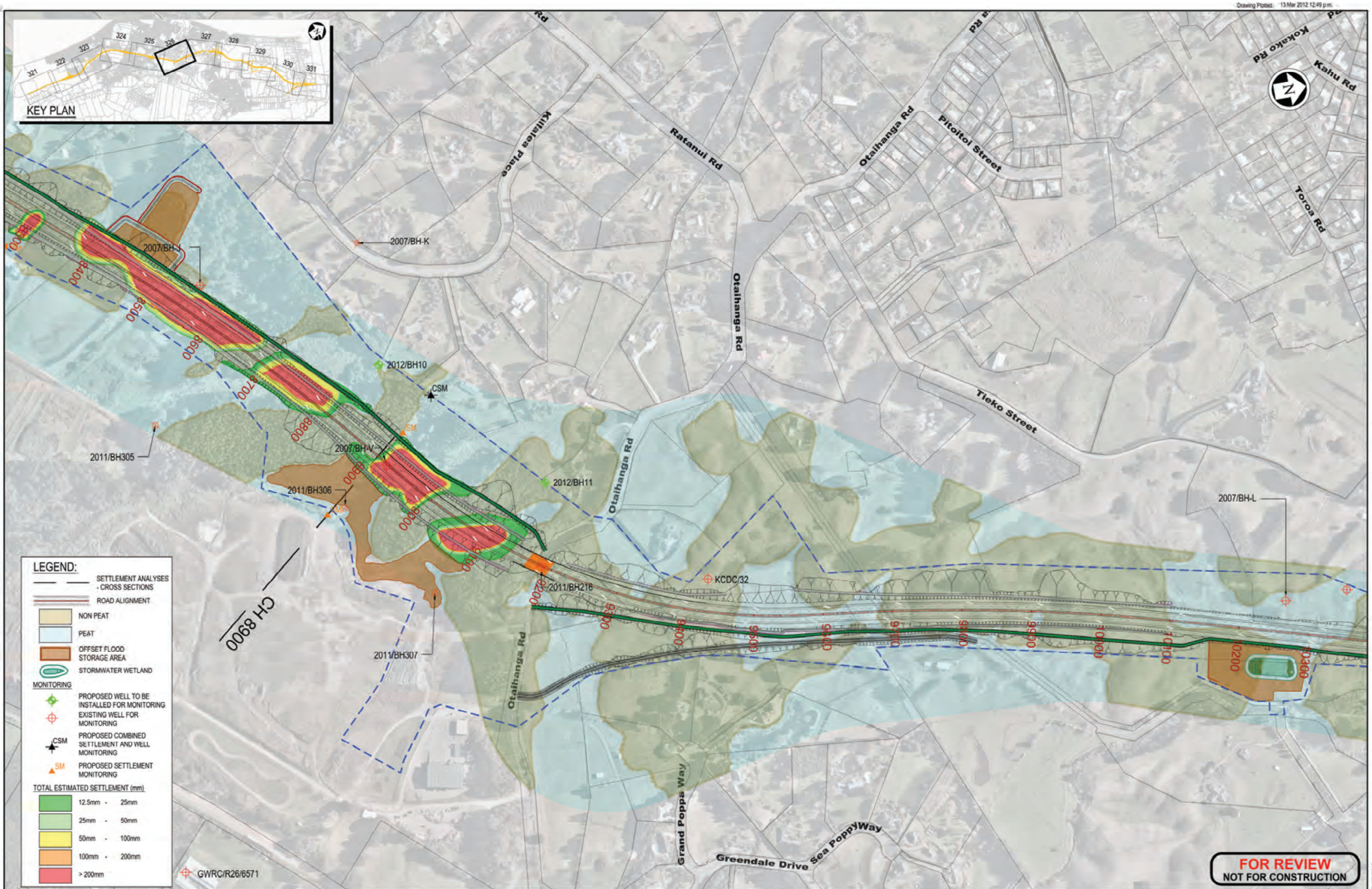
MACKAYS TO PEKA PEKA EXPRESSWAY

SETTLEMENT MONITORING PLANS
SHEET 5 OF 11

GT-SE-325

A

Drawing Plotted: 13 Mar 2012 12:49 p.m.



NOTES:
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Original Scale (A3)
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NZ TRANSPORT AGENCY
WAKA KOTAHI

MACKAYS TO PEKA PEKA EXPRESSWAY

SETTLEMENT MONITORING PLANS
SHEET 6 OF 11

GT-SE-326

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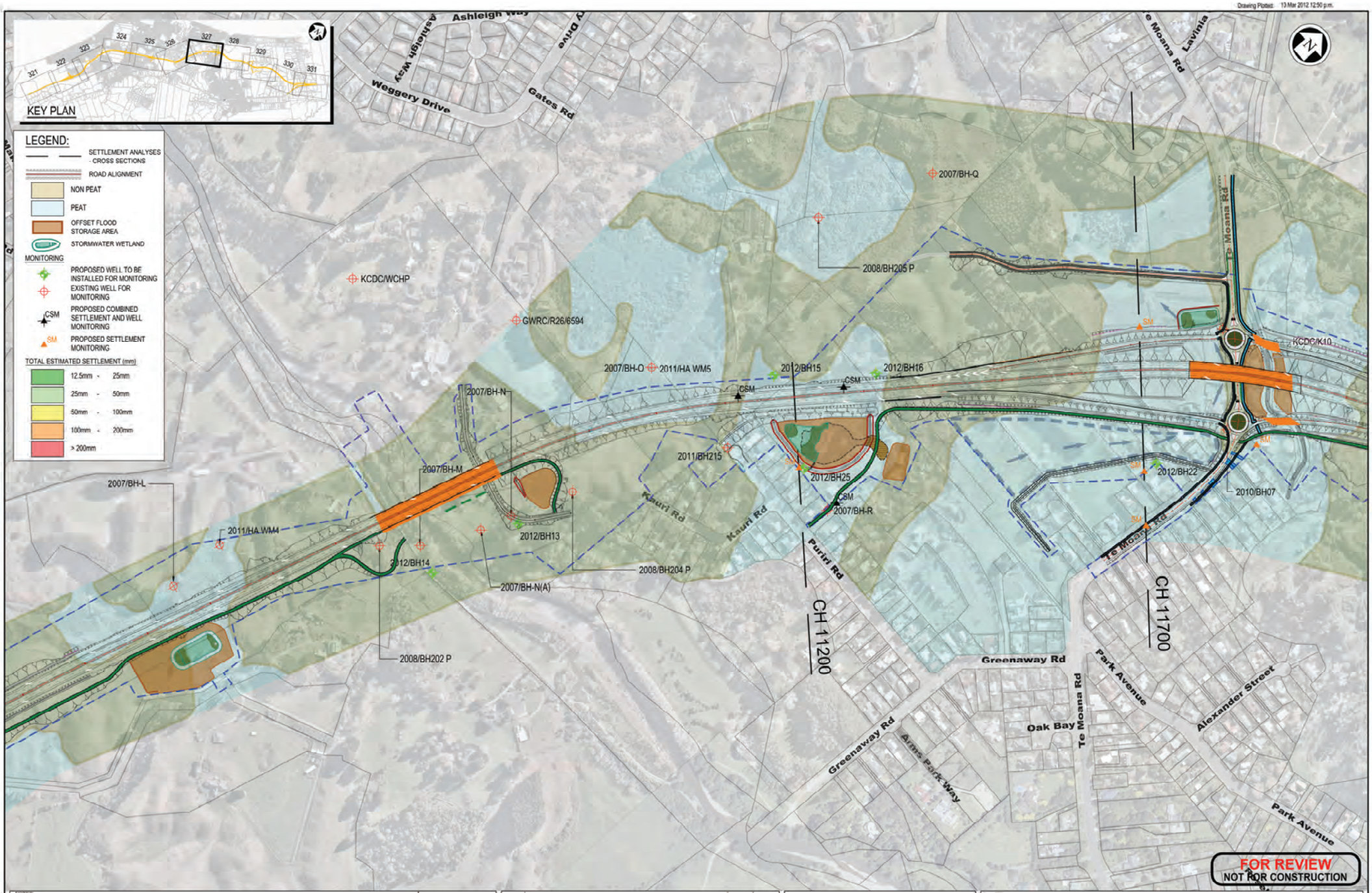

NOTES:
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Original Scale (A3) 1:5000

NZ TRANSPORT AGENCY WAKA KOTAHI

MACKAYS TO PEKA PEKA EXPRESSWAY

SETTLEMENT MONITORING PLANS
SHEET 7 OF 11

GT-SE-327 A

Drawing Plotted: 13-Mar-2012 12:52 p.m.

LEGEND:

- SETTLEMENT ANALYSES - CROSS SECTIONS
- ROAD ALIGNMENT
- NON PEAT
- PEAT
- OFFSET FLOOD STORAGE AREA
- STORMWATER WETLAND

MONITORING

- PROPOSED WELL TO BE INSTALLED FOR MONITORING
- EXISTING WELL FOR MONITORING
- CSM PROPOSED COMBINED SETTLEMENT AND WELL MONITORING
- SM PROPOSED SETTLEMENT MONITORING

TOTAL ESTIMATED SETTLEMENT (mm)

- 12.5mm - 25mm
- 25mm - 50mm
- 50mm - 100mm
- 100mm - 200mm
- > 200mm

Te Moana Rd
KCDC/K10
SM
2011/BH207
2012/BH22
2010/BH07
2012/BH17
2011/BH208
2011/BH209
2012/BH18
2011/BH210
KCDC/K4
CH 11700
Alexander Street
Park Avenue
Rosebank
Ngarara Rd
Ngarara Rd

FOR REVIEW
NOT FOR CONSTRUCTION

NOTES:
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1:5000

NZ TRANSPORT AGENCY
WAKA KOTAHI

MACKAYS TO PEKA PEKA EXPRESSWAY

SETTLMENT MONITORING PLANS
SHEET 8 OF 11

GT-SE-328

A

KCDC/TW3
KCDC/K6
KCDC/K5
Ngarara Rd
2011/BH210
End Farm Rd
Smithfield Rd
KCDC/KB7
2011/BH211A
SM
2012/BH23
2012/BH19
2010/BH12
2012/BH20
CSM
KCDC/K12
CH 14400

LEGEND:

- SETTLEMENT ANALYSES - CROSS SECTIONS
- ROAD ALIGNMENT
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- PEAT
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- STORMWATER WETLAND

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- 100mm - 200mm
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FOR REVIEW
NOT FOR CONSTRUCTION

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Original Scale (A3)
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NZ TRANSPORT AGENCY
WAKA KOTAHI

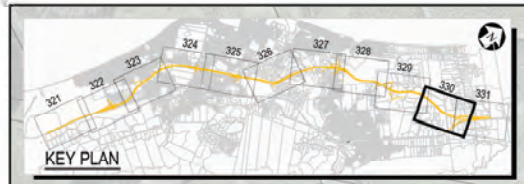
Project: MACKAYS TO PEKA PEKA EXPRESSWAY

Title: SETTLEMENT MONITORING PLANS
SHEET 9 OF 11

Drawing No: GT-SE-329

Rev: A

Drawing Plotted: 13-Mar-2012 12:59 p.m.



Kensington Drive

Peka Peka Rd

KCDC/13

Ngarara Rd

2010/BH13

2011/BH309

2011/BH308

2011/BH310

SH 1

Greenhill Rd

CH 16000

LEGEND:

- SETTLEMENT ANALYSES - CROSS SECTIONS
- ROAD ALIGNMENT
- NON PEAT
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- OFFSET FLOOD STORAGE AREA
- STORMWATER WETLAND

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FOR REVIEW
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NZ TRANSPORT AGENCY
WAKA KOTAHI

MACKAYS TO PEKA PEKA EXPRESSWAY

SETTLEMENT MONITORING PLANS
SHEET 10 OF 11

GT-SE-330

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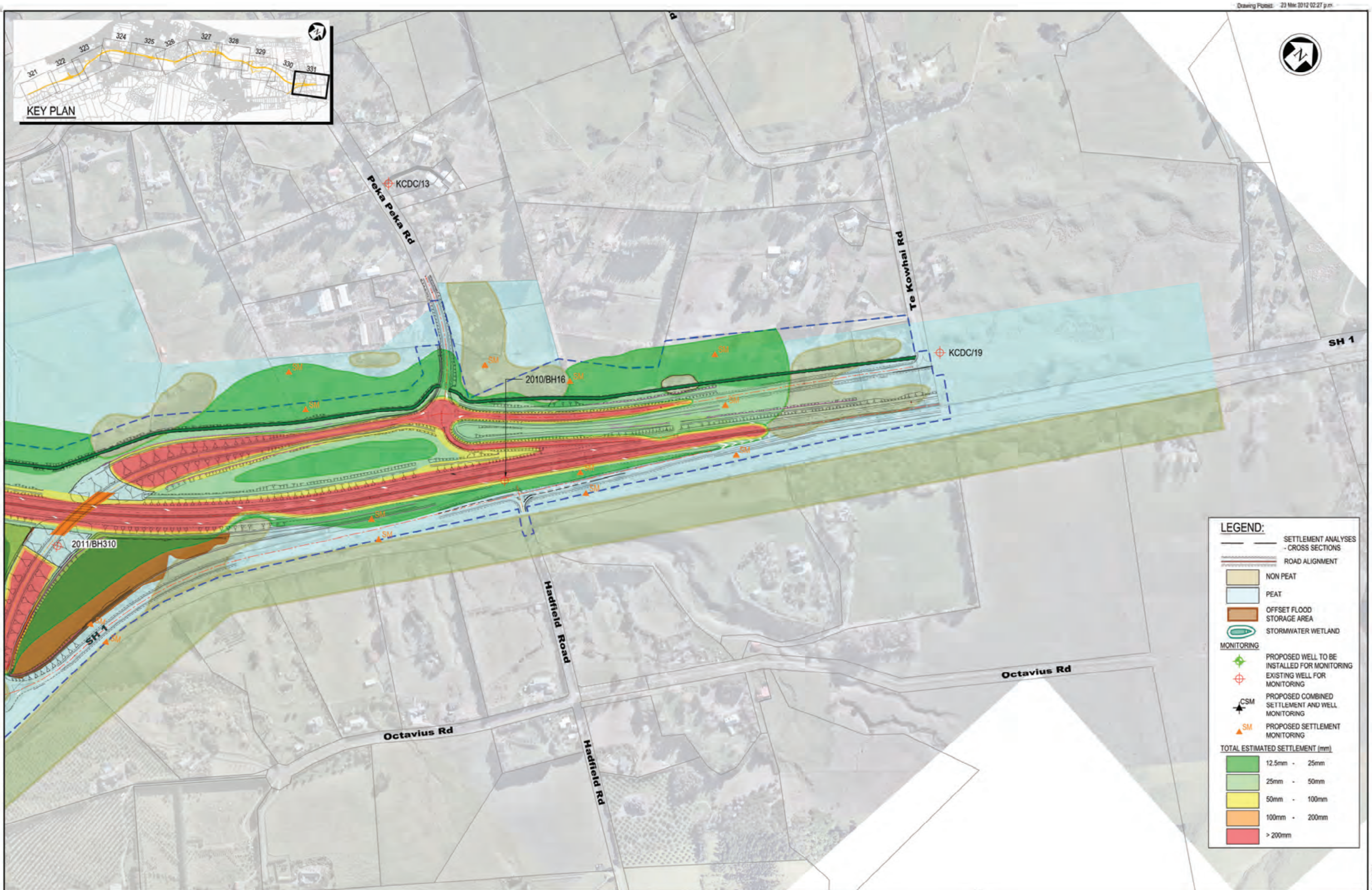

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Revision	Amendment	Approved	Date
1	AEE LODGEMENT	NMN	15.03.12

NZ TRANSPORT AGENCY
WAKA KOTAHI

MACKAYS TO PEKA PEKA EXPRESSWAY

SETTLEMENT MONITORING PLANS
SHEET 11 OF 11

FOR CONSENTING

GT-SE-331

Rev: 1

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Appendix J.B

Settlement Reporting Templates

Settlement Monitoring Report – Table of Contents

Executive Summary

Section 1: Site Identification (including location map)

Section 2: Scope of Monitoring Undertaken (including construction stage)

Section 3: Monitoring Methodology

Section 4: Field and Office QA/ QC

Section 5: Results, including:

- Any variation to previous monitoring locations/ methodology
- Date of monitoring
- Settlement mark survey data (as reduced levels and changes to baseline levels)
- Assessment of damage categories (based on this survey data)

Section 6: Conclusions, including:

- Discussion of trends and explanation of results
- Summary