13. Air quality

This chapter provides the air quality impact assessment of the proposal. It describes the existing environment, assesses the impacts of construction and operation on air quality, and provides mitigation measures.

13.1 Assessment approach

13.1.1 Relevant pollutants

Air quality may be impacted by a number of pollutants, each of which has different emission sources and effects on human health and the environment. The air quality assessment of the proposal is focused on the highest-risk impacts with the potential to occur during construction and operation. During construction, there is the potential for impacts as a result of emissions of total suspended particulate matter in the form of airborne particulate matter (less than 10 microns in size – that is, PM_{10}) and dust deposition.

Fine particle emissions associated with exhausts from mobile plant and stationary engines used during construction activities are accounted for in the emission factors for earthmoving and handling used in the air quality assessment. Engine emission sources during construction are expected to be discontinuous, transient, and mobile.

Total suspended particles and dust deposition is usually assessed against annual assessment criteria, which is not relevant for a proposal where construction works progress along a proposal site. As a result, for this proposal, PM_{10} was considered to be the worst-case pollutant for construction activities when determining potential impacts and distances at which relevant criteria are achieved.

During operation, the highest-risk impacts are likely to occur from rail exhaust emissions as a result of the increase in train movements, with the main emissions for consideration being oxides of nitrogen and particulate matter.

13.1.2 Methodology

The assessment involved:

- reviewing existing regional ambient air quality and meteorology
- undertaking a screening level construction air quality impact assessment
- identifying sensitive receivers near the proposal site that may be exposed to levels of construction dust above the relevant criteria
- qualitatively assessing the potential for air quality impacts during operation
- providing mitigation measures.

13.1.3 Legislative and policy context to the assessment

The POEO Act provides the statutory framework for managing pollution in NSW, including the procedures for issuing licences for environmental protection on aspects such as waste, air, water and noise pollution control. Companies and property owners are legally bound to control emissions (including particulates and deposited dust) from construction sites under the POEO Act. Activities undertaken onsite must not contribute to environmental degradation, and pollution and air emissions must not exceed the standards. Where an EPL applies, air quality requirements (including criteria) will be specified by the licence. Further information on the POEO Act as it relates to the proposal is provided in chapter 3.

The *Protection of the Environment Operations (Clean Air) Regulation 2010* (the Clean Air Regulation) provides regulatory measures to control emissions from motor vehicles, fuels, and industry. The proposal would be operated to ensure it complies with the Clean Air Regulation.

Air quality impact assessment criteria are prescribed by the *Approved Methods for the Modelling and Assessment of Air Pollutants in NSW* (DEC, 2005) (known as 'the Approved Methods'). These generally apply to stationary sources of air pollution. However, as the construction period for the proposal as a whole would be around 18 months, the particulates and deposited dust criteria in the Approved Methods were used for the assessment of potential construction impacts of the proposal.

Odour from stationary sources is assessed using the *Technical framework: Assessment and management of odour from stationary sources in NSW* (DEC, 2006). Odorous air emissions are not generally associated with locomotives and freight haulage, as the concentrations of odorous substances such as nitrogen dioxide (NO_2), sulphur dioxide (SO_2), and volatile organic compounds (VOCs) have relatively low odour thresholds, and are generally not detected at concentrations below their health-related air quality objectives.

The National Environment Protection Council of Environmental Ministers, now the National Environment Protection Council (NEPC), set uniform national standards for ambient air quality in February 2016. These are known as the *National Environment Protection (Ambient Air Quality) Measure* ('the Air NEPM'). The Air NEPM sets non-binding standards and ten-year goals (for 2026). The goal for the Air NEPM is a PM_{10} of 50 micrograms per cubic metre (µg/m^3) as a 24-hour average (no exceedances per year) and a $PM_{2.5}$ goal of 25 µg/m^3 as a 24-hour average.

The Air NEPM standards apply to regional air quality as it affects the general population. The standards do not apply in areas impacted by localised air emissions, such as industrial sources, construction activity, and heavily trafficked streets and roads.

Background concentrations of air pollutants are ideally obtained from ambient monitoring data collected at a proposal site in accordance with the Approved Methods. The Approved Methods recognises that this data is rare, and that data is typically obtained from monitoring sites as close as possible to a proposal site, where sources of air pollution resemble the existing sources at the proposal site.

13.2 Existing environment

13.2.1 Ambient (background) air quality

Regional air quality within the study area is mainly influenced by rural activities, vehicle emissions, mining and exploration activities, and limited industrial/processing activities. The National Pollutant Inventory lists three sources of emissions between Parkes and Narromine. Two of these are extractive industries from which the primary emissions are likely to be dust, with minor emissions of nitrogen oxides and volatile organic compounds. One industry is associated with mineral, metal and chemical wholesaling, where volatile organic compounds may be released.

There is no publicly available air quality monitoring data for the study area. The nearest air quality monitoring station that provides publicly available data is operated by OEH at Bathurst (located about 135 kilometres to the east of Parkes). Background air quality was derived using PM_{10} average and 70th percentile PM_{10} values for the last five years for Bathurst. These are provided in Appendix F.

A conservative approach was adopted for the assessment, and the highest 70th percentile PM_{10} value was used to represent background air quality for the study area. The highest 70th percentile PM_{10} was 16.9 µg/m^3, which is below the NSW annual average criteria of 30 µg/m^3.

Due to the inland location of the proposal site, and the lack of any concentrated emission sources, the ambient background levels of gaseous pollutants such as SO_2, NO_2 and CO was considered to be negligible, at a level of zero. Background levels of odours were also considered to be negligible.

13.2.2 Local meteorology

Climate data was obtained from the Bureau of Meteorology (BoM) Parkes Airport site (site number 065068). The data indicates that the study area has a warm temperate climate, with significant temperature variations between summer and winter. January is the hottest month at Parkes with a mean maximum temperature of 33.3 degrees, which drops to 14.2 degrees in July. Most of the annual 644 millimetres of rainfall occurs in summer, with autumn and winter usually drier. Wind speeds, which are of particular importance when determining the potential for dust impacts, are typically greater in spring and summer.

Local meteorology depends on local topography, land use, vegetation, and watercourses, and would vary along the proposal site. To conduct a conservative assessment, worst-case meteorology was assumed for dust dispersion, based on all possible wind directions and speeds.

Five-year wind roses were sourced for the study area (from willyweather.com.au) for Parkes airports.

As shown in Figure 13.1, the five year wind rose for Parkes Airport indicates that calm, light and gentle winds occur for nearly 80 per cent of the time, with 20 per cent of wind above 19.8 kilometres per hour. This is a level that could cause nuisance dust. Most high winds occur from the north-east and south-west quadrants, meaning that dust impacts would be more likely to occur opposite to these directions.

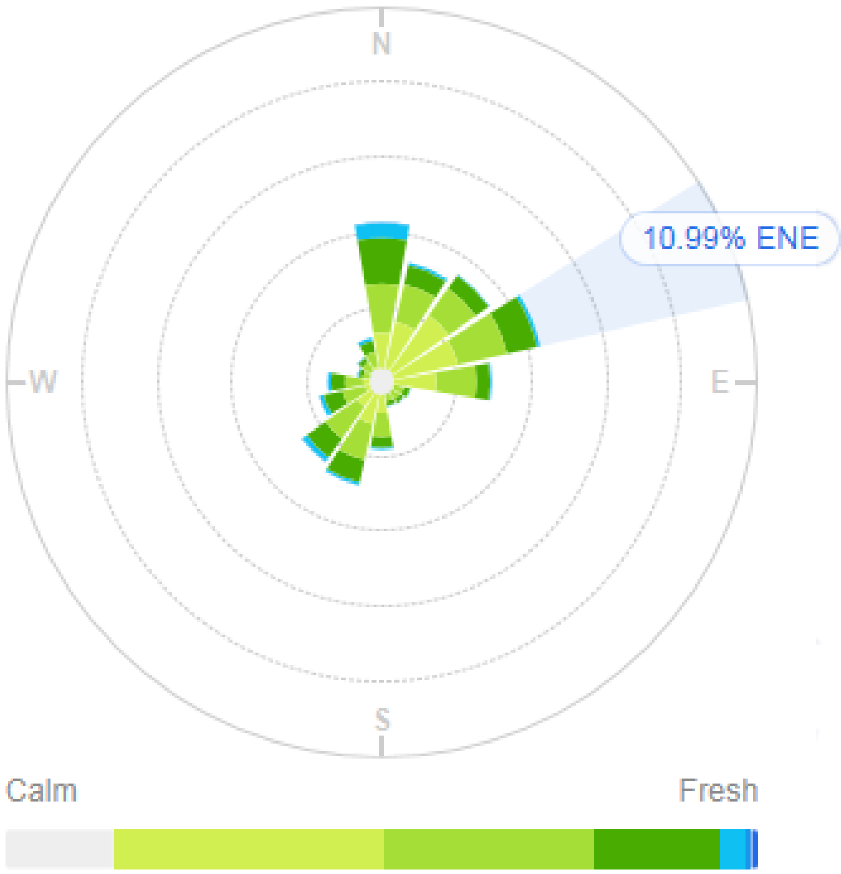


Figure 13.1 Five year wind rose for Parkes Airport

13.3 Assessment criteria

The air quality impact assessment criteria for the proposal are provided in Table 13.1.

The criteria for particulate matter (PM_{10}) and total suspended particles are prescribed by the Air NEPM and the Approved Methods respectively. PM_{10}, which has a 24-hour assessment criteria, is most relevant for assessing construction impacts. Dust deposition criteria are mainly used to assess the potential for amenity impacts. These criteria should to be met at existing or future off-site sensitive receptors. Particulate and dust deposition levels are provided as cumulative impacts, where the predicted impact of the proposal is added to the adopted background levels.

Assessment criteria relating to operation of the proposal (SO_2, NO_2, PM_{10}, $PM_{2.5}$, carbon monoxide, and benzene) are also provided in Table 13.1.

Table 13.1 Adopted air quality impact assessment criteria

Pollutant	Averaging period	Criteria[1]
PM_{10}	24 hours	50 µg/m^3
	Annual	25 µg/m^3
$PM_{2.5}$	24 hours	25 µg/m^3
	Annual	8 µg/m^3
Total suspended particles	Annual	90 µg/m^3
Dust deposition	Annual	2 g/m^2/month[2]
Sulfur dioxide (SO_2)	10 minutes	712 µg/m^3
	1 hour	570 µg/m^3
	24 hours	228 µg/m^3
	Annual	60 µg/m^3
Nitrogen dioxide (NO_2)	1 hour	246 µg/m^3
	Annual	62 µg/m^3
Carbon monoxide (CO)	15 minutes	100 mg/m^3
	1 hour	30 mg/m^3
	8 hours	10 mg/m^3
Benzene	1 hour	29 µg/m^3

Notes: 1: Based on the Air NEPM and the Approved Methods
2: Maximum increment. Maximum cumulative impact of 4 g/m^2/month

13.4 Impact assessment

13.4.1 Risk assessment

Potential impacts

The environmental risk assessment for the proposal (summarised in Appendix B) included an assessment of the potential air quality risks. The assessed risk level for the majority of potential risks to air quality was between low and medium. Risks with an assessed level of medium or above include:

- generation of dust during construction (from exposed soil/stockpiles, excavation, and vehicle movements)
- emissions from vehicles or plant during construction.

How potential impacts would be avoided

In general, potential air quality impacts would be avoided by:

- managing air quality in accordance with relevant legislative and policy requirements, as outlined in section 13.1.3
- managing air quality in accordance with the EPLs for construction and operation
- implementing the air quality mitigation measures provided in section 13.5.

13.4.2 Sensitive receivers

Residences, schools, sports grounds, medical clinics, hospitals, wetlands and some flora are considered to be sensitive receivers in relation to the potential health and amenity impacts of dust. Most of the proposal site traverses sparsely settled rural land. However, for short lengths, the proposal site would be located within/close to towns and residences. No wetlands are located in the vicinity of the proposal site. The potential for indirect impacts to biodiversity as a result of dust generation are considered in chapter 10.

The proposal would be generally located more than 200 metres from most residences and non-residential sensitive receivers. Based on a review of aerial photography and GIS mapping, 30 sensitive receivers, consisting of residences only, were identified within 200 metres of the proposal site for the purposes of the air quality assessment. Sensitive receivers are shown in Figure 13.2.

13.4.3 Construction impacts

The processes that have the potential to generate particulate matter during construction are:

- mechanical disturbance − dust emissions as a result of the operation/movement of construction vehicles and equipment, including disturbance associated with the excavation, handling and transport of waste.
- wind erosion − dust emissions from exposed, disturbed soil surfaces under high wind speeds, including erosion associated with the on-site storage of waste.

Fine particle emissions associated with exhausts from mobile plant and stationary engines used during construction activities were accounted for in the study's dust emission factors for earthmoving and handling.

Dust dispersion modelling

An emissions inventory for potential particulate sources was derived for the proposal and is provided in Appendix F. Table 13.2 summarises the estimated total dust emissions from the main identified sources. The site compound emissions were assumed to be from site establishment, not ongoing operation during construction. Dust impacts from spoil sites were not considered significant due to their small size and low level of potential emissions.

Table 13.2 Estimated emissions of PM_{10} during construction

Source of construction dust	Assumed dimensions for the purposes of the assessment (m)	Total emissions of PM_{10} (grams per second)
Construction in the rail corridor	30 x 100	0.11
Site compound	250 x 250	0.59
Spoil site	50 x 50	0.02

A screening level assessment was undertaken with consideration of the Approved Methods. The predicted worst-case 24 hour PM_{10} concentrations are presented in Appendix F as concentration versus distance graphs for the following scenarios:

- Scenario 1 – construction within the proposal site in areas where upgrades to formation are required, widening of embankments, and construction of the Parkes north west connection.
- Scenario 2 – construction within the proposal site where the track is being upgraded, significant earthworks are not expected, and the potential for dust impacts is lower than for Scenario 1.
- Scenario 3 – establishment of site compounds.

The calculations used a background dust level of 16.9 $\mu g/m^3$ and are worst case predictions, with the actual values dependent on background dust levels and local meteorology on any given day.

Modelling results

The results for scenario 1 show that the criteria of 50 $\mu g/m^3$ may be exceeded at a distance of up to 100 metres from the proposal site under worst case conditions. There are 13 sensitive receivers within 100 metres of the proposal site.

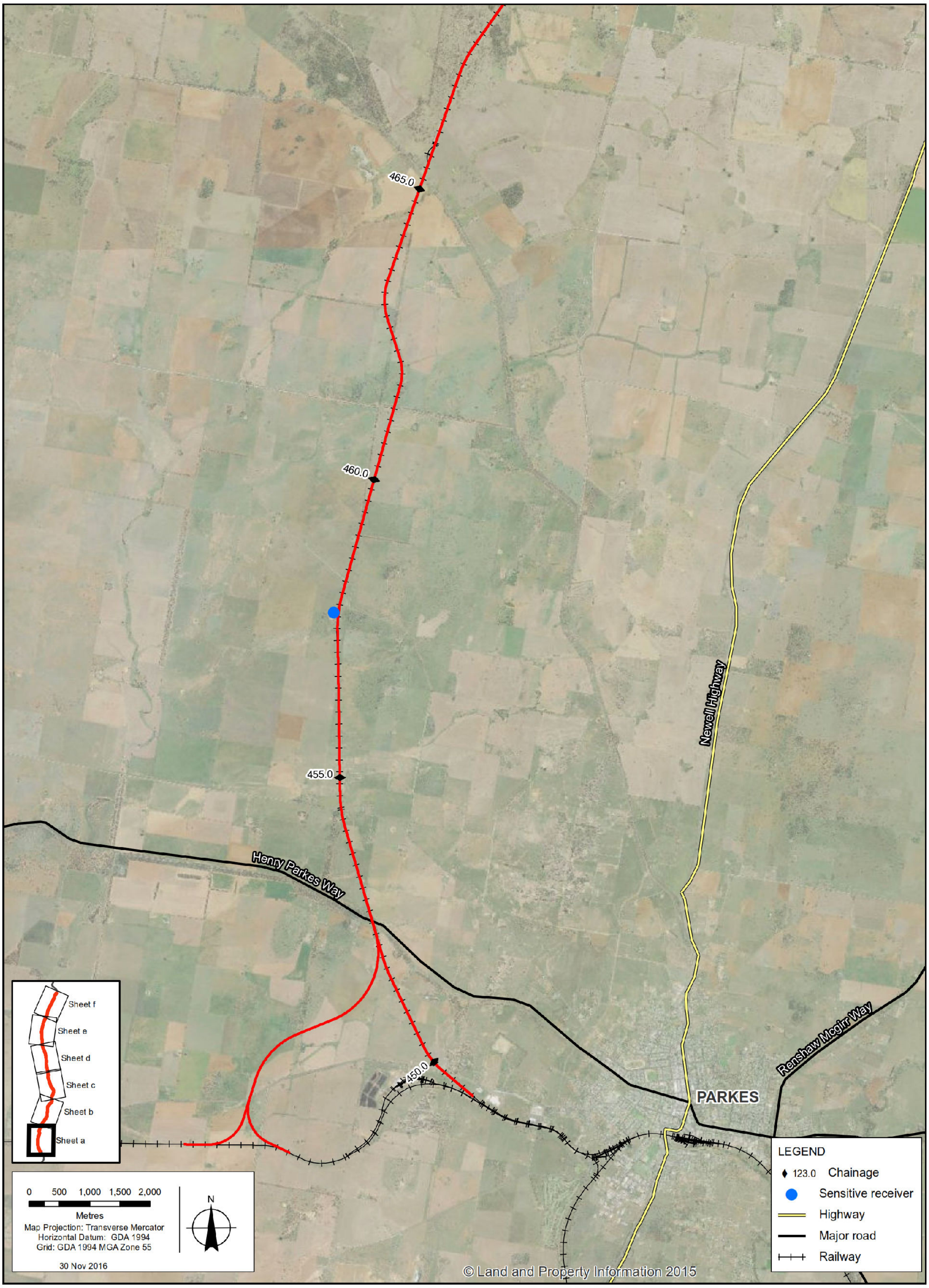
The results for scenario 2 show that the criteria of 50 $\mu g/m^3$ may be exceeded at a distance of up to 20 metres from the proposal site under worst case conditions. There are no sensitive receivers within 20 metres of the proposal site.

The impacts from construction along the proposal site would be short-term, as construction works would move along the proposal site, limiting the duration of potential impacts at any one location.

The results for scenario 3 show that the criteria of 50 $\mu g/m^3$ may be exceeded at a distance of up to 150 metres from compounds under worst case conditions. This impact would be temporary and short term, as once the site is established, the potential for dust impacts would be much lower. There are no sensitive receivers within 150 metres of any of the proposed compound sites.

Measures to manage the potential for construction air quality impacts are provided in section 13.5. The level and number of measures implemented would depend on the location of construction with respect to sensitive receivers and activities undertaken. During construction, additional dust control measures would be adopted for scenario 1 or during dry conditions if visible dust plumes are moving off-site towards sensitive receivers.

Based on the findings of the assessment, it is expected that the generation of dust emissions due to construction can effectively be mitigated by implementation of the mitigation measures outlined in in section 13.5.



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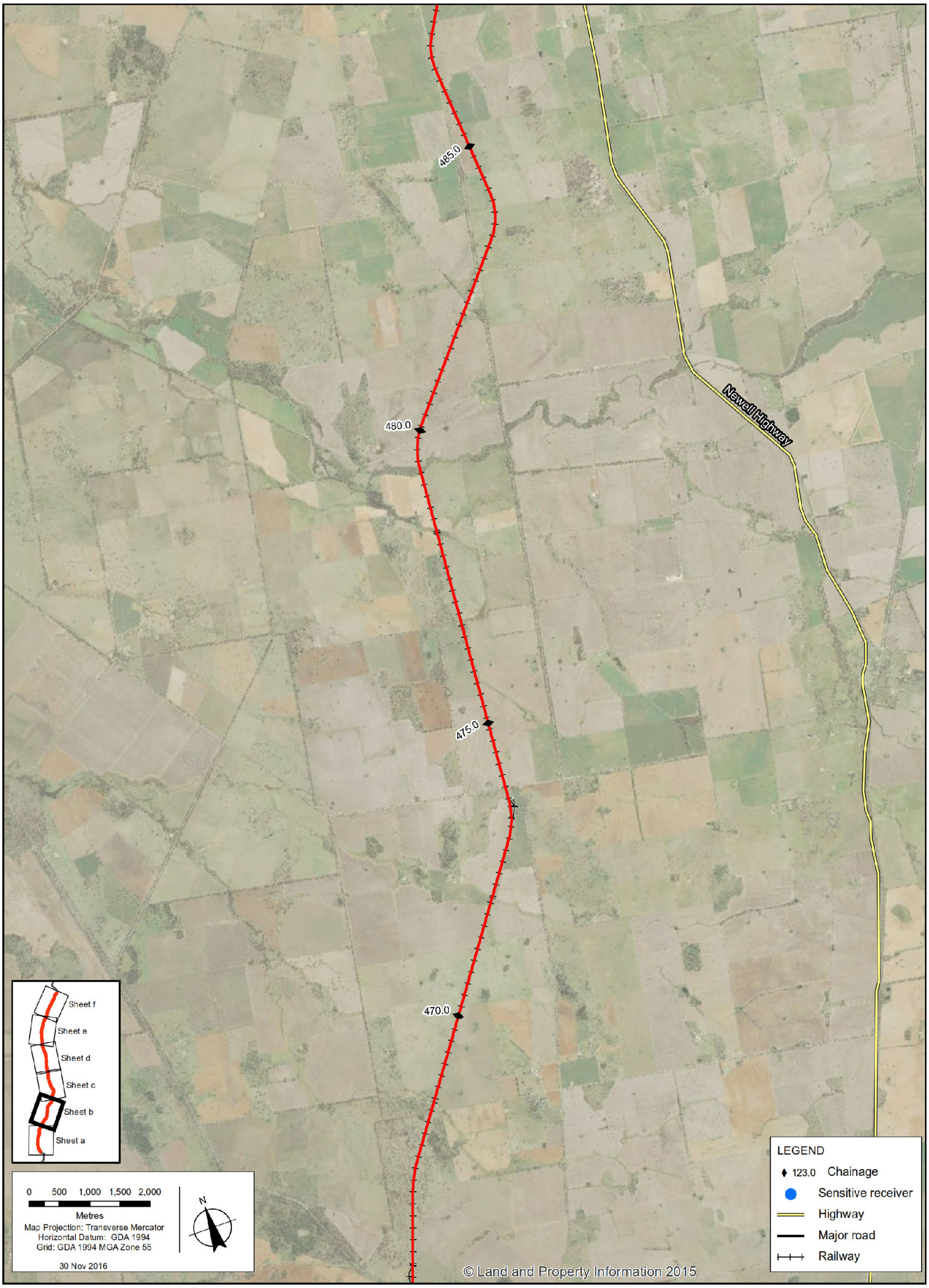
Data source: Commonwealth of Australia (Geoscience Australia), 250K Topographic Data Series 3, 2006.

Figure 13.2a

Air quality sensitive receiver locations



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Data source: Commonwealth of Australia (Geoscience Australia), 250K Topographic Data Series 3, 2006.

Figure 13.2b
Air quality sensitive receiver locations

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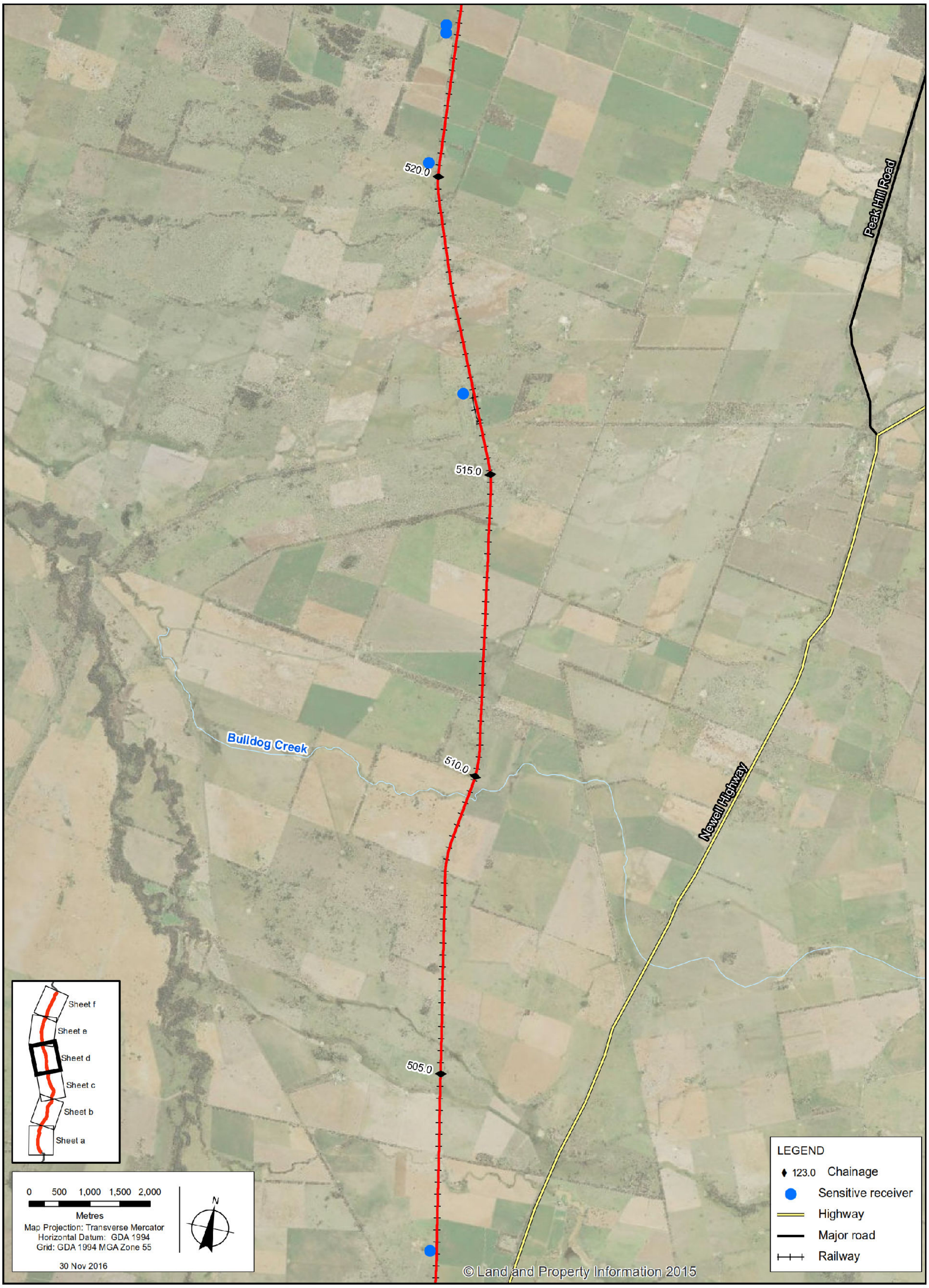
Data source: Commonwealth of Australia (Geoscience Australia), 250K Topographic Data Series 3, 2006.

Figure 13.2c
Air quality sensitive receiver locations



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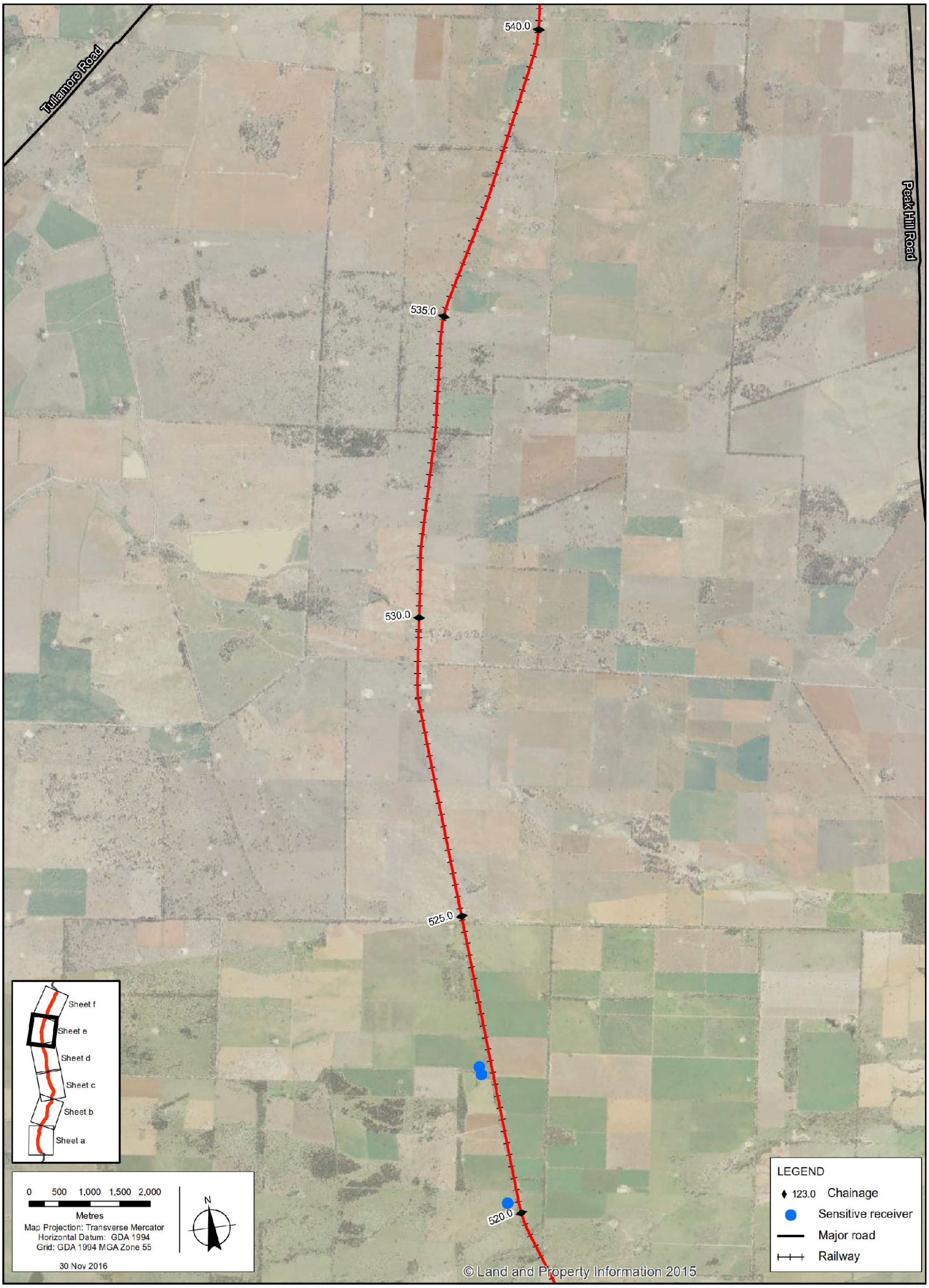
Data source: Commonwealth of Australia (Geoscience Australia), 250K Topographic Data Series 3, 2006.

Figure 13.2d
Air quality sensitive receiver locations



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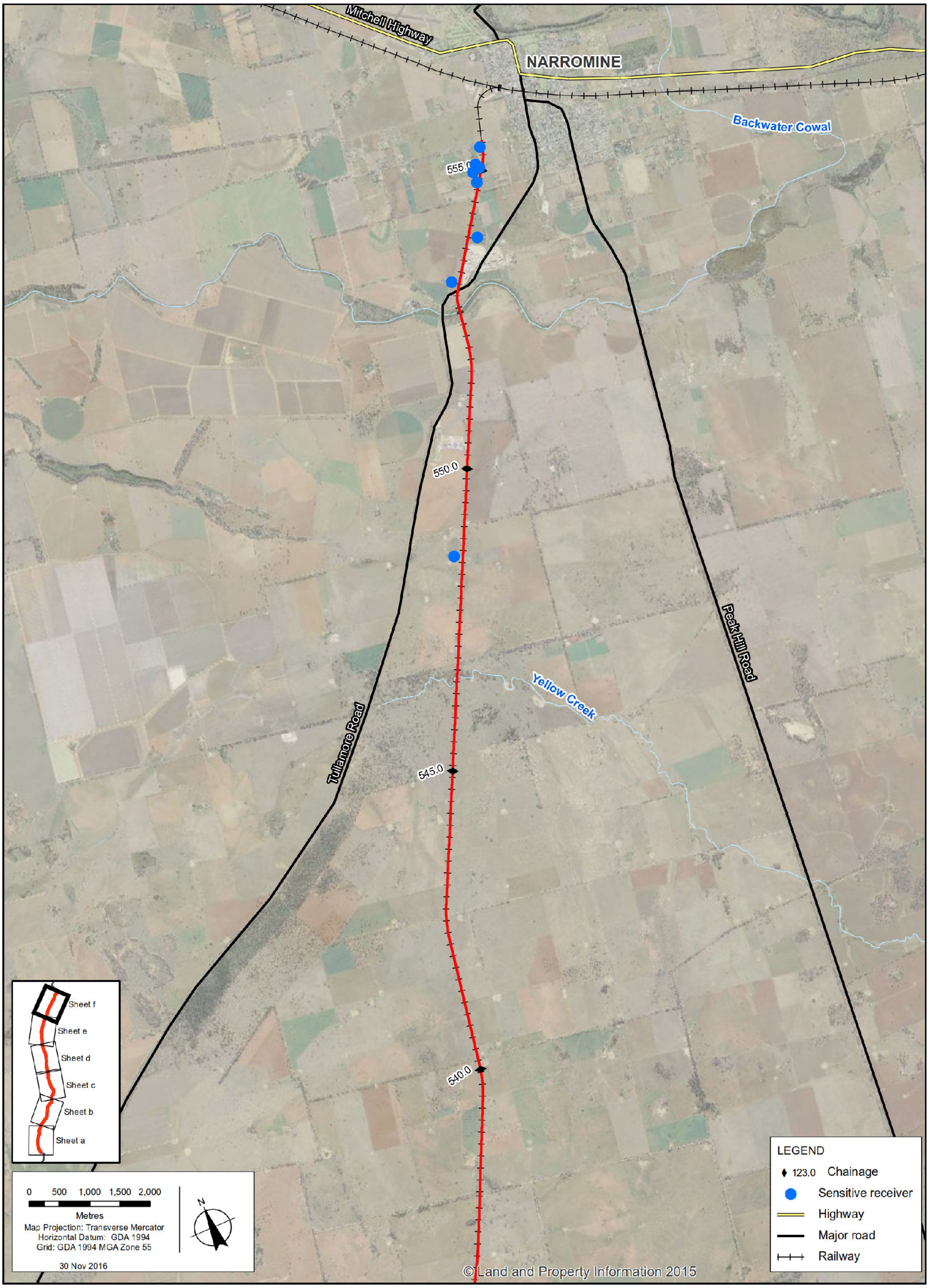
Data source: Commonwealth of Australia (Geoscience Australia), 250K Topographic Data Series 3, 2006.

Figure 13.2e
Air quality sensitive receiver locations



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Data source: Commonwealth of Australia (Geoscience Australia), 250K Topographic Data Series 3, 2006.

Figure 13.2f

Air quality sensitive receiver locations

13.4.4 Operation impacts

Operation of the proposal would result in an increase in the number of freight trains travelling along the rail corridor. It is estimated that Inland Rail would be trafficked by an average of 8.5 trains per day in 2025, increasing to the estimated maximum of 15 trains per day in 2040. This rail traffic would be in addition to the existing rail traffic using the Parkes to Narromine line.

Diesel locomotives, like trucks and cars, emit nitrogen oxides and particulate matter to the air. Air quality impacts from busy rail corridors are generally only an issue in densely populated areas, with poor outdoor air circulation. *Development near rail corridors and busy roads – interim guideline* (Department of Planning, 2008), suggests that air quality should be a design consideration within 20 metres of a freeway or main road with moderate congestion levels. The guideline provides no specific reference to a distance from rail corridors.

The results of the *Northern Sydney Freight Corridor Strathfield Rail Underpass Air Quality Assessment* (Parsons Brinckerhoff, 2012) were reviewed with respect to the potential impacts of the operation of freight trains. It is noted that this assessment was for a rail line operating in an urban area with many more sensitive receivers. This assessment included air quality modelling of 81 class diesel locomotives undertaking a minimum of 32 movements per day (16 in each direction) at 75 kilometres per hour. The results of modelling indicated that, for all assessed pollutants (NO_2, SO_2, CO, PM_{10}, $PM_{2.5}$ and benzene), the predicted levels were significantly below the impact assessment criteria at a distance of 50 metres from the track. The predicted increment of PM_{10} as a 24-hour average was 0.06 µg/m^3, and the increment of $PM_{2.5}$ was 2 µg/m^3, which complied with the assessment criteria at all sensitive receivers.

As the levels of operational rail traffic along the proposal site would be much lower than for the Northern Sydney Freight Corridor, the operational emissions as a result of the proposal are expected to be much lower. The emissions from use of the existing rail corridor as a result of the proposal would increase as a result of the increase in the number of trains travelling along the corridor, however the emissions are still expected to be below the relevant impact assessment criteria.

Air pollution from transport corridors decreases significantly with distance, and is expected to be negligible for the proposal.

13.4.5 Cumulative impacts

The construction impact assessment in section 13.4.3 includes existing dust levels in regional NSW. The results show cumulative dust levels, which include the background and predicted increment from construction in the study area. The assessment found that the predicted particulate levels from construction would be unlikely to extend farther than 150 metres from work areas, and would have insignificant cumulative impacts with other approved projects. Predicted particulate increment from construction would not impact on regional air quality, and would be localised to a few hundred metres of the construction works.

Operational air quality impacts are not expected at distances greater than 20 metres from the proposal site. There are no identified significant sources of air pollutants, within 20 metres of the proposal site, and cumulative impacts are not expected.

13.5 Mitigation and management

13.5.1 Approach to mitigation and management

An air quality management sub-plan would be prepared as part of the CEMP and implemented during construction to ensure that air quality impacts do not exceed relevant air quality criteria. The air quality management sub-plan would help ensure that dust and emissions are managed in an environmentally sound manner, and in accordance with statutory requirements.

During operation, air quality would be managed to achieve compliance with the operational environmental protection licence.

13.5.2 Consideration of the interactions between mitigation measures

Mitigation measures to control air quality impacts may overlap with the measures proposed for the control of erosion and sedimentation (described in chapters 5 and 26), as the major pollutant of concern is dust.

All mitigation measures for the proposal would be consolidated and described in the CEMP. The CEMP would identify measures that are common between different aspects. Common impacts and common mitigation measures would be consolidated to ensure consistency and implementation.

13.5.3 Managing residual impacts

The mitigation and management measures proposed are expected to reduce the potential for impacts to air quality resulting from construction and operation. With the implementation of these measures, residual impacts are expected to be minimal.

13.5.4 Summary of mitigation measures

To mitigate the potential impacts to air quality, the following measures would be implemented.

Table 13.3 Air quality mitigation measures

Stage	Impact	Mitigation measures
Pre-construction/ construction	General air quality impacts	An air quality management sub-plan would be prepared and implemented as part of the CEMP. It would include measures to minimise the potential for air quality impacts on the local community and environment, and would address all aspects of construction, including: - spoil handing - machinery operating procedures - soil treatments - stockpile management - haulage - dust suppression - monitoring.
	Construction activities and activities with earthworks that may cause dust impacts	Where sensitive receivers are located within 150 metres of construction works, or visible dust is generated from vehicles using access roads, road watering would be implemented.
Operation	Rail vehicle emissions	The proposal would be managed in accordance with the air quality management requirements specified in the EPL.
	Impacts during maintenance	Maintenance service vehicles and equipment would be maintained and operated in accordance with the manufacturers specifications.

14. Soils and contamination

This chapter provides the results of the soils and contamination assessment of the proposal as relevant to the EIS. It describes the existing soil environment, assesses the impacts of construction and operation, and provides recommended mitigation measures.

14.1 Assessment approach

14.1.1 Methodology

As an input to the design of the proposal, contamination and geotechnical assessments were undertaken to identify design constraints and the potential for human health impacts and/or environmental risks. These assessments were reviewed, and results relevant to the potential for soil and contamination impacts are provided in this chapter.

The contamination assessment undertaken as an input to the design included a desktop assessment to identify the potential for contamination along the proposal site, involving:

- a review of historical aerial photographs and a site visit to identify whether there are/have been any land uses that may have resulted in contamination issues
- searches of the NSW EPA Contaminated Sites Register and the list of sites which have been notified to the EPA
- a review of ARTC's contaminated site register.

The geotechnical assessment undertaken as an input to the design involved excavating 172 test pits along the proposal site. For the contamination assessment, 36 soil test pits were excavated into the existing track formation. Test pit locations are shown on Figure 14.1. Soil samples were collected from the contamination test pits and submitted to a National Association of Testing Authorities (NATA) accredited laboratory for analysis of the following contaminants of potential concern:

- asbestos
- total recoverable hydrocarbons
- polycyclic aromatic hydrocarbons
- organochlorine pesticides
- heavy metals (arsenic, cadmium, chromium, copper, mercury, lead, nickel, and zinc)
- polychlorinated biphenyls.

A summary of the results of the assessments relevant to the EIS is provided in this chapter.

14.1.2 Legislative and policy context to the assessment

Assessment framework

The contamination assessment was undertaken in accordance with guidelines made under section 105 of the *Contaminated Land Management Act 1997* (the CLM Act). These and other relevant guidelines include:

- *Contaminated Sites: Guidelines for Consultants Reporting on Contaminated Sites* (OEH, 2011a)
- *Contaminated Sites: Guidelines on the Duty to Report Contamination under the Contaminated Land Management Act 1997* (EPA, 2015a)
- *Contaminated Sites: Sampling Design Guidelines* (EPA, 1995)
- *National Environment Protection (Assessment of Site Contamination) Measure 1999*, 2013 amendment (the NEPM)
- *Acid Sulfate Soils Assessment Guidelines* (ASSMAC, 2008)
- *Managing Land Contamination Planning Guidelines SEPP 55 – Remediation of Land* (Department of urban Affairs and Planning and EPA, 1998).

Assessment criteria

The assessment criteria (investigation levels) for the contamination assessment were taken from the following guideline levels provided by the NEPM (refer to Schedule B1 of the NEPM):

- Health investigation levels:
  - to assess human health risk via all relevant pathways of exposure
  - the level adopted for this assessment was D – commercial/industrial use.
- Health screening levels:
  - for hydrocarbon vapour intrusion under different land use scenarios
  - the level adopted for this assessment was D – commercial/industrial use.

The desktop assessment did not identify a potential risk to ecological receptors from contaminated soils during construction. Therefore, ecological screening/investigation levels were not adopted as assessment criteria.

Asbestos

The assessment criteria for asbestos was taken from the NEPM and *Managing asbestos in or on soil* (WorkCover, 2014). These provide guidance on what constitutes an ‘acceptable’ level of asbestos in soil. The NEPM emphasises that the assessment and management of asbestos contamination should take into account the condition of the asbestos materials, the potential for damage, and resulting release of asbestos fibres. Bonded asbestos in sound condition represents a low human health risk. However, both friable and fibrous asbestos materials have a significantly higher potential to generate, or be associated with, free asbestos fibres, and may represent a significant human health risk if disturbed and fibres are made airborne.

Waste classification

A preliminary soil waste classification was completed to guide any offsite soil disposal that may be required. The analyte concentrations in the tested soil samples were compared to the criteria in Table 2 of the *Waste Classification Guidelines, Part 1: Classifying Waste* (EPA, 2014). Further information on the application of the waste classification guidelines is provided in chapter 24.

14.2 Existing environment

14.2.1 Geological and soil settings

The proposal site crosses flat to undulating rises along the lower western slopes of a north-south trending range. The range is associated with the meta-sedimentary units of the Hervey syncline in the south, and the granitic Bulga Range in the north.

The proposal site is located in the Central Lachlan Fold Belt. Near surface materials include Tertiary to Quaternary aged red silty alluvium over intermittently outcropping folded and faulted Silurian and Ordovician aged sedimentary and minor metamorphic sequences.

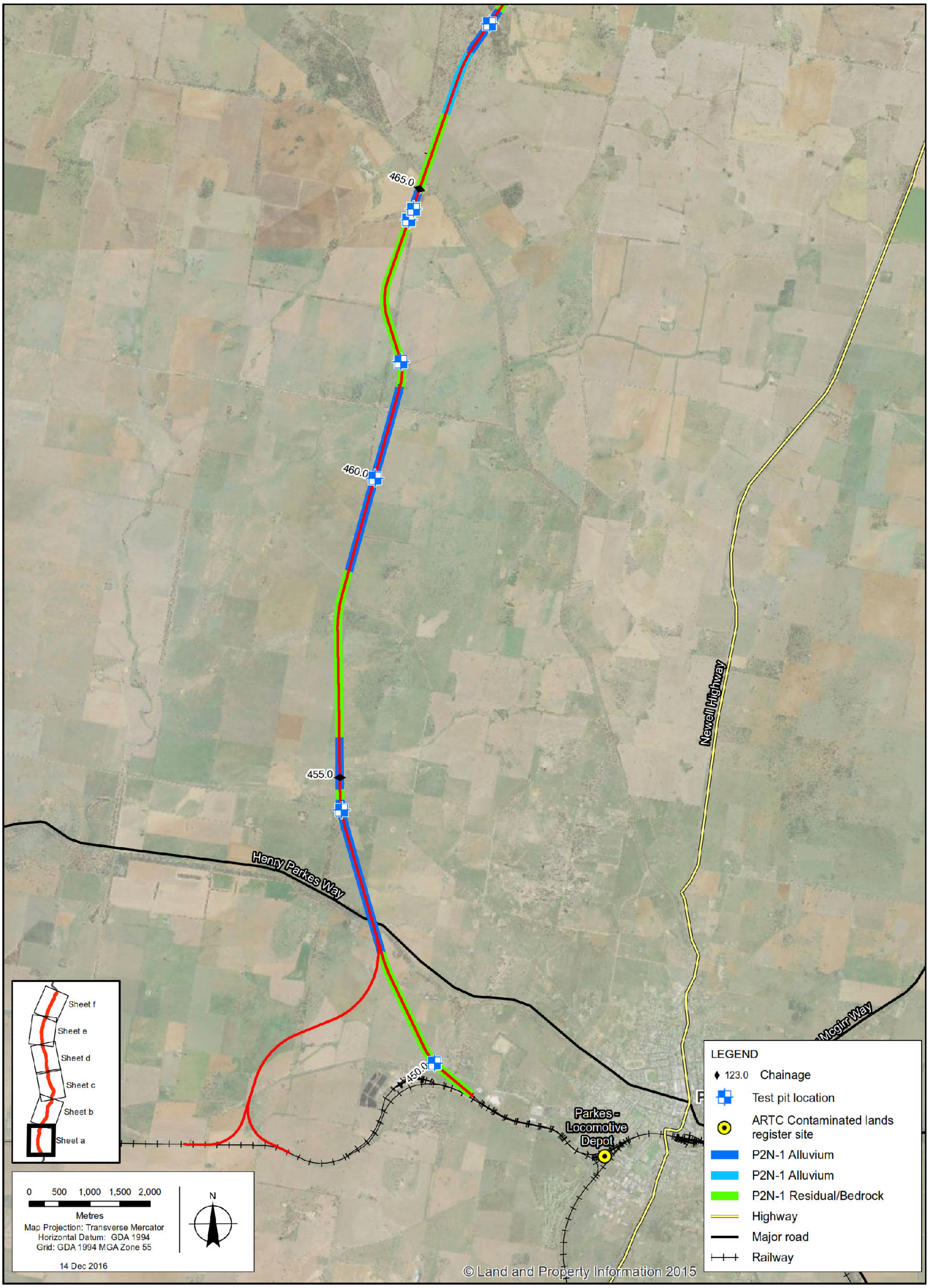
Thick reactive brown and grey clay soils are predominantly associated with the near level terrain north of Peak Hill. The undulating terrain south of Peak Hill consists of moderately thick red and brown sandy and silty clay soils. Soil types are shown on Figure 14.1.

Based on regional groundwater bore information, groundwater is anticipated to be located between seven and 60 metres below the ground surface, but generally over 20 metres below the ground surface. Subsurface conditions noted during the contamination and geotechnical assessments are listed in Table 13.1.

Of the soils present in the proposal site, the main potential issue relates to dispersive soils, which are located north of Peak Hill. The presence of gullying or other erosion features in the study area was not noted.

Table 14.1 Summary of subsurface conditions

Subsurface type	Depth encountered (metres)	Generalised description
Ballast – encountered in track formation only		
Top ballast	0.2 to 0.5	Gravel, coarse angular to sub-angular igneous gravel. Clean to moderately fouled.
Sub-ballast	0.2 to 0.75	Gravel, fine to coarse grained, angular to sub angular basalt. Typically, with sand. Fouled to highly fouled.
Fill		
Ash fill (in track formation only)	0.44 to 0.9	Clayey sand, low plasticity fines with gravel and minor clay. Comprising coal and carbonaceous shale.
Clay fill	0.05 to 1.3	Clay, generally encountered as sandy, or trace with sand or gravel, medium to high plasticity, typically derived from local alluvium or residual soil.
Natural soil		
Topsoil	0.05 to 0.65	Clay, typically encountered as sandy, or trace to with sand or gravel, with organics and roots, medium to high plasticity.
Alluvium	0.15 to greater than 2.4	Clay variably encountered as sandy or gravelly, or trace to with sand or gravel, medium to high plasticity.
Colluvium	0.8 to 1.1	Clay, trace gravel or with sand, medium to high plasticity.
Residual	0.9 to greater than 2.4	Clay, varyingly encountered as trace to with gravel or sand, medium to high plasticity.
Bedrock		
Sandstone	Greater than 1.1 to greater than 2.3	Fine to medium grained, extremely to highly weathered, and extremely low to very low strength.
Siltstone	Greater than 1.2 to greater than 2.3	Thinly laminated to laminated, with possibly slight metamorphic textures, typically extremely to highly weathered, and extremely low to very low strength.
Basalt	Greater than 0.4 to greater than 2.2	Generally extremely to highly weathered, and extremely low to low strength.



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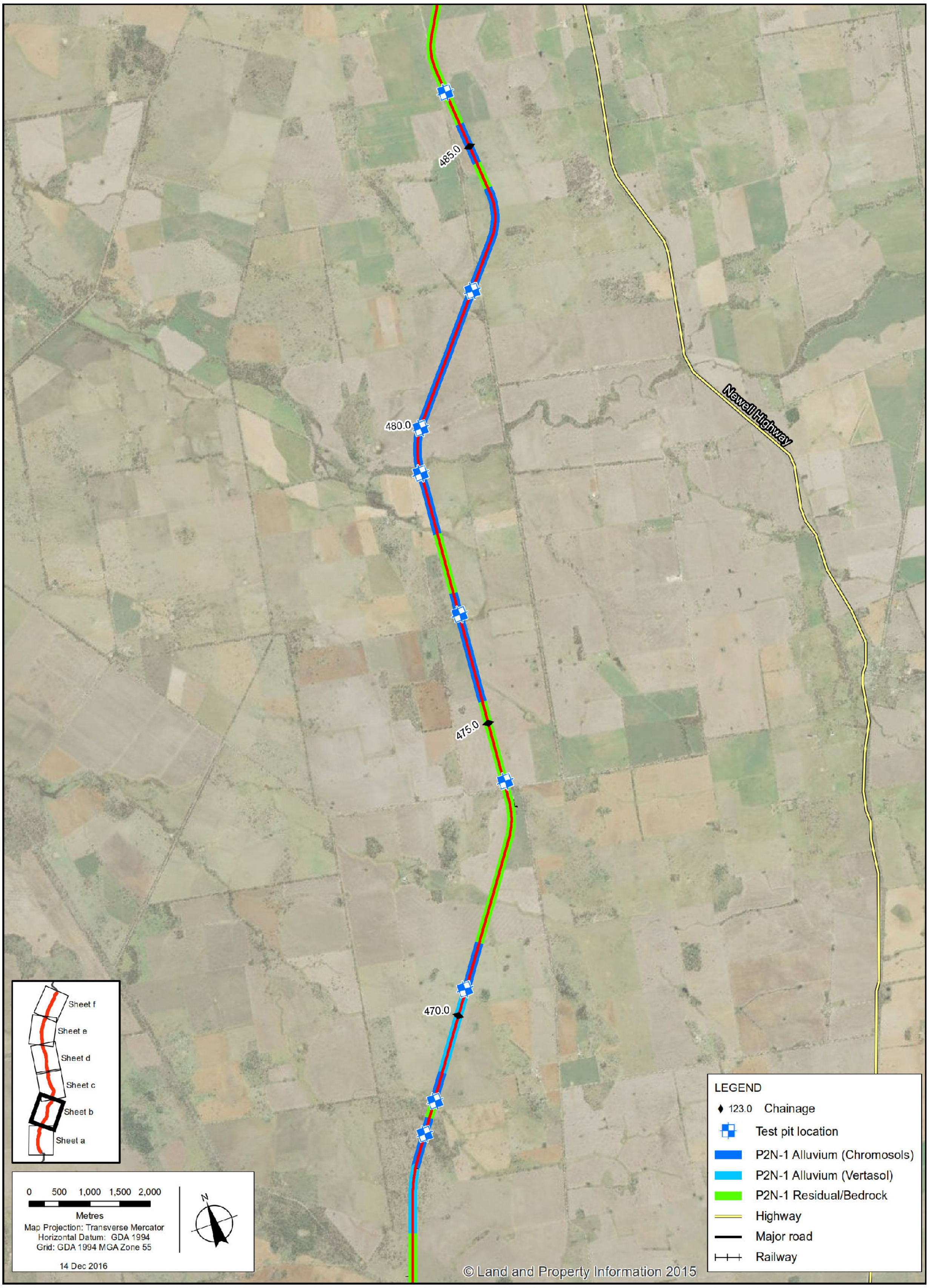
Data source: Commonwealth of Australia (Geoscience Australia), 250K Topographic Data Series 3, 2006.

Figure 14.1a

Soils and contamination



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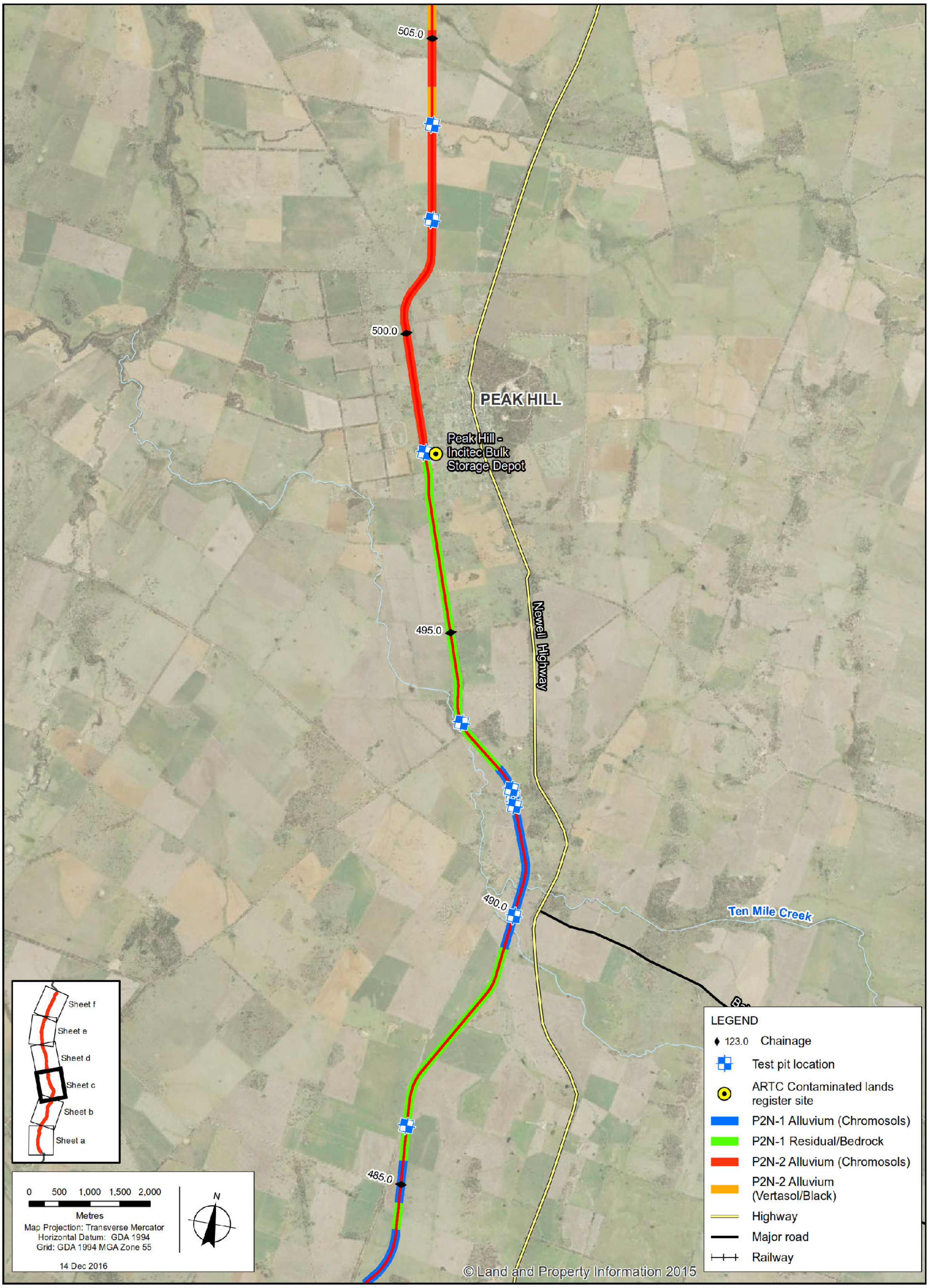
Data source: Commonwealth of Australia (Geoscience Australia), 250K Topographic Data Series 3, 2006.

Figure 14.1b

Soils and contamination



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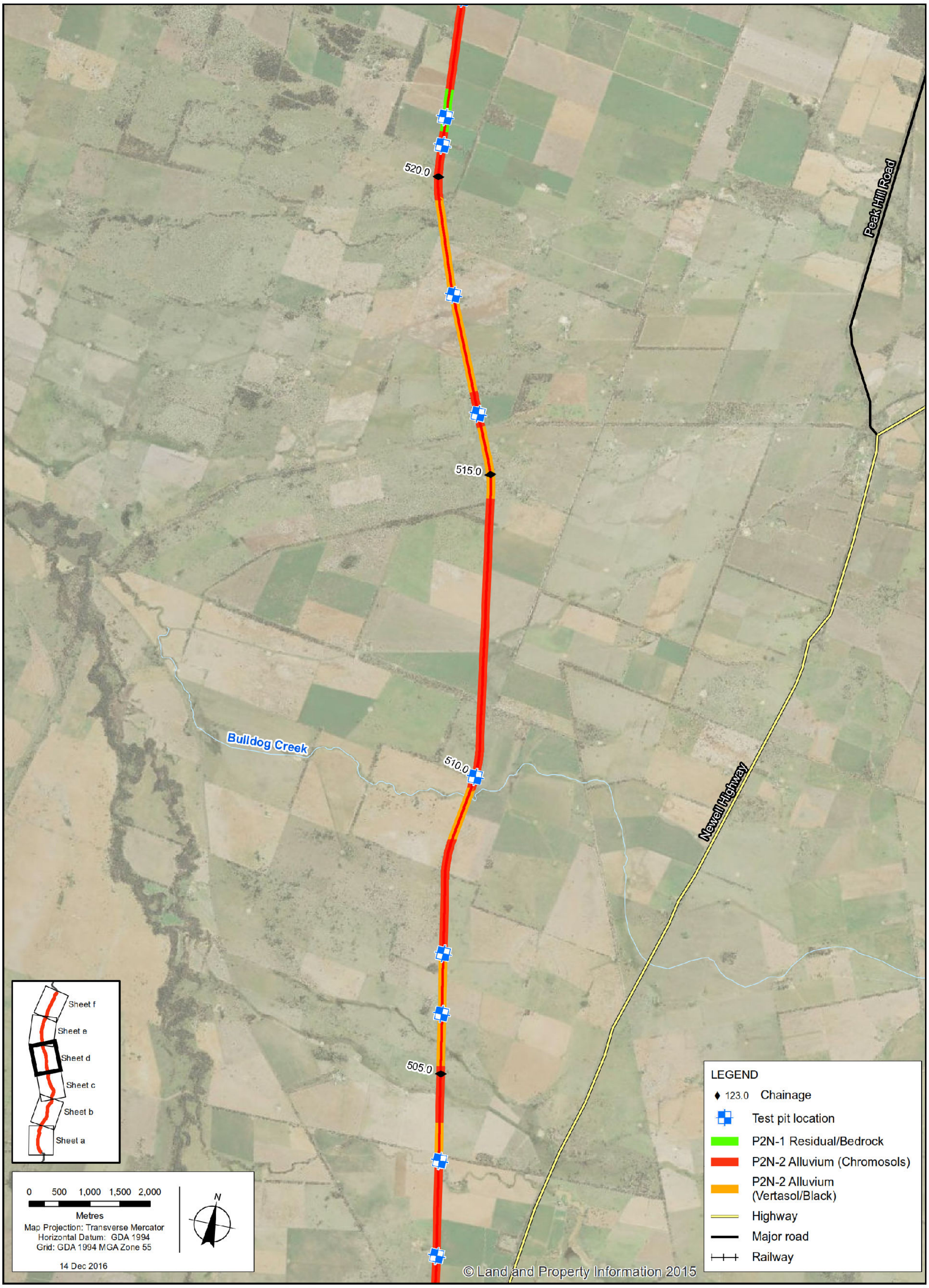
Data source: Commonwealth of Australia (Geoscience Australia), 250K Topographic Data Series 3, 2006.

Figure 14.1c
Soils and contamination



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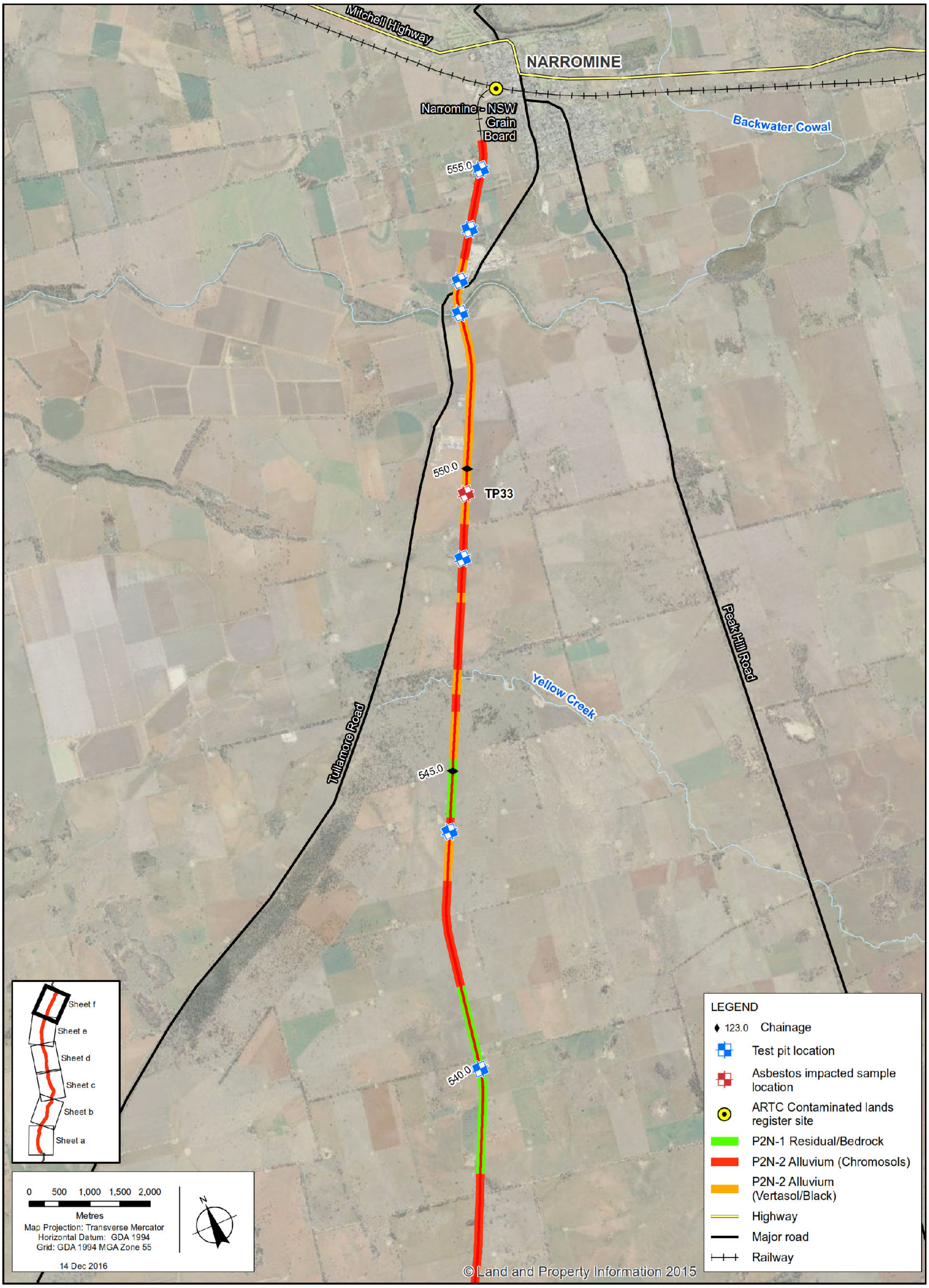
Data source: Commonwealth of Australia (Geoscience Australia), 250K Topographic Data Series 3, 2006.

Figure 14.1d
Soils and contamination

G:\22\17916\GIS\Maps\Deliverables\P2N\EIS\2217916_EIS012_P2N_Soils_0.mxd

Data source: Commonwealth of Australia (Geoscience Australia), 250K Topographic Data Series 3, 2006.

Figure 14.1e
Soils and contamination



G:\22\17916\GIS\Maps\Deliverables\P2N\EIS\2217916_EIS012_P2N_Soils_0.mxd

Data source: Commonwealth of Australia (Geoscience Australia), 250K Topographic Data Series 3, 2006.

Figure 14.1f

Soils and contamination

Acid sulfate soils

Acid sulfate soils are the common name given to naturally occurring sediments that contain iron sulfide minerals. If the soils are drained, excavated or exposed to air, the sulfides react with oxygen to form sulfuric acid. Acid sulfate soils are widespread around coastal regions and are locally associated with saline sulfate-rich groundwater in some agricultural areas, or with freshwater wetlands. Given the distance of the proposal site from the coast and its elevation, no acid sulfate soils are expected or known to occur. A review of the Australian Soil Resource Information System undertaken on 17 June 2016 (CSIRO, 2016) found that the proposal site is located in an area of low probability to no known occurrence of acid sulfate soils. The potential to encounter acid sulfate soils during construction has therefore not been considered further.

Saline soils

Areas prone to salinity are usually at low positions in the landscape, such as in valley floors and along floodplains. The OEH NSW Soil and Land Information System contains data points identifying evidence of soil salinity where soils have been sampled previously. A review of this database undertaken on 17 June 2016 (eSPADE, 2016) indicated that generally no salting was evident at sample locations in the vicinity of the proposal site (within one kilometre). Salting was evident at isolated locations in the region, the closest being about 2.5 kilometres to the east of the proposal near Trewilga, however these are likely associated with farming practices and are site-specific. The findings of the geotechnical laboratory analysis of soil samples was consistent with this. The potential to encounter saline soils during construction has therefore not been considered further.

14.2.2 Potential for contamination

There are no sites listed on the EPA's Contaminated Sites Register or list of notified sites within/close to the proposal site. Three sites listed on ARTC's contaminated sites register are located within/close to the proposal site. These sites have been leased from ARTC for use as service stations, grain or fuel storage. The locations of these sites are shown on Figure 14.1.

Based on the land uses immediately surrounding the proposal site (described in chapters 2 and 20) and the findings of the desktop assessment, potential sources of contamination in the vicinity of the proposal site are considered to include:

- agricultural activities – which may be associated with hydrocarbons, pesticides and hazardous materials from demolition, deterioration of old buildings, and/or landfilling
- unknown fill and waste materials – which may be associated with various hazardous materials, including asbestos, heavy metals, pesticides, and hydrocarbons
- imported fill and ballast within the rail corridor – which may be associated with asbestos, hydrocarbons, heavy metals, and polycyclic aromatic hydrocarbons
- industrial activities adjacent to the rail corridor – which may be associated with hydrocarbons, oils, chemical storage, heavy metals, and hazardous building materials.

The targeted site investigations found no visual or olfactory evidence of contamination in any of the test pits. Illegal dumping of waste materials was observed, including storage containers that may contain, or have contained, chemicals or fuel.

All samples except one had laboratory results below the limit of reliability and below the relevant human health screening criteria.

One site recorded the presence of chrysotile asbestos in sandy gravel fill material. This site (reference TP33) is located in the existing rail corridor about five kilometres south-west of Narromine (shown on Figure 14.1). The potential source of this asbestos was considered to be the dilapidated building located adjacent to the site. Soils in the vicinity of this location would be classified as special waste (asbestos) in accordance with the *Waste Classification Guidelines* (EPA, 2014). Soils sampled at other test pit locations along the corridor are consistent with a general solid waste classification.

The contamination assessment confirmed that the soils are suitable to remain within the proposal site for the use proposed (that is, for railway purposes). Based on the findings of the contamination assessment, the proposal site does not contain gross contamination, and does not meet the criteria requiring it to be notified to the EPA under section 60 of the CLM Act.

14.3 Impact assessment

The following assessment considers the potential for soil and contamination impacts as a result of the construction and operation of the proposal. The potential for impacts to water quality as a result of soil erosion, run-off, and potential contamination is considered in chapter 16. The potential for impacts as a result of the transport of hazardous materials and dangerous goods is considered in chapter 25.

14.3.1 Risk assessment

Potential impacts

The environmental risk assessment for the proposal (summarised in Appendix B) included an assessment of the potential for soils and contamination risks. The assessed risk level for the majority of potential risks to soils, and from contamination, was between low and medium. Risks with an assessed level of medium or above include:

- impacts associated with the disturbance of contaminated soils during construction
- increased erosion and sedimentation due to excavation activities and vehicle movement
- contamination of soils/groundwater due to spills and leaks during construction
- changes to the surface, including as a result of vegetation removal and the creation of embankments, increasing the potential for erosion and sedimentation.

How potential impacts would be avoided

In general, potential soils and contamination impacts would be avoided by:

- managing contamination in accordance with relevant legislative and policy requirements, as described in section 14.1.2
- designing, constructing and operating the proposal to minimise impacts from soil issues
- implementing the soil and contamination mitigation measures described in section 14.4.

14.3.2 Construction impacts

Soil

Excavation and ground disturbance activities, if not adequately managed, could have the following impacts:

- erosion of exposed soil and stockpiled materials, particularly in areas where dispersive soils are present
- dust generation from excavation, backfilling and vehicle movements over exposed soil
- an increase in sediment loads entering the stormwater system and/or local runoff, and therefore nearby receiving waterways
- increase salinity levels in soil.

These impacts are considered to be minimal, as exposure of soils would be temporary and short-term in duration. It is expected that the majority of excavated spoil, consisting of either ballast, fill, or natural soils, would be reused during track formation works, or used to construct spoil mounds within the rail corridor (as described in chapter 8). Excess spoil not able to be used for either backfill or spoil mounds due to the presence of contamination would be stockpiled in a suitable location for transport and disposal off-site at an appropriately licensed waste facility.

The following construction activities have the potential to directly impact on the soil environment.

Earthworks and vegetation removal

Construction would temporarily expose the ground surface through vegetation removal, and excavation of construction footprints for structures, including culverts. The temporary exposure of these areas to water runoff and wind could increase soil erosion potential, particularly where construction is undertaken in areas which are characterised by dispersive soils. In addition, the removal of vegetation and top soils could increase the amount of water infiltration, particularly in areas of perched groundwater (see chapter 15), causing the water table to rise and bringing salt to the root zone and soil surface. Increased salinity in soils can affect plant health, leading to a loss of productive species and a dominance of salt-tolerant species.

Periods of heavy and frequent rainfall could also lead to increased runoff and flooding. Loose material may be eroded during rainfall events by runoff, increasing the potential for movement of soils and sedimentation of local drainage lines. This may in turn influence the vegetation and habitat of adjacent areas by smothering groundcover vegetation or by changing soil surface characteristics.

The potential for soil erosion and runoff impacts would be minimised by the implementation of the mitigation measures described in section 14.4.

Reinstatement

Reinstatement activities would require minor earthworks that could lead to the erosion of disturbed soils where they are not stabilised appropriately.

Vehicle movements, including machinery and support vehicles

Vehicles and machinery used during construction could result in compaction or erosion of surface soils, and/or transport excess material onto sealed roads. These impacts would be minimised by the implementation of the mitigation measures described in section 14.4.

Contamination

As described in section 14.2.2, potentially contaminating land uses are present along and in the vicinity of the proposal site. If land associated with these land uses is disturbed, there is the potential for off-site contamination. Exposure or disturbance of contaminants may have the following potential for impacts:

- direct contact and/or inhalation by site workers, users and visitors
- impacts to surrounding environmental receivers (including surrounding ecosystems and flora and fauna, where present)
- mobilisation and migration of surface and subsurface contaminants via leaching, runoff and/or subsurface flow, impacting nearby soils, surface water, and groundwater.

Based on the results of the targeted site investigations, there is minimal potential for contamination to be encountered during construction. There is the risk of exposure to site workers if the dilapidated building located next to site TP33 needs to be removed. No residences are located within 100 metres of site TP33, therefore the potential for off-site impacts to sensitive receivers is considered to be low.

Unexpected soil contamination could also be encountered, the evidence of which could include:

- unexpected staining or odours
- potential asbestos containing materials
- unexpected underground storage tanks, buried drums or machinery, etc.

There is also potential for chemical and fuel spills during construction as a result of the operation and movement of construction plant and vehicles, which may result in localised contamination of soils and/or groundwater.

These impacts would be managed by implementing the mitigation measures described in section 14.4.

14.3.3 Operation impacts

Contamination

During operation, there is a risk of accidental spillage of petroleum, chemicals or other hazardous materials as a result of leakage or rail accidents. Spills could pollute downstream waterways and groundwater if unmitigated. The potential for contamination is considered to be low, based on the amount of vehicles and equipment which would likely be used during maintenance. This impact would be minimised by implementing existing ARTC procedures to manage spills.

Soil

During operation, erosion of dispersive soils to the north of Peak Hill could result in silting of drainage infrastructure, including culverts. To manage this potential operational impact, dispersive soils would be treated where exposed in cut batters, culvert crossings, and drainage lines during construction. Additional operational impacts from unsuitable soils would be minimised by taking soil types into account during design and construction.

Maintenance and repair activities may require excavation and ground disturbance, which could result in short term impacts similar to those described in section 14.3.2. These impacts would be managed by implementing the mitigation measures described in section 14.4.

14.4 Mitigation and management

14.4.1 Approach to mitigation and management

Soil

Site-specific analysis would be undertaken during detailed design as an input to the design of the proposal and appropriate treatment measures (as required). Design documents would specify construction procedures to identify and address ‘unsuitable’ subgrade soils.

Prior to construction, a soil and water management sub-plan would be prepared as part of the CEMP in accordance with relevant guidelines, including *Managing Urban Stormwater Volume 1* (Landcom, 2004) and *Volume 2C* (DECC, 2008).

Auditing and monitoring would be undertaken during construction to ensure that the CEMP and relevant sub-plans are being implemented.

Contamination

A contamination and hazardous materials sub-plan would be developed as part of the CEMP to detail how potential and actual contaminated soils and materials would be managed to minimise the potential for on and off-site impacts. An unexpected finds protocol would be developed as part of the sub-plan to ensure that any unexpected contamination encountered during construction does not expose workers, site users, and/or the environment to contamination in excess of regulatory guideline levels.

The unexpected finds protocol would outline the activities to be undertaken in the event that previously undetected contamination is identified, which would include making the site safe, carrying out an assessment of the finds, and managing the finds based on the results of the assessment.

A waste management plan would also be developed as part of the CEMP, as described in chapter 24. The waste management plan would include an asbestos management component to ensure waste materials which contain asbestos are appropriately managed.

The health and safety plan (described in section 25.4) would also include measures to help minimise the exposure of workers to potentially contaminated soil, including material containing asbestos.

Further information on the approach to environmental management during construction is provided in chapter 26.

14.4.2 Consideration of the interactions between mitigation measures

Mitigation measures to control impacts associated with soil and contamination may overlap with measures proposed for the control of air quality, health and safety, and waste management impacts. All mitigation measures for the proposal would be consolidated and described in the CEMP. The plan would identify measures that are common between different aspects. Common impacts and common mitigation measures would be consolidated to ensure consistency and implementation.

14.4.3 Summary of mitigation measures

To mitigate the potential for soil and contamination impacts, the following measures would be implemented.

Table 14.2 Summary of mitigation measures

Stage	Impact	Mitigation measures
Detailed design	Structural integrity	Foundation and batter design would include engineering measures to minimise operational risks from shrink swell, dispersive, and/or low strength soils.
	Dilapidated building near site TP33	The presence of asbestos in this building would be confirmed through a hazardous material survey, and any removal required would be undertaken in accordance with *How to Safely Remove Asbestos Code of Practice* (Safe Work Australia, 2016).
Pre-construction/ construction	General soil and erosion management	A soil and water management sub-plan would be prepared as part of the CEMP. It would include a detailed list of measures that would be implemented during construction to minimise the potential for soil and contamination impacts, including: ▸ allocation of general site practices and responsibilities ▸ material management practices ▸ stockpiling and topsoil management, including prompt stabilisation of spoil mounds and treatment of dispersive soils in mounds (for example, through mixing of gypsum) ▸ surface water and erosion control practices that take into account site-specific soil types (for example, dispersive soils).
	Contamination	A contamination and hazardous materials sub-plan would be prepared and implemented as part of the CEMP. It would include: ▸ measures to minimise the potential for contamination impacts on the local community and environment ▸ procedures for incident management and managing unexpected contamination finds (an unexpected finds protocol).

Stage	Impact	Mitigation measures
Operation	Soil erosion and sedimentation	During any maintenance work where soils are exposed, sediment and erosion control devices would be installed in accordance with *Managing Urban Stormwater: Soils and Construction* (Landcom, 2004).
	Contamination	ARTC's existing spill response procedures would be reviewed to determine applicability and suitability during operation. The adopted procedure would include measures to minimise the potential for impacts on the local community and the environment as a result of any leaks and spills.