8 Noise and vibration

This chapter summarises the noise and vibration impact assessment prepared by EMM which is provided in full in Appendix E. The assessment was prepared with reference to the noise and vibration assessment of the GGP prepared by Atkins Acoustics and Associates Pty Limited (Atkins) as part of the AECOM (2009a) EA.

8.1 Existing environment

8.1.1 Potentially affected receptors

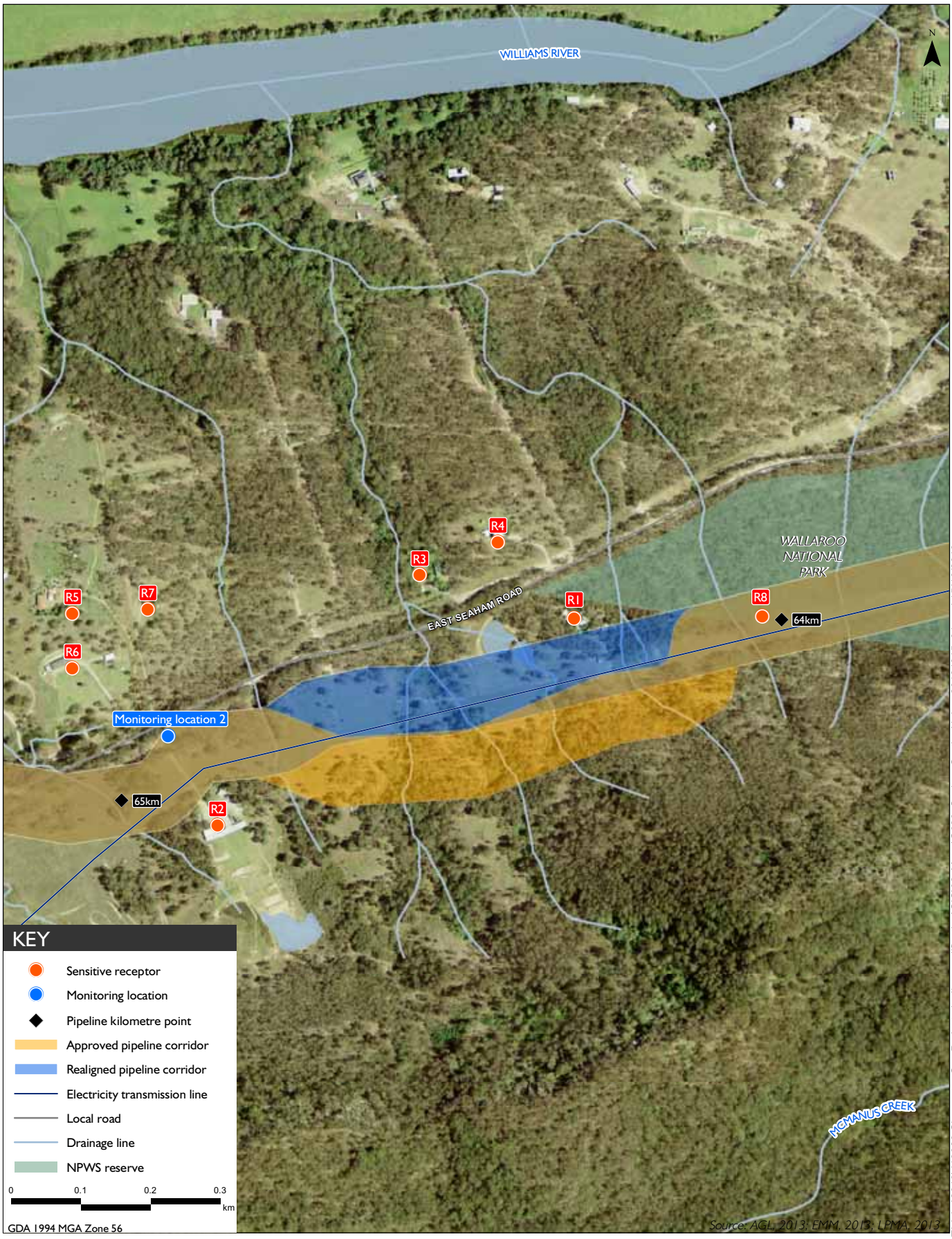
Atkins (2009) identified that sensitive receptors are typically more than 200 m from the approved pipeline corridor, though there are a small number of receptors in the order of 30 to 100 m from its centre-line.

Aerial photographs were analysed to identify the closest sensitive receptors to the proposed modified pipeline corridor alignments and TRS. Representative receptors selected for assessment are identified on Figures 8.1 to 8.4 and in Table 8.5. Their approximate distances from the proposed pipeline corridor's centre-line are provided in Table 8.5. It is noted that all identified dwellings were conservatively assumed to be a potentially affected receptor and assessed, irrespective of whether or not they are occupied.

Potentially sensitive receptors were identified to mostly be residences more than 200 m from the corridor, though some dwellings were identified between 45 and 200 m from the corridor's centre-line. This is consistent with the range of offset distances identified and assessed by Atkins (2009). Other receptors selected for assessment were a gun club (R2) and Wallaroo National Park (R8) near the Seaham section and the Oakfield Ranch (R36), Hunter Region Botanic Gardens (R40), Tomago Village Caravan Park (R41) and Historic Tomago House (R42) between 245 m and 2.6 km from the Tomago section.

The proposed realignments within the Seaham, Brandy Hill and Millers Forest sections and western part of the Tomago section are relatively minor and sensitive receptors are the same for the approved and proposed modified pipeline corridor alignments. Potentially sensitive receptors near the eastern end of the pipeline corridor and TRS, at Tomago, are different to those for the approved pipeline corridor and HDS at Hexham. The proposed modification would result in the pipeline being slightly closer to some of these receptors and further from others, as follows:

- Seaham section: up to 100 m closer to some receptors along East Seaham Road;
- Brandy Hill section: up to around 60 m closer to a receptor at its northern end, and up to 335 m further from receptors to the east, in Brandy Hill;
- Millers Forest section: around 50 m closer to receptors east of the alignment and around 50 m further from receptors to the west; and
- Tomago section: more than 40 m further from receptors in and around Woodberry, around 370 m further from Oakfield Ranch, approximately 1.7 km further from Tomago Village Caravan Park and closer to the Hunter Region Botanic Gardens. The proposed activities at Tomago will generally be further from sensitive receptors than was the case for the previously assessed and approved activities at Hexham.

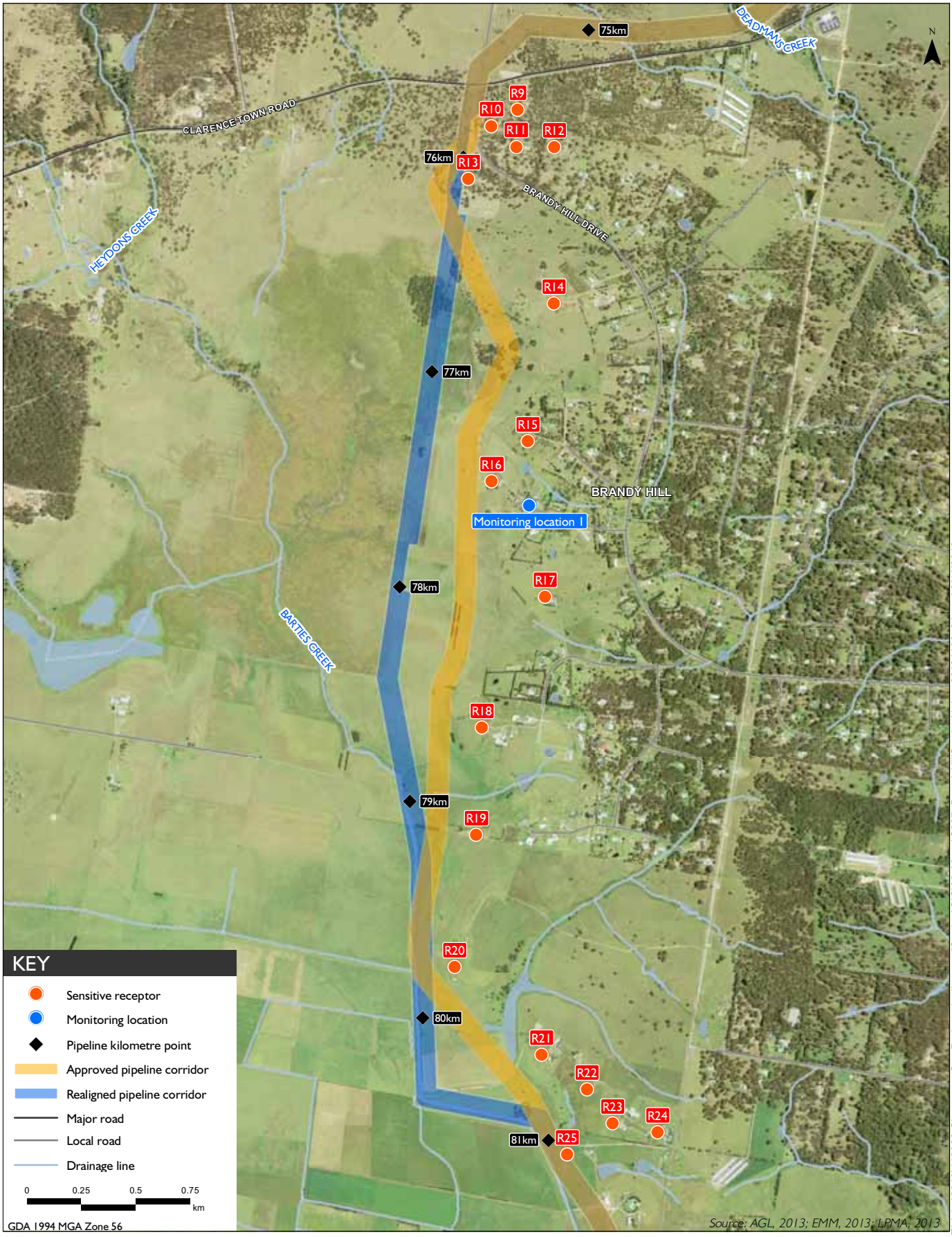


EMM

Seaham section - short term monitoring locations and sensitive receptors

Minor pipeline corridor realignments EA

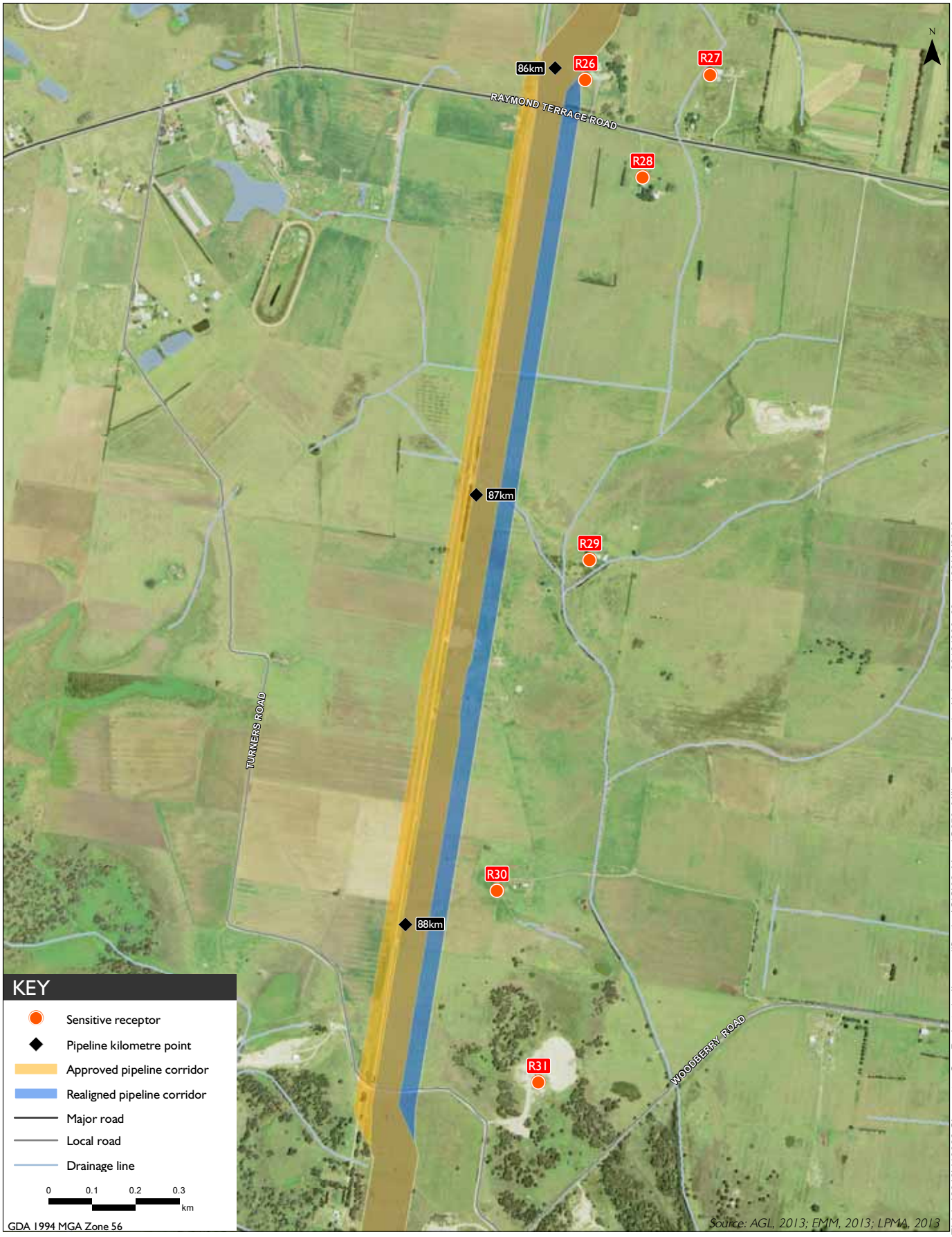
Figure 8.1



Brandy Hill section - short term monitoring locations and sensitive receptors

Minor pipeline corridor realignments EA

Figure 8.2

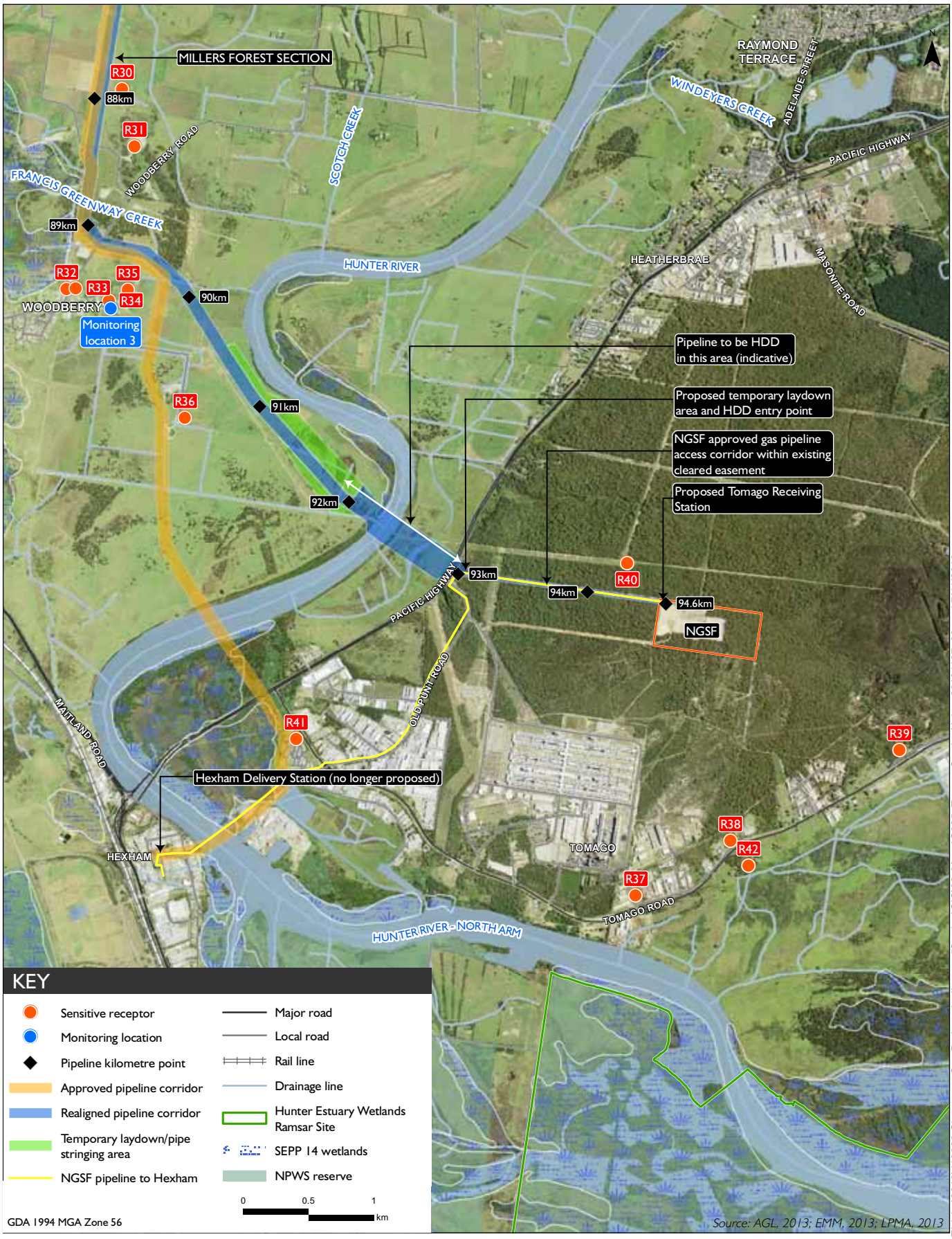


EMM

Millers Forest section - sensitive receptors

Minor pipeline corridor realignments EA

Figure 8.3



Tomago section - short term monitoring locations and sensitive receptors

Minor pipeline corridor realignments EA

Figure 8.4

8.1.2 Ambient noise environment

The noise assessment conducted as part of the AECOM (2009a) EA characterised the ambient noise environment. It identified several influences on the acoustic environment along the approved pipeline corridor alignment, ranging from mining and industrial noises sources to rural and conservation areas dominated by rural and natural sounds with limited traffic influences. Atkins (2009) undertook attended and unattended noise monitoring to characterise background noise in the vicinity of the HDS, however monitoring was not undertaken for the pipeline corridor. In the absence of monitoring data, the 2009 study conservatively assumed a rating background level (RBL) along the pipeline corridor of 30 dBA, consistent with the minimum recommendation in the EPA (2000) *NSW Industrial Noise Policy* (INP).

The proposed TRS, at Tomago, is around 4.3 km north-east of the formerly-proposed HDS at Hexham, and has a different ambient noise environment. Background noise data collected for the HDS's assessment in 2009 is therefore not relevant for the TRS. The ambient noise environment in the vicinity of the proposed TRS was however characterised by Atkins (2011), as part of the noise assessment for the NGSF EA. This included attended and continuous unattended noise monitoring. The RBLs for representative residential receptors in the vicinity of the proposed TRS are provided in Table 8.7. These have been used to determine the TRS assessment criteria.

The Atkins (2009, 2011) data on background and noise amenity levels has been supplemented by additional data collected as part of this EA. Short-term attended noise measurements were undertaken at the three locations shown on Figures 8.1, 8.2 and 8.4 on 4 October 2013, to characterise background noise levels in the vicinity of the Seaham, Brandy Hill, Millers Forest and Tomago sections. Monitoring details are provided in Appendix E and the results are summarised in Table 8.1. The RBLs used to determine assessment criteria for each of the residential receptors assessed were determined based on these measurements, in accordance with methods in the EPA (2000) INP.

Field observations were that the existing noise environment in the vicinity of the Seaham and Brandy Hill sections is dominated by rural and natural sounds such as wind and animal noises, with minimal traffic contribution. This is also the case for some parts of the Millers Forest and potentially Tomago sections. The noise environment in the vicinity of other parts of the Millers Forest and Tomago sections is influenced by urban and industrial noise sources, including road, rail and air traffic.

Table 8.1 Short term 15-minute attended background noise measurements, 4 October 2013

Location	Start time	Total measured noise levels, dB(A)		Comments
		L_{90}	L_{eq}	
M2 - 668 East Seaham Road[1] (representative of Seaham section)	8:36	39	56	Minimal traffic. Car passbys, rural and animal noises audible. Increasing winds.
M1 – Werai Close (representative of Brandy Hill section)	7:43	38	48	Nature, dogs, birds and distant traffic noise audible.
M3 - 33 Nilands Avenue (representative of Millers Forest and Tomago sections)	9:19	41	57	Background traffic, car passbys and suburban hum audible. Plane flyovers and train passbys. Increasing winds.

Notes: 1. Data collected after 10 minutes was affected by winds and so was excluded.

8.2 Impact assessment

8.2.1 Construction

i Construction noise

a. Assessment approach and criteria

The 2009 study qualitatively assessed potential noise impacts associated with construction of the approved pipeline and HDS. It predicted noise levels from representative construction activities at a range of offset distances, though the focus was on the proposed noise management strategies (which will also be applied to the proposed modified sections of pipeline and TRS). This EA includes a qualitative assessment, using the same methods as the 2009 study, however also quantitatively assesses predicted construction noise levels at representative receptors, in accordance with the EPA's *Interim Construction Noise Guideline* (ICNG) (DECC 2009).

Criteria for the construction noise assessment were determined in accordance with the ICNG, for both standard and out of hours (OOH) construction work where noise from these activities is audible at residences. The criteria are provided in Table 8.2 and are the intrusive $L_{Aeq(15minute)}$ criteria. For residential receptors these are the RBL plus 10 dBA within standard hours and RBL plus 5 dBA for OOH work. Standard hours are Monday to Friday 7.00 am to 6.00 pm, Saturday 8.00 am to 1.00 pm and no work on Sundays or public holidays (DECC 2009). Construction work outside of these times is considered 'OOH work'. Consideration was also given to the ICNG criteria of 75 dB(A) for 'highly noise affected' receptors. The criteria for receptors R2, R8, R36, R40 and R42 are the ICNG-prescribed noise management levels for active and passive recreation areas (65 and 60 dB(A) respectively) as appropriate, and only apply when the areas are in use.

Table 8.2 Construction noise criteria – standard and out of hours

Receptor		RBL, dB(A) (day)	Criteria, Leq(15-min)	
			Standard hours[1]	OOH[1]
Residential receptors - Seaham (R1, R3-R7)		39	49	44
Residential receptors – Brandy Hill (R9-R25)		38	48	43
Residential receptors – Millers Forest section (R26-R31)		41	51	46
Residential receptors – Tomago:	R32-R35	41	51	46
	R37, R38	46	56	51
	R39	42	52	47
	R41	50	60	55
Active recreation receptors (R2, R36)		N/A	65 (when in use)	65 (when in use)
Passive recreation receptors (R8, R40, R42)		N/A	60 (when in use)	60 (when in use)

Notes: 1. Standard hours are Monday to Friday 7 am to 6 pm; Saturday 8 am to 1 pm; and no construction work on Sundays or public holidays (DECC 2009). The criteria for OOH work apply to all works outside of standard hours.

b. Results

Potential noise generating activities associated with construction of the realigned sections of pipeline and TRS are generally consistent with those identified and assessed by Atkins (2009) for the approved pipeline and HDS respectively. In the case of pipeline construction these include preparing access tracks, vegetation clearing, earthworks and pipe laying. For the TRS these include site preparation and civil and general construction works.

A list of anticipated construction plant and equipment to be used, and their sound power levels, is provided in Appendix E. Depending on the activity being undertaken at any point in time this could include graders, water carts, timber shredder, chainsaws, trenching machine, excavator, rock saw, side booms, passing machine, trucks, generator, roller, concrete truck and/or a crane. While these activities and equipment are the same as those approved, this assessment examines the potential for any change to impacts associated with the proposed minor changes to the location of construction activities.

Predicted indicative noise levels from representative construction activities at a range of offset distances are provided in Tables 8.3 and 8.4 for the pipeline and TRS respectively. These are the same results as those in the Atkins (2009) report for the approved pipeline and HDS respectively. They do not consider attenuation from topography or ground absorption and assume that all equipment identified in Appendix E will be operational at one time. The results are therefore considered to be conservative. Pipeline construction works will be transient, with the duration of works (and associated noise exposure) for most locations along the pipeline corridor expected to be less than three weeks.

Table 8.3 Predicted pipeline construction noise levels $L_{eq(15\text{-}min)}$, dB(A)

Activity	Distance from construction activity						
	25 m	100 m	250 m	500 m	1,000 m	2,000 m	3,000 m
Access track construction	72	60	52	46	40	34	30
Vegetation clearing	83	71	63	57	51	45	41
Earthworks	76	64	56	50	44	38	34
Pipe installation	77	65	57	51	45	39	35

Table 8.4 Predicted TRS construction noise levels $L_{eq(15\text{-}min)}$, dBA

Activity	Distance from construction activity			
	100 m	250 m	500 m	1000 m
Site preparation/clean up	65	57	51	45
Civil and construction	69	61	55	49

Atkins (2009) did not undertake background noise monitoring to establish RBLs (and site-specific construction noise goals) along the pipeline corridor. However, in the absence of this data the background RBL was assumed to be 30 dBA, and so a target noise goal of 40 dBA at residential receptors during standard hours. Based on background monitoring for this EA, the criteria for residential receptors along the modified pipeline corridor alignment was determined to be generally between 48 and 51 dBA during standard hours and 43 to 46 dBA for OOH works, though higher at some locations near the Tomago industrial area. Using this information in conjunction with the results in Tables 8.3 and 8.4 indicates that, as identified in the 2009 assessment, construction noise levels are likely to generally satisfy the relevant criteria at receptors within approximately 500 m and 1,000 m of construction activities. Exceedances are predicted at closer receptors however these impacts would be temporary and generally short-term. Proposed management and monitoring measures are discussed in Section 8.3.

Predictions of construction noise levels have been made at representative sensitive receptors near the Seaham, Brandy Hill, Millers Forest and Tomago sections, considering the same representative construction activities listed in Tables 8.3 and 8.4. To enable quantitative assessment of potential impacts the results have been compared against the criteria established specifically for these receptors (refer Section 8.2.1(i)a). The results are provided in full in Appendix E and summarised in Table 8.5 for the anticipated highest noise generating activity. That is, vegetation clearing for pipeline construction and civil and general construction works for the TRS.

The predicted noise levels are generally within the range predicted in the 2009 assessment and indicate that the noisiest phases of construction would result in criteria exceedances at the nearest sensitive receptors. These receptors are the same as those that would have been affected by the approved route and the realigned route is further from most of them which would effectively reduce potential noise impacts. For receptors within around 50 m of construction activities this may include exceedances of the ICNG highly noise affected criteria of 75 dB(A).

As expected, the highest predicted noise levels are at the closest sensitive receptor to proposed works, being at the edge of the Wallaroo National Park, directly adjacent to construction activities. There are no park facilities at this location and it is unlikely to be in regular use (the criteria for the park only apply when it is in use). Further, the approved corridor passes through this national park.

Noise impacts would however be temporary, during construction of the pipeline, its ancillary facilities, and the TRS, and can be appropriately managed by the existing Project approval conditions for noise impacts. Construction time (and associated noise exposure) for most locations along the pipeline corridor is expected to be less than three weeks.

Table 8.5 Predicted construction noise levels $L_{eq(15\text{-}min)}$, dB(A)

Receptor	Distance from corridor centre (m) [1]	RBL (day)	Construction noise goal		Predicted construction noise	
			Standard hours[2]	OOH[2]	Pipeline – veg. clearing	TRS – civil & construction
Seaham section						
R1. 730 East Seaham Road[3]	45	39	49	44	78	-
R2. 668 East Seaham Road	115	n/a	65	65	70	-
R3. 717 East Seaham Road	185	39	49	44	62	-
R4. 735 East Seaham Road	205	39	49	44	61	-
R5. 667 East Seaham Road	335	39	49	44	60	-
R6. Lot 2 667 East Seaham Road	295	39	49	44	62	-
R7. 671 East Seaham Road	250	39	49	44	63	-
R8. Wallaroo National Park	-[4]	n/a	60	60	111	-
Brandy Hill section						
R9. 994 Clarence Town Road	285	38	48	43	62	-
R10. 104 Brandy Hill Drive	140	38	48	43	68	-
R11. 102 Brandy Hill Drive	235	38	48	43	64	-
R12. 100 Brandy Hill Drive	405	38	48	43	59	-
R13. 115 Brandy Hill Drive	50	38	48	43	77	-
R14. 83 Brandy Hill Drive	515	38	48	43	57	-
R15. 19 Neika Close	500	38	48	43	57	-
R16. 22 Werai Close	355	38	48	43	60	-
R17. 12 Warrigal Close	690	38	48	43	54	-
R18. 153 Warrigal Close	400	38	48	43	59	-
R19. 2C McClymonts Swamp Rd	280	38	48	43	62	-
R20. Lot 152 Unnamed Road	150	38	48	43	67	-
R21. Lot 2 Ralstones Road	545	38	48	43	56	-
R22. 6 Ralstones Road (under construction)	260	38	48	43	63	-
R23. 42 Ralstones Road	345	38	48	43	60	-
R24. 38 Ralstones Road	540	38	48	43	56	-
R25. Ralstones Road	190	38	48	43	65	-
Millers Forest section						
R26. 947 Raymond Terrace Road	45	41	51	46	78	-
R27. 969 Raymond Terrace Road	310	41	51	46	61	-
R28. Lot 111A Raymond Terrace Road	215	41	51	46	64	-
R29. 576 Unnamed Road	230	41	51	46	64	-
R30. 244 Woodberry Road	145	41	51	46	68	-
R31. 265 Woodberry Road	310	41	51	46	61	-

Table 8.5 Predicted construction noise levels $L_{eq(15\text{-}min)}$, dB(A)

Receptor	Distance from corridor centre (m) [1]	RBL (day)	Construction noise goal		Predicted construction noise	
			Standard hours[2]	OOH[2]	Pipeline – veg. clearing	TRS – civil & construction
Tomago section						
R32. 410 Woodberry Road	425	41	51	46	58	-
R33. 407 Woodberry Road	375	41	51	46	60	-
R34. 33 Nilands Lane	400	41	51	46	59	-
R35. 39-41 Nilands Lane	300	41	51	46	61	-
R36. 135 Oakfield Road - Oakfield Ranch	510	n/a	65	65	57	-
R37. 9 School Drive	2,000	46	56	51	-	43
R38. 45 School Drive	1,700	46	56	51	-	44
R39. 5 Graham Drive	2,125	42	52	47	-	42
R40. Hunter Region Botanic Gardens	245	n/a	60	60	57[5]	61
R41. Tomago Village Caravan Park	2,600	50	60	55	-	41
R42. Historic Tomago House	1,930	n/a	60	60	-	43

Notes: *1. ROW may not necessarily coincide with the corridor's centre-line.*

2. Standard hours are Monday to Friday 7 am to 6 pm; Saturday 8 am to 1 pm; and no construction work on Sundays or public holidays (DECC 2009). The criteria for OOH work apply to all works outside of standard hours.

3. AGL-owned.

4. Located immediately adjacent to the pipeline corridor. Therefore an indicative distance of 1 m was used for calculations.

5. This is the predicted noise level during pipeline installation as pipeline construction near the Hunter Region Botanic Gardens will be within an existing cleared easement and will not require vegetation clearing.

ii Road noise

The proposed modification is not expected to result in any material change to traffic generation during construction and so would not change the road traffic noise predictions from those in the 2009 EA. Roads to be used by vehicles accessing the proposed modified sections of pipeline corridor and TRS will be generally consistent with those to be used for the approved GGP.

While the 2009 road traffic noise assessment used the EPA (1999) *Environmental Criteria for Road Traffic Noise* (ECRTN) which has been superseded by the *NSW Road Noise Policy* (RNP) (DECCW 2011), the relevant criteria used by Atkins (2009) are unchanged.

Accordingly there is no change to the road traffic noise assessment results from those reported by Atkins (2009) as a result of the proposed modification or the updated assessment policy. In summary, these results were that traffic generated during GGP construction would be minimal compared to background road traffic volumes and the relevant criteria would be satisfied.

iii Vibration

Atkins (2009) identified that the main source of ground vibration would be use of rock hammers. The proposed modification does not involve any change to vibratory activities and so the 2009 vibration assessment results are unchanged by the proposed modification. In summary Atkins (2009) predicted that rock hammer use would satisfy the relevant criteria for structural damage at distances of around 20 m, with ground vibration levels up to 0.5 mm/s at this distance. For sensitive structures, such as heritage buildings, the stricter criteria of 0.3 mm/sec would be satisfied at 40 m. More detail on the criteria and results is provided in the technical report in Appendix E.

The 2009 EA includes a commitment that there will be no use of rock hammers within 20 m of a residence. This safeguard will also be applied to the proposed modified sections of pipeline.

iv Blasting

The blasting limits adopted by the EPA are provided in the ANZECC (1990) *Technical Basis for Guidelines to Minimise Annoyance due to Blasting Overpressure and Ground Vibration*. These address airblast noise overpressure and ground vibration, the two main acoustic effects of blasting. A summary of blast limits is provided in Table 8.6. These are the same as the criteria in Condition 3.19 of the Project approval.

Table 8.6 Airblast overpressure and ground vibration limits

Airblast overpressure level dB(Lpeak)	**Allowable exceedance**
115	5% of the total number of blasts over 12 months
120	0
Ground vibration	
Peak particle velocity (mm/s)	**Allowable exceedance**
5	5% of the total number of blasts over 12 months
10	0

Source: ANZECC (1990).

The 2009 assessment identified that confined blasting may be required during construction, such as to remove rock outcrops. Blast holes would be drilled and filled with an explosive charge and detonated with the aid of primers and detonators. There is no change to this as a result of the proposed modification and so the Atkins (2009) vibration assessment results are unchanged by the proposed modification.

In summary, Atkins (2009) predicted air blast overpressure and ground vibration for a range of maximum instantaneous charges (MICs) at various offset distances. It was predicted that the ANZECC (1990) air-blast overpressure and ground vibration goals (115 dBLin and 5 mm/sec respectively) can be satisfied with the employment of controlled MIC (1 to 3 kg) at a distance of 200 m. The 2009 EA includes a commitment that there will be no blasting within 200 m of a residence. This safeguard will also be applied to the proposed modified sections of pipeline.

8.2.2 Operations

i Operational noise – pipeline

Consistent with the findings of Atkins (2009), no significant noise sources were identified in association with the proposed pipeline operation, other than emergency venting at the MLV facility. As discussed in Section 2.4.8, periodic venting may be required in the event of an emergency necessitating depressurising of the pipeline. Venting would generate noise however this is expected to be infrequent, temporary and short-term. Specific noise limits would not apply to this activity.

ii Operational noise – TRS

a. Criteria

Atkins (2009) provided a preliminary operational noise assessment for the HDS, including establishing criteria for sensitive receptors surrounding this facility. Given the revised location for the end of pipeline facilities, now proposed to be at the TRS at Tomago, revised criteria are required for this facility, accounting for background noise levels and land use in the surrounding area.

The criteria used for the operational noise assessment have been determined in accordance with the EPA (2000) INP. Intrusive $L_{Aeq(15minute)}$ and amenity $L_{Aeq(period)}$ criteria were determined for each assessment period (day, evening and night). The INP requires that both the intrusive and amenity criteria are satisfied. The more limiting of the two becomes the project specific noise level (PSNL) or operational criteria.

The intrusive criteria, which are applicable to residential receptors, are presented in Table 8.7. These criteria are the existing RBL plus 5 dBA and apply to noise from the TRS alone. The amenity criteria are provided in Table 8.8 and are the INP recommended 'acceptable' amenity $L_{Aeq(period)}$ noise levels for given land uses, for example urban residential or passive recreation. These criteria apply to all industrial noise at a particular locality and so have been used in the cumulative noise assessment in Section 8.2.2(ii)c.

Table 8.7 Operational criteria – TRS

Receptor type	Period	RBL, dB(A)[1]	Intrusive criteria dB(A), $L_{eq,15\text{-}min}$ (PSNL)
Residential (R37, R38)	Day (7.00 am to 6.00 pm)	46	51
	Evening (6.00 pm to 10.00 pm)	44	49
	Night (10.00 pm to 7.00 am)	44	49
Residential (R39)	Day (7.00 am to 6.00 pm)	42	47
	Evening (6.00 pm to 10.00 pm)	39	44
	Night (10.00 pm to 7.00 am)	37	42
Residential (R41)	Day (7.00 am to 6.00 pm)	50	55
	Evening (6.00 pm to 10.00 pm)	48	53
	Night (10.00 pm to 7.00 am)	46	51

Notes: 1. Daytime RBL source: Atkins (2011).

Table 8.8 Recommended acceptable and maximum amenity criteria – cumulative noise

Receptor type	Period	Recommended $L_{eq\ (period)}$ noise level	
		Acceptable	Maximum
Passive recreation (R40, R42)	When in use	50	55
Residential (R37-39 and R41)	Day	60	65
	Evening	50	55
	Night	45	50

In addition to the intrusive and amenity noise assessments, the potential for sleep disturbance was assessed. The sleep disturbance criteria are the night-time RBLs plus 15 dBA for the $L_{A1(1minute)}$ noise level, as per the INP.

b. Assessable meteorological conditions

Noise modelling was undertaken for calm conditions (no wind or temperature gradient) and for prevailing meteorological conditions. Under various wind and/or temperature gradient conditions, noise levels may increase or decrease at a particular location compared to those experienced during calm conditions. For example, noise levels at a receptor can increase when the wind blows from source to receiver and/or under temperature inversion conditions.

Prevailing meteorological conditions that require assessment are the conditions defined in the INP that are a 'feature' of the area. A 'feature' is a condition that occurs at least 30% of the time in an assessment period and season. Based on the INP and the meteorological analysis conducted as part of the 2009 study, the relevant conditions which have been modelled and assessed are as shown in Table 8.9.

Table 8.9 Modelled meteorological conditions – TRS operation

Scenario	Wind speed (m/s)	Wind direction	Temperature (°C)	Inversion
1 – calm	0	N/A	20	N/A
2	2	NE	20	N/A
3	2	N	15	N/A
4	2	WNW	15	N/A
5	0	N/A	15	2°/100m

c. Results

Operating noise from the TRS would be consistent with that for the approved HDS. It would be dependent on design factors including the number of process trains, gas flow pressure and velocities, valve types, pipe sizes and the location of bends and valves, details of which will be confirmed during its detailed design. A list of anticipated operating plant and equipment at the TRS, and their sound power levels under high and low flow rates, is provided in Appendix E. As the TRS design is yet to be finalised, detailed noise controls have not yet been determined and so the emission levels were conservatively modelled for a hypothetical unmitigated scenario. The noise controls will be finalised during its detailed design.

Noise levels from TRS operation were modelled with Brüel and Kjær Predictor Version 8.14 noise modelling software, using the same algorithm as in the 2009 study. Three-dimensional digitised ground contours in the vicinity of the TRS were incorporated. Noise modelling was undertaken for calm conditions and the prevailing meteorological conditions identified in Table 8.9. It conservatively assumed that all equipment would be operational at one time and at full power. The noise predictions associated with high and low flow operation of the TRS are presented in Table 8.10 compared against the criteria discussed in Section 8.2.2(ii)a. The results in the 'INP' columns are for the worst-case assessable noise-enhancing meteorological conditions at that receptor.

It is noted that noise impacts from either option for the odourant facility's location are considered to be comparable for the purpose of this assessment.

Table 8.10 Predicted operational noise levels at receptors – TRS

Receptor	Criteria, dB(A)			Predicted noise levels, $L_{eq(15\text{-}min)}$, dB(A)			
	Day	Evening	Night	High flow rate		Low flow rate	
				Calm	INP[1]	Calm	INP[1]
R37. 9 School Drive	51	49	49	40	45	<30	<30
R38. 45 School Drive	51	49	49	38	46	<30	<30
R39. 5 Graham Drive	47	44	42	32	39	<30	<30
R40. Hunter Region Botanic Gardens	50	50	50	46	46	<30	<30
R41. Tomago Caravan Park	55	53	51	<30	34	<30	<30
R42. Historic Tomago House	50	50	50	35	43	<30	<30

Notes. *1. Predicted noise levels are for the worst-case meteorological conditions at each receptor.*

2. Day is the period from 7 am to 6 pm Monday to Saturday or 8 am to 6 pm on Sundays and public holidays. Evening is the period from 6 pm to 10 pm. Night is the remaining periods.

The results in Table 8.10 indicate that operational noise associated with the TRS will comply with the relevant criteria for all assessed periods and meteorological conditions at all assessed receptors. This is an improvement when compared with the HDS at Hexham, which was closer to sensitive receptors and predicted to result in criteria exceedances.

A cumulative assessment was made considering predicted (unmitigated) noise from the TRS, combined with that from existing industrial noise sources in the area and predicted future operating noise from the approved NGSF. The predictions for the NGSF were sourced from its EA. The assessment was made for the worst-case assessable meteorological conditions at each receptor. That is, source-to-receptor winds and inversion conditions at receptors to the south, being R37, R38, R39 and R42, and source-to-receptor winds for R40 and R41, being the Hunter Region Botanic Gardens and Tomago Village Caravan Park. The results are presented in Table 8.11.

Table 8.11 Cumulative noise assessment at sensitive receptors

Receptor	Criteria, dB(A)[2]			Predicted noise levels, $L_{eq(15\text{-}min)}$, dB(A)					
	Day	Evening	Night	TRS		NGSF[1]	Industry L_{Aeq}[1]	Total cumulative L_{Aeq}	
				High flow	Low flow			High flow	Low flow
R37. 9 School Dr.	60	50	45	45	25	20[3]	43[3]	**47**	43
R38. 45 School Dr.	60	50	45	46	26	20	43	**48**	43
R39. 5 Graham Dr.	60	50	45	39	19	24	38	42	38
R40. Hunter Region Botanic Gardens	50	50	50	46	26	40	N/A	47	40
R41. Caravan Park	60	50	45	34	14	19	43	44	43
R42. Historic Tomago House	50	50	50	43	23	20[3]	43[3]	44	43

Notes: *1. Source: Atkins (2011).*

2. Day is the period from 7 am to 6 pm Monday to Saturday or 8 am to 6 pm on Sundays and public holidays. Evening is the period from 6 pm to 10 pm. Night is the remaining periods.

3. Adopted value from nearby 45 School Drive receptor.

4. Predicted noise levels are for the worst-case meteorological conditions at each receptor.

5. Bold font indicates exceedance of the night criteria.

The results in Table 8.11 indicate that during high flow TRS operating conditions (unmitigated) in the night and concurrent worst-case INP-assessable meteorological conditions (temperature inversion and prevailing source-to-receptor winds), cumulative noise is predicted to exceed the criteria by up to 3 dB(A) at School Drive receptors (R37 and R38). As an indication, a noise level increase of 1 to 2 dBA is not noticeable. There is a relatively low likelihood of concurrent occurrence of all the conditions required for the criteria exceedance. Noise management and mitigation measures are discussed in Section 8.3.

Compliance is predicted for all other assessed conditions, periods and locations, including in all instances during low flow conditions.

Due to the continuous nature of anticipated TRS noise sources, no intermittent noise events that could result in sleep disturbance impacts are anticipated during its operation. Consistent with findings of the 2009 study, it is considered that operational $L_{A1,1min}$ noise levels from the TRS would not be greater than 5 to 10 dB(A) above the operational L_{eq} levels. As sleep disturbance criteria are generally set at 15 dB(A) above operational L_{eq} criteria it is considered that the EPA's sleep disturbance criteria will be satisfied.

iii Road noise

The proposed modification is not expected to result in any material change to GGP traffic generation during operations and so would not change the road traffic noise predictions from those in the AECOM (2009a) EA. Roads to be used by vehicles accessing the proposed modified sections of pipeline corridor and TRS will be generally consistent with those to be used for the approved GGP. The applicable criteria used by Atkins (2009) are unchanged by the updated RNP. Accordingly there is no change to the road traffic noise assessment results from those reported by Atkins (2009) as a result of the proposed modification or the updated assessment policy. In summary, these results were that traffic generated during GGP operations would be minimal compared to background road traffic volumes and the relevant criteria would be satisfied.

iv Vibration and blasting

No vibratory or blasting activities have been identified in association with the proposed modification and therefore no assessment is required.

8.3 Management and monitoring

The noise and vibration assessment results are generally consistent with those in the AECOM (2009a) EA for the approved pipeline and HDS. No additional noise or vibration impacts were identified in association with the proposed construction or operational activities.

Project approval Condition 3.24 requires development of a detailed design noise report in consultation with DECCW (now EPA) to confirm the predicted noise levels associated with the HDS at sensitive receptors. This was partly in response to criteria exceedances predicted during HDS operation. Provided the TRS is generally constructed and operated as described previously, an equivalent measure is not considered necessary for the TRS, which is further from sensitive receptors than the HDS. Operating noise from the TRS is predicted to generally comply with the relevant criteria, even with the highly conservative modelling assumptions applied. Conditions 4.3 and 4.4 of the Project approval include provisions for a monitoring program to confirm the noise emission performance of the GGP and determine any associated requirement for remedial measures, which is considered to be appropriate for the TRS.

The existing approved measures are considered suitable for the proposed modification and no additional management or monitoring measures are required. The only modifications required to the existing Project approval conditions in respect of noise and vibration is removal of measures applicable to the HDS, including operating noise limits, and insertion of limits applicable to the TRS. It is considered that the noise and vibration impacts associated with the proposed modification can be effectively managed by compliance with the existing Project approval conditions, which include:

- prescribed hours for pipeline construction works that would generate audible noise at any sensitive receptor (Condition 3.14) and for blasting (Condition 3.15), with written approval of the Director-General required for any variation to these construction hours. This would be subject to consultation and notification for surrounding receptors, provision of all reasonable and feasible measures identified to minimise noise impact and the other details specified in Condition 3.16;
- implementing all reasonable and feasible measures to minimise noise generation from construction, consistent with requirements of the ICNG (DECC 2009) and including noise generated by heavy vehicle haulage and other construction traffic (Condition 3.17);
- noise monitoring to confirm the noise emission performance of the project (Condition 4.3) with remedial measures implemented if required (Condition 4.4);
- complaints procedure (Conditions 6.2 and 6.3);
- community and stakeholder engagement plan (Condition 6.5);
- a CEMP including measures to monitor and manage noise, vibration and blasting impacts (Condition 7.2(g));
- an OEMP including measures to monitor and manage noise emissions (Condition 7.4(e)iii);

- ensuring that blasting does not exceed the preferred values for vibration outlined in the ANZECC (1990) *Technical basis for guidelines to minimise annoyance due to blasting overpressure and ground vibration* (Condition 3.18);

- ensuring that ground vibration from construction does not exceed the preferred values for vibration outlined in the ANZECC (1990) *Technical basis for guidelines to minimise annoyance due to blasting overpressure and ground vibration* (Condition 3.19), and that prior to each blasting event, relevant local councils and potentially affected landowners are notified (Condition 3.20); and

- ensuring that vibration from the pipeline's construction does not exceed the preferred values for vibration outlined in *Assessing Vibration : A Technical Guideline* (DEC 2006) (Condition 3.21).

Consistent with the findings of Atkins (2009), given that no significant noise sources were identified in association with the proposed operation of the pipeline, other than short-term emergency venting, no mitigation measures are required in respect of its operation.

The Project approval (Condition 1.1) also requires the GGP be carried out in accordance with the AECOM (2009a) EA which includes the following additional requirements that would need to be applied to the modified project:

- no use of rock hammers within 20 m of a residence; and

- no blasting to be undertaken within 200 m of a residence.

8.4 Conclusions

EMM has completed a noise and vibration assessment for the proposed modification. The assessment results are consistent with those in the AECOM (2009a) EA for the approved GGP. No additional noise or vibration impacts were identified in association with the proposed activities. This is as expected given that:

- the proposed construction and operating activities for the modified sections of pipeline and the TRS are generally unchanged from those described in the AECOM (2009a) EA for the approved pipeline and HDS, respectively; and

- sensitive receptor offset distances from the proposed pipeline corridor realignments are generally within the range identified in the AECOM (2009a) EA for the approved pipeline corridor alignment. The proposed TRS at Tomago is further from sensitive receptors than the previously-proposed HDS at Hexham.

Consistent with predictions by Atkins (2009), short-term construction activities within the modified pipeline corridor alignment and at the TRS are predicted to result in criteria exceedances at the closest sensitive receptors. These temporary, short-term impacts can be appropriately managed by the existing approved management measures in the AECOM (2009a) EA and Project approval conditions.

No significant noise sources were identified in association with the proposed pipeline operation, other than short-term emergency venting at the MLV. Venting would generate noise however this would be infrequent, temporary and short-term.

Operating noise from the TRS is predicted to comply with the relevant criteria for all assessed periods and operating conditions at all sensitive receptors. This is an improvement when compared with the HDS at Hexham, which was closer to sensitive receptors and predicted to result in criteria exceedances. When considering cumulative noise from existing industry and the approved NGSF, and conservative unmitigated predictions from the proposed TRS, minor (up to 3 dBA) exceedances of the criteria are predicted at residences on School Drive. These exceedances are limited to worst-case assessable meteorological conditions in the night and high flow operations at the TRS. The existing Project approval conditions include provisions for validation monitoring to confirm noise emission performance and determine any associated requirement for remedial measures. These measures are considered appropriate for the TRS. Operation of the TRS is not anticipated to have any sleep disturbance impacts.

The proposed modification is not expected to result in any material change to traffic generation during construction or operations and so would not change the road traffic noise assessment results or conclusions from those in the AECOM (2009a) EA.

The proposed modification does not involve any change to proposed vibratory or blasting activities and so the 2009 vibration and blasting assessment results are unchanged. Based on these results AGL has committed to no use of rock hammers within 20 m of a residence and no blasting within 200 m of a residence.

In summary, the noise and vibration assessment results are consistent with those in the original AECOM (2009a) EA for the approved GGP. Noise and vibration can be appropriately managed and mitigated through the existing approved measures in the AECOM (2009a) EA and Project approval. The only modifications required to the existing Project approval conditions in respect of noise and vibration is removal of measures applicable to the HDS, including operating noise limits, and insertion of limits applicable to the TRS.