TILENGA PROJECT ESIA - APPENDIX H:
Air Quality

May 2018

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Annex 1

Annex 1: AERMOD Sensitivity Test

A.1 Introduction

The main assessment reported in the Air Quality Chapter uses the dispersion modelling software ADMS 5. This software was selected because of its functionality, which also allows model runs using US Environmental Protection Agency approved AERMOD model, through the ADMS 5 interface. This appendix describes a sensitivity analysis that was undertaken to compare the ADMS 5 model output with the AERMOD output.

A.2 Methodology

The sensitivity analysis focuses on a single scenario (Op2b), and the model inputs between the ADMS model run and the AERMOD model run were identical and as reported in Air Quality Chapter. The AERMOD function in ADMS does not allow for the quantification of averaging periods of less than 1 hour, nor the consideration of the ADMS chemistry module. Therefore the comparison of model output considers pollutants with averaging periods of 1 hour and above and predicted NO_X contributions without chemistry.

A.3 Results

The comparison of results predicted using different dispersion methods is summarised in Table 6-A1. The table shows that for the model parameters selected, the ADMS 5 method of predicting dispersion impacts consistently over-predicted impacts at the worst affected offsite receptor locations compared to the AERMOD method of predicting dispersion impacts.

There is limited published material available on any comparison between the two models, but professional experience suggests that ADMS tends to predict higher concentrations at locations close to modelled sources, but lower concentrations at locations further away from the modelled sources. The worst case offsite impacts reported in the main chapter and Table 6-A1 concern the nearest receptors to the Central Processing Facility.

Table A1-1: Predicted Pollutant Concentration Impacts for Controlled Operational Emissions – Dispersion Model Sensitivity

Meteorological Year	NO_X (Conc. µg/m^3)		PM_{10} (Conc. µg/m^3)		$PM_{2.5}$ (Conc. µg/m^3)		CO (Conc. µg/m^3)		HCs
	Annual mean	Daily Mean	Annual mean	Daily Mean	Annual mean	Daily Mean	8 Hr Mean	Hourly Mean	Daily Mean
Scenario Op2b									
ADMS 5	10.8	472.0	1.3	9.1	1.3	9.1	63.9	157.6	10.0
AERMOD	5.7	265.4	0.6	3.7	0.6	3.7	29.2	88.6	3.0
Comparison (AERMOD / ADMS 5)	53%	56%	47%	40%	47%	40%	46%	56%	30%

Annex 2

Annex 2: Meteorological Data Sensitivity Test

A.4 Introduction

The main assessment reported in the Air Quality Chapter uses a hybrid meteorological dataset, which amalgamates periods of data gathered near to the Project area in 2014 with data for the remaining periods from Entebbe Airport. This sensitivity analysis considers the impact of the proposed development using multiple years of meteorological data.

A.5 Method

The sensitivity analysis focuses on a single scenario (Op2b), and the model inputs between the ADMS model run and the AERMOD model run, other than the meteorological data, were identical and as reported in Air Quality Chapter.

A.6 Results

The comparison of results predicted using different meteorological years is summarised in Table 6-B1. The table shows that impacts at the worst affected location (i.e. maximum offsite impacts) differ to those reported in the main assessment for this scenario. This is likely due to the more localised conditions incorporated in the amalgamated data. This can be seen in Figure 6-5 of the main assessment. The wind rose plot for the amalgamated data does not share the periods in the Entebbe wind roses where, for a good proportion of hours, winds are blown from the north. Instead, during these periods, wind conditions closer to the Project site blow from other direction, notably the south east.

By applying the worst alternative meteorological year for each pollutant, scenario Op2b would have a negligible magnitude of impact for all averaging periods for CO and a low magnitude of impact for annual mean and hourly mean concentrations of NO_2 and annual mean concentrations of PM_{10}. There would be a moderate adverse magnitude of impact for annual mean and daily mean concentrations of $PM_{2.5}$. For annual mean concentration of PM_{10}, ambient concentrations are such the receptor sensitivity is moderate. For daily mean $PM_{2.5}$, ambient concentrations are such the receptor sensitivity is low. The impact significance for both of these pollutants would be moderate-low. For annual mean $PM_{2.5}$, ambient concentrations are such the receptor sensitivity is moderate. The impact significance for this pollutant would therefore be moderate at the worst affected offsite receptor location. However, the impact significance reported here for $PM_{2.5}$ impacts are considered conservative for the following reasons:

- Receptor sensitivity has been determined by the concentrations of $PM_{2.5}$ monitored during the baseline survey. Baseline concentrations for all particulate sizes measured during the survey were elevated, due to the naturally dusty conditions often experienced within the region, rather than due to combustion, industry or urban emissions sources.
- Plant suppliers do not publish emissions data for $PM_{2.5}$. Instead, the emissions data for PM_{10} that is published has been used as a proxy to represent $PM_{2.5}$. In reality, only a proportion of the PM_{10} emissions will be as $PM_{2.5}$, so actual impacts will be less than those reported in Table 6-B1.

In light of the assumptions above, the moderate-low and moderate impacts reported in Table 6-B1 would be considered to represent a low impact significance, which is insignificant.

Table A2-1: Predicted Pollutant Concentrations for Controlled Operational Emissions – Meteorological Sensitivity

Meteorological Year	*NO_2 (Conc. µg/m³)*		*PM_{10} (Conc. µg/m³)*		*$PM_{2.5}$ (Conc. µg/m³)*		*CO (Conc. µg/m³)*			
	Annual mean	*Daily Mean*	*Annual mean*	*Daily Mean*	*Annual mean*	*Daily Mean*	*8 Hr Mean*	*Hourly Mean*	*30 Min Mean*	*15 Min Mean*
Scenario Op2b (Comparison (Entebbe data / amalgamated data) given as a %)										
2014 Amalgamated dataset	5.1	26.1	1.3	9.1	1.3	9.1	63.9	157.6	161.1	162.9
2012 Entebbe	7.23 1.4%	39 1.5%	2 1.5%	8.7 1.0%	2 1.5%	8.7 1.0%	58.5 0.9%	175.6 1.1%	188.2 1.2%	195.5 1.2%
2013 Entebbe	8.24 1.6%	43.11 1.7%	2.5 1.9%	11.6 1.3%	2.5 1.9%	11.6 1.3%	90.1 1.4%	162 1.0%	164.9 1.0%	166.5 1.0%
2014 Entebbe	8.46 1.7%	33.14 1.3%	2.3 1.8%	11.3 1.2%	2.3 1.8%	11.3 1.2%	64.2 1.0%	157.6 1.0%	161.1 1.0%	162.9 1.0%
2015 Entebbe	8.85 1.7%	39.23 1.5%	2.6 2.0%	11.1 1.2%	2.6 2.0%	11.1 1.2%	66.9 1.0%	149.8 1.0%	153.1 1.0%	154.8 1.0%
2016 Entebbe	9.56 1.9%	32.84 1.3%	2.7 2.1%	10.1 1.1%	2.7 2.1%	10.1 1.1%	69.2 1.1%	129.6 0.8%	130.9 0.8%	131.6 0.8%

Annex 3

Annex 3 Baseline Data Collection

A.7 Baseline Monitoring

The baseline air quality environment, at locations within and around the Study Area, was quantified using a variety of techniques. The field measurements being undertaken comprised:

- Long term passive monitoring of monthly and representative annual average concentrations of NO_X, NO_2, SO_2, O_3 and VOCs (Benzene), using Palmes diffusion tube devices;
- Short term passive monitoring of 24 hour average concentrations of NO_2, SO_2, and H_2S, using Radiello diffusion tube devices; and
- Short term (15 minute and 1 hour averages) monitoring of particulate matter <10 micrometers (PM_{10}) and <2.5 micrometers ($PM_{2.5}$) and Total Suspended Particulate (TSP) using a portable handheld light scattering device.

The Palmes diffusion tubes (vertically held plastic tubes illustrated in Figure 1)were setup and then left in situ to monitor monthly mean concentrations of NO_X, NO_2, SO_2, O_3 and VOCs (Benzene).

The Radiello samplers (horizontally held absorbant tubes illustrated in Figure 1) were setup to measure short-term concentrations of NO_2, SO_2 and H_2S (24 hour mean).

Figure 1. Palmes Diffusion tube and Radiello samplers monitoring ambient air quality at AQ3.

A non-passive method was used to monitor short-term concentrations of particulate matter (1 hour mean and 15 minute mean), as TSP, PM_{10} and $PM_{2.5}$, using an electronic light-scattering device as shown in Figure 2 (Turnkey DustMate). The calibration certificate for this device is presented in Figure 3.

Figure 2. DustMate monitoring ambient air quality at AQ3A

Figure 3. DustMate Calibration Certificate for the period 05/10/2016 – 05/10/2017

Dust Monitor Service/Calibration Certificate

Instrument Details		Calibration No: 10947	
Customer: AECOM			
Instrument: DustMate	*Serial Number:* DM12198		*Software Version:* D3.04
Date of Last Service: N/A		*Date Supplied New:* 05/10/2016	

Calibration Factors prior to Servicing			
Measured Flow Rate: N/A *cc/min*		*Total pump useage:* N/A *hours*	
TSP: 1.0	*PM10:* 1.0	*PM2.5:* 1.0	*PM1.0:* 1.0
Inhalable: /	*Thoracic:* /	*Respirable:* /	*PM2.0:* /

Fault Report:

New Instrument.

Work Carried Out:

Calibration.

Charge battery ☑. *Change reference filter* ☑.

Photometer Scale 2125	*Laser current* 26 mA	*Flow rate* 600 cc/min	*Stray light* 0 *mV*
Wind inputs OK ☒	*External inputs OK* ☒	*Inlet Heater OK* ☒	*Alarm output OK* ☑
Clean-Air filter OK ☑	*Backup-Filter OK* ☑	*PC-Link OK* ☑	*Telemetry OK* ☒

Parts Required:

None.

Instrument Calibration against Reference Instrument

reading is with new calibration factor applied

Fraction	*Zero*	*Reading*	*Reference*	*New Cal. Factor*
TSP	0.0 *μg/m^3*	300.1 *μg/m^3*	309.2 *μg/m^3*	1
PM10	0.0 *μg/m^3*	296.4 *μg/m^3*	301.8 *μg/m^3*	1
PM2.5	0.00 *μg/m^3*	270.99 *μg/m^3*	252.55 *μg/m^3*	1
PM1.0	0.00 *μg/m^3*	54.48 *μg/m^3*	58.66 *μg/m^3*	1
Reference Instrument: TNO2126		*Date Reference Calibrated:* 10/06/16		

Signed: Terry Sandbach	*Date:* 05/10/2016	*Temperature:* 21.7 °C

Calibration Due: 05/10/2017

QF031
Issue 02
Jan 2010

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TILENGA PROJECT ESIA - APPENDIX I:
Noise and Vibration

May 2018

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Appendix I1: Secondary Noise Survey Data

Appendix I1. Secondary Noise Survey Data Summaries

Table I1-1: Secondary Data: Summary of available noise measurements performed by other consultants north of the Victoria Nile

Source of information (TEP Uganda)	Sampling locations north of the Victoria Nile	Measured noise levels dB(A) (B)								Noise sources	Site Description	Summary of the available results
		L_{AMax}	L_{Aeq}	L_{A90}	L_{A50}	L_{10}	Average dB(A) (A)	Max	Min			
DE/ENV/2013/2/053 Proposed Victoria Nile 3D Seismic Coverage, April 2013	Along the Victoria Nile river. Surveys conducted in February 2013.	- (B)	37.9	34.5	36.3	40	-	-	-	Birds, hippos, aircraft (distant)	Bush camping site near Delta point, about 20m from water's edge.	Overall, noise levels observed during the study were typical of noise expected in a rural and wilderness setting. L_{eq} at all locations north of the Nile was within the permissible limits. Both natural (fauna) and anthropogenic sources contributed to baseline; although noise levels were generally higher where human presence/activity is significantly higher.
		-	43.2	37.2	38.8	-	-	-	-	Birds, hippos and frogs	Fringing wetland off Buligi Track.	
		-	43.7	36.5	41.1	-	-	-	-	Birds, hippos, frogs, bushbuck, boats (n. 3) and vehicles.	At 5m from water's edge near Paraa ferry crossing.	
		-	-	-	-	-	71.3	-	-	Pick-up transit.	Packwach Highway	
		-	-	-	-	-	66.1	-	-	Mini bus transit.	Packwach Highway	
		-	-	-	-	-	76.7	-	-	Two pick-ups transit.	Packwach Highway	
		-	-	-	-	-	73	-	-	Fuso truck transit.	Packwach Highway	
		-	-	-	-	-	57.5	-	-	Two pick-ups transit.	Packwach Highway	
DE/ENV/2012/R/048 Proposed Appraisal Drilling: Jobi East Field, January 2013	Sampling locations based on proximity to sensitive receptors as well as the location of the proposed drill pads. Surveys conducted in December 2012.	-	-	-	-	-	57.45	-	-	-	Around Jobi East-7 (F) site.	In general the baseline noise levels recorded exceeded the permissible noise levels for environmental and recreational areas whose permissible level is set at 45dB (A) during the
		-	-	-	-	-	57.55	-	-	-		
		-	-	-	-	-	57.65	-	-	-		
		-	-	-	-	-	57.8	-	-	-		
		-	-	-	-	-	57.75	-	-	-		
		-	-	-	-	-	57.8	-	-	-		

Source of information (TEP Uganda)	Sampling locations north of the Victoria Nile	Measured noise levels dB(A) (B)								Noise sources	Site Description	Summary of the available results
		L_{AMax}	L_{Aeq}	L_{A90}	L_{A50}	L_{10}	Average dB(A) (A)	Max	Min			
		-	-	-	-	-	57.8	-	-	-		day, according to the National Environment (Noise Standards and Control Regulations 2003) but were as a result of the effects of wind blowing through vegetation.
		-	-	-	-	-	57.85	-	-	-		
		-	-	-	-	-	57.85	-	-	-		
		-	-	-	-	-	58.1	-	-	Recurring thunder.	Access road Junction to Jobi East-7 (F) drill pad.	
		-	-	-	-	-	57.85	-	-	-	Around Jobi East-G site.	In general the baseline noise levels recorded exceeded the permissible noise levels for environmental and recreational areas whose permissible level is set at 45dB (A) during the day, according to the National Environment (Noise Standards and Control Regulations 2003) but were partially influenced by birds calls, wind blowing through vegetation.
		-	-	-	-	-	57.9	-	-	-		
		-	-	-	-	-	57.9	-	-	-		
		-	-	-	-	-	57.3	-	-	-		
		-	-	-	-	-	56.85	-	-	-		
		-	-	-	-	-	57.15	-	-	-		
		-	-	-	-	-	56.7	-	-	-		
		-	-	-	-	-	57	-	-	-		
		-	-	-	-	-	57.05	-	-	-		
		-	-	-	-	-	56.8	-	-	-		
		-	-	-	-	-	57.95	-	-	-	Around Jobi East-6 (I) site.	In general the baseline noise levels recorded exceeded the permissible noise levels for environmental and recreational areas whose permissible level is set at 45dB (A) during the day, according to the National Environment
		-	-	-	-	-	58	-	-	-		
		-	-	-	-	-	57.85	-	-	-		
		-	-	-	-	-	58.1	-	-	-		
		-	-	-	-	-	58.05	-	-	-		
		-	-	-	-	-	57.95	-	-	-		
		-	-	-	-	-	57.9	-	-	-		

Source of information (TEP Uganda)	Sampling locations north of the Victoria Nile	Measured noise levels dB(A) (B)								Noise sources	Site Description	Summary of the available results
		L_{AMax}	L_{Aeq}	L_{A90}	L_{A50}	L_{10}	Average dB(A) (A)	Max	Min			
		-	-	-	-	-	57.9	-	-	-		(Noise Standards and Control Regulations 2003) but were influenced by the windy conditions.
		-	-	-	-	-	58.05	-	-	-		
		-	-	-	-	-	58	-	-	-		
DE/ENV/2012/R/012 Proposed Jobi-5 (E) Appraisal Well, January 2013	The locations chosen within approximately 100 m of the well site centre.	-	73.2	56.3	68.5	77.8	-	-	-	Birds and insects.	Around Jobi-5 (E).	Noise sources identified during the time of measurements were non-anthropogenic (birds and insects). The background noise levels exceeded the maximum permissible noise levels for 'environmental or recreational sites' specified in the National Environment (Noise Standards and Control) Regulations, 2003.
		-	76.4	50.7	69.4	81.4	-	-	-	Birds and insects.		
DE/ENV/2012/R/041 Proposed Jobi-2 well testing, October 2012	Sampling point located in the proximity to sensitive receptors (i.e. wildlife) as well as the location of the proposed drill pad. Surveys conducted in July 2012.	-	-	-	-	-	56	-	-	-	Around Jobi 2.	The average noise levels logged are similar to other measurements made within the MFNP for other studies
		-	-	-	-	-	57	-	-	-		
		-	-	-	-	-	57	-	-	-		
		-	-	-	-	-	57.1	-	-	-		
		-	-	-	-	-	56.7	-	-	-		
		-	-	-	-	-	56.7	-	-	-		
		-	-	-	-	-	56.9	-	-	-		
		-	-	-	-	-	57	-	-	-		
		-	-	-	-	-	57.4	-	-	-		
		-	-	-	-	-	57.2	-	-	-		

Source of information (TEP Uganda)	Sampling locations north of the Victoria Nile	Measured noise levels dB(A) (B)								Noise sources	Site Description	Summary of the available results
		L_{AMax}	L_{Aeq}	L_{A90}	L_{A50}	L_{10}	Average dB(A) (A)	Max	Min			
		-	-	-	-	-	56.9	-	-	-		
		-	-	-	-	-	56.8	-	-	-		
		-	-	-	-	-	57	-	-	-		
		-	-	-	-	-	57.1	-	-	-		
		-	-	-	-	-	56.6	-	-	-		
		-	-	-	-	-	56.9	-	-	-		
		-	-	-	-	-	56.9	-	-	-		
		-	-	-	-	-	57.3	-	-	-	Along the access road to Jobi 2.	
		-	-	-	-	-	57.6	-	-	-	Along the access road to Jobi 2.	
DE/ENV/2012/R/042 Proposed Jobi East-2 well testing, October 2012	Ambient noise measuring points were taken at the Jobi East-2 site and the access road to the site. Surveys conducted in July 2012.	-	-	-	-	-	57.2	-	-	-	Around Jobi East-2.	The average noise levels logged are similar to other measurements made within the MFNP for other studies.
		-	-	-	-	-	57.2	-	-	-		
		-	-	-	-	-	56.9	-	-	-		
		-	-	-	-	-	57.2	-	-	-		
		-	-	-	-	-	57.2	-	-	-		
		-	-	-	-	-	57.3	-	-	-		
		-	-	-	-	-	57.4	-	-	-		
		-	-	-	-	-	57.4	-	-	-		
		-	-	-	-	-	57.4	-	-	-		
		-	-	-	-	-	56.8	-	-	-		
		-	-	-	-	-	57.2	-	-	-		

Source of information (TEP Uganda)	Sampling locations north of the Victoria Nile	Measured noise levels dB(A) (B)								Noise sources	Site Description	Summary of the available results
		L_{AMax}	L_{Aeq}	L_{A90}	L_{A50}	L_{10}	Average dB(A) (A)	Max	Min			
		-	-	-	-	-	56.9	-	-	-		
		-	-	-	-	-	57.1	-	-	-		
		-	-	-	-	-	56.9	-	-	-		
		-	-	-	-	-	56.9	-	-	-		
		-	-	-	-	-	56.5	-	-	-		
		-	-	-	-	-	56.9	-	-	-		
		-	-	-	-	-	57	-	-	-	Junction of access road to Jobi East-2.	
DE/ENV/2012/R/043 Proposed Appraisal Drilling: Jobi-6 (F), November 2012	The ambient noise points based on their proximity to sensitive receptors (i.e. wildlife) as well as the location of the drill pad and along the existing access road to the drill pad. Surveys conducted in July 2012.	-	-	-	-	-	76.6	-	-	Decommissioning activities within existing Jobi-3 (D) drill pad site (no rig activities).	Existing Jobi-3 (D) drill pad site, 15 m from the onsite generator which was in operation.	The average noise levels logged are similar to other measurements made within the MFNP for other studies.
		-	-	-	-	-	61.6	-	-		At the drill pad entrance (existing Jobi-3 (D) drill pad site).	
		-	-	-	-	-	65.9	-	-		Existing Jobi-3 (D) drill pad site, at the onsite offices.	
		-	-	-	-	-	57.3	-	-	Decommissioning activities within existing Jobi-3 (D) drill pad site (no rig activities).	Existing Jobi-3 (D) drill pad site, at the borehole.	
DE/ENV/2012/047 Proposed Appraisal Drilling: Mpyo	Ambient background noise measurement points based on proximity to sensitive receptors as well as	-	-	-	-	-	59.6	-	-	-	50 m West of proposed Mpyo-4 (F) drill pad.	The high values are due to the wind blowing at the time the noise measurements were taken.

Source of information (TEP Uganda)	Sampling locations north of the Victoria Nile	Measured noise levels dB(A) (B)								Noise sources	Site Description	Summary of the available results
		L_{AMax}	L_{Aeq}	L_{A90}	L_{A50}	L_{10}	Average dB(A) (A)	Max	Min			
Field (north area), December 2012	the location of the proposed pads: at every 50 and 100 m along the cardinal directions, outside the proposed drill pad locations, and long the proposed access road route and on the main Paraa-Pakwach road, which forms a junction with the proposed drill pad access roads. Surveys conducted on 5th July and 23rd November 2012.	-	-	-	-	-	60.3	-	-	-	100 m West of proposed Mpyo-4 (F) drill pad.	According to the Noise standard and control Regulations (2003), baseline noise levels recorded exceeded the permissible noise levels for environmental and recreational areas set at 45dB (A) during the day.
		-	-	-	-	-	60.5	-	-	-	50 m East of proposed Mpyo-4 (F) drill pad.	
		-	-	-	-	-	60.3	-	-	-	100 m East of control proposed Mpyo-4 (F) drill pad.	
		-	-	-	-	-	64.3	-	-	-	50 m North of proposed Mpyo-4 (F) drill pad.	
		-	-	-	-	-	60.4	-	-	-	100 m North of proposed Mpyo-4 (F) drill pad.	
		-	-	-	-	-	64.1	-	-	-	50 m South of proposed Mpyo-4 (F) drill pad.	
		-	-	-	-	-	65.5	-	-	-	100 m South of proposed Mpyo-4 (F) drill pad.	
		-	-	-	-	-	63.4	-	-	-	Access road approaching Drill pad.	
		-	-	-	-	-	59.9	-	-	-	200 m North of proposed Mpyo-2 (H) drill pad.	Results are similar to other measurements in MFNP. According to the Noise standard and control Regulations (2003), baseline noise levels recorded exceeded the permissible noise
		-	-	-	-	-	55.4	-	-	-	250 m West of proposed Mpyo-2 (H) drill pad.	
		-	-	-	-	-	55.3	-	-	-	300 m West of proposed Mpyo-2 (H) drill pad.	

Source of information (TEP Uganda)	Sampling locations north of the Victoria Nile	Measured noise levels dB(A) (B)								Noise sources	Site Description	Summary of the available results
		L_{AMax}	L_{Aeq}	L_{A90}	L_{A50}	L_{10}	Average dB(A) (A)	Max	Min			
		-	-	-	-	-	58.2	-	-	-	250 m East of proposed Mpyo-2 (H) drill pad.	levels for environmental and recreational areas set at 45dB (A) during the day.
		-	-	-	-	-	56.9	-	-	-	300 m East of proposed Mpyo-2 (H) drill pad.	
		-	-	-	-	-	57.9	-	-	-	250 m North of proposed Mpyo-2 (H) drill pad.	
		-	-	-	-	-	57.7	-	-	-	300 m North of proposed Mpyo-2 (H) drill pad.	
		-	-	-	-	-	58	-	-	-	100 m from the proposed Mpyo-2 (H) H drill pad.	
		-	-	-	-	-	58	-	-	-	50 m from the proposed Mpyo-2 (H) drill pad.	
		-	-	-	-	-	57.4	-	-	-	Access road point to proposed Mpyo-2 (H) drill pad.	
		-	-	-	-	-	57	-	-	-	Point off the Paraa-Pakwach road.	
HOGL/004-08 Hartebeest-1 Onshore Oil Exploration Well - Pura-1 onshore exploration oil well, August 2008	No information about the location.	-	-	-	-	-	56.7	58.3	55.1	Natural background conditions (birds, insects and crickets).	Hartebeest-1 well site location.	No information
TUL /ECO/11/EIA-11 Proposed Jobi-Rii Field	Sampling points within approximately 100 m of each well site centre.	-	-	-	-	-	59.05	65.8	52.3	-	Jobi-4 (C).	The maximum recorded noise levels at both locations exceed both the

Source of information (TEP Uganda)	Sampling locations north of the Victoria Nile	Measured noise levels dB(A) (B)								Noise sources	Site Description	Summary of the available results
		L_{AMax}	L_{Aeq}	L_{A90}	L_{A50}	L_{10}	Average dB(A) (A)	Max	Min			
Appraisal Drilling, January 2012		-	-	-	-	-	62.25	67.9	56.6	-		daytime legislated limits for environmental or recreational sites (2003). However, this is attributable to 'natural' background conditions (birds and insects) since no anthropogenic sources of noise were observed in the area at the time of monitoring.
		-	-	-	-	-	62.1	70.1	54.1	-	Jobi-3 (D).	
		-	-	-	-	-	65.9	72.3	59.5	-		

Table I1-2: Secondary Data: Summary of available noise measurements performed by other consultants south of the Victoria Nile

Source of information (TEP Uganda)	Sampling locations south of the Victoria Nile	Measured noise levels dB(A) (B)								Noise sources	Site Description	Summary of the available results
		L_{AMax}	L_{Aeq}	L_{A90}	L_{A50}	L_{10}	Average dB(A) (A)	Max	Min			
DE/ENV/2013/2/053 Proposed Victoria Nile 3D Seismic Coverage, April 2013	Along the Victoria Nile river. Surveys conducted in February 2013.	- (B)	46	35.9	38.2	45.6	-	-	-	Birds, hippos, insects in the proximity of a tree and a boat transit.	Paraa ferry crossing (ID sampling point NA4).	Overall, noise levels observed during the study were typical of noise expected in a rural and wilderness setting. Three out of four locations on the south bank exceeded the limits albeit by a minor degree. It can be concluded therefore that background noise levels are higher in disturbed areas on the south bank. Both natural (fauna) and anthropogenic sources contributed to baseline; although noise levels were generally higher on the south bank where human presence is significantly higher.
		-	36.8	31.1	33.6	-	-	-	-	Birds, aircraft transit (distant).	Preferred mooring location at Wild Frontiers lease land (ID sampling point NA5).	
		-	45.4	40.3	43.2	-	-	-	-	Hippos, people talking in the vicinity of a water source.	Unnamed river access near Murchison River Lodge (alternative mooring location) (ID sampling point NA6).	
		-	-	-	-	-	-	-	-			
DE/ENV/2013/R/049 Proposed Appraisal Drilling: Mpyo Field (south area), February 2013	Sampling points at every 60 m along the cardinal directions of the 3 proposed drill pad sites. Extra measurements taken along the proposed access roads to these sites. Other ambient background noise measurement points were selected based on proximity to sensitive receptors as well as the location of the proposed drill pads. Surveys conducted in December 2012.	-	-	-	-	-	58.7	-	-	Wind blowing through vegetation.	Mpyo-D site.	Based on the National Environment (Noise Standards and Control Regulations 2003), baseline noise levels exceeded the permissible noise levels for environmental and recreational areas whose permissible level is set at 45 dB (A) during the day, but these noise measurements are within a similar range to other measurements undertaken from other studies and conducted within the MFNP.Noise levels recorded at and within the project site were influenced by wind blowing through vegetation.
		-	-	-	-	-	59.1	-	-			
		-	-	-	-	-	58.5	-	-			
		-	-	-	-	-	58.3	-	-			
		-	-	-	-	-	58.5	-	-			
		-	-	-	-	-	58.3	-	-	Wind blowing through vegetation.	Paraa-Masindi road junction: sensitive receptor near Mpyo-D.	
		-	-	-	-	-	58.6	-	-	Partially influenced by birds chirping and wind blowing through vegetation.	Mpyo-L site.	Based on the National Environment (Noise Standards and Control Regulations 2003), baseline noise levels exceeded the permissible noise levels for environmental and recreational areas whose permissible level is
		-	-	-	-	-	58.7	-	-			
		-	-	-	-	-	58.2	-	-			
		-	-	-	-	-	58.3	-	-			
		-	-	-	-	-	58.1	-	-			
		-	-	-	-	-	58.3	-	-			
		-	-	-	-	-	58.3	-	-			

Source of information (TEP Uganda)	Sampling locations south of the Victoria Nile	Measured noise levels dB(A) (B)								Noise sources	Site Description	Summary of the available results
		L_{AMax}	L_{Aeq}	L_{A90}	L_{A50}	L_{10}	Average dB(A) (A)	Max	Min			
		-	-	-	-	-	58	-	-			set at 45 dB (A) during the day, but these noise measurements are within a similar range to other measurements undertaken from other studies and conducted within the MFNP. Noise levels recorded at the site were influenced by bird calls and wind blowing through vegetation.
		-	-	-	-	-	57.6	-	-			
		-	-	-	-	-	58.4	-	-	Partially influenced by birds chirping and wind blowing through vegetation.	Paraa-Masindi access road junction.	
		-	-	-	-	-	58.8	-	-	Partially influenced by birds chirping and wind blowing through vegetation.	Seasonal river (695 m East of the site).	
		-	-	-	-	-	58.7	-	-	-	Mpyo-6 (M) site.	Based on the National Environment (Noise Standards and Control Regulations 2003), baseline noise levels recorded exceeded the permissible noise levels for residential areas set at 50 dB(A) during the day, but these noise measurements are within a similar range to other measurements undertaken at other sites when similar studies have been conducted within the area. Noise levels recorded at this site were mainly influenced by local community human conversation, sounds made by domesticated animals (poultry and goats) and insect and birds calls.
		-	-	-	-	-	58.6	-	-	-		
		-	-	-	-	-	58.8	-	-	-		
		-	-	-	-	-	59.2	-	-	-		
		-	-	-	-	-	58.8	-	-	-		
		-	-	-	-	-	59.3	-	-	-		
		-	-	-	-	-	59.1	-	-	-		
		-	-	-	-	-	60.1	-	-	-		
		-	-	-	-	-	59.3	-	-	-		
		-	-	-	-	-	60.1	-	-	-	Homestead. Sensitive receptors.	
		-	-	-	-	-	59.5	-	-	-		
		-	-	-	-	-	58.9	-	-	-		
		-	-	-	-	-	59	-	-	-		
		-	-	-	-	-	63	-	-	-		
		-	-	-	-	-	65	-	-	-		
		-	-	-	-	-	62.3	-	-	-	Mubako Trading Centre.	
		-	-	-	-	-	59	-	-	-	Wetland.	
		-	-	-	-	-	58.8	-	-	-	Homestead.	
		-	-	-	-	-	58.4	-	-	-		
		-	-	-	-	-	58.3	-	-	-		
		-	-	-	-	-	58.5	-	-	-		
		-	-	-	-	-	58.8	-	-	-	Church.	

Table I1-3: Secondary Data: Summary of available noise measurements performed by other consultants west of the Victoria Nile

Source of information (TEP Uganda)	Sampling locations west of the Victorai Nile	Measured noise levels dB(A) [B]								Noise sources	Site Description	Summary of the available results
		L_{AMax}	L_{Aeq}	L_{A90}	L_{A50}	L_{10}	Average dB(A) [A]	Max	Min			
DE/ENV/2012/R/028 Proposed expansion of Adundu Camp, Nebbi District, West Nile, September 2012	Sampling location nearby human receptors (homesteads) and fauna receptors (grazing cattle and birds).	- [B]	46.4	31	36.3	52	-	-	-	Nesting birds on the nearby trees.	-	Noise sources mainly non-anthropogenic (nesting birds in the nearby trees). The background noise levels are within the maximum permissible noise levels for 'environmental or recreational sites' specified in the National Environment (Noise Standards and Control) Regulations, 2003.
DE/ENV/2012/R/039 Ondyek-1 (A) Well Project, October 2012	Measurements were undertaken at locations around the proposed drill pad with potential receptors. Surveys conducted in April 2012.	56.9	41.5	33	38.5	-	-	-	-	Clucking chickens, birds chirping and human conversation.	-	With the exception of areas close to the Pakwach – Panyimur – Dei road, Panyimur Sub County and Aboko Trading Centre, noise measurements at the rest of the points within the 2 km from the drill pad indicated an environment that was devoid of sources of noise. National noise regulations require that the maximum permissible noise level for general environment in a residential area with small industrial or small scale production and commercial activities is 60 dB(A) during the day and 50 dBA at night.
		56.4	43.6	37	41.5	-	-	-	-	Youth congregation and birds chirping.	-	
		64.7	45.1	32.5	39	-	-	-	-	Human conversation, bleating goats and wood chopping activity in the vicinity.	-	
		58.5	41.5	35.5	38.5	-	-	-	-	Human conversation, birds chirping, bleating goats and rustling leaves.	-	
		52	41.9	32.5	39.5	-	-	-	-	Birds chirping and human conversation.	-	
		66.3	51.7	39	47	-	-	-	-	Birds chirping and human conversation.	-	
		56.3	43.1	36.5	40.5	-	-	-	-	-	-	
		65.6	46.3	38	43	-	-	-	-	-	-	
		59.2	44.8	37.5	42.5	-	-	-	-	-	-	
		78.5	71	69	70.5	-	-	-	-	Panyimur market activity, noises from a cassava mill.	In the proximity of the Panyimur market.	
		61.8	46.1	40	42.5	-	-	-	-	Birds chirping and human conversation	Close to the Pakwach – Panyimur – Dei road.	

Source of information (TEP Uganda)	Sampling locations west of the Victorai Nile	Measured noise levels dB(A) [(B)]								Noise sources	Site Description	Summary of the available results
		L_{AMax}	L_{Aeq}	L_{A90}	L_{A50}	L_{10}	Average dB(A) [(A)]	Max	Min			
		65	49.6	44	46.5	-	-	-	-	Vehicles transit and croaking frogs.	Close to the Pakwach – Panyimur – Dei road.	
		74.1	60.2	48.5	54.5	-	-	-	-	Vehicles transit and children conversation in the vicinity of a borehole.	Close to the Pakwach – Panyimur – Dei road.	
		58.3	45.4	37	42.5	-	-	-	-	Birds chirping.	-	
		55.8	42.1	34	38.5	-	-	-	-	Birds chirping and human conversation.	-	
		53.5	41.3	35.5	38	-	-	-	-	-	-	
DE/ENV/2012/R/014 Proposed Pakech Camp to support West Nile Exploration Drilling, August 2012	Noise levels were measured at the nearest receptor from the proposed camp site. Surveys conducted in April 2012.	57.3	38.4	30.0	35.0	-	-	-	-	-	-	Major sources of noise included birds and traffic along the Pakwach – Arua Highway. The area is relatively quiet as seen from the relatively low noise levels recorded.
DE/ENV/2012/R/033 Riwu-1 (A) Exploration Well Project-Environmental and Social Impact Statement, October 2012	Surveys conducted in April 2012.	55.8	38.3	32.5	36.0	-	-	-	-	Birds chirping and rustling leaves.	-	The results indicated a relatively quiescent environment around the proposed Riwu-1 (A) drill pad. The predominant sources of noise were birds and livestock with little or no human influence at the sampled locations.
		52.7	37.0	31.0	34.5	-	-	-	-		-	
		72.1	54.4	34.5	42.5	-	-	-	-		-	
		64.0	46.2	34.0	40.5	-	-	-	-	Wood chopping activity and birds chirping.	-	
		59.7	42.0	37.0	39.0	-	-	-	-	Birds chirping and rustling leaves.	-	
		62.1	41.9	31.0	37.5	-	-	-	-	Birds chirping.	-	
		67.7	49.6	30.5	36.5	-	-	-	-	Construction of a hut, human conversation and a cock-crow.	-	
		59.0	42.8	34.0	39.0	-	-	-	-	Birds chirping and rustling leaves.	-	
		54.2	48.9	46.0	48.5	-	-	-	-	Rustling leaves and human conversation.	-	
		66.4	46.4	34.5	41.5	-	-	-	-	Birds chirping and herdsman's whistling.	-	
		55.5	44.6	35.0	41.5	-	-	-	-	Rustling leaves and human conversation.	-	
DE/ENV/2012/R/034 Omuka-A Well Project-Environmental and Social	Baseline noise measurement was undertaken at locations around the proposed	60.7	46.8	42.0	45.0	-	-	-	-	Birds chirping and wood chopping activity.	-	The baseline noise measurements indicated a relatively quiescent environment currently devoid of sources of high
		62.0	46.1	40.5	43.5	-	-	-	-		-	

Source of information (TEP Uganda)	Sampling locations west of the Victorai Nile	Measured noise levels dB(A) [B]								Noise sources	Site Description	Summary of the available results
		L_{AMax}	L_{Aeq}	L_{A90}	L_{A50}	L_{10}	Average dB(A) [A]	Max	Min			
Impact Statement, October 2012	drill pad with potential receptors. The drill pad is located in the Western rift valley along the shoreline areas of Lake Albert. Coordinates: 309760E, 243034N (UTM 36N, WGS 84). Surveys conducted in April 2012.	59.8	48.1	40.5	46.0	-	-	-	-	Human conversation, rustling leaves and birds chirping.	-	noise pollution. National noise regulations require that the maximum permissible noise levels for general environment in a residential area with small industrial or small scale production and commercial activities are 60 dB (A) during the day and 50 dB (A) at night.
		93.7	83.9	80.5	83.0	-	-	-	-	Loud bar music and barking dogs.	-	
		61.0	42.8	38.0	40.5	-	-	-	-	Human conversation, rustling leaves and birds chirping.	-	
		54.9	42.8	39.5	42.0	-	-	-	-	Loud music, human conversation and birds chirping.	-	
		58.8	43.5	34.5	39.0	-	-	-	-	Kayonga Primary School, motorcycle transit, human conversation and birds chirping.	-	
		58.9	55.4	54.0	55.5	-	-	-	-	School, chirping birds and crickets, rustling leaves, distant thunder	-	
		65.0	50.0	42.5	46.5	-	-	-	-	Birds chirping, strong breeze and rustling leaves.	-	
		59.4	47.7	41.0	45.5	-	-	-	-	Human conversation, wood chopping activities and clucking chickens.	-	
		66.8	49.6	43.5	47.0	-	-	-	-	Sounds from a Pentecostal church, bird chirping and human conversation.	-	
		65.6	47.8	42.5	46.0	-	-	-	-	Sounds from a Health Centre, human conversation and road traffic.	-	
		61.8	49.1	42.0	45.0	-	-	-	-	Motorcycle transit, bleating goats and strong breeze through the vegetation.	-	
		57.7	48.2	46.0	47.5	-	-	-	-	Bird chirping, loud music from a radio playing in the vicinity, human conversation and rustling leaves.	-	

Source of information (TEP Uganda)	Sampling locations west of the Victorai Nile	Measured noise levels dB(A) (B)								Noise sources	Site Description	Summary of the available results
		L_{AMax}	L_{Aeq}	L_{A90}	L_{A50}	L_{10}	Average dB(A) (A)	Max	Min			
		70.8	54.0	49.5	51.0	-	-	-	-	Strong breeze, bushfire crackling, chirping birds.	-	
		66.9	52.8	47.5	50.5	-	-	-	-	Loud music from a stereo playing, birds chirping and children speaking and playing in the proximity of a school.	-	
		54.3	41.9	39.0	40.5	-	-	-	-	Bird chirping, human conversation and rustling leaves.	-	
		48.2	39.7	32.5	37.0	-	-	-	-	Bird chirping, human conversation and motorcycle transit.	-	
DE/ENV/2012/R/038 Okuma-A Exploration Well Project-Environmental and Social Impact Statement, October 2012	The drill pad is located at Nyapolo Village about 500 m from the Pakwach-Nebbi Highway. Its coordinates are 319005E, 271368N. Surveys conducted in April 2012.	57.8	45.4	35.5	41.5	-	-	-	-	Children conversation, crowing chicken and birds chirping.	-	The results of baseline noise measurements indicated an environment with low levels of noise at the time measurements were carried out. The common sources of noise were birds with relatively low human influence at the sampled locations.
		58.3	43.4	33.0	40.5	-	-	-	-	Mooing cattle, birds chirping and human conversation.	-	
		54.7	44.0	36.5	41.5	-	-	-	-	Birds chirping and rustling leaves.	-	
		65.3	47.4	35.5	40.5	-	-	-	-	Birds chirping, rustling leaves and human conversation.	-	
		65.6	44.0	34.5	40.5	-	-	-	-	Birds chirping and rustling leaves.	-	
		74.7	69.9	69.0	69.0	-	-	-	-	Noise form a power generator, highway traffic and human conversation.	-	
		63.6	47.4	33.0	35.5	-	-	-	-	Crowing chicken, birds chirping and rustling leaves.	-	
		52.4	39.4	29.5	36.0	-	-	-	-	Low noise from the distant highway traffic, birds chirping and rustling leaves.	-	
		62.5	37.5	30.0	34.0	-	-	-	-	Birds chirping and rustling leaves.	-	

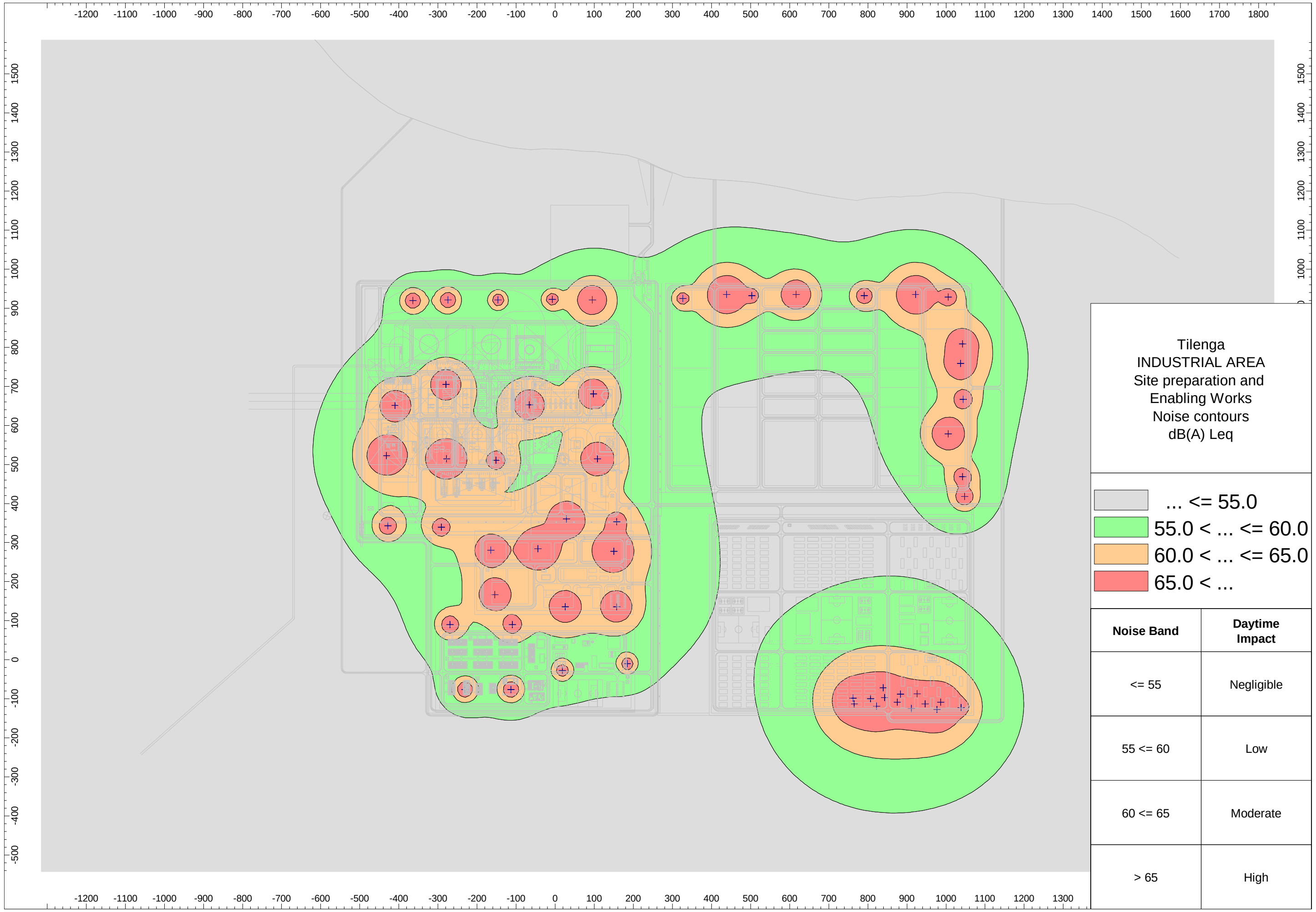
Source of information (TEP Uganda)	Sampling locations west of the Victorai Nile	Measured noise levels dB(A) [(B)]								Noise sources	Site Description	Summary of the available results
		L_{AMax}	L_{Aeq}	L_{A90}	L_{A50}	L_{10}	Average dB(A) [(A)]	Max	Min			
		60.2	47.6	39.5	43.5	-	-	-	-	Highway traffic, birds chirping and rustling leaves.	-	
		54.9	42.8	31.5	38.0	-	-	-	-	Birds and crickets chirping, highway traffic and rustling leaves.	-	
		57.9	42.1	32.0	36.5	-	-	-	-	Homestead.	-	
		58.3	40.6	30.5	38.5	-	-	-	-		-	
		69.9	50.2	41.5	47.0	-	-	-	-	Noise from a radio playing and goats bleating.	-	
		57.4	47.3	36.5	43.0	-	-	-	-	Highway traffic, human conversation	-	
		67.6	43.5	31.5	35.5	-	-	-	-	Birds chirping.	-	
		56.9	44.1	34.5	38.5	-	-	-	-	Birds chirping and rustling leaves.	-	
		65.7	49.1	32.5	39.5	-	-	-	-	Barking dog.	-	
		56.9	38.8	31.0	35.0	-	-	-	-	Human conversation and wood chopping activity.	-	
		56.8	38.4	32.0	36.0	-	-	-	-	School, church	-	
		65.3	49.6	34.0	40.5	-	-	-	-	Clucking chicken and highway traffic.	-	
		59.5	45.7	31.0	37.0	-	-	-	-	Birds chirping and highway traffic.	-	
		70.6	50.0	34.0	42.0	-	-	-	-	Goat bleating and human conversation.	-	
DE/ENV/2012/R/040 Alwala-A Well Project-Environmental and Social Impact Statement, October 2012	The drill pad is located in Kiyaya West village, in a cotton garden about 1.5 km from Boro Trading Centre on Pakwach - Panyimur road (coordinates: 0317933E, 0259247N - UTM 36N, WGS 84). Surveys conducted in April 2012.	55.1	40.3	31.5	37.0	-	-	-	-	Rustling leaves, human conversation and birds chirping.	-	The results indicated an environment with low levels of noise at the time of measurements was undertaken. The prevalent noise sources were birds and no significant human sources existed at the proposed site.
		51.4	35.9	27.5	33.0	-	-	-	-		-	
		54.1	41.8	31.5	36.5	-	-	-	-		-	
		59.3	42.0	31.0	37.5	-	-	-	-	Squeaking bicycle, human conversation and birds chirping.	-	
		60.4	45.8	36.5	42.5	-	-	-	-	Birds chirping and human conversation.	-	
		65.4	47.1	37.0	42.5	-	-	-	-	Bird and crickets sounds.	-	
		58.2	44.6	35.5	41.5	-	-	-	-	Birds chirping and human conversation.	-	
		63.2	39.5	30.0	34.0	-	-	-	-		-	

Source of information (TEP Uganda)	Sampling locations west of the Victorai Nile	Measured noise levels dB(A) [B]								Noise sources	Site Description	Summary of the available results
		L_{AMax}	L_{Aeq}	L_{A90}	L_{A50}	L_{10}	Average dB(A) [A]	Max	Min			
		53.6	41.2	32.0	37.0	-	-	-	-	Crying baby, human conversation and a cow mooing in the proximity.	-	

Appendix I2: Site Preparation and Enabling Works Results

Appendix I2. Site Preparation and Enabling Works Results

Figure I2-1: Industrial Area Site Preparation and Enabling Works Daytime Noise Contours



Noise Band	Daytime Impact
<= 55	Negligible
55 <= 60	Low
60 <= 65	Moderate
> 65	High

The assessment of noise due to site preparation and enabling works at the Industrial Area is presented in Section 7.6.3.2.1

Figure I2-2: Industrial Area Site Preparation and Enabling Works Receptor Analysis

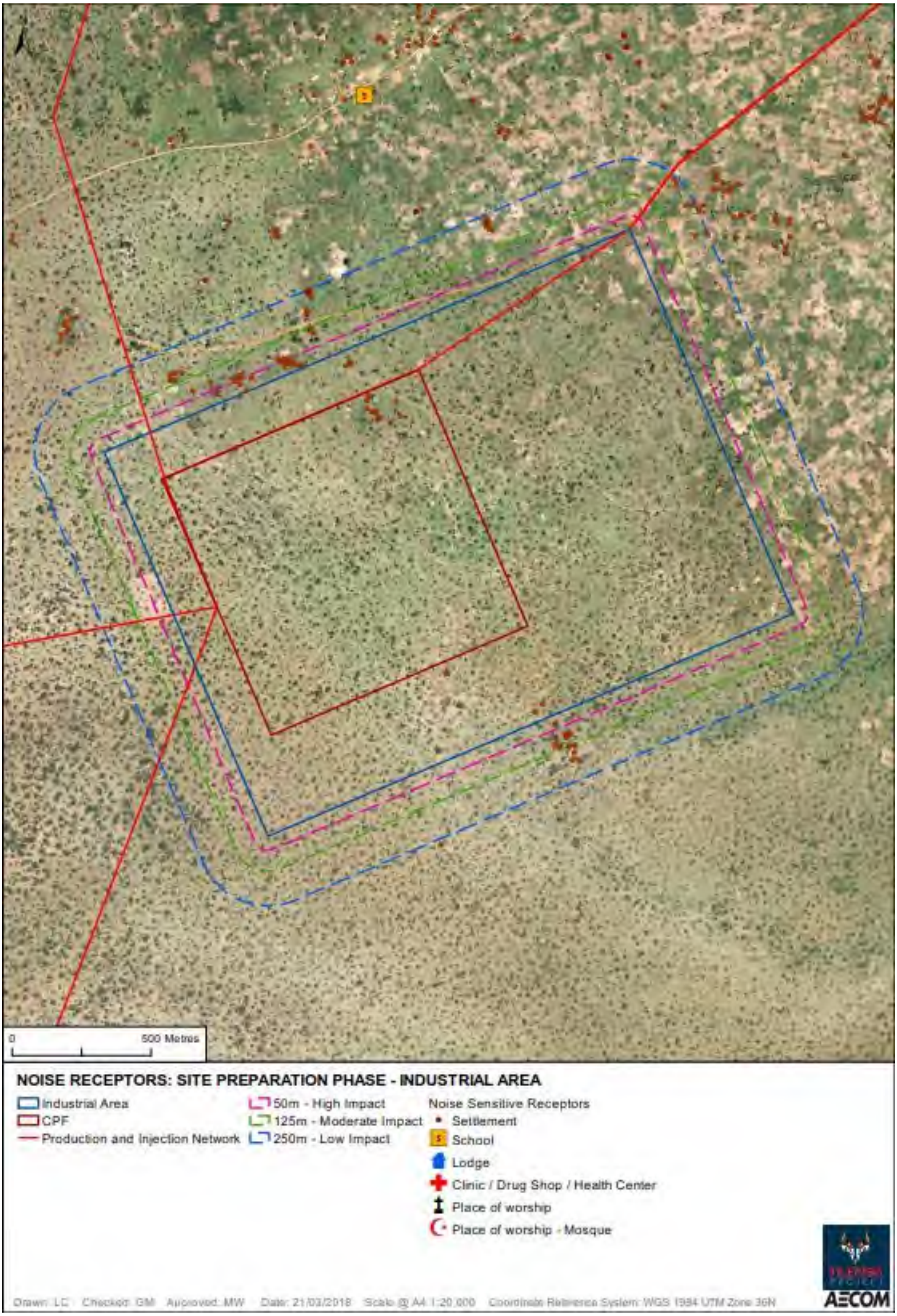
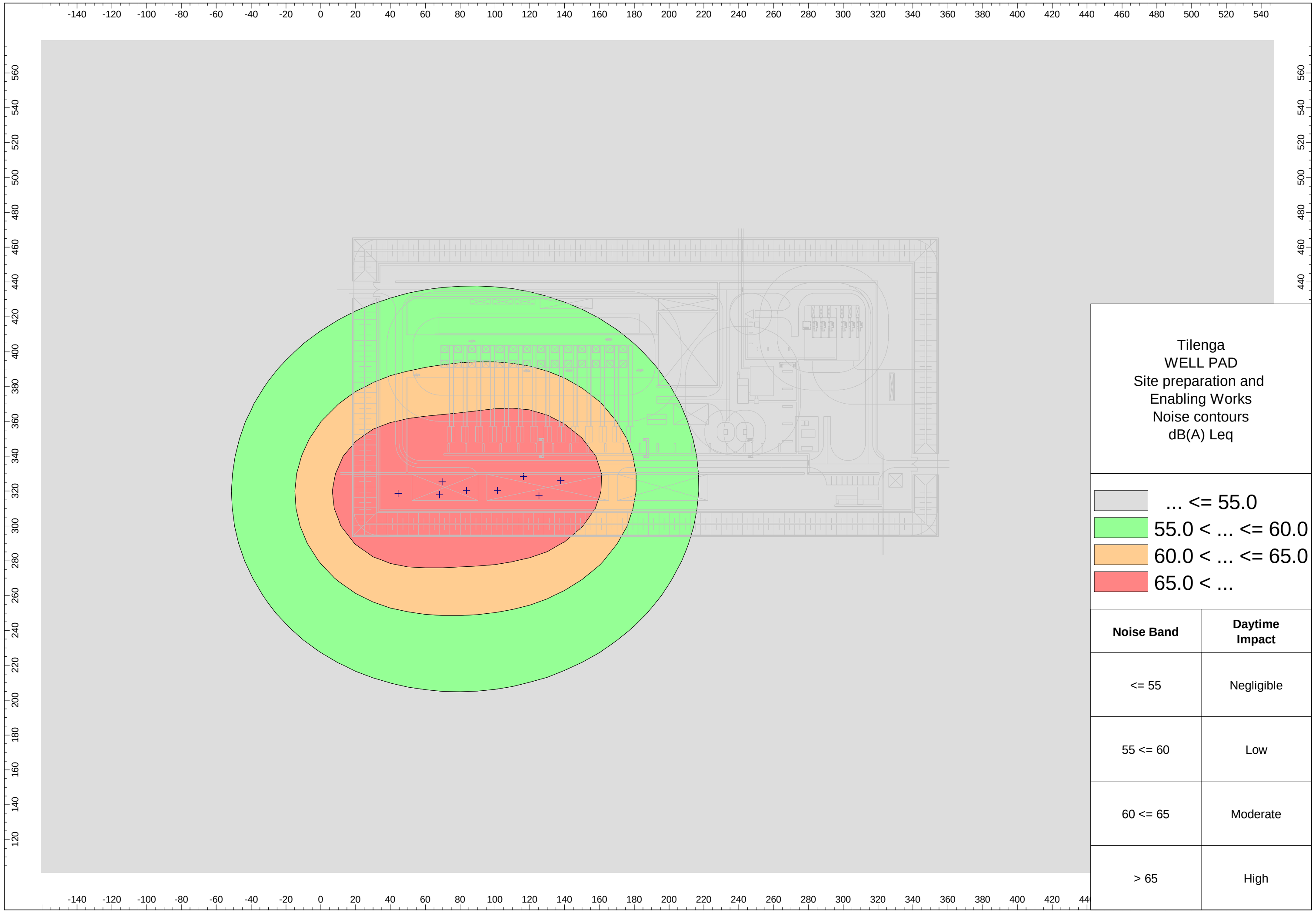


Figure I2-3: Well Pad Site Preparation and Enabling Works Daytime Noise Contours



Noise Band	Daytime Impact
<= 55	Negligible
55 <= 60	Low
60 <= 65	Moderate
> 65	High

The assessment of noise due to site preparation and enabling works at well pad sites is presented in Section 7.6.3.2.2

Figure I2-4: GNA-01 Site Preparation and Enabling Works Daytime Receptor Analysis

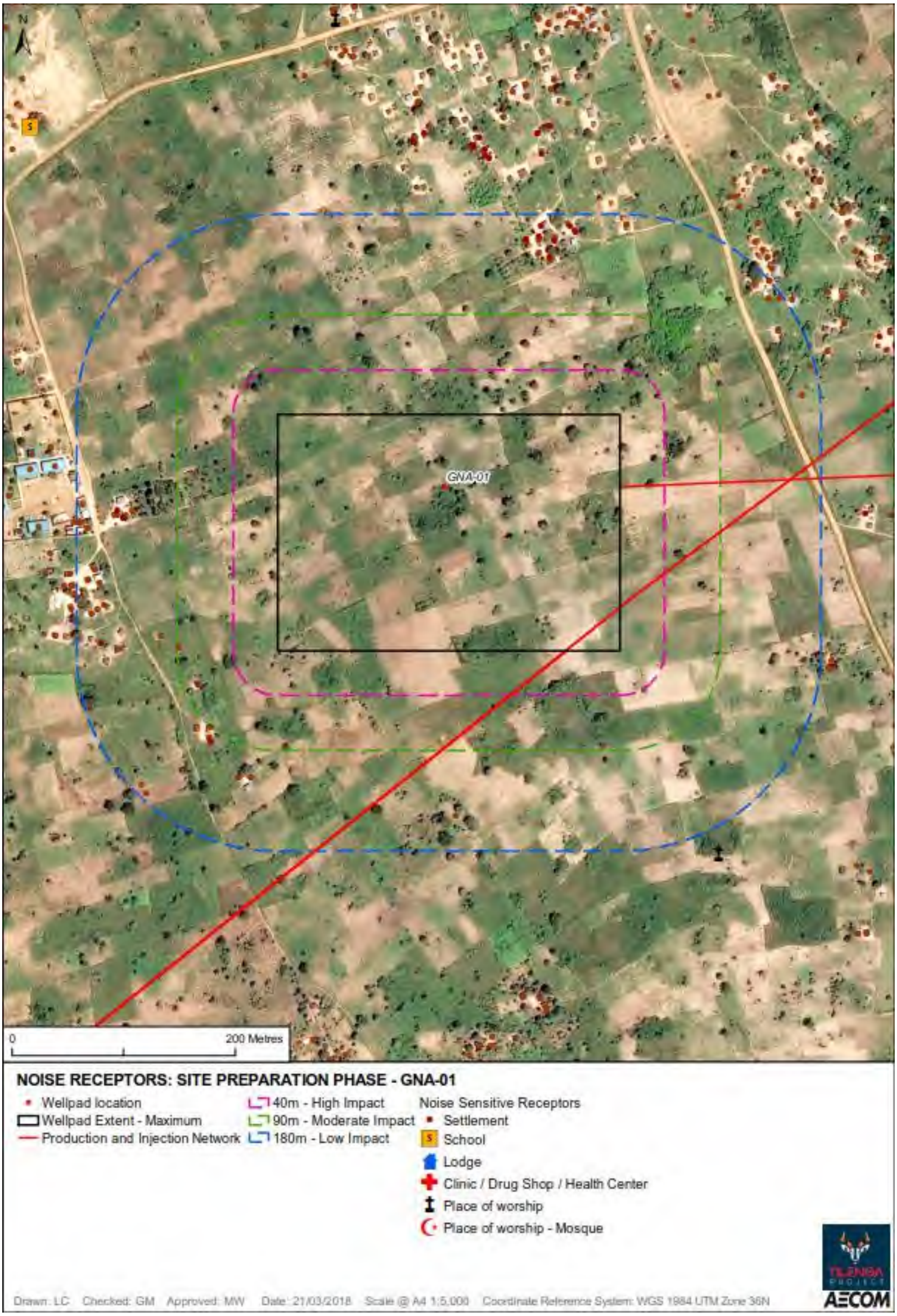


Figure I2-5: GNA-02 Site Preparation and Enabling Works Daytime Receptor Analysis

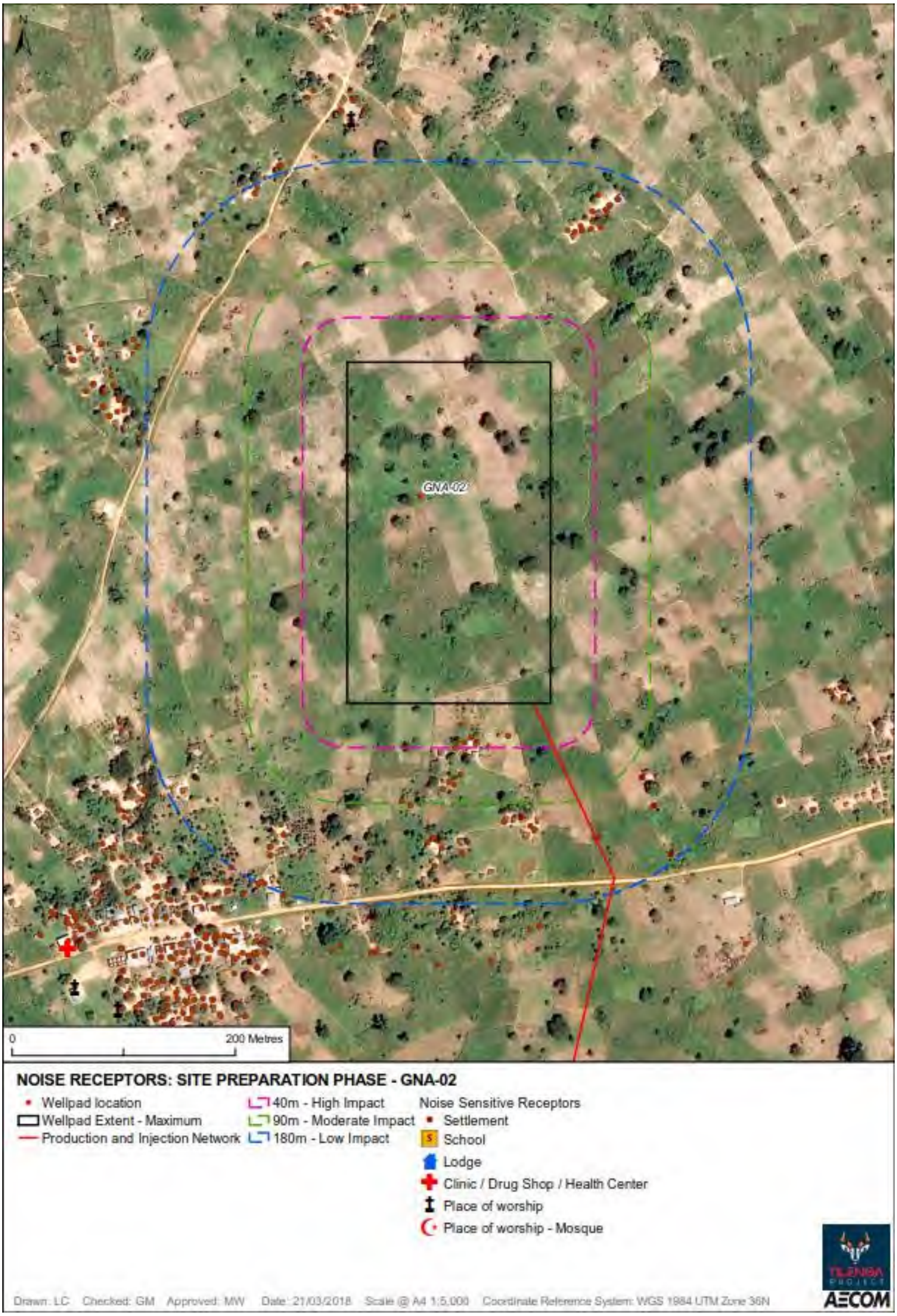


Figure I2-6: GNA-03 Site Preparation and Enabling Works Daytime Receptor Analysis

Figure I2-7: GNA-04 Site Preparation and Enabling Works Daytime Receptor Analysis

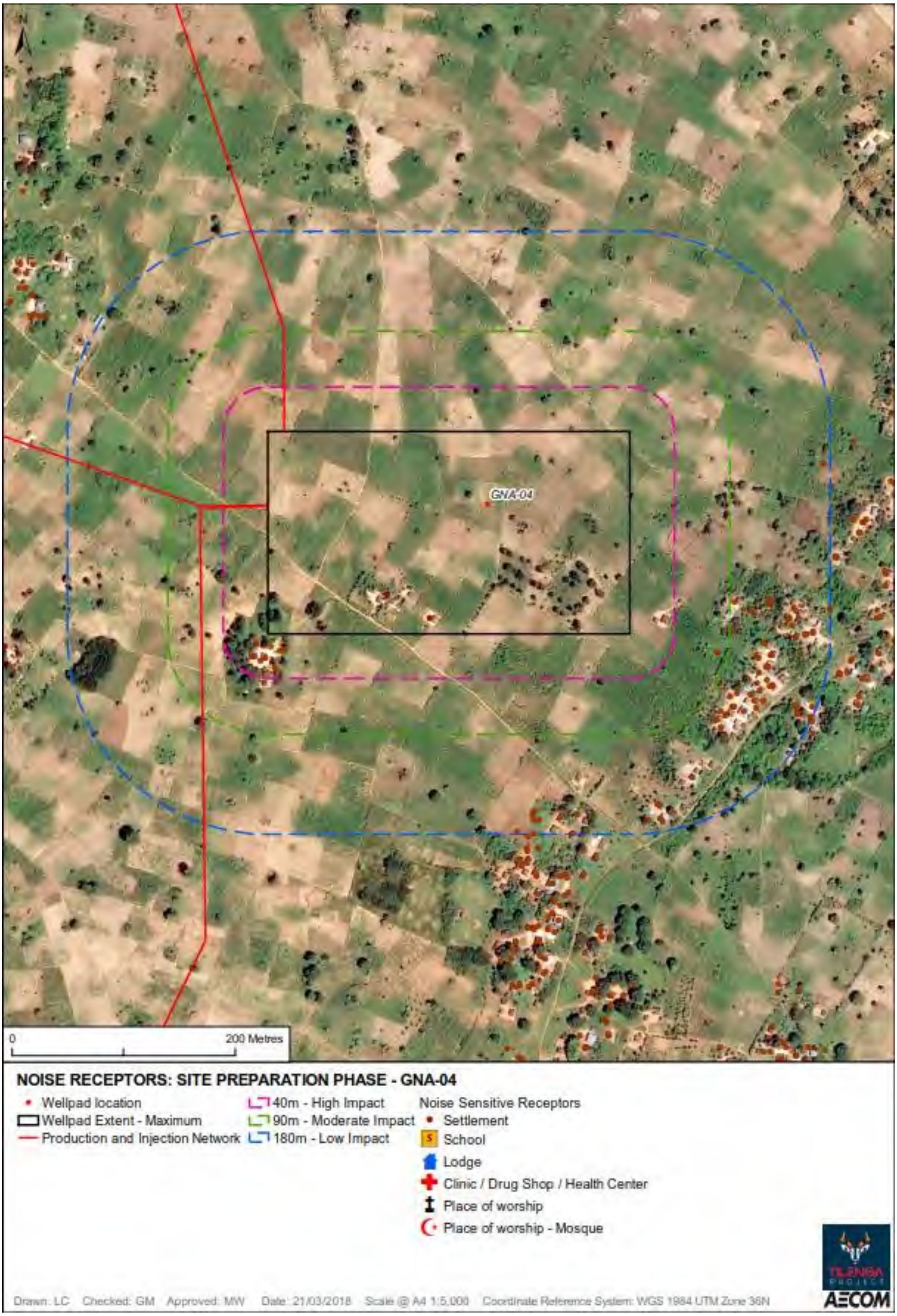


Figure I2-8: JBR-01 Site Preparation and Enabling Works Daytime Receptor Analysis

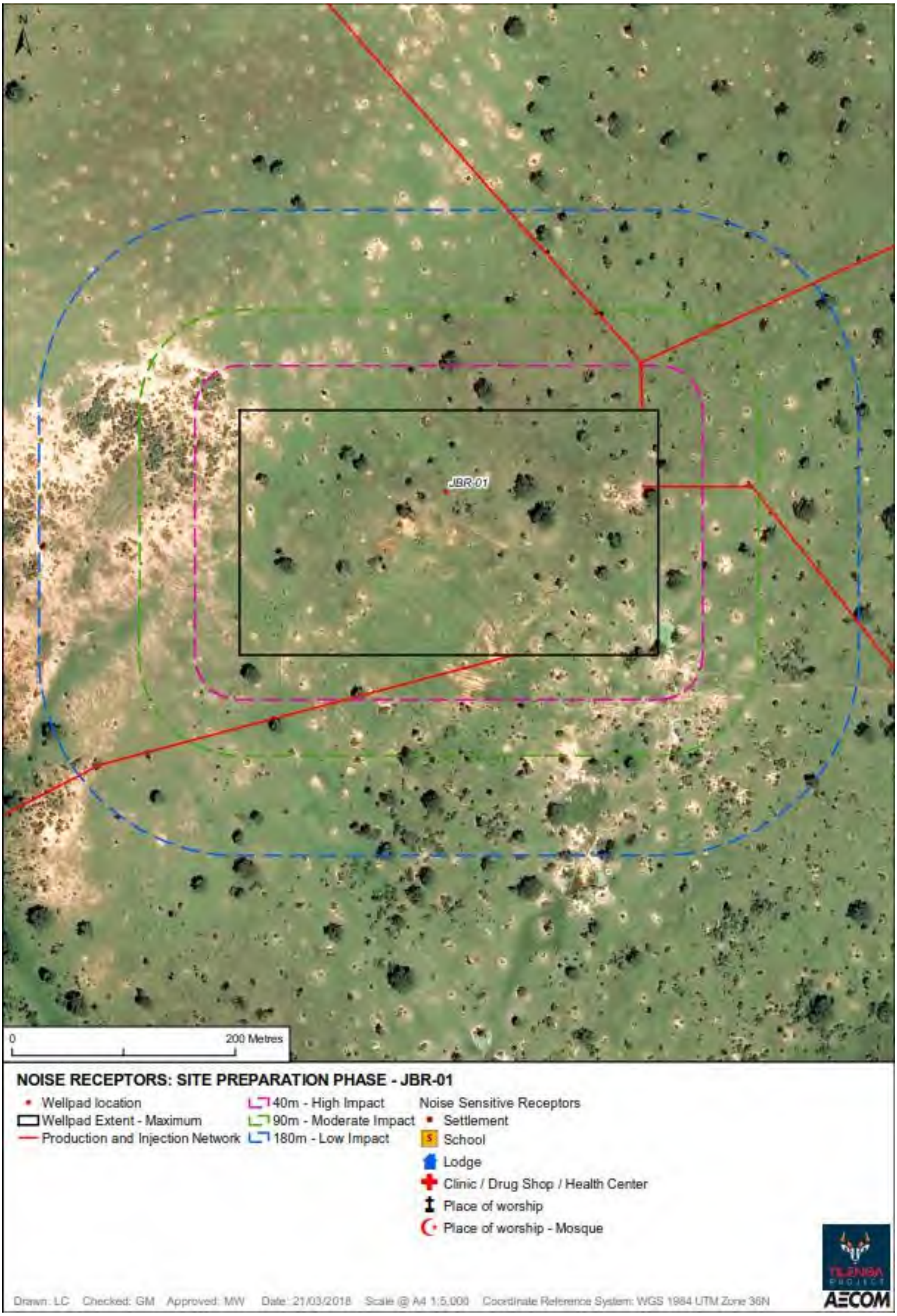


Figure I2-9: JBR-02 Site Preparation and Enabling Works Daytime Receptor Analysis

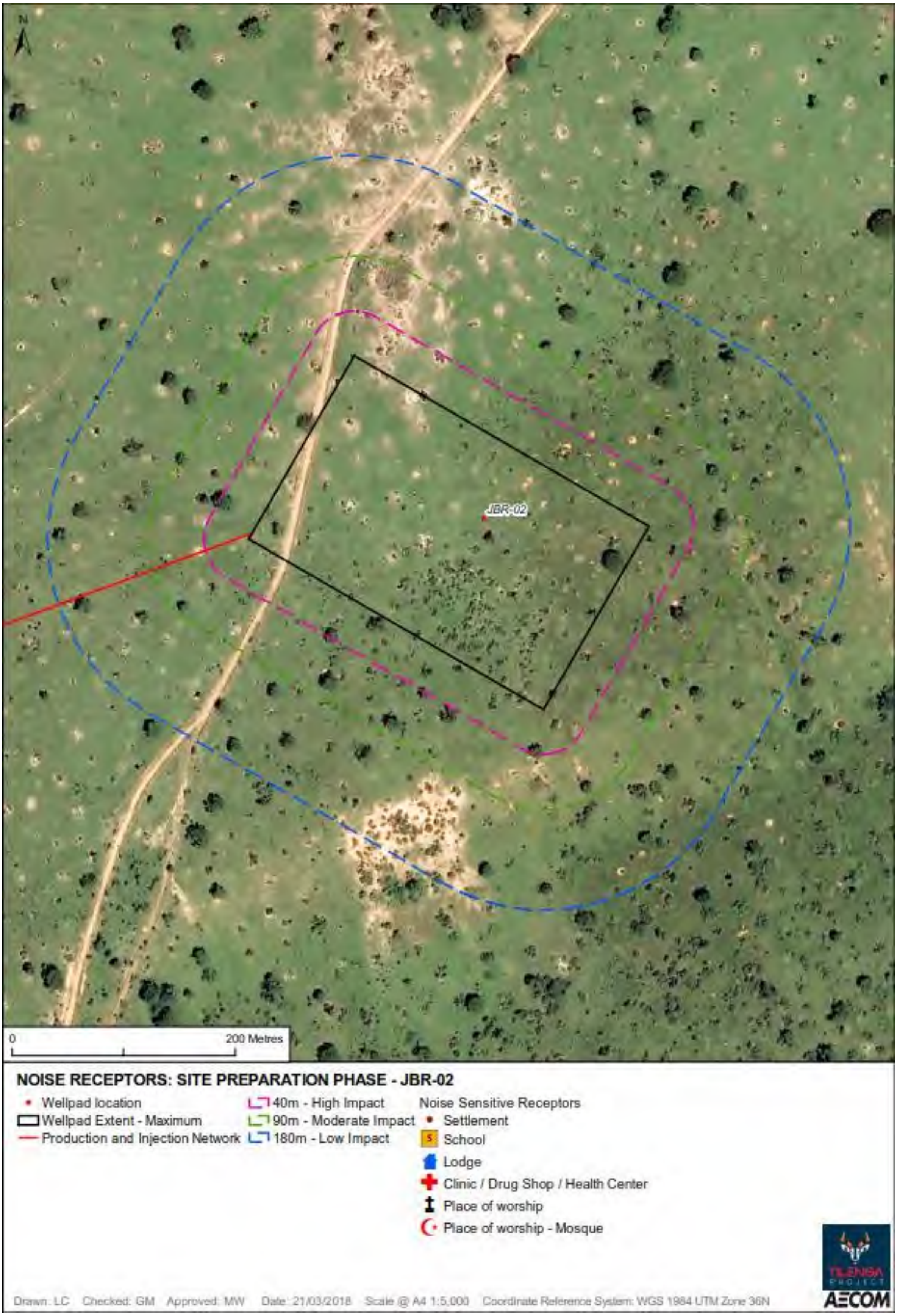


Figure I2-10: JBR-03 Site Preparation and Enabling Works Daytime Receptor Analysis

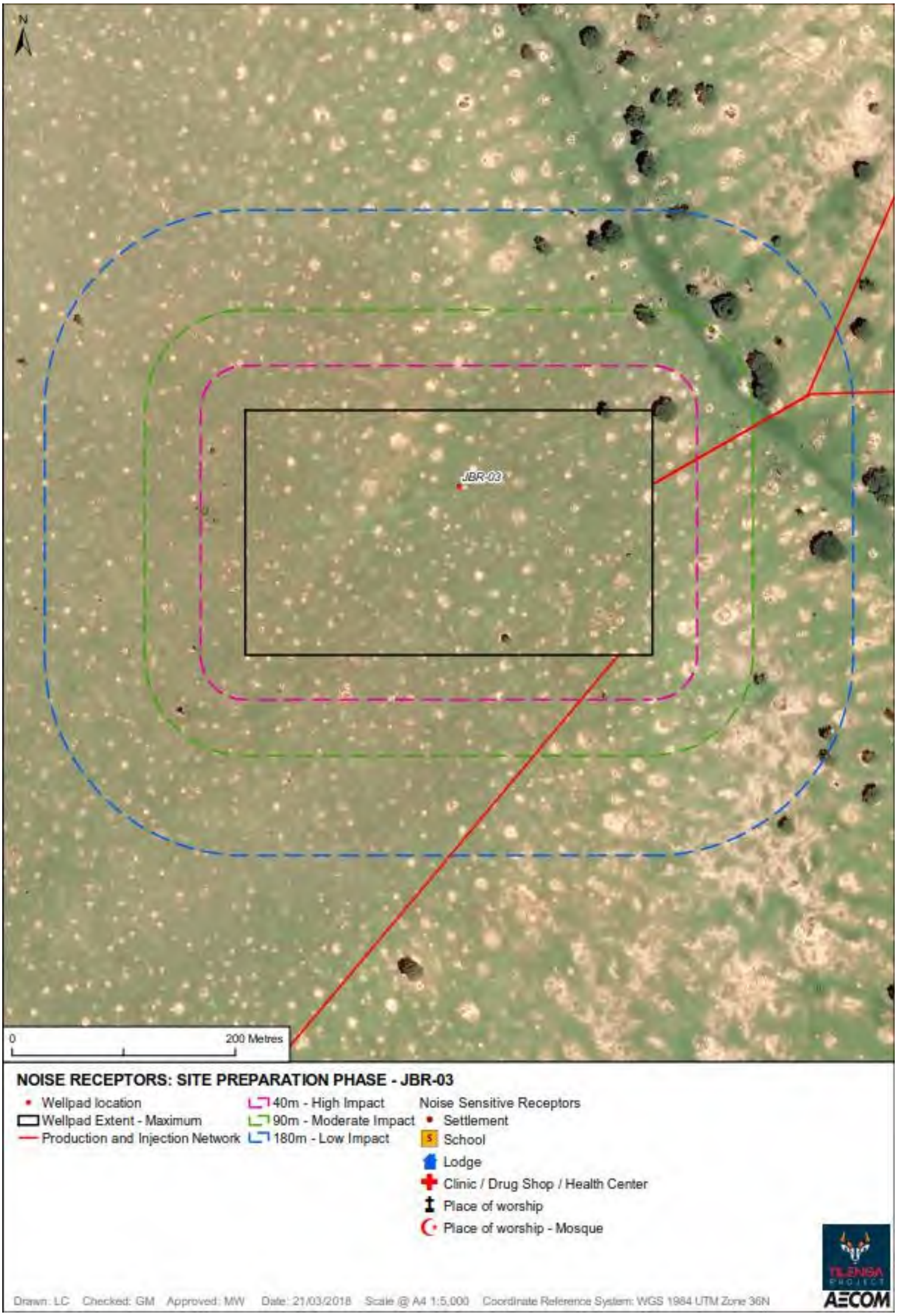


Figure I2-11: JBR-04 Site Preparation and Enabling Works Daytime Receptor Analysis

Figure I2-12: JBR-05 Site Preparation and Enabling Works Daytime Receptor Analysis

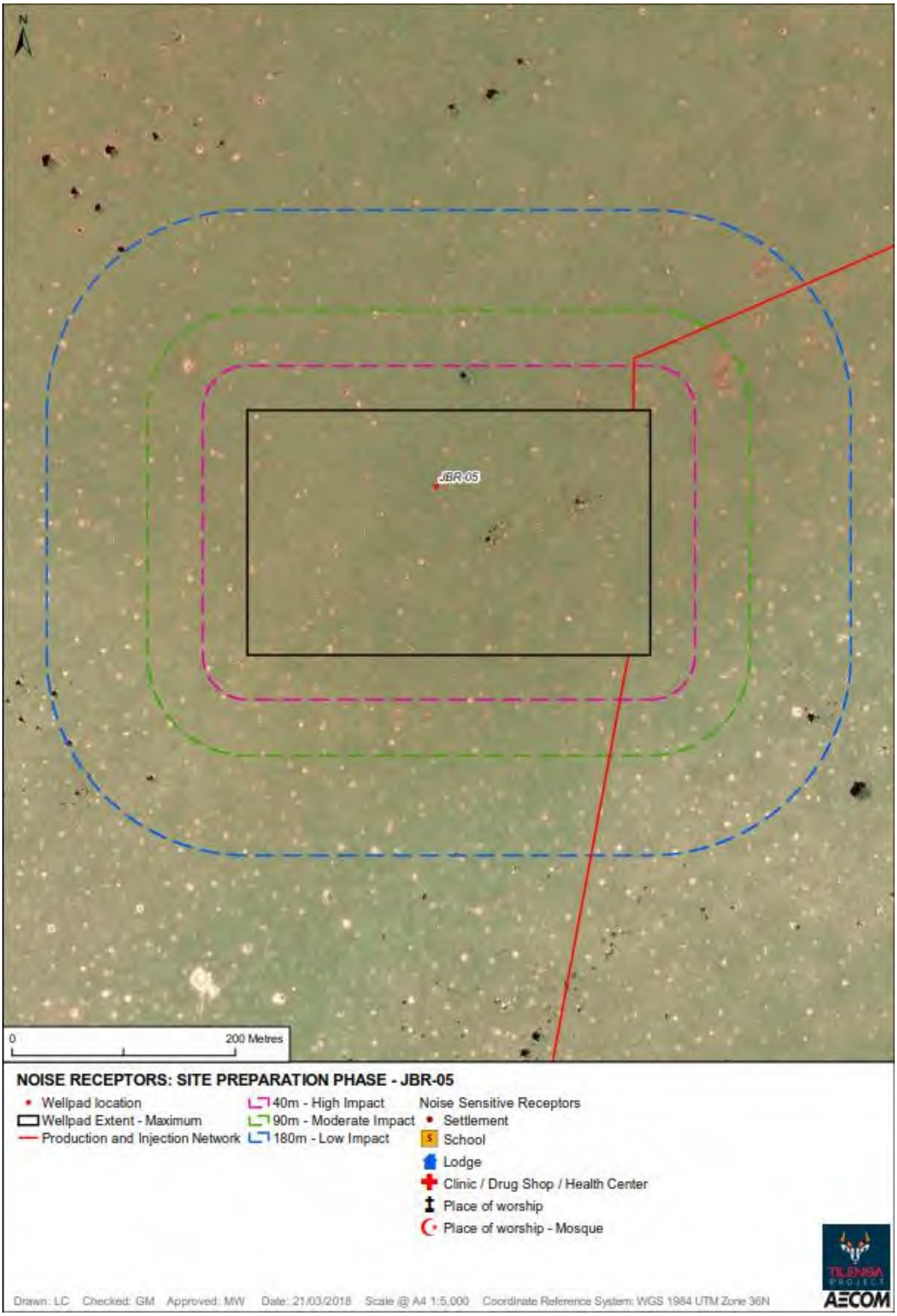


Figure I2-13: JBR-06 Site Preparation and Enabling Works Daytime Receptor Analysis

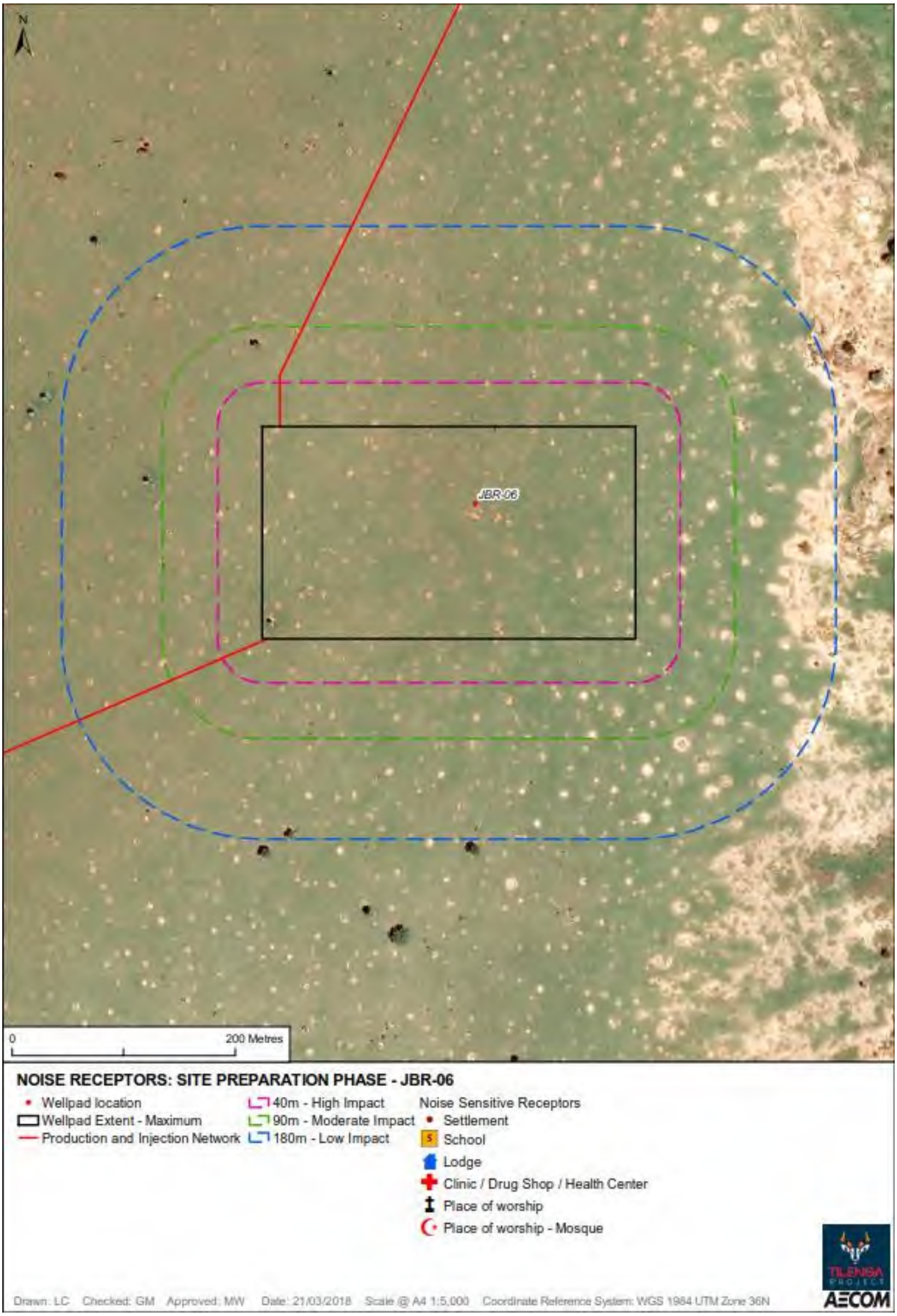


Figure I2-14: JBR-07 Site Preparation and Enabling Works Daytime Receptor Analysis

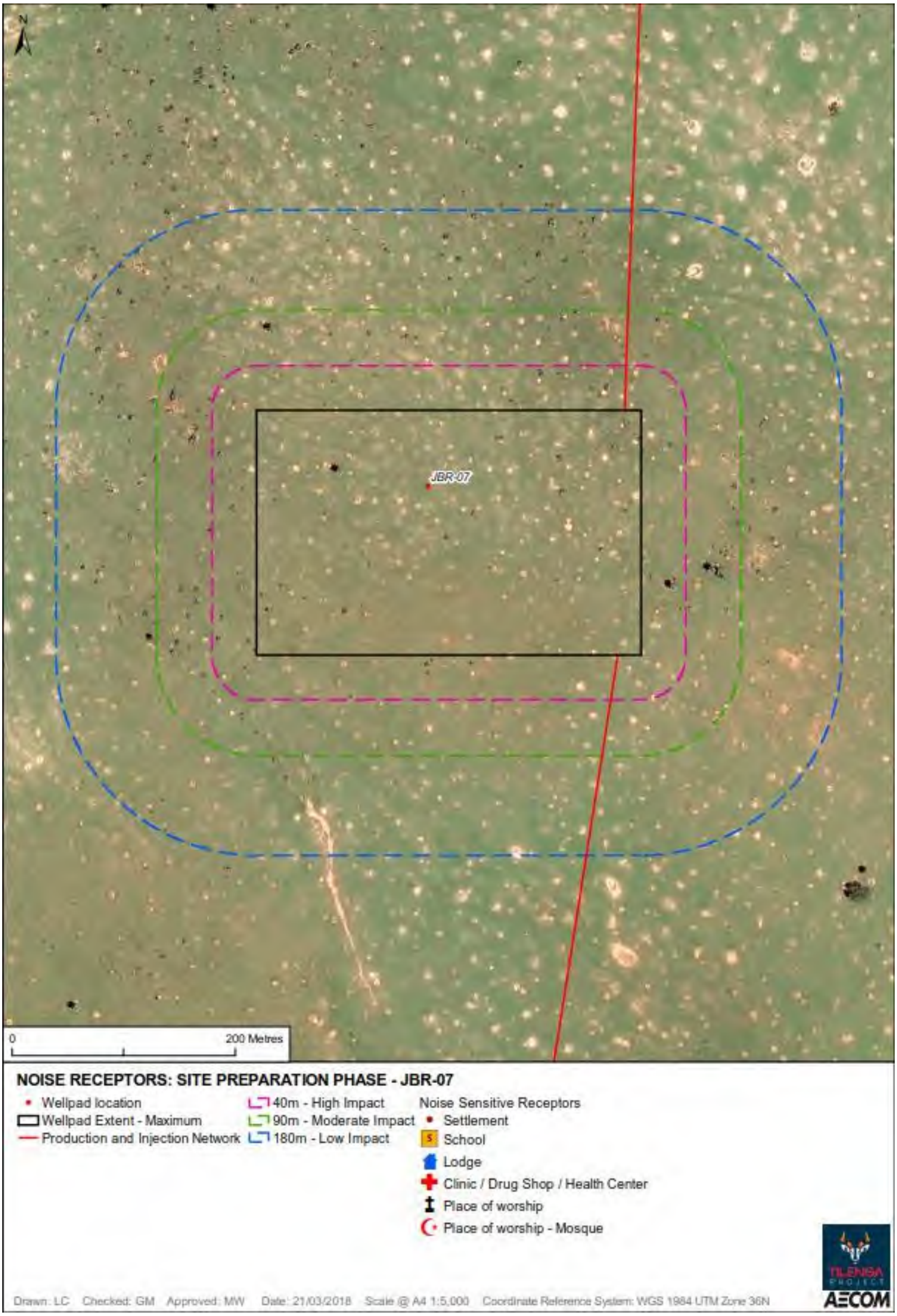


Figure I2-15: JBR-08 Site Preparation and Enabling Works Daytime Receptor Analysis

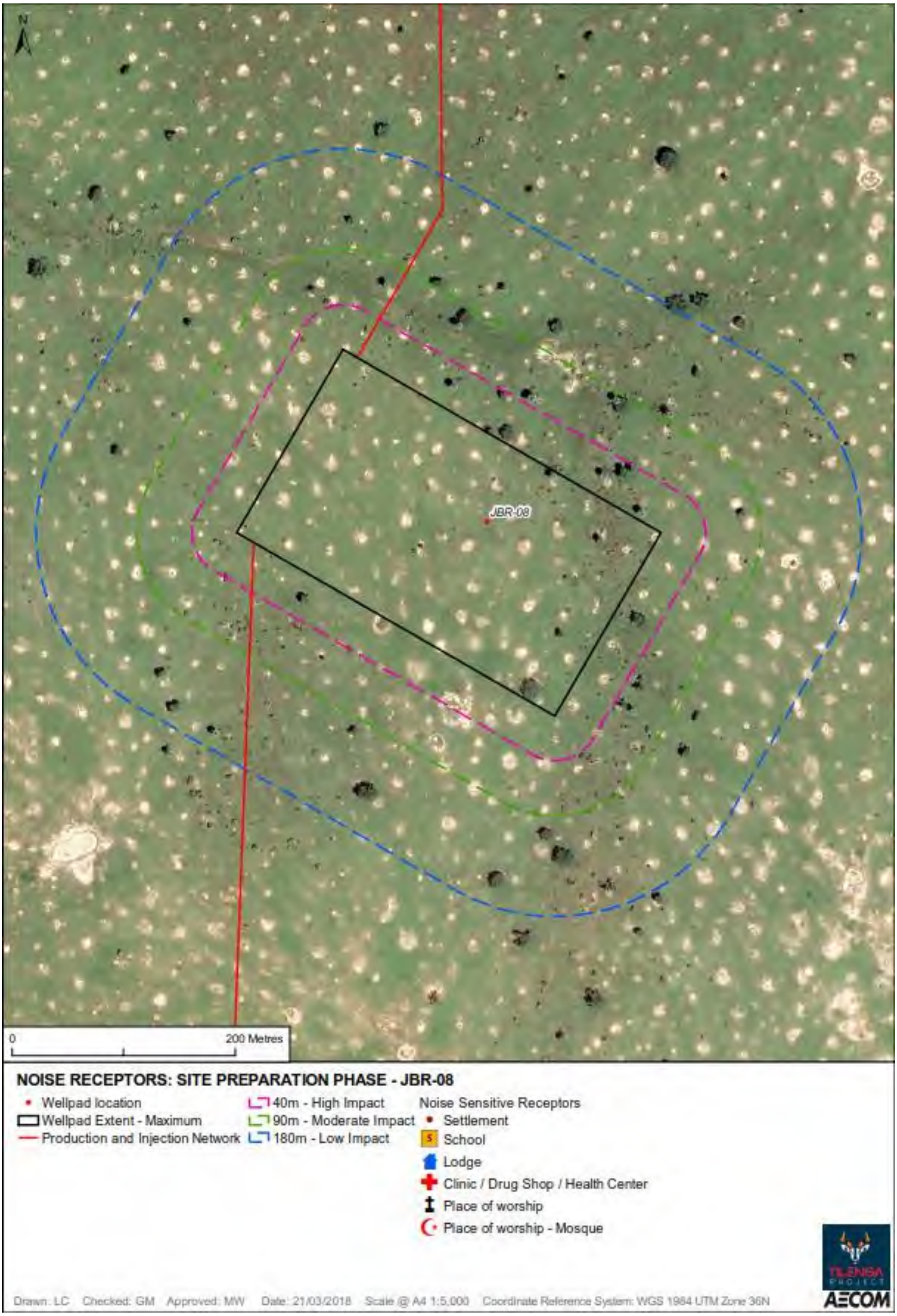


Figure I2-16: JBR-09 Site Preparation and Enabling Works Daytime Receptor Analysis

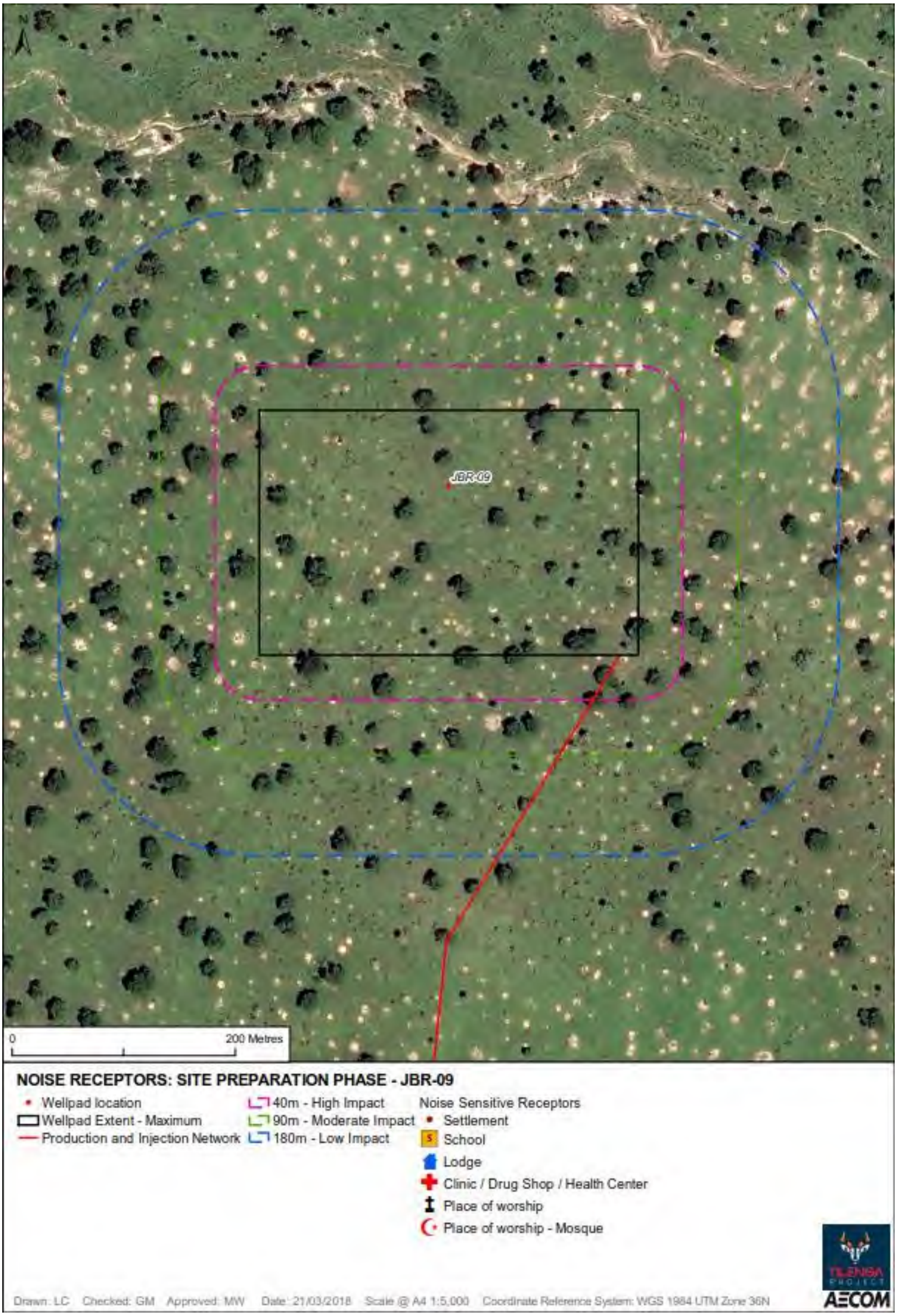


Figure I2-17: JBR-10 Site Preparation and Enabling Works Daytime Receptor Analysis

Figure I2-18: KGG-01 Site Preparation and Enabling Works Daytime Receptor Analysis

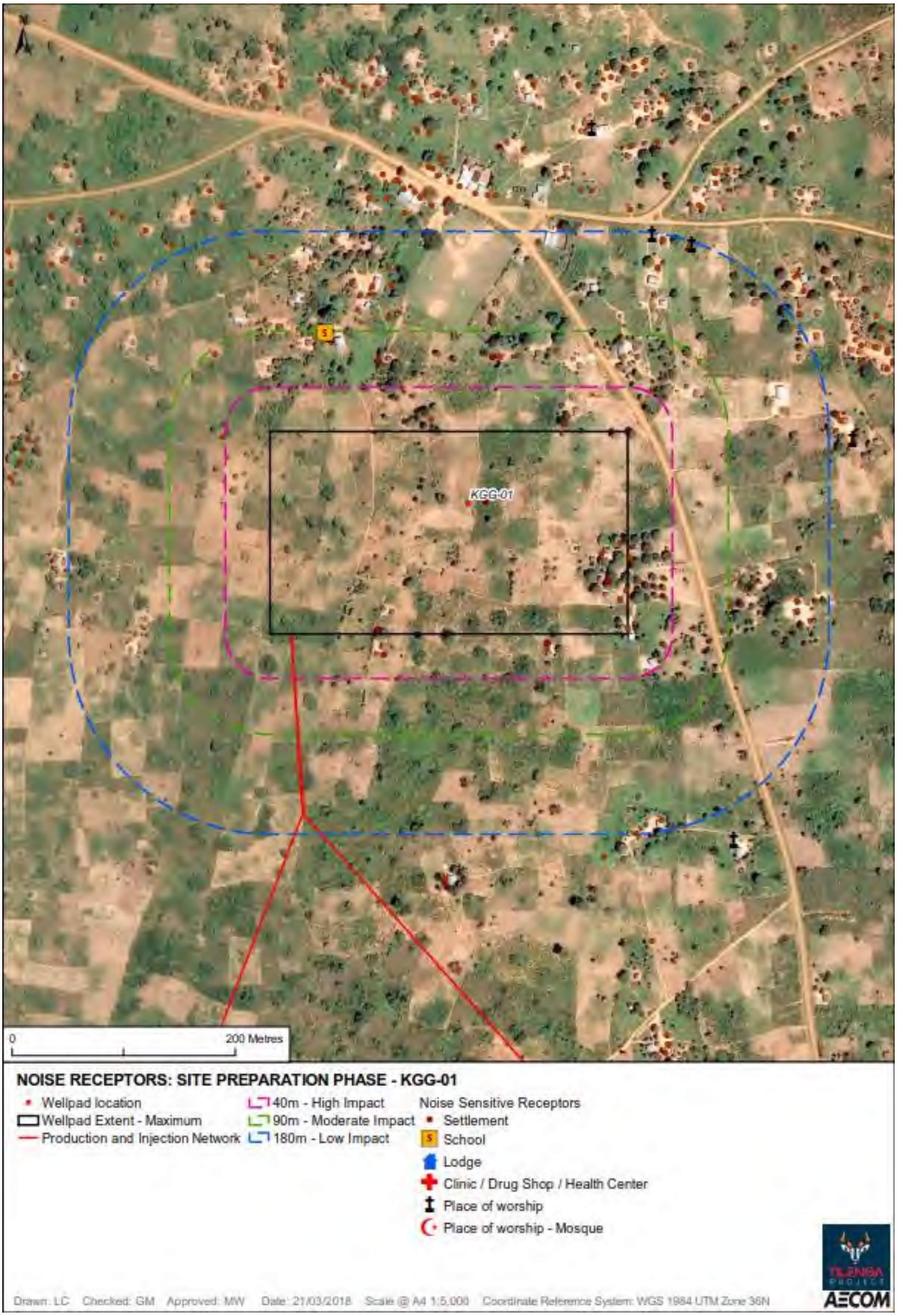


Figure I2-19: KGG-03 Site Preparation and Enabling Works Daytime Receptor Analysis

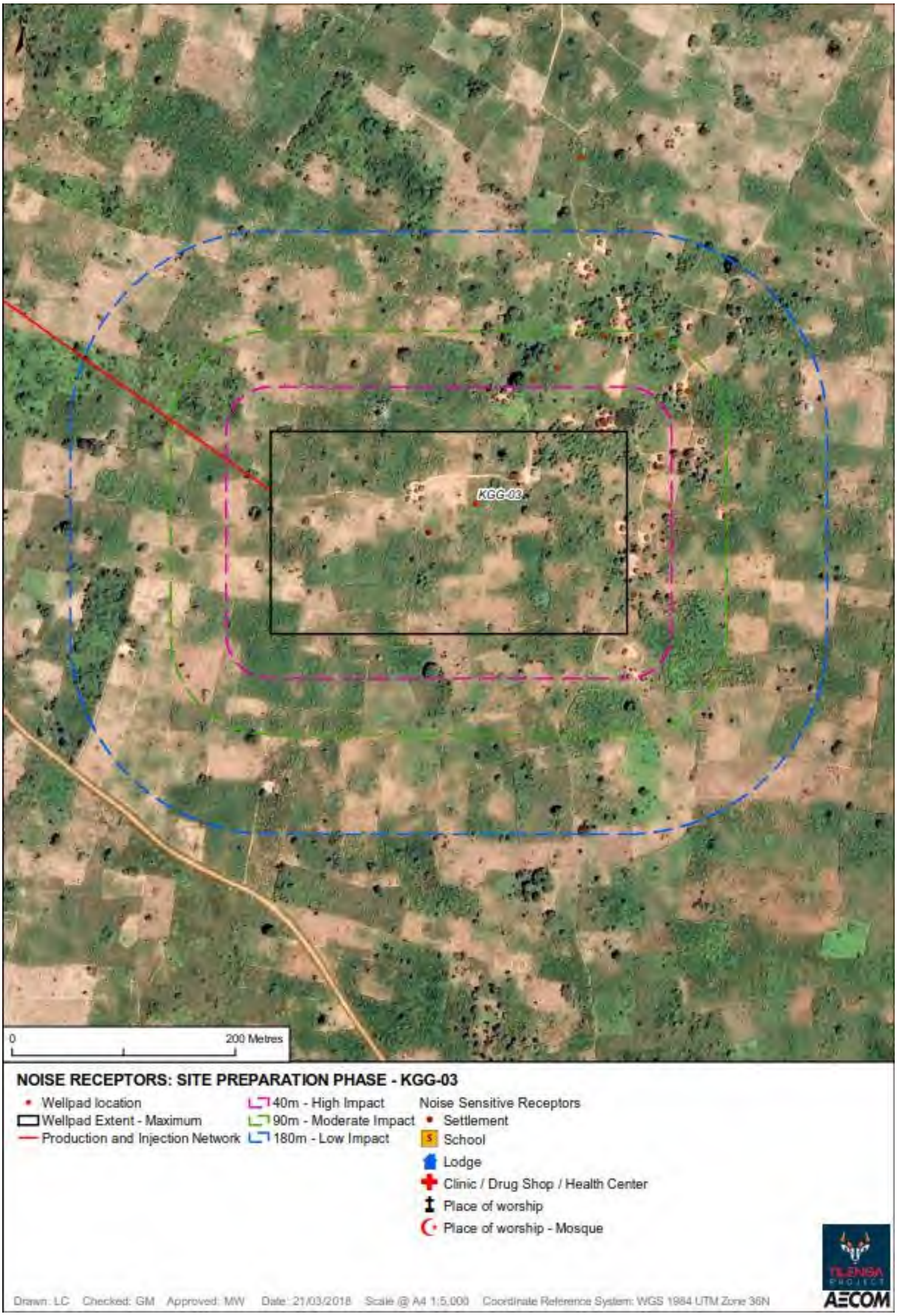


Figure I2-20: KGG-04 Site Preparation and Enabling Works Daytime Receptor Analysis

Figure I2-21: KGG-05 Site Preparation and Enabling Works Daytime Receptor Analysis

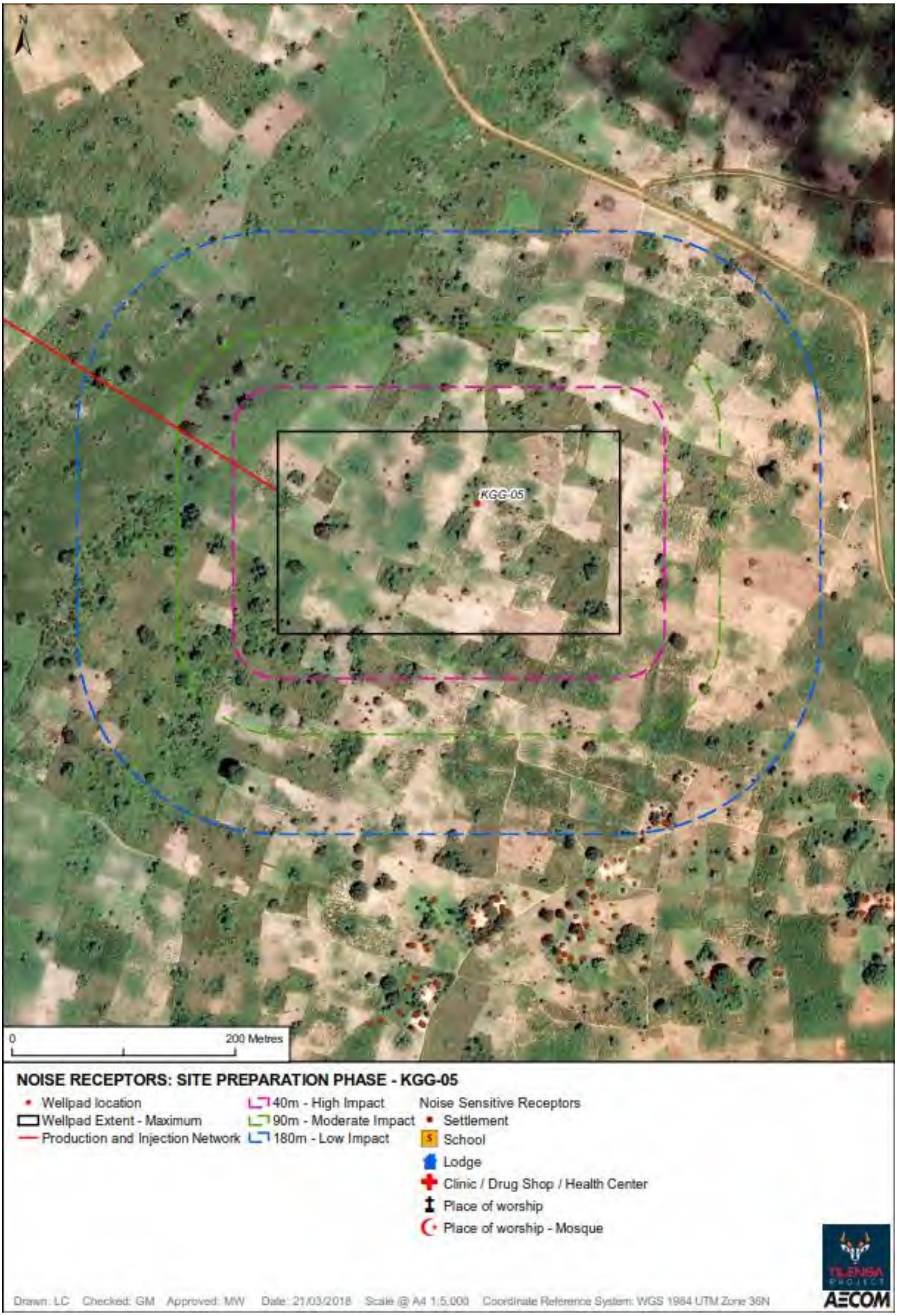


Figure I2-22: KGG-06 Site Preparation and Enabling Works Daytime Receptor Analysis

Figure I2-23: KGG-09 Site Preparation and Enabling Works Daytime Receptor Analysis

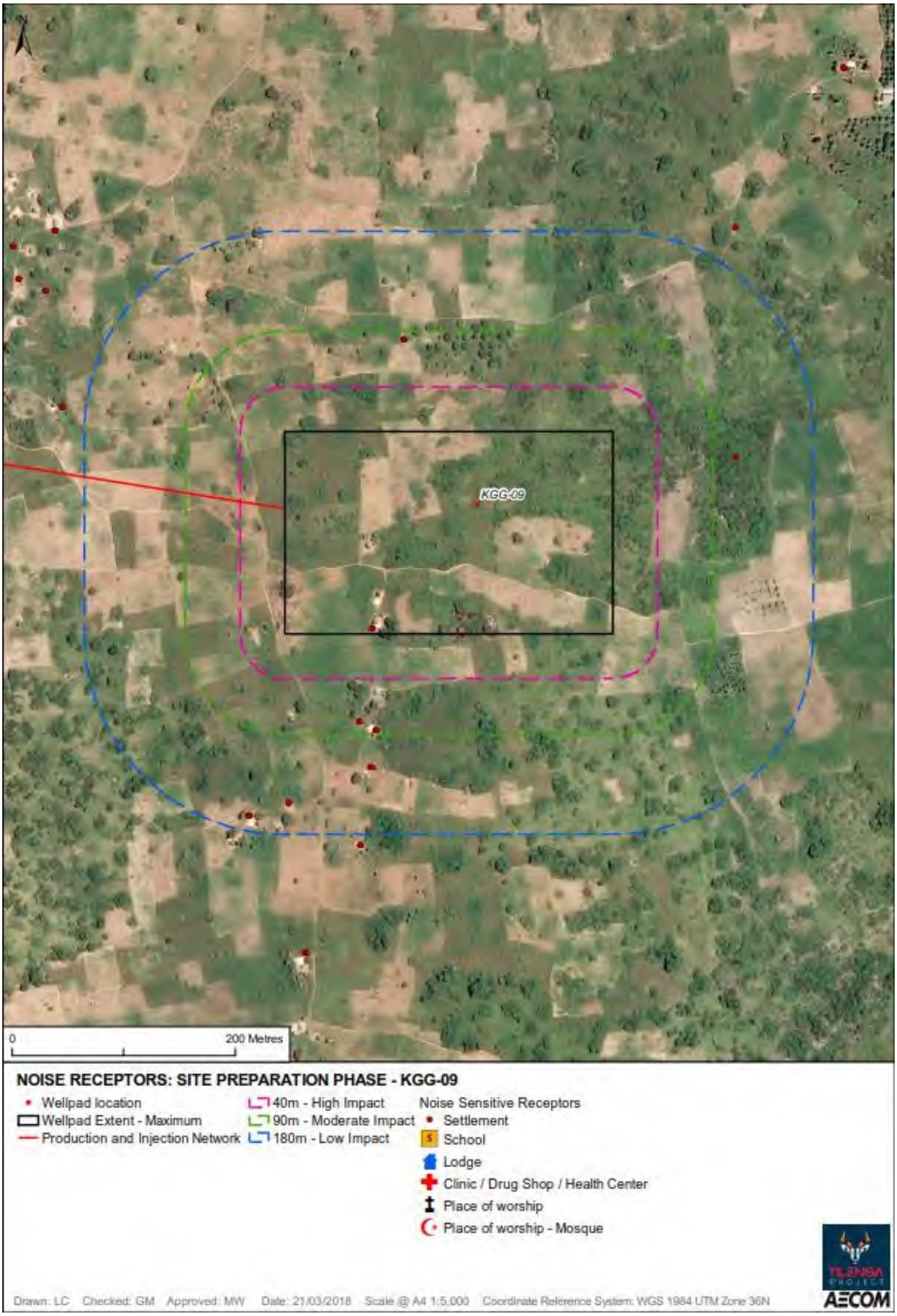


Figure I2-24: KW-01 Site Preparation and Enabling Works Daytime Receptor Analysis

Figure I2-25: KW-02A Site Preparation and Enabling Works Daytime Receptor Analysis

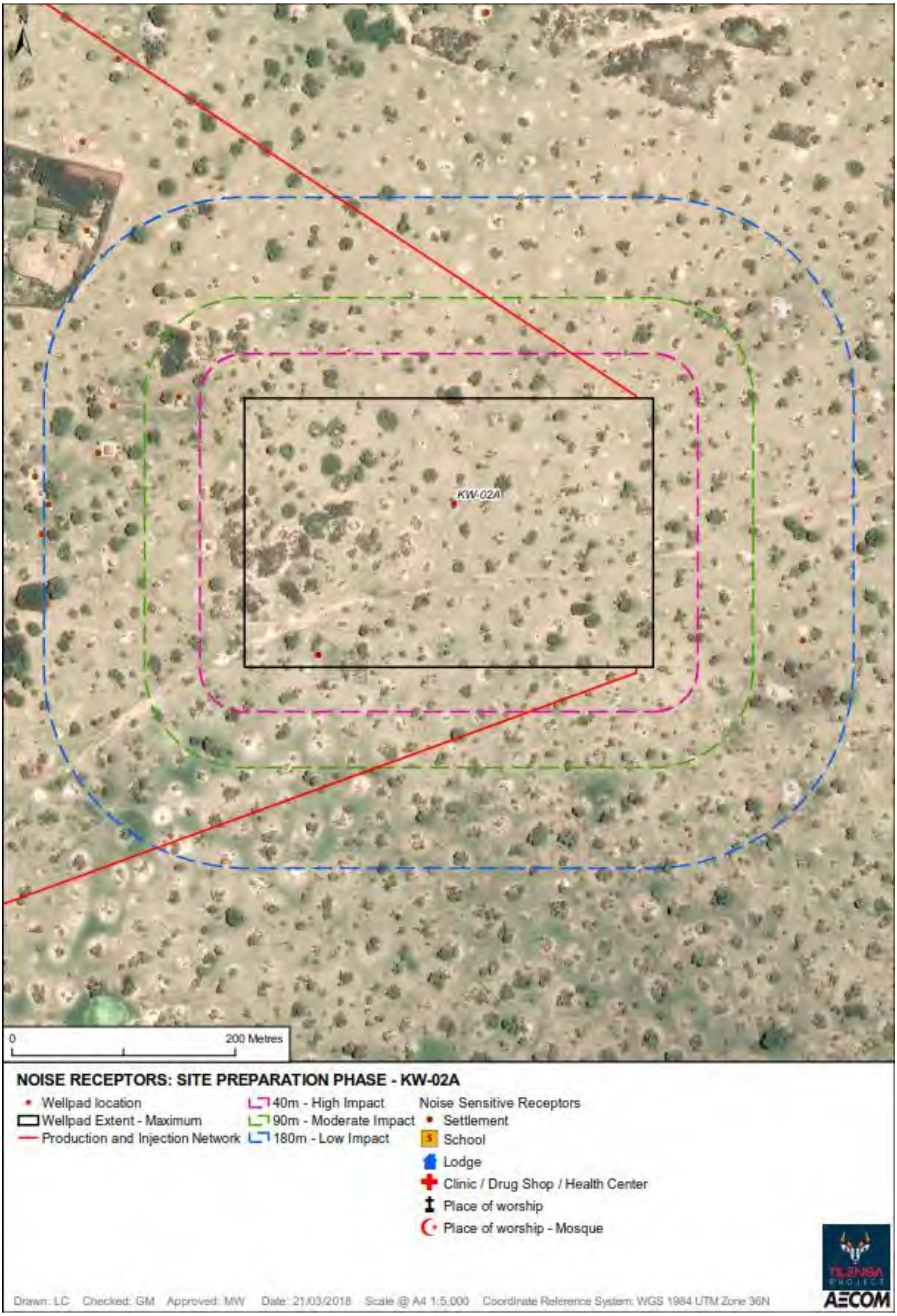


Figure I2-26: KW-02B Site Preparation and Enabling Works Daytime Receptor Analysis

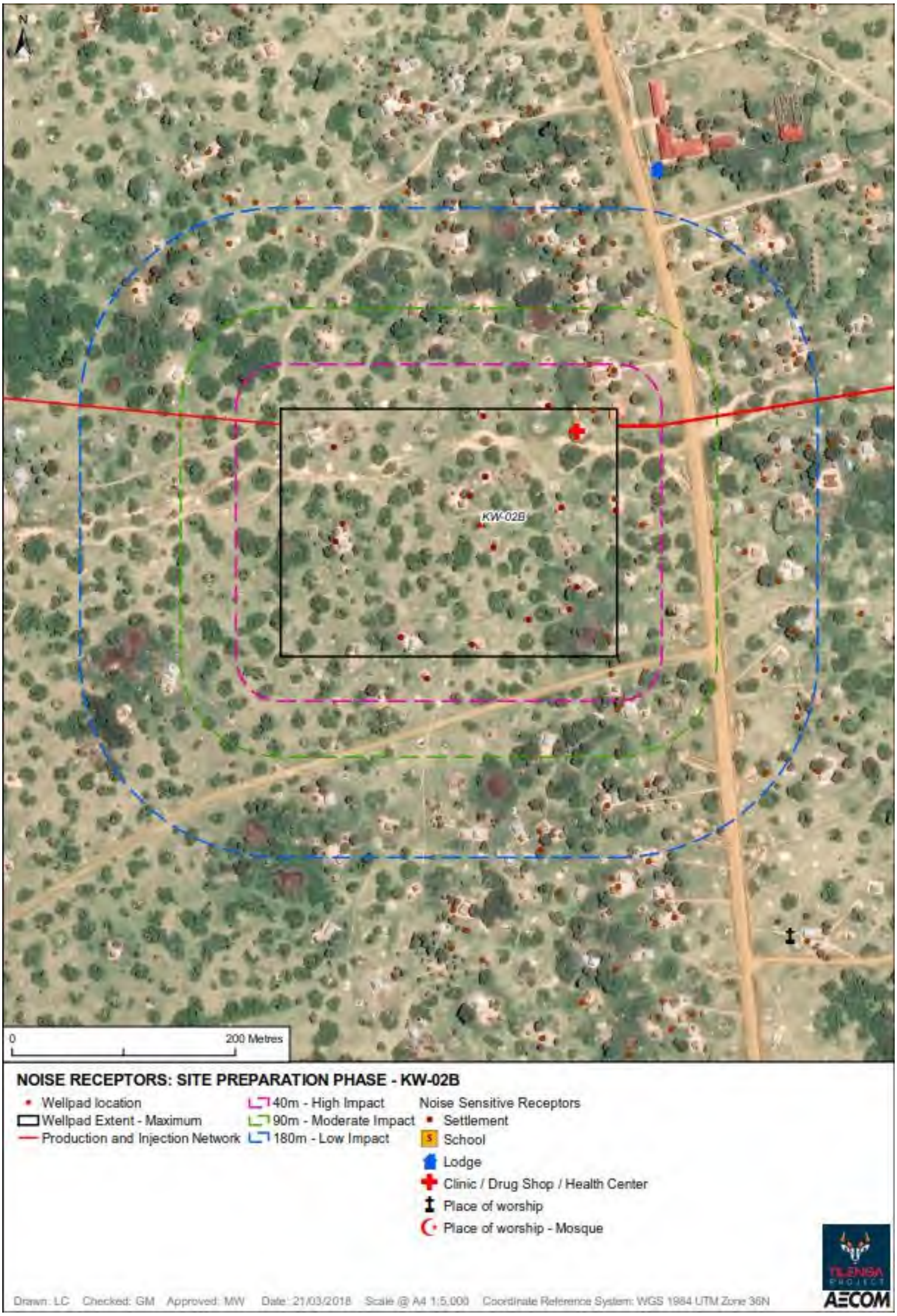


Figure I2-27: NGR-01 Site Preparation and Enabling Works Daytime Receptor Analysis

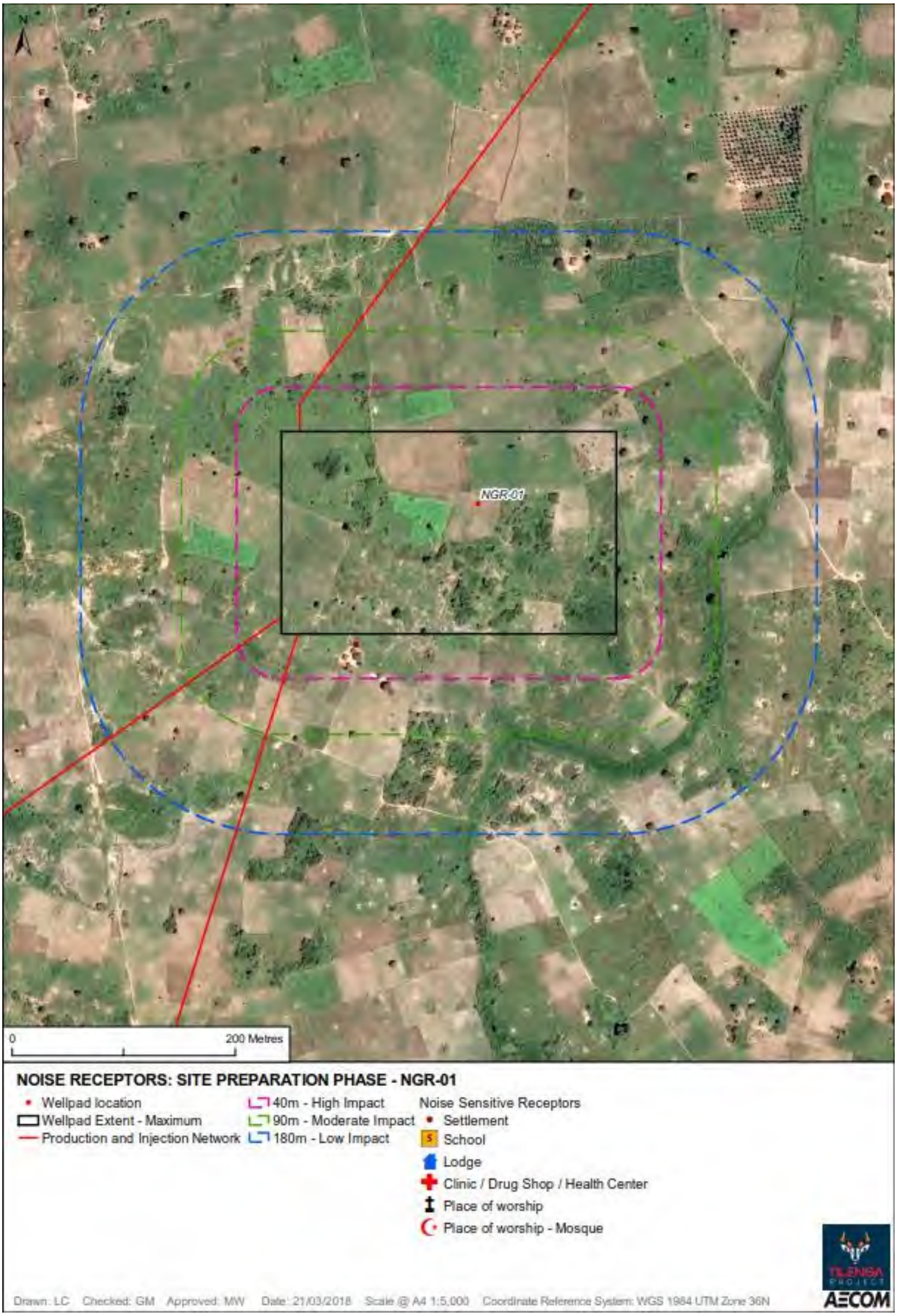


Figure I2-28: NGR-02 Site Preparation and Enabling Works Daytime Receptor Analysis

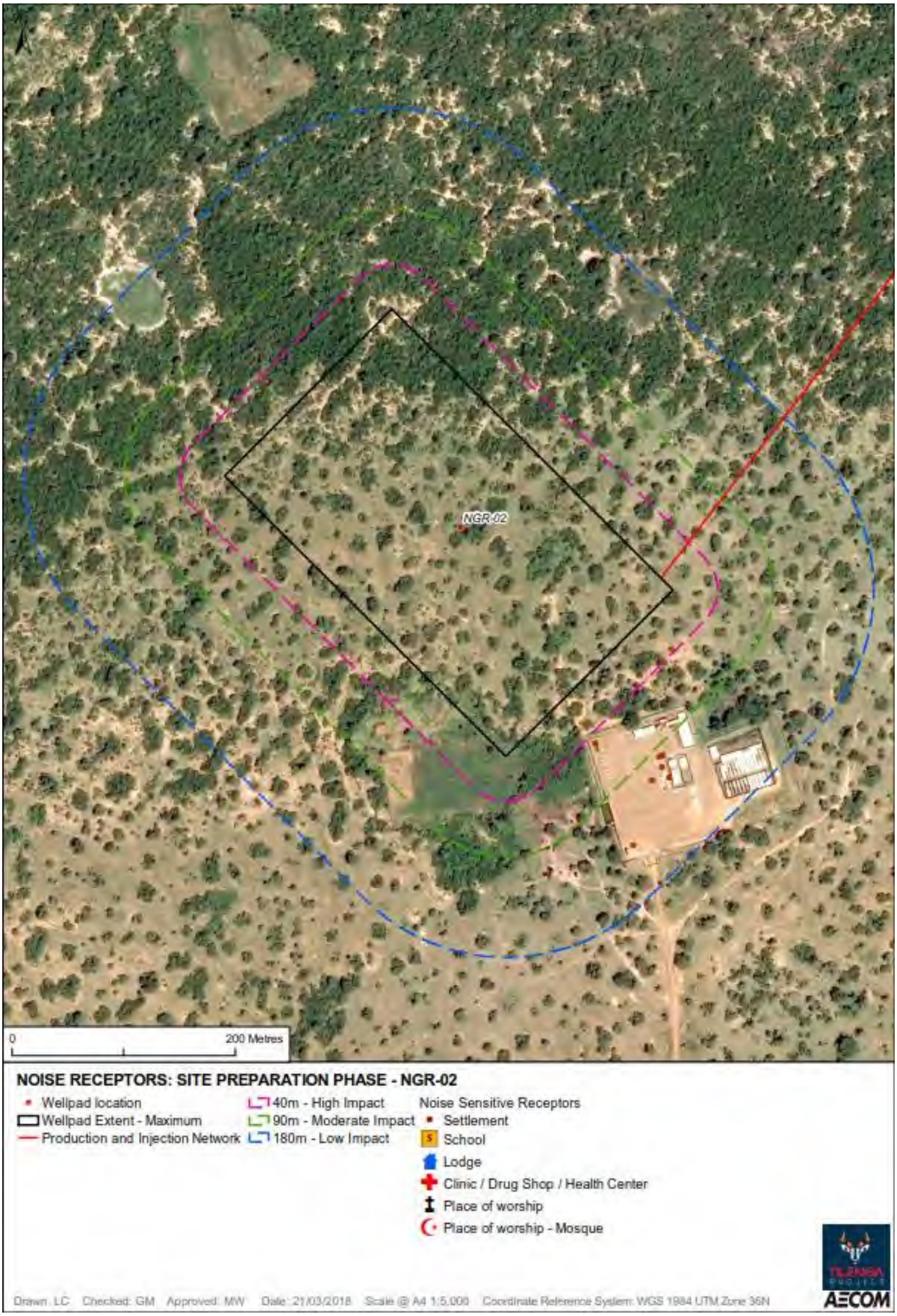


Figure I2-29: NGR-03A Site Preparation and Enabling Works Daytime Receptor Analysis

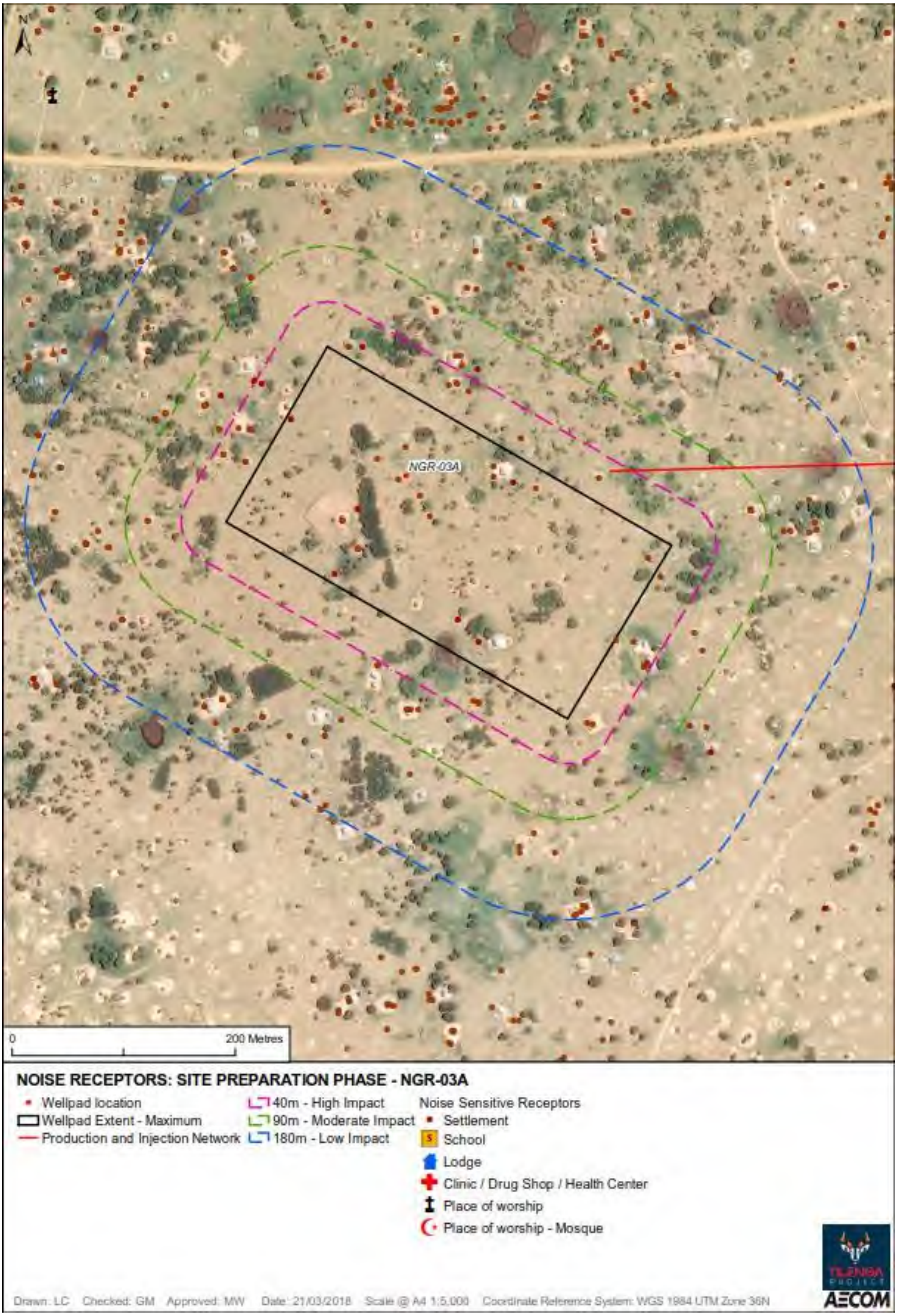


Figure I2-30: NGR-05A Site Preparation and Enabling Works Daytime Receptor Analysis

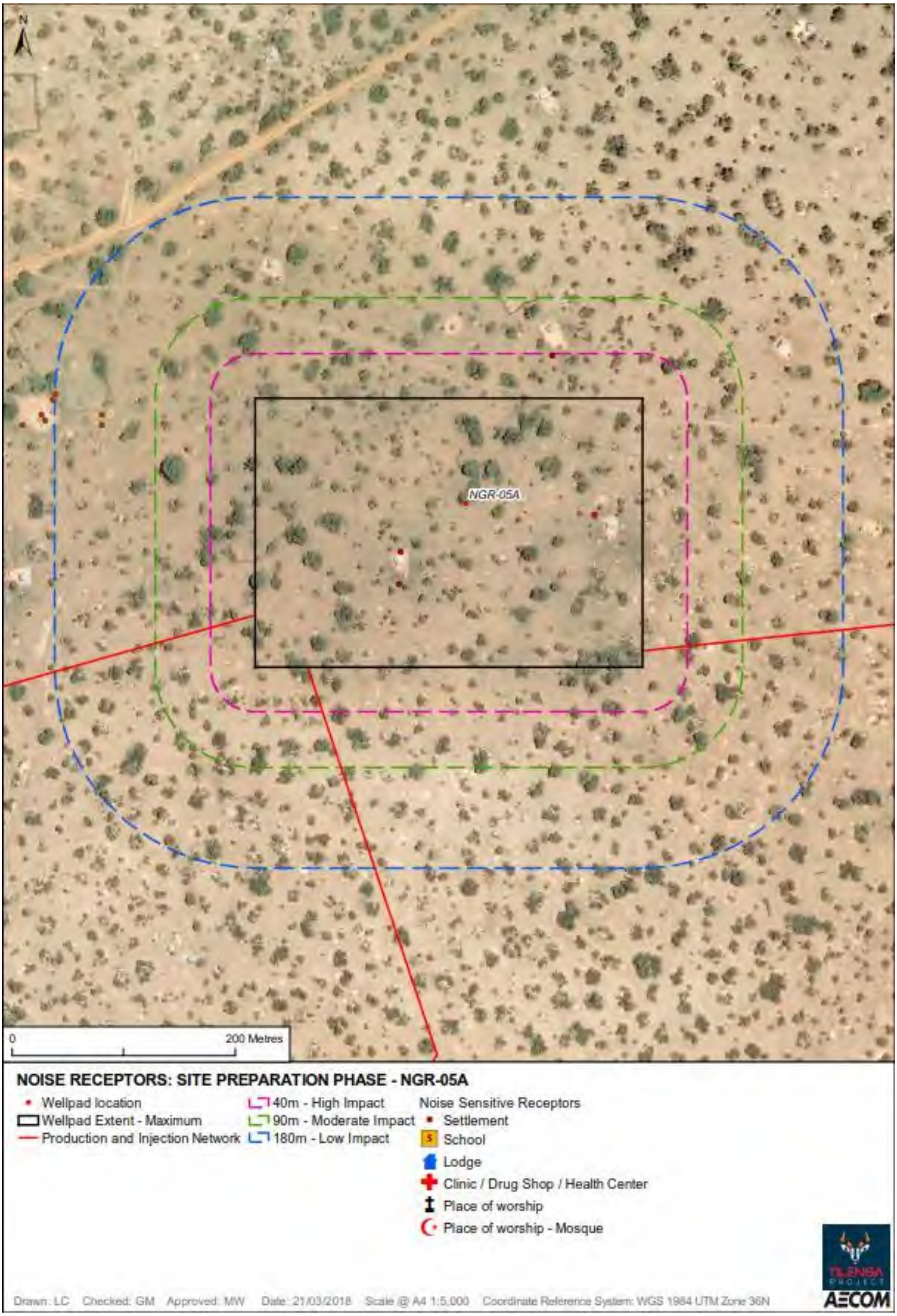


Figure I2-31: NGR-06 Site Preparation and Enabling Works Daytime Receptor Analysis

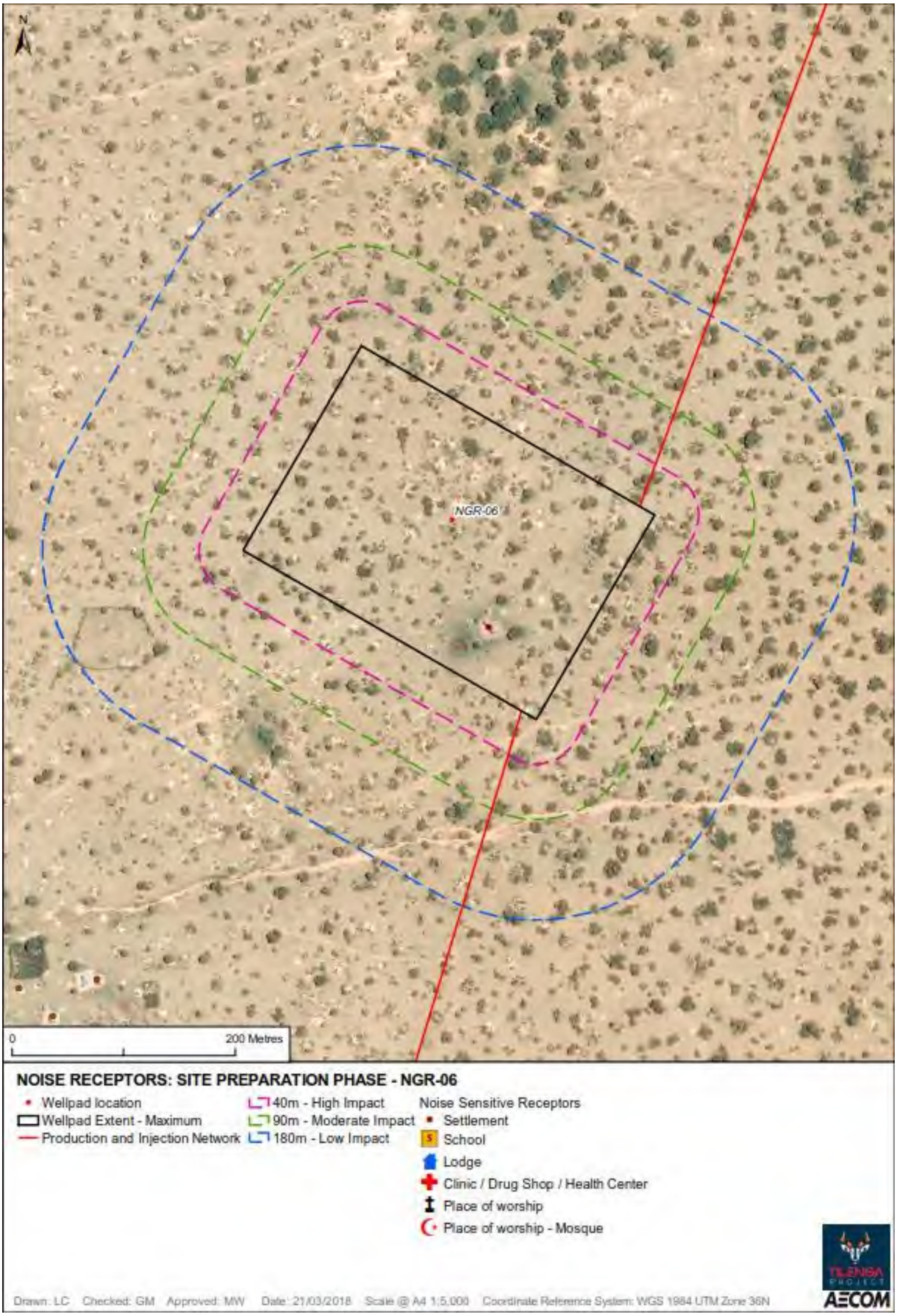


Figure I2-32: NSO-01 Site Preparation and Enabling Works Daytime Receptor Analysis

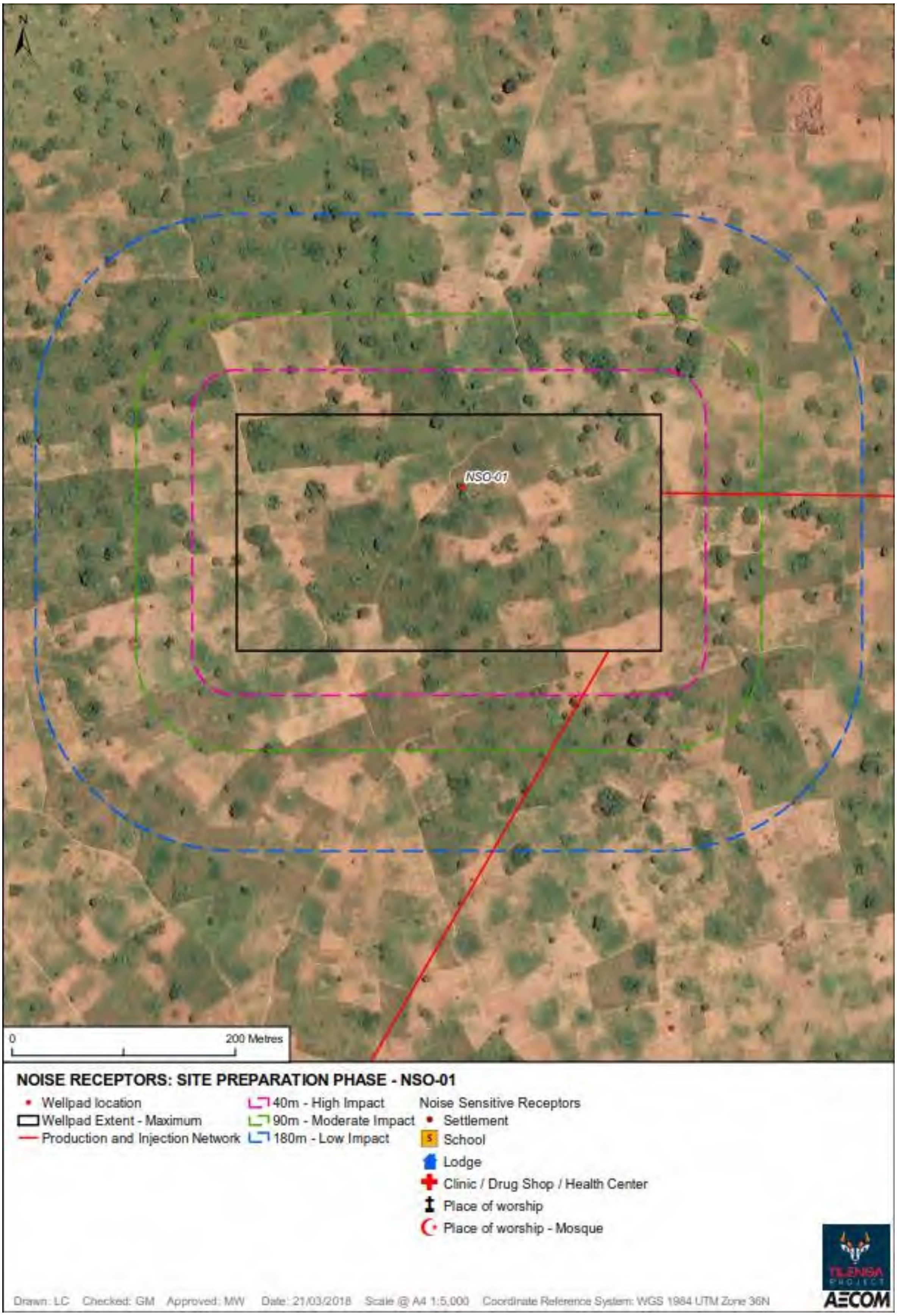


Figure I2-33: NSO-02 Site Preparation and Enabling Works Daytime Receptor Analysis

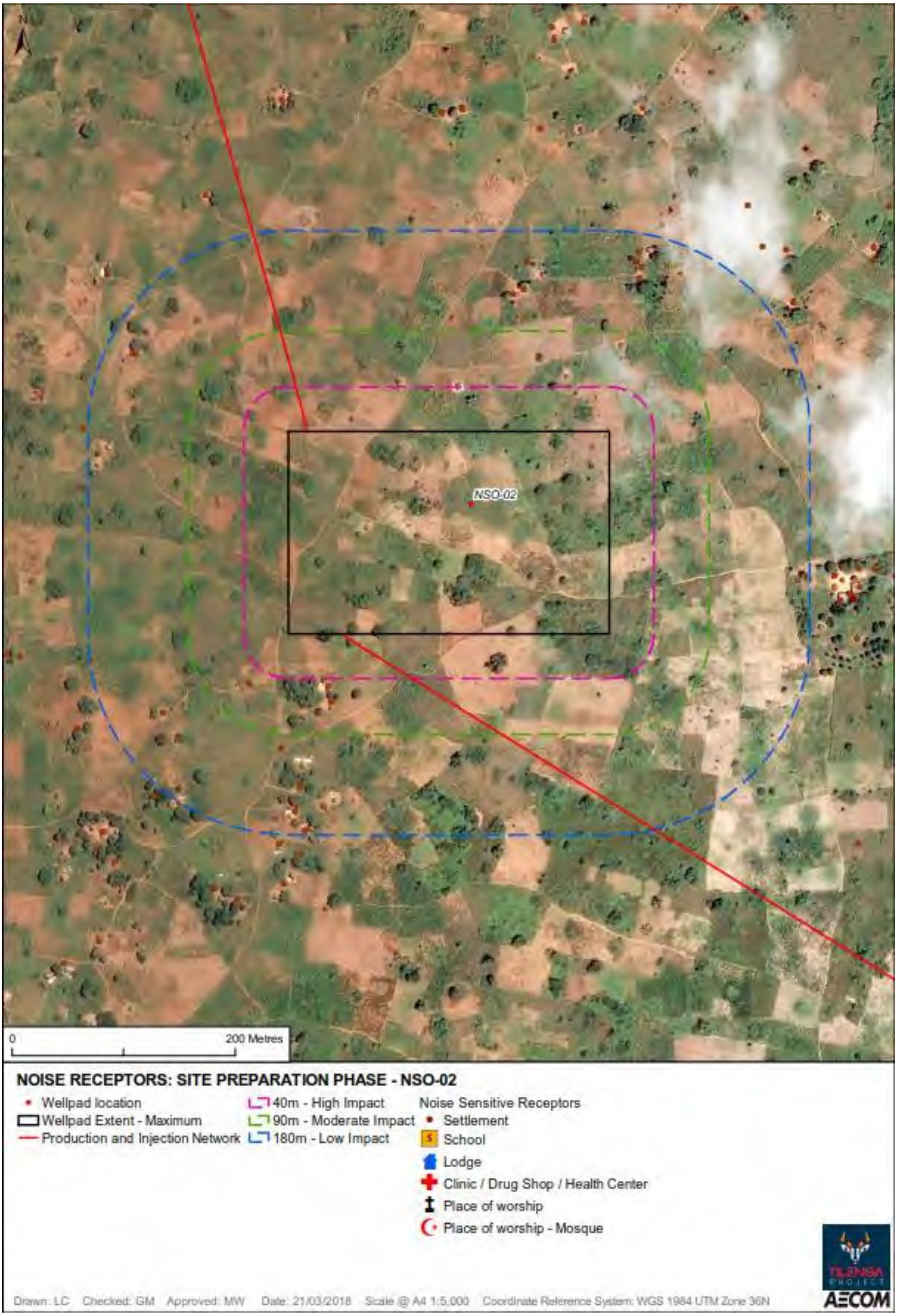


Figure I2-34: NSO-03 Site Preparation and Enabling Works Daytime Receptor Analysis

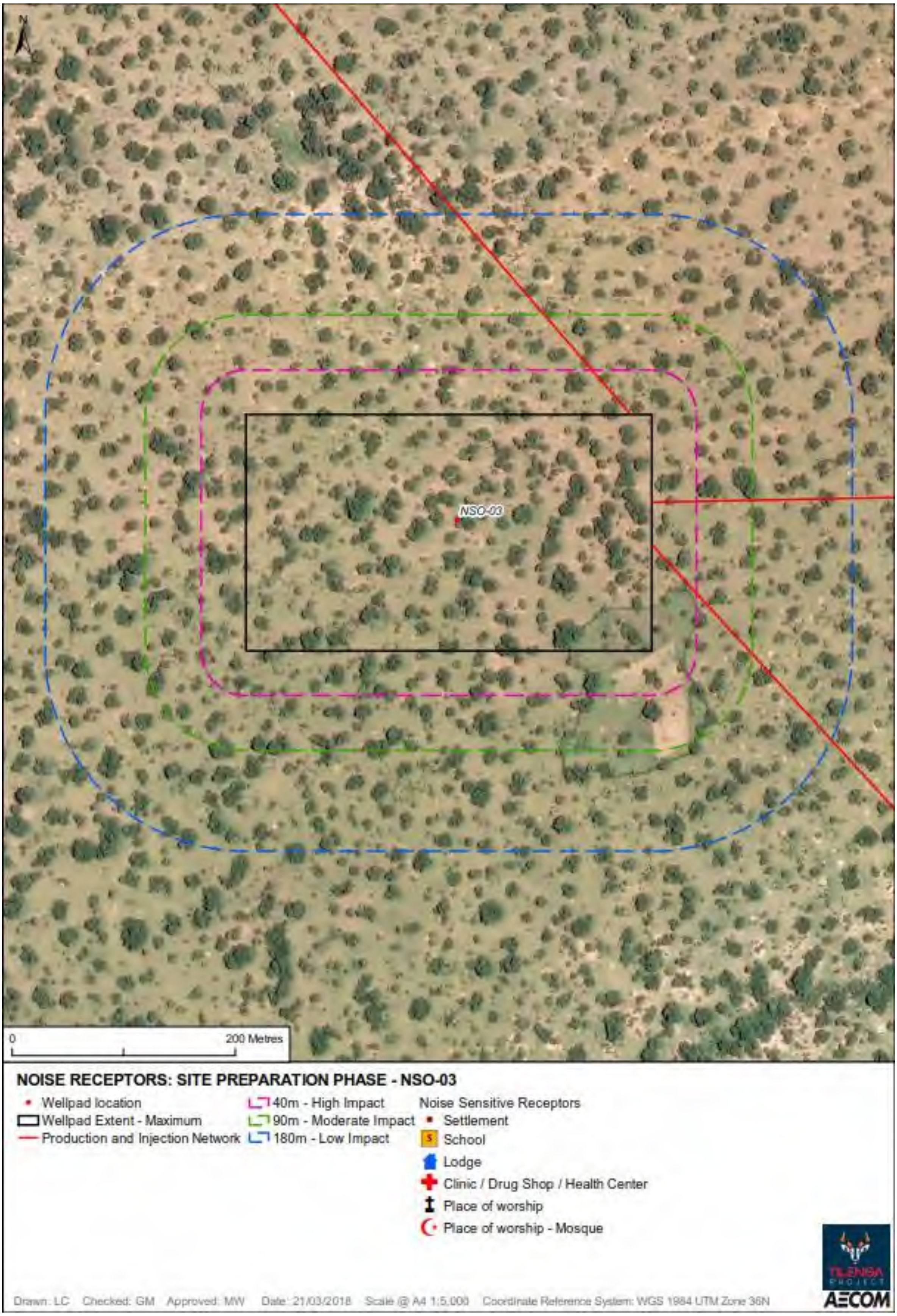


Figure I2-35: NSO-04 Site Preparation and Enabling Works Daytime Receptor Analysis

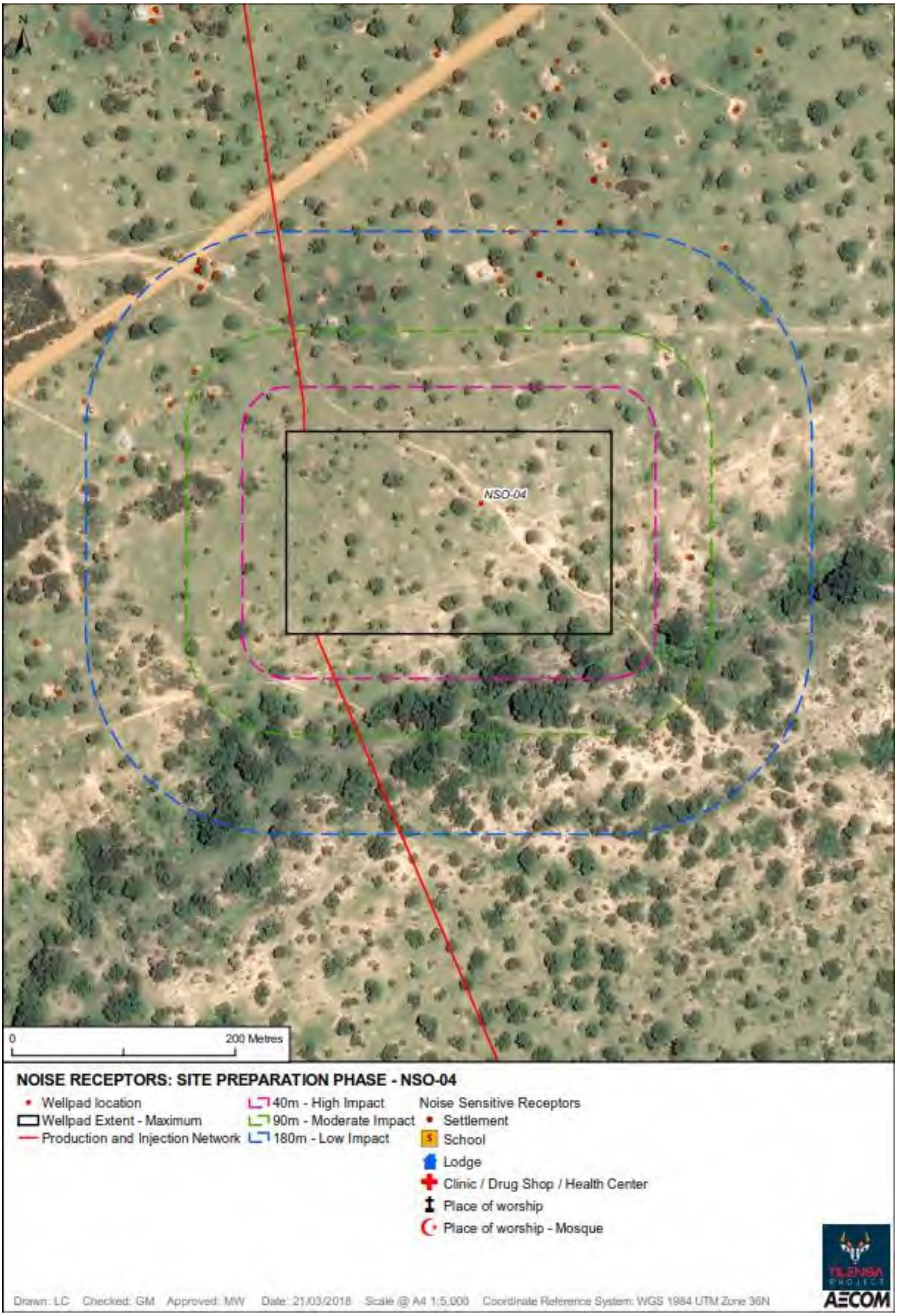


Figure I2-36: NSO-05 Site Preparation and Enabling Works Daytime Receptor Analysis

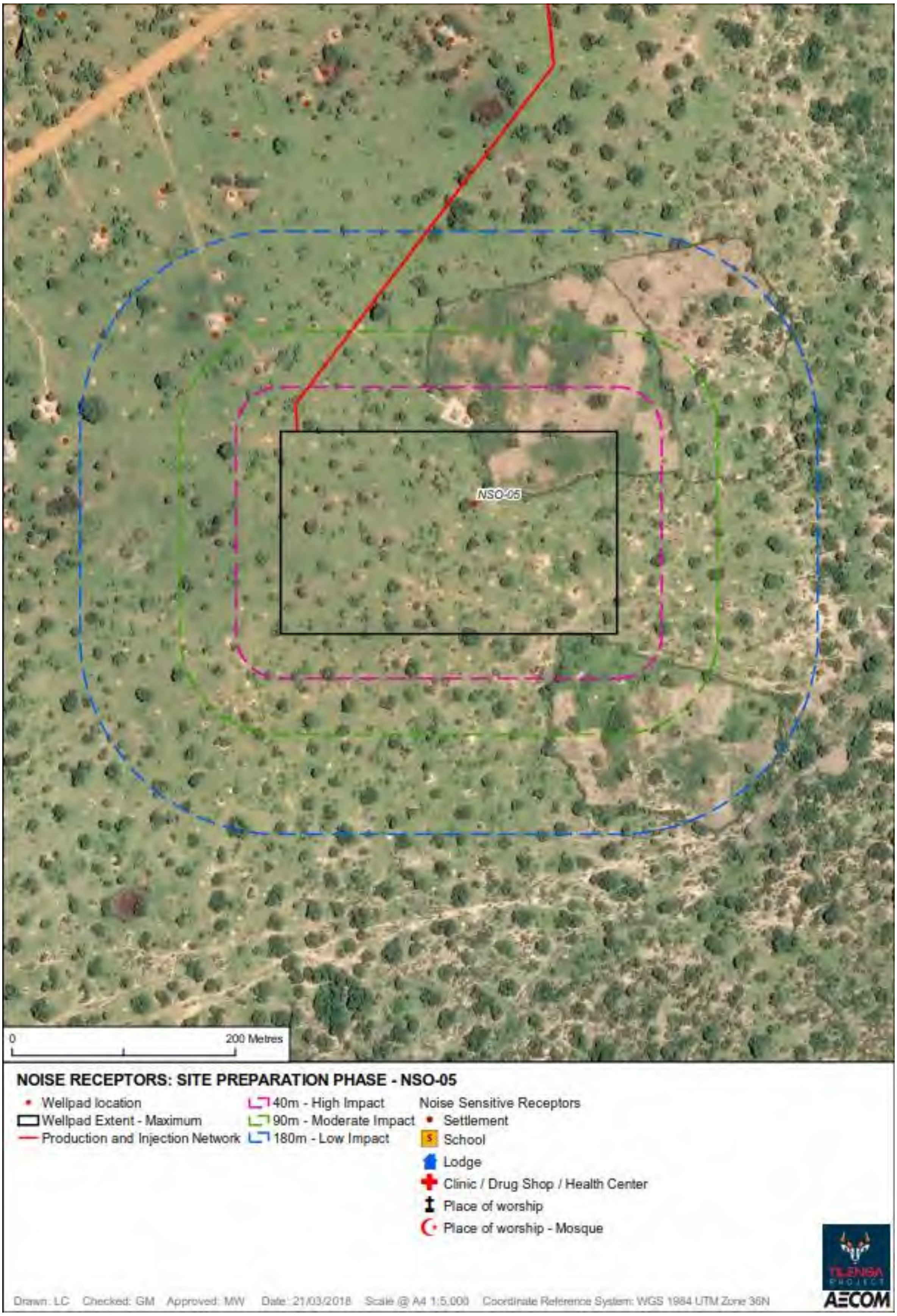


Figure I2-37: NSO-06 Site Preparation and Enabling Works Daytime Receptor Analysis

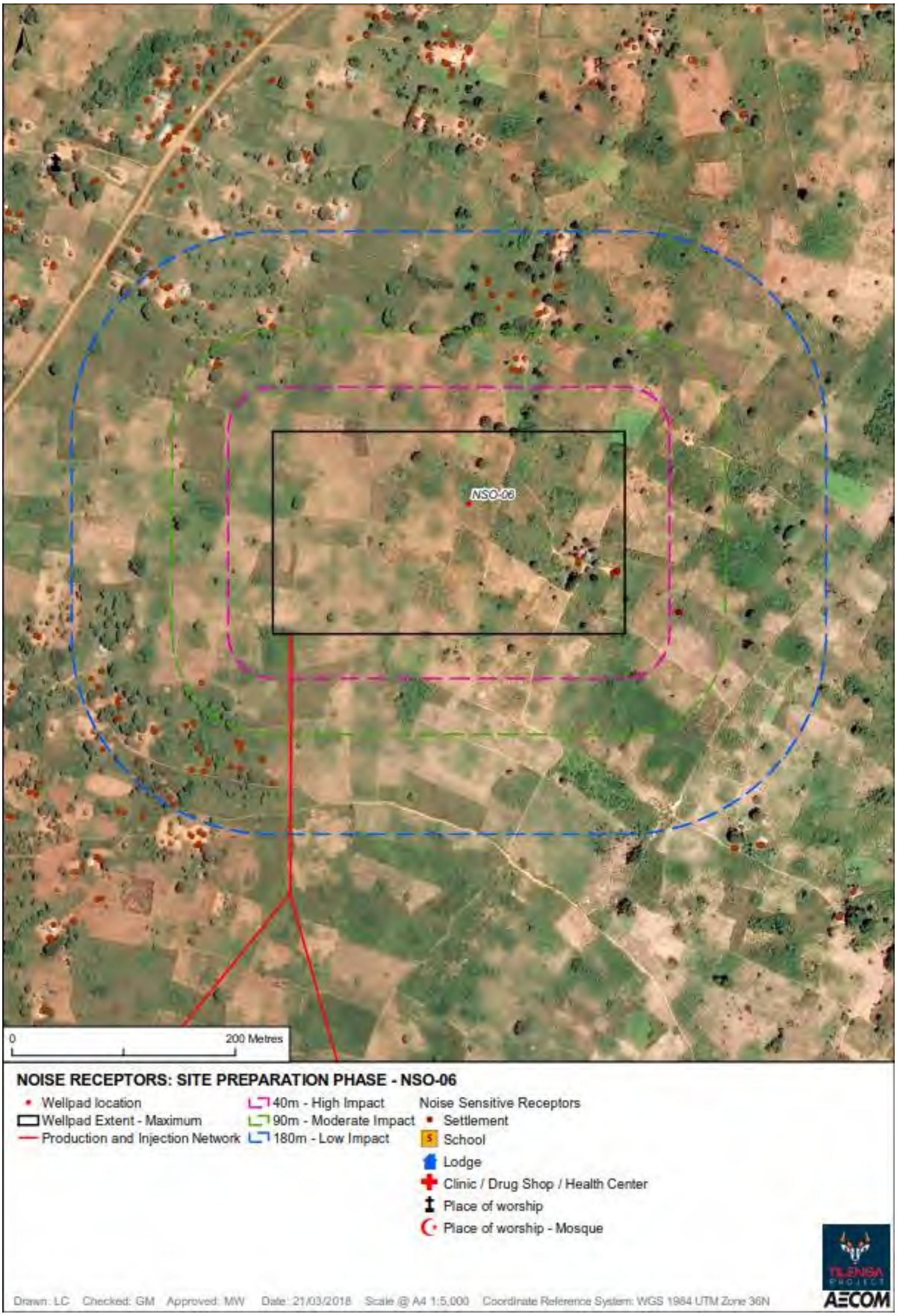
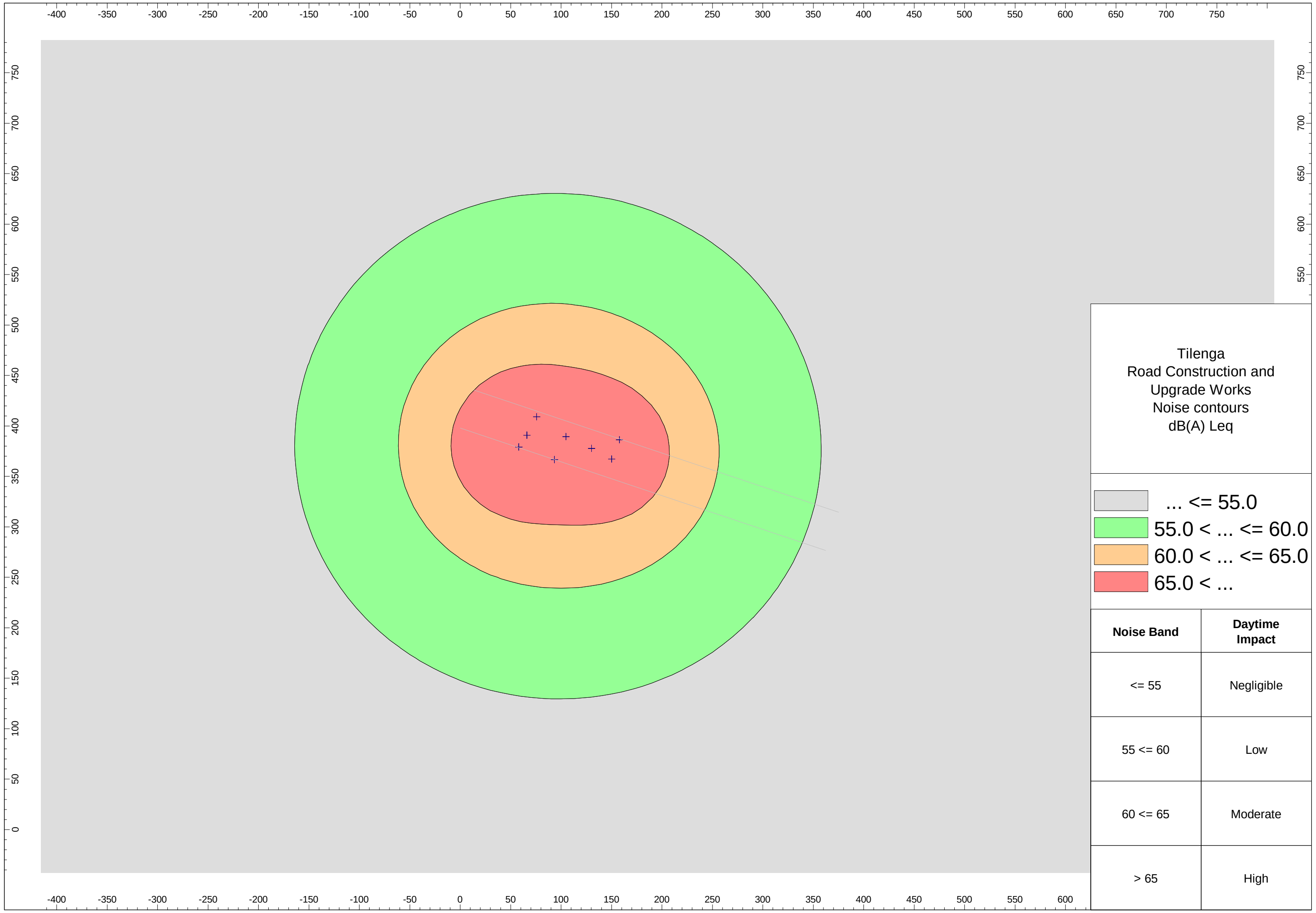


Figure I2-38: Road Construction Daytime Noise Contours



Noise Band	Daytime Impact
<= 55	Negligible
55 <= 60	Low
60 <= 65	Moderate
> 65	High

The assessment of noise due to road construction/ upgrade works is presented in Section 7.6.3.2.7

Figure I2-39: Road Construction Receptor Analysis – Road A1

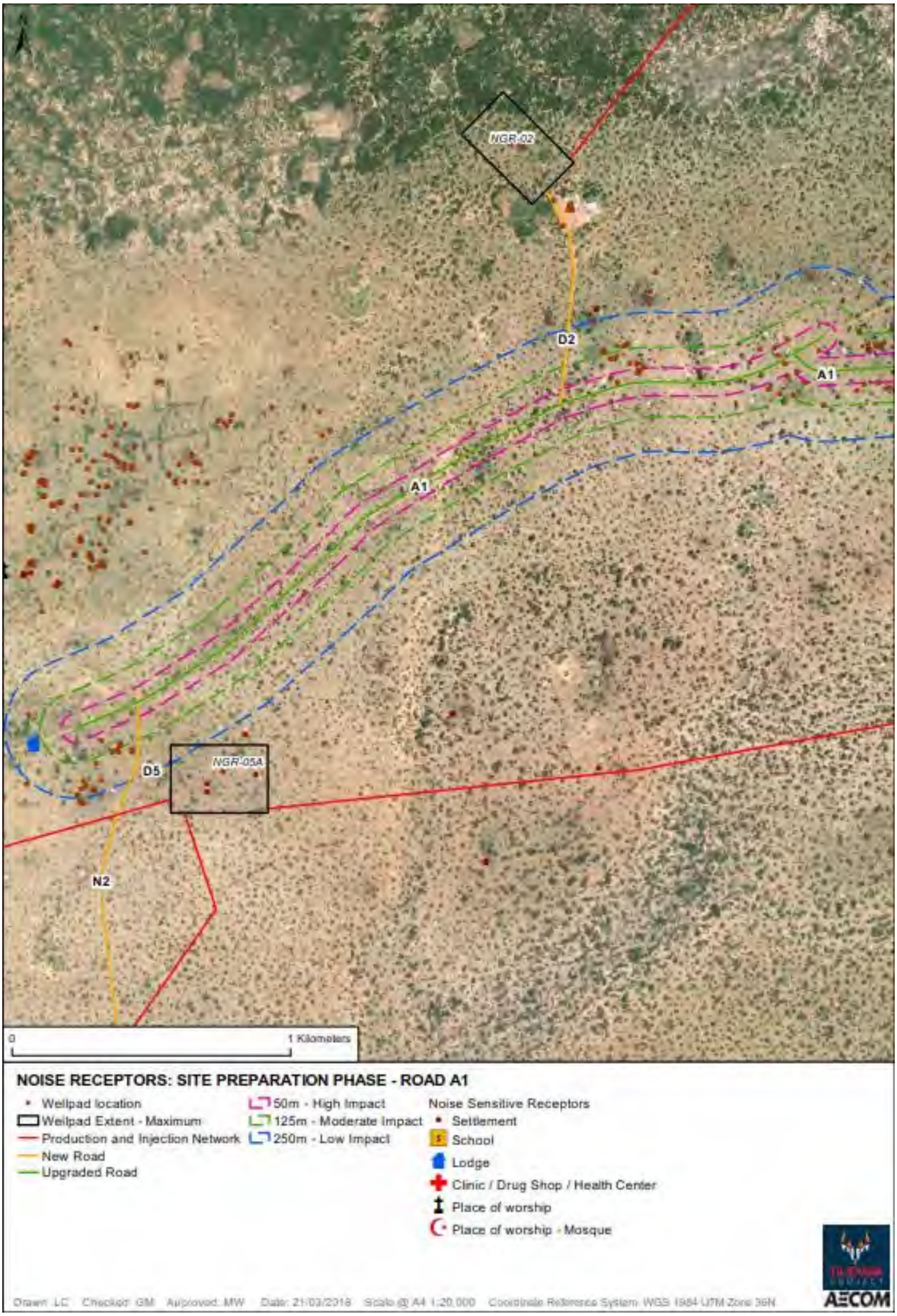


Figure I2-40: Road Construction Receptor Analysis – Road A1

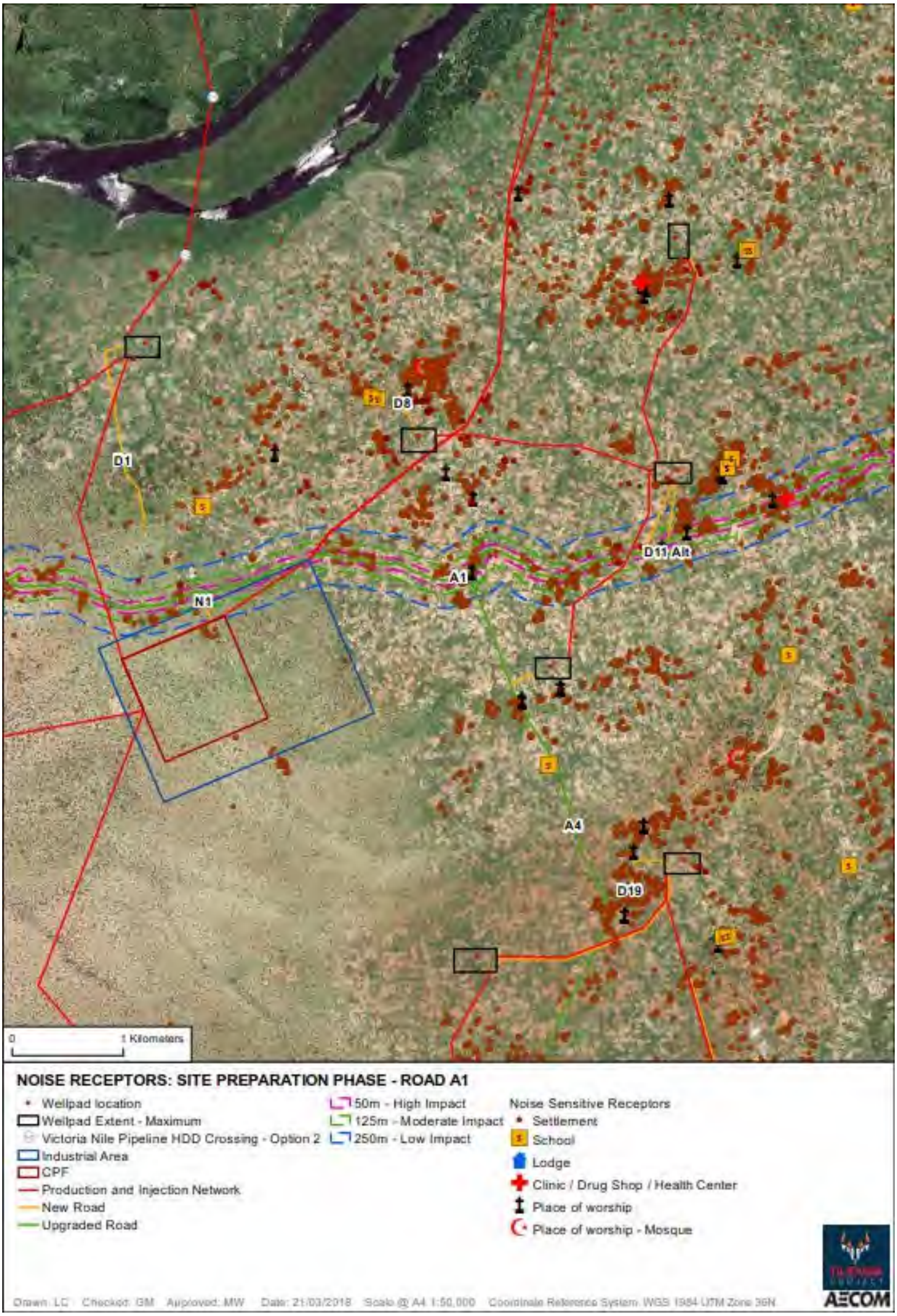


Figure I2-41: Road Construction Receptor Analysis – Road A2

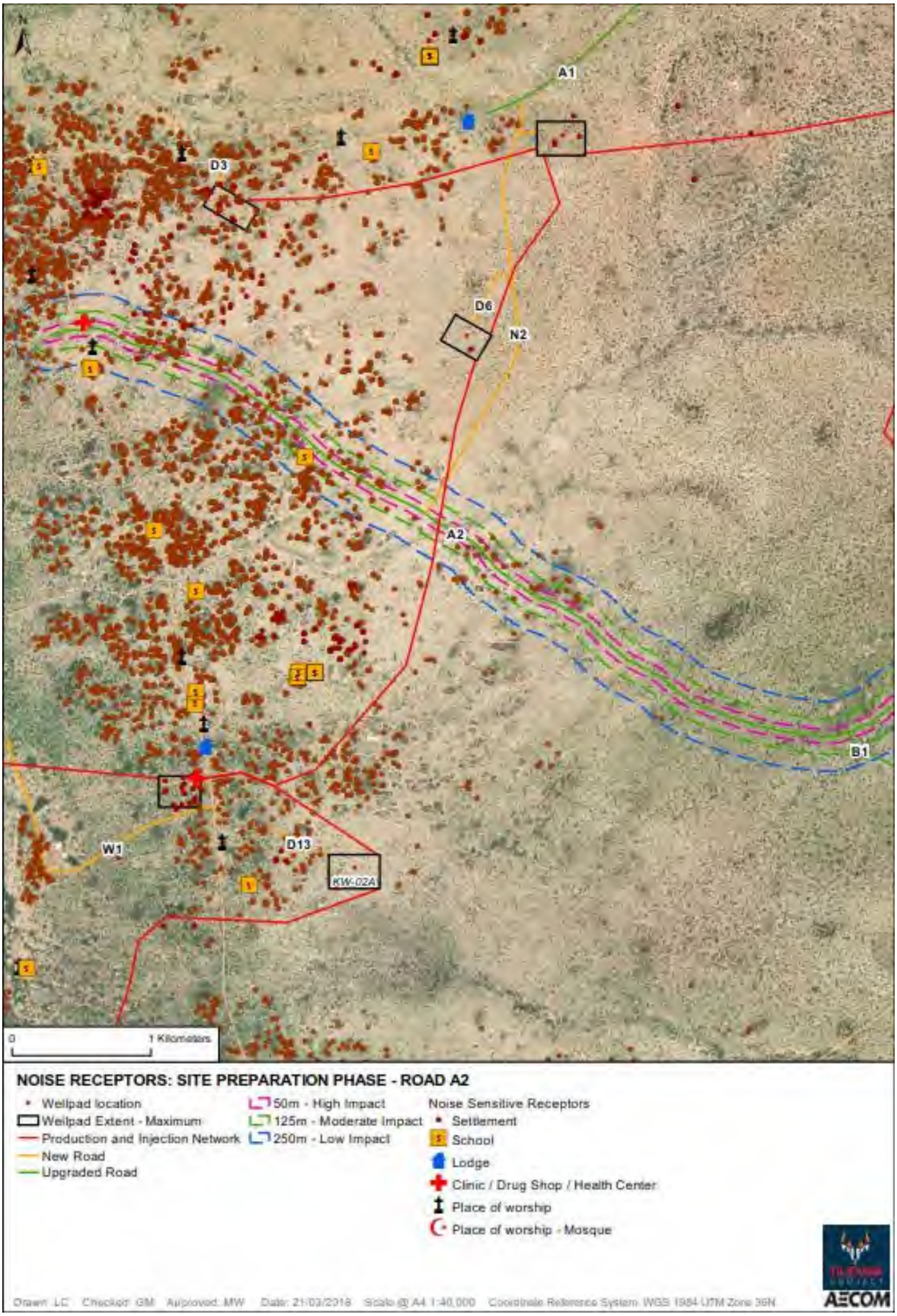


Figure I2-42: Road Construction Receptor Analysis – Road A2

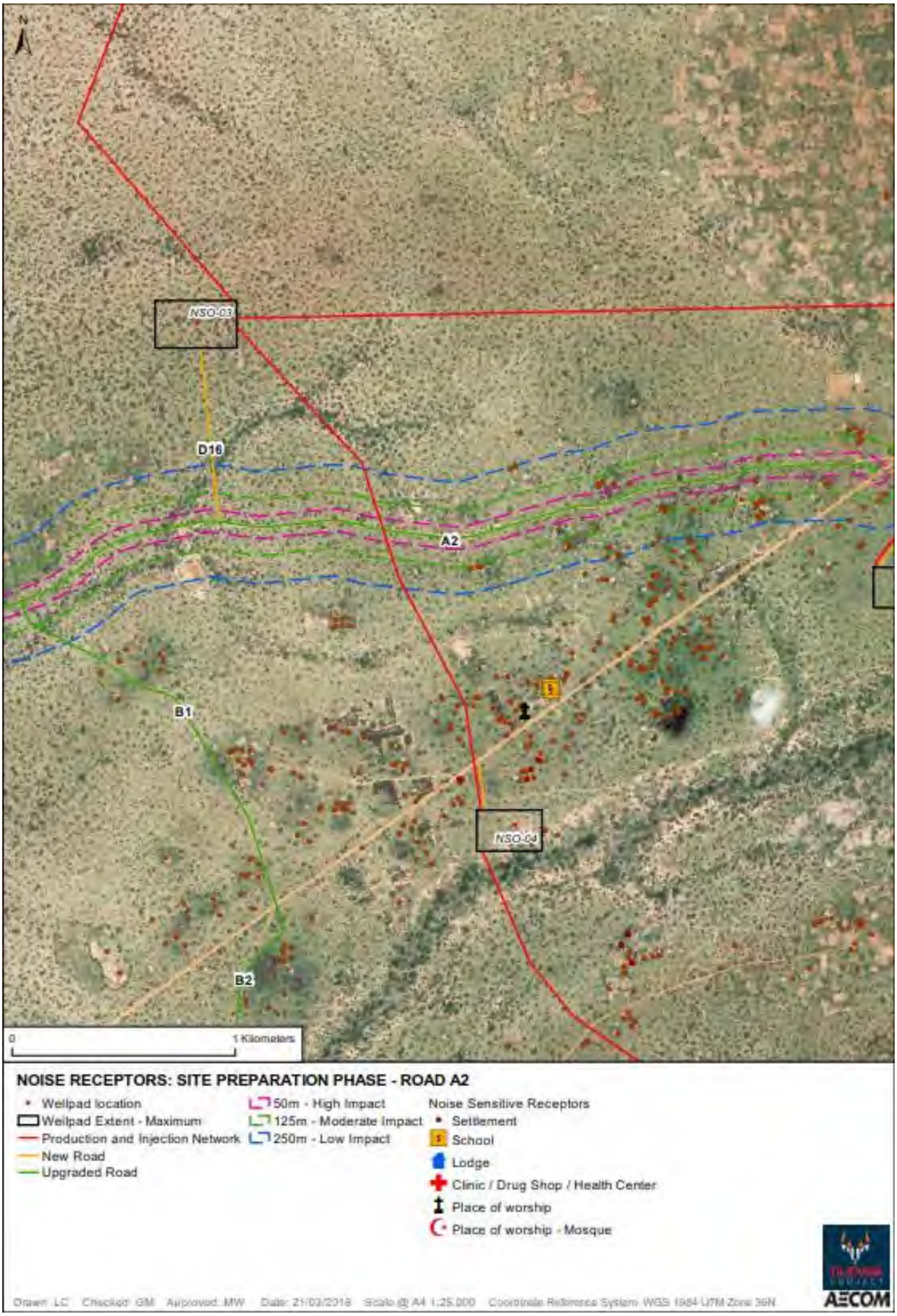


Figure I2-43: Road Construction Receptor Analysis – Road A3

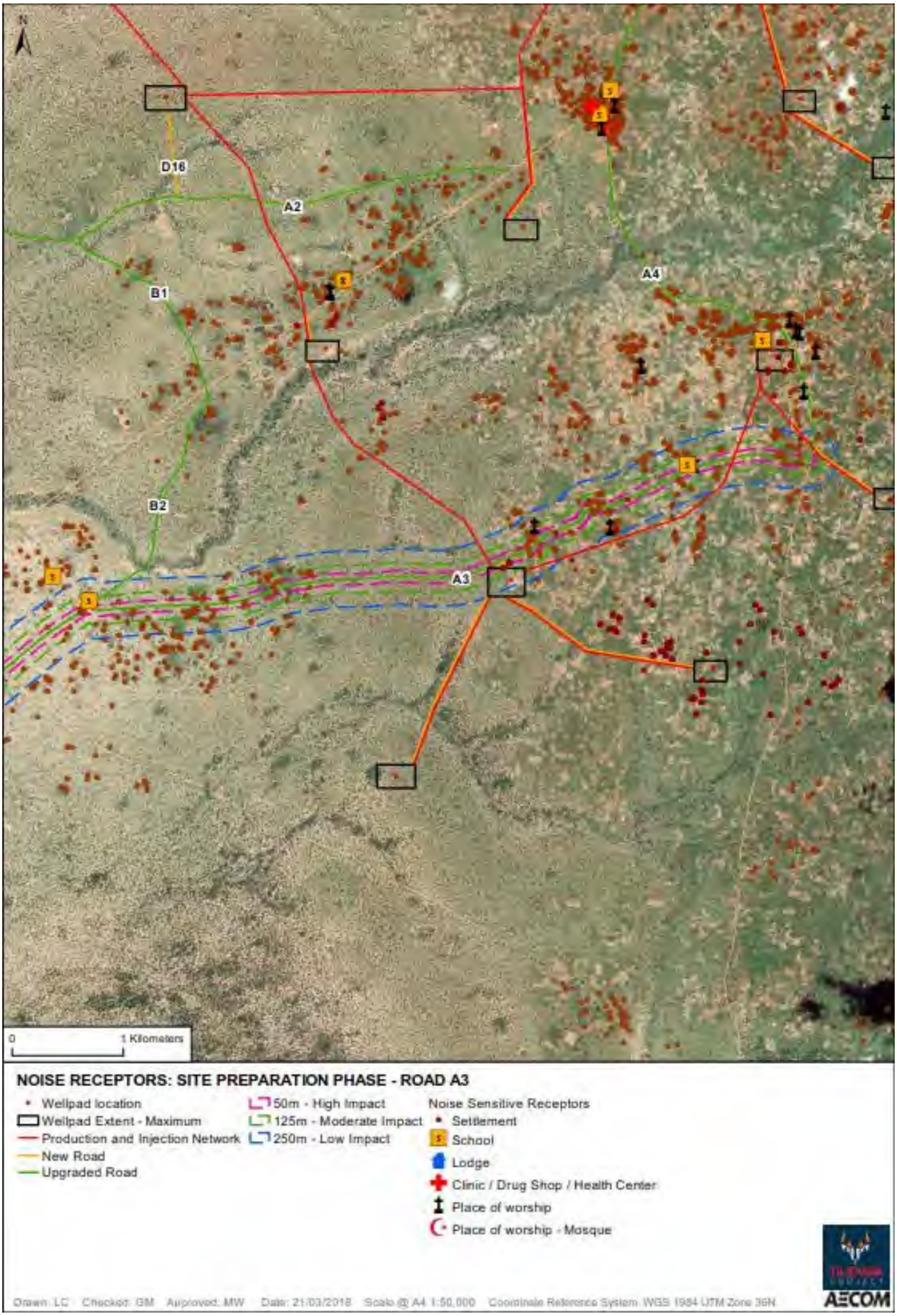


Figure I2-44: Road Construction Receptor Analysis – Road A3

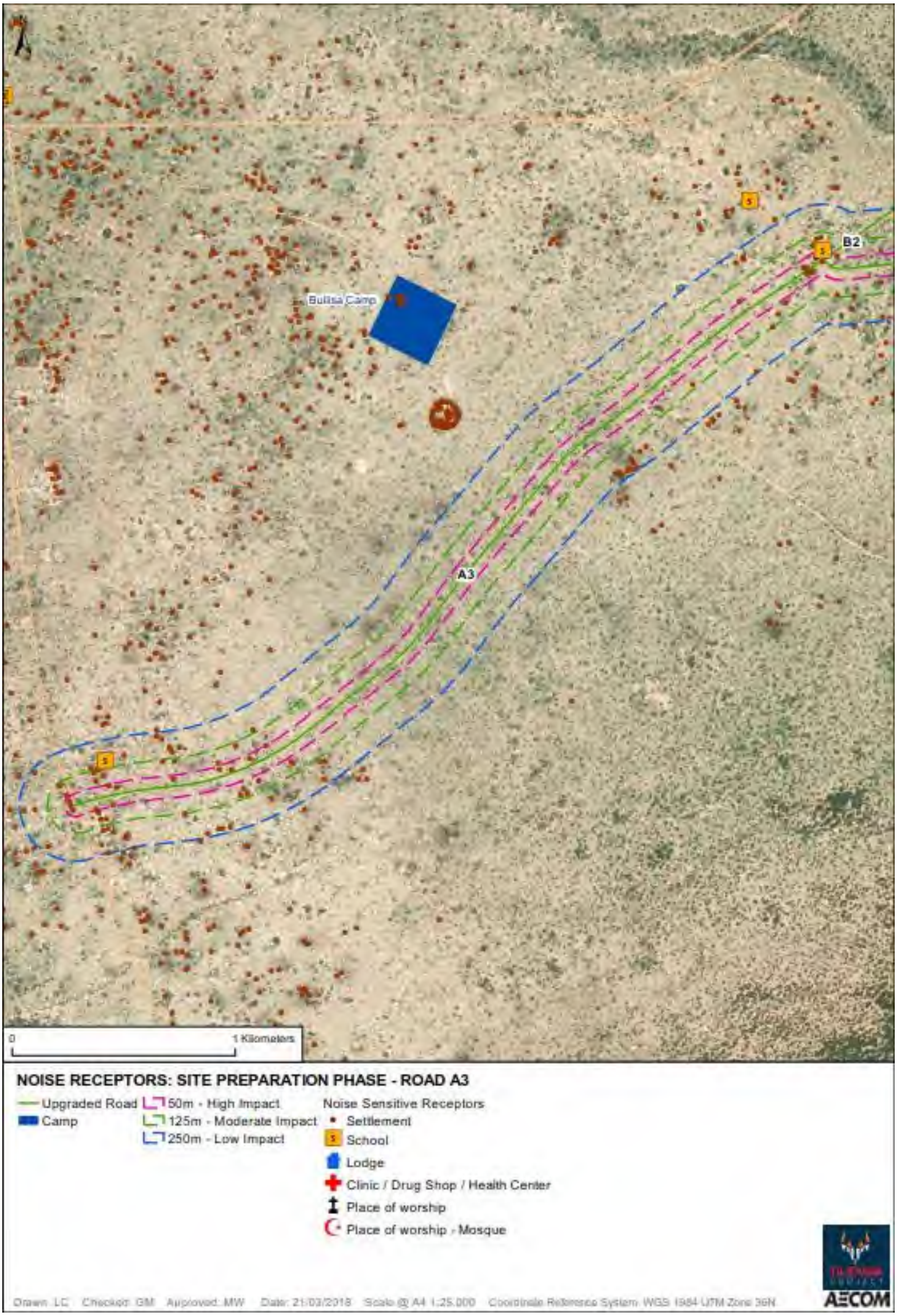


Figure I2-45: Road Construction Receptor Analysis – Road A4

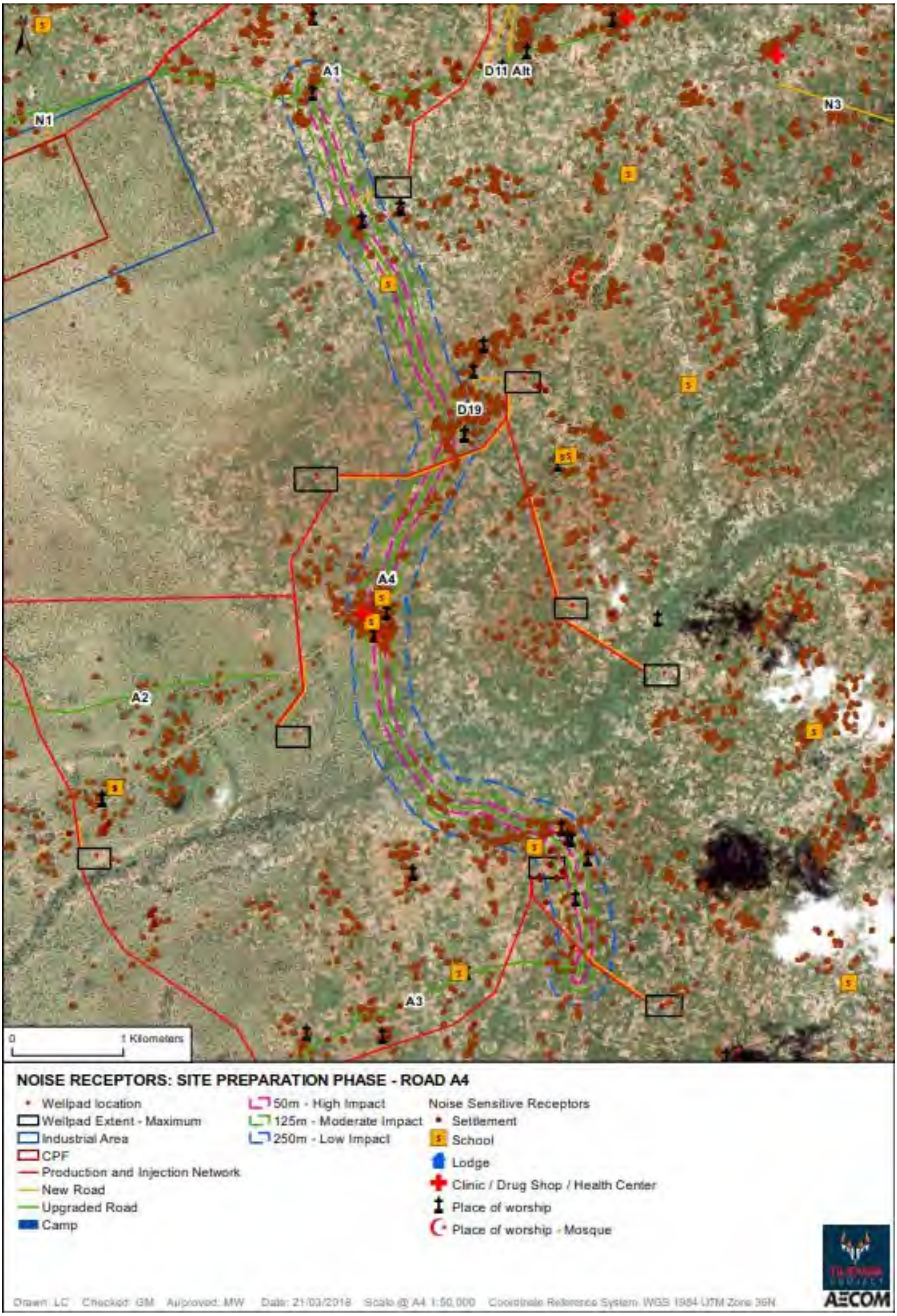


Figure I2-46: Road Construction Receptor Analysis – Road B1

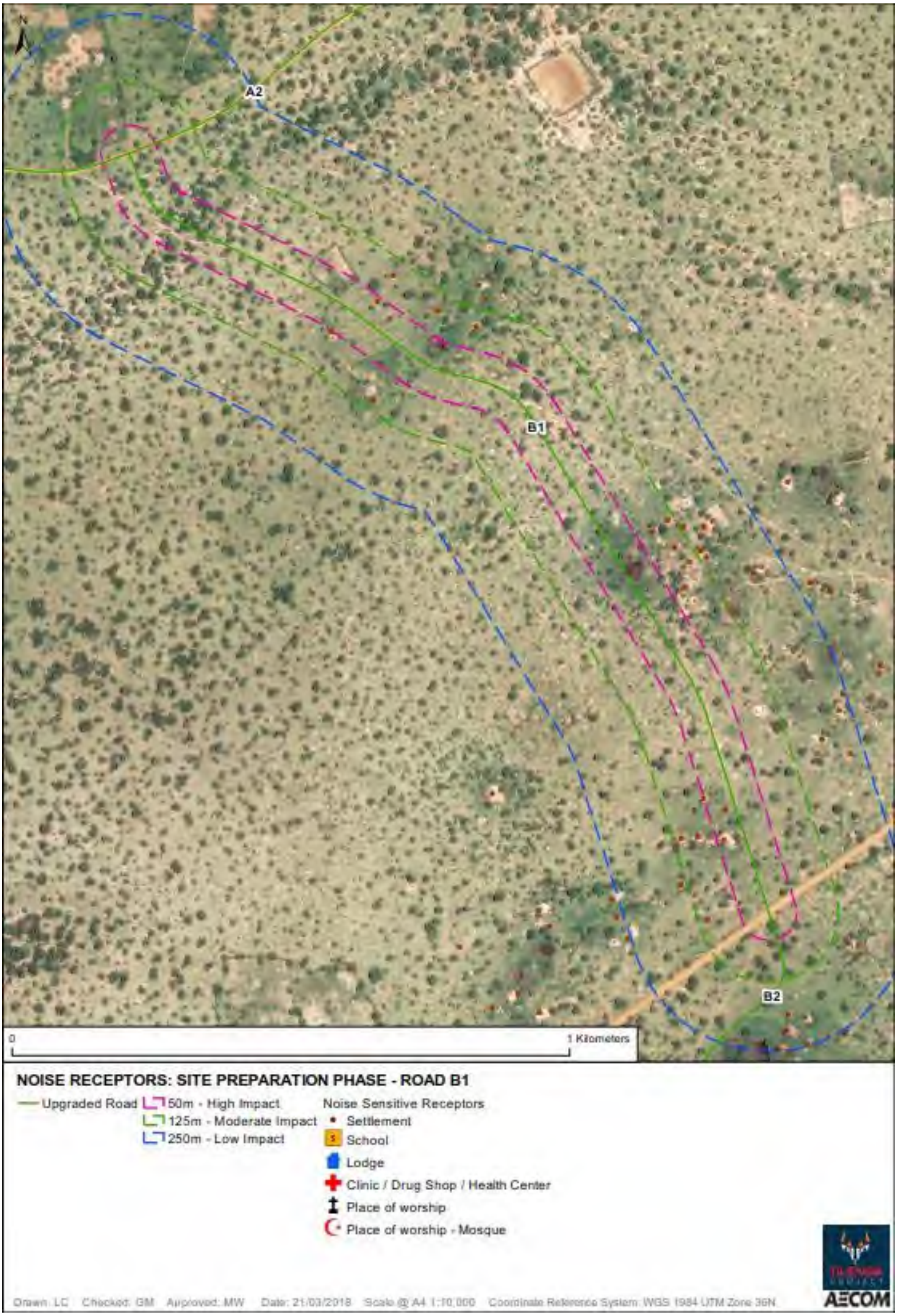


Figure I2-47: Road Construction Receptor Analysis – Road B2

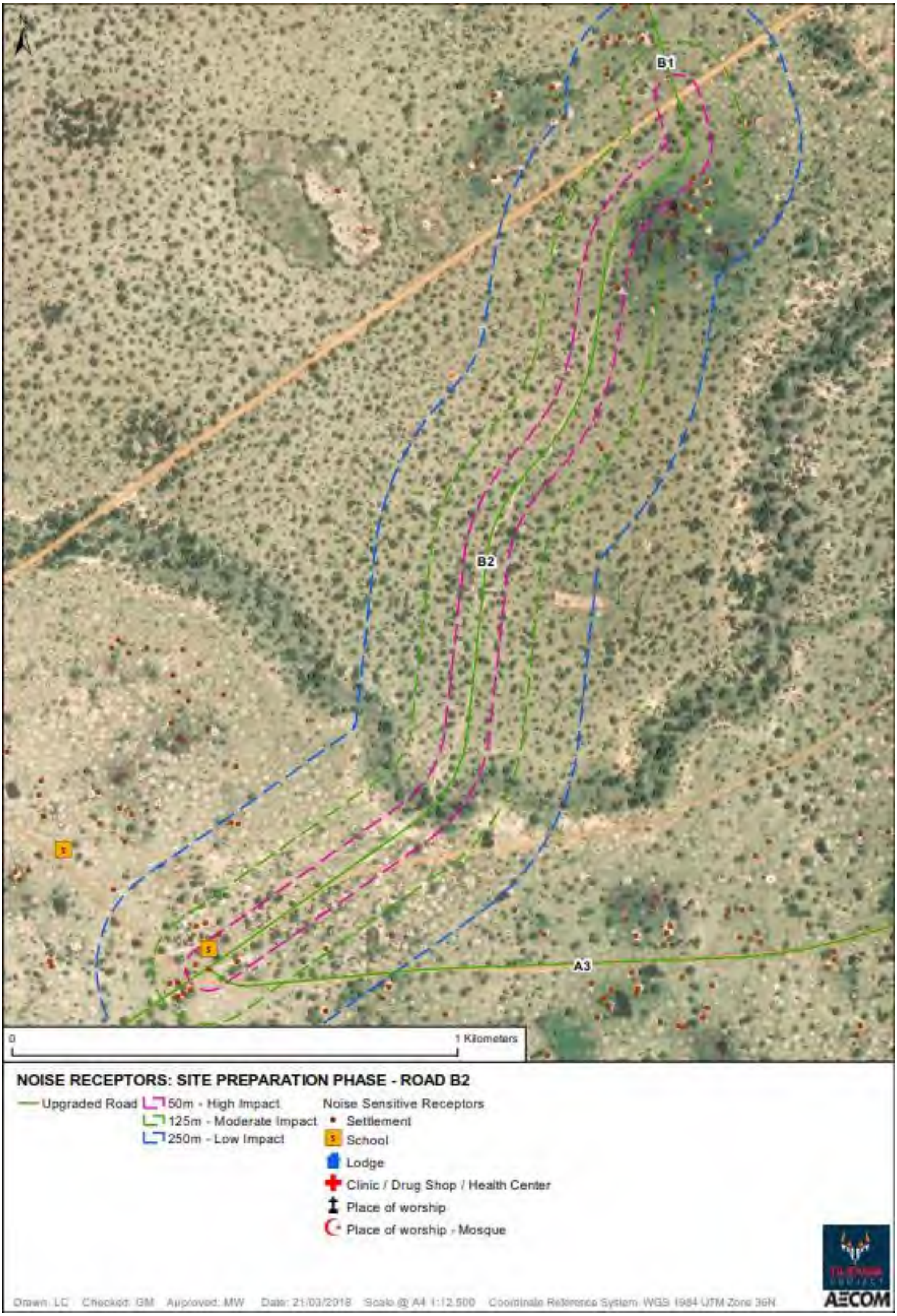


Figure I2-48: Road Construction Receptor Analysis – Road C1

Figure I2-49: Road Construction Receptor Analysis – Road C2

Figure I2-50: Road Construction Receptor Analysis – Road C3

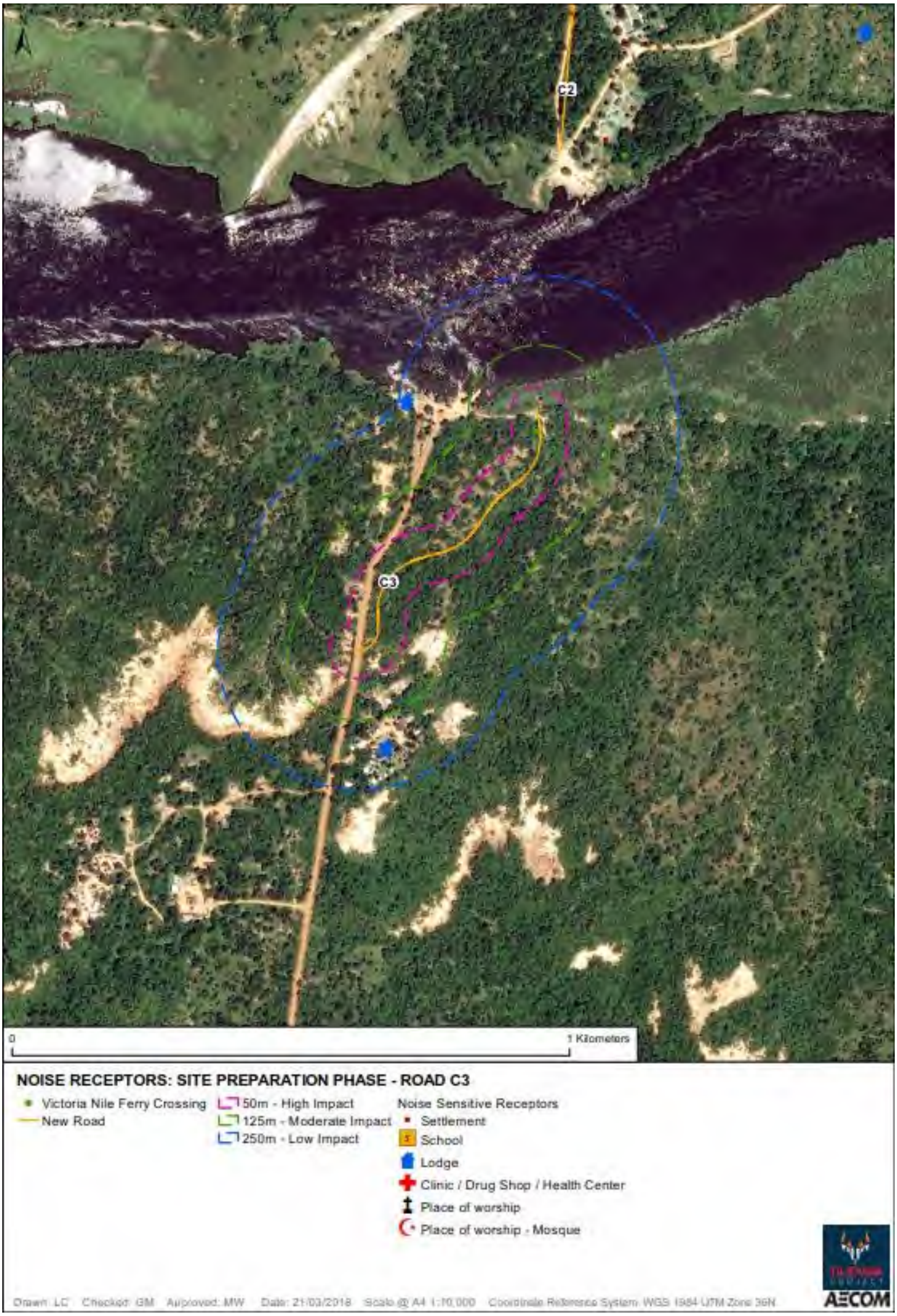


Figure I2-51: Road Construction Receptor Analysis – Road D1

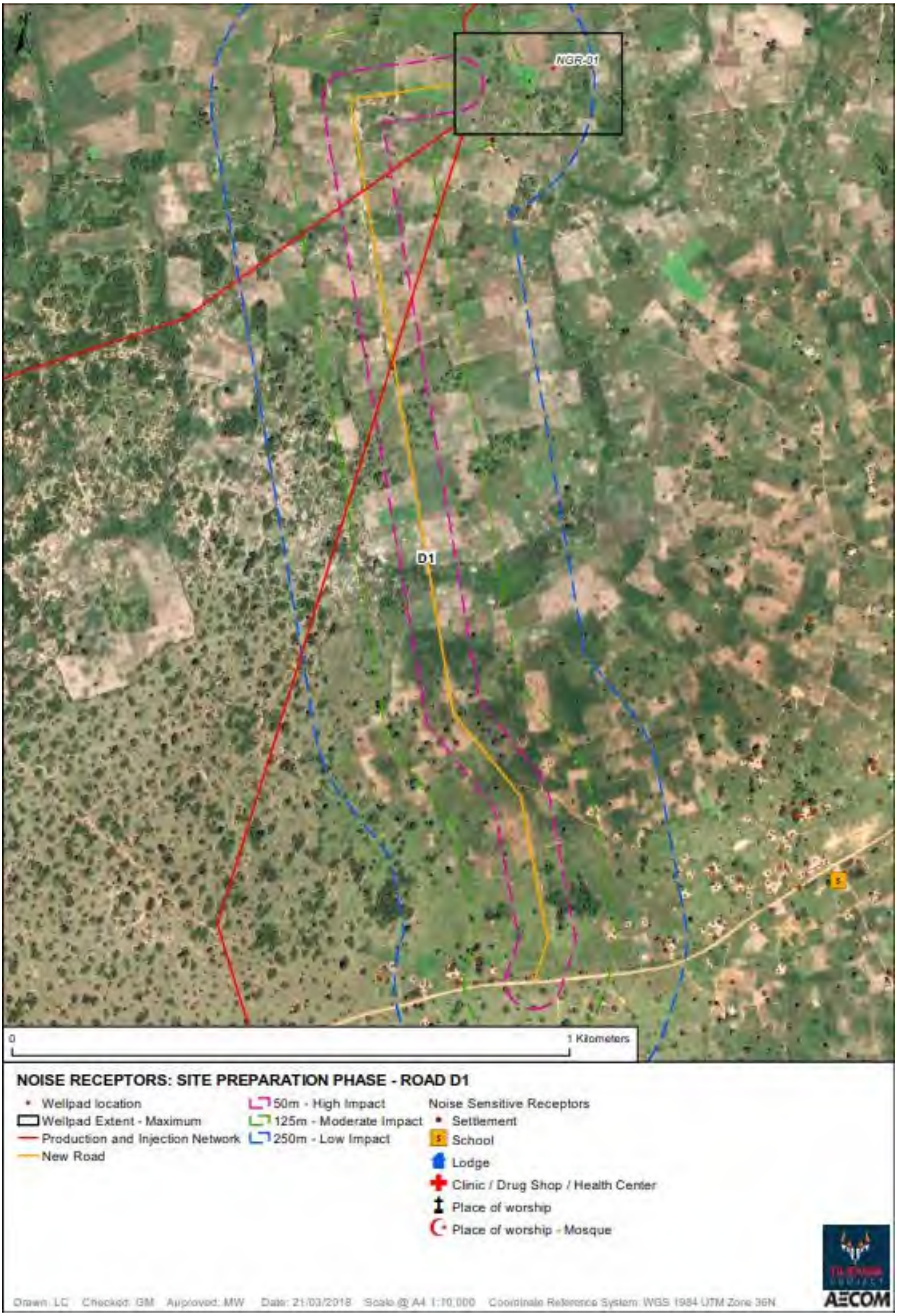


Figure I2-52: Road Construction Receptor Analysis – Road D10

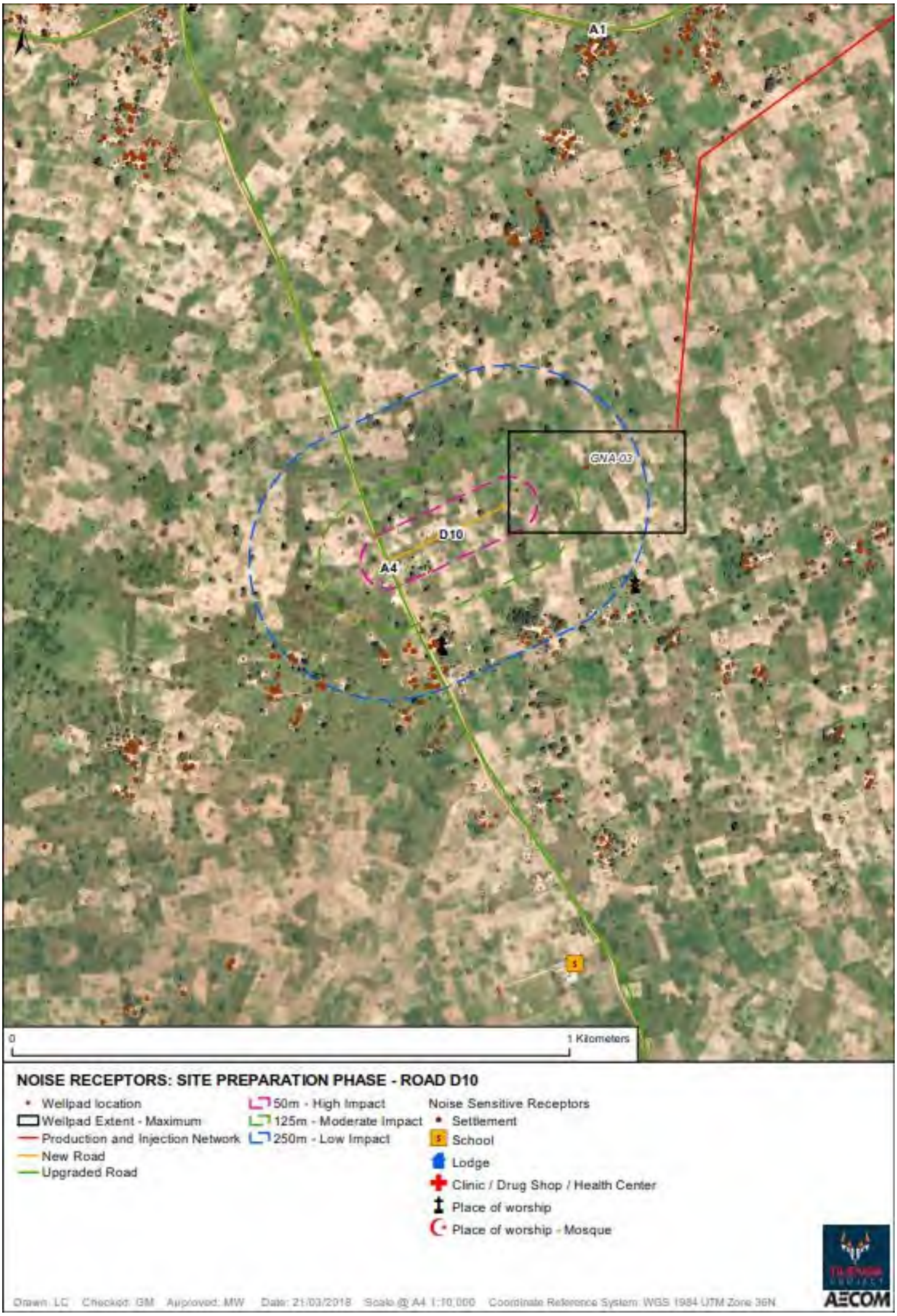


Figure I2-53: Road Construction Receptor Analysis – Road D11

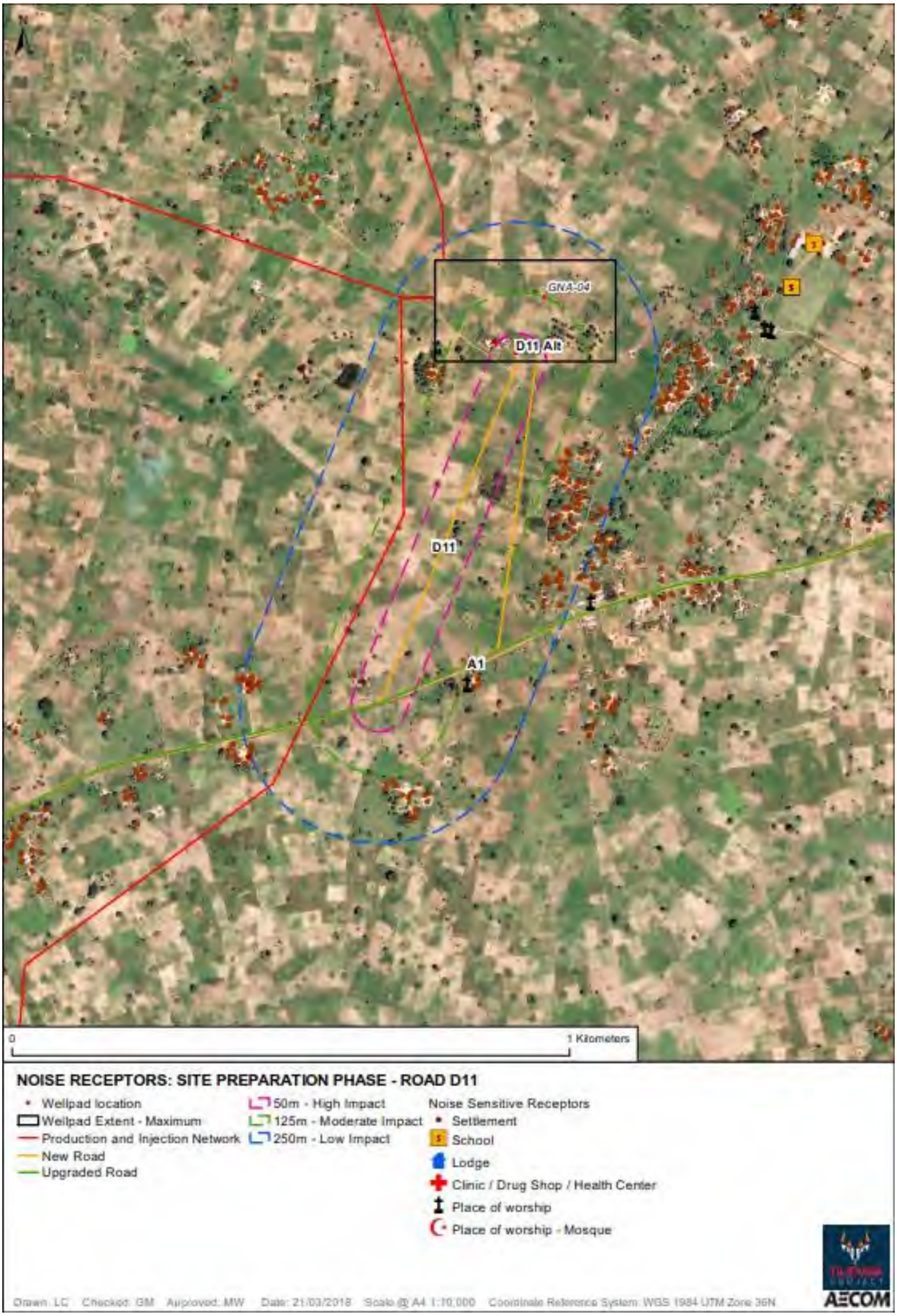


Figure I2-54: Road Construction Receptor Analysis – Road D11 (alternative route)

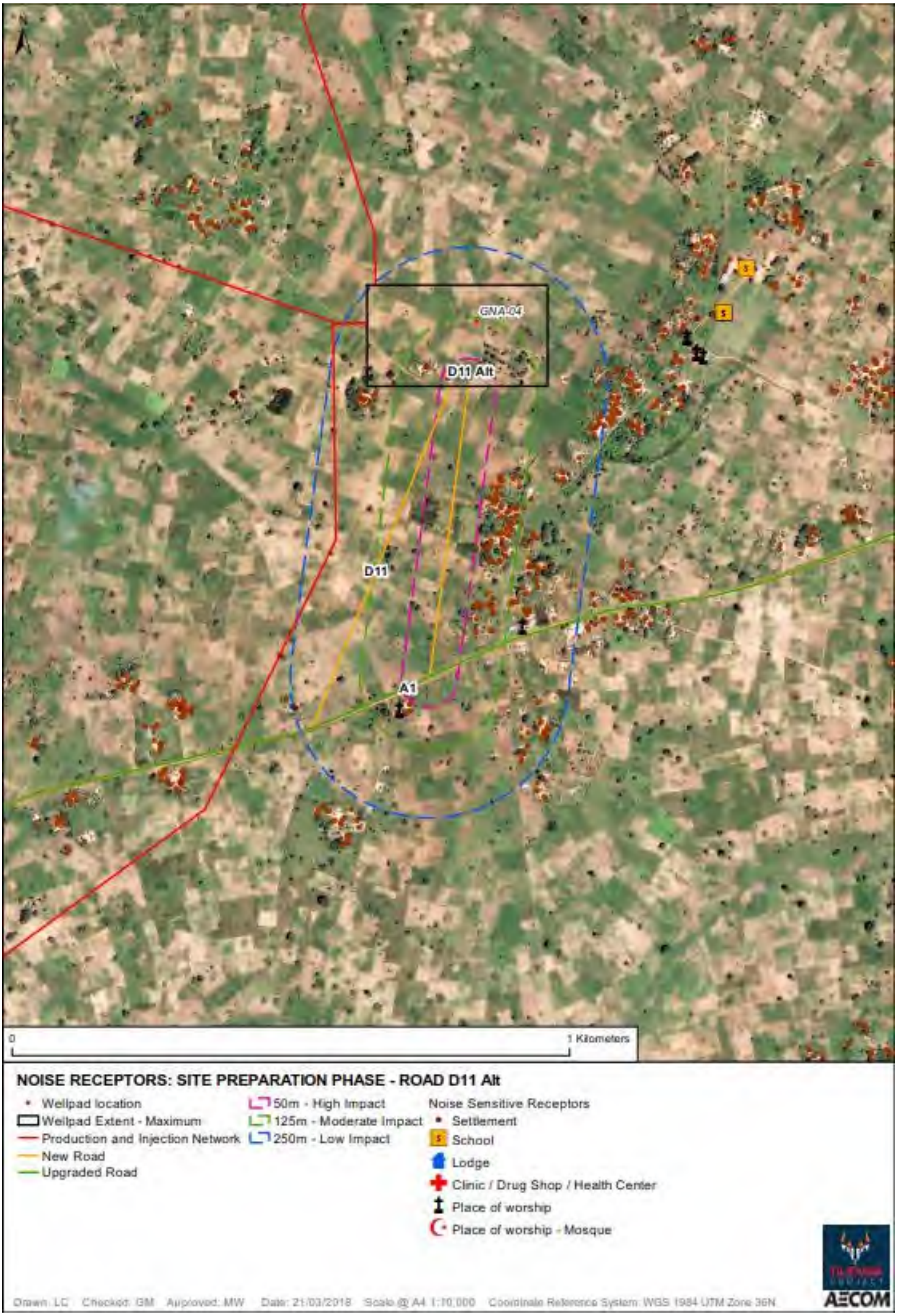


Figure I2-55: Road Construction Receptor Analysis – Road D12

Figure I2-56: Road Construction Receptor Analysis – Road D13

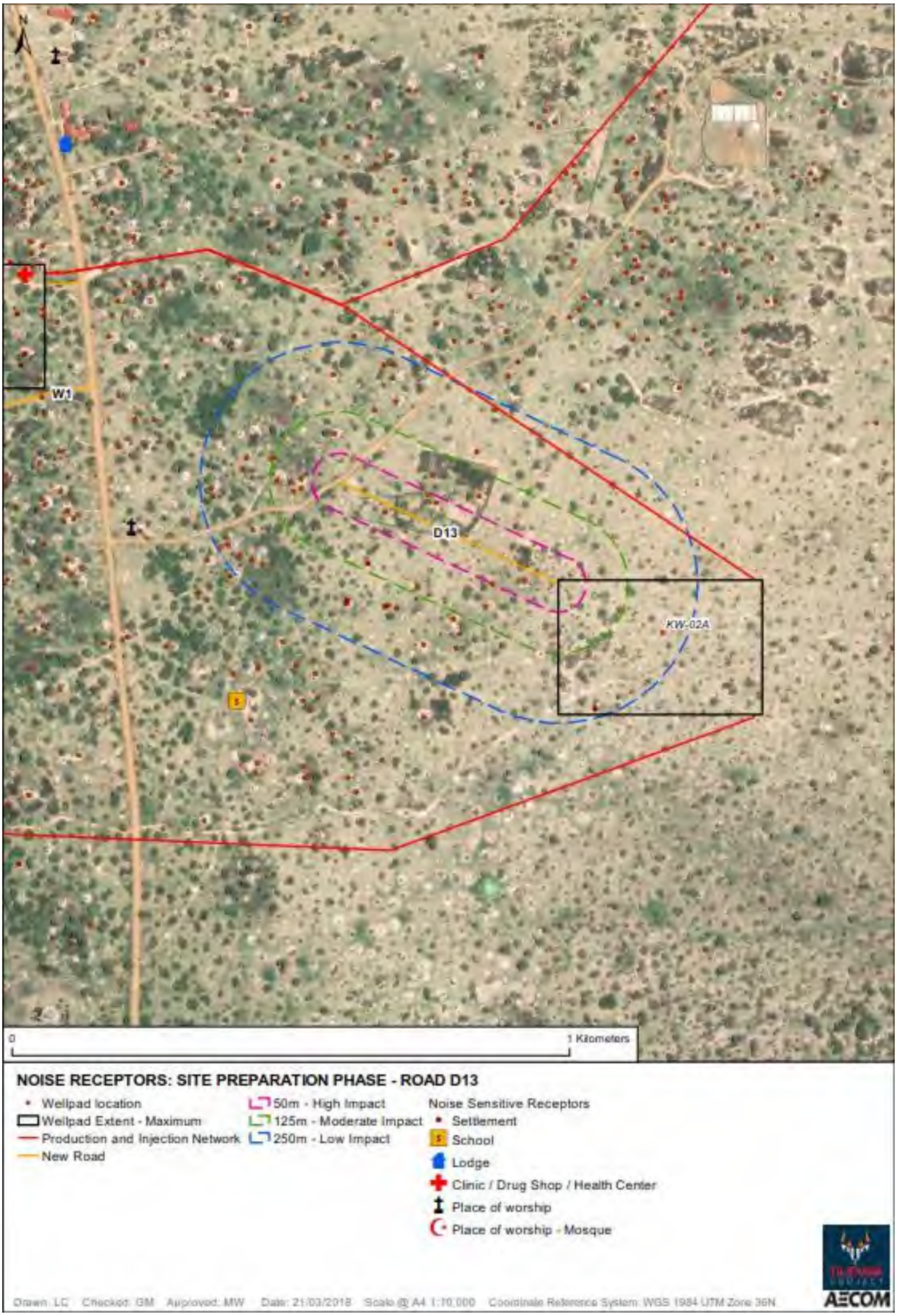


Figure I2-57: Road Construction Receptor Analysis – Road D14

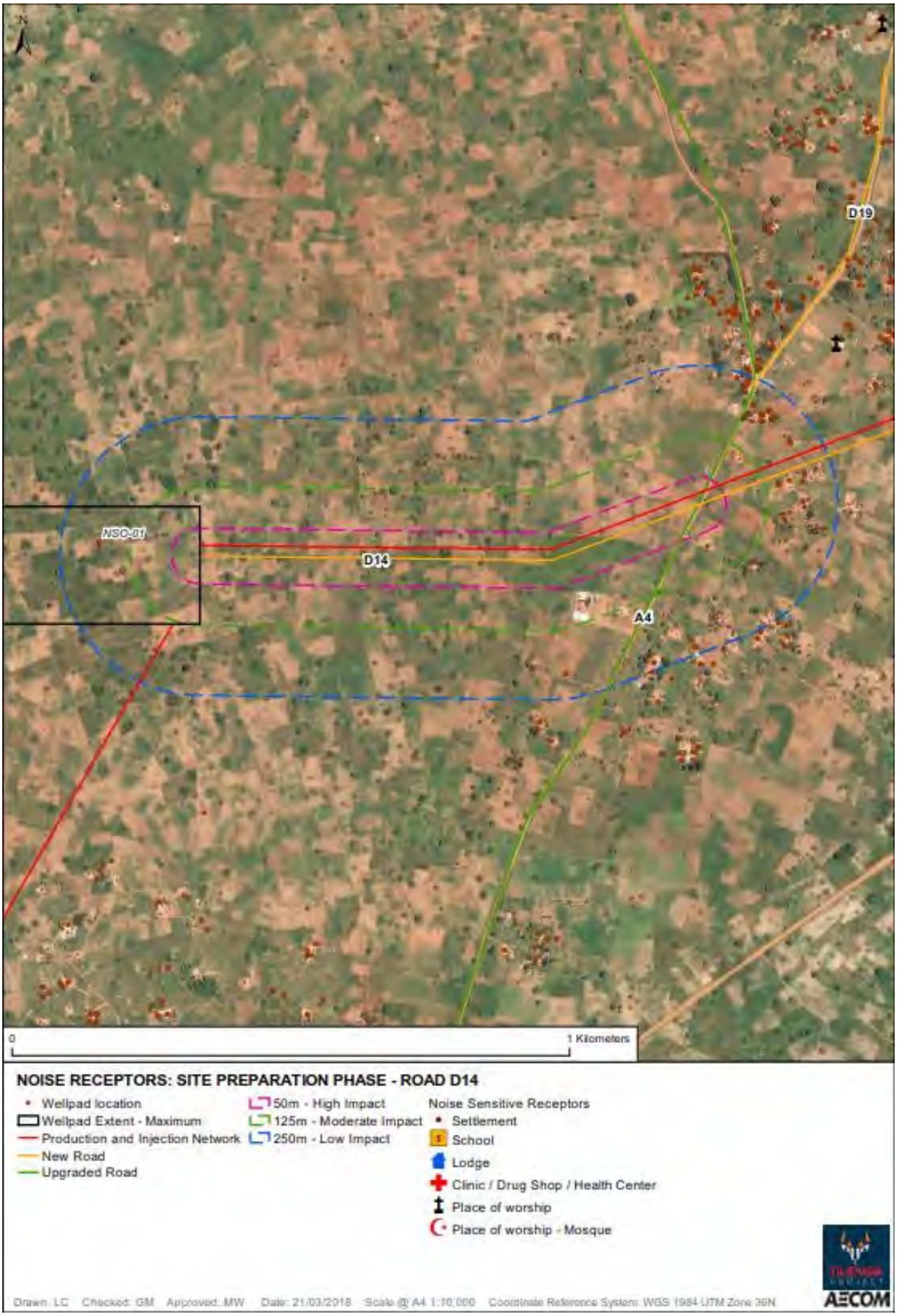


Figure I2-58: Road Construction Receptor Analysis – Road D15

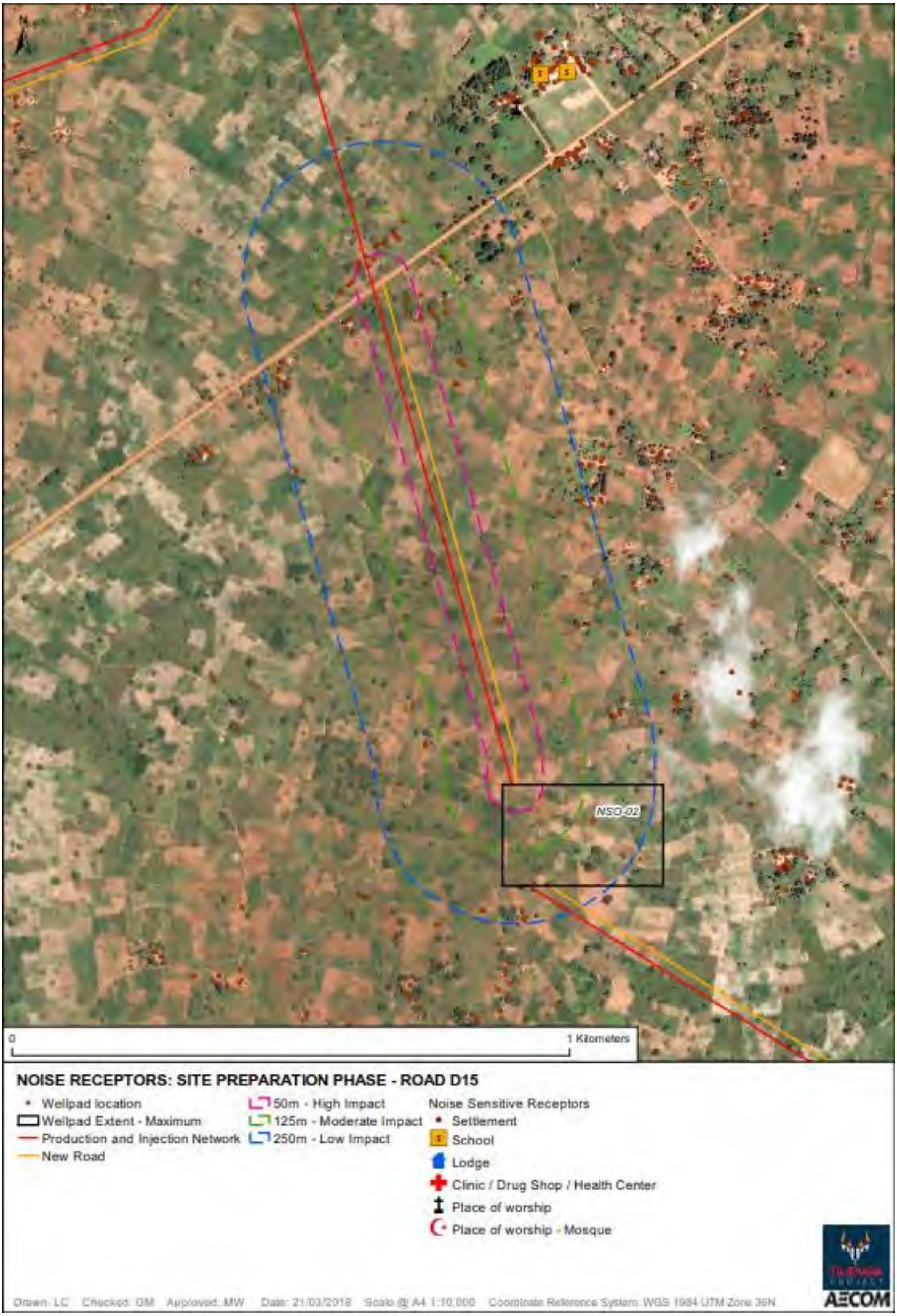


Figure I2-59: Road Construction Receptor Analysis – Road D16

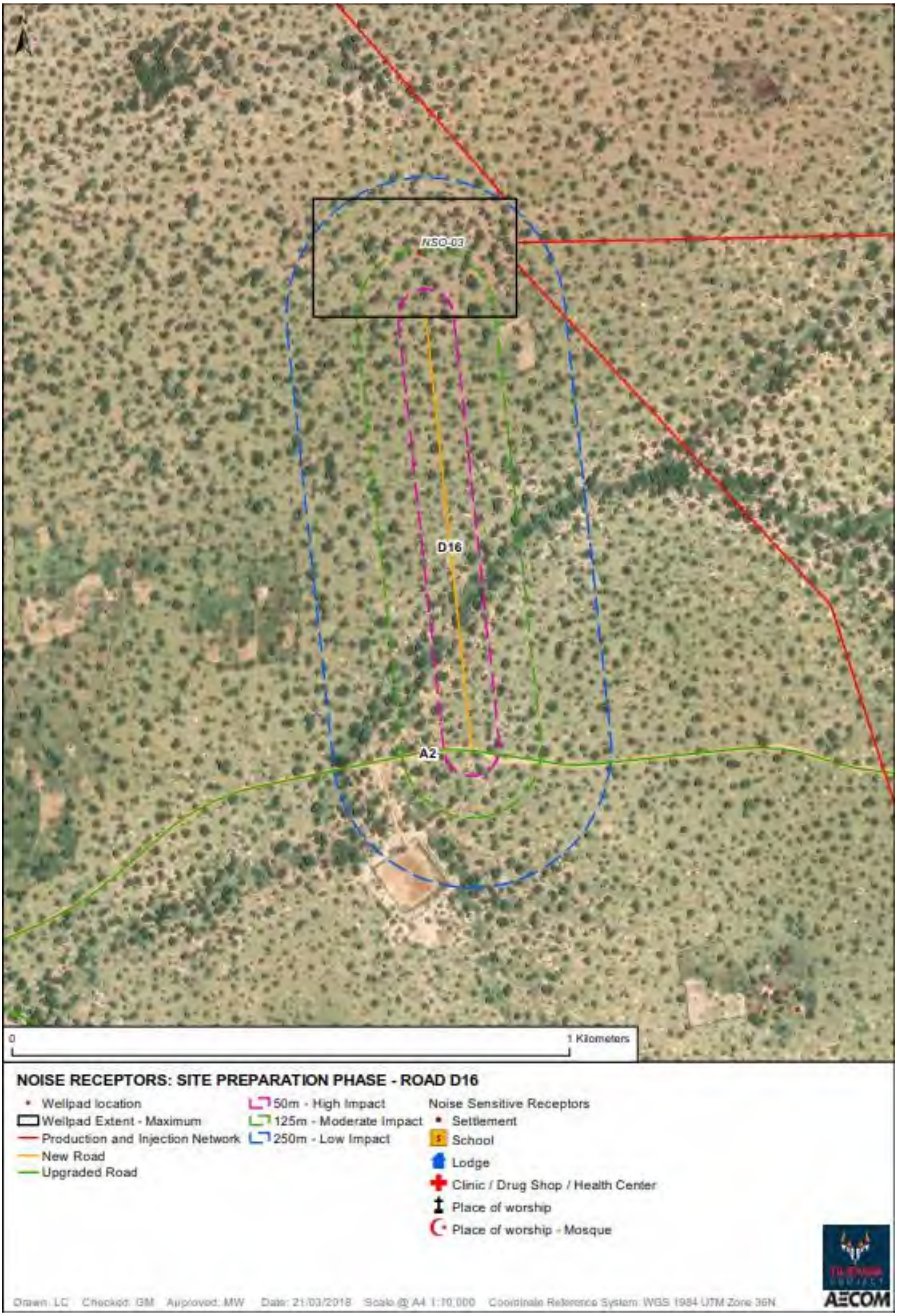


Figure I2-60: Road Construction Receptor Analysis – Road D17

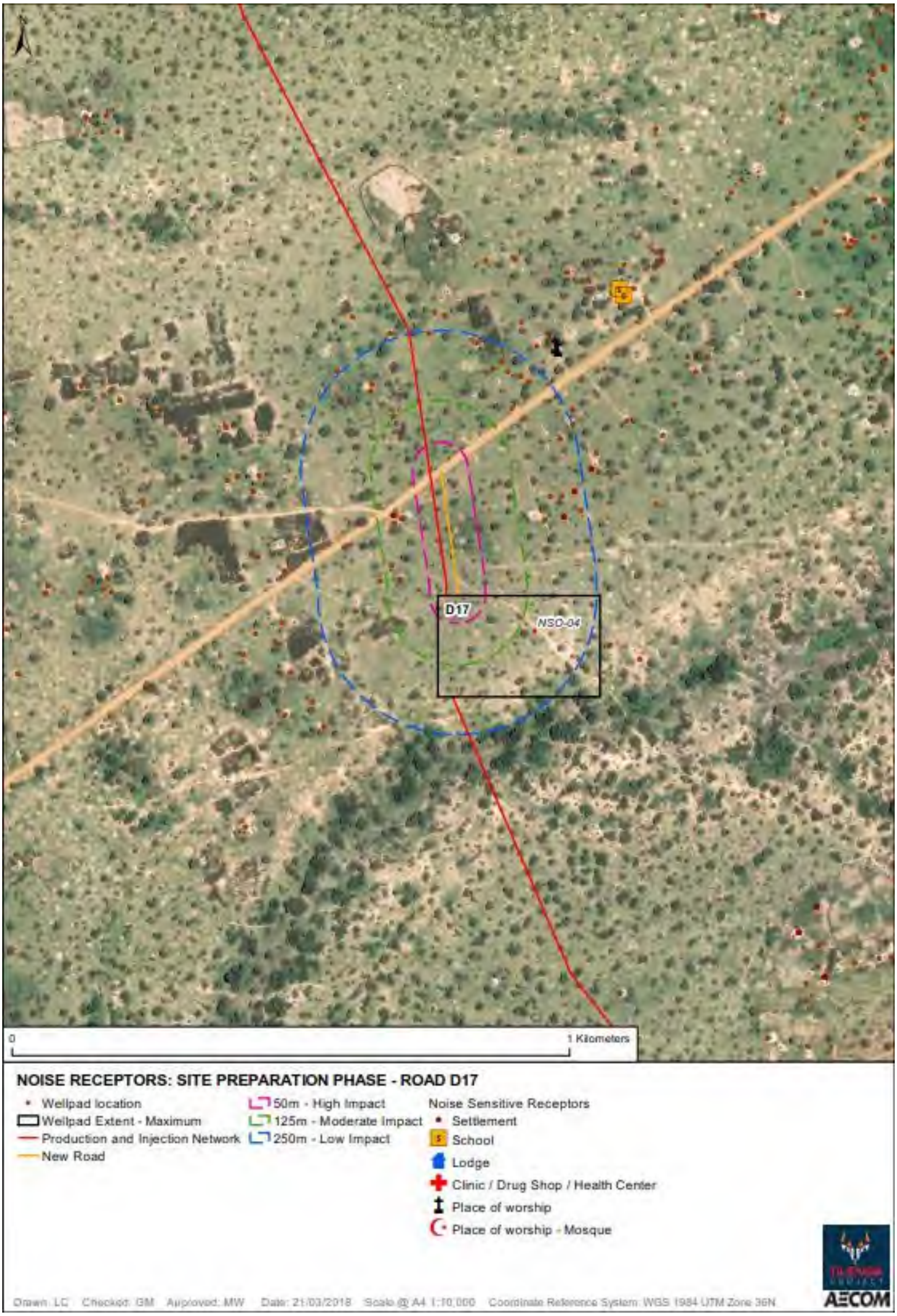


Figure I2-61: Road Construction Receptor Analysis – Road D18

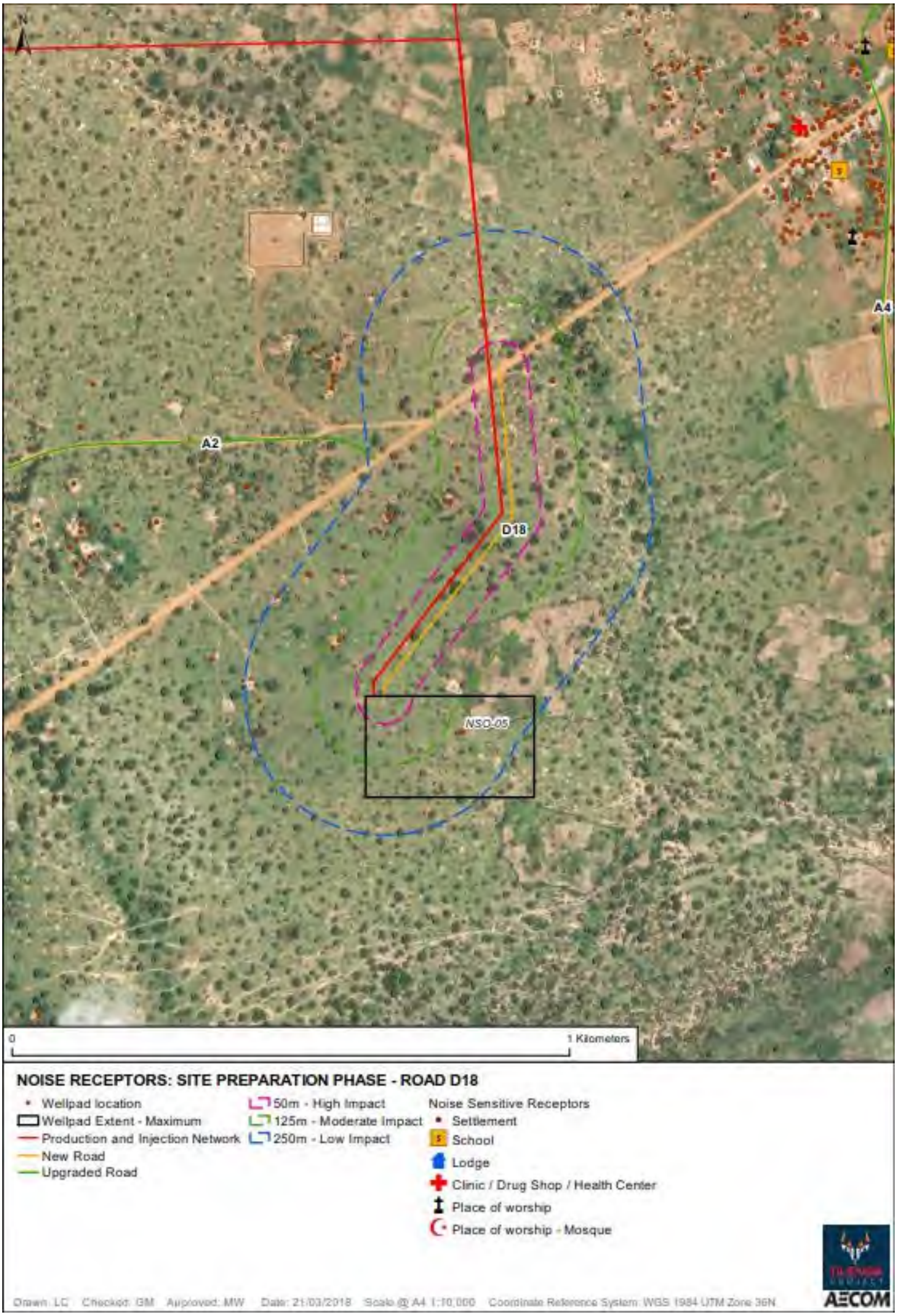


Figure I2-62: Road Construction Receptor Analysis – Road D19

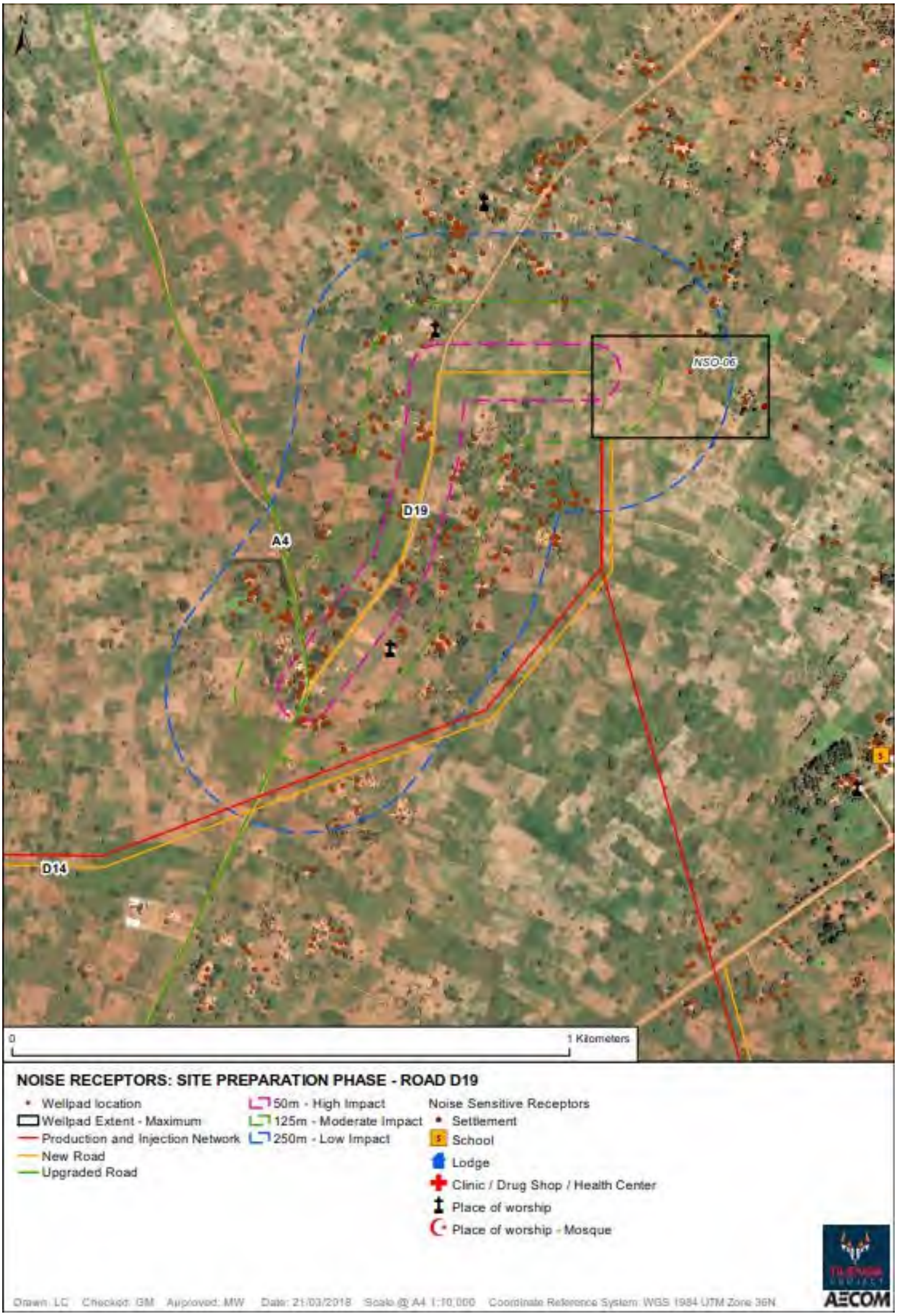


Figure I2-63: Road Construction Receptor Analysis – Road D19 (alternative route)

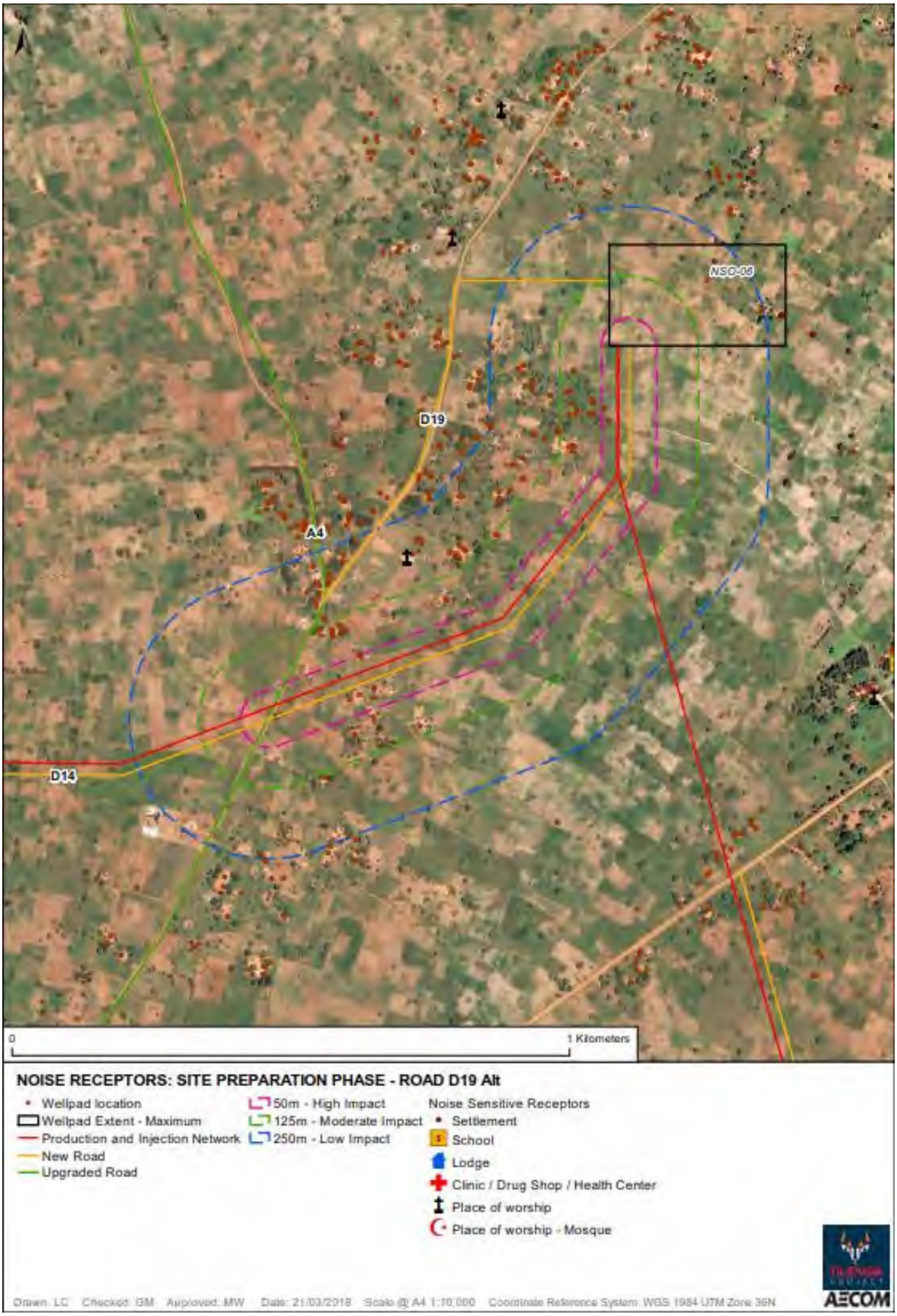


Figure I2-64: Road Construction Receptor Analysis – Road D2

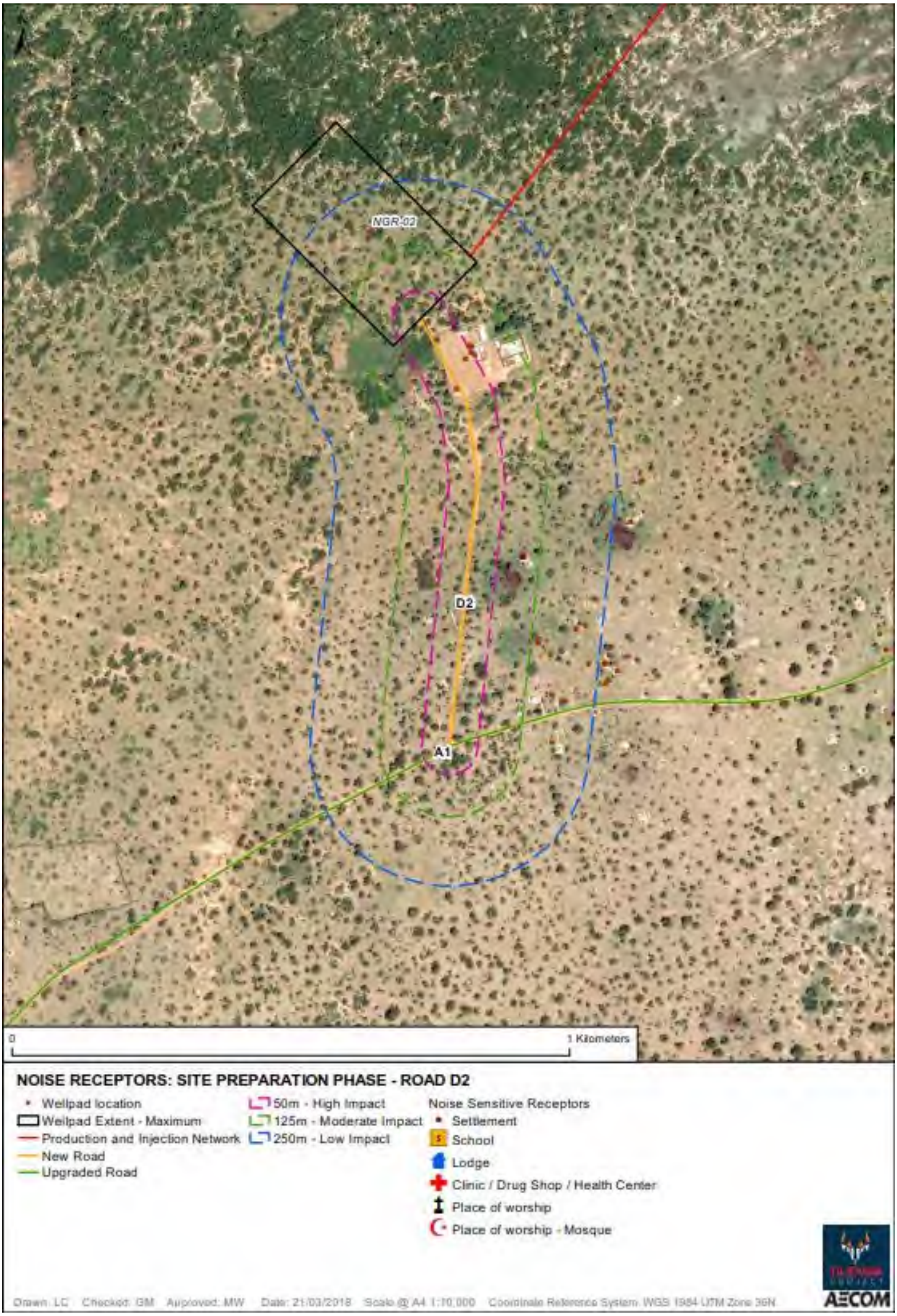


Figure I2-65: Road Construction Receptor Analysis – Road D20

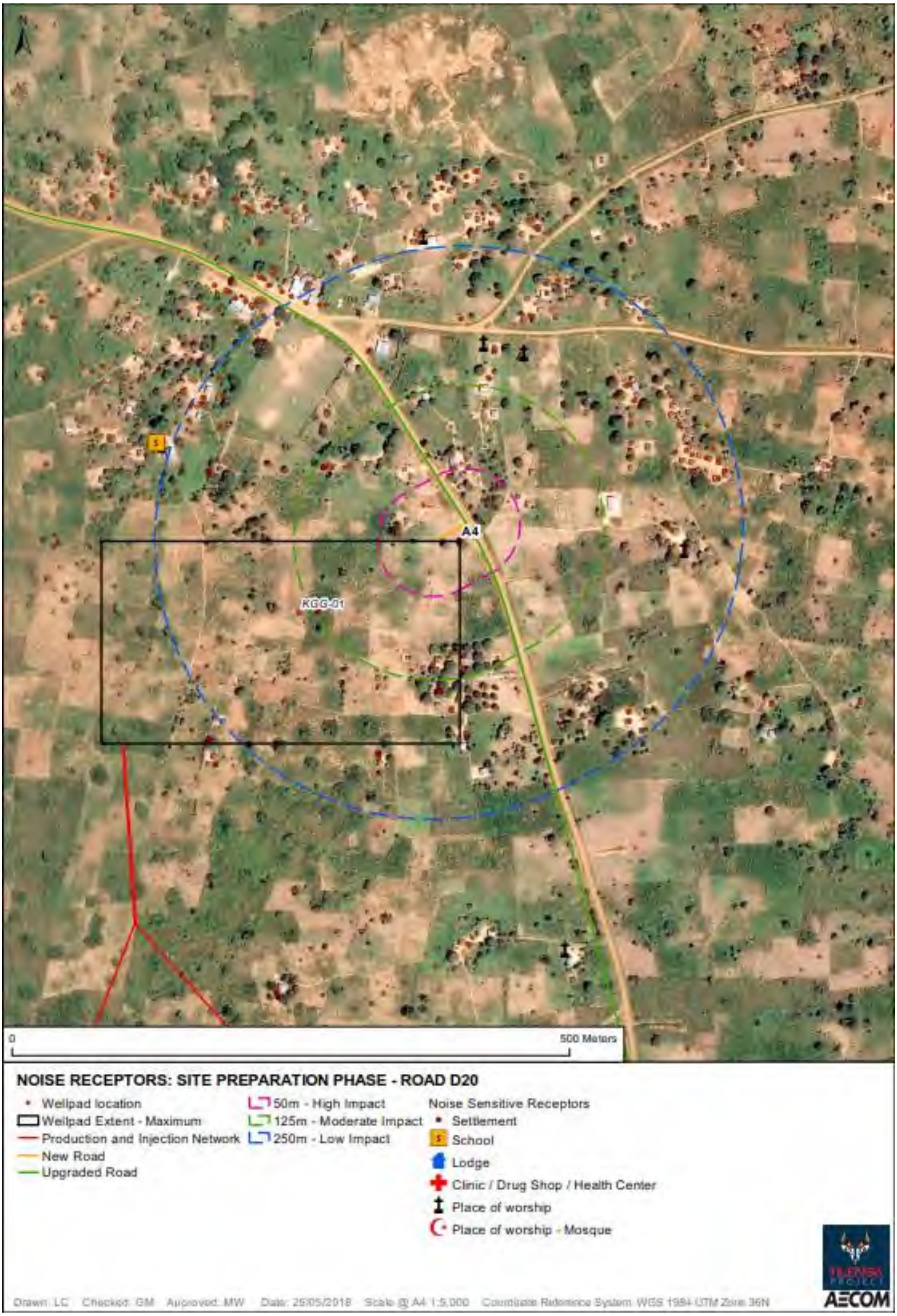


Figure I2-66: Road Construction Receptor Analysis – Road D22

Figure I2-67: Road Construction Receptor Analysis – Road D23

Figure I2-68: Road Construction Receptor Analysis – Road D24

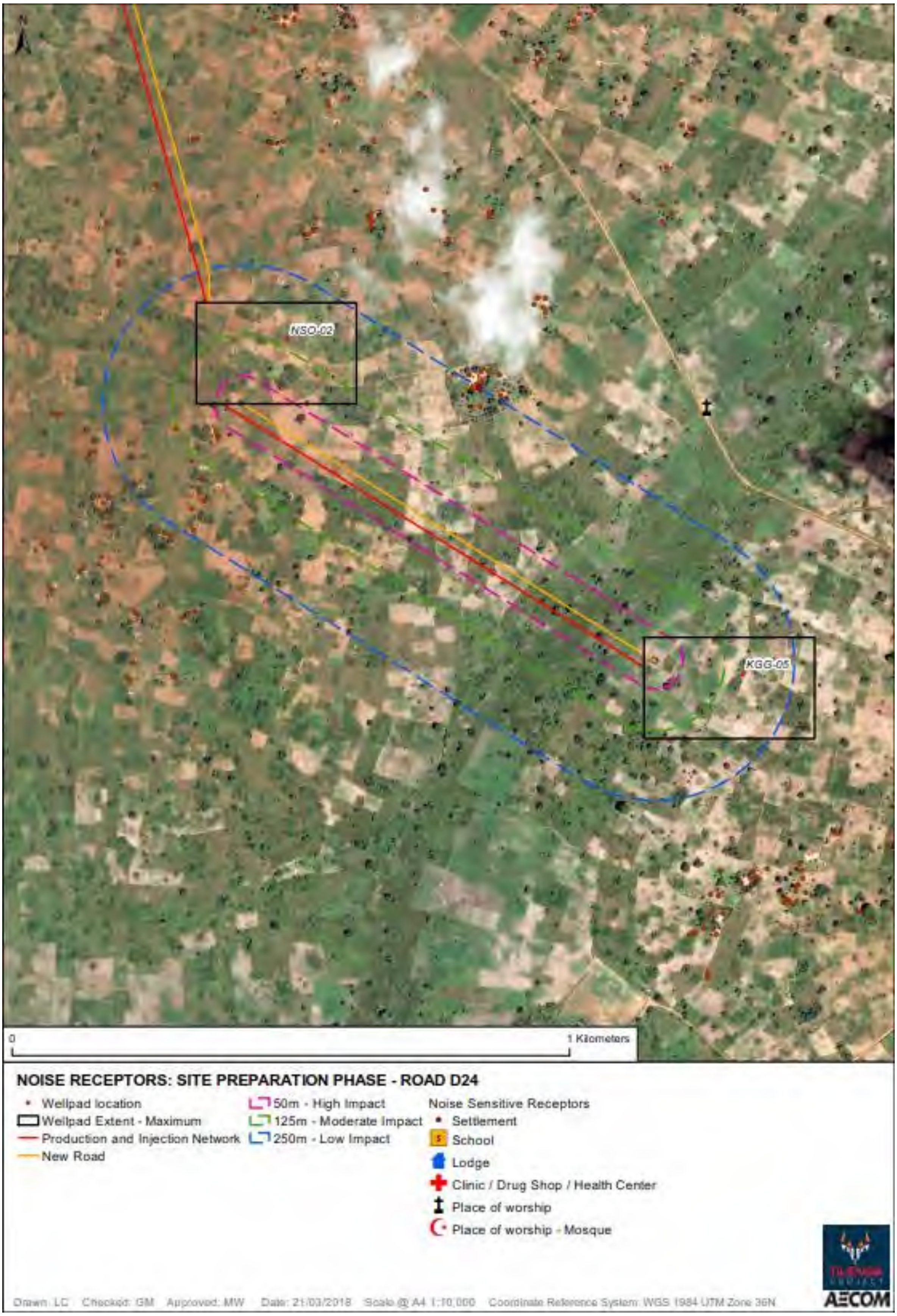


Figure I2-69: Road Construction Receptor Analysis – Road D25

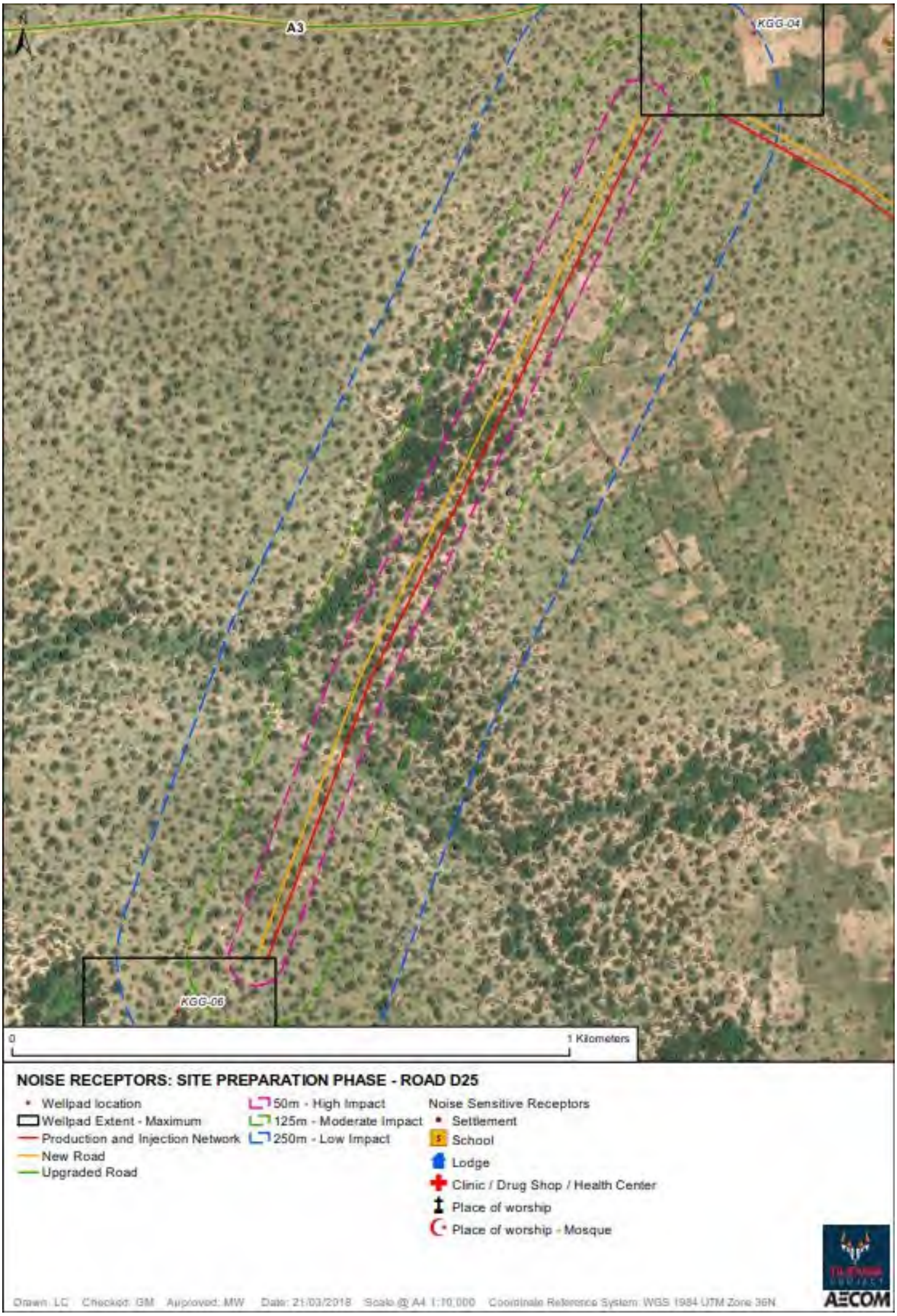


Figure I2-70: Road Construction Receptor Analysis – Road D26

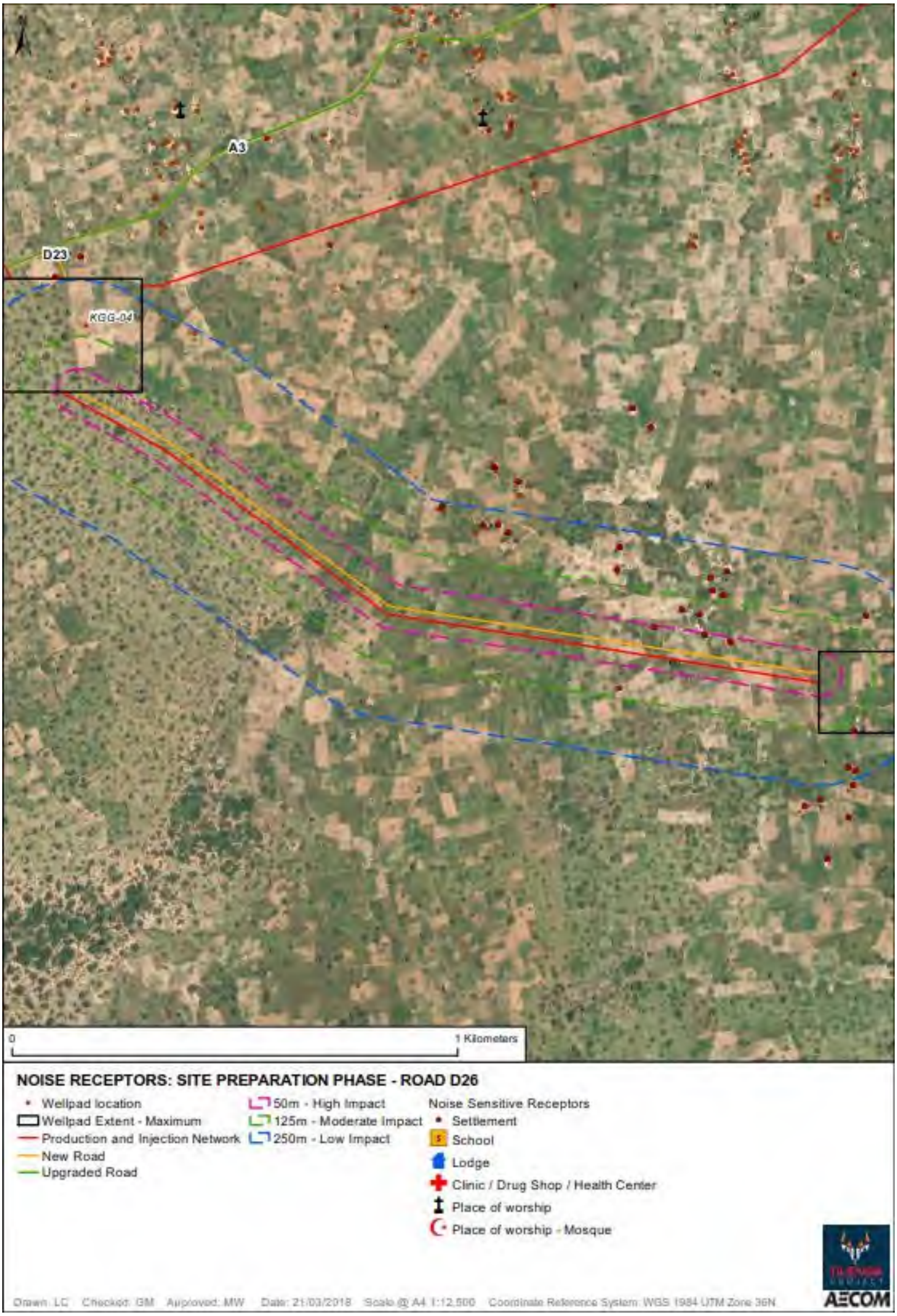


Figure I2-71: Road Construction Receptor Analysis – Road D27

Figure I2-72: Road Construction Receptor Analysis – Road D3

Figure I2-73: Road Construction Receptor Analysis – Road D5

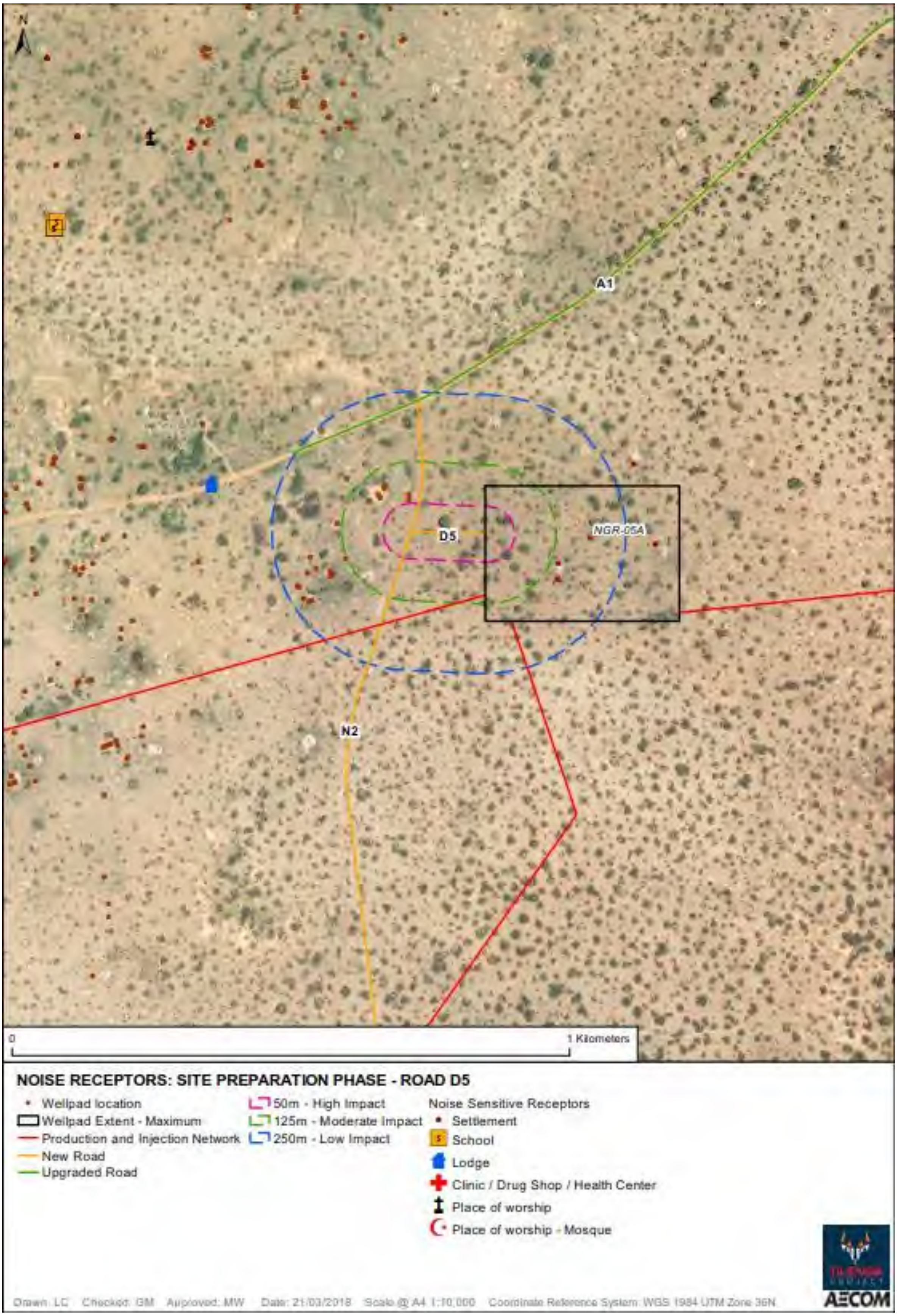


Figure I2-74: Road Construction Receptor Analysis – Road D6

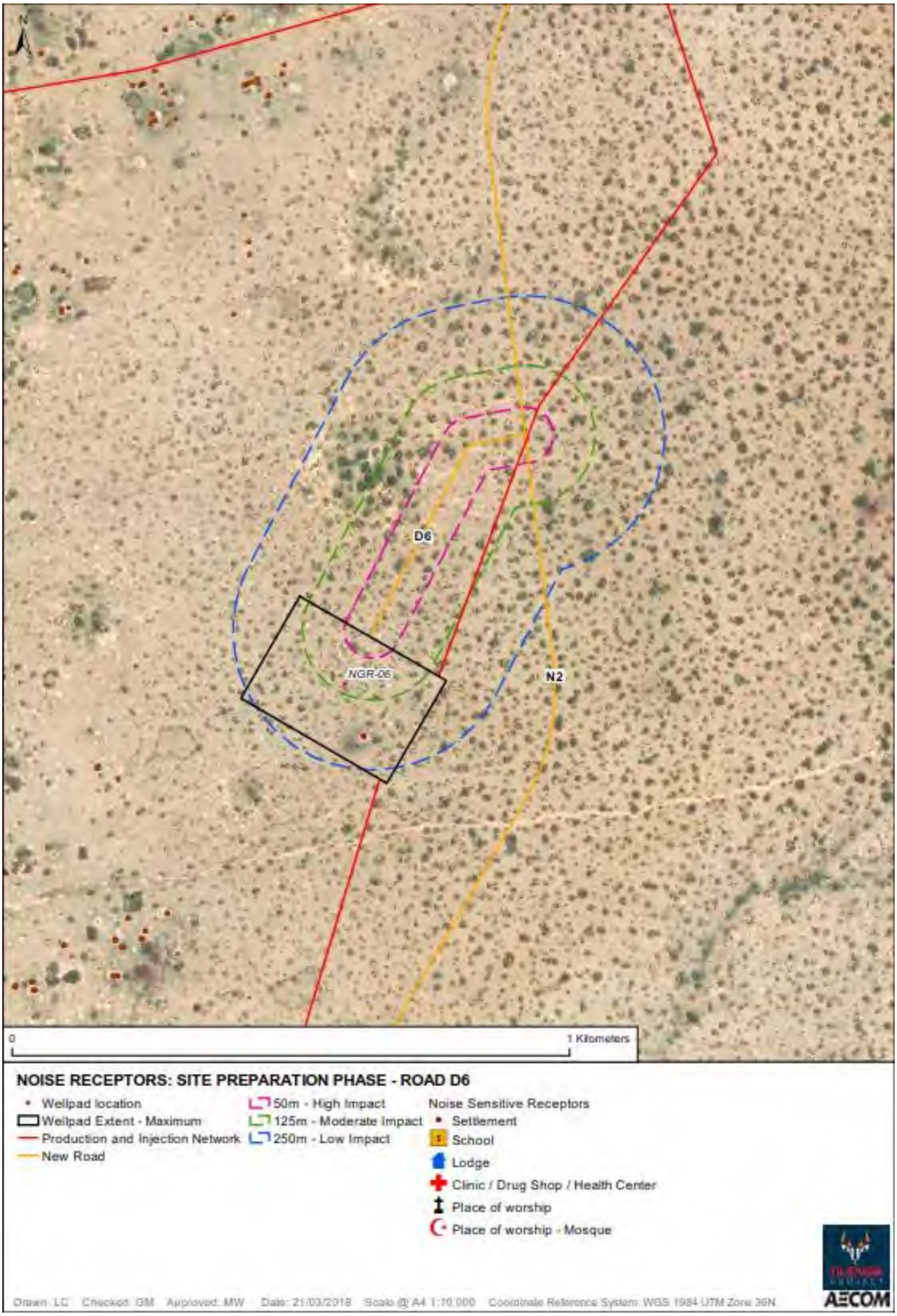


Figure I2-75: Road Construction Receptor Analysis – Road D8

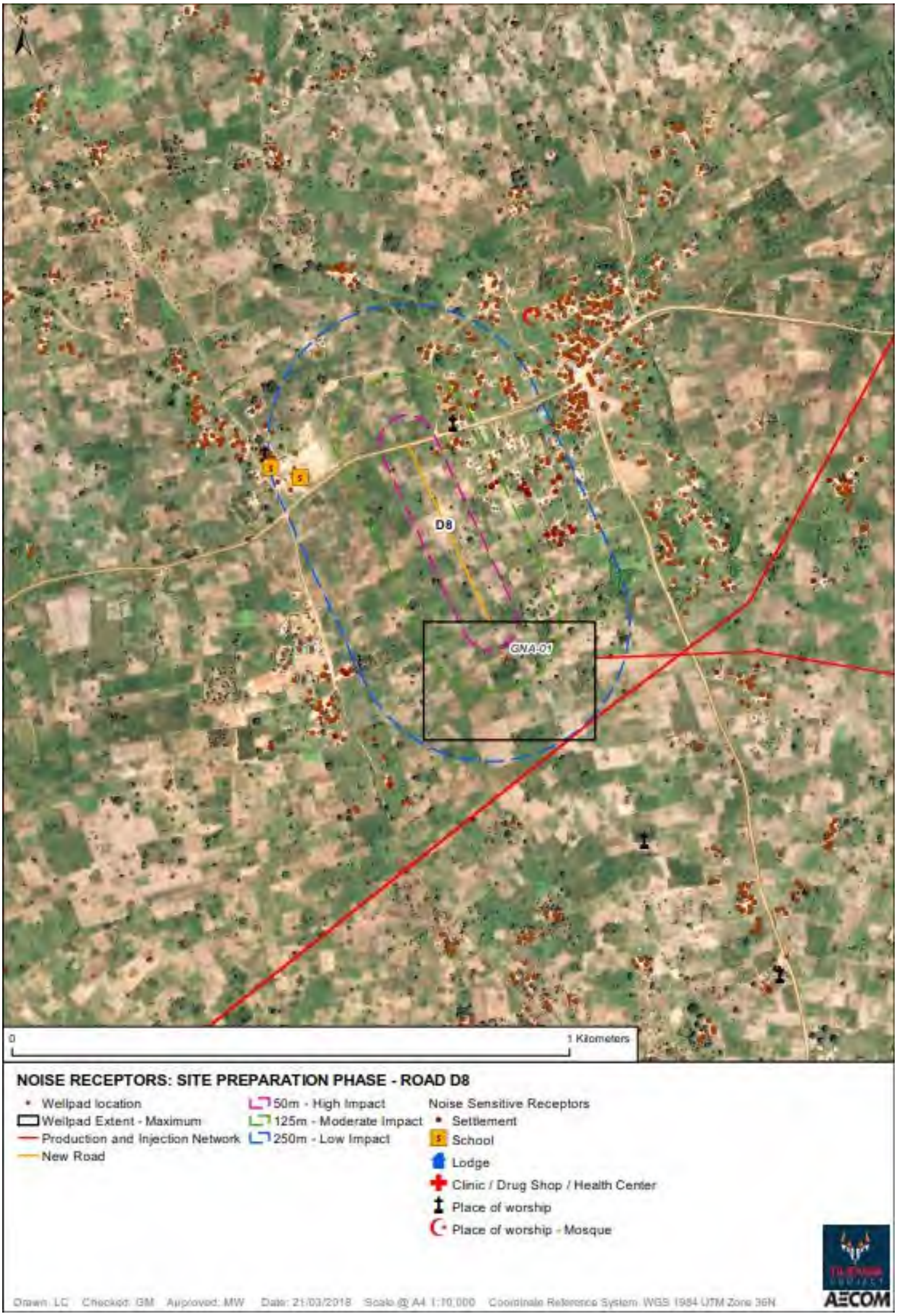


Figure I2-76: Road Construction Receptor Analysis – Road D9

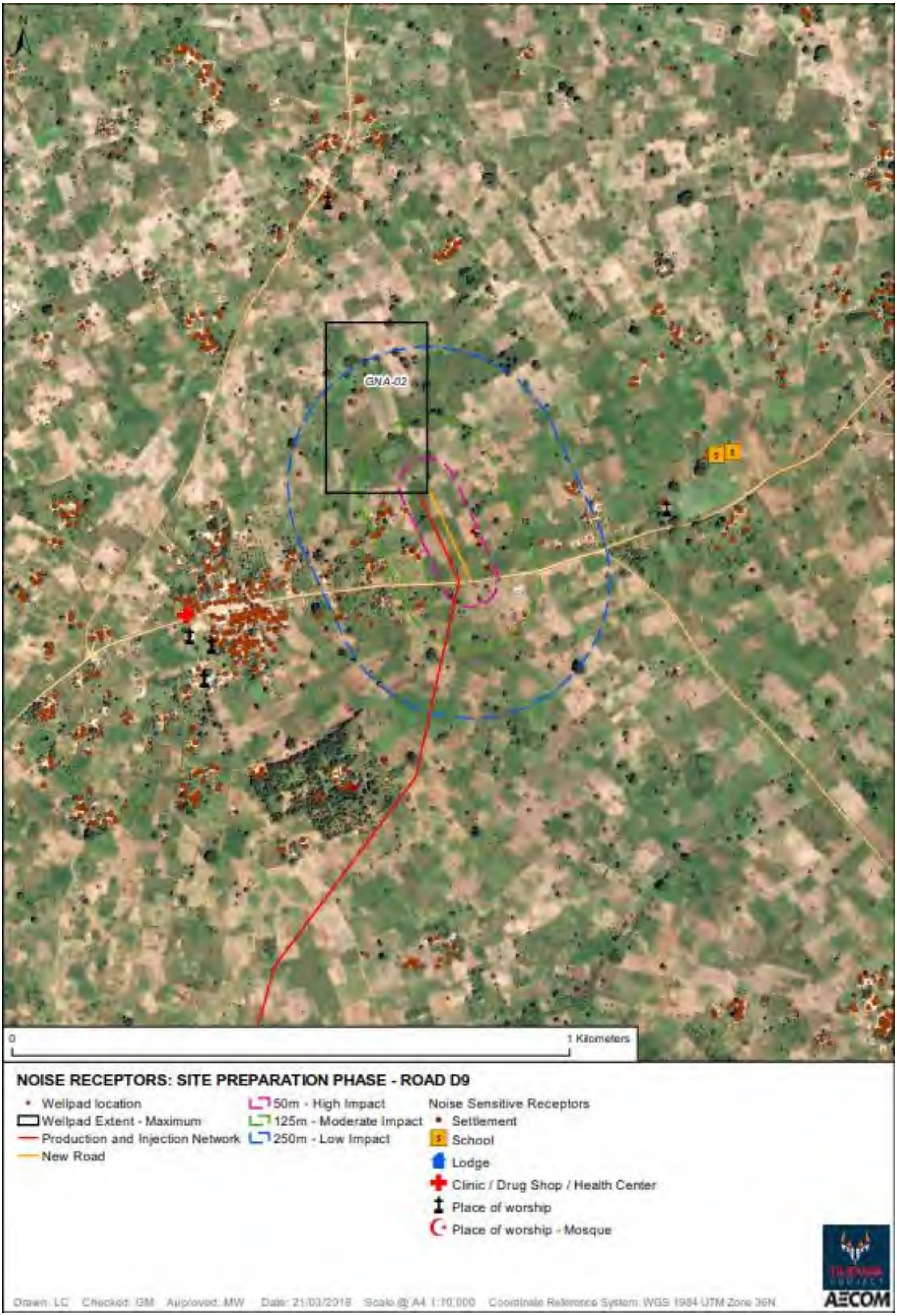


Figure I2-77: Road Construction Receptor Analysis – Road N1

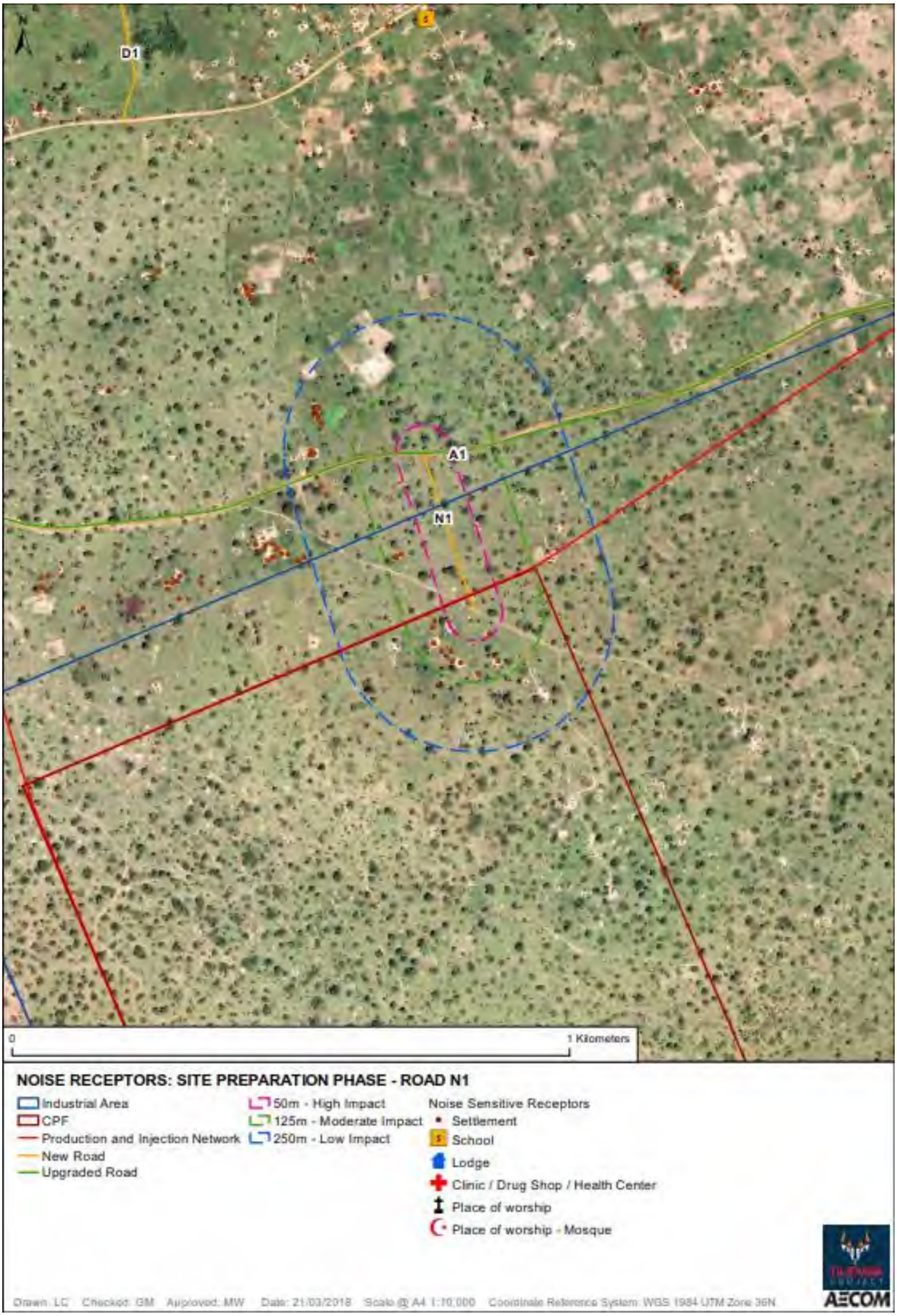


Figure I2-78: Road Construction Receptor Analysis – Road N2

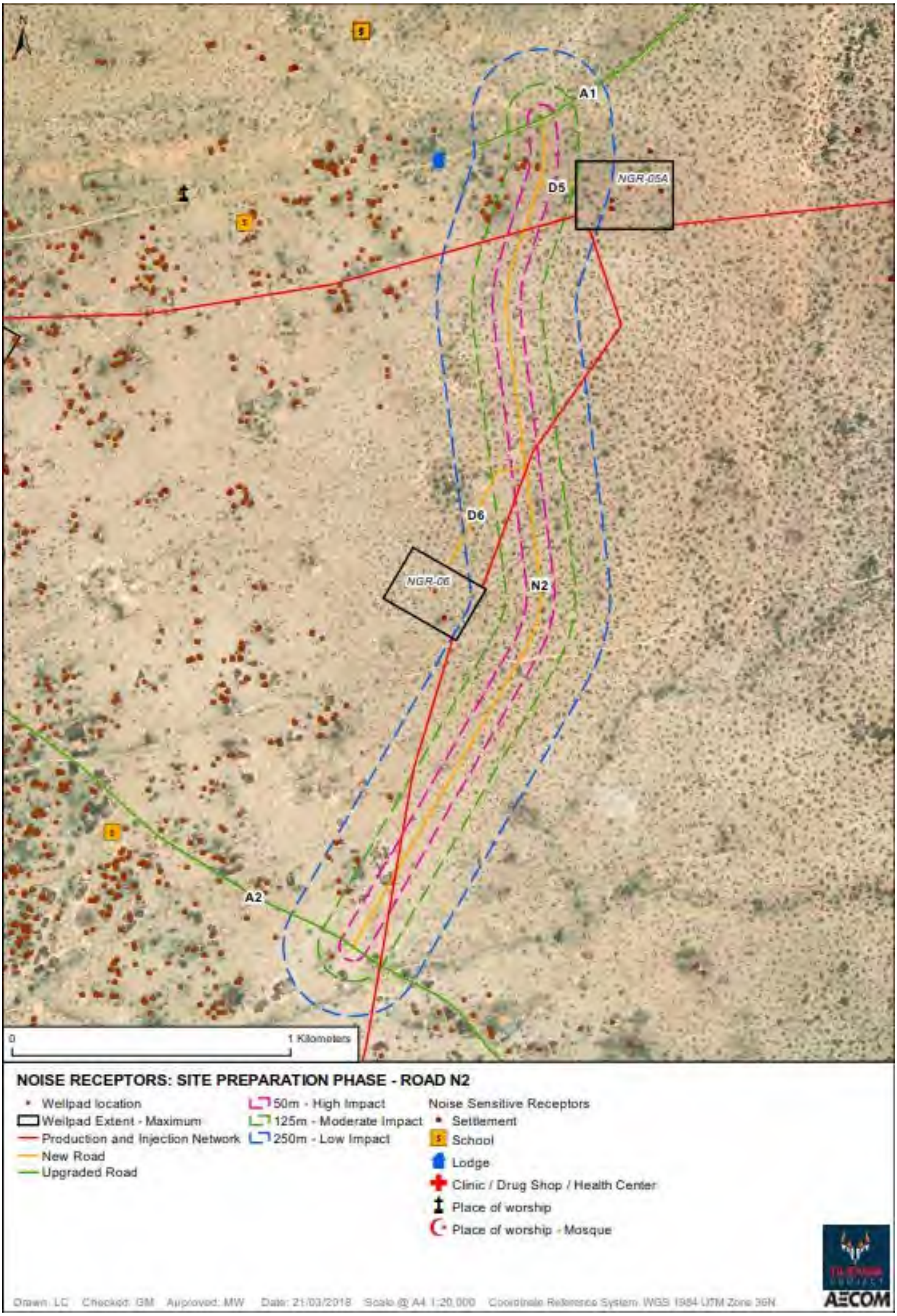
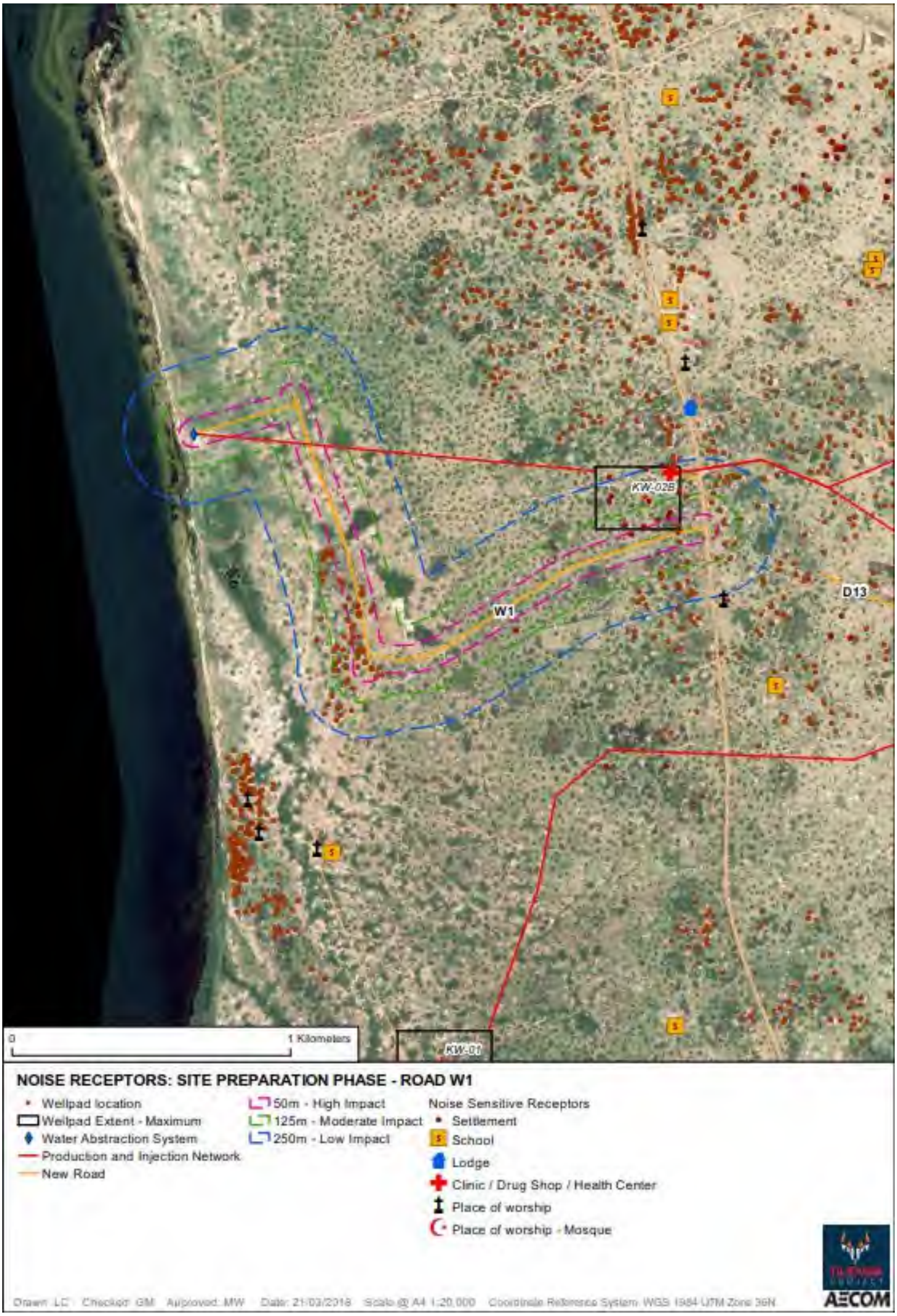


Figure I2-79: Road Construction Receptor Analysis – Road N3

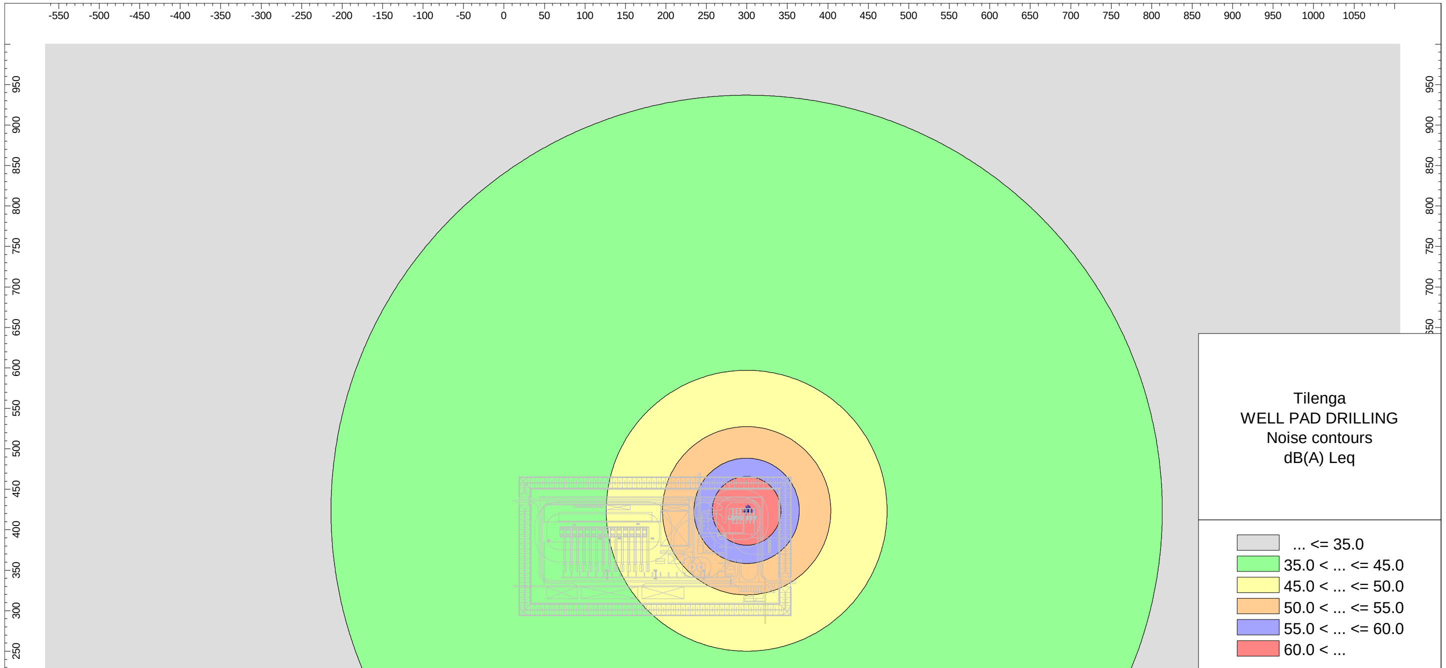
Figure I2-80: Road Construction Receptor Analysis – Road W1



Appendix I3: Construction and Pre-Commissioning Phase Results

Appendix I3. Construction and Pre-Commissioning Phase Noise Contour Plots

Figure I3-1: Well Pad Drilling Night-time Noise Contours



Noise Band	Daytime Impact	Night-time Impact
<= 35		Negligible
35 <= 45	Negligible	Low
45 <= 50		Moderate
50 <= 55	Low	
55 <= 60	Moderate	High
> 60	High	

The assessment of noise due to well drilling works is presented in Section 7.6.4.2.3

Figure I3-2: GNA-01 Night-time Well Pad Drilling Receptor Analysis

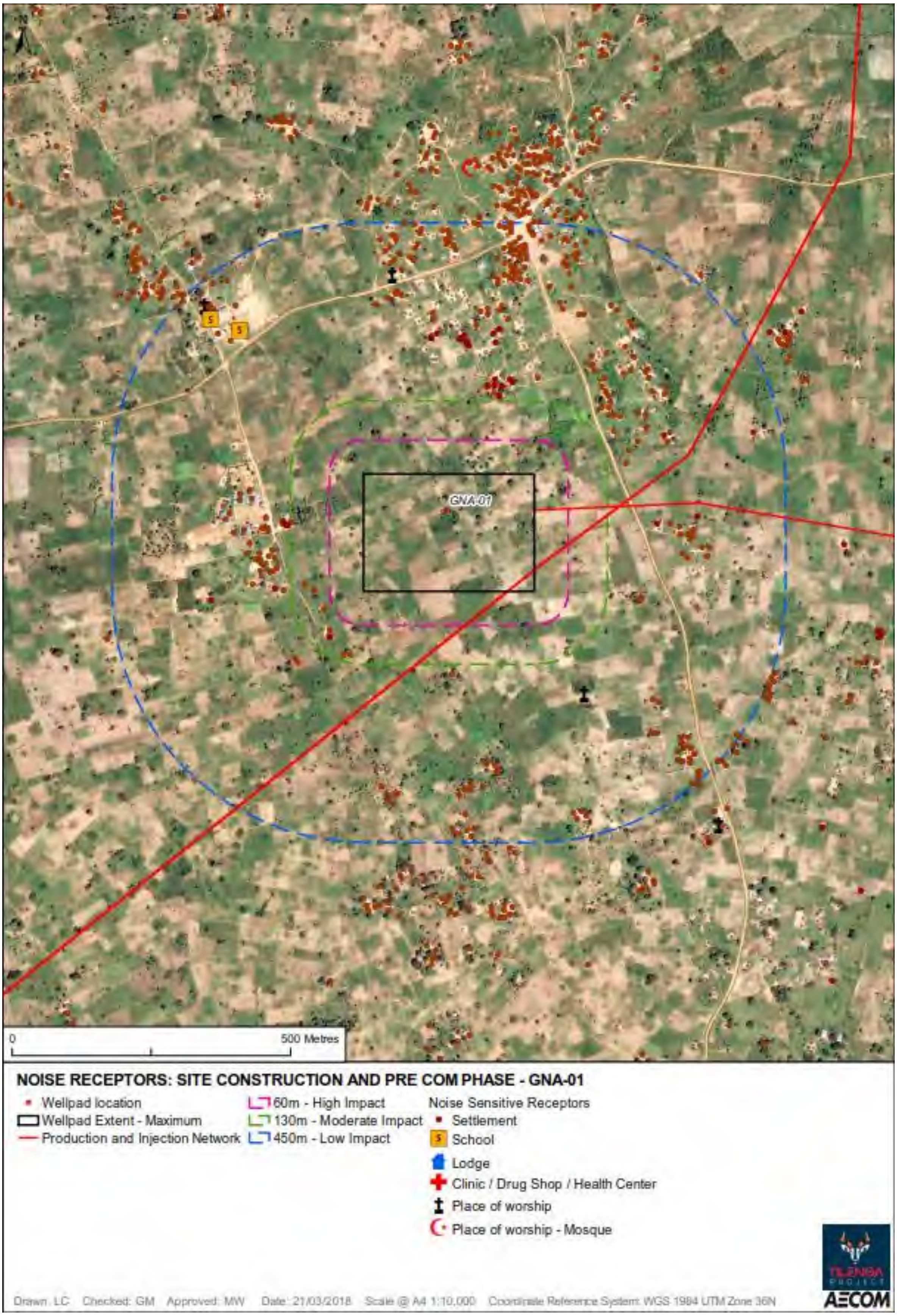


Figure I3-3: GNA-02 Night-time Well Pad Drilling Receptor Analysis

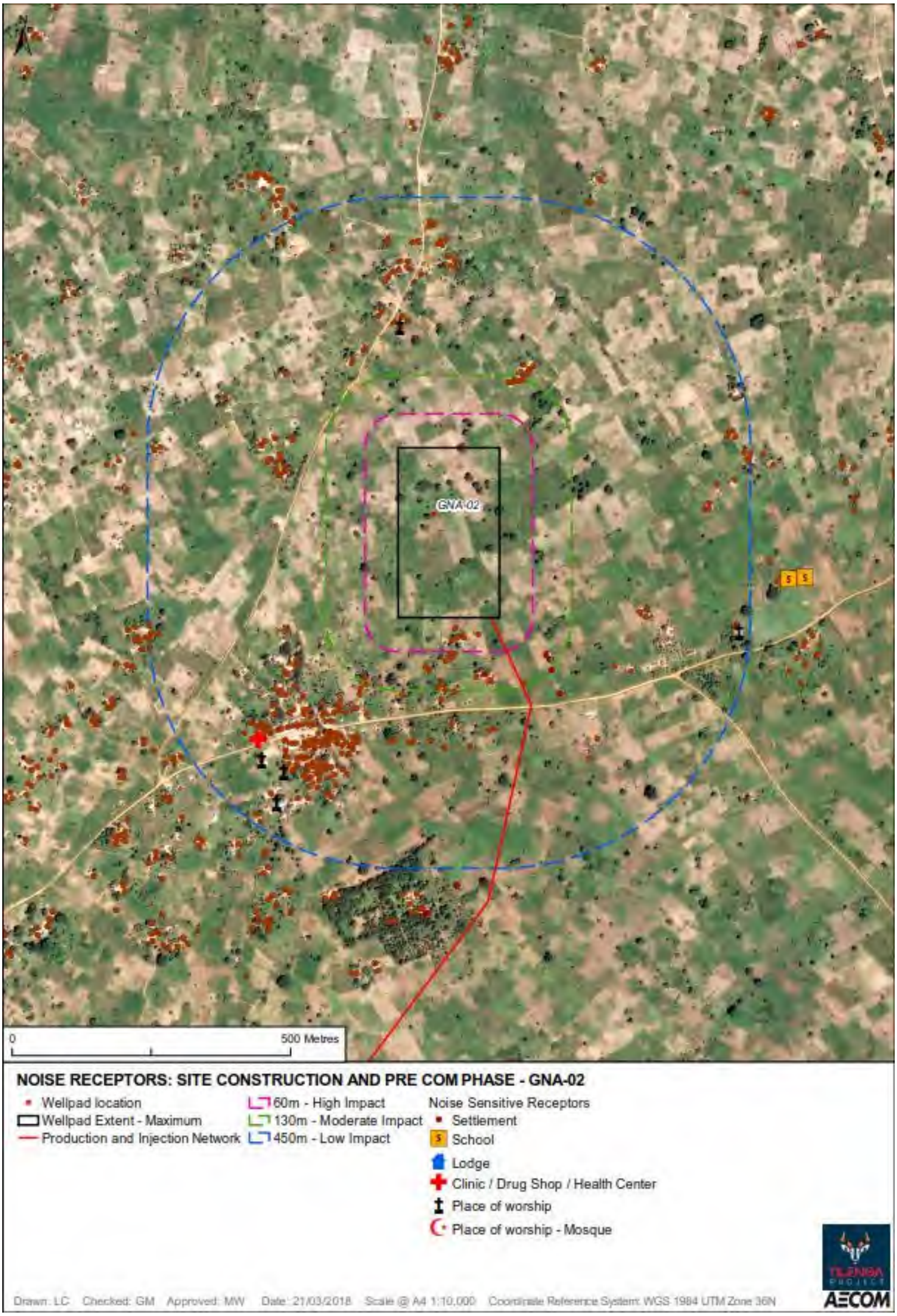


Figure I3-4: GNA-03 Night-time Well Pad Drilling Receptor Analysis

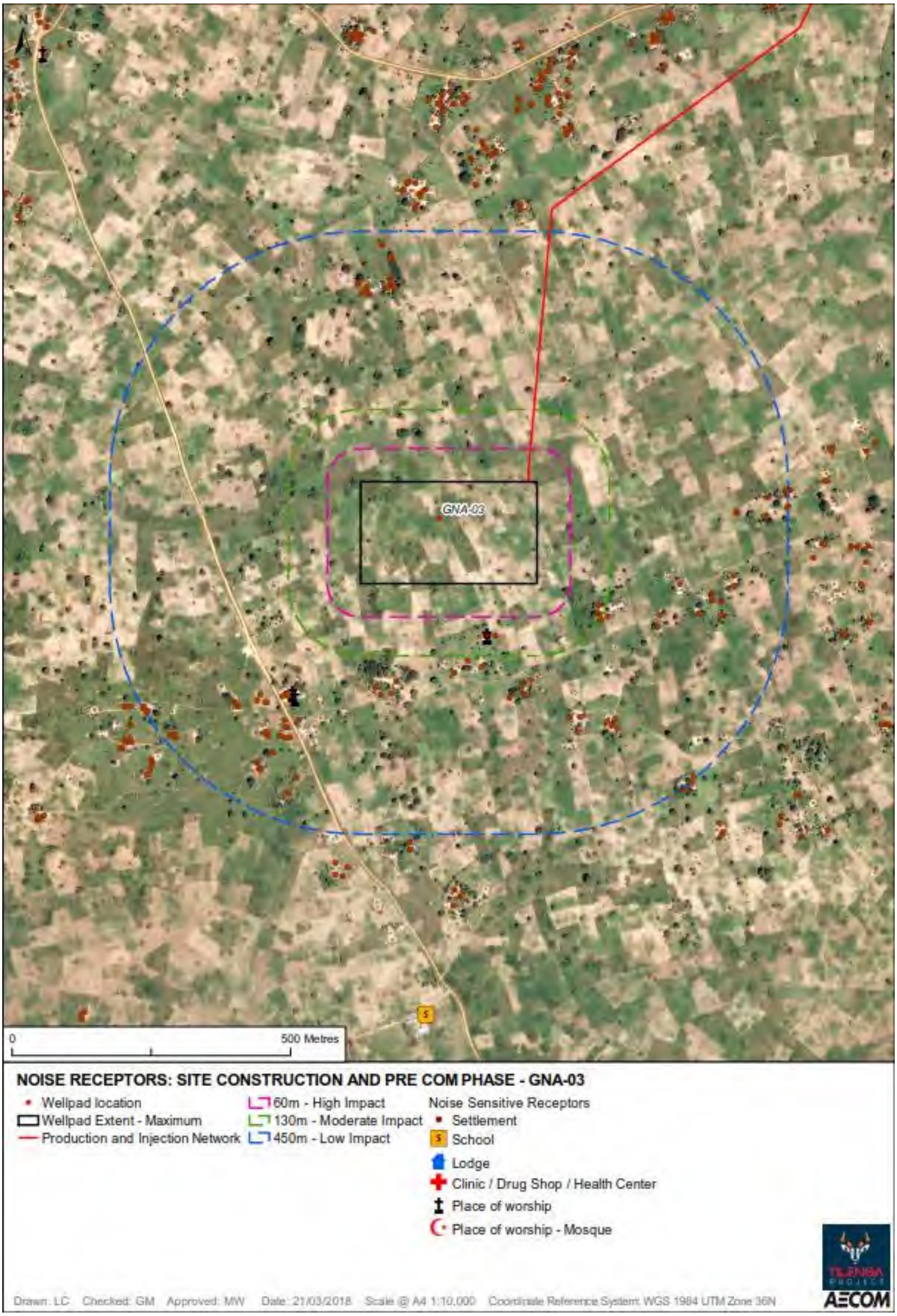


Figure I3-5: GNA-04 Night-time Well Pad Drilling Receptor Analysis

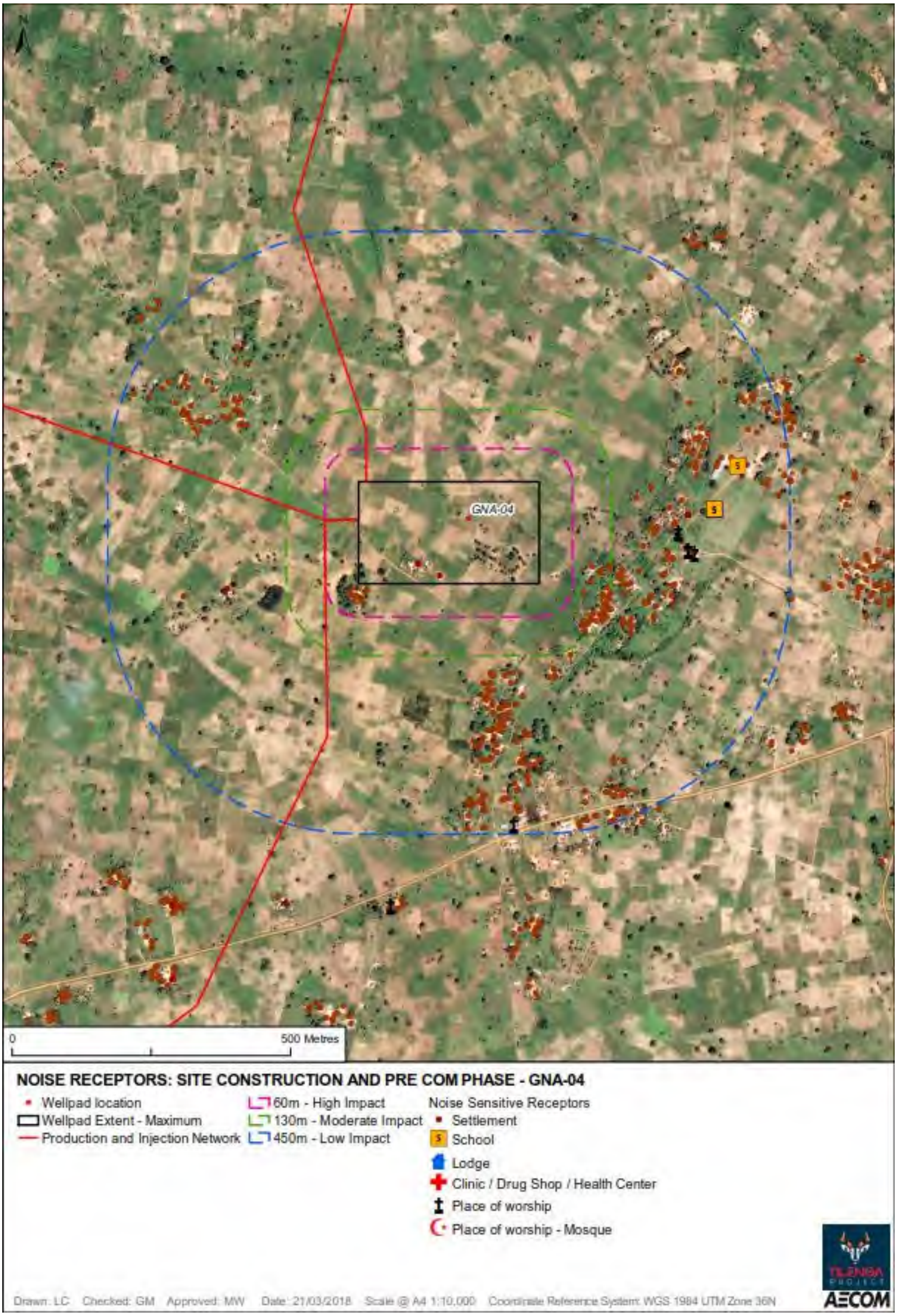


Figure I3-6: JBR-01 Night-time Well Pad Drilling Receptor Analysis

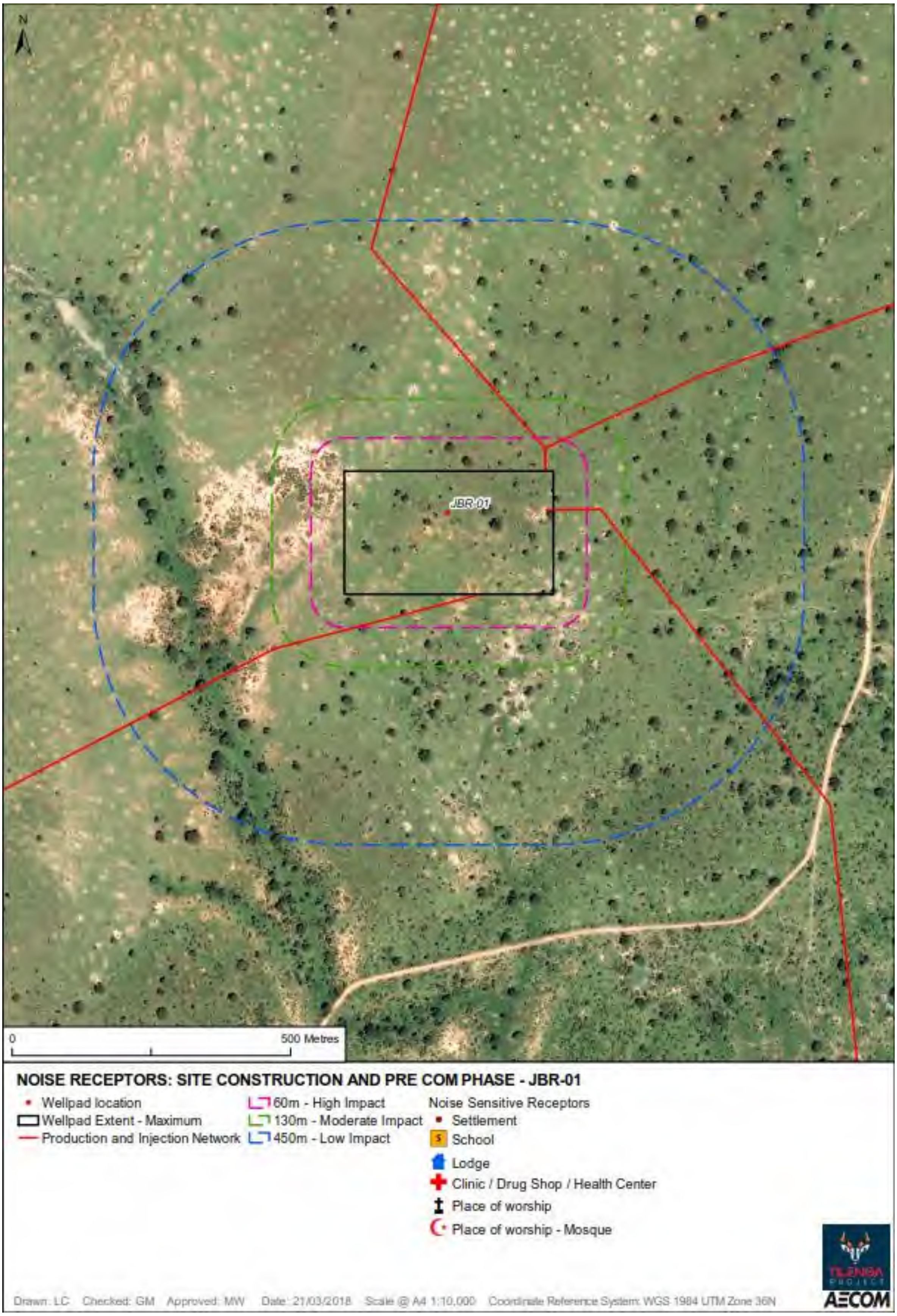


Figure I3-7: JBR-02 Night-time Well Pad Drilling Receptor Analysis

Figure I3-8: JBR-03 Night-time Well Pad Drilling Receptor Analysis

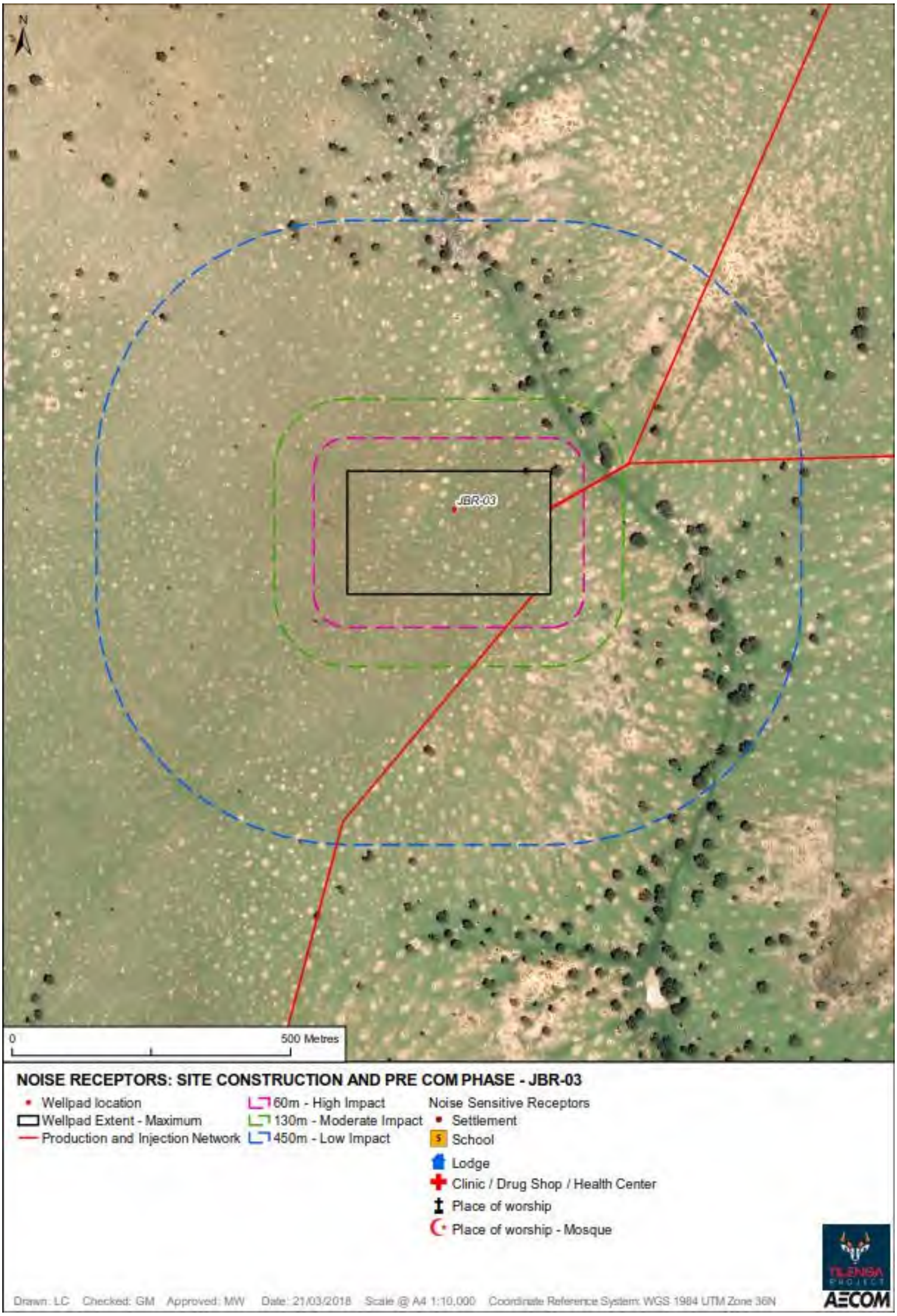


Figure I3-9: JBR-04 Night-time Well Pad Drilling Receptor Analysis

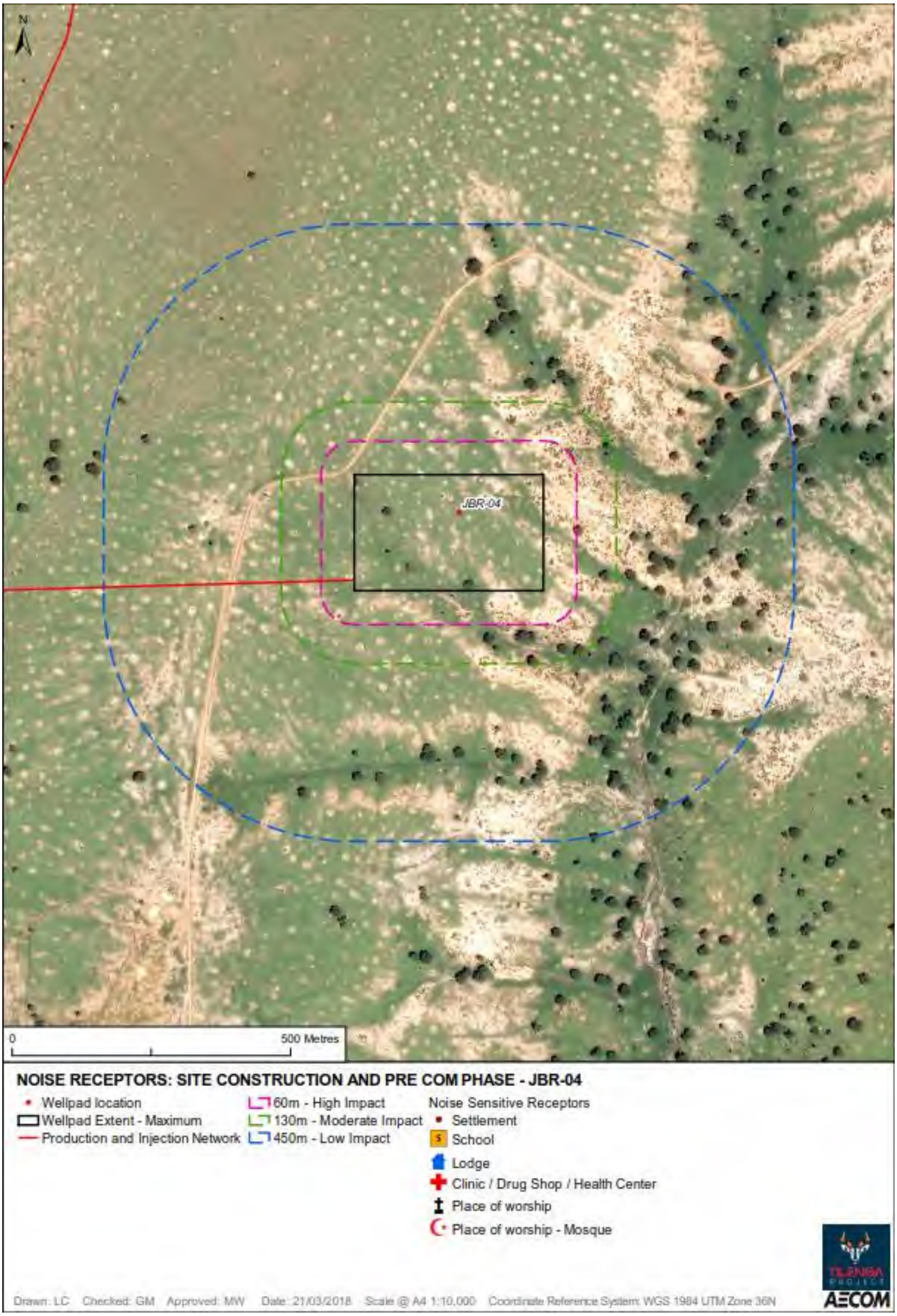


Figure I3-10: JBR-05 Night-time Well Pad Drilling Receptor Analysis

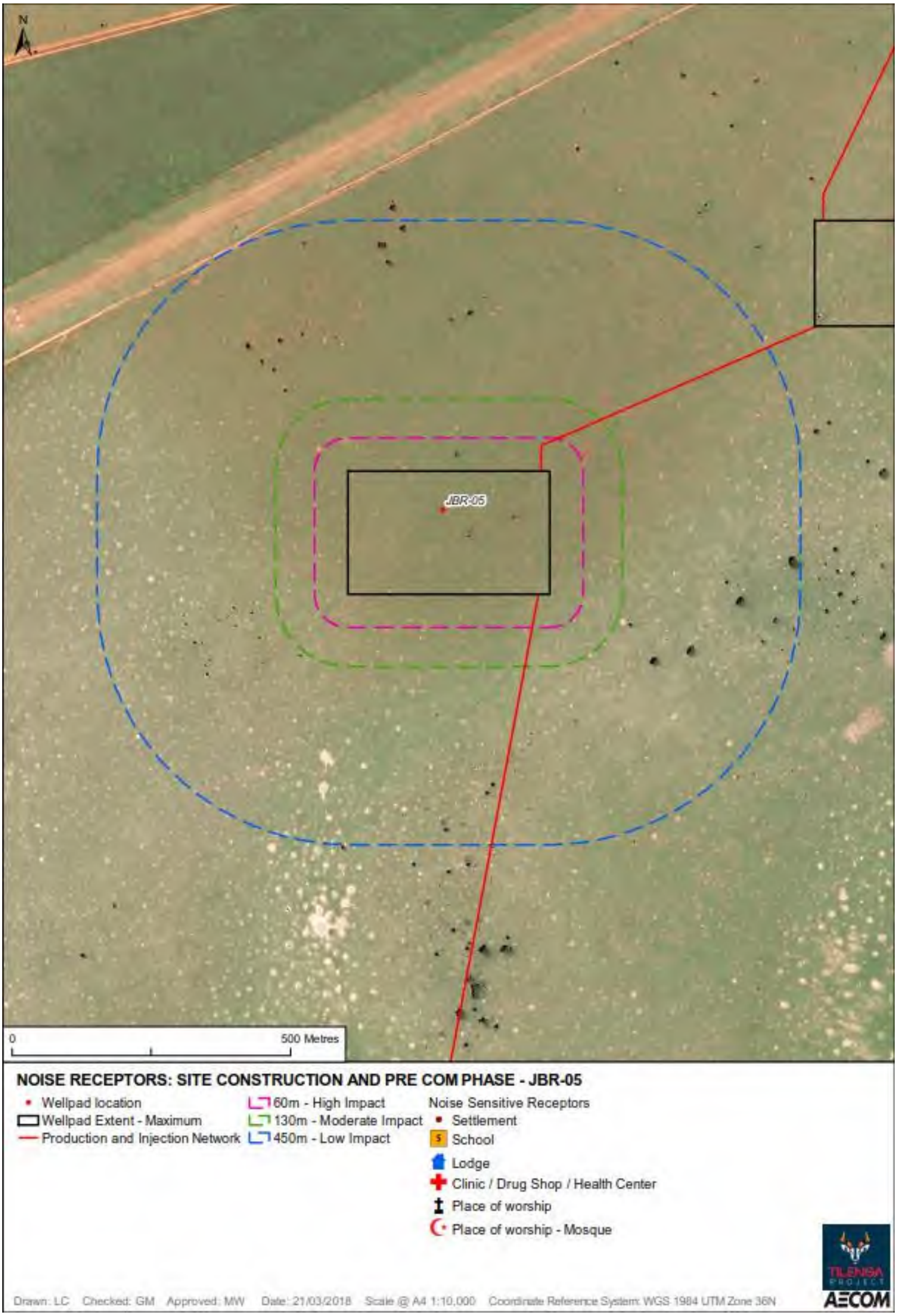


Figure I3-11: JBR-06 Night-time Well Pad Drilling Receptor Analysis

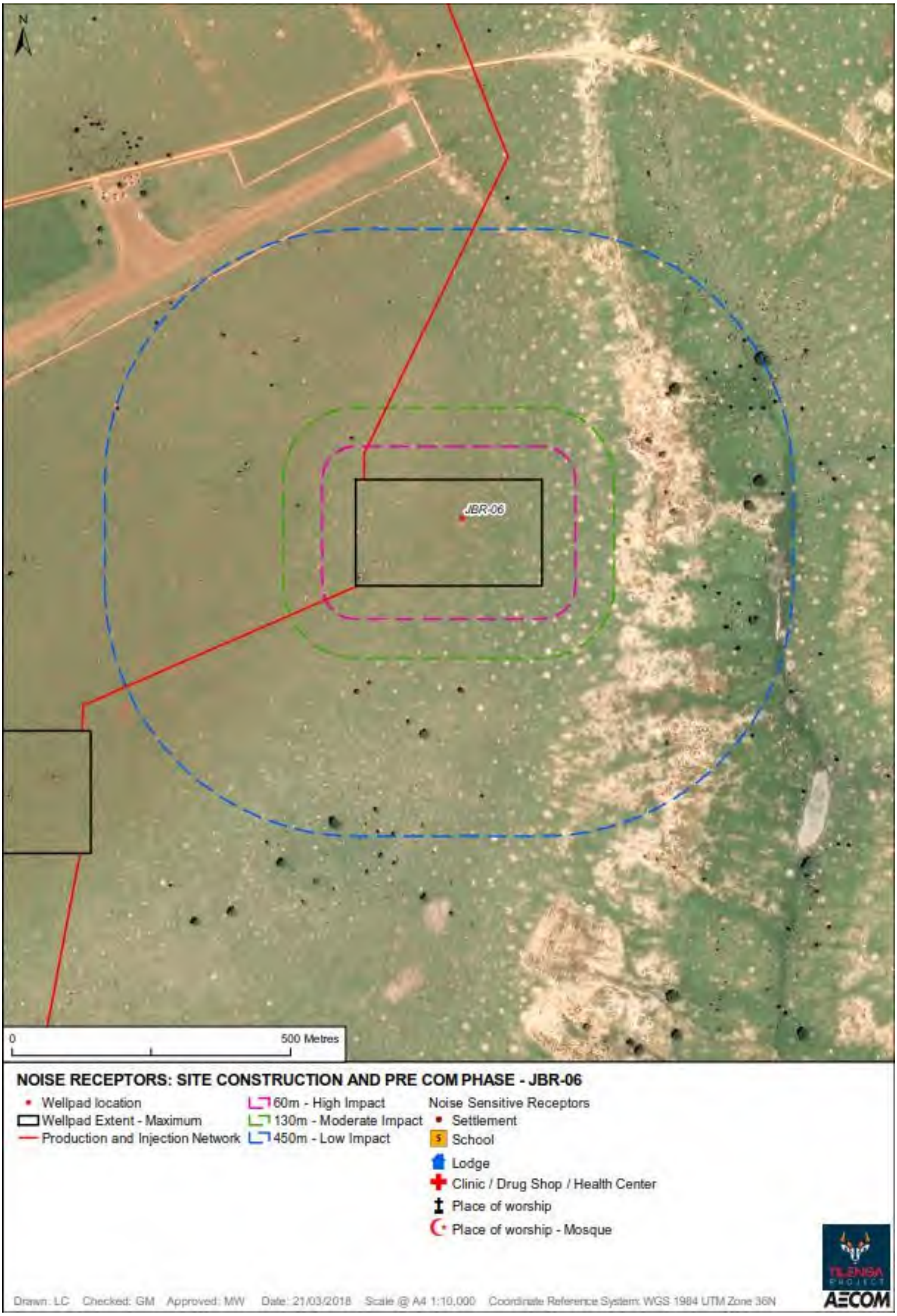


Figure I3-12: JBR-07 Night-time Well Pad Drilling Receptor Analysis

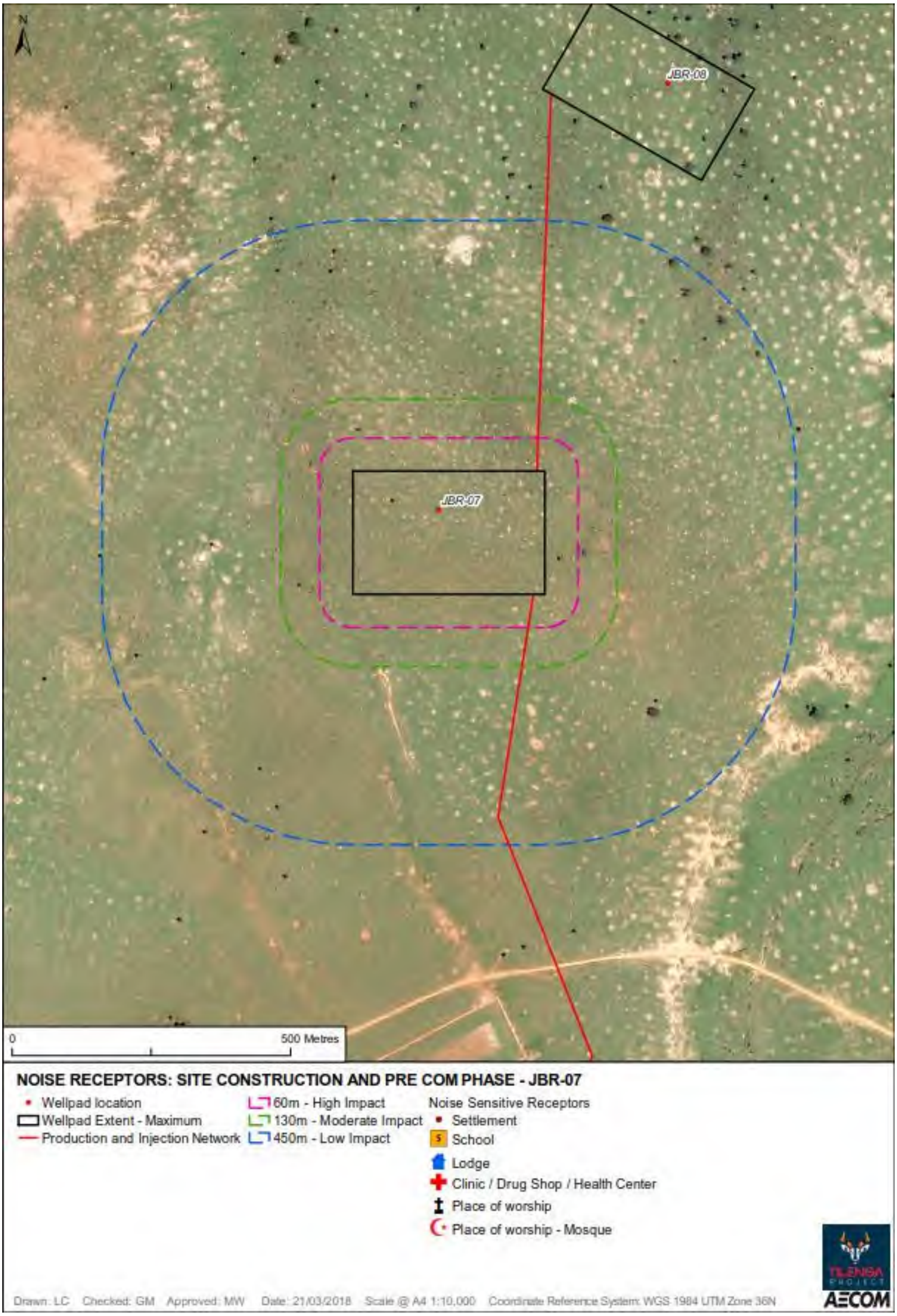


Figure I3-13: JBR-08 Night-time Well Pad Drilling Receptor Analysis

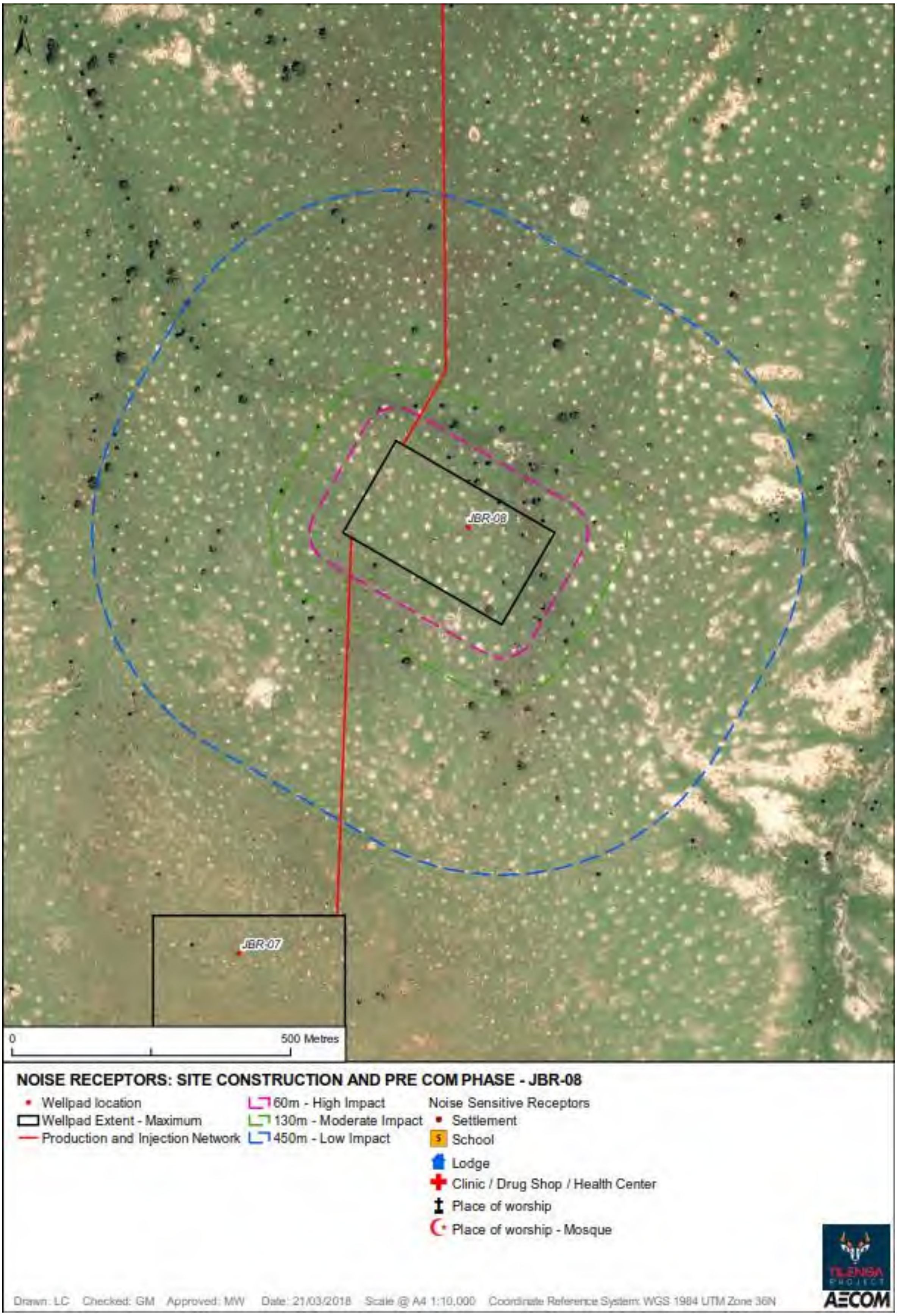


Figure I3-14: JBR-09 Night-time Well Pad Drilling Receptor Analysis

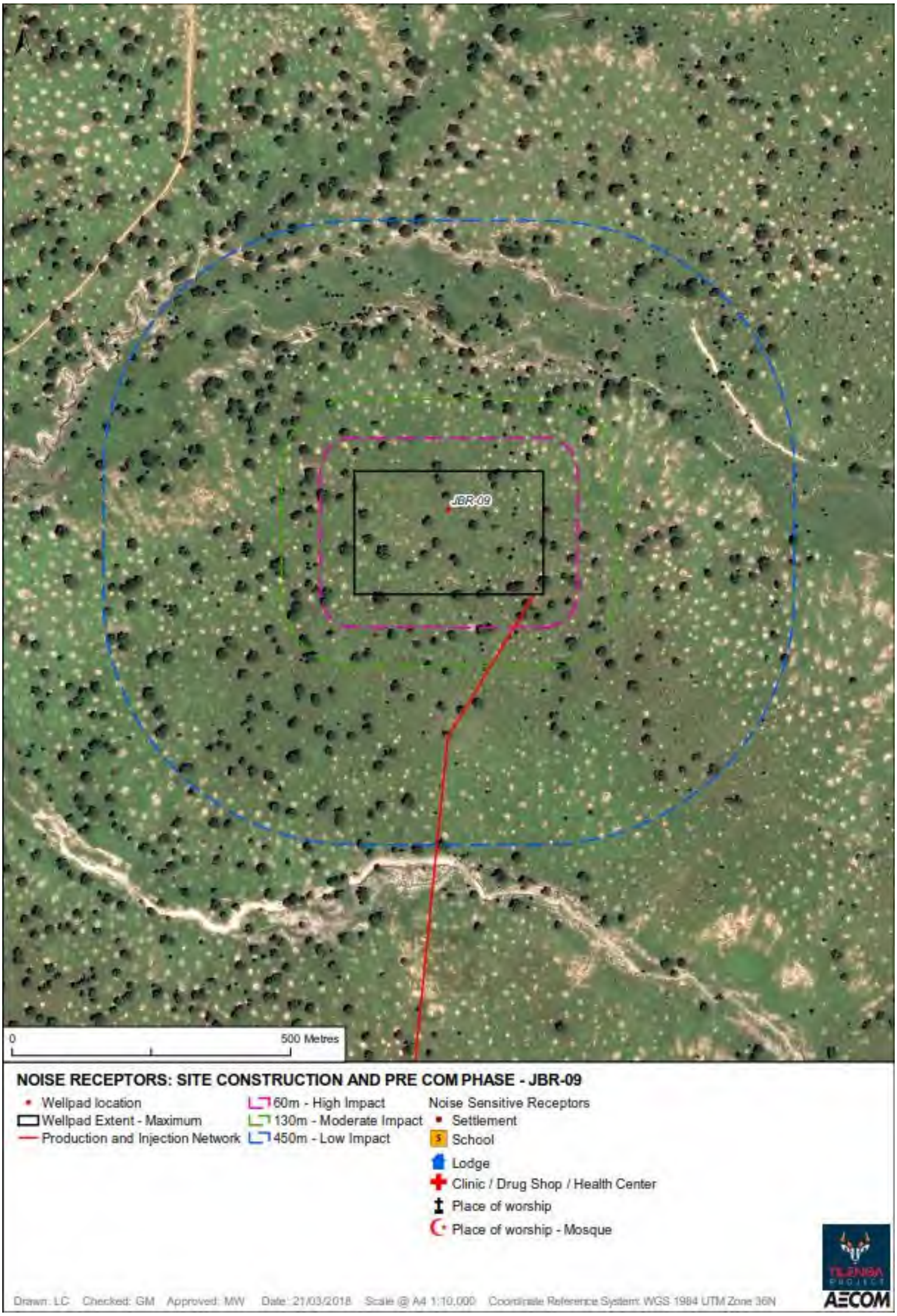


Figure I3-15: JBR-10 Night-time Well Pad Drilling Receptor Analysis

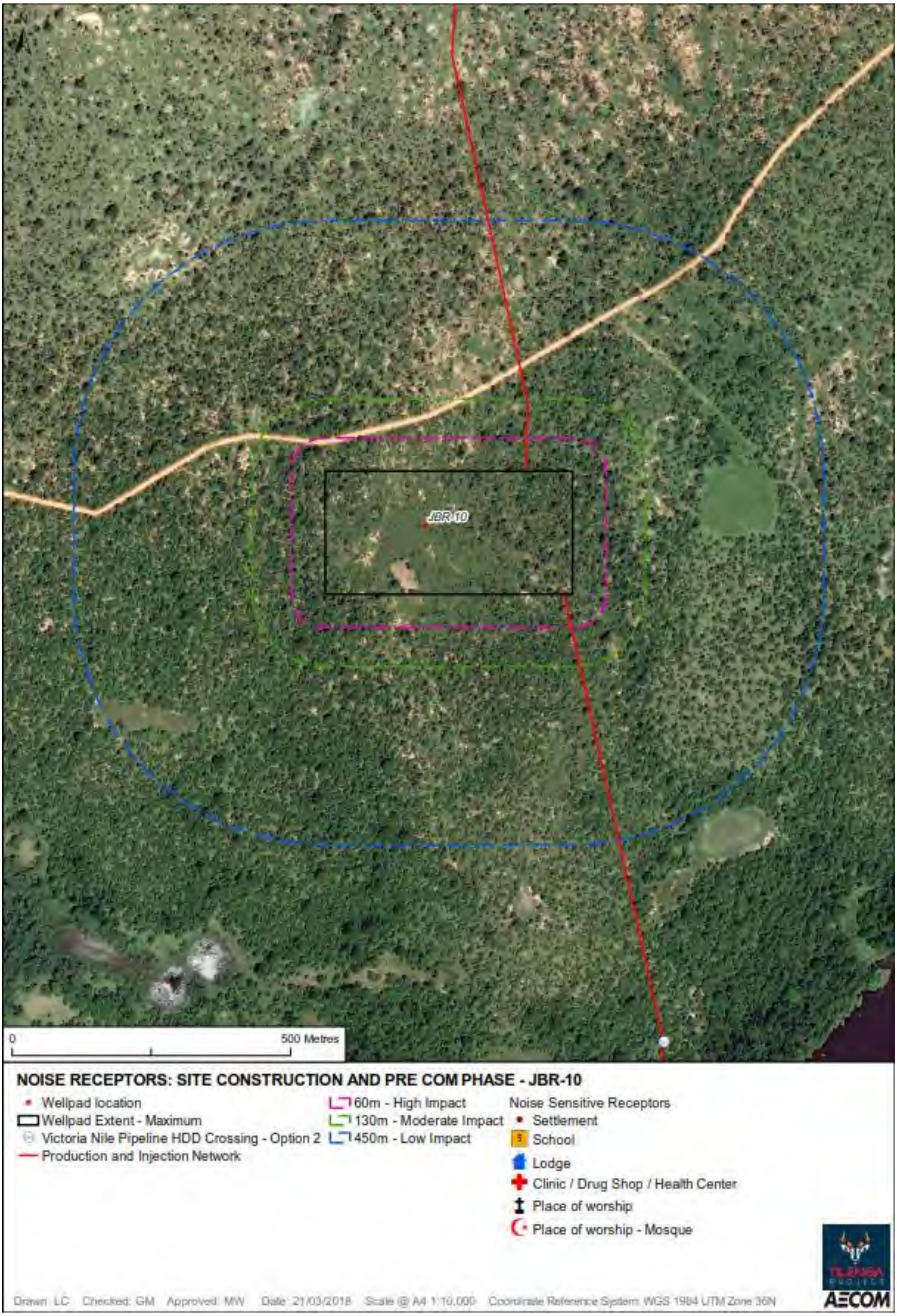


Figure I3-16: KGG-01 Night-time Well Pad Drilling Receptor Analysis

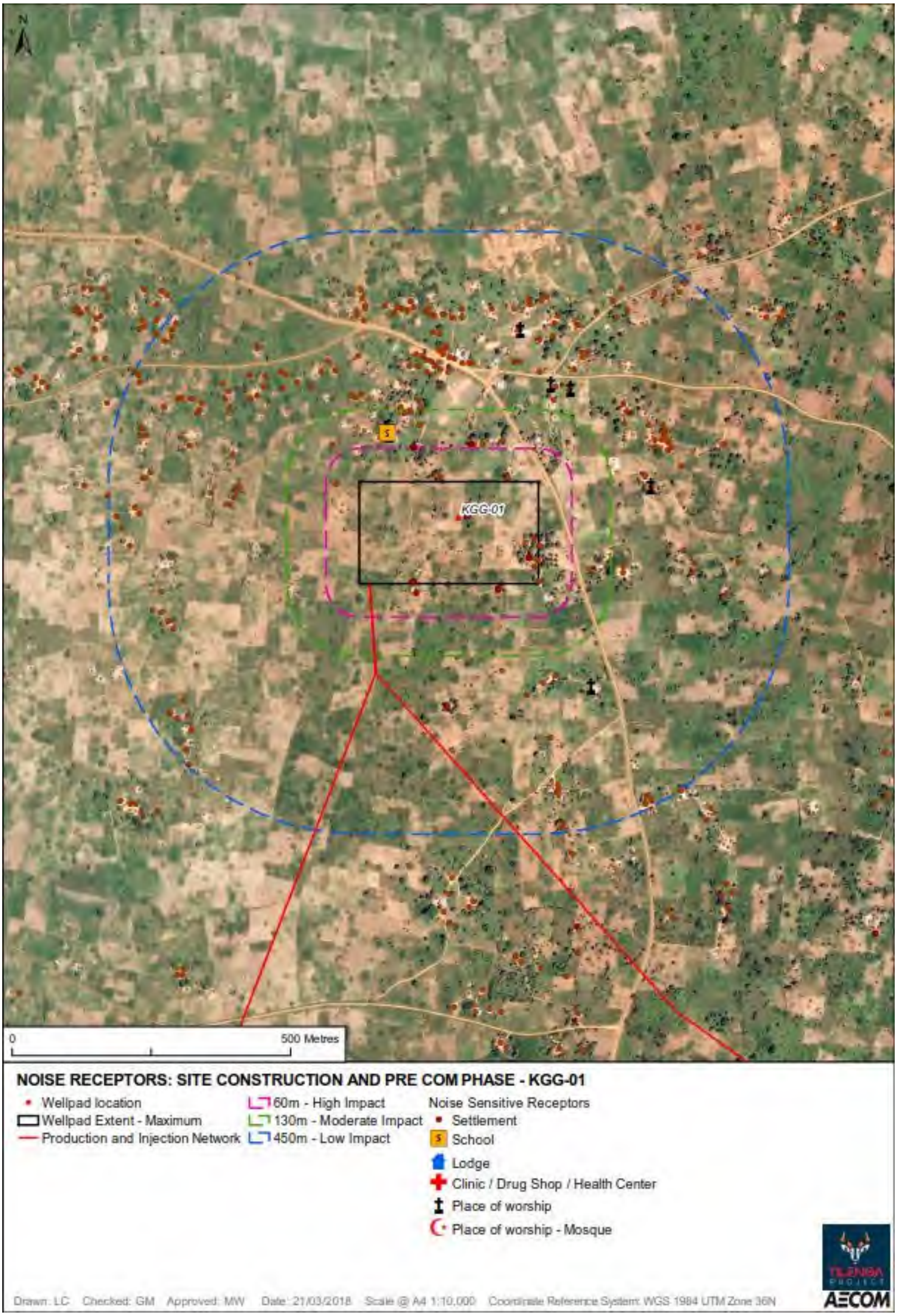


Figure I3-17: KGG-03 Night-time Well Pad Drilling Receptor Analysis

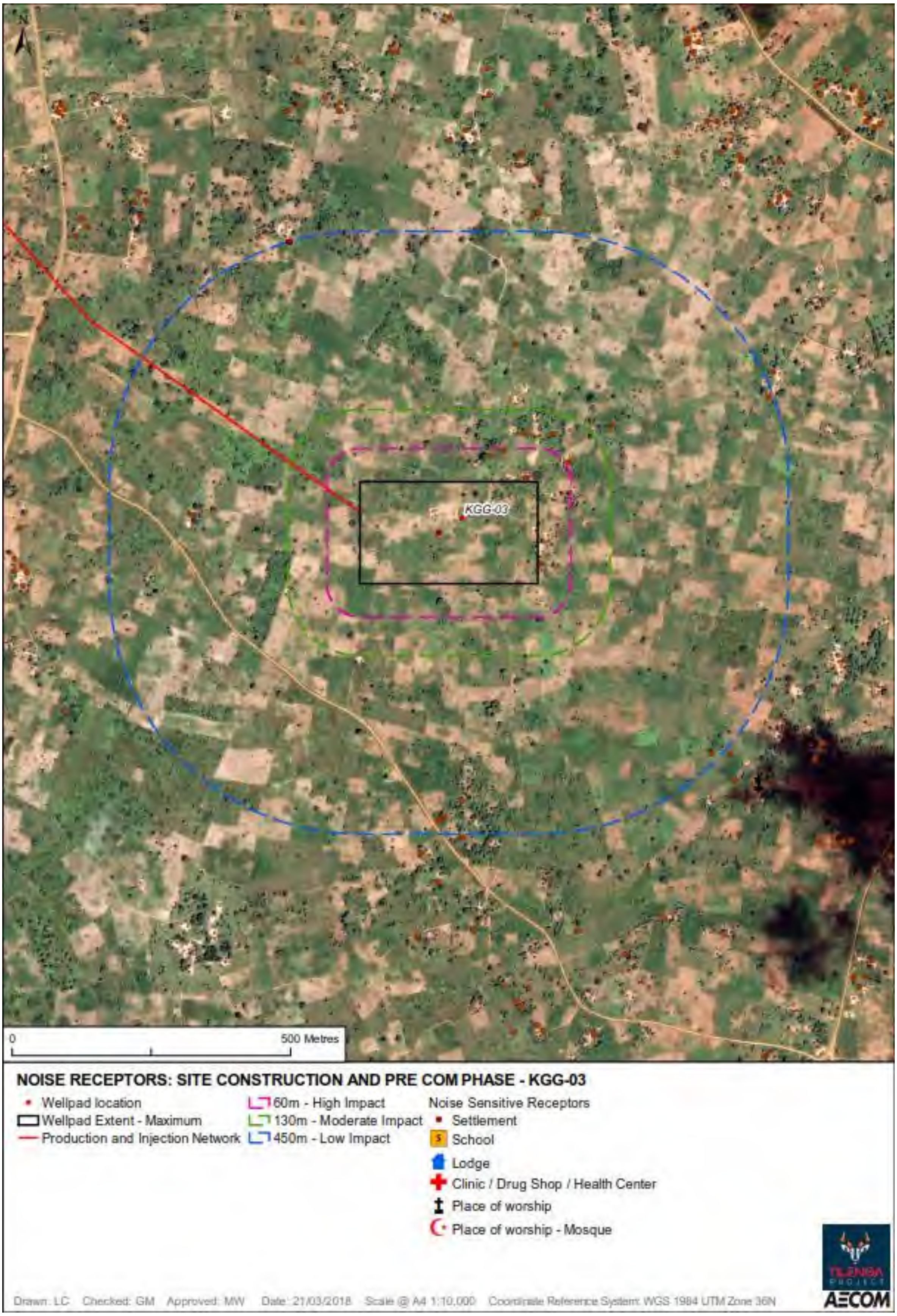


Figure I3-18: KGG-04 Night-time Well Pad Drilling Receptor Analysis

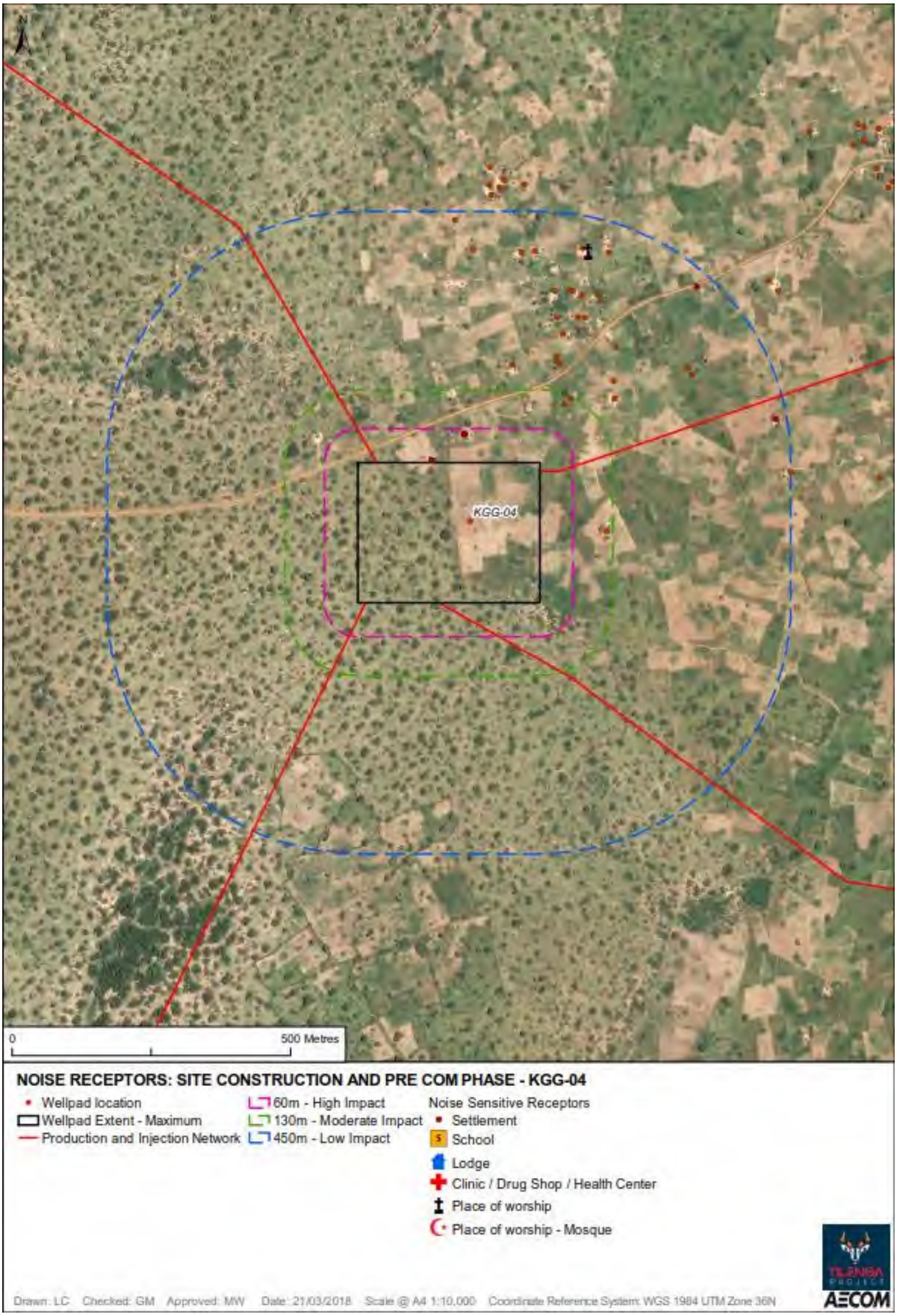


Figure I3-19: KGG-05 Night-time Well Pad Drilling Receptor Analysis

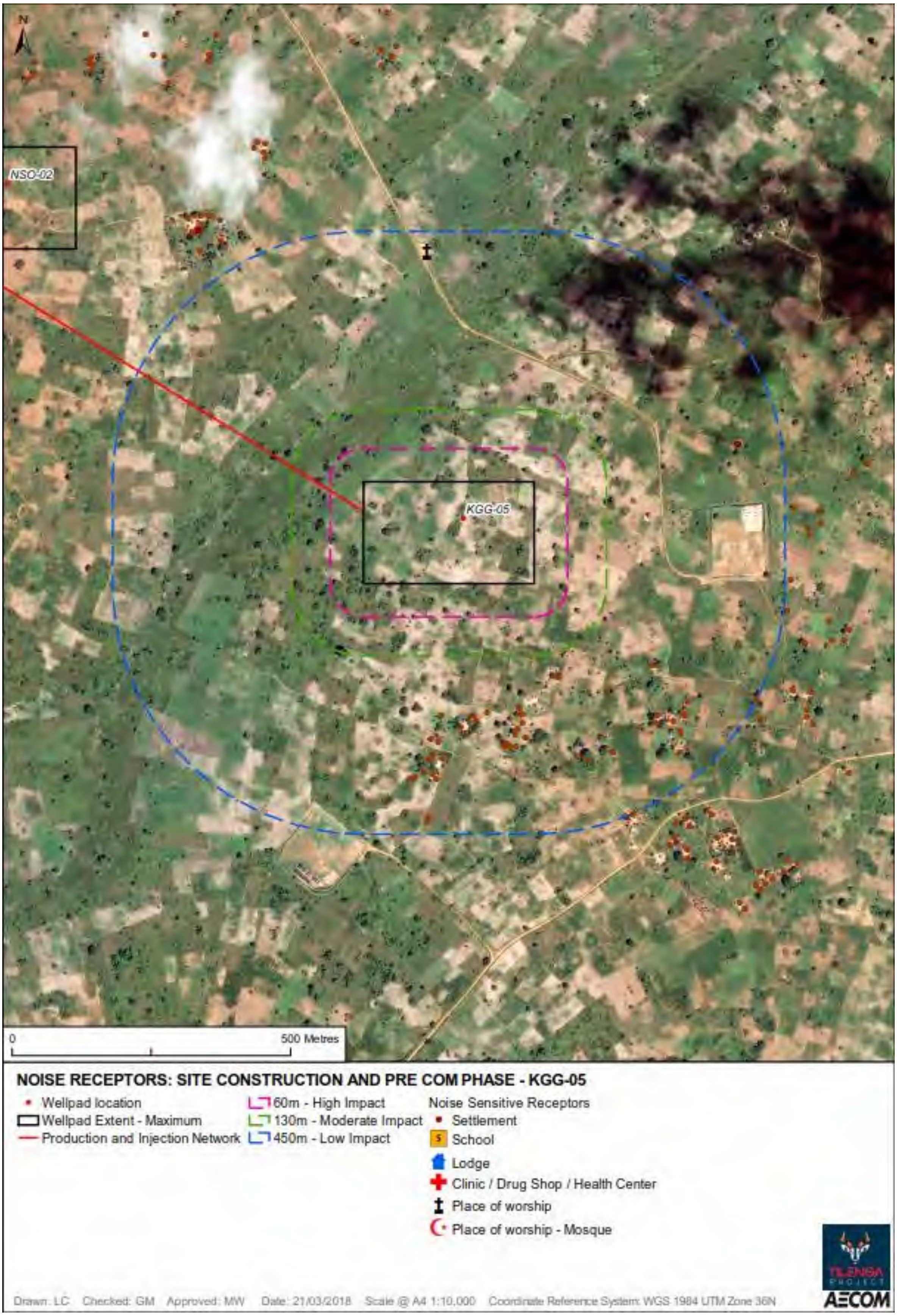


Figure I3-20: KGG-06 Night-time Well Pad Drilling Receptor Analysis

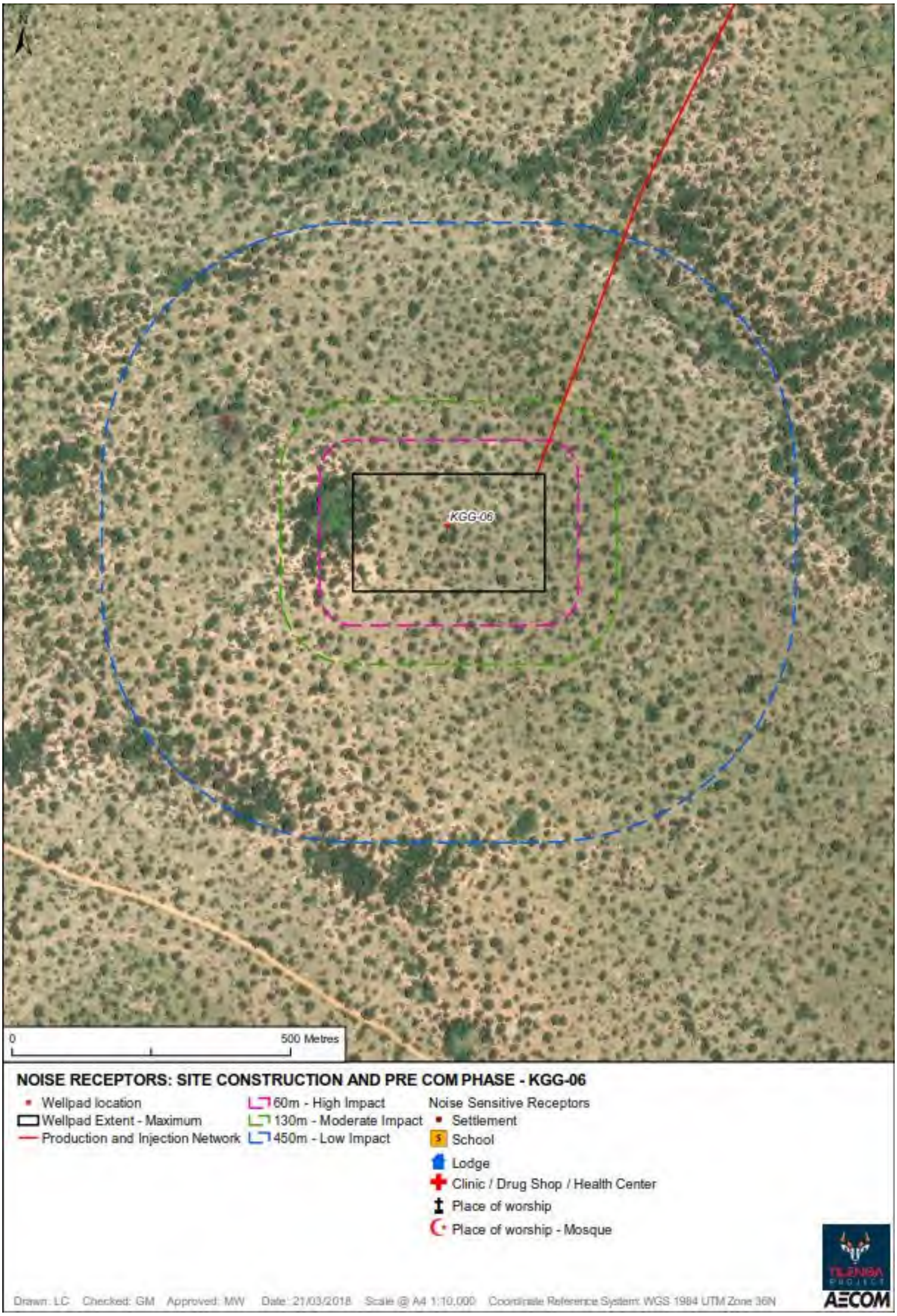


Figure I3-21: KGG-09 Night-time Well Pad Drilling Receptor Analysis

Figure I3-22: KW-01 Night-time Well Pad Drilling Receptor Analysis

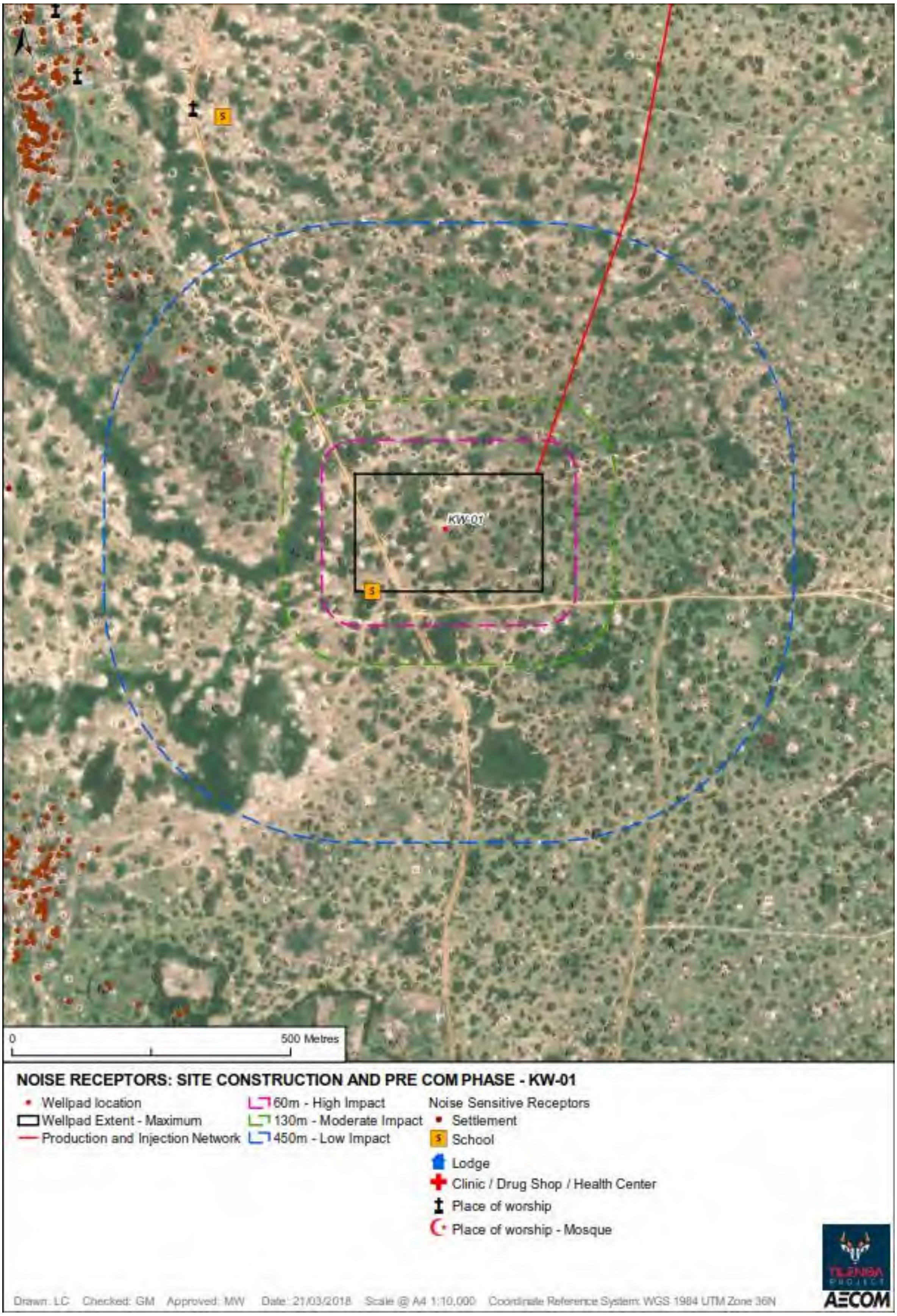


Figure I3-23: KW-02A Night-time Well Pad Drilling Receptor Analysis

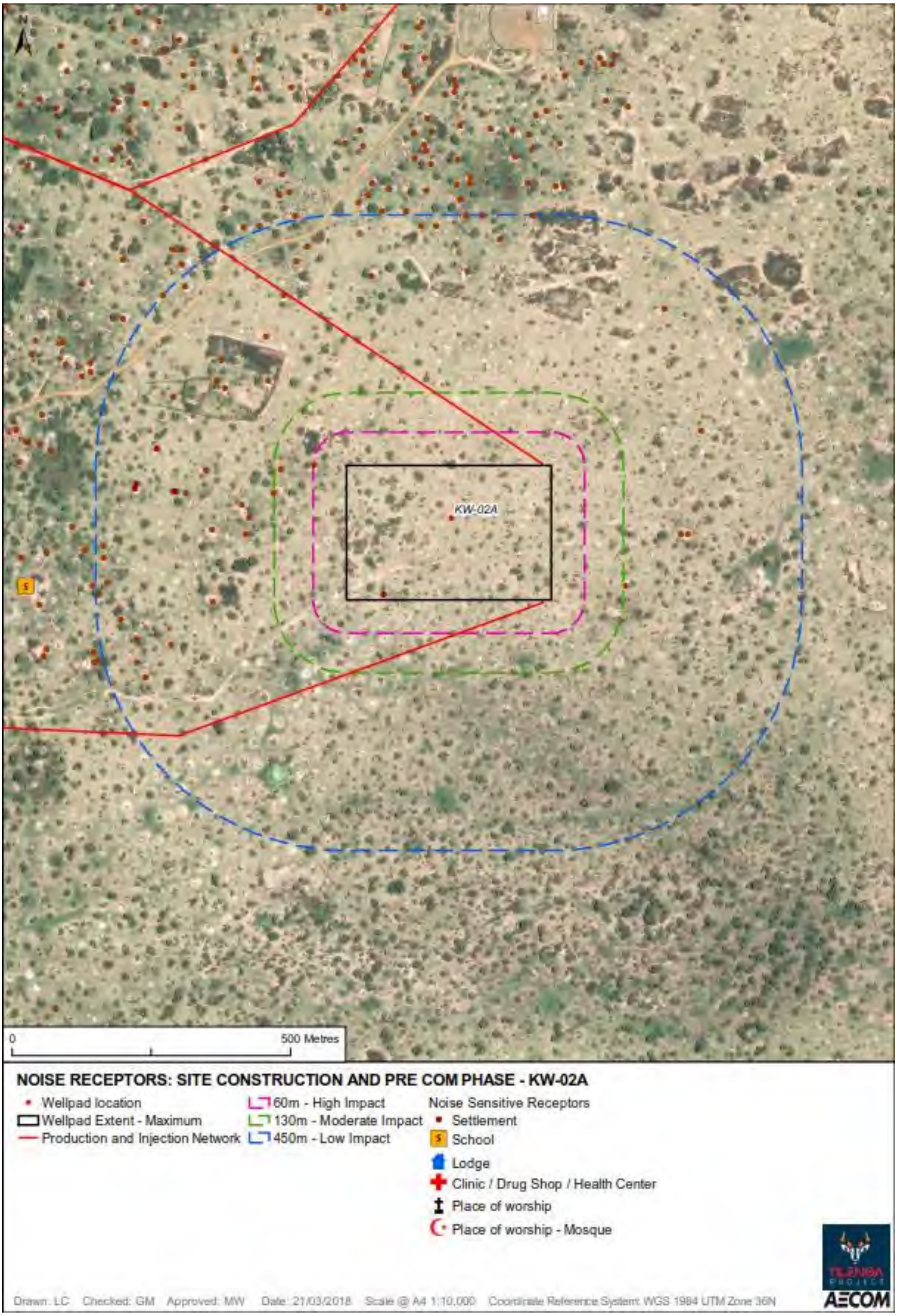


Figure I3-24: KW-02B Night-time Well Pad Drilling Receptor Analysis

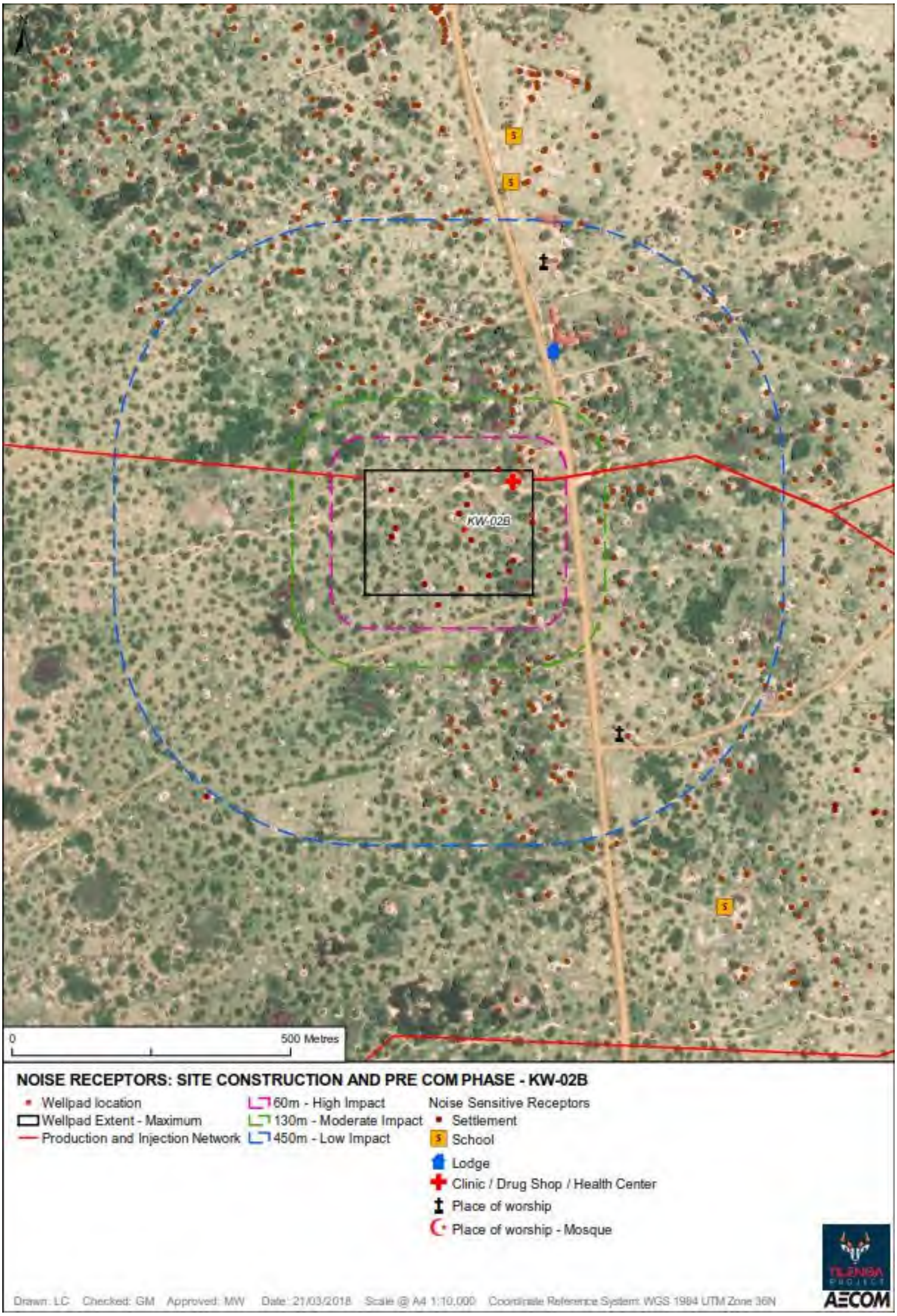


Figure I3-25: NGR-01 Night-time Well Pad Drilling Receptor Analysis

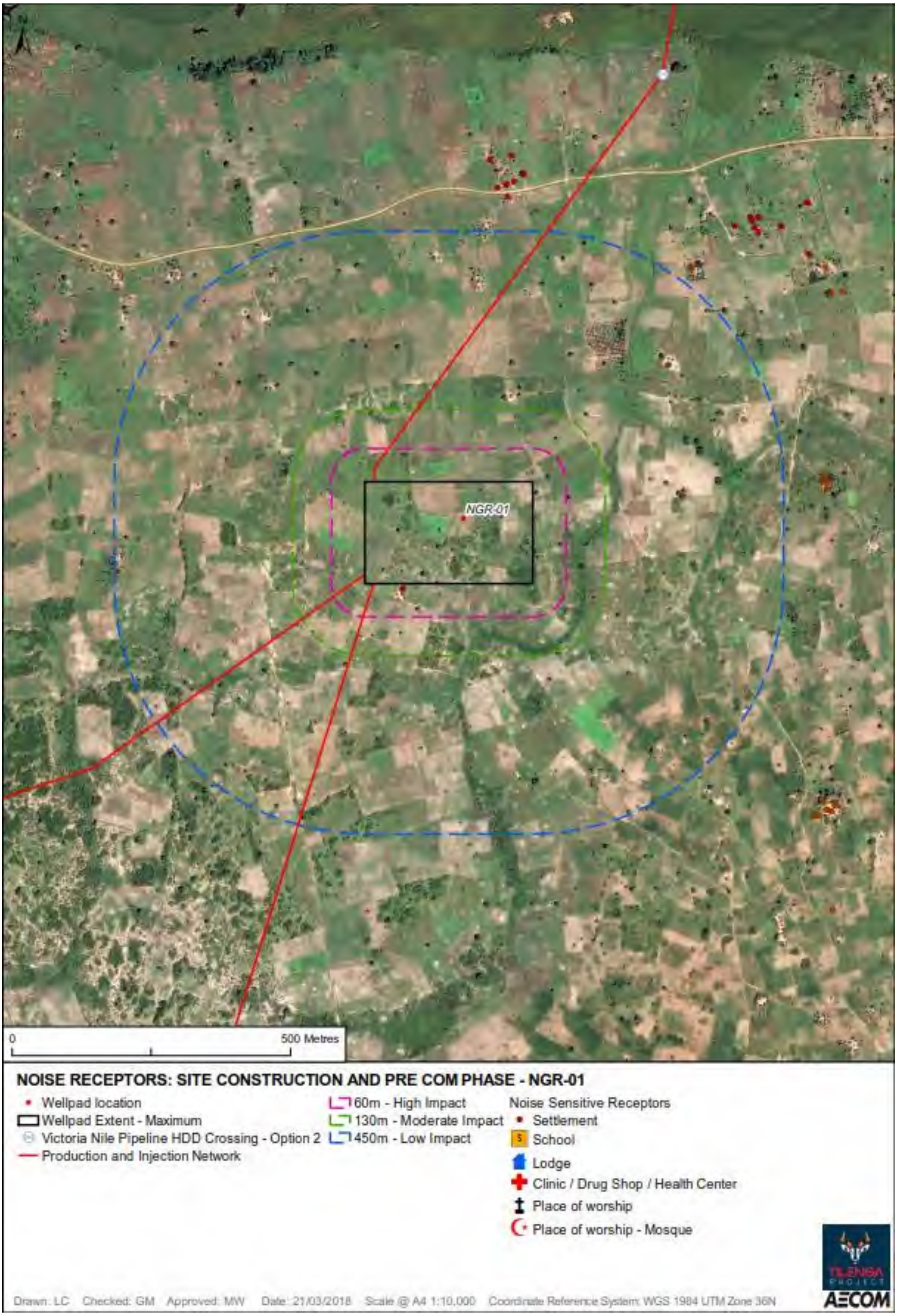


Figure I3-26: NGR-02 Night-time Well Pad Drilling Receptor Analysis

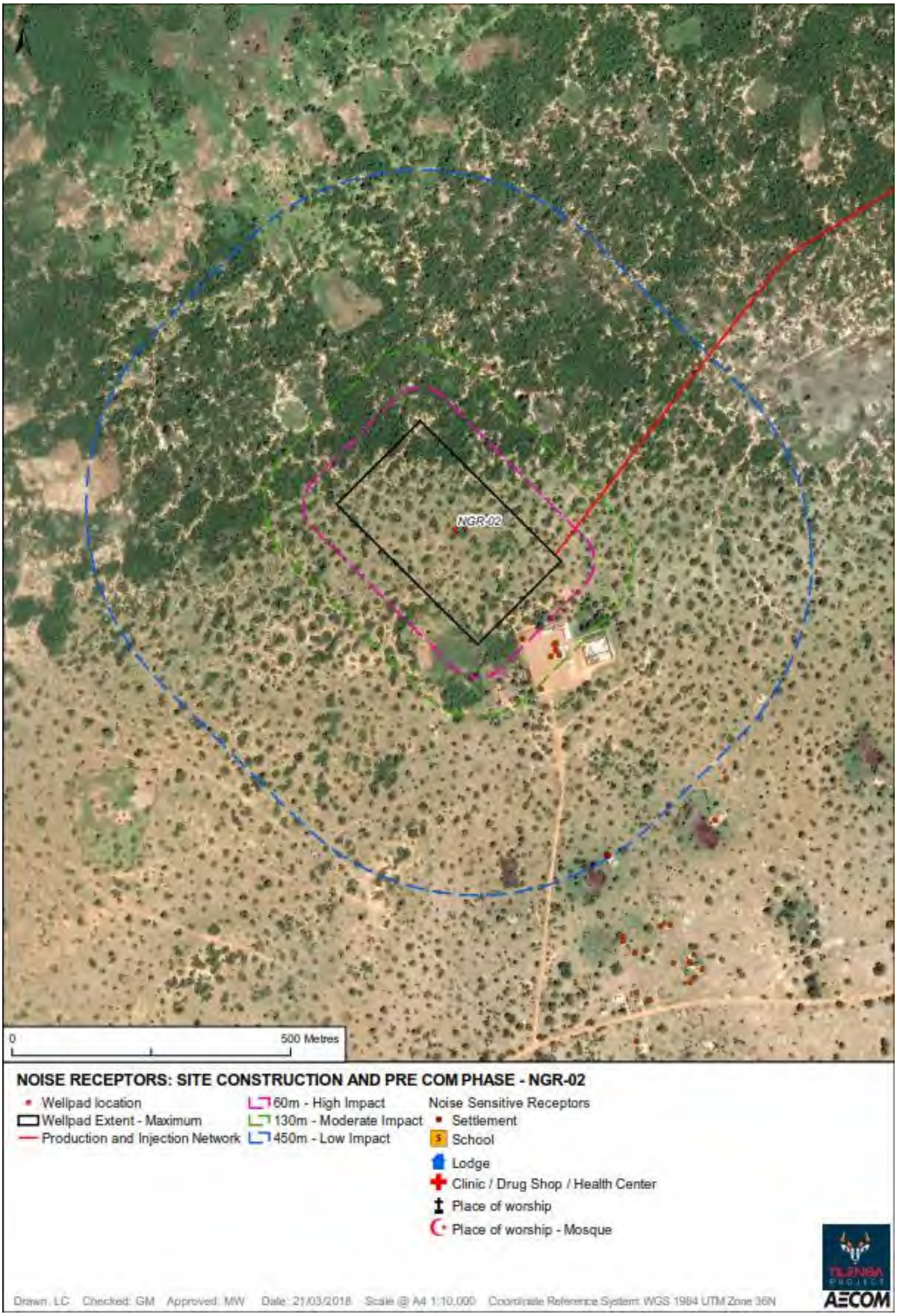


Figure I3-27: NGR-03A Night-time Well Pad Drilling Receptor Analysis

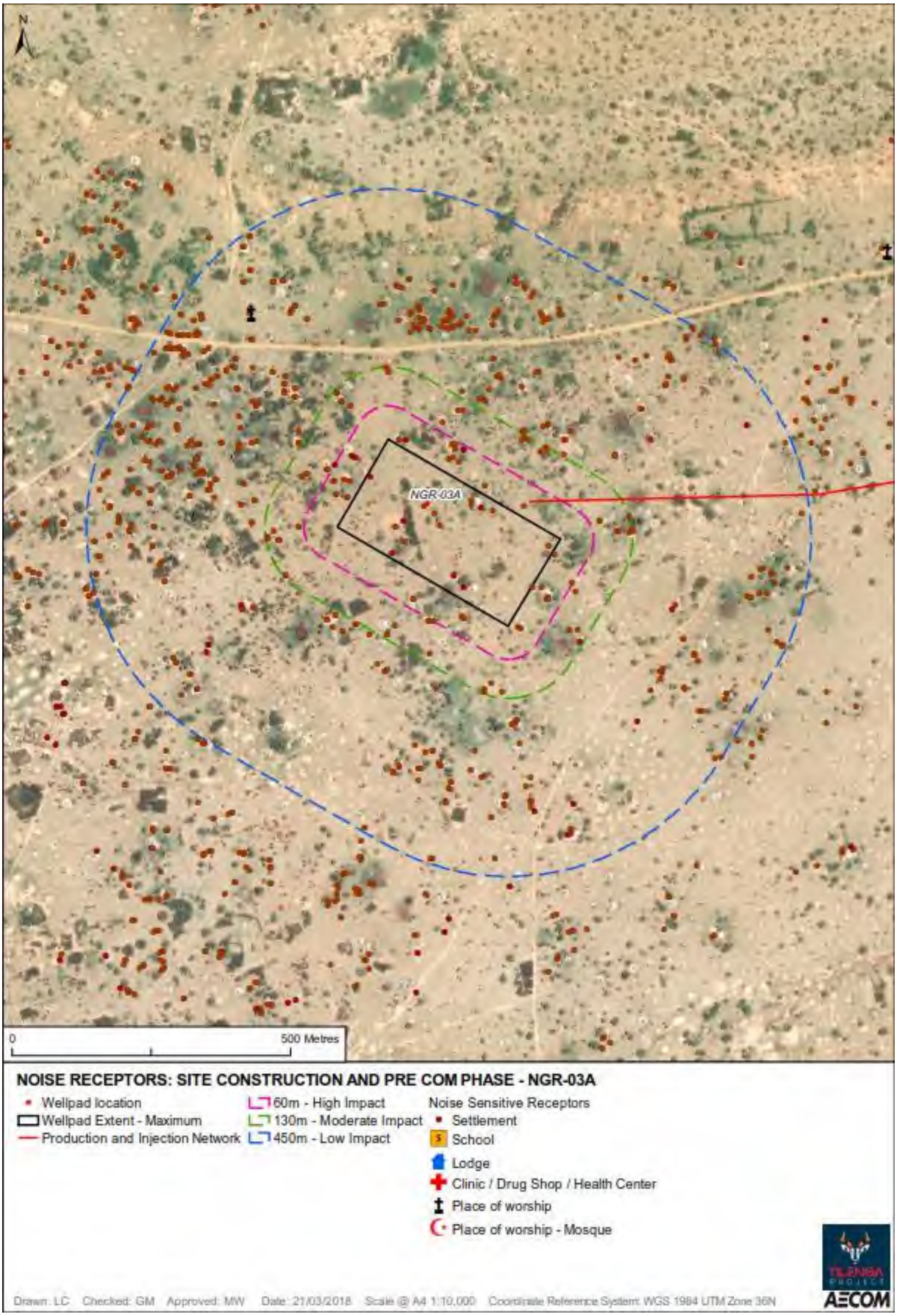


Figure I3-28: NGR-05A Night-time Well Pad Drilling Receptor Analysis

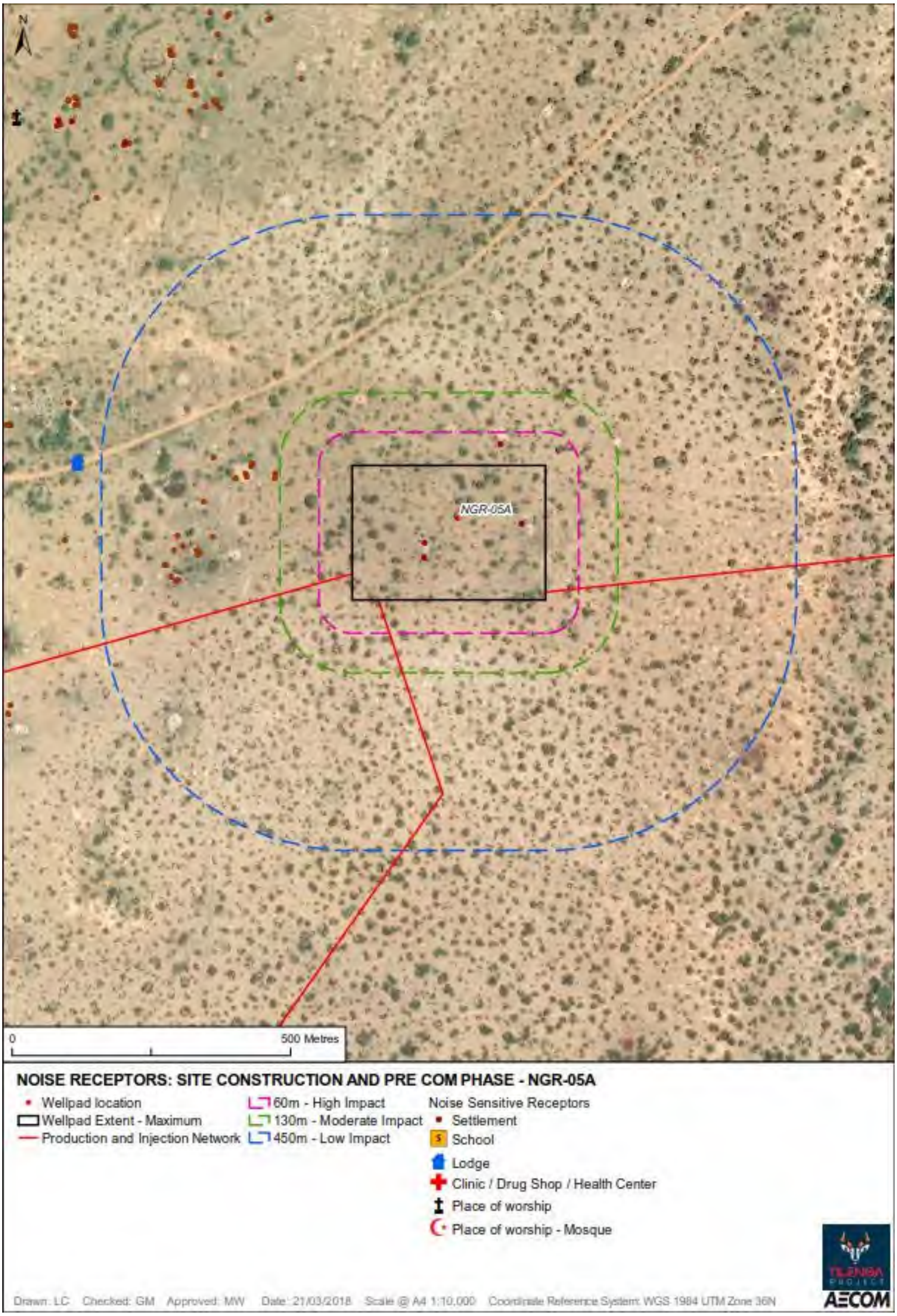


Figure I3-29: NGR-06 Night-time Well Pad Drilling Receptor Analysis

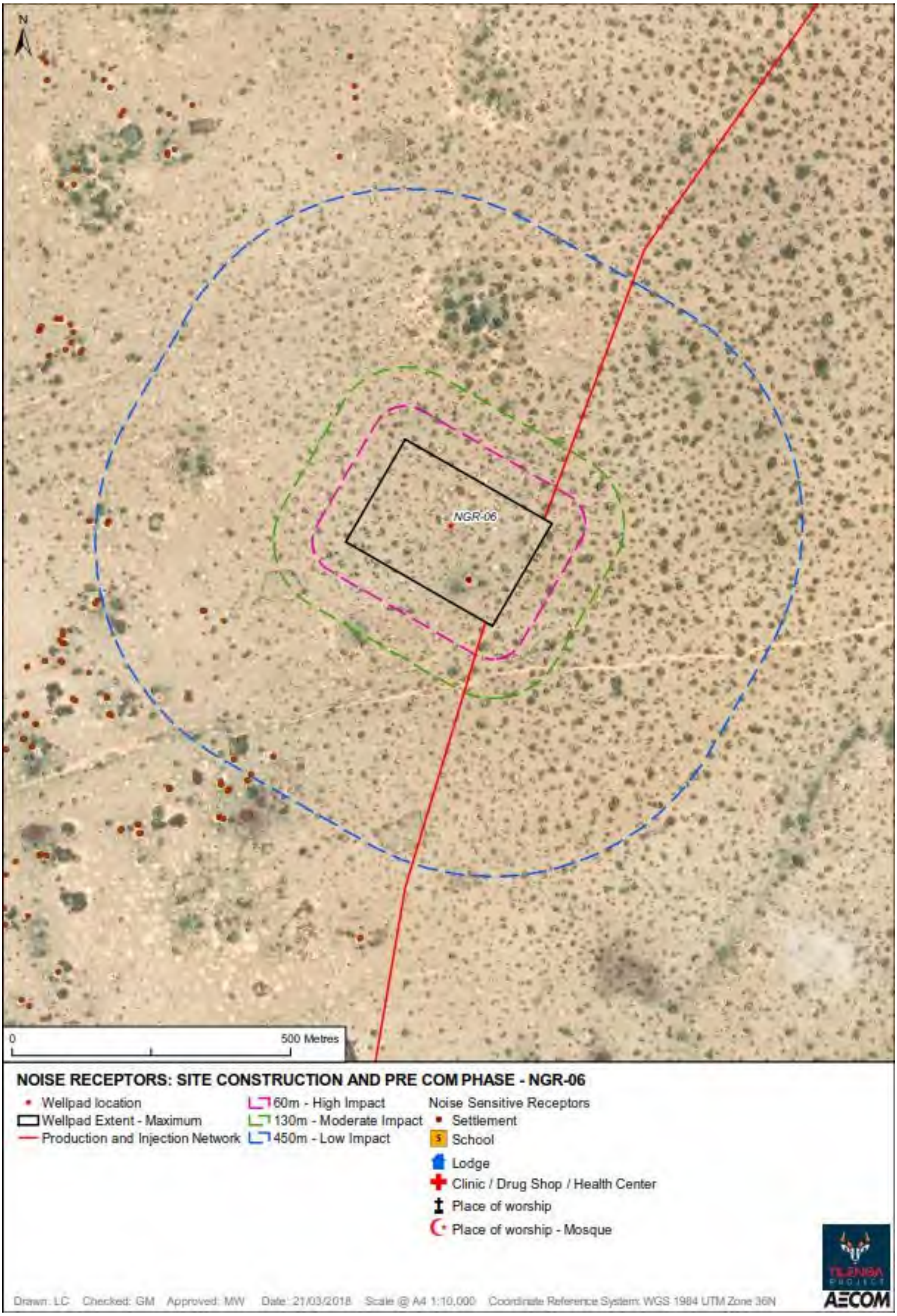


Figure I3-30: NSO-01 Night-time Well Pad Drilling Receptor Analysis

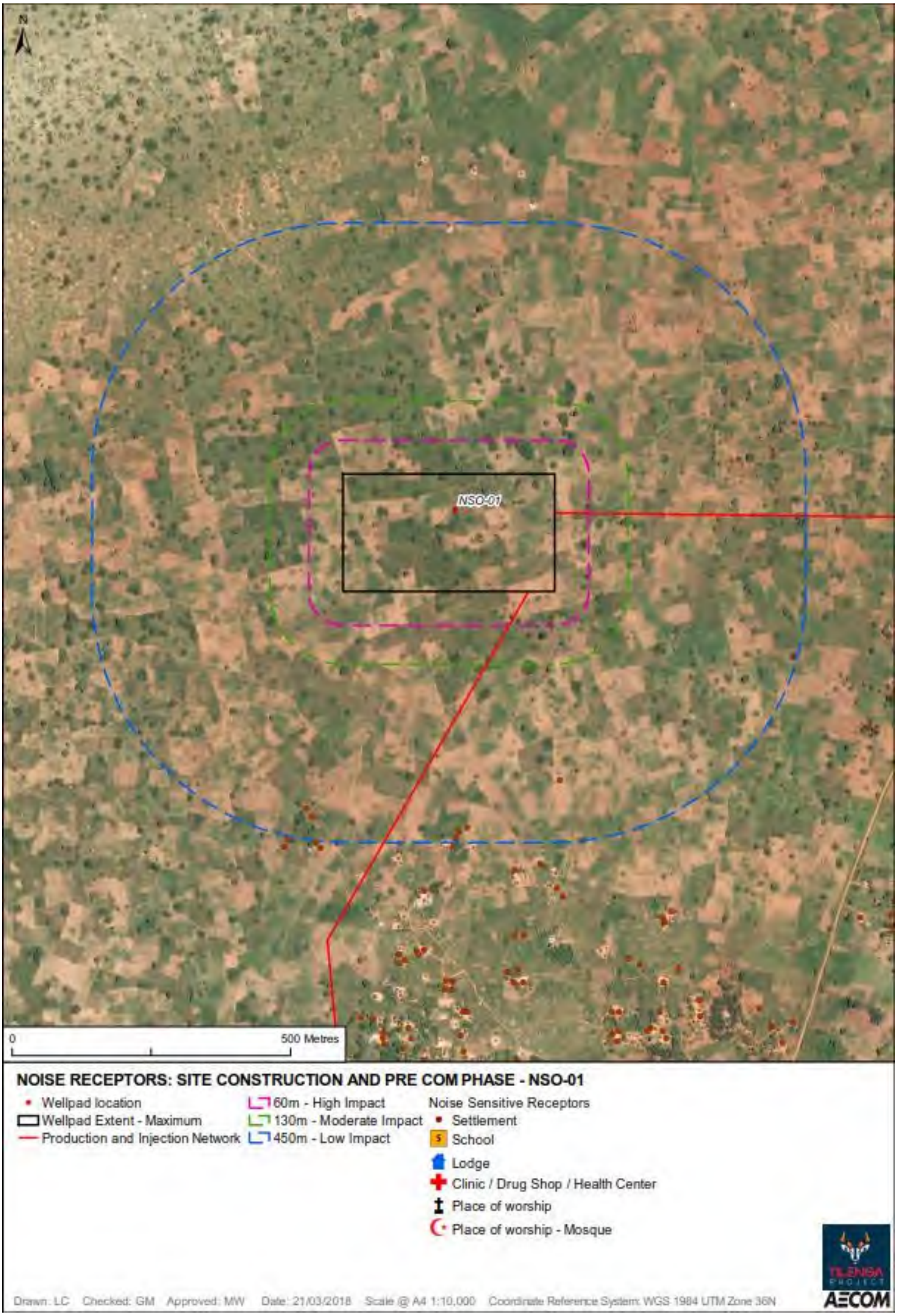


Figure I3-31: NSO-02 Night-time Well Pad Drilling Receptor Analysis

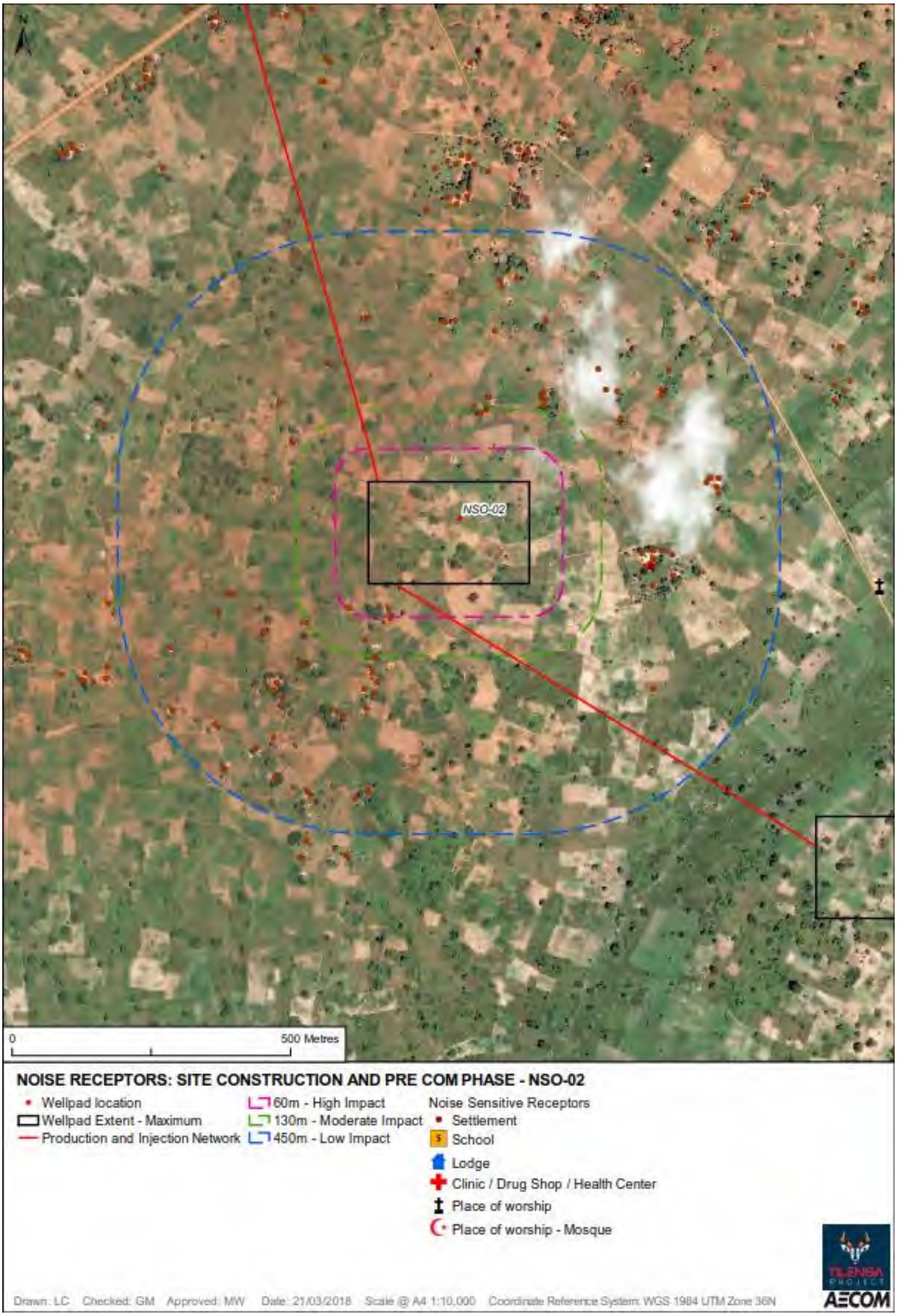


Figure I3-32: NSO-03 Night-time Well Pad Drilling Receptor Analysis

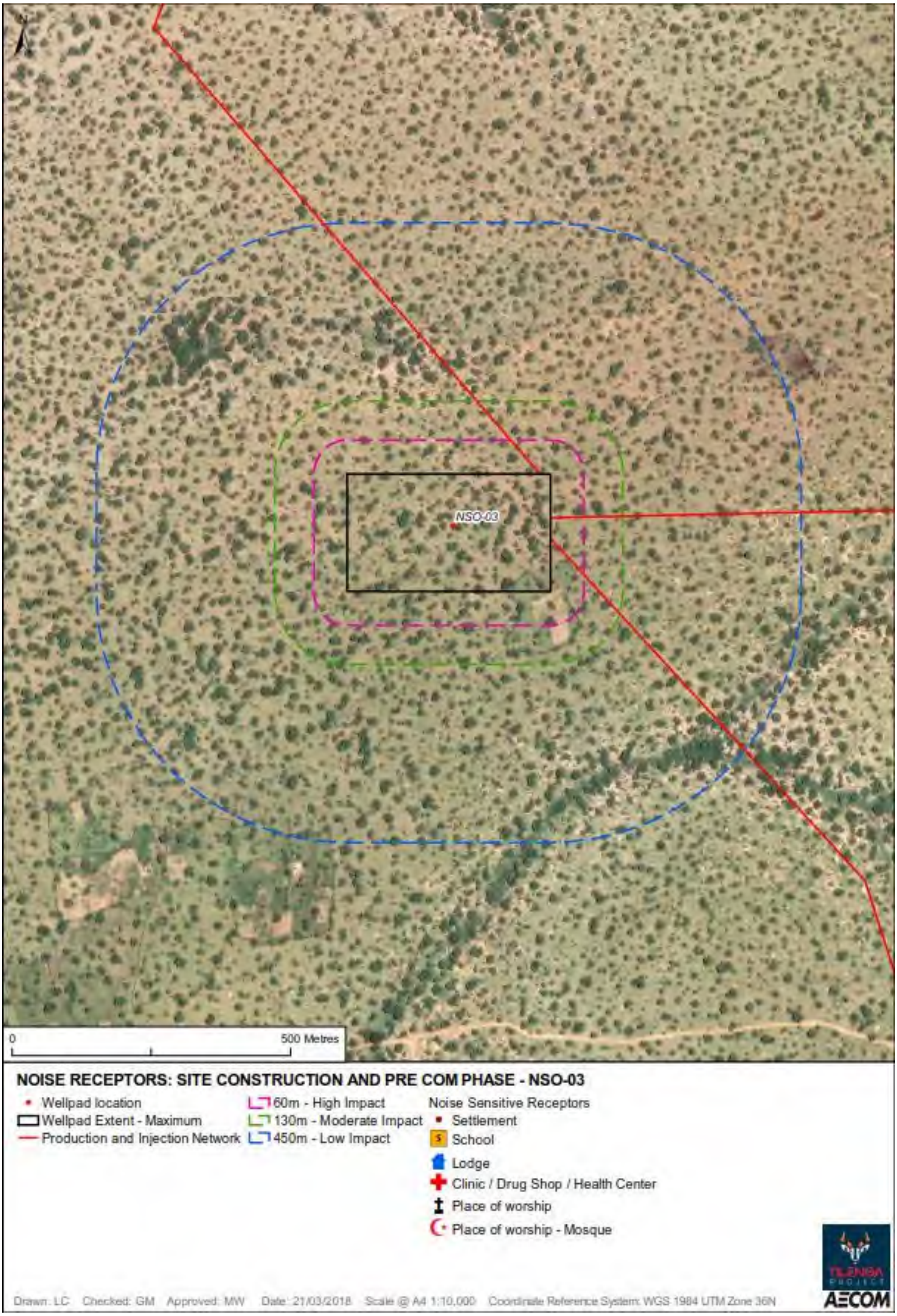


Figure I3-33: NSO-04 Night-time Well Pad Drilling Receptor Analysis

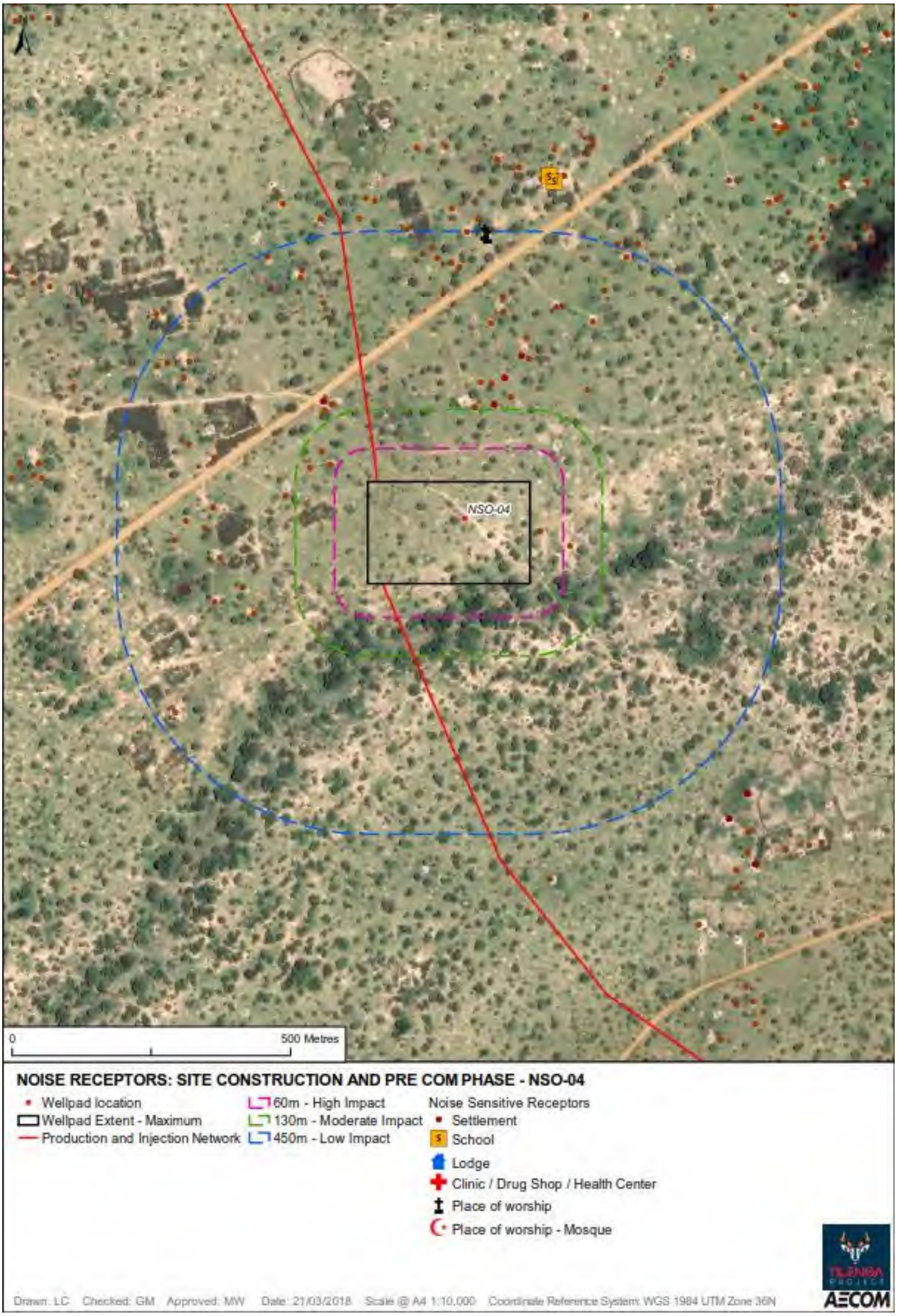


Figure I3-34: NSO-05 Night-time Well Pad Drilling Receptor Analysis

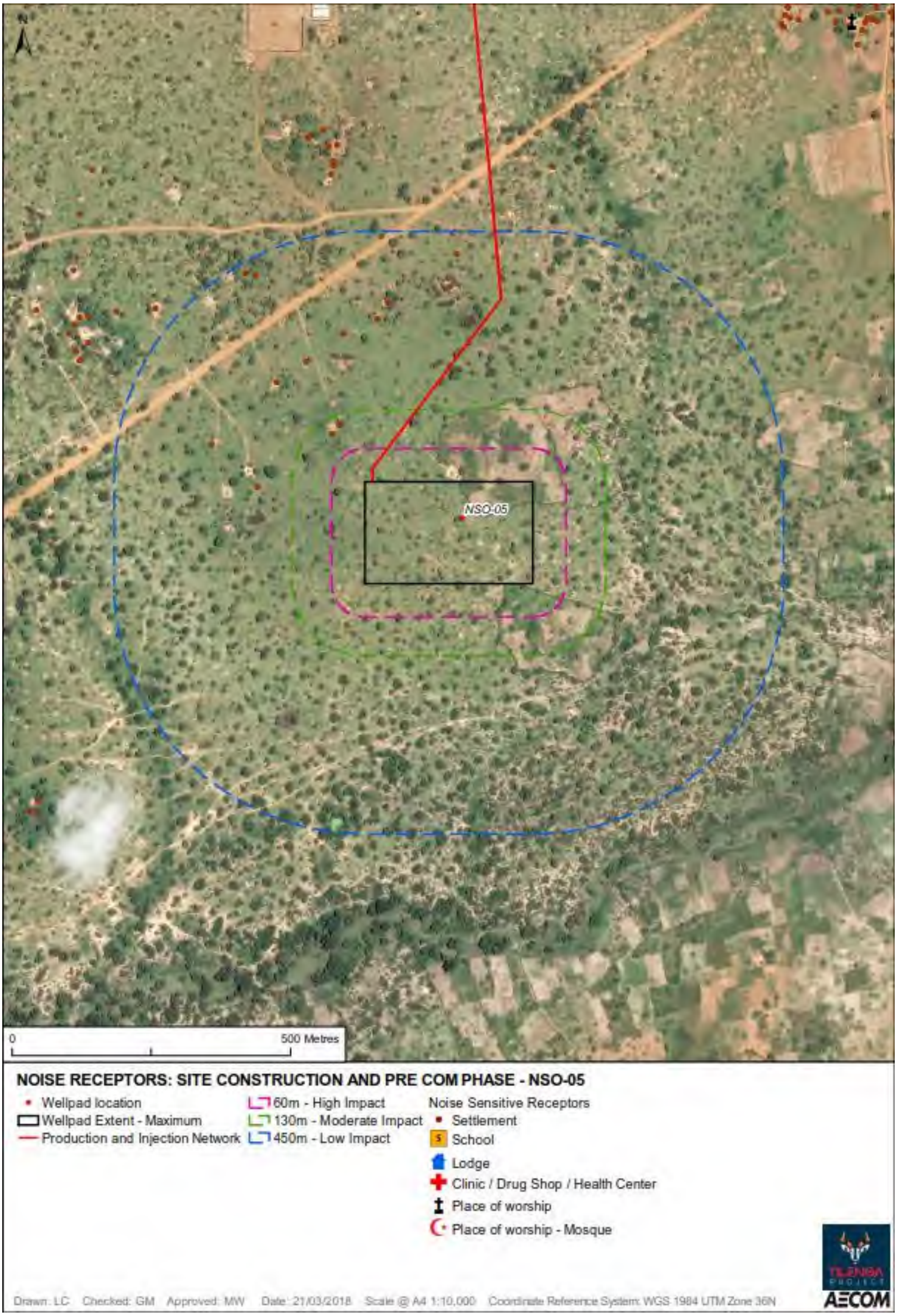


Figure I3-35: NSO-06 Night-time Well Pad Drilling Receptor Analysis

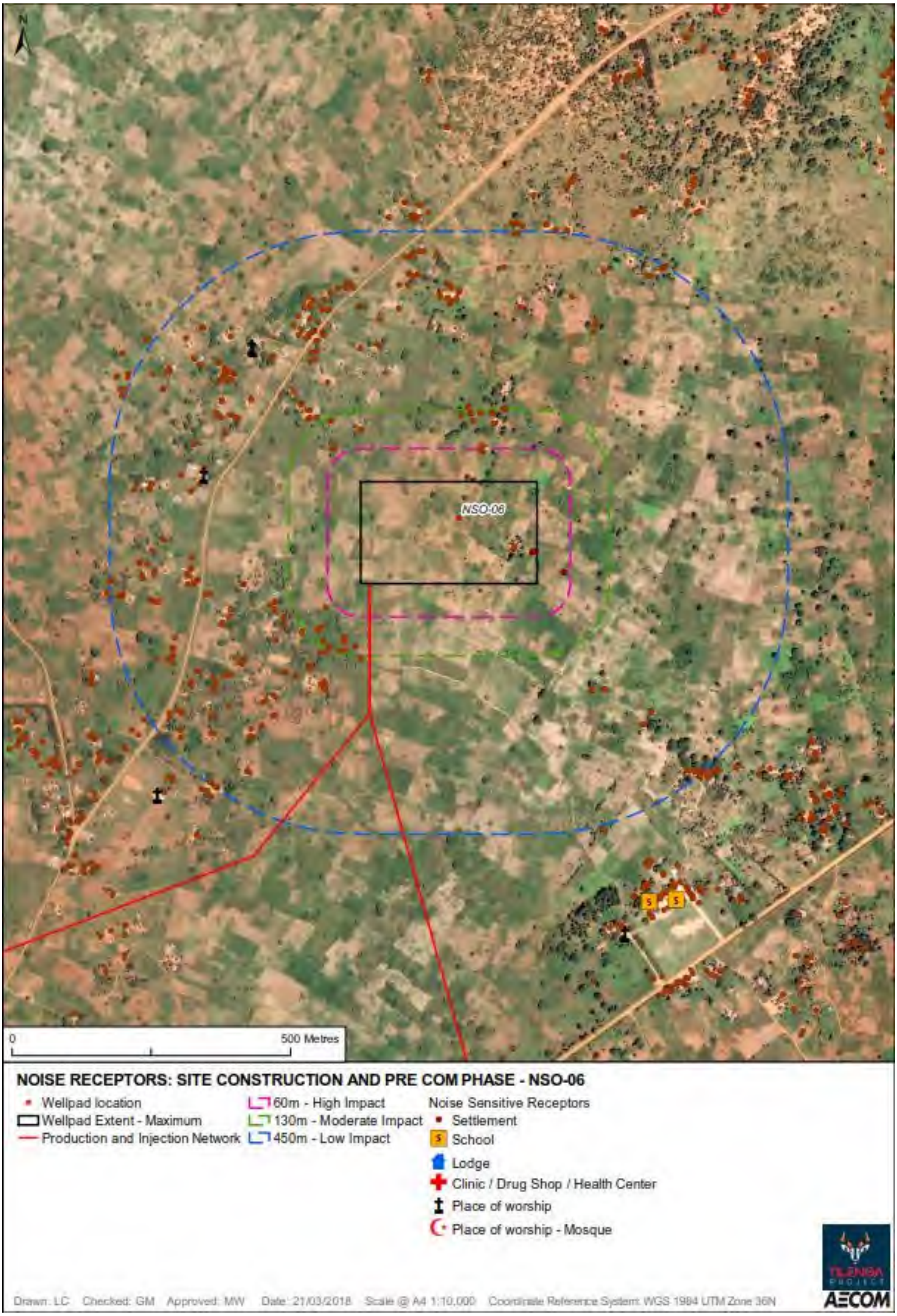
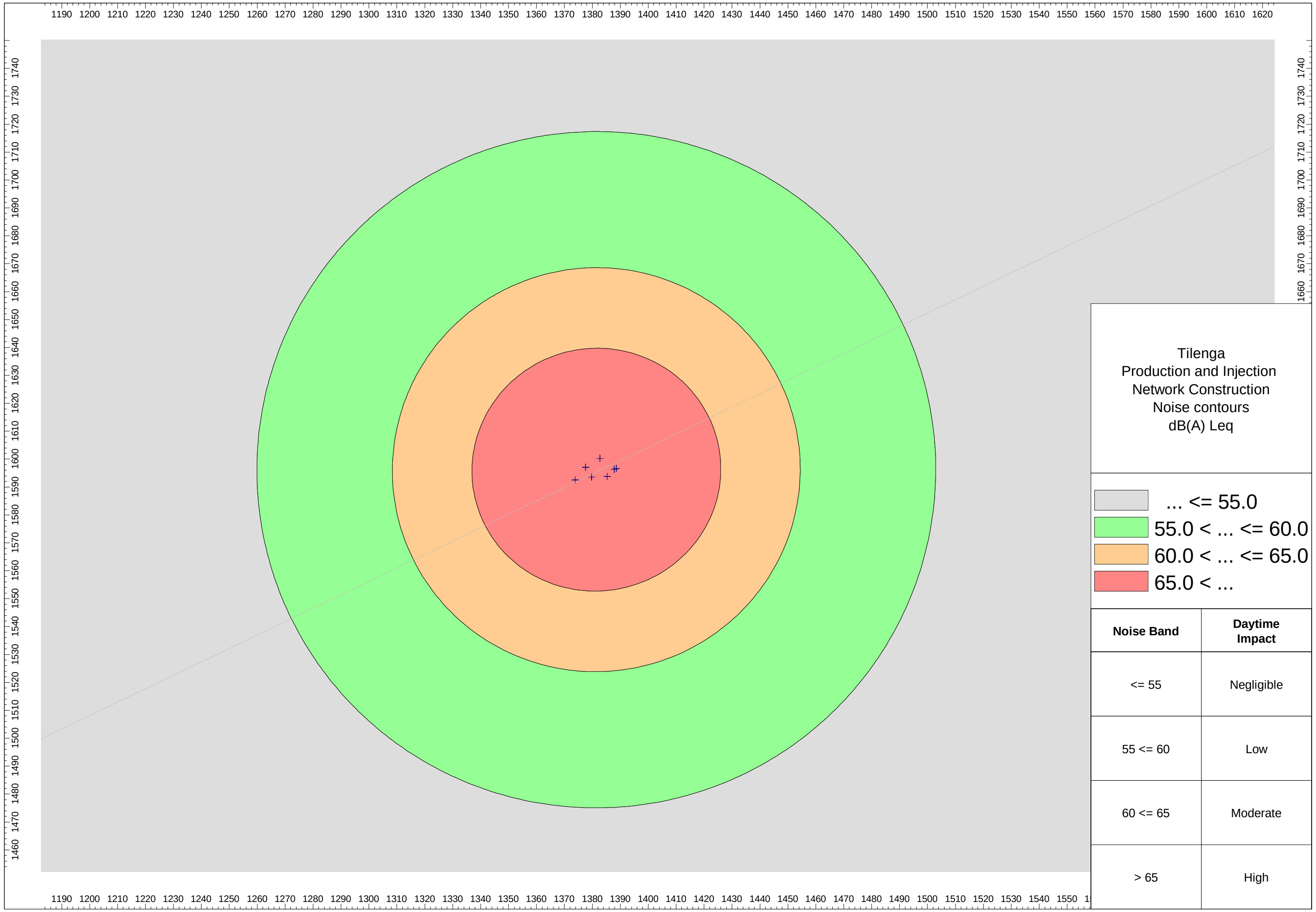


Figure I3-36: Production and Injection Network Construction Daytime Noise Contours



Noise Band	Daytime Impact
<= 55	Negligible
55 <= 60	Low
60 <= 65	Moderate
> 65	High

The assessment of noise due to construction of the production and injection network is presented in Section 7.6.4.2.5

Figure I3-37: Production and Injection Network Construction Receptor Analysis – CNA-01 to CPF

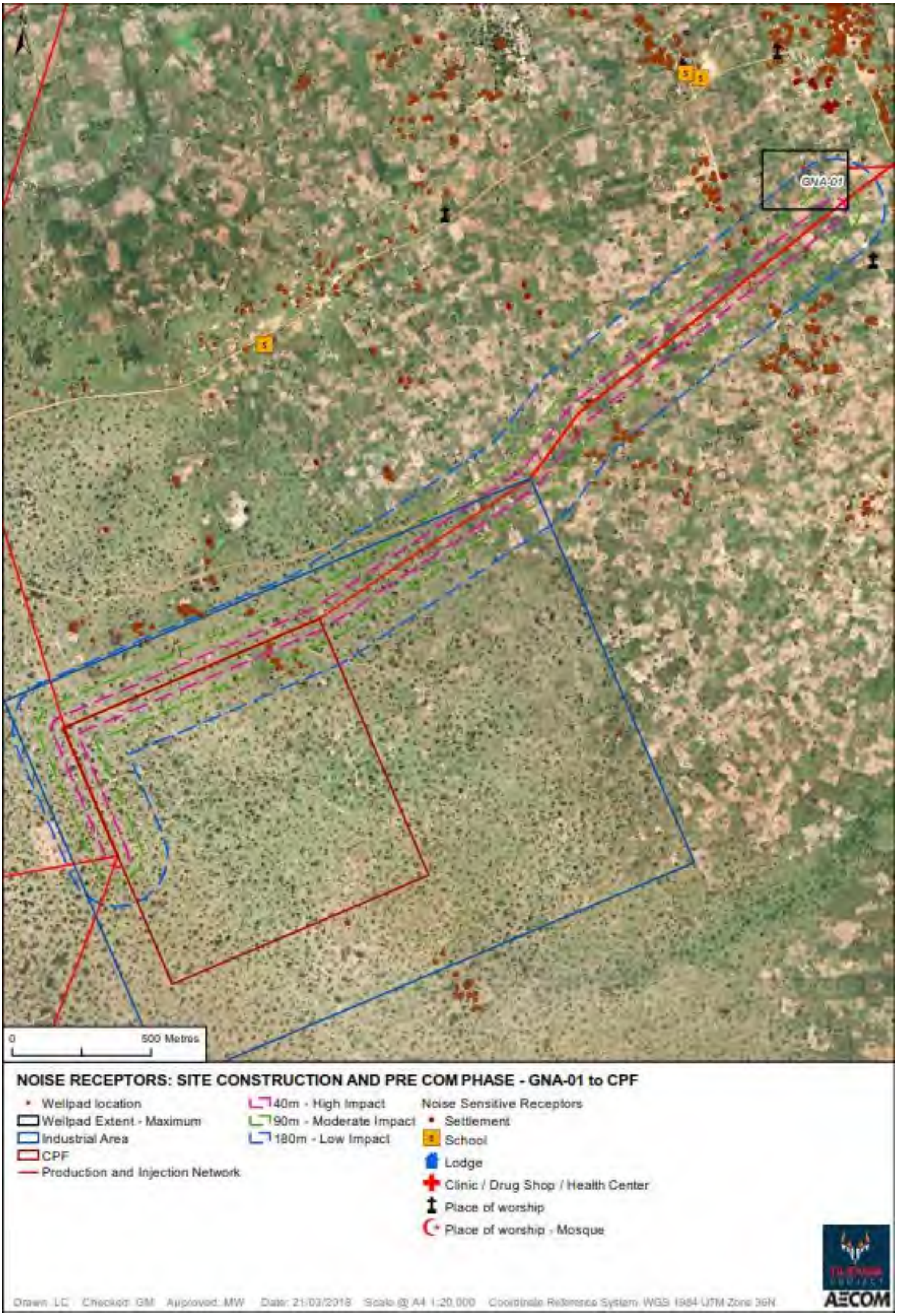


Figure I3-38: Production and Injection Network Construction Receptor Analysis – GNA-02 to GNA-04

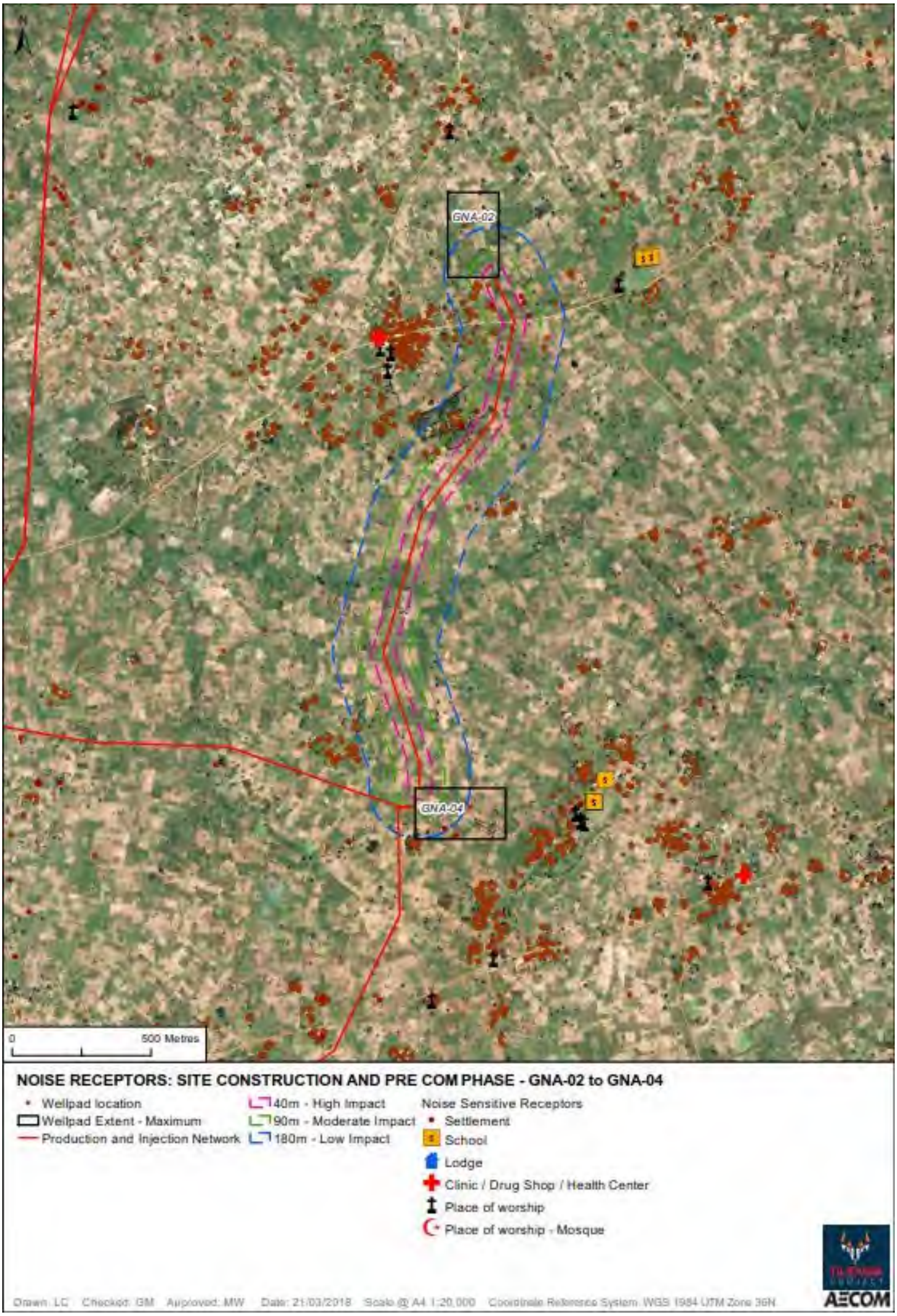


Figure I3-39: Production and Injection Network Construction Receptor Analysis – GNA-04 to GNA-01

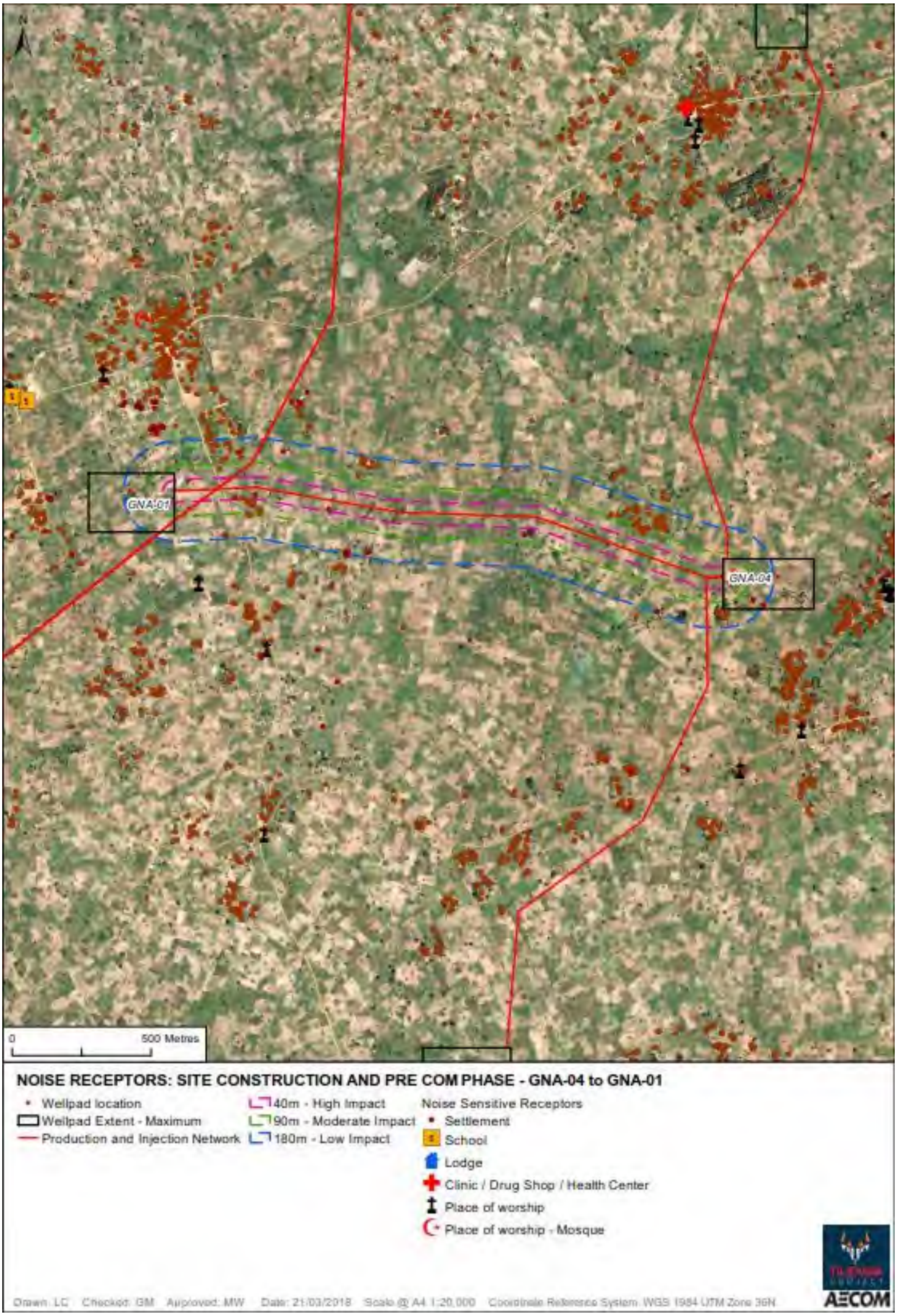


Figure I3-40: Production and Injection Network Construction Receptor Analysis – GNA-04 to GNA-03

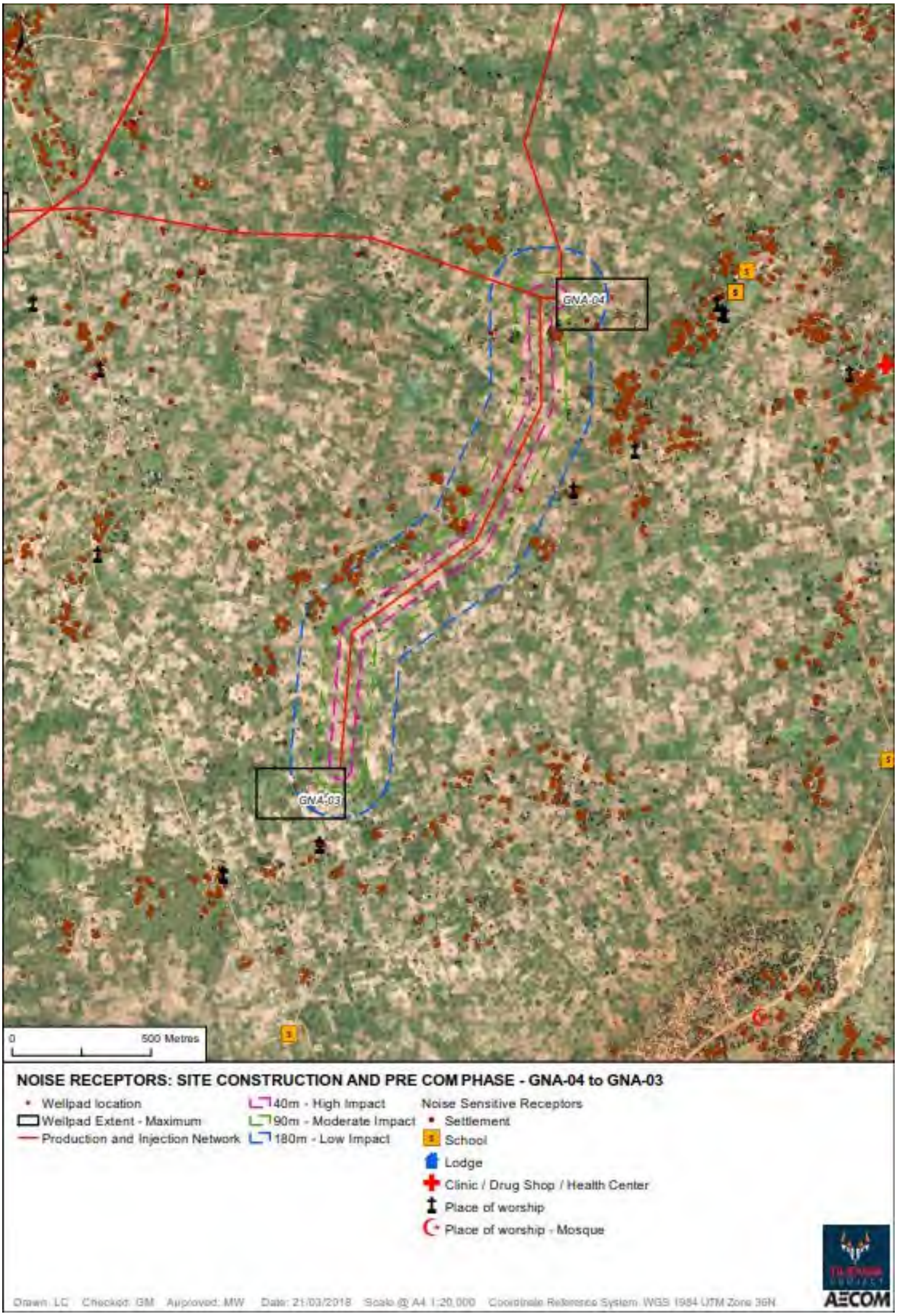


Figure I3-41: Production and Injection Network Construction Receptor Analysis – JBR-01 to HDD Crossing (option 1)

Figure I3-42: Production and Injection Network Construction Receptor Analysis – JBR-02 to JBR-01

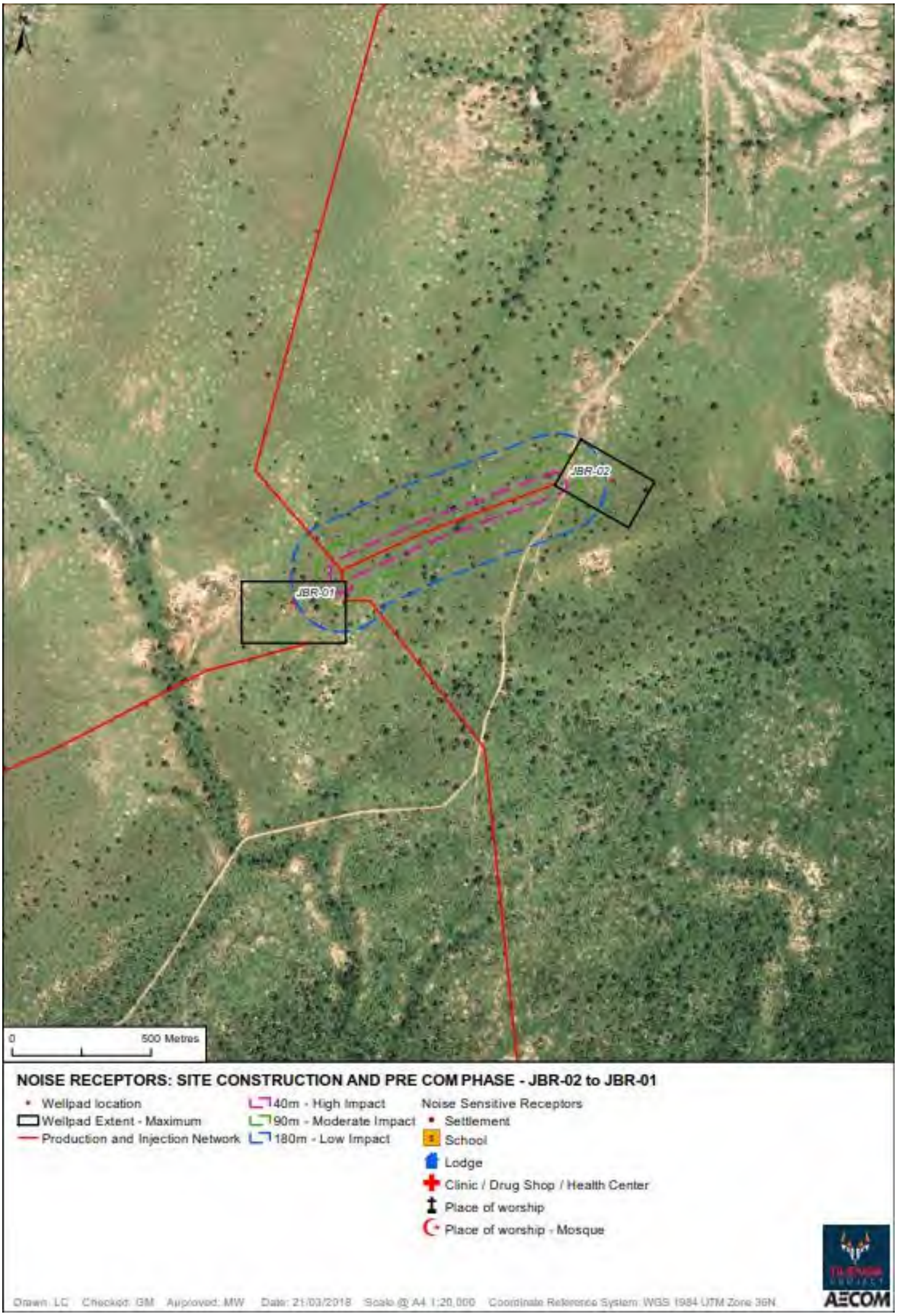


Figure I3-43: Production and Injection Network Construction Receptor Analysis – JBR-03 to JBR-01

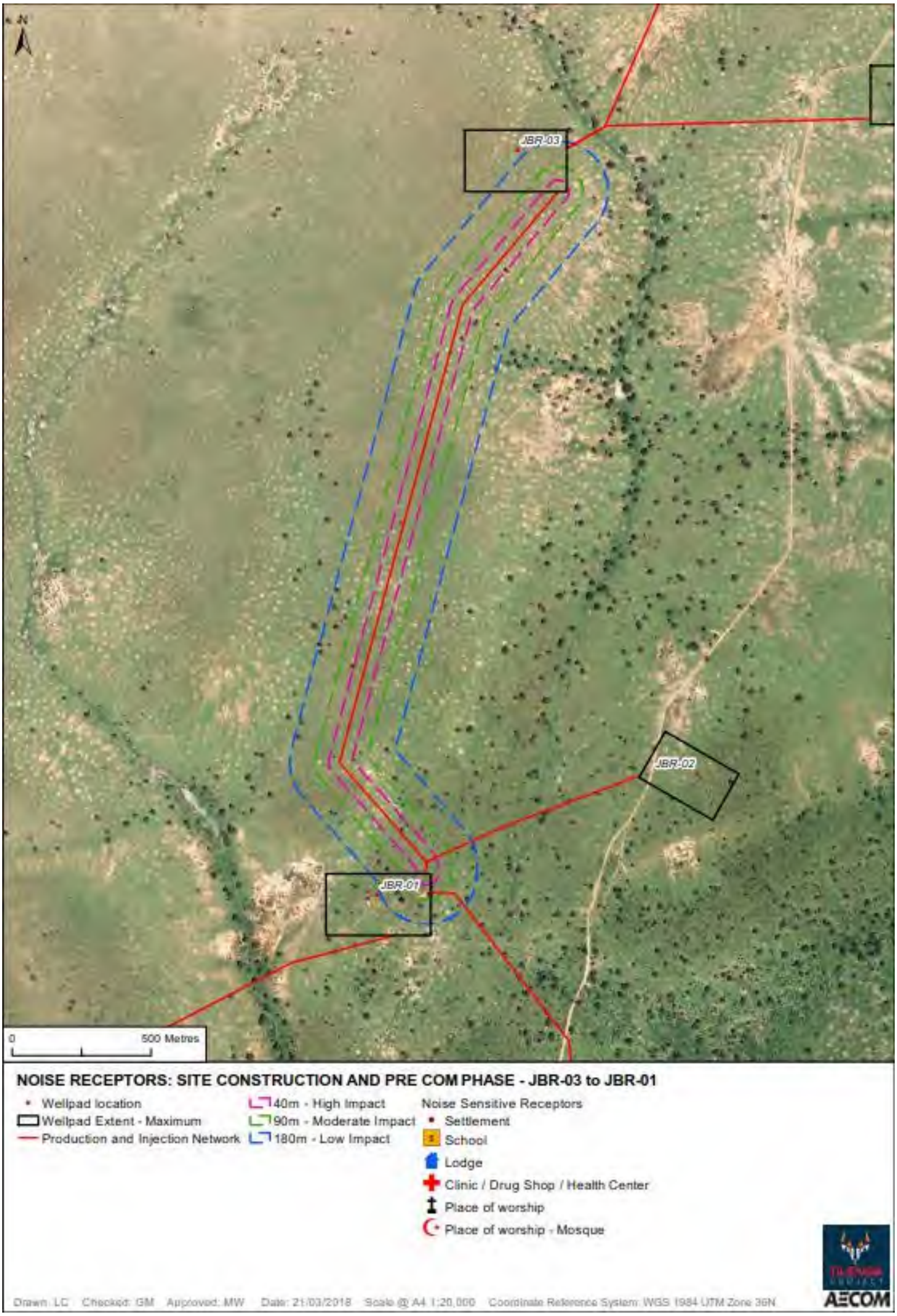


Figure I3-44: Production and Injection Network Construction Receptor Analysis – JBR-04 to JBR-03

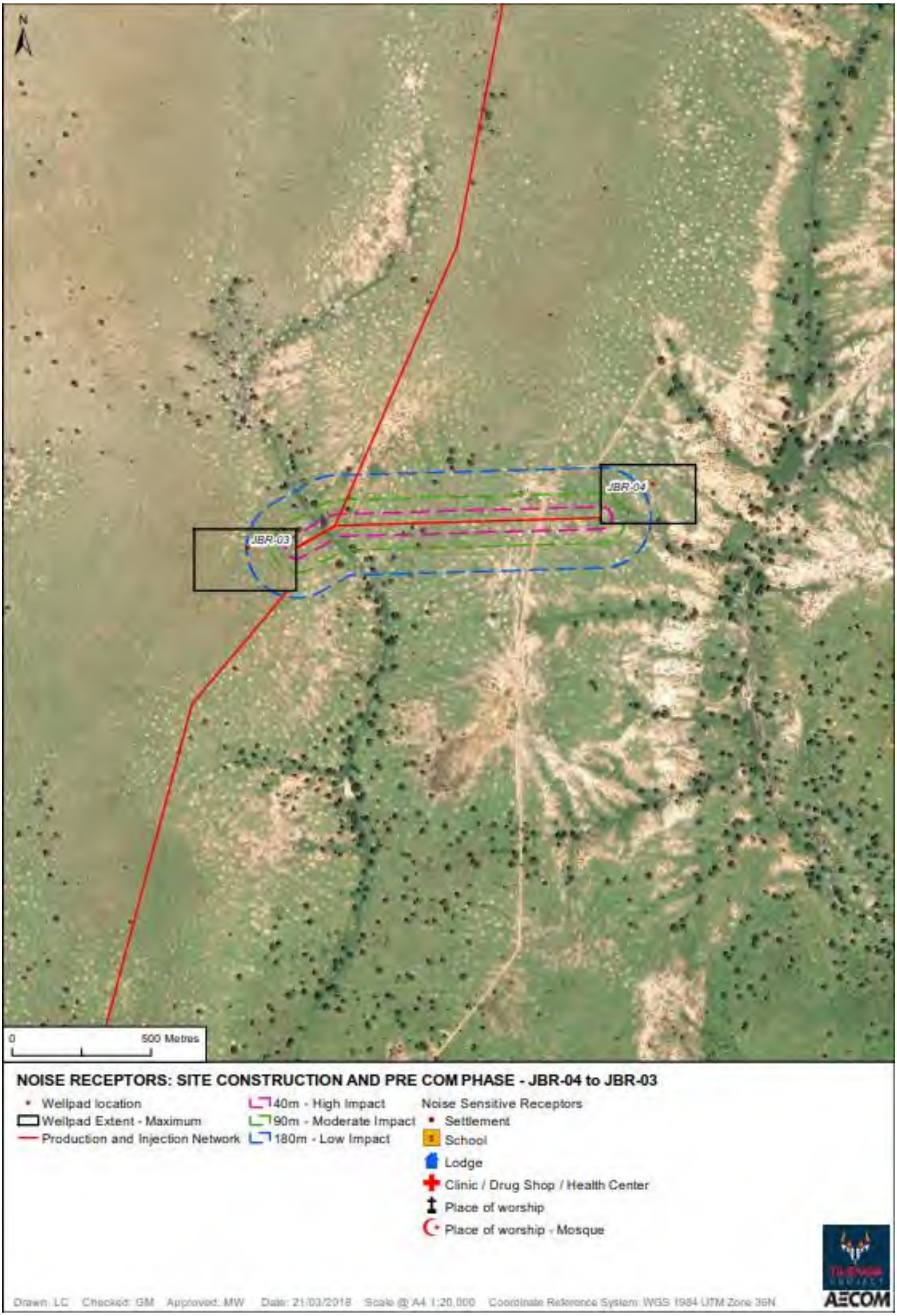


Figure I3-45: Production and Injection Network Construction Receptor Analysis – JBR-05 to JBR-03

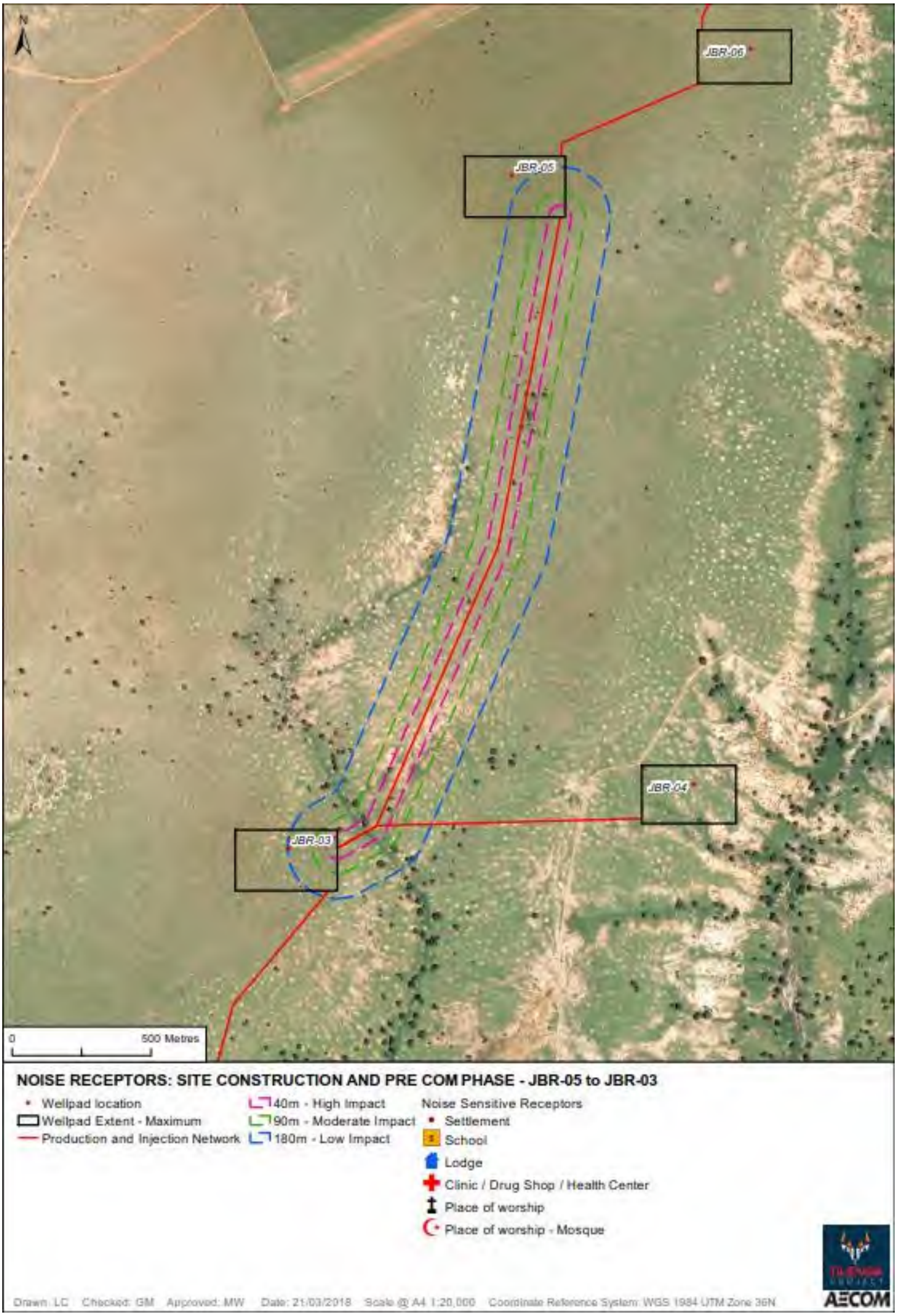


Figure I3-46: Production and Injection Network Construction Receptor Analysis – JBR-06 to JBR-05

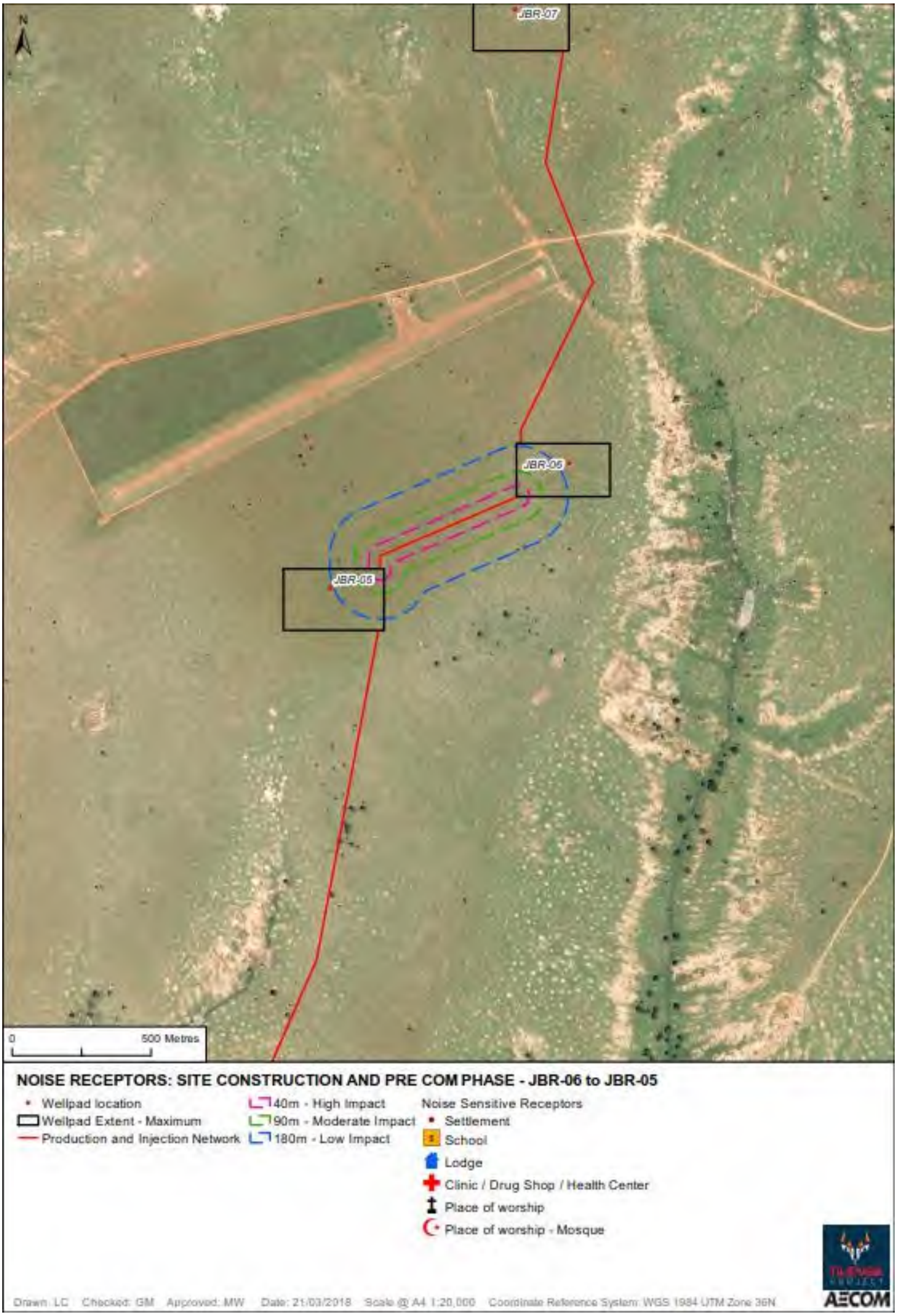


Figure I3-47: Production and Injection Network Construction Receptor Analysis – JBR-07 to JBR-08

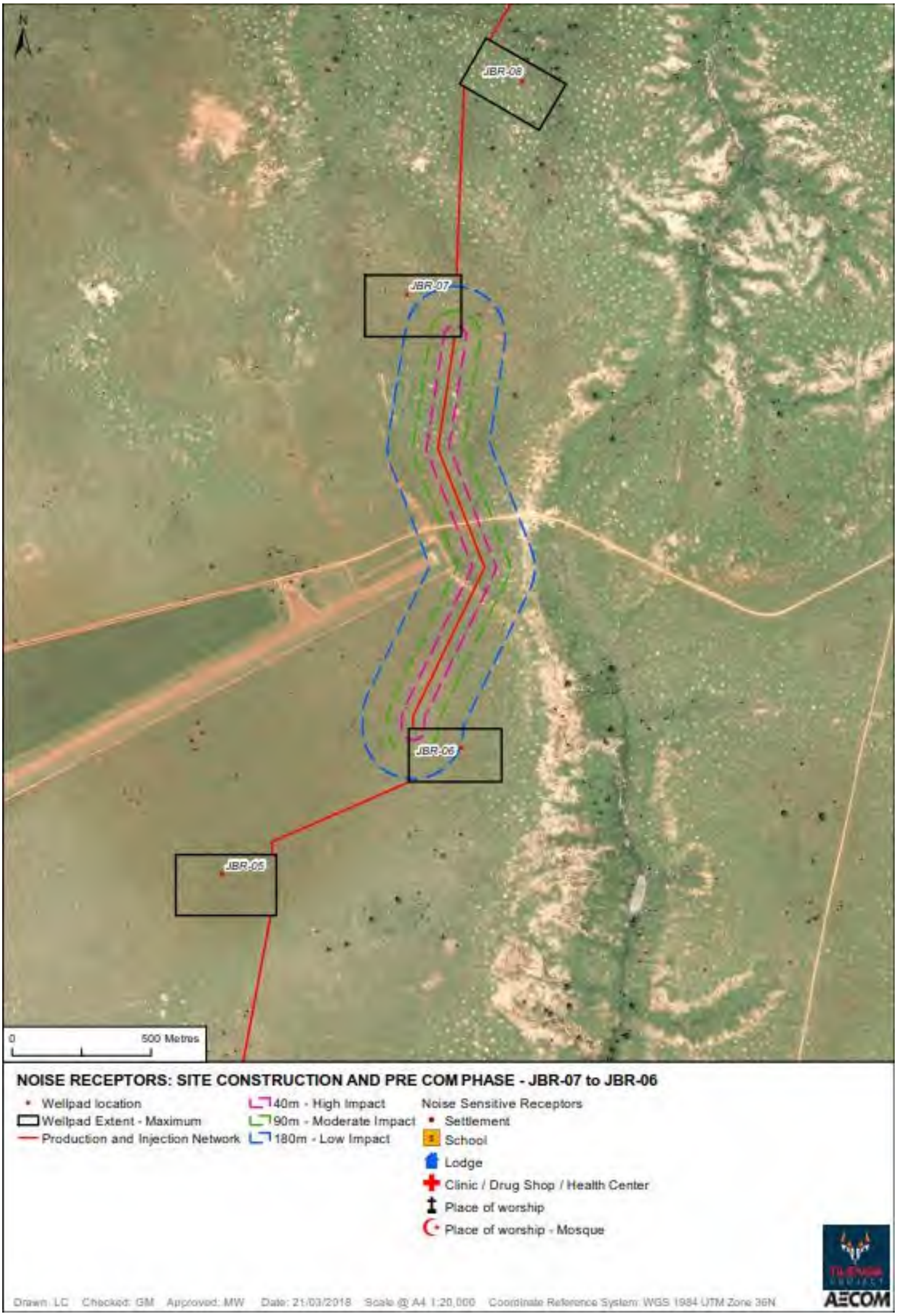


Figure I3-48: Production and Injection Network Construction Receptor Analysis – JBR-08 to JBR-07

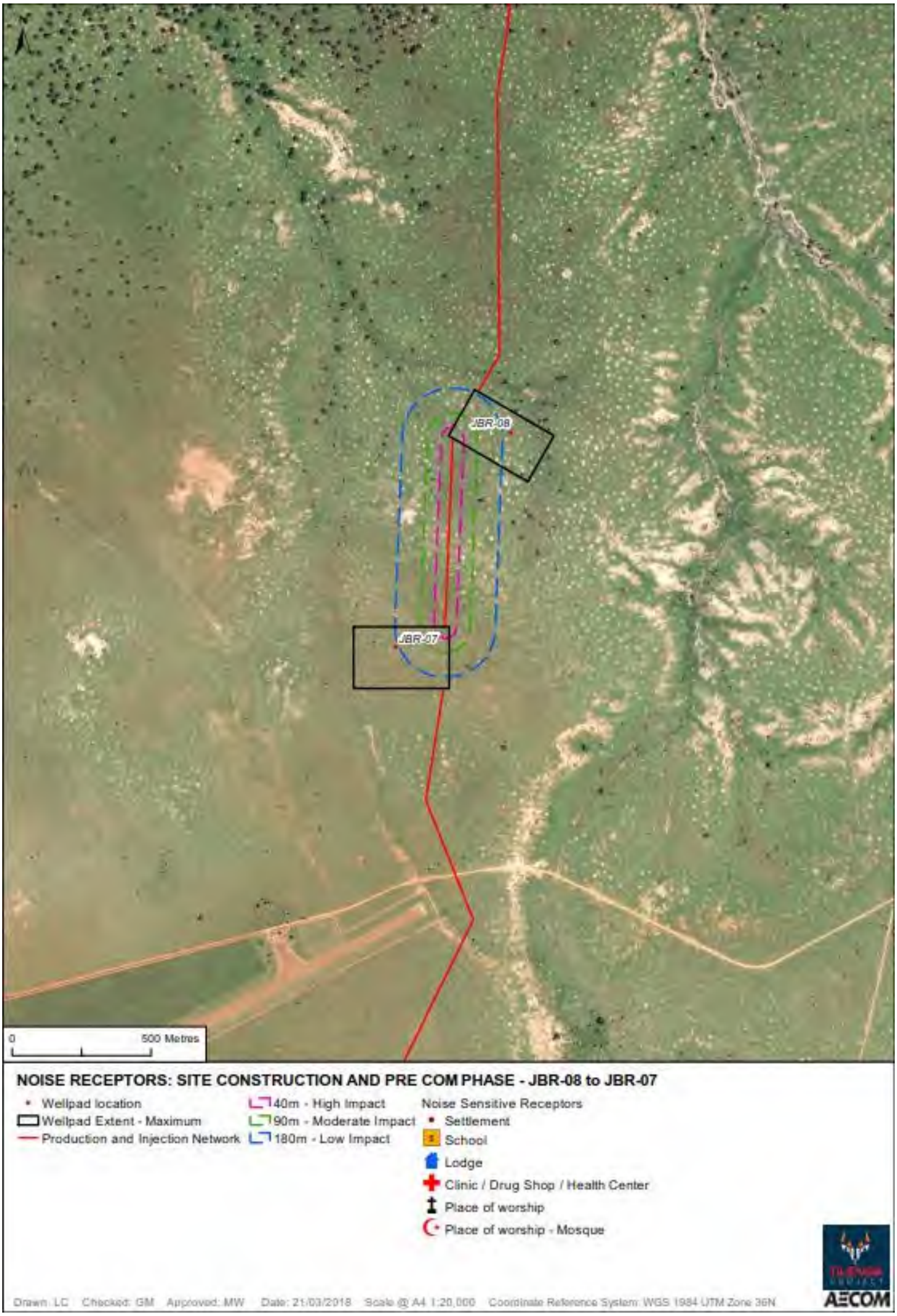


Figure I3-49: Production and Injection Network Construction Receptor Analysis – JBR-09 to JBR-08

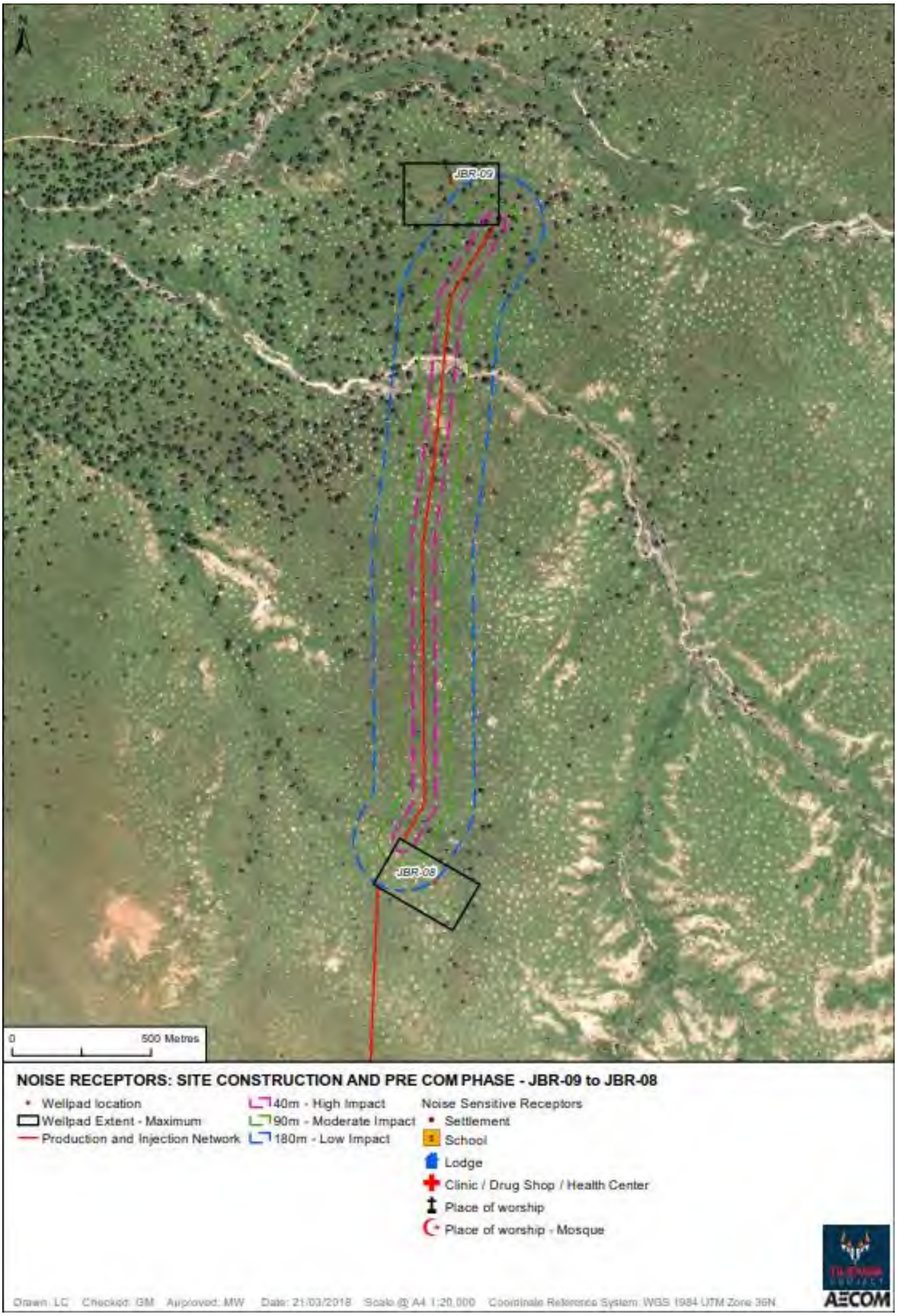


Figure I3-50: Production and Injection Network Construction Receptor Analysis – JBR-10 to JBR-01

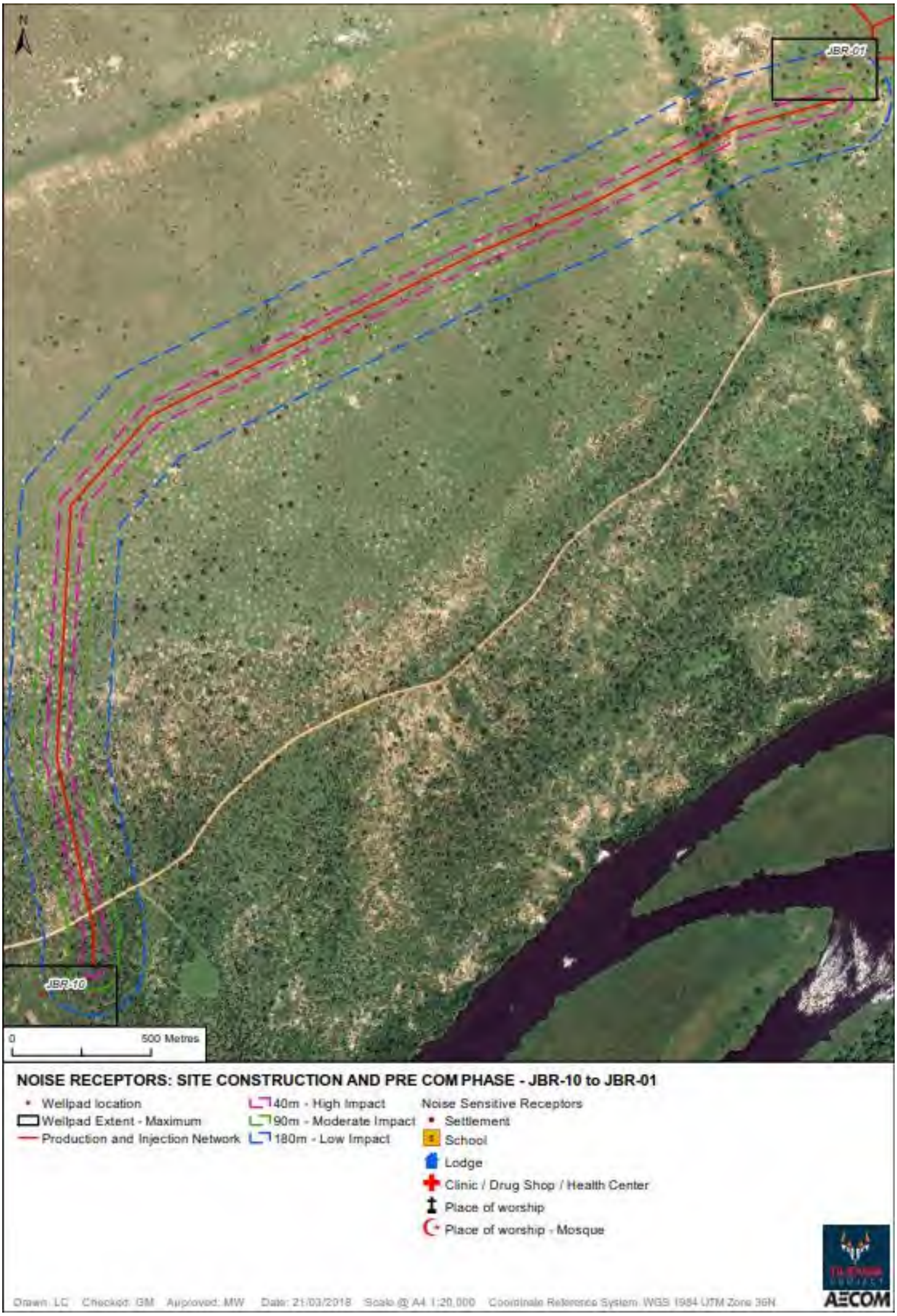


Figure I3-51: Production and Injection Network Construction Receptor Analysis – JBR-10 to HDD Crossing (option 2)

Figure I3-52: Production and Injection Network Construction Receptor Analysis – KGG-01 to KGG-04

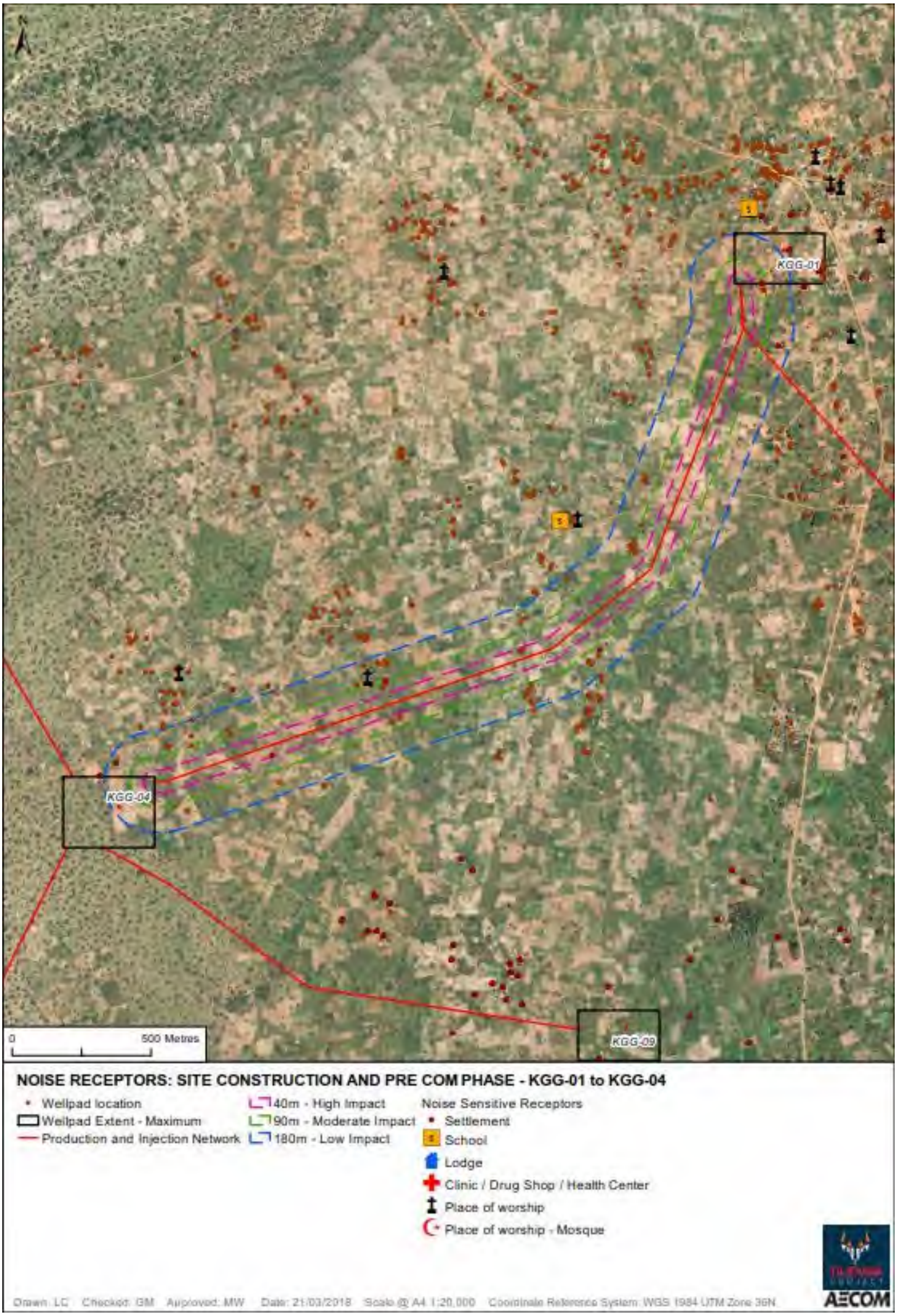


Figure I3-53: Production and Injection Network Construction Receptor Analysis – KGG-03 to KGG-01

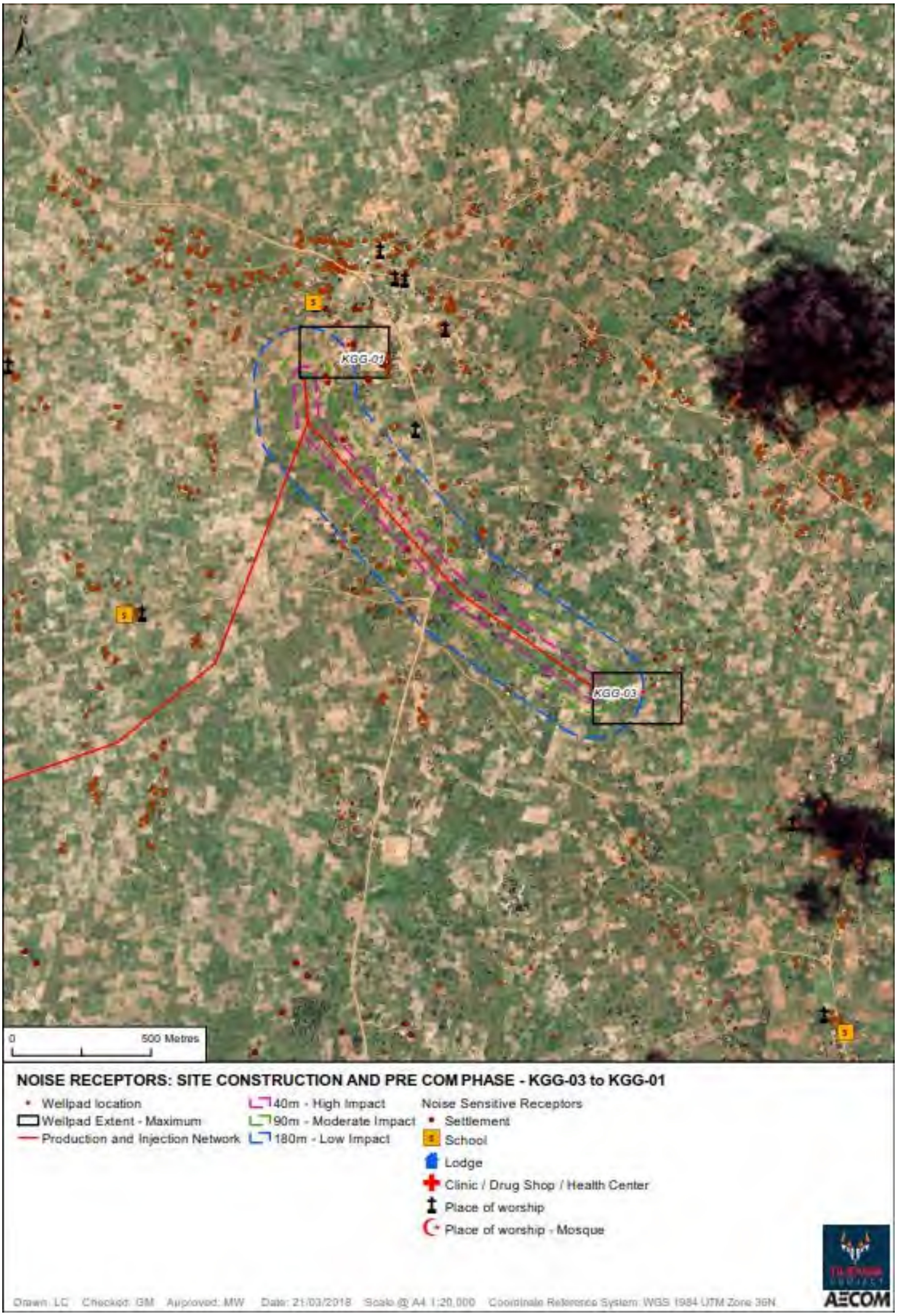


Figure I3-54: Production and Injection Network Construction Receptor Analysis – KGG-04 to NSO-04

Figure I3-55: Production and Injection Network Construction Receptor Analysis – KGG-05 to NSO-02

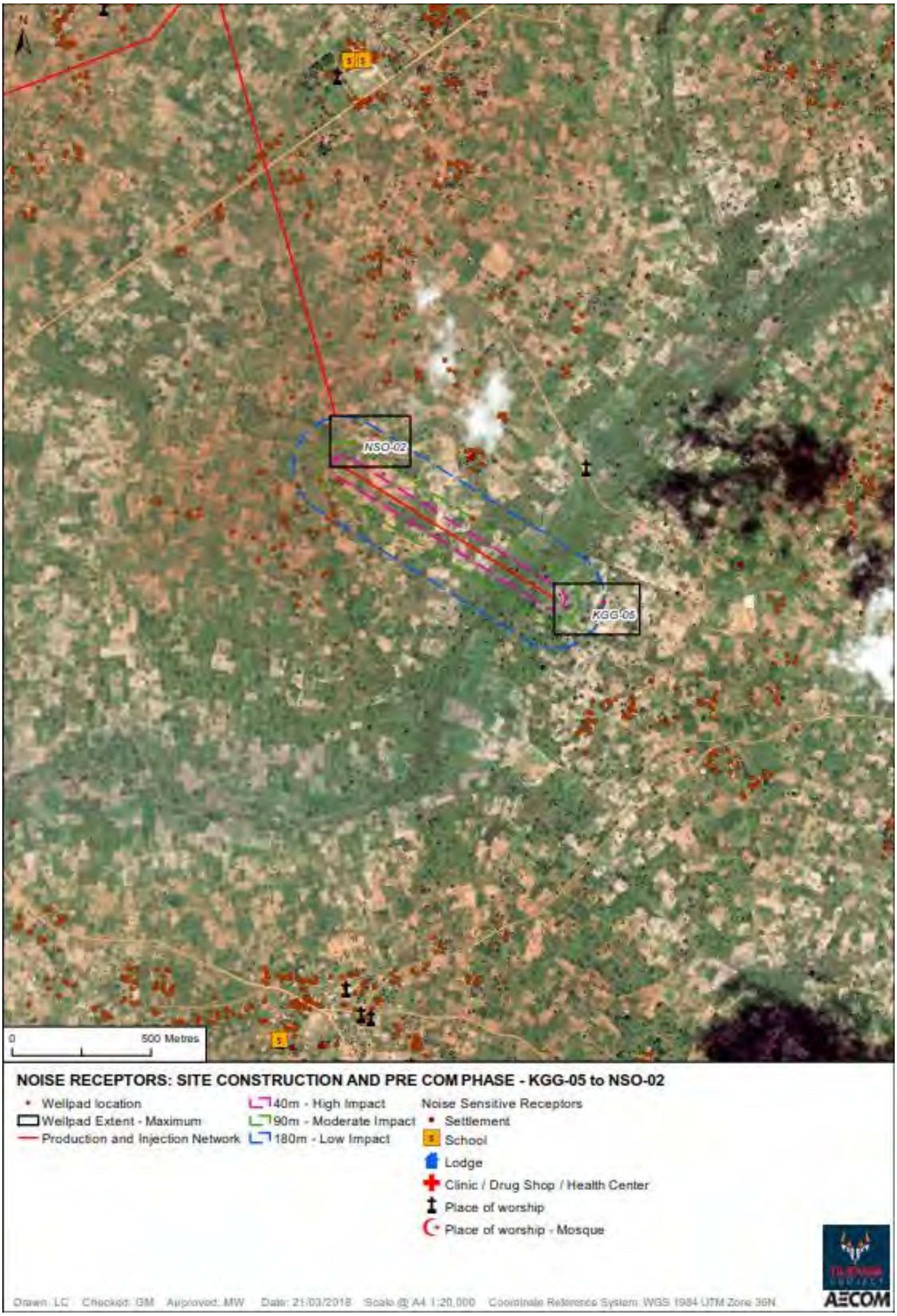


Figure I3-56: Production and Injection Network Construction Receptor Analysis – KGG-06 to KGG-04

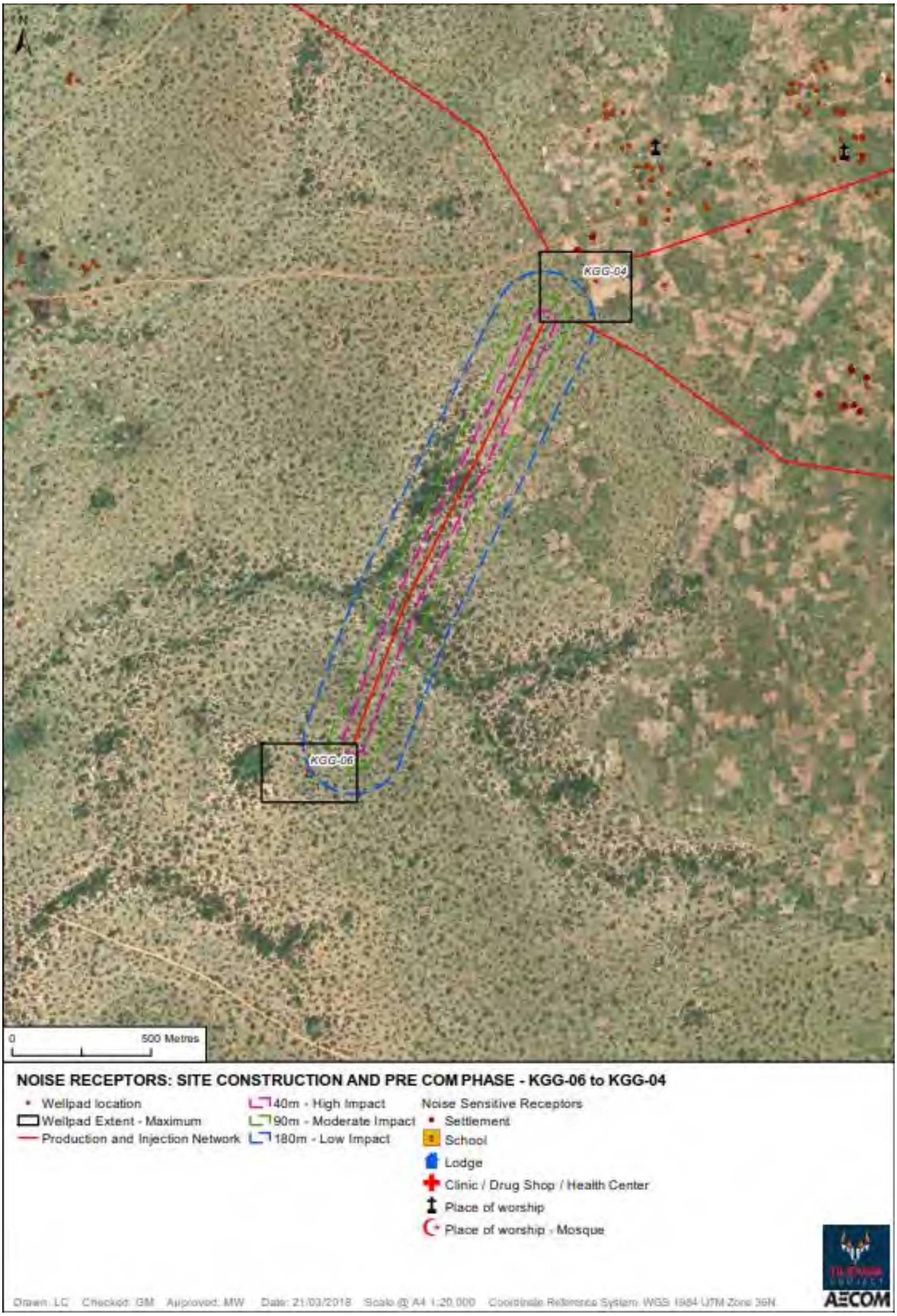


Figure I3-57: Production and Injection Network Construction Receptor Analysis – KGG-09 to KGG-04

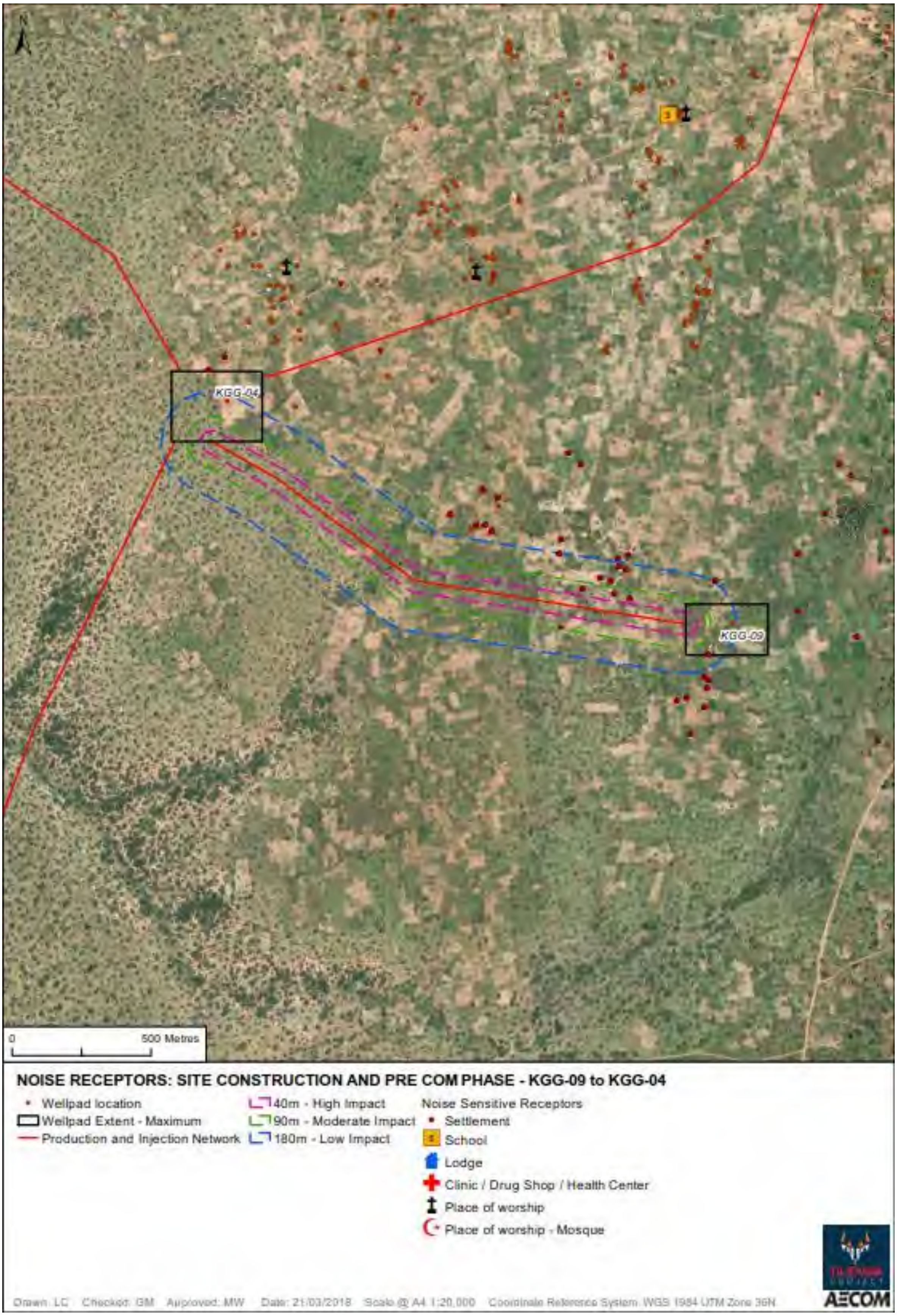


Figure I3-58: Production and Injection Network Construction Receptor Analysis – KW-01 to KW-02A

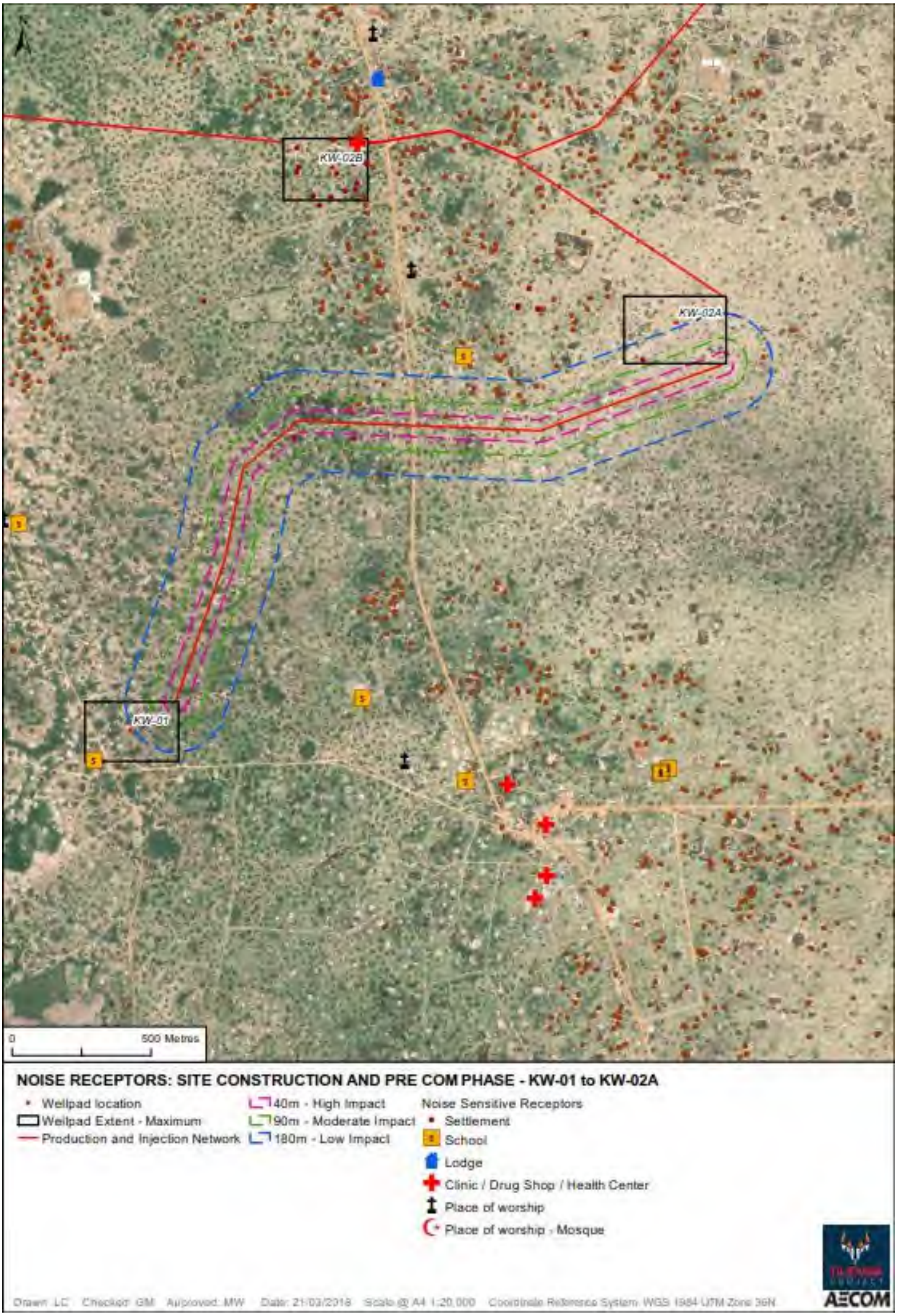


Figure I3-59: Production and Injection Network Construction Receptor Analysis – KW-02A to KW-02B

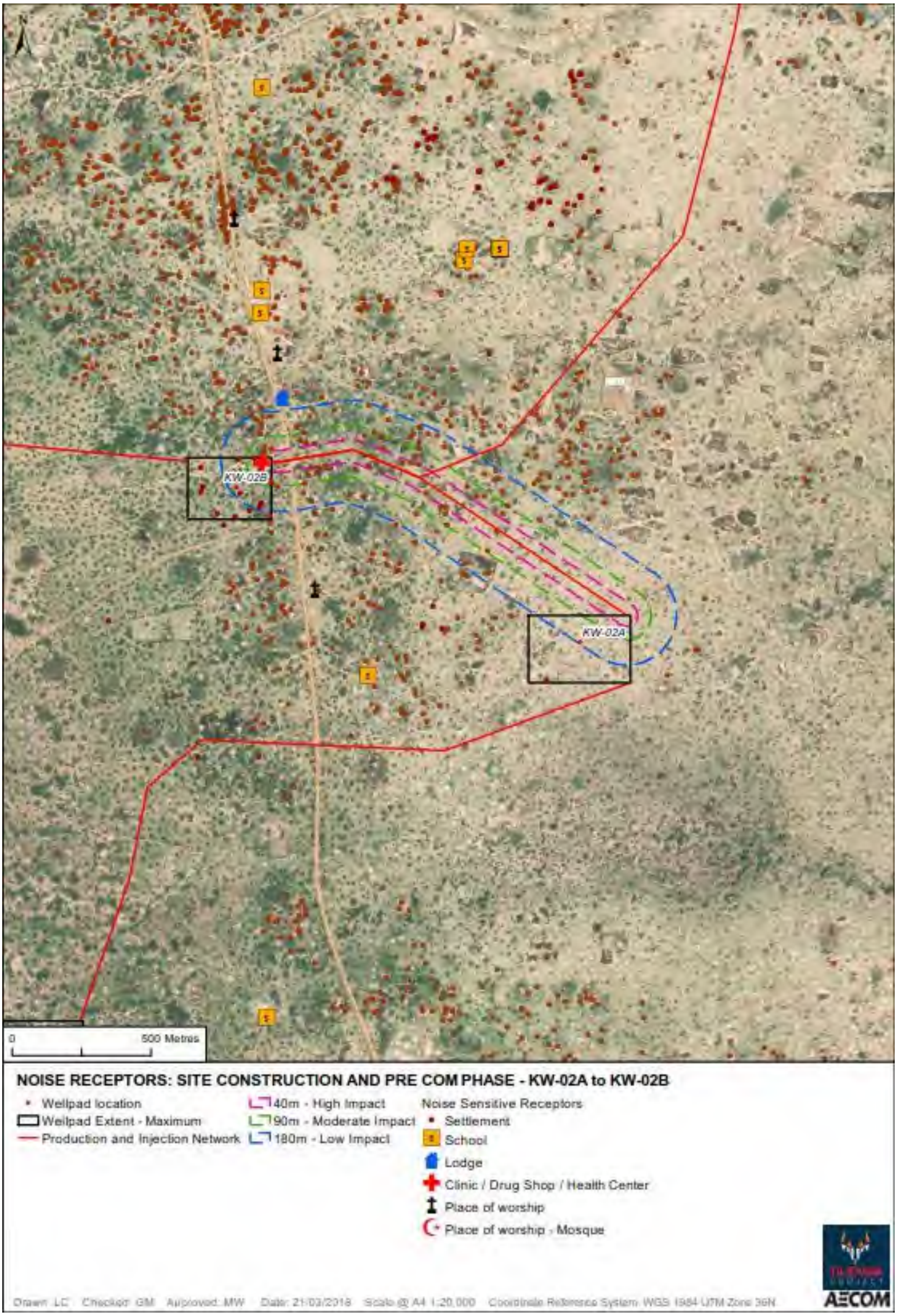


Figure I3-60: Production and Injection Network Construction Receptor Analysis – KW-02B to NGR-06

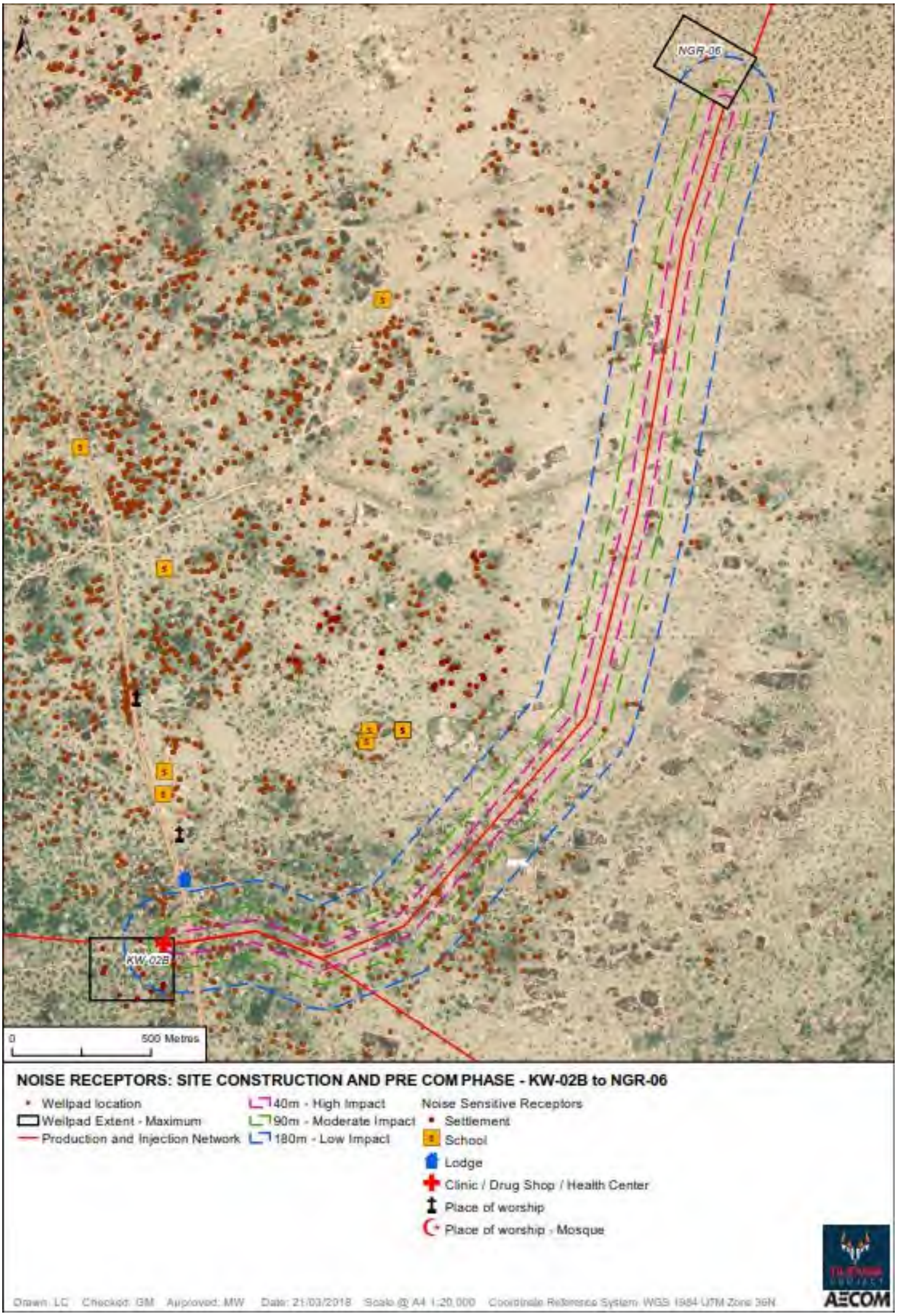


Figure I3-61: Production and Injection Network Construction Receptor Analysis – NGR-02 to NGR-01

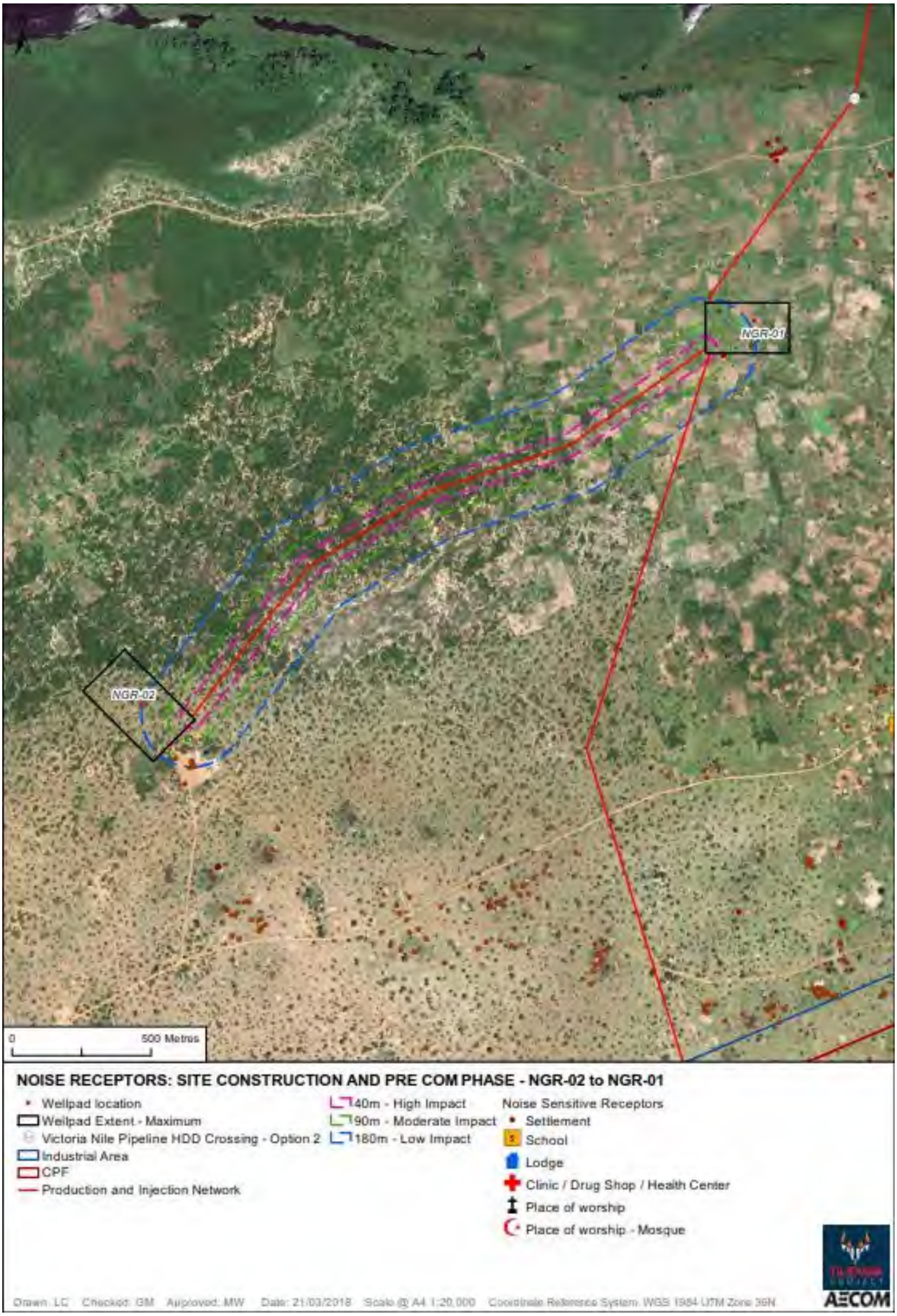


Figure I3-62: Production and Injection Network Construction Receptor Analysis – NGR-03A to NGR-05A

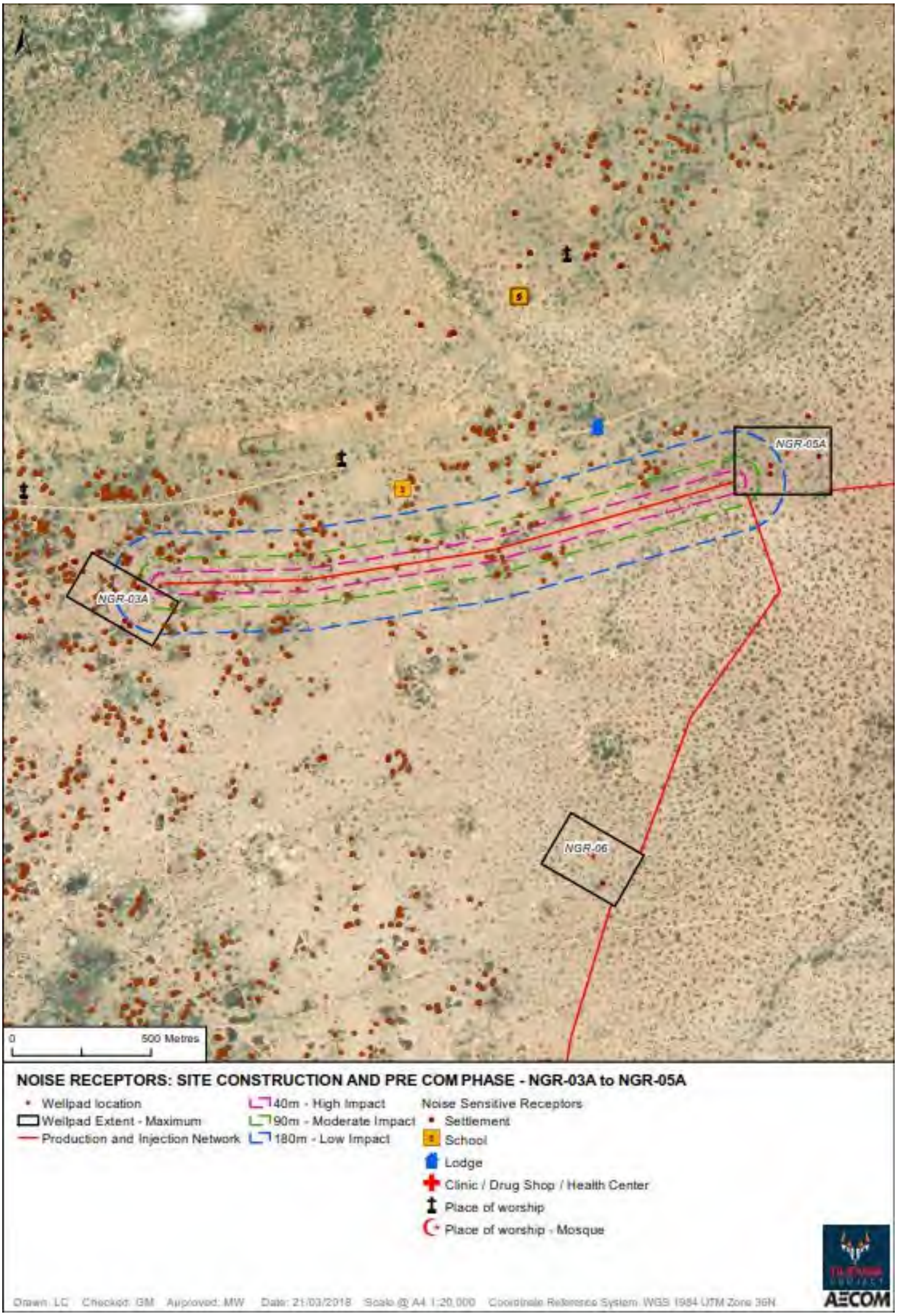


Figure I3-63: Production and Injection Network Construction Receptor Analysis – NGR-05A to CPF

Figure I3-64: Production and Injection Network Construction Receptor Analysis – NGR-06 to NGR-05A

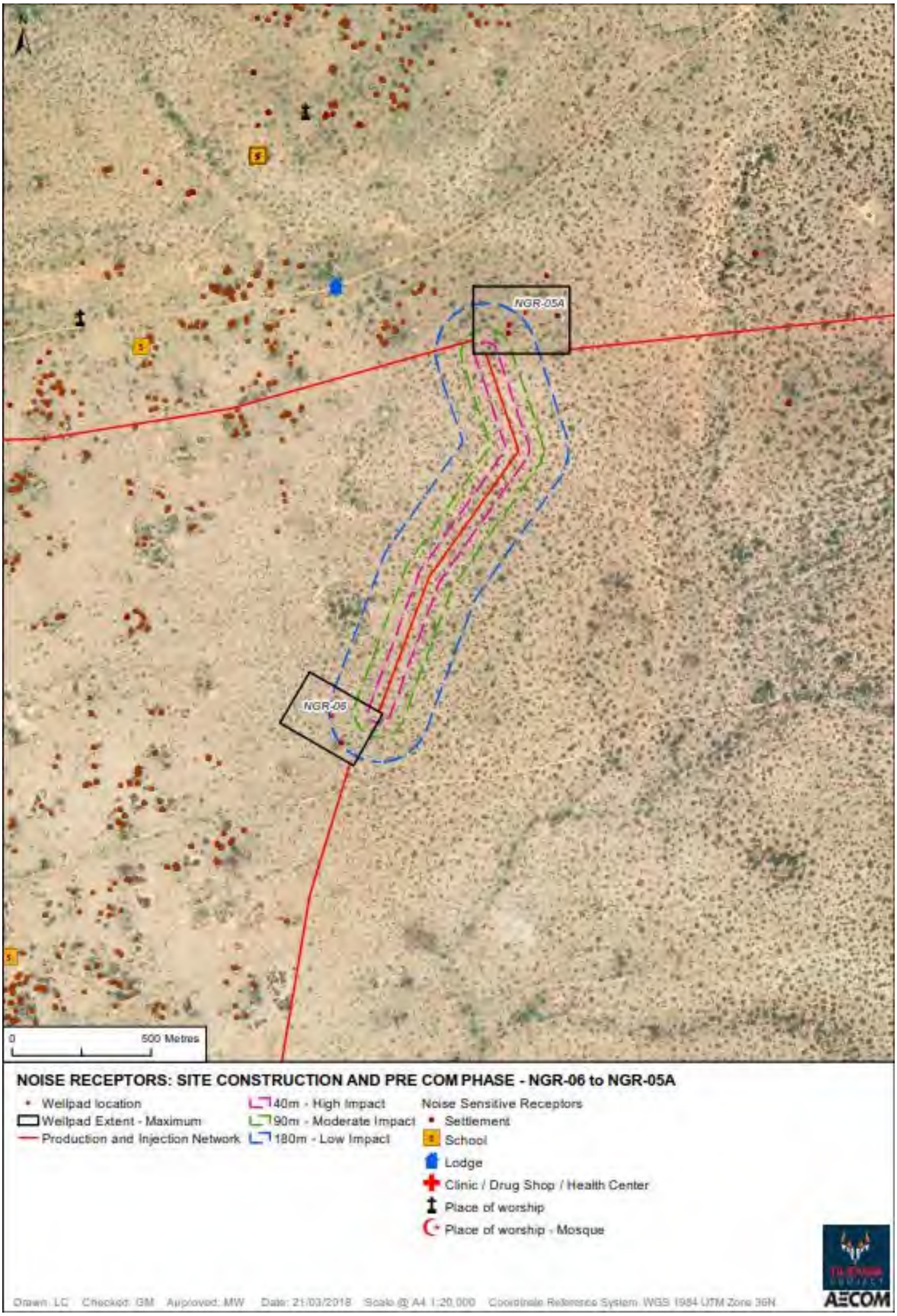


Figure I3-65: Production and Injection Network Construction Receptor Analysis – HDD Crossing (option 1) to CPF

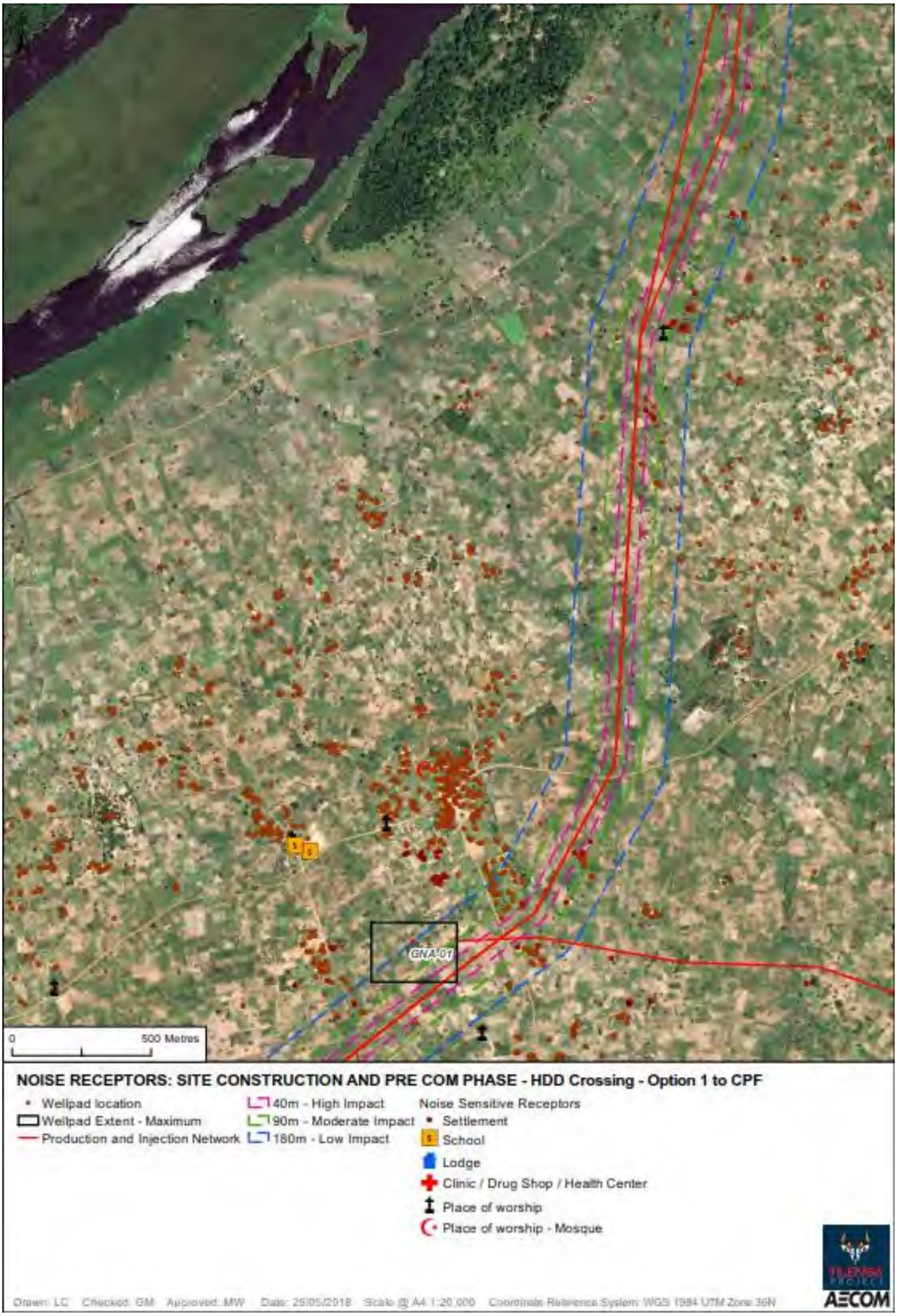


Figure I3-66: Production and Injection Network Construction Receptor Analysis – HDD Crossing (option 1) to CPF – alternative route

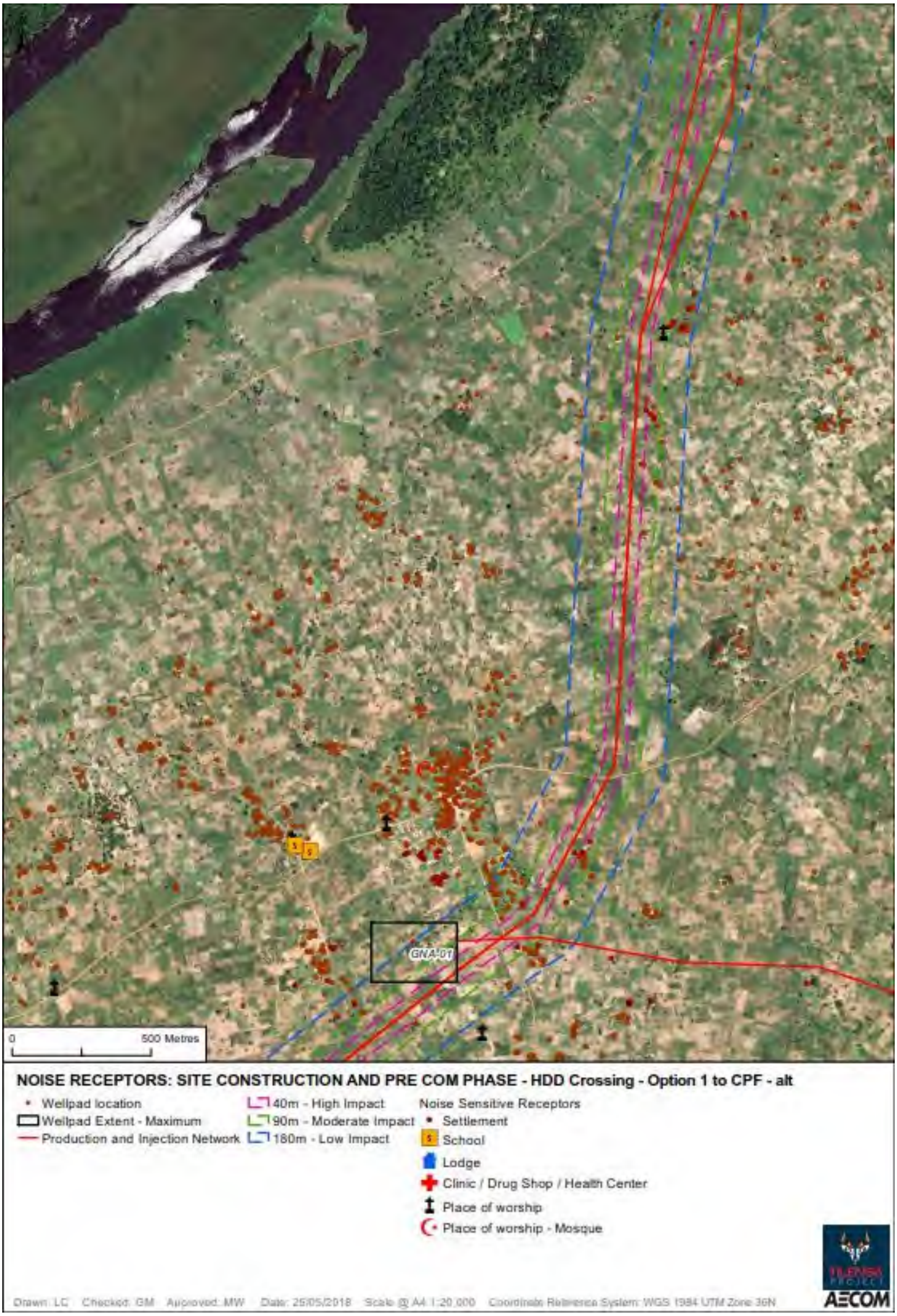


Figure I3-67: Production and Injection Network Construction Receptor Analysis – HDD Crossing (option 1) to HDD Crossing (option 1)

Figure I3-68: Production and Injection Network Construction Receptor Analysis – HDD Crossing (option 2) to CPF via NGR-01

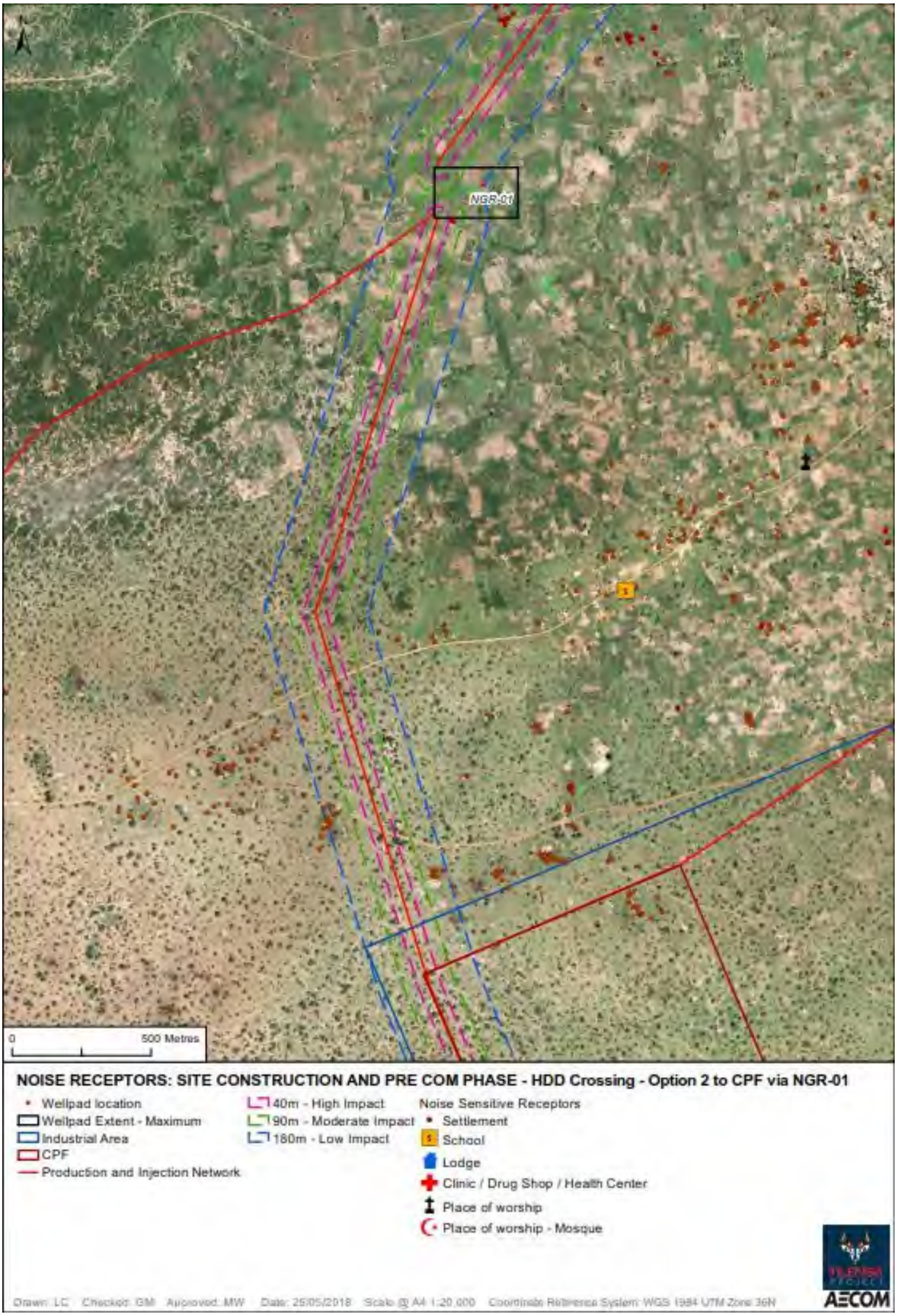


Figure I3-69: Production and Injection Network Construction Receptor Analysis – HDD Crossing (option 2) to HDD Crossing (option 2)

Figure I3-70: Production and Injection Network Construction Receptor Analysis – NS0-01 to NS0-05

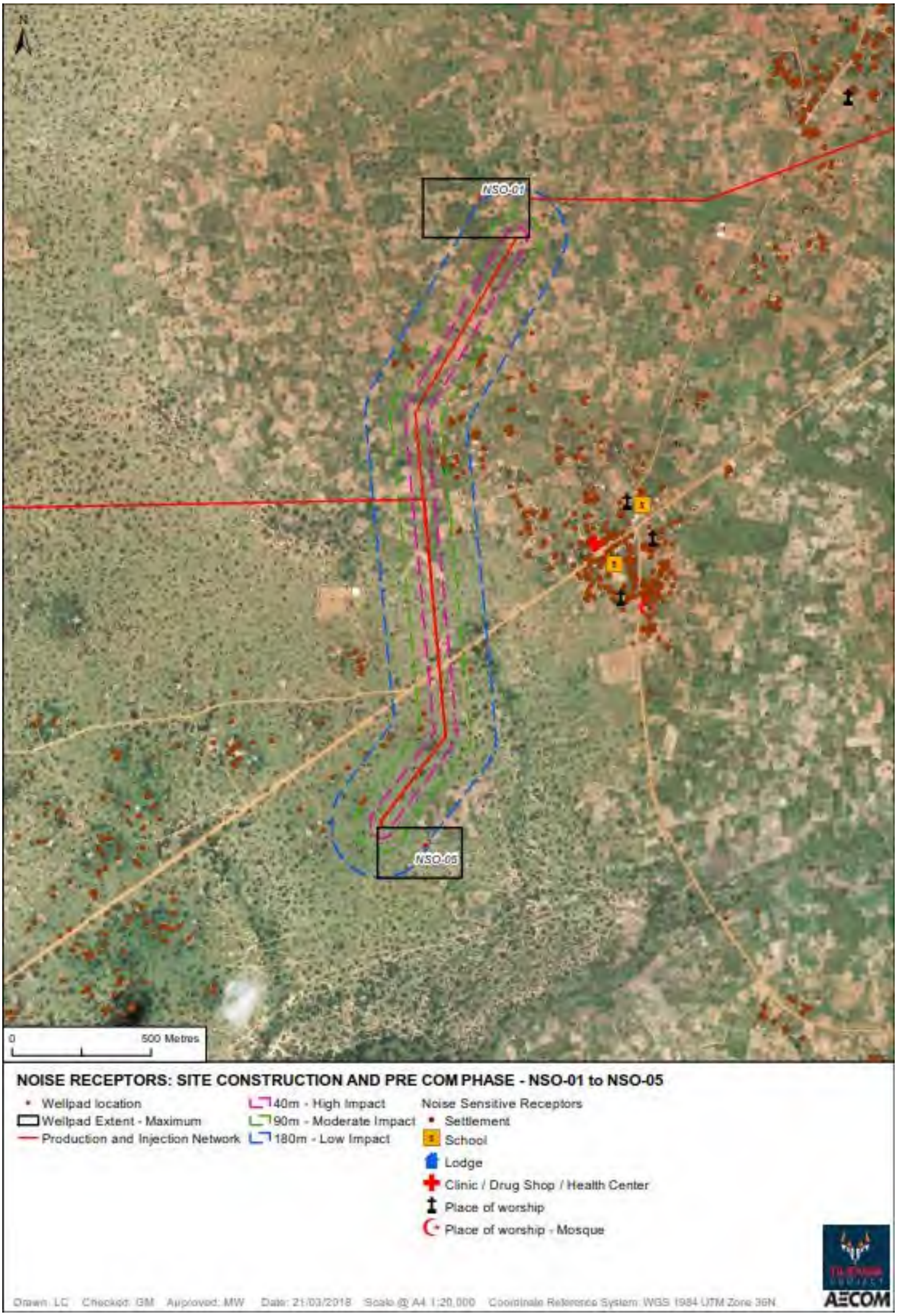


Figure I3-71: Production and Injection Network Construction Receptor Analysis – NS0-02 to NS0-06

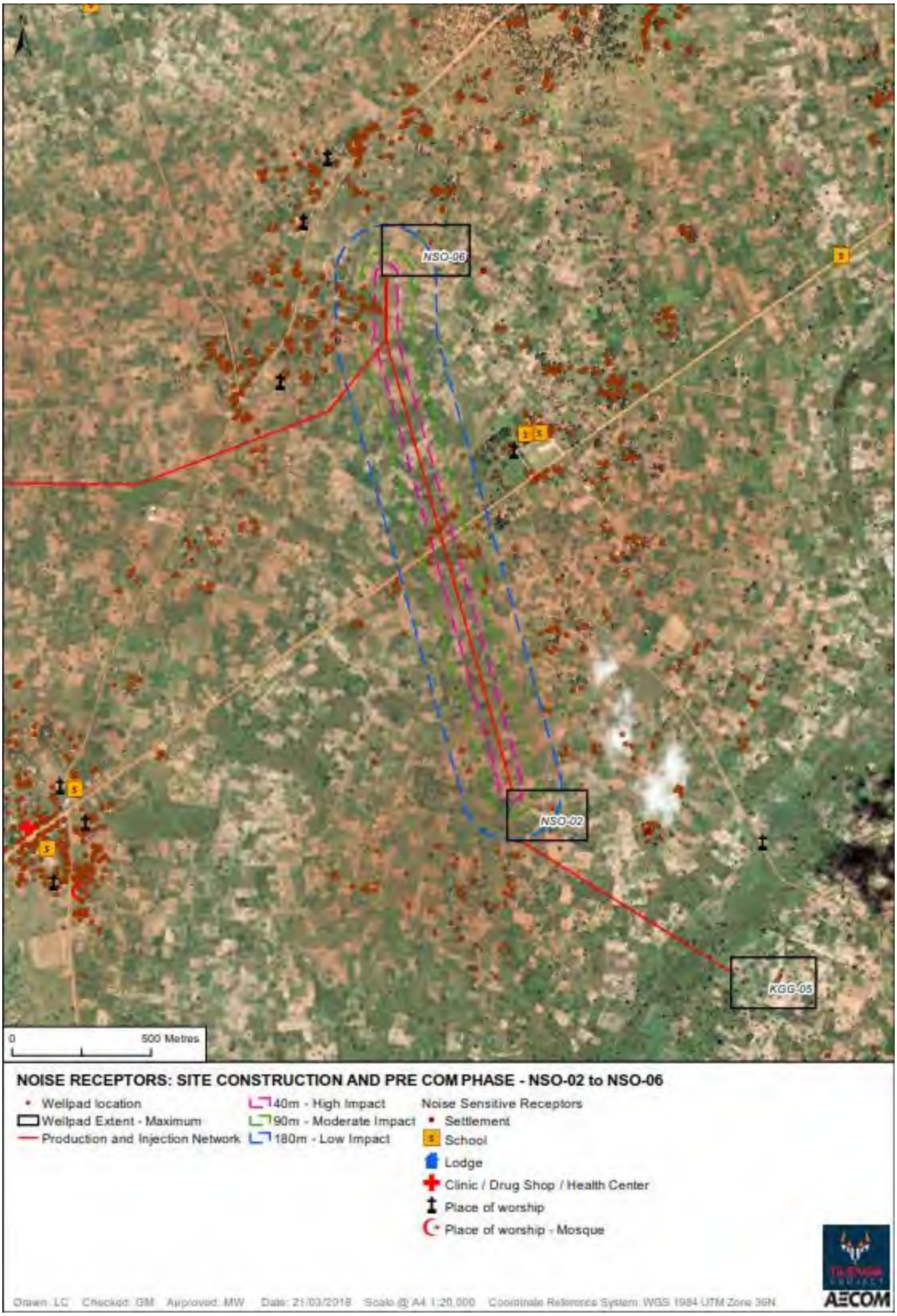


Figure I3-72: Production and Injection Network Construction Receptor Analysis – NS0-03 to CPF

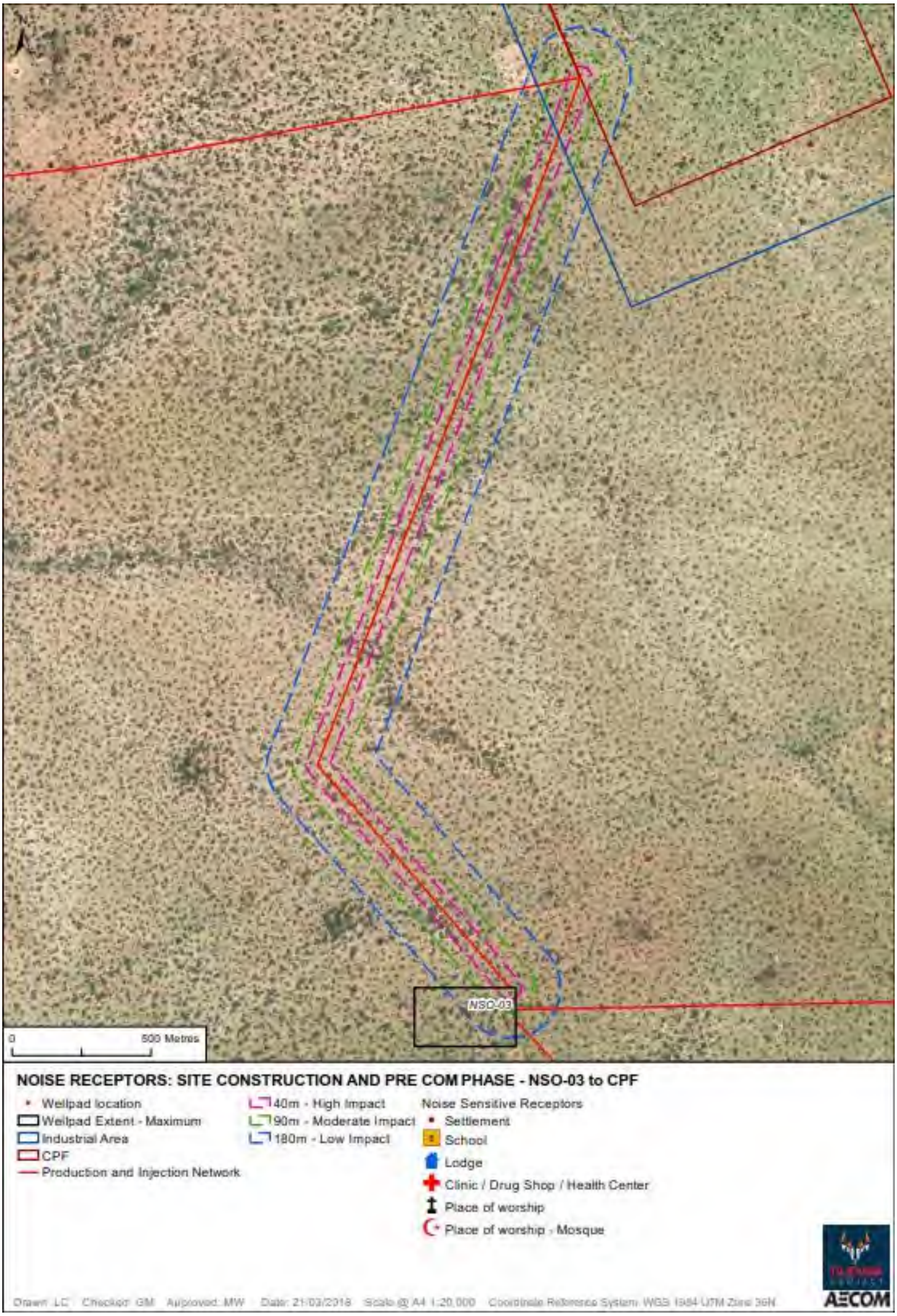


Figure I3-73: Production and Injection Network Construction Receptor Analysis – NSO-04 to NS0-03

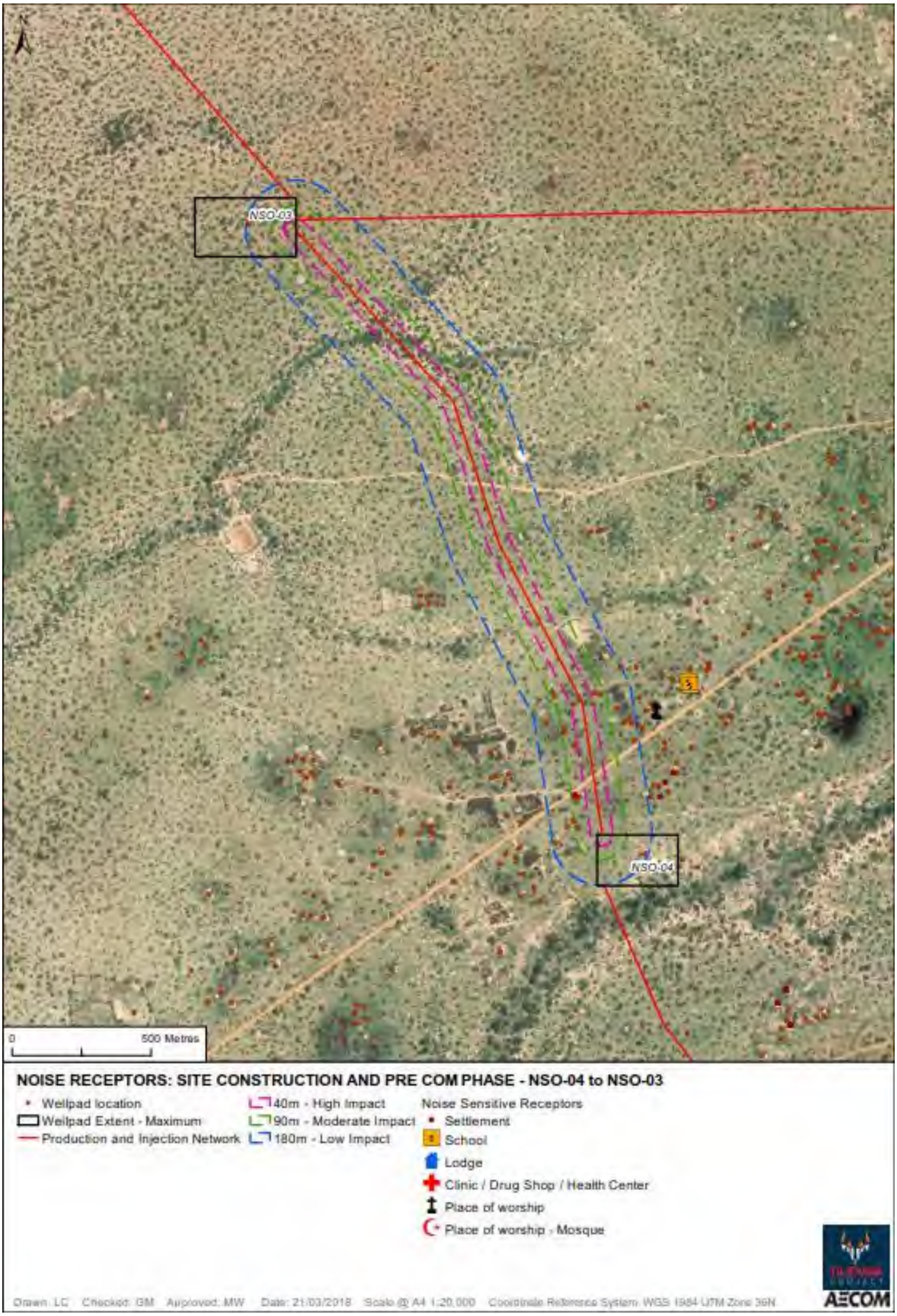


Figure I3-74: Production and Injection Network Construction Receptor Analysis – NSO-05 to NS0-03

Figure I3-75: Production and Injection Network Construction Receptor Analysis – NSO-06 to NS0-01

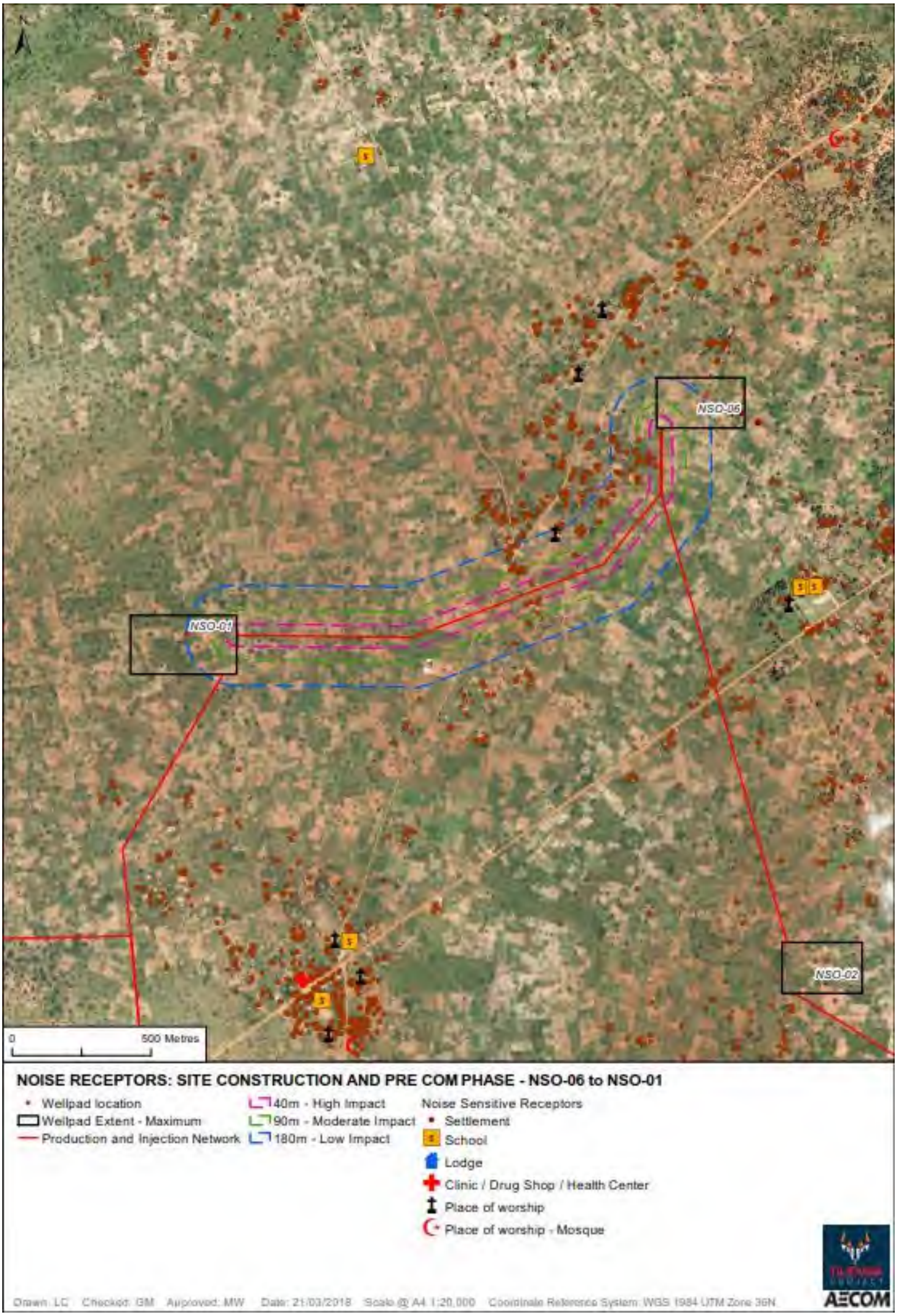


Figure I3-76: Production and Injection Network Construction Receptor Analysis – Water station to KW-02B

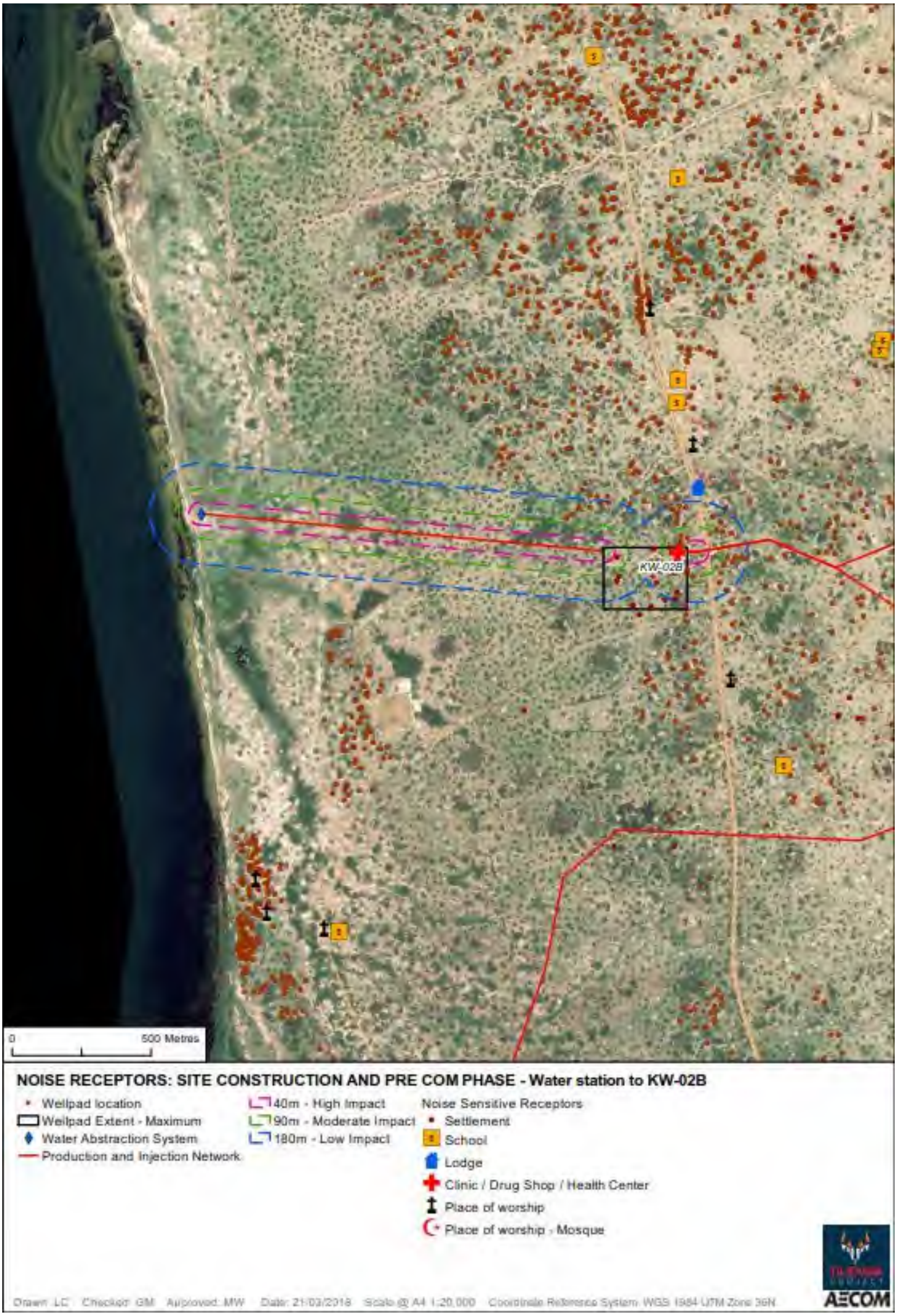
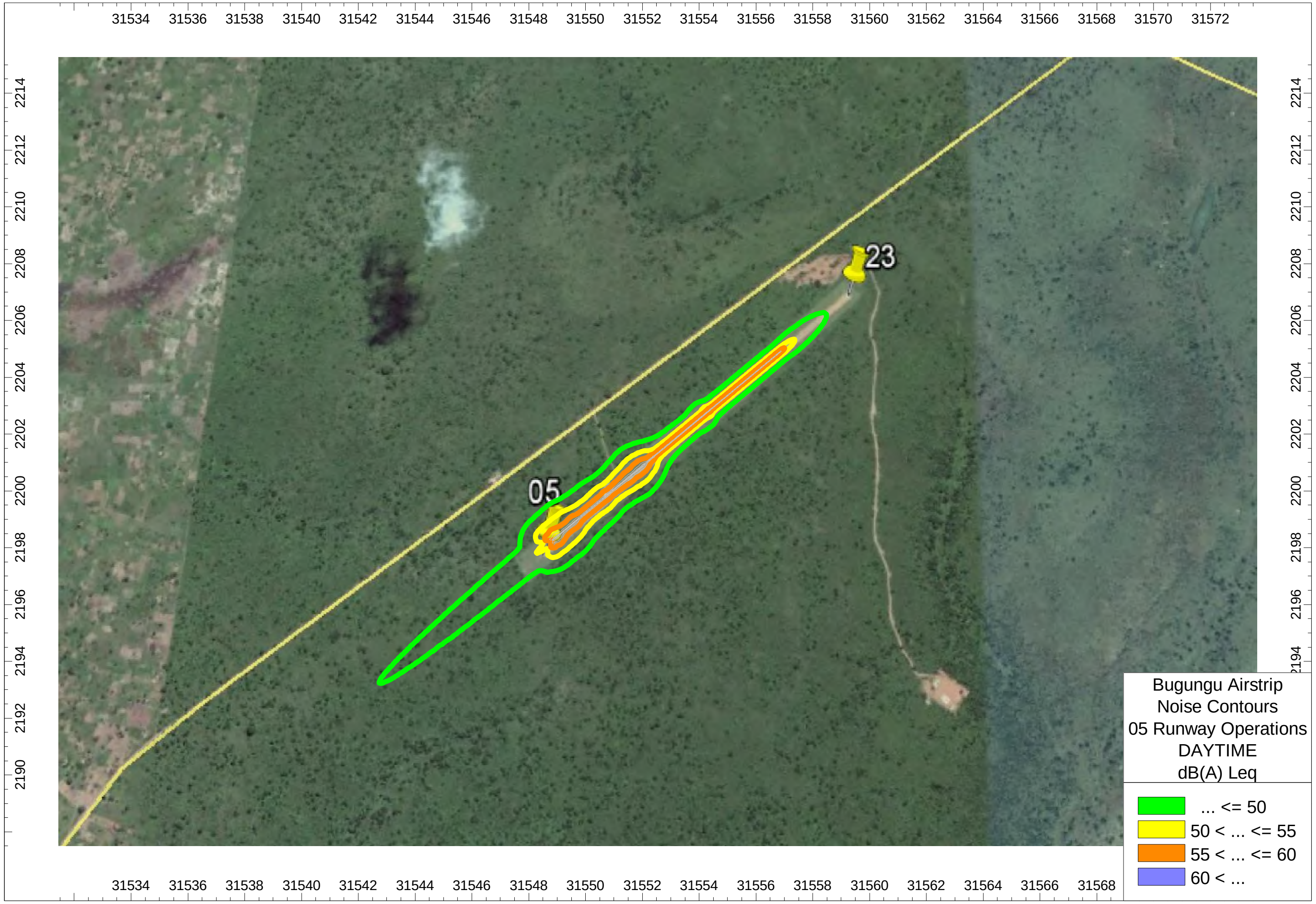
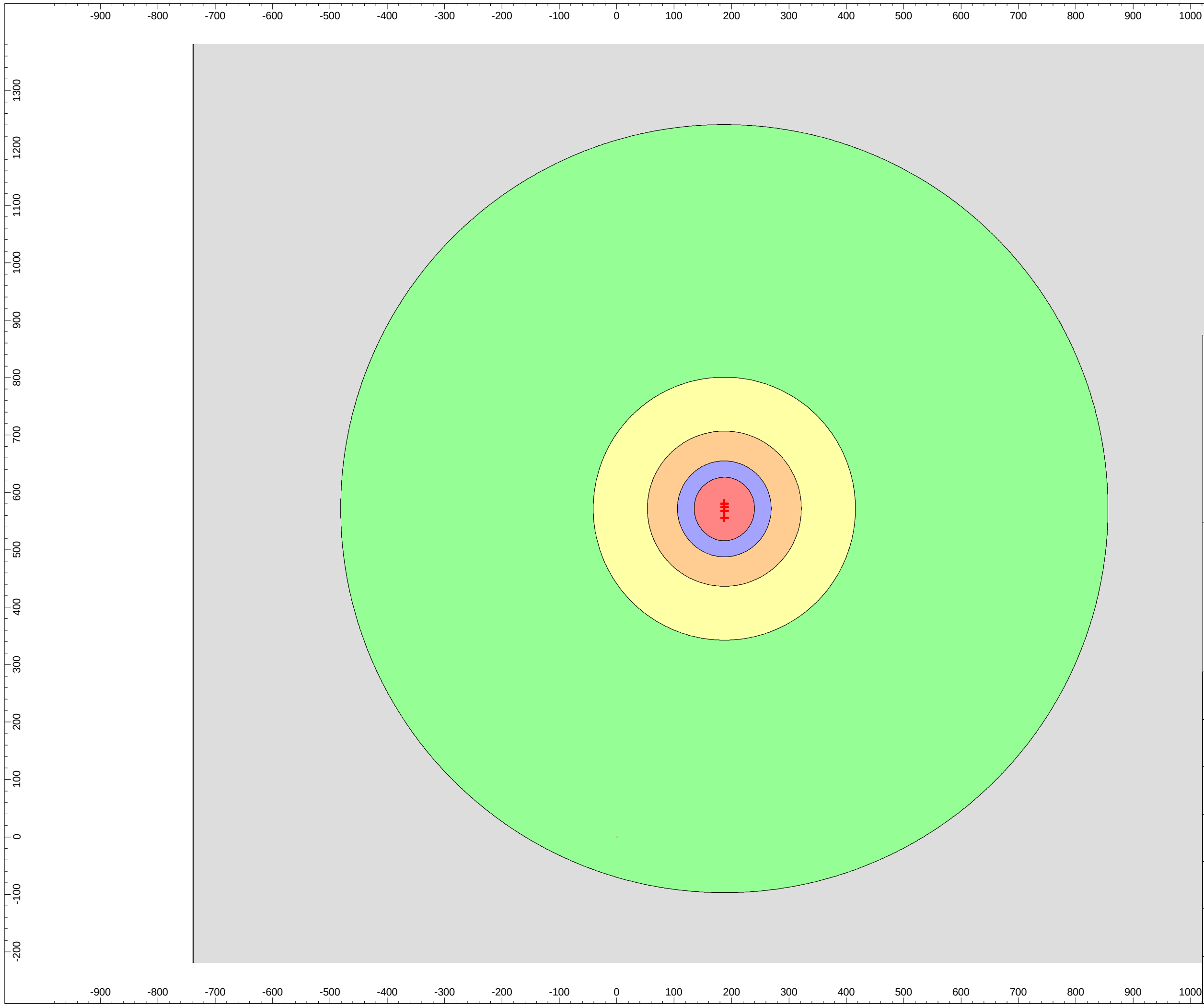


Figure I3-77: Bugungu Airstrip Noise Contours for 05 Runway Operations



The assessment of noise due to aircraft movements at Bugungu Airfield is presented in Section 7.6.4.2.7

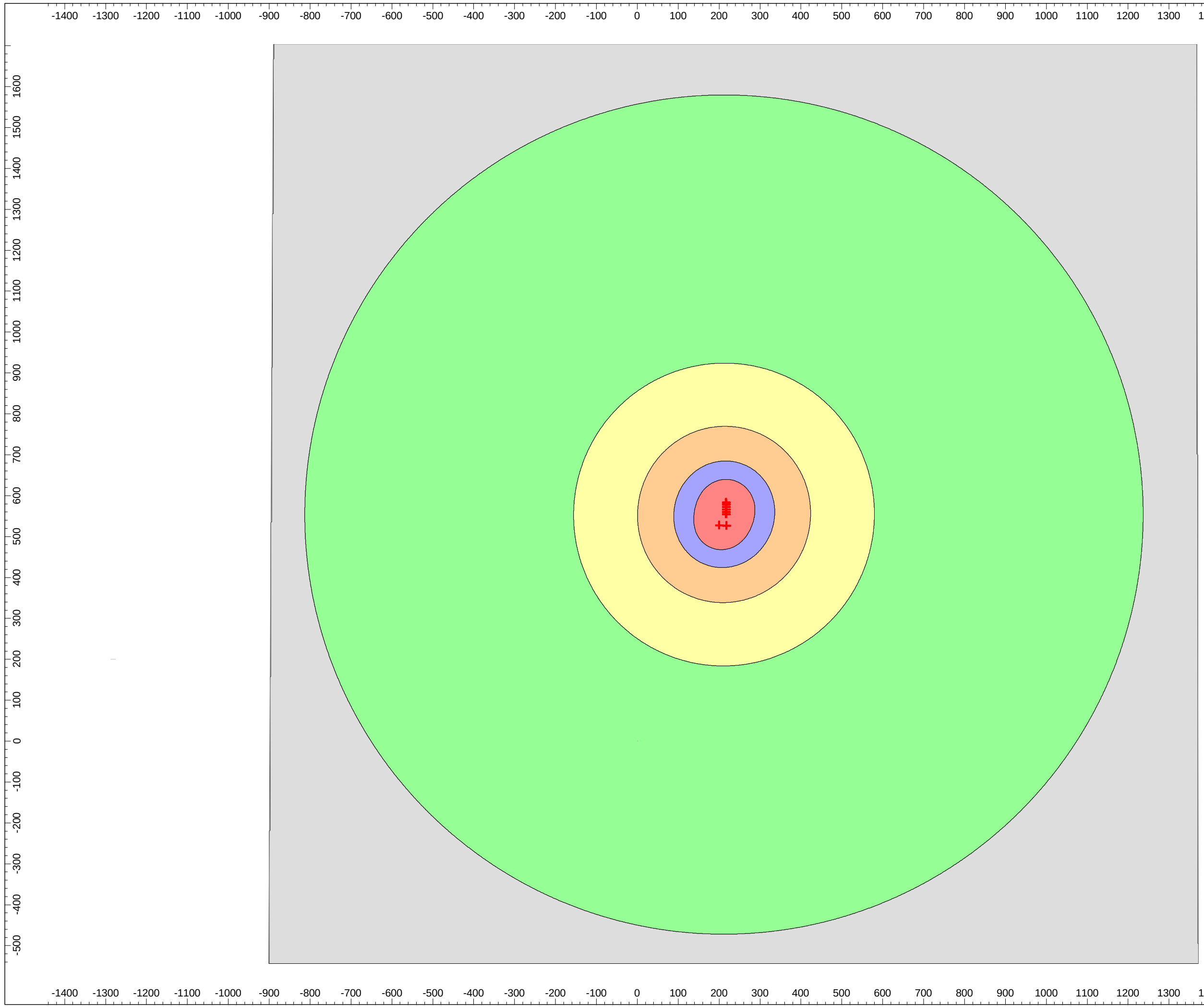
Figure I3-78: Victoria Nile HDD Drilling – North Side



Noise Band	Daytime Impact	Night-time Impact
<= 35		Negligible
35 <= 45	Negligible	Low
45 <= 50		Moderate
50 <= 55	Low	
55 <= 60	Moderate	High
> 60	High	

The assessment of noise due to HDD drilling activities is presented in Section 7.6.4.2.10

Figure I3-79: Victoria Nile HDD Drilling – South Side



Noise Band	Daytime Impact	Night-time Impact
<= 35		Negligible
35 <= 45	Negligible	Low
45 <= 50		Moderate
50 <= 55	Low	
55 <= 60	Moderate	High
> 60	High	

The assessment of noise due to HDD drilling activities is presented in Section 7.6.4.2.10

Figure I3-80: Option 1 Victoria Nile HDD Drilling Receptor Analysis – South Side

Figure I3-81: Option 1 Victoria Nile HDD Drilling Receptor Analysis – North Side

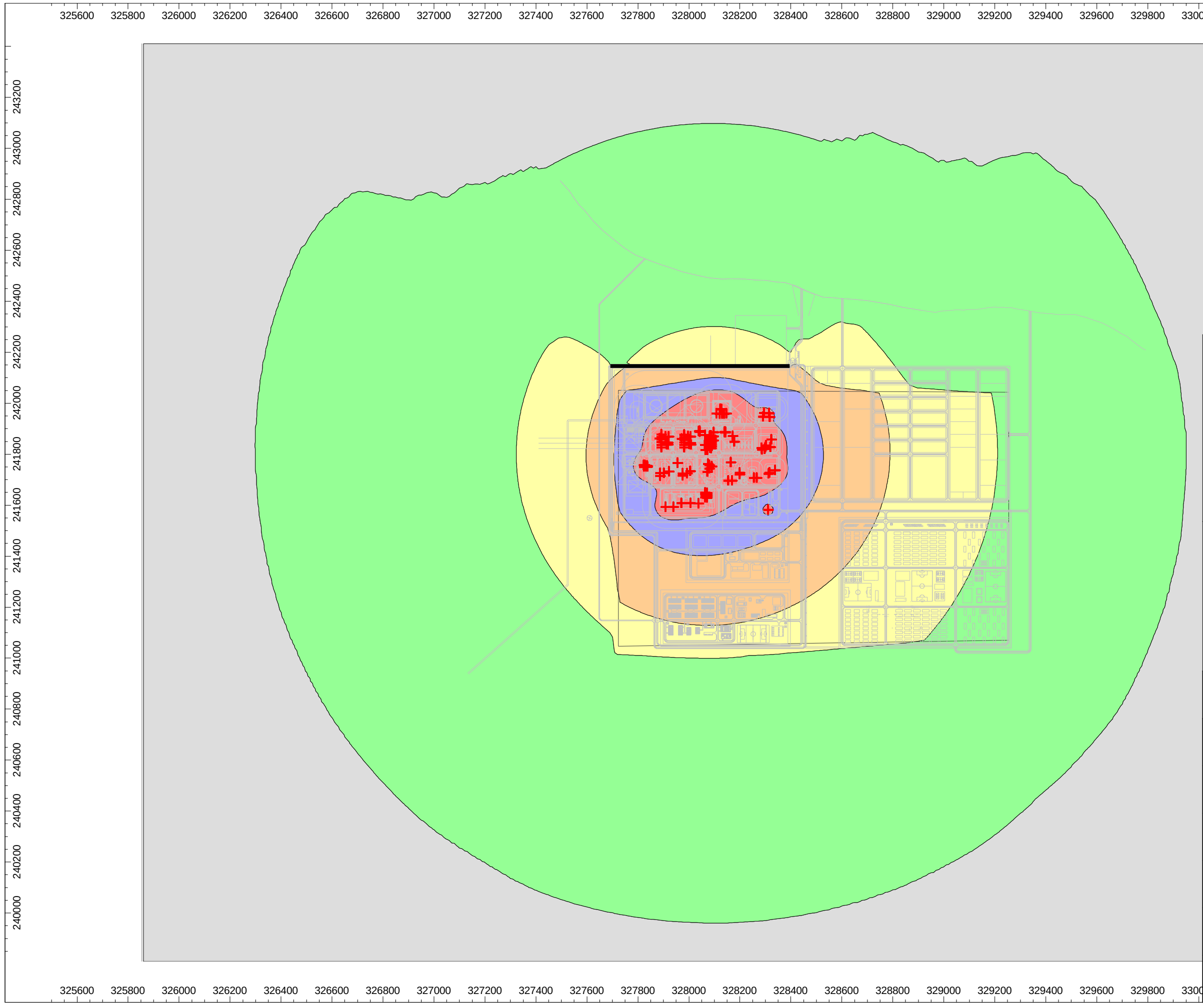
Figure I3-82: Option 2 Victoria Nile HDD Drilling Receptor Analysis – South Side

Figure I3-83: Option 2 Victoria Nile HDD Drilling Receptor Analysis – North Side

Appendix I4: Commissioning and Operation Phase Results

Appendix I4. Commissioning and Operation Noise Contour Plots

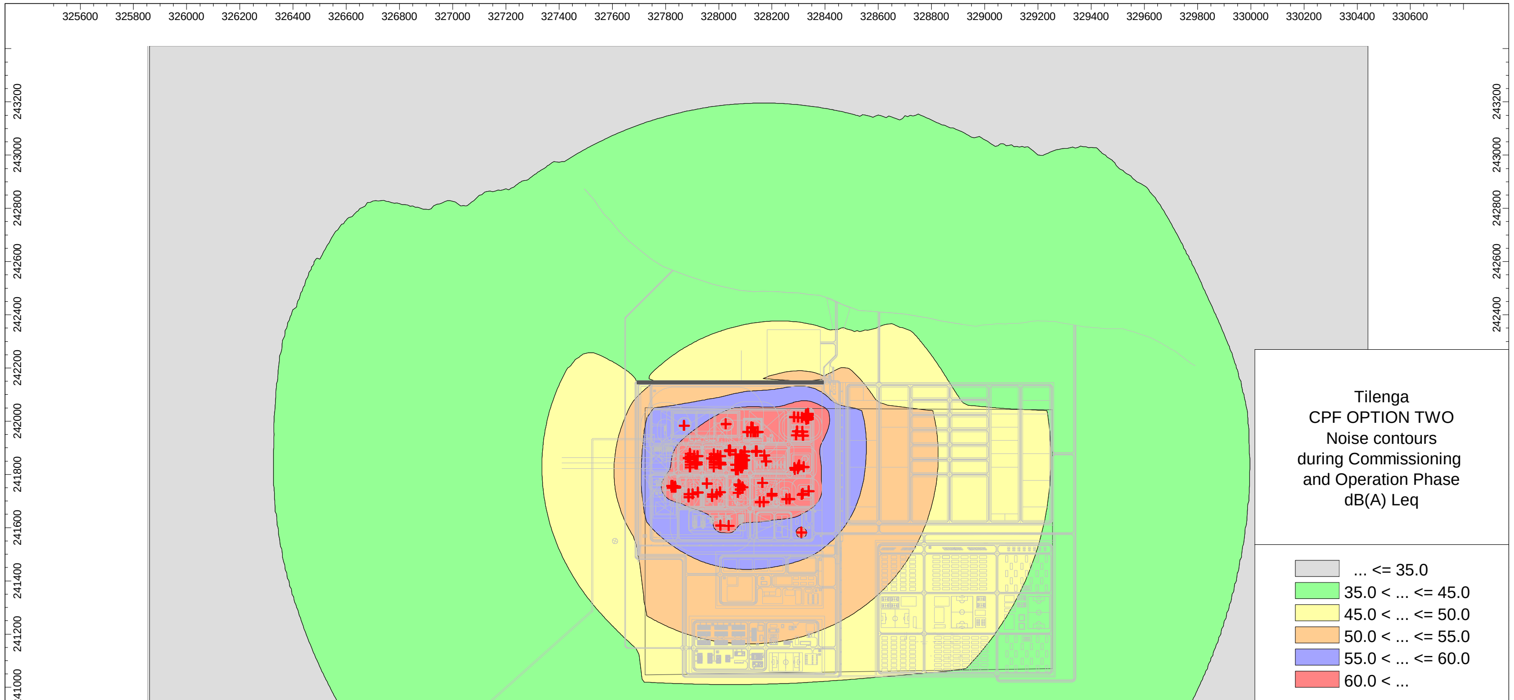
Figure I4-1: CPF Option 1 Commissioning and Operation Noise Contours



Noise Band	Daytime Impact	Night-time Impact
<= 35		Negligible
35 <= 45	Negligible	Low
45 <= 50		Moderate
50 <= 55	Low	
55 <= 60	Moderate	High
> 60	High	

The assessment of noise due to the operational Industrial Area is presented in Section 7.6.5.2.1

Figure I4-2: CPF Option 2 Commissioning and Operation Noise Contours



Noise Band	Daytime Impact	Night-time Impact
<= 35	Negligible	Negligible
35 <= 45		Low
45 <= 50		Moderate
50 <= 55	Low	High
55 <= 60	Moderate	
> 60	High	

The assessment of noise due to the operational Industrial Area is presented in Section 7.6.5.2.1

Figure I4-3: CPF Options Commissioning and Operation Night-time Receptor Analysis

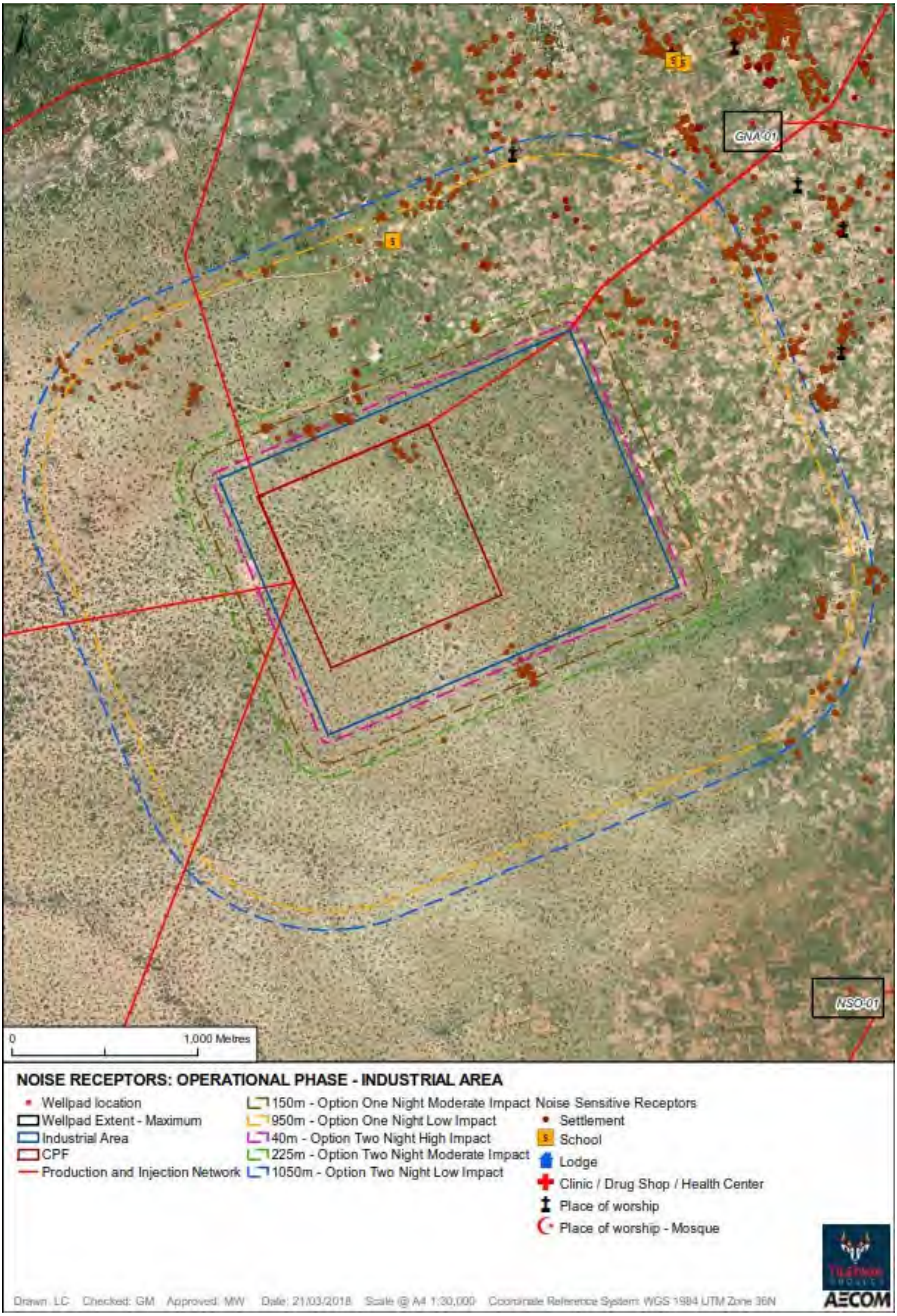
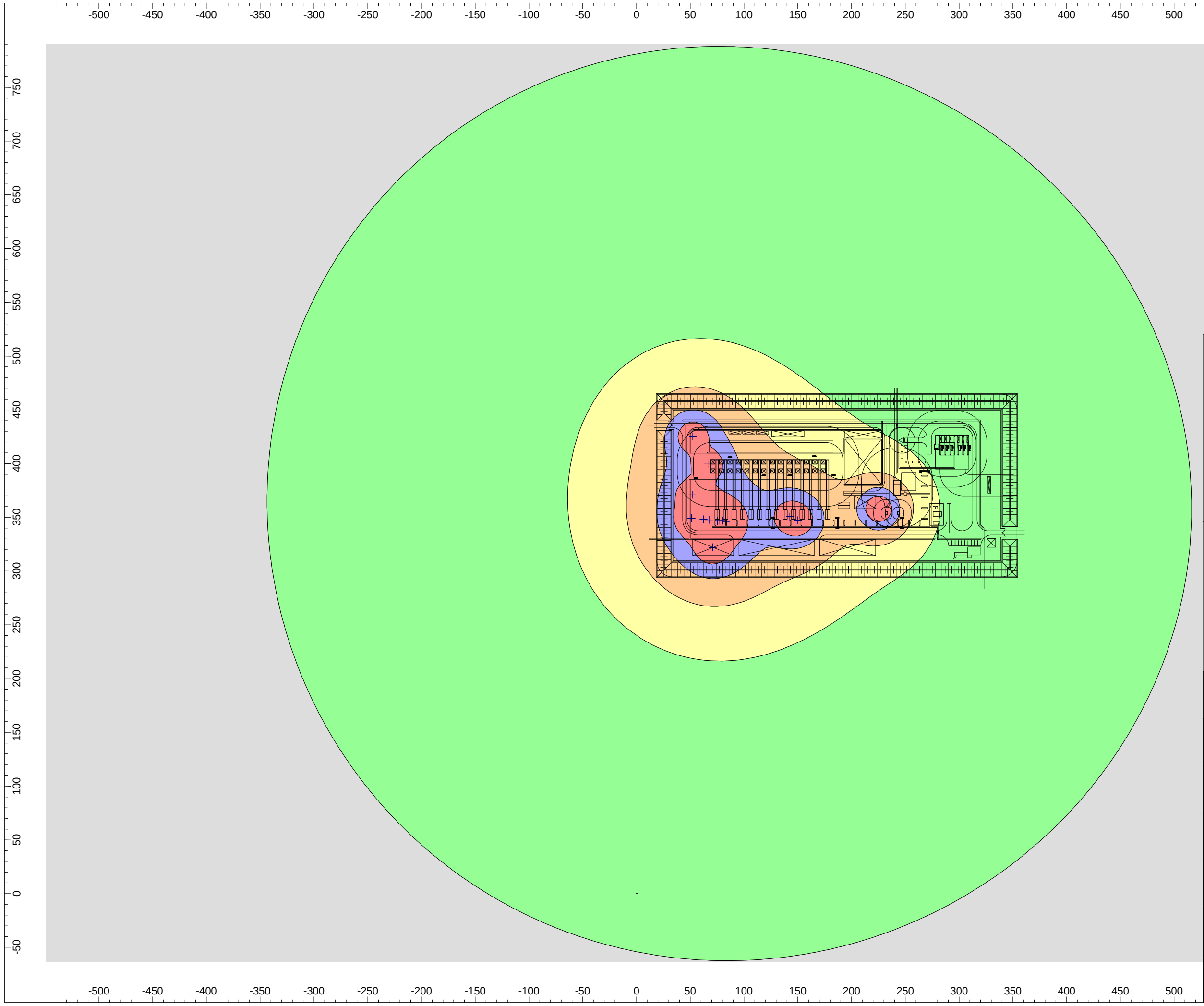


Figure I4-4: Well Pad Commissioning and Operation Noise Contours



<table>
<tr><th>Noise Band</th><th>Daytime Impact</th><th>Night-time Impact</th></tr>
<tr><td><= 35</td><td rowspan="3">Negligible</td><td>Negligible</td></tr>
<tr><td>35 <= 45</td><td>Low</td></tr>
<tr><td>45 <= 50</td><td>Moderate</td></tr>
<tr><td>50 <= 55</td><td>Low</td><td rowspan="3">High</td></tr>
<tr><td>55 <= 60</td><td>Moderate</td></tr>
<tr><td>> 60</td><td>High</td></tr>
</table>

The assessment of noise due to operational well pads is presented in Section 7.6.5.2.2

Figure I4-5: GNA-01 Commissioning and Operation Receptor Analysis

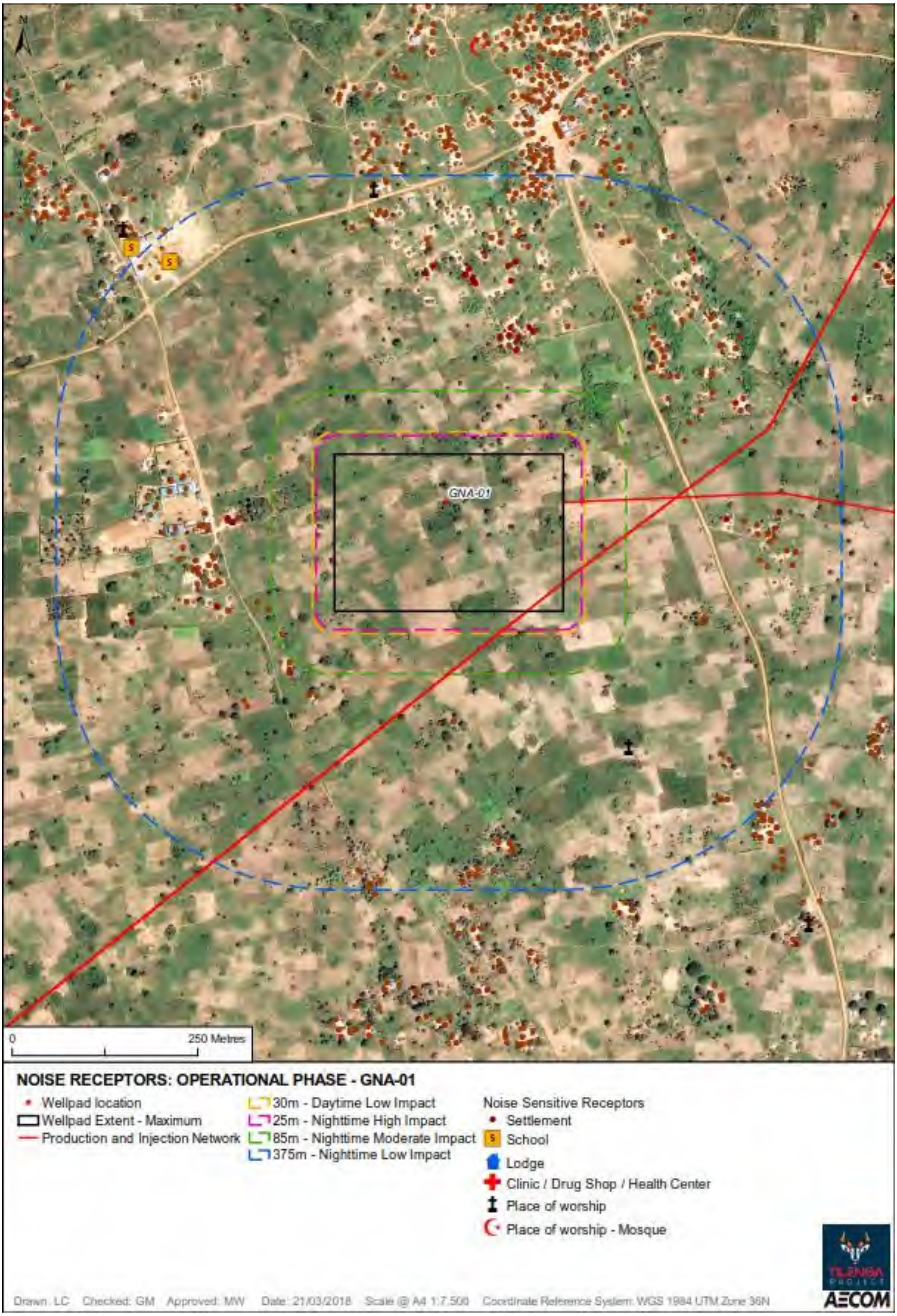


Figure I4-6: GNA-02 Commissioning and Operation Receptor Analysis

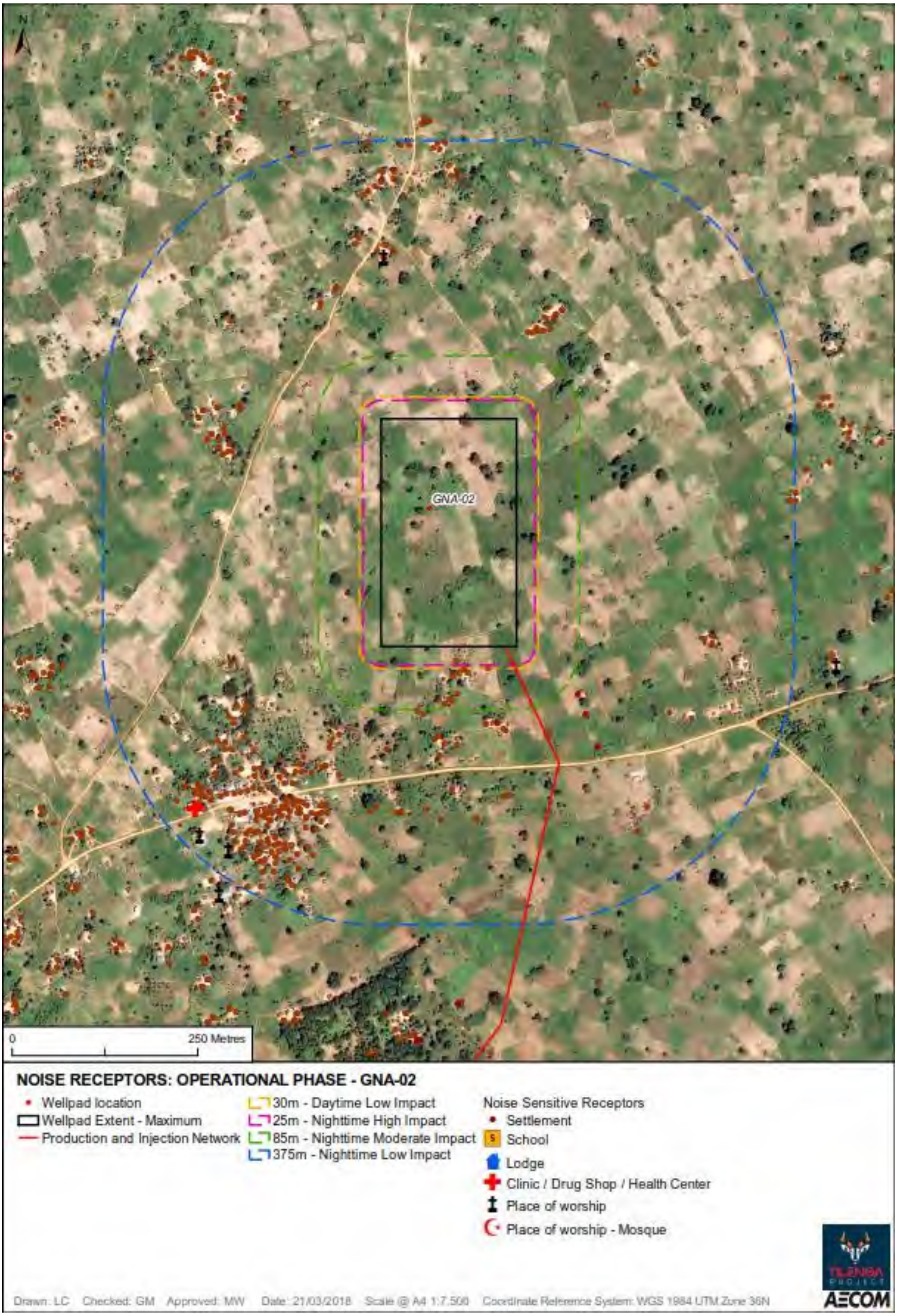


Figure I4-7: GNA-03 Commissioning and Operation Receptor Analysis

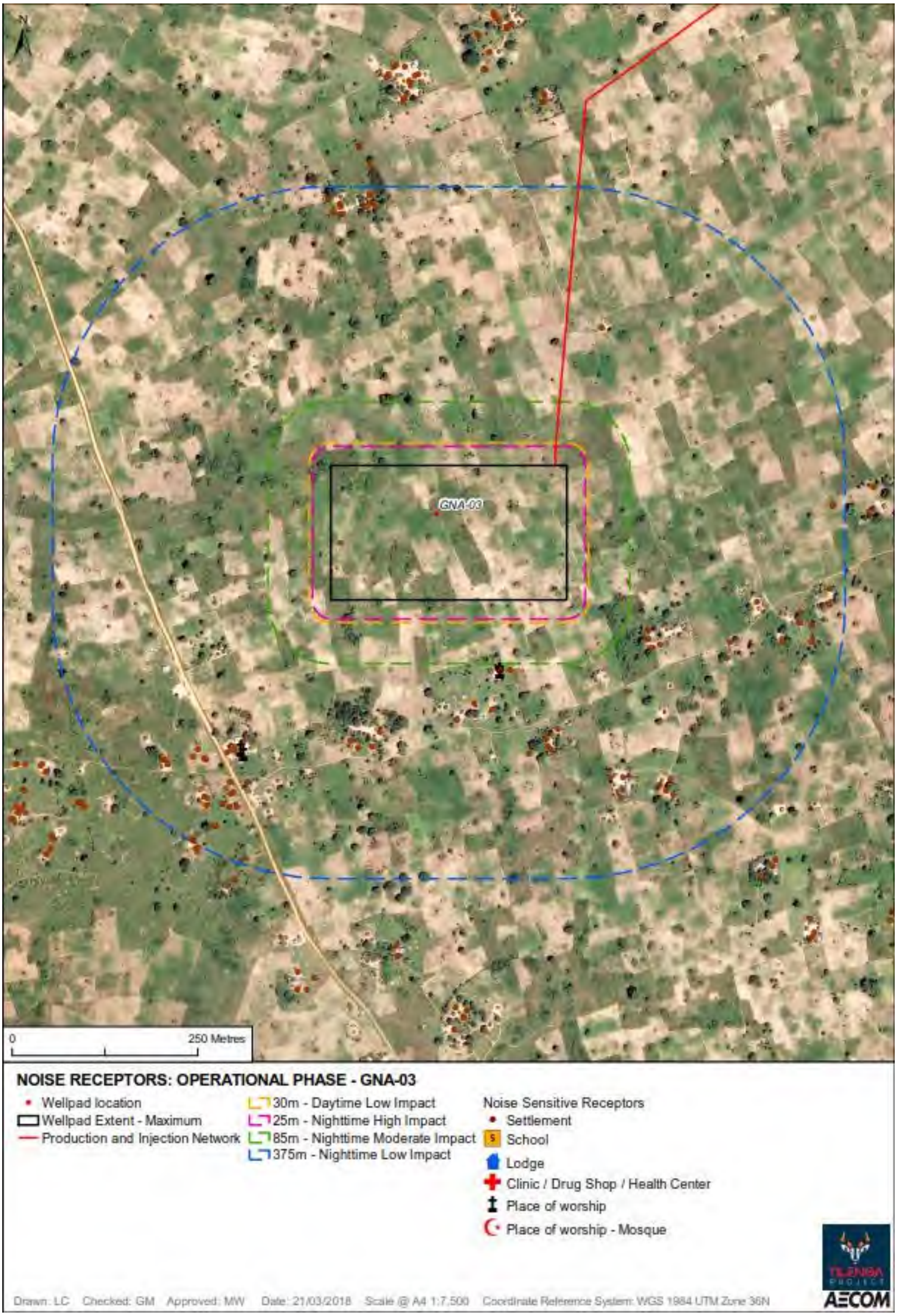


Figure I4-8: GNA-04 Commissioning and Operation Receptor Analysis

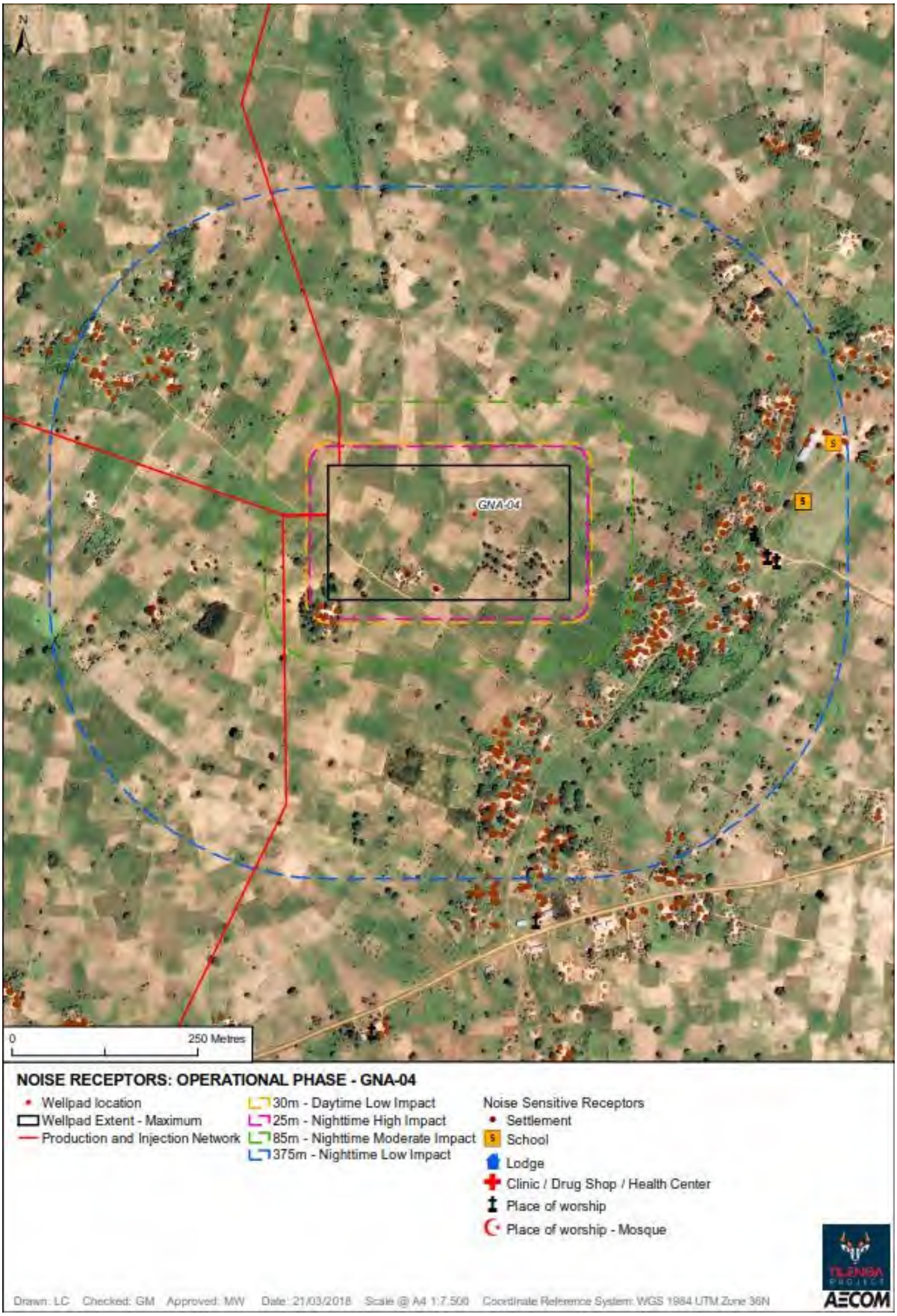


Figure I4-9: JBR-01 Commissioning and Operation Receptor Analysis

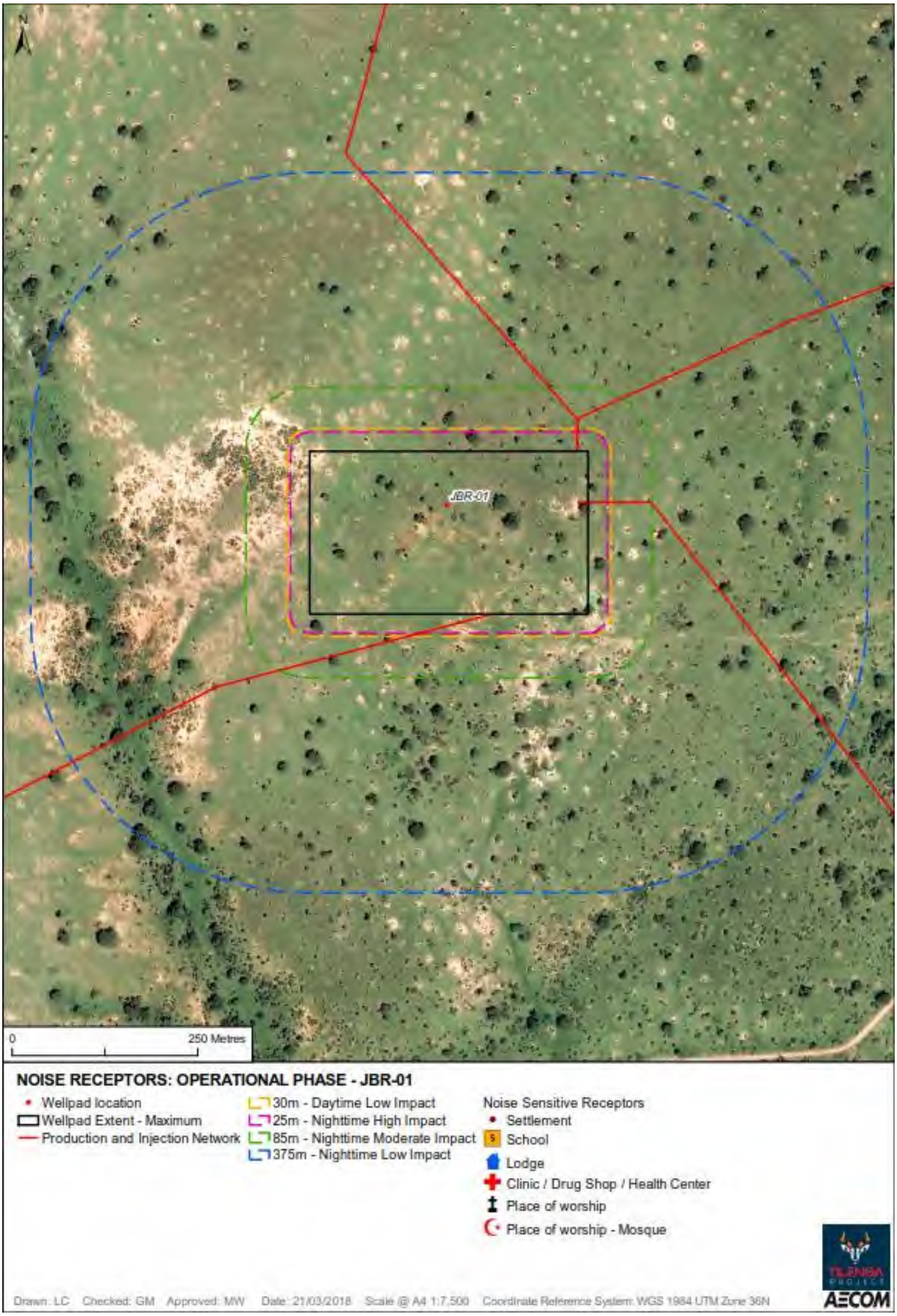


Figure I4-10: JBR-02 Commissioning and Operation Receptor Analysis

Figure I4-11: JBR-03 Commissioning and Operation Receptor Analysis

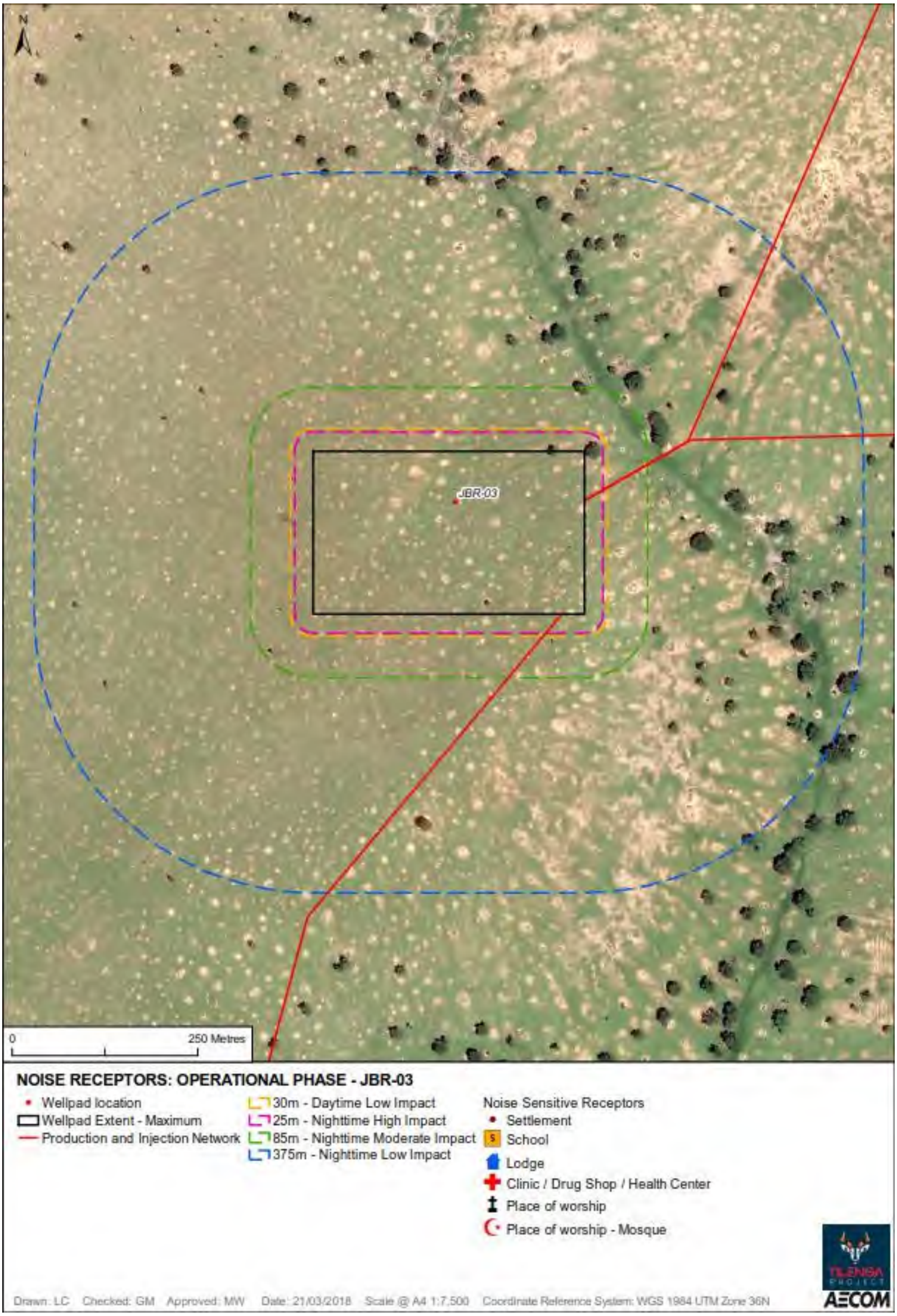


Figure I4-12: JBR-04 Commissioning and Operation Receptor Analysis

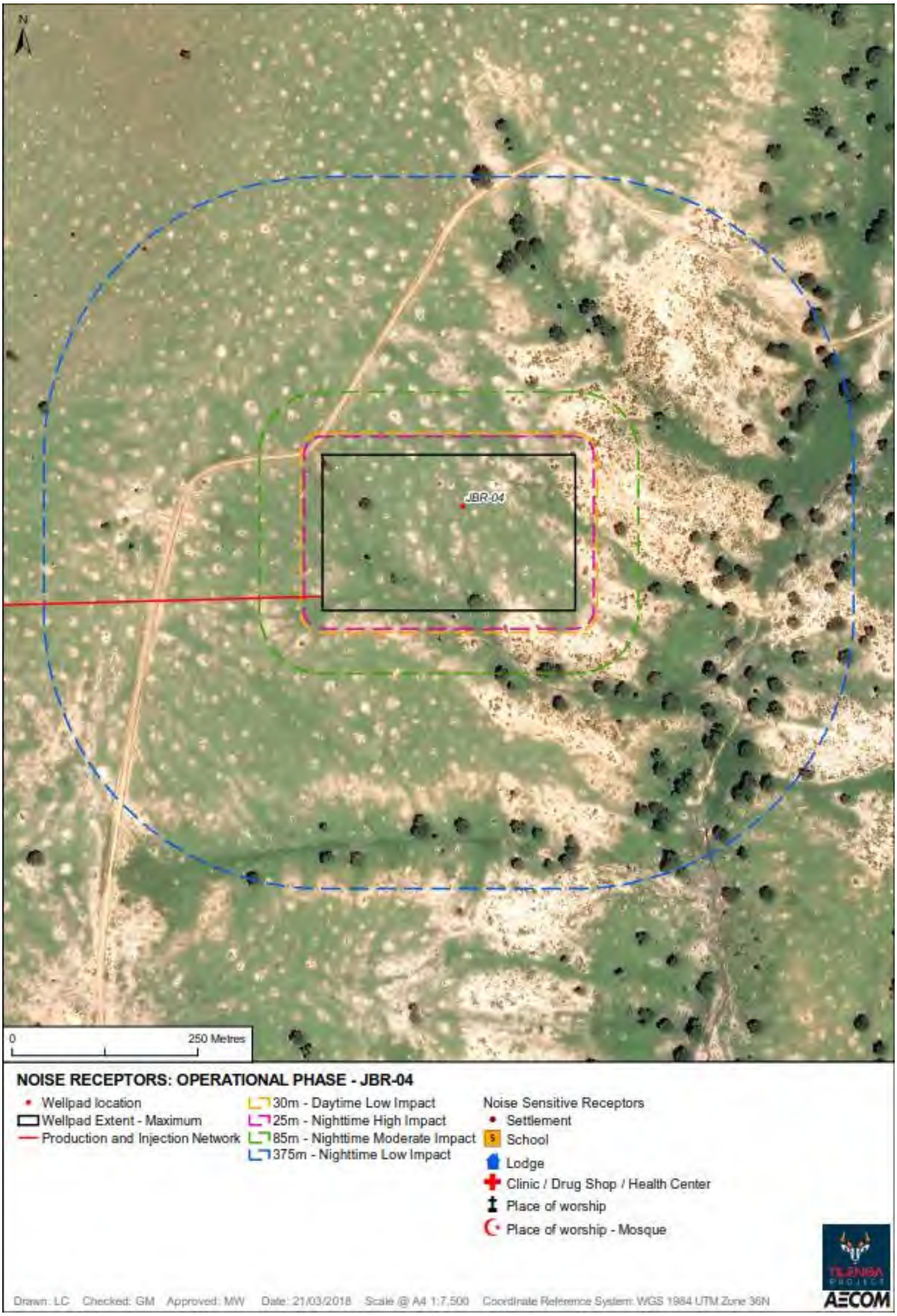


Figure I4-13: JBR-05 Commissioning and Operation Receptor Analysis

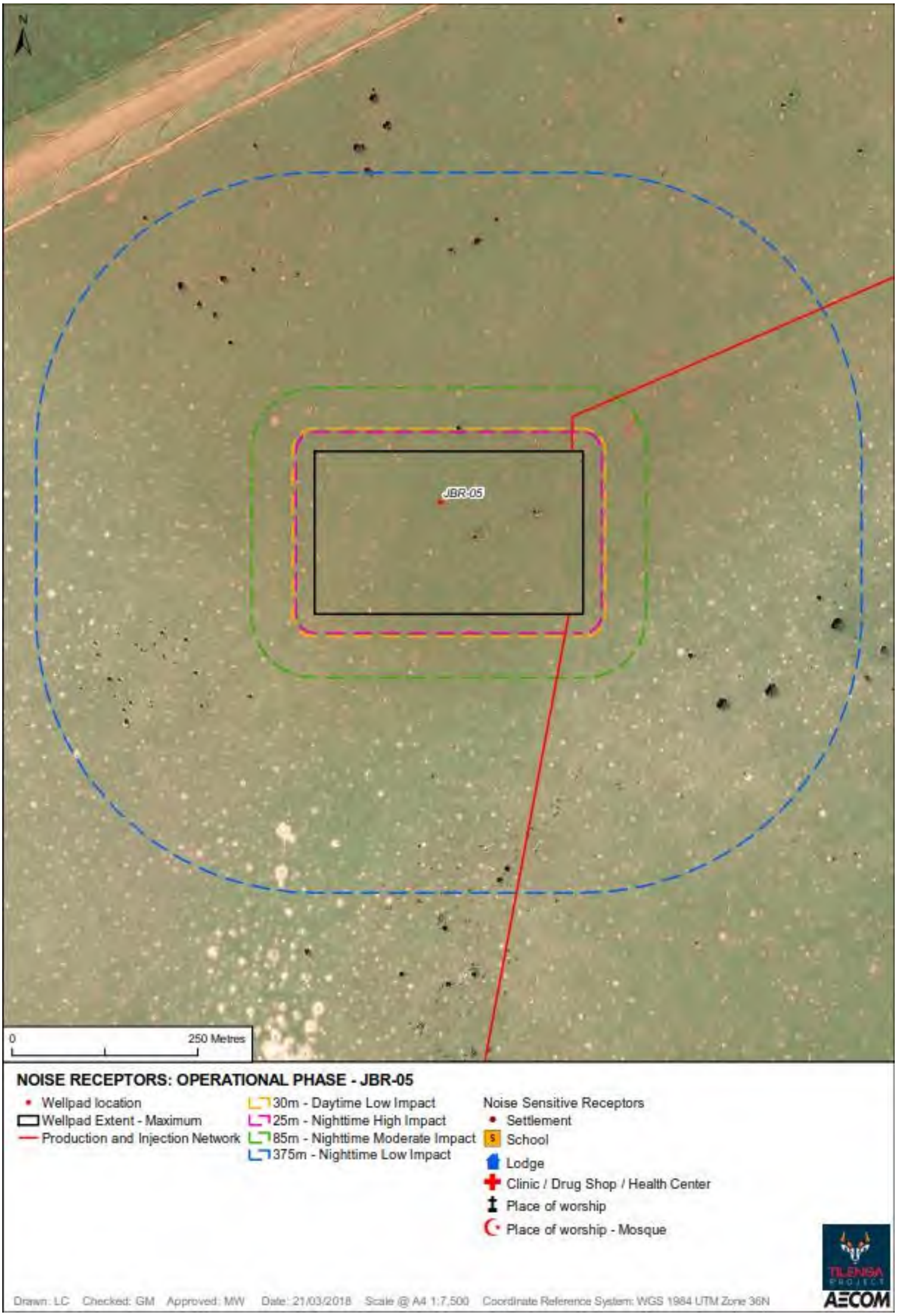


Figure I4-14: JBR-06 Commissioning and Operation Receptor Analysis

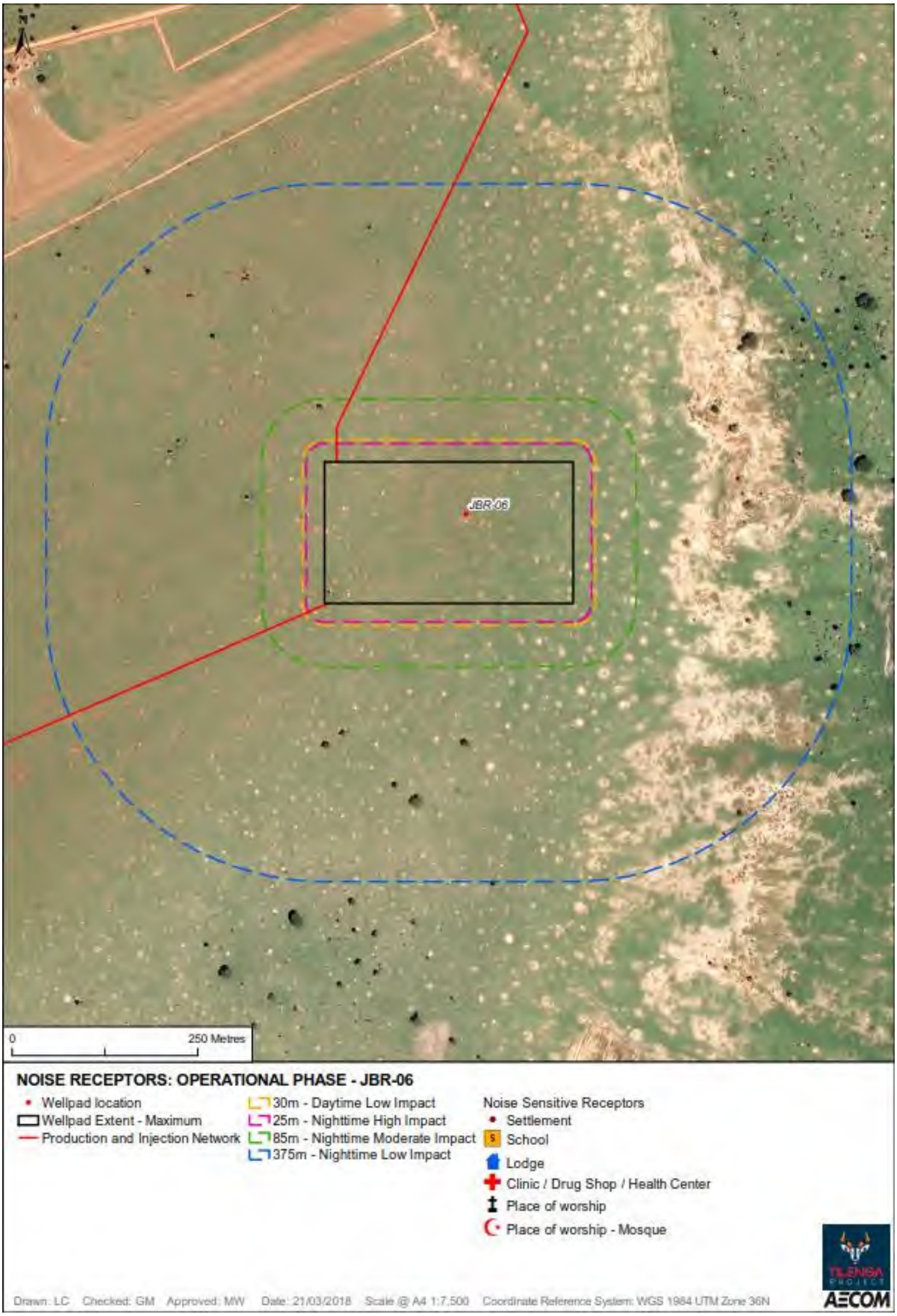


Figure I4-15: JBR-07 Commissioning and Operation Receptor Analysis

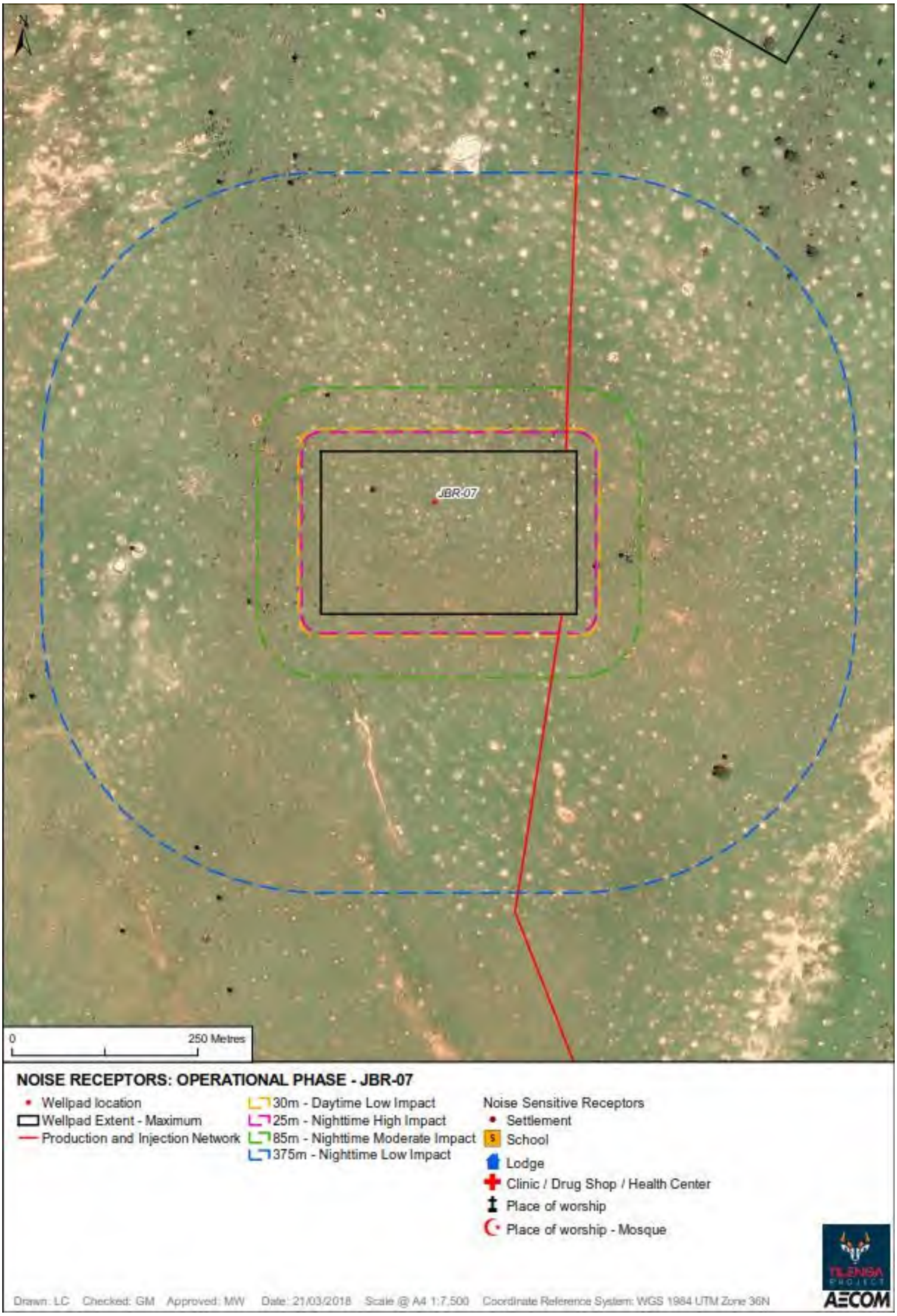


Figure I4-16: JBR-08 Commissioning and Operation Receptor Analysis

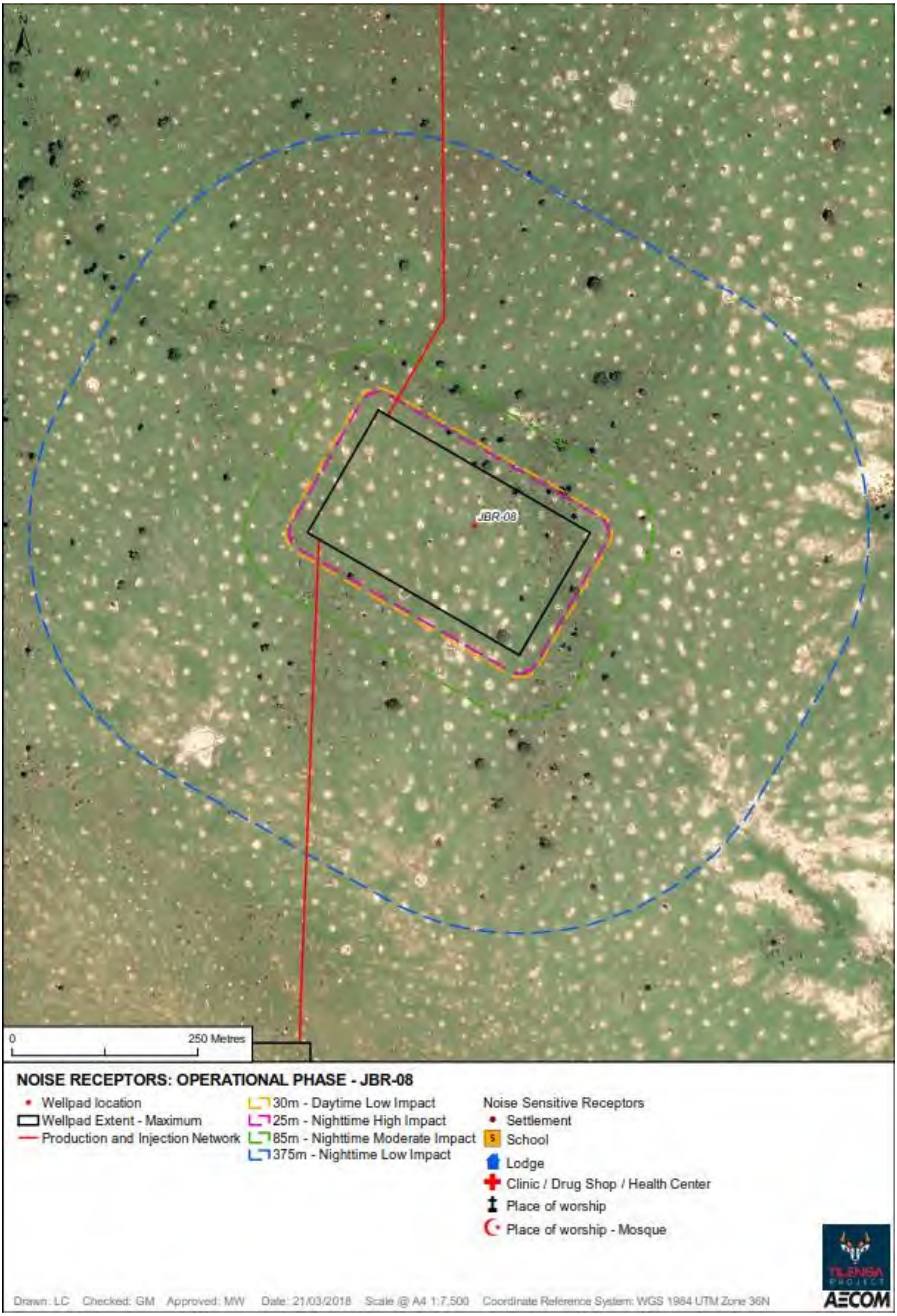


Figure I4-17: JBR-09 Commissioning and Operation Receptor Analysis

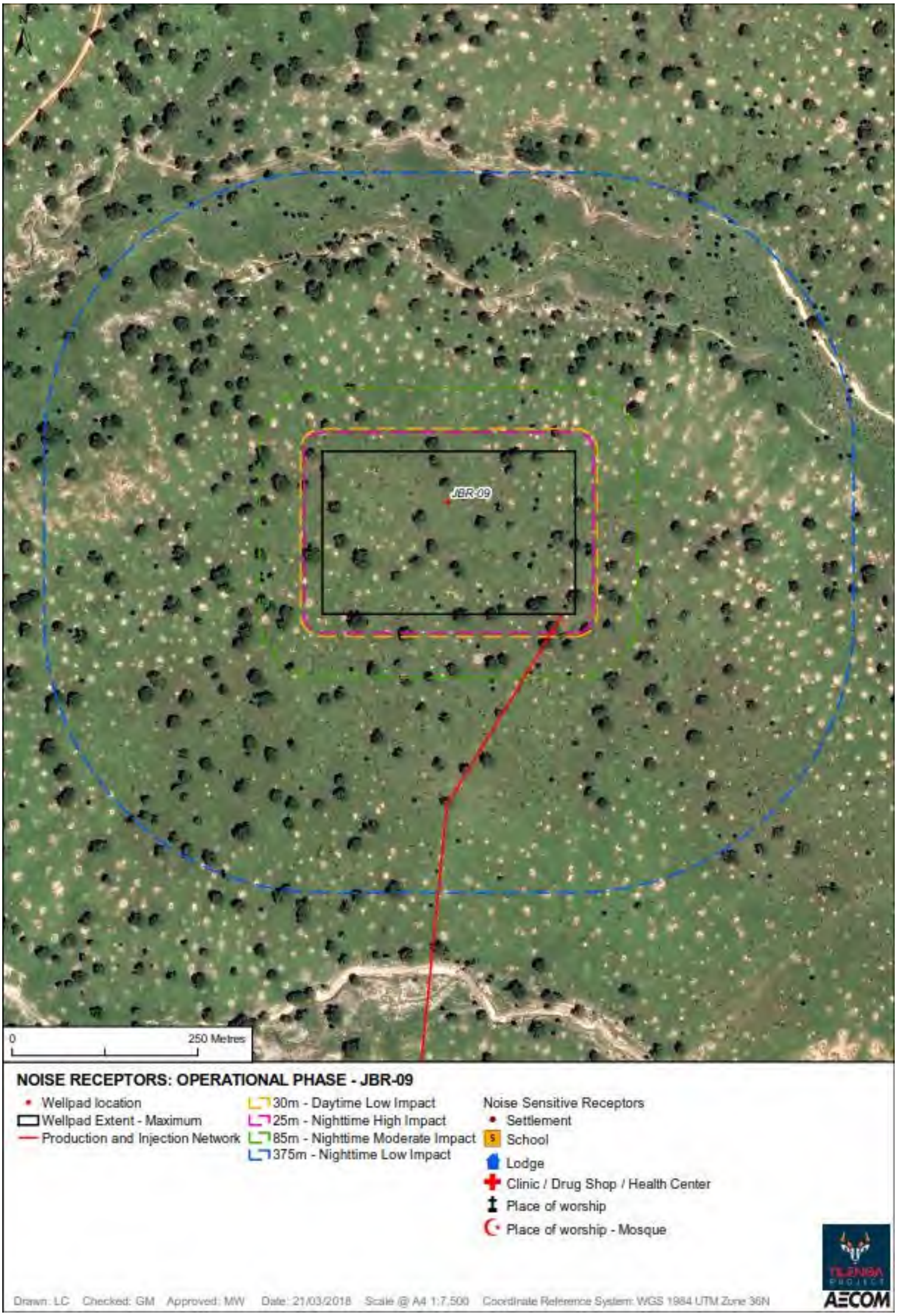


Figure I4-18: JBR-10 Commissioning and Operation Receptor Analysis

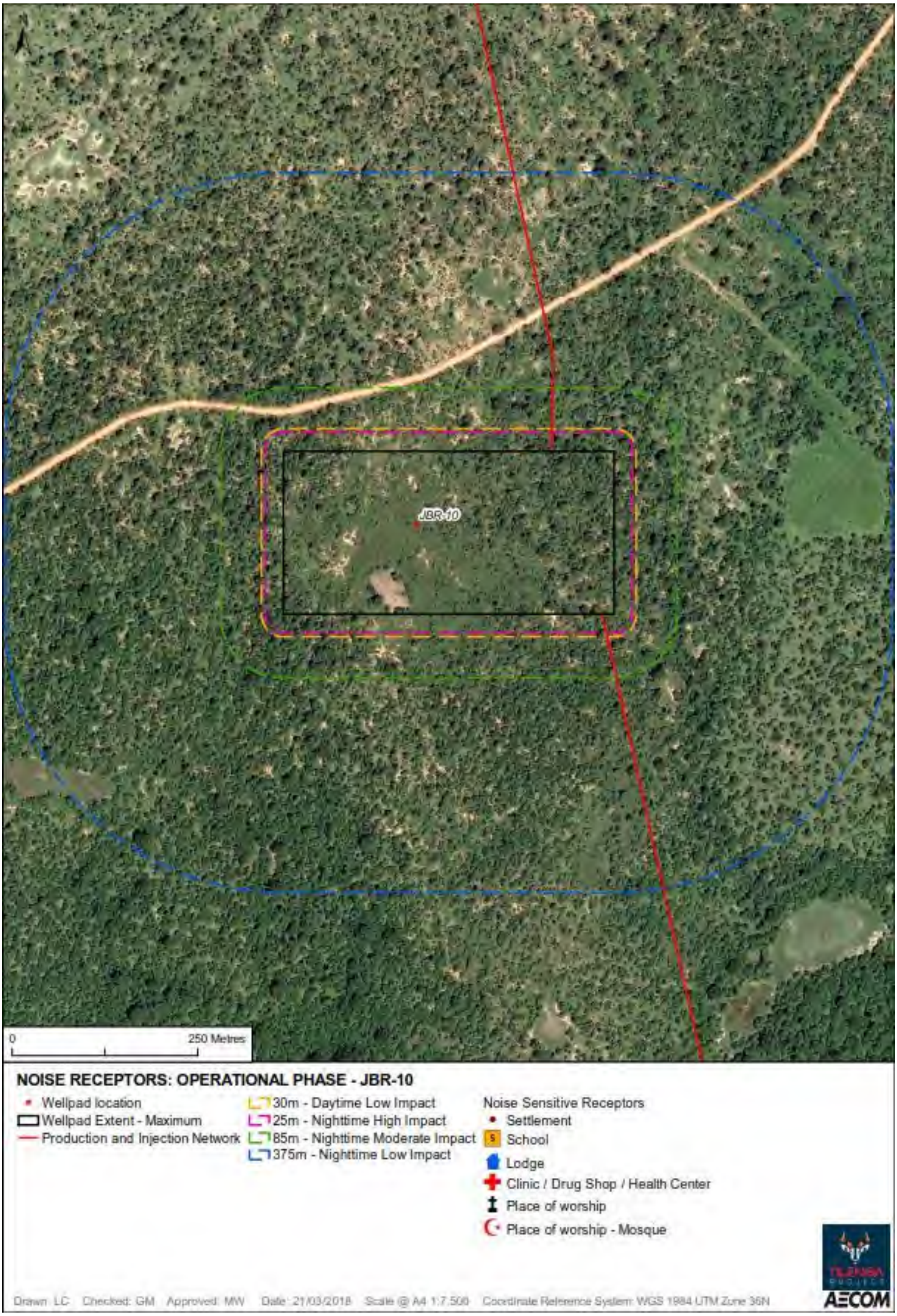


Figure I4-19: KGG-01 Commissioning and Operation Receptor Analysis

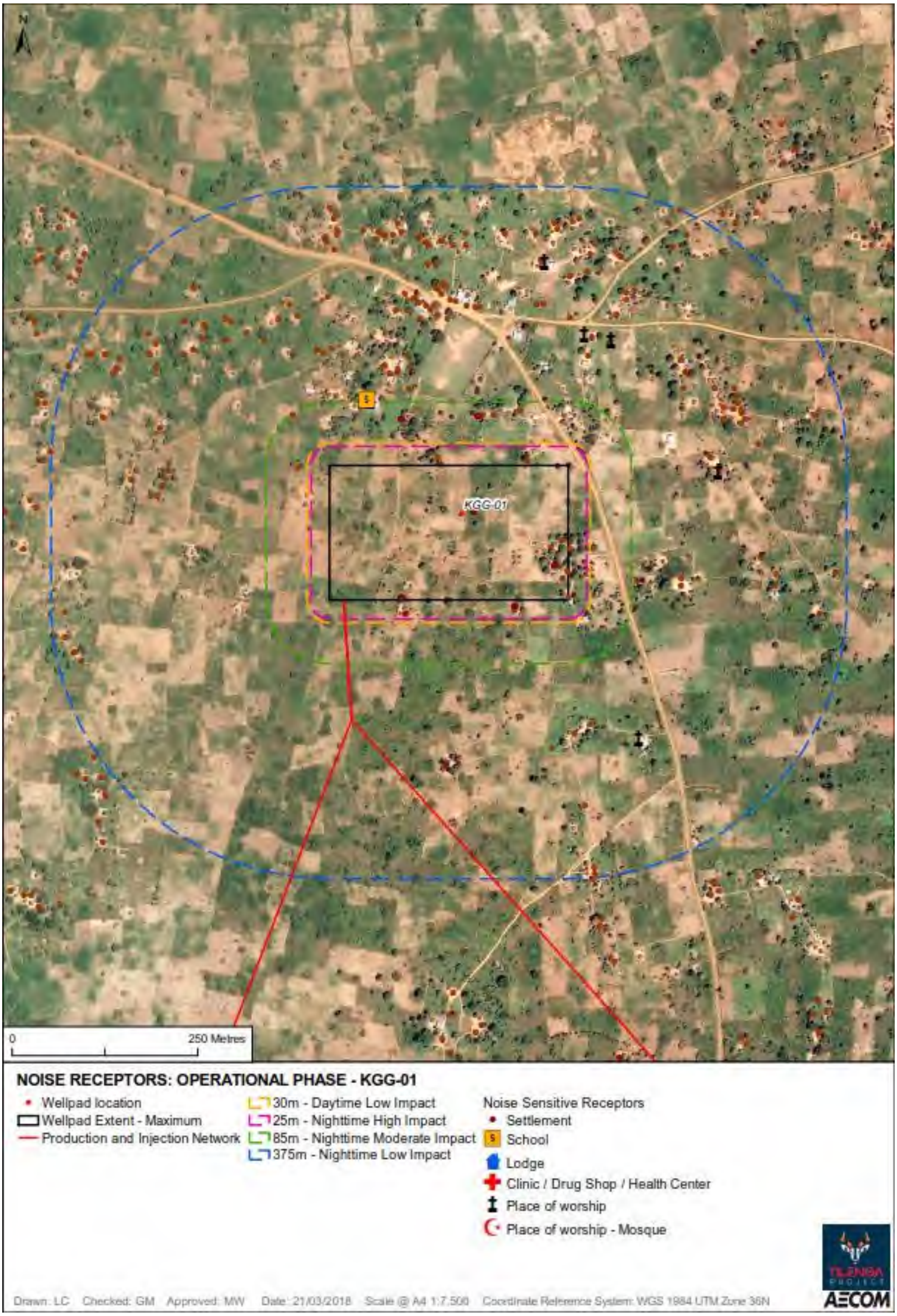


Figure I4-20: KGG-03 Commissioning and Operation Receptor Analysis

Figure I4-21: KGG-04 Commissioning and Operation Receptor Analysis

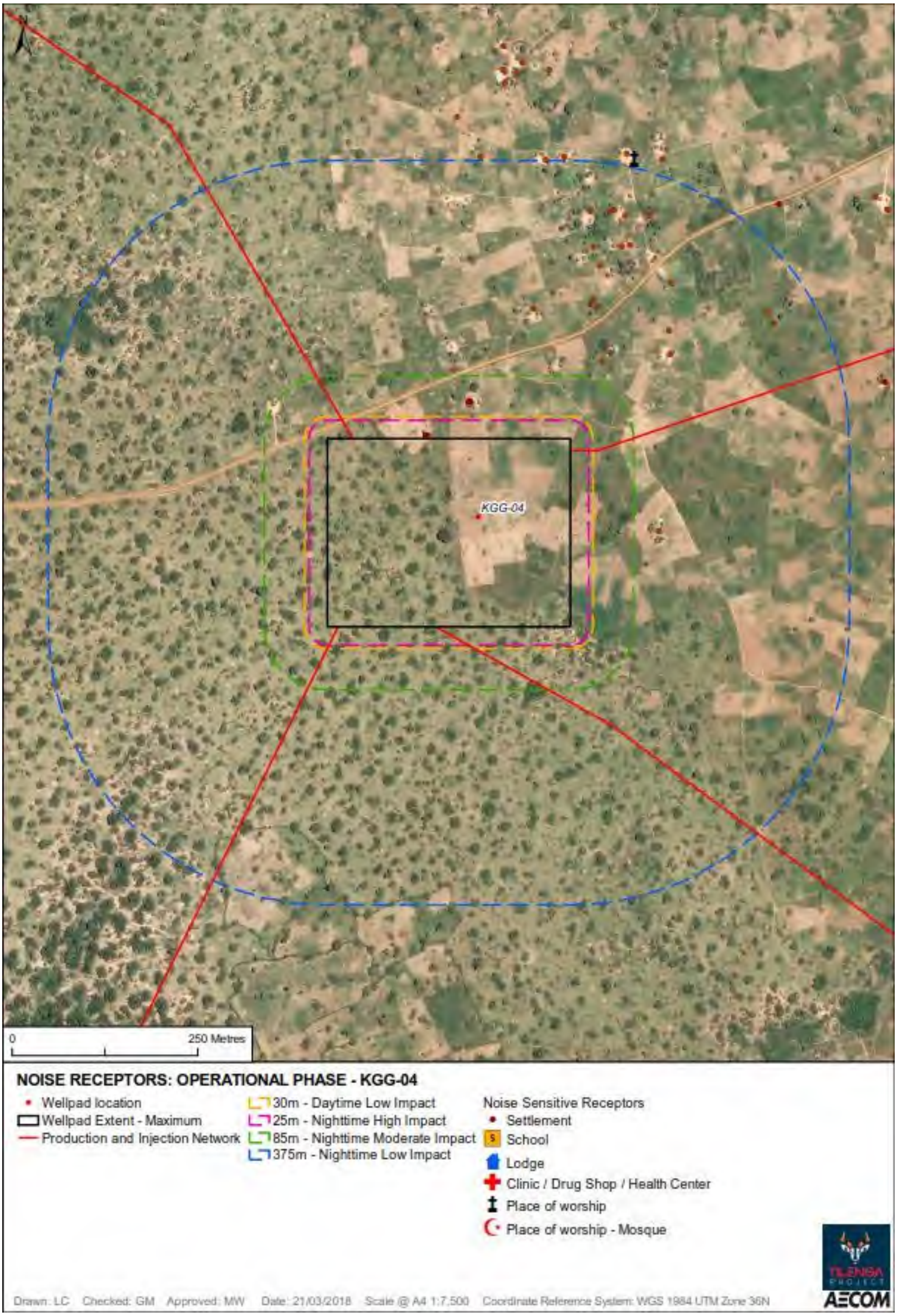


Figure I4-22: KGG-05 Commissioning and Operation Receptor Analysis

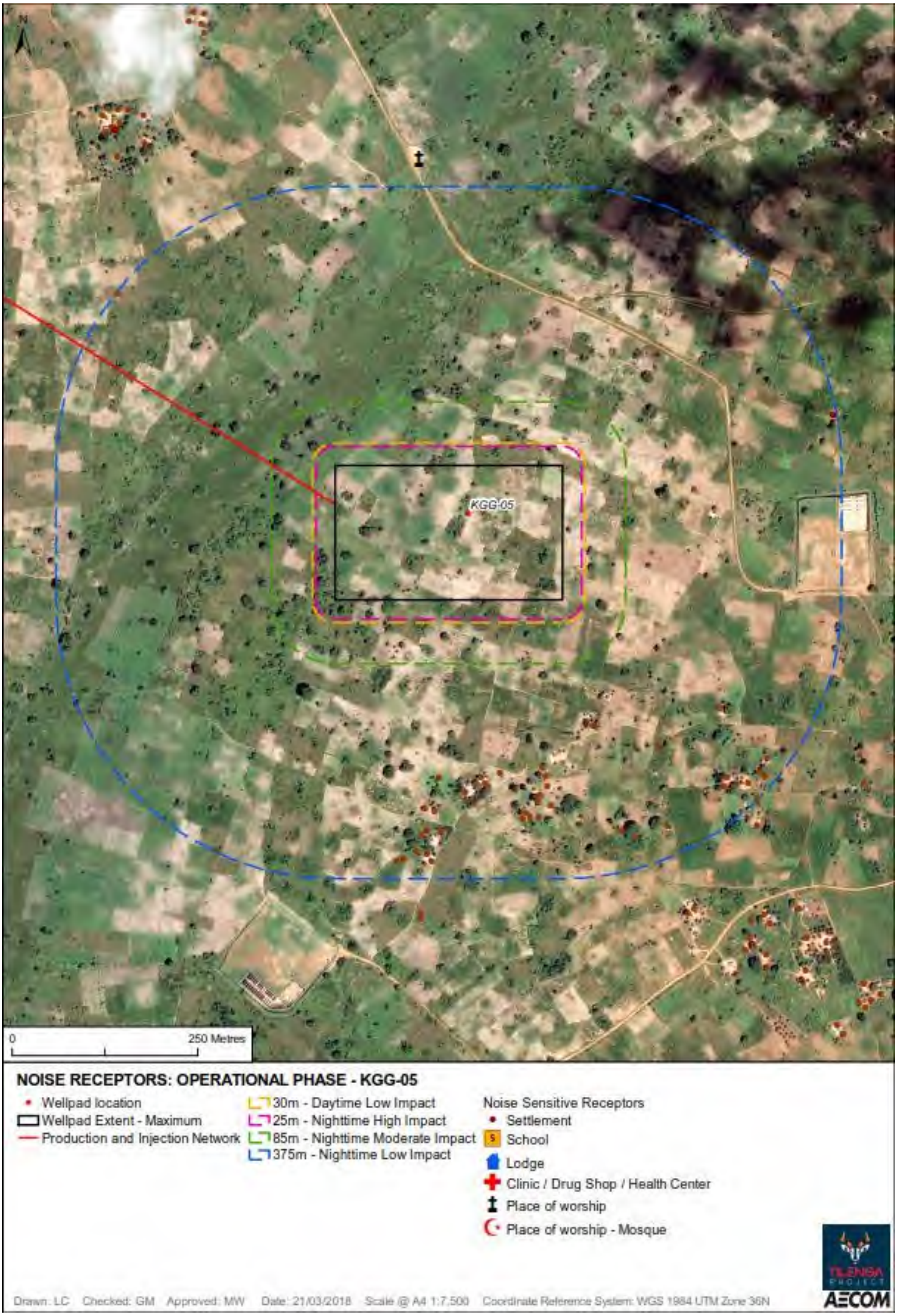


Figure I4-23: KGG-06 Commissioning and Operation Receptor Analysis

Figure I4-24: KGG-09 Commissioning and Operation Receptor Analysis

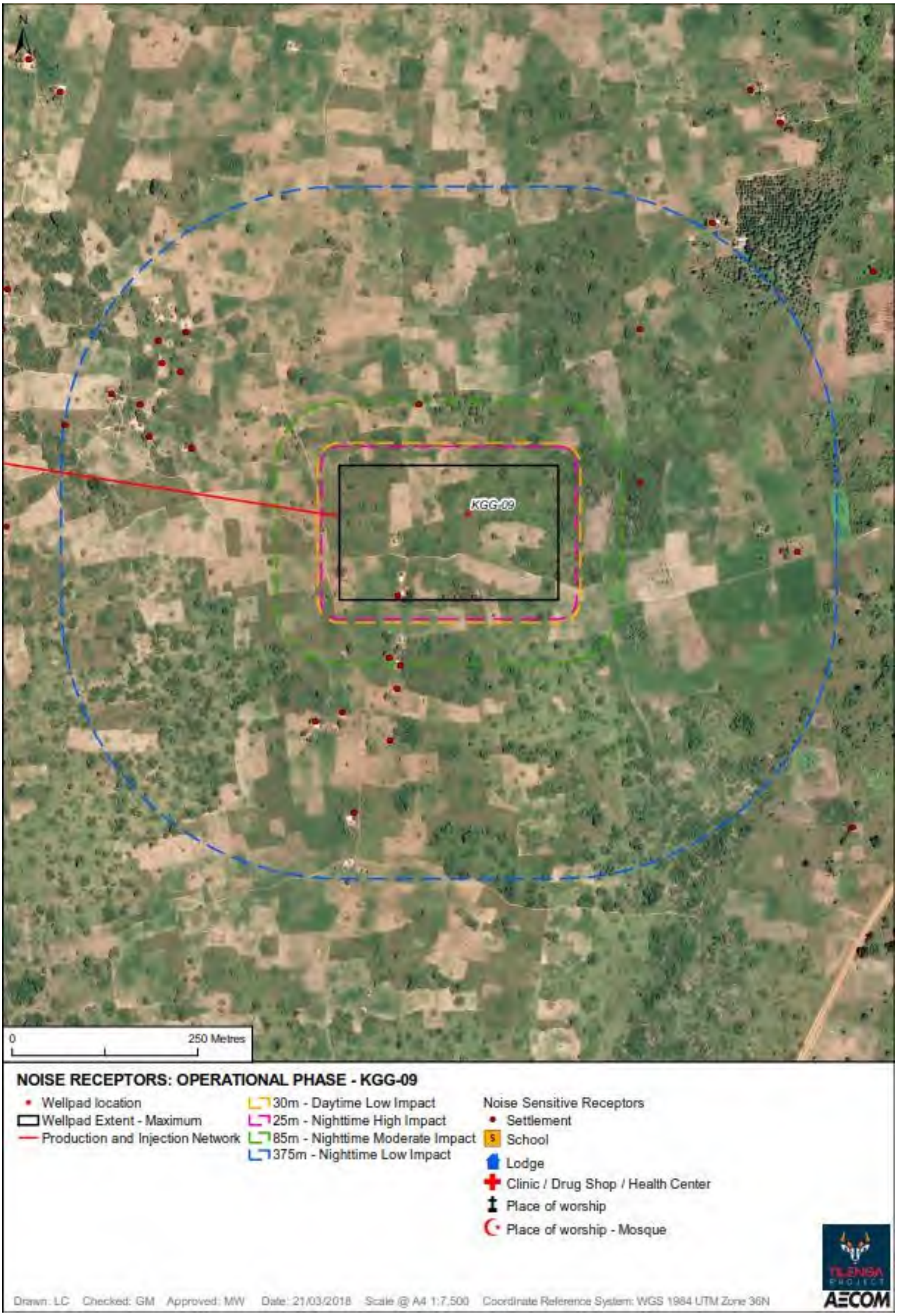


Figure I4-25: KW-01 Commissioning and Operation Receptor Analysis

Figure I4-26: KW-02A Commissioning and Operation Receptor Analysis

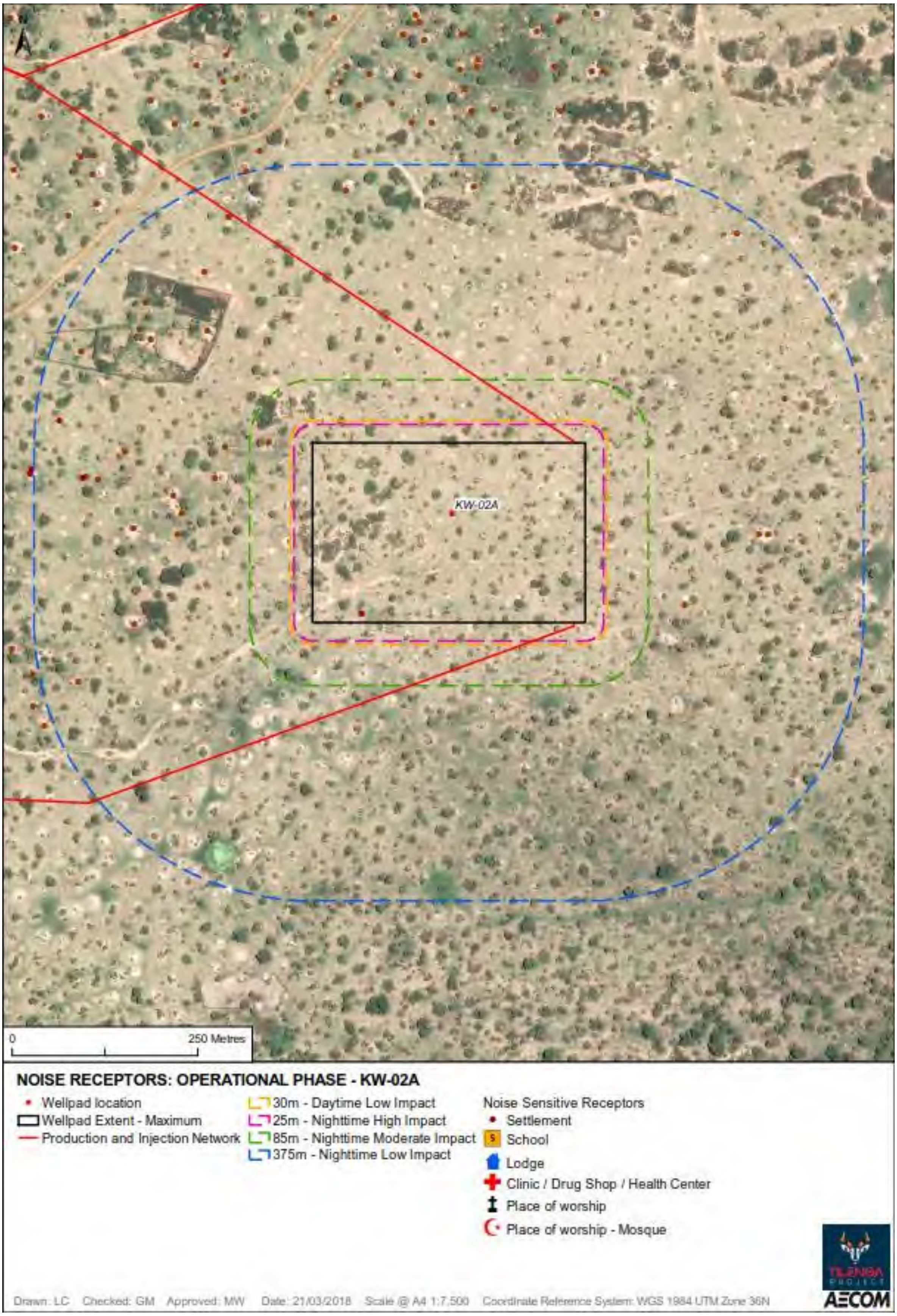


Figure I4-27: KW-02B Commissioning and Operation Receptor Analysis

Figure I4-28: NGR-01 Commissioning and Operation Receptor Analysis

Figure I4-29: NGR-02 Commissioning and Operation Receptor Analysis

Figure I4-30: NGR-03A Commissioning and Operation Receptor Analysis

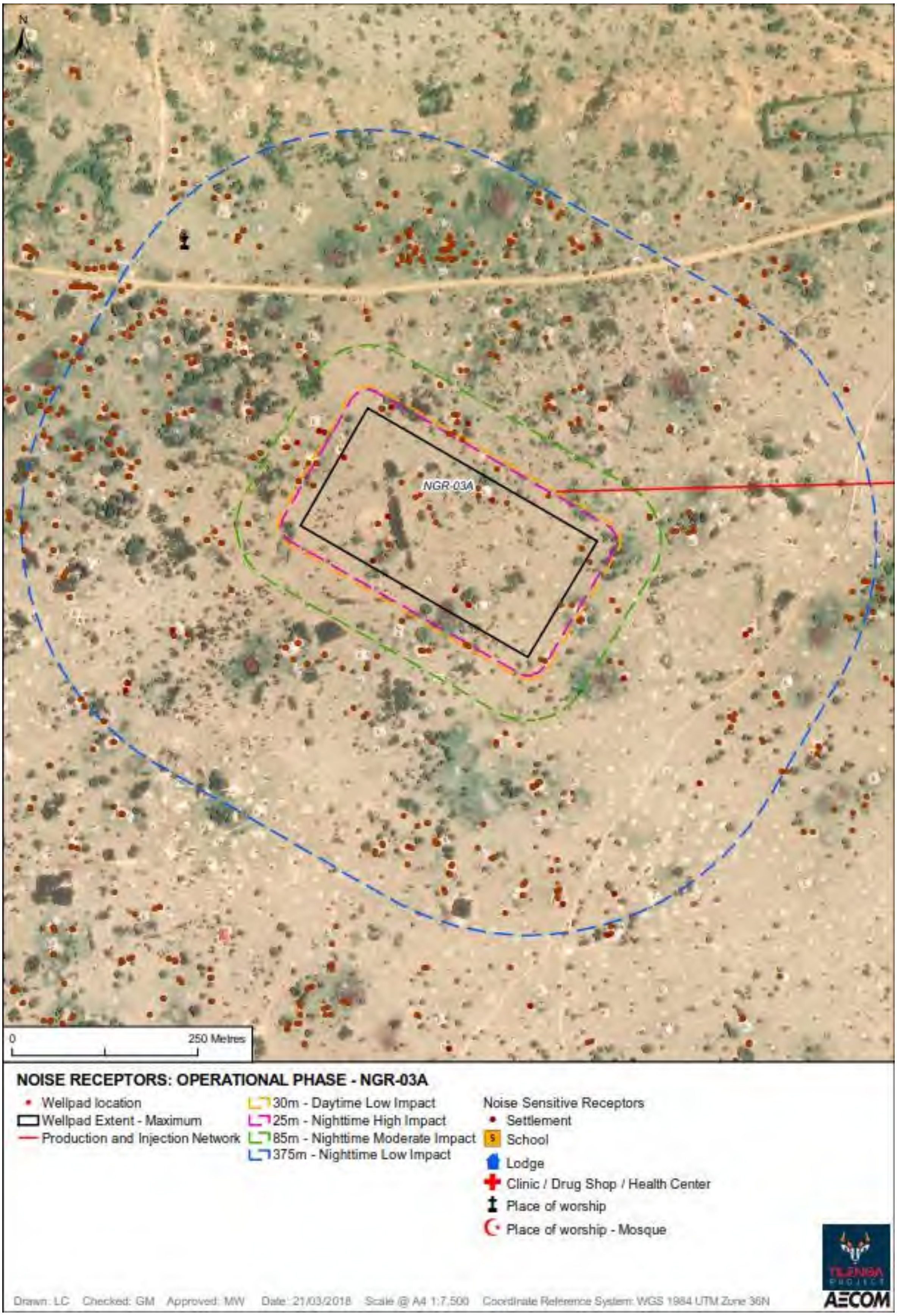


Figure I4-31: NGR-05A Commissioning and Operation Receptor Analysis

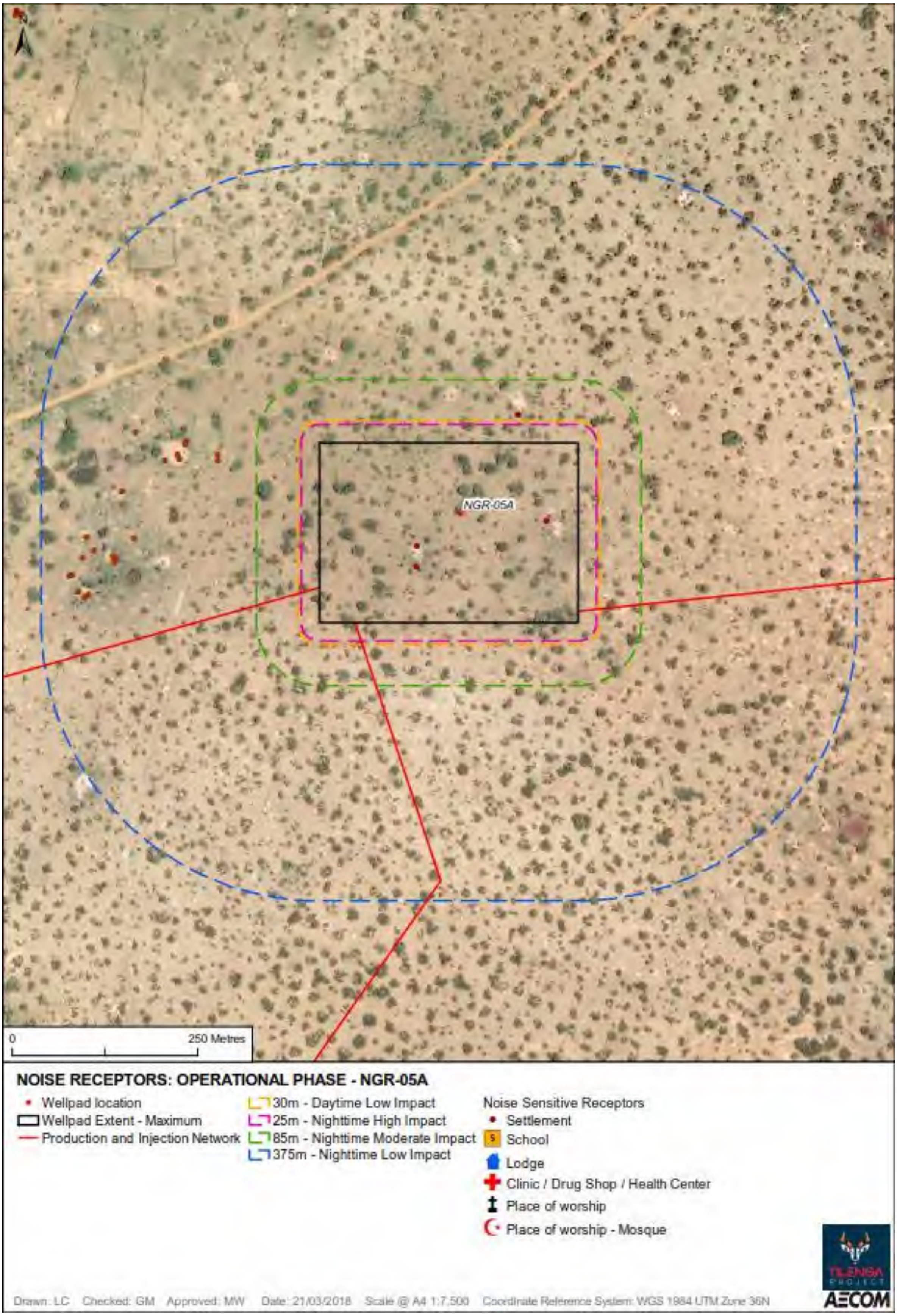


Figure I4-32: NGR-06 Commissioning and Operation Receptor Analysis

Figure I4-33: NSO-01 Commissioning and Operation Receptor Analysis

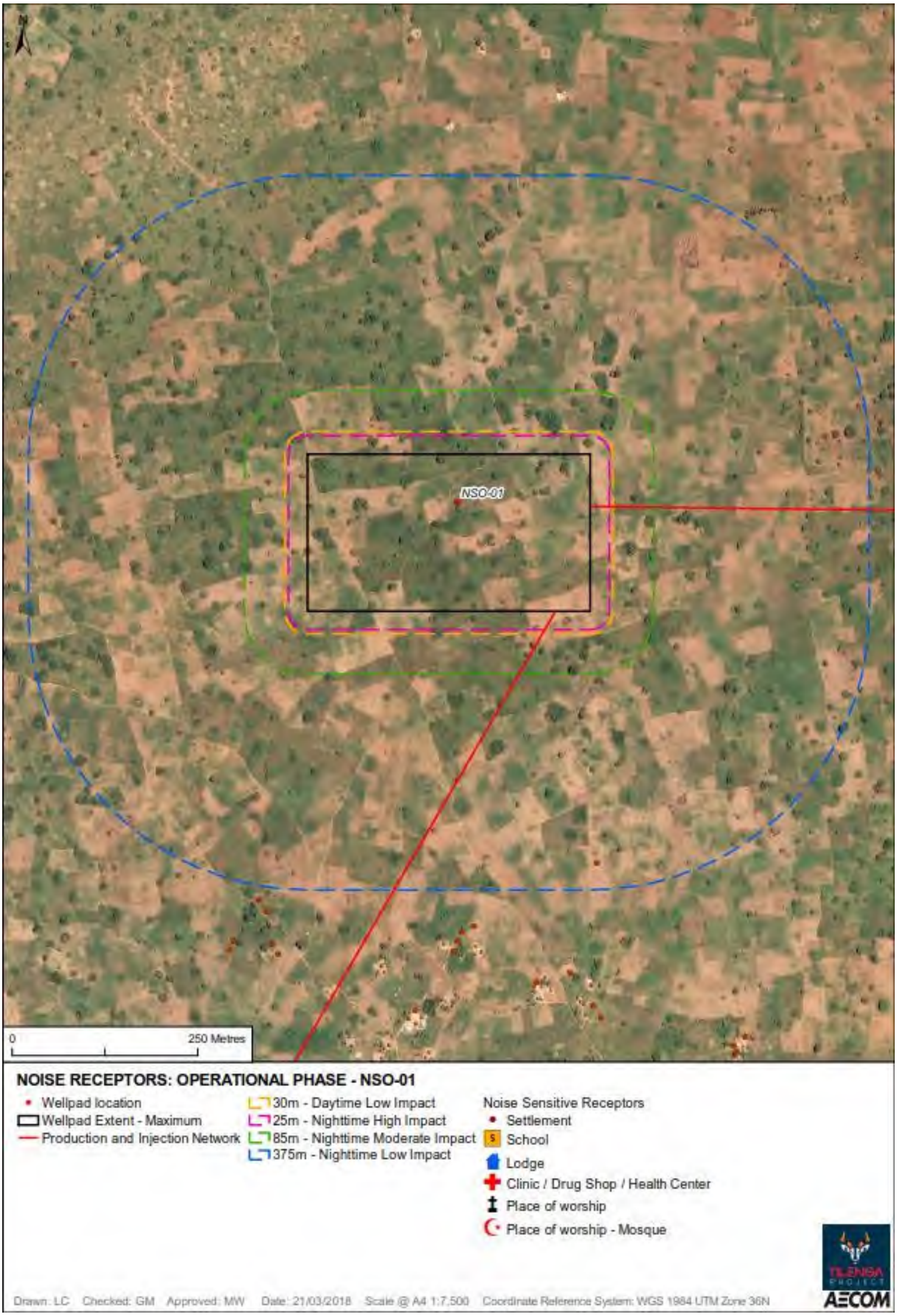


Figure I4-34: NSO-02 Commissioning and Operation Receptor Analysis

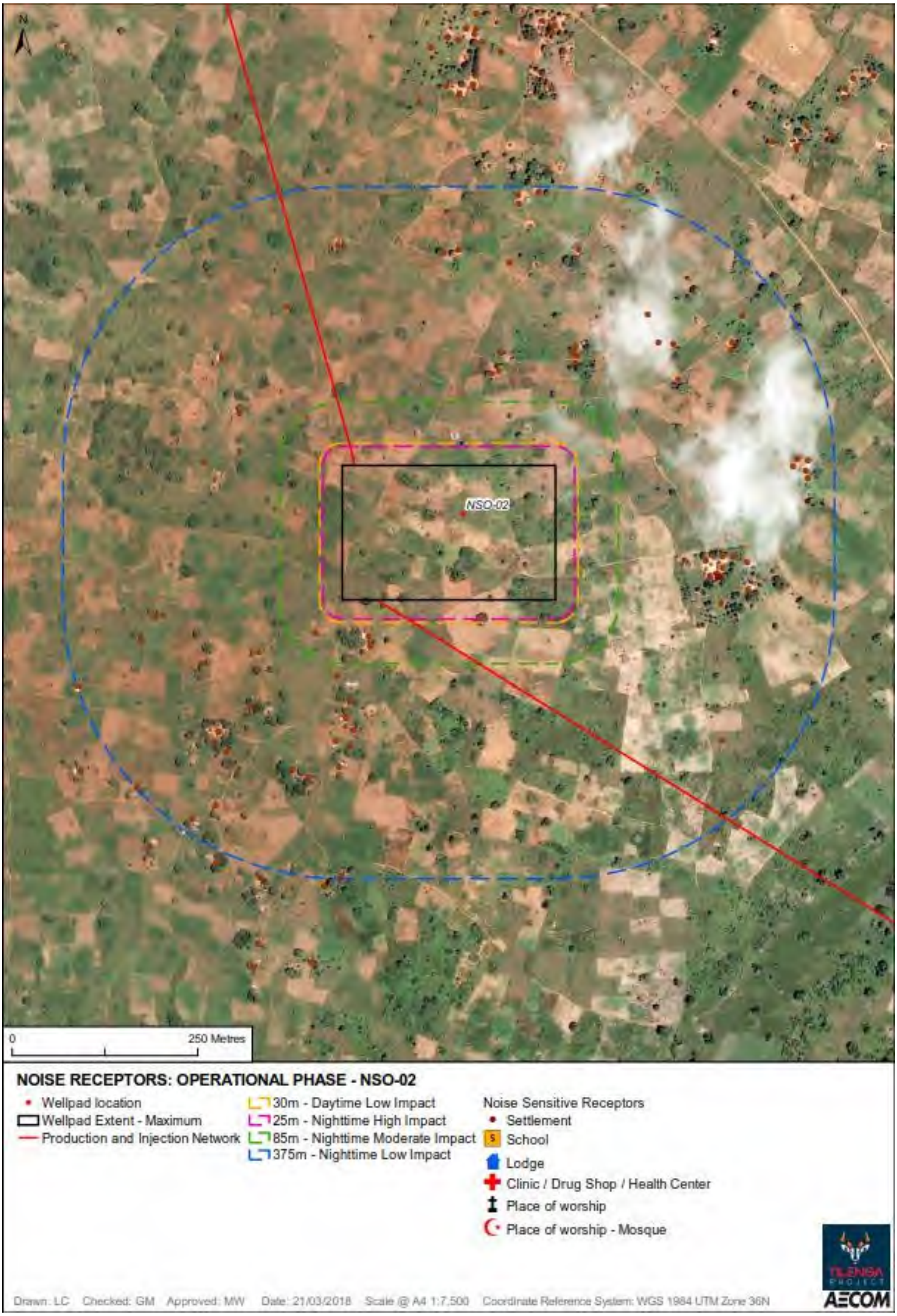


Figure I4-35: NSO-03 Commissioning and Operation Receptor Analysis

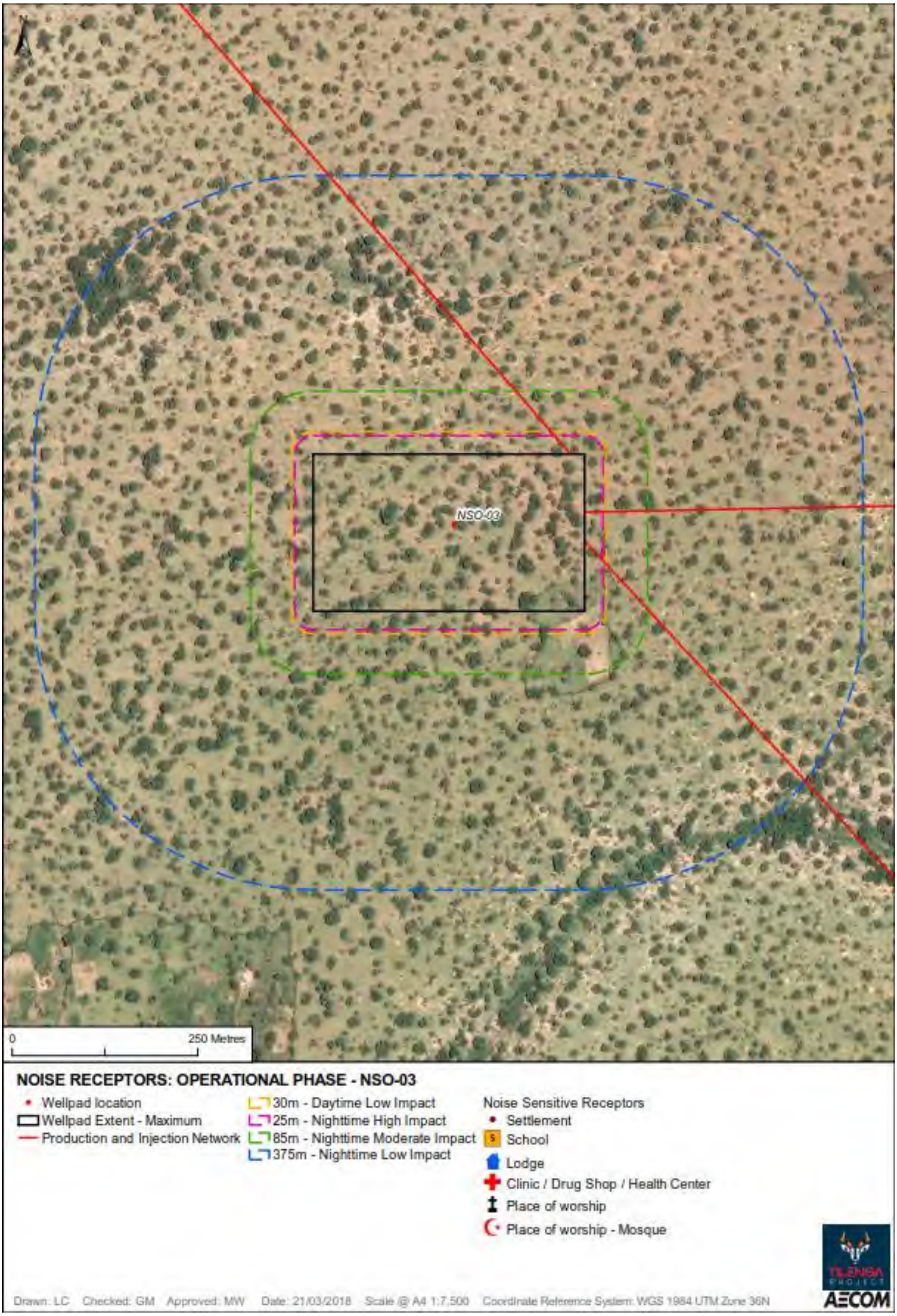


Figure I4-36: NSO-04 Commissioning and Operation Receptor Analysis

Figure I4-37: NSO-05 Commissioning and Operation Receptor Analysis

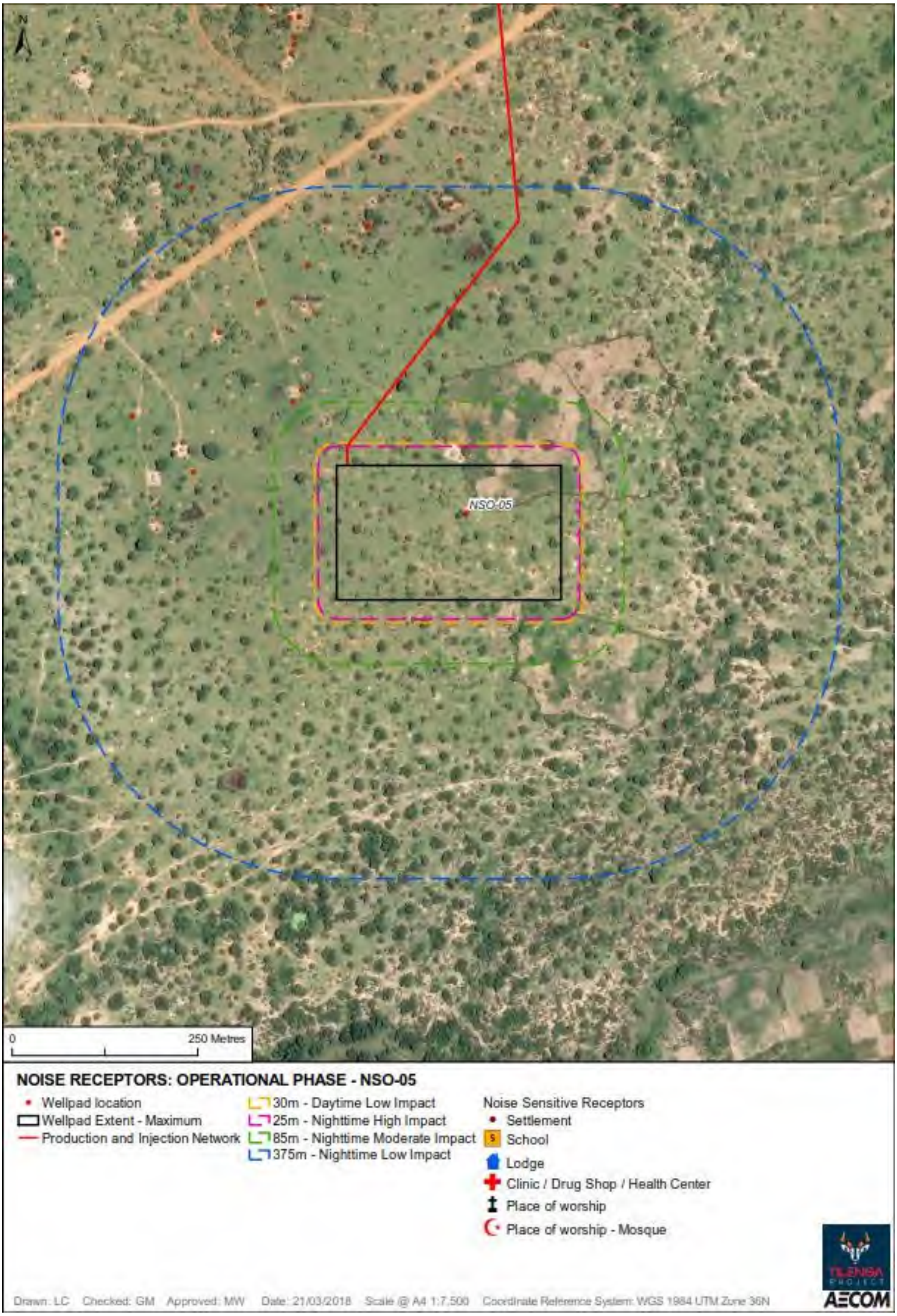
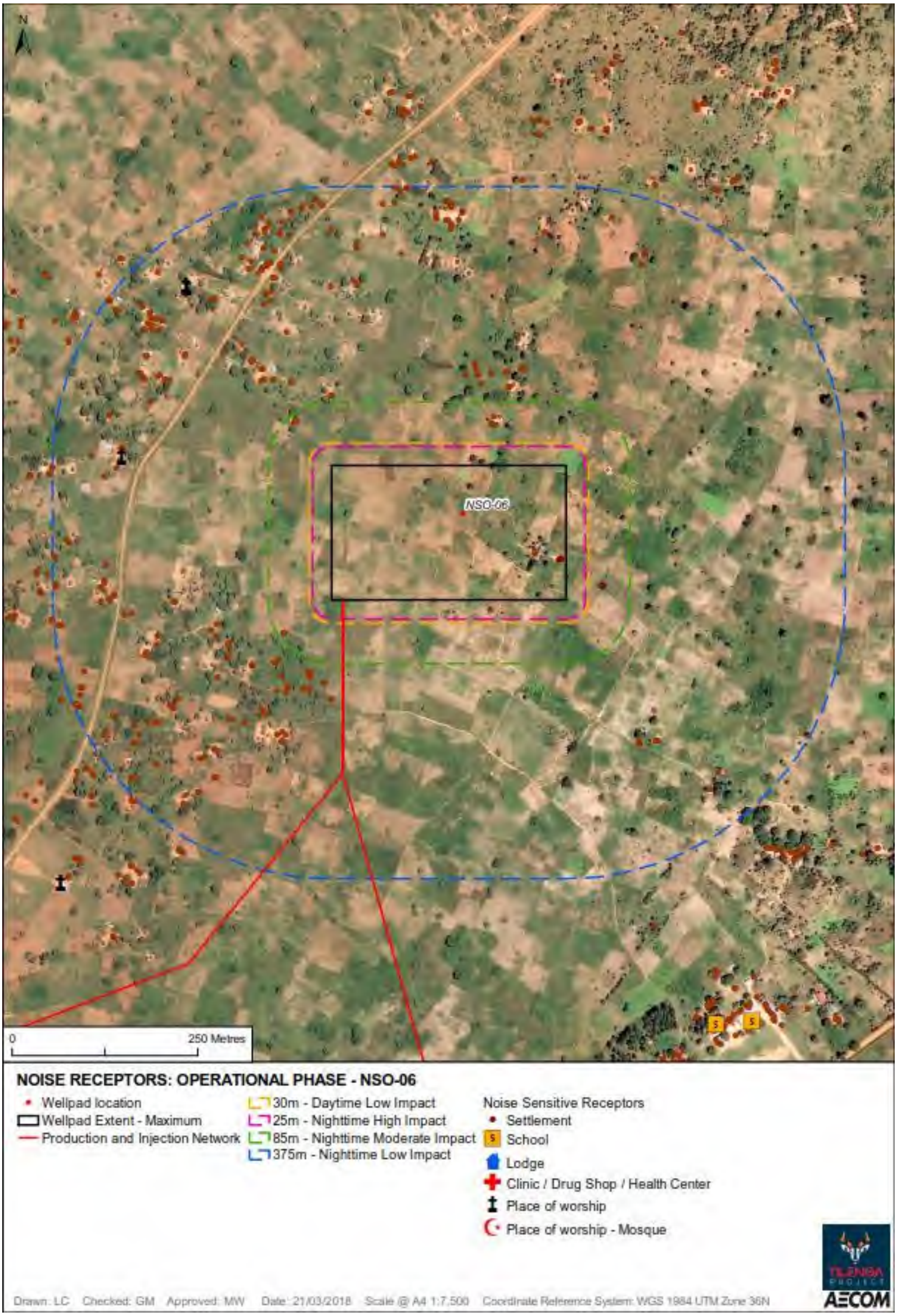


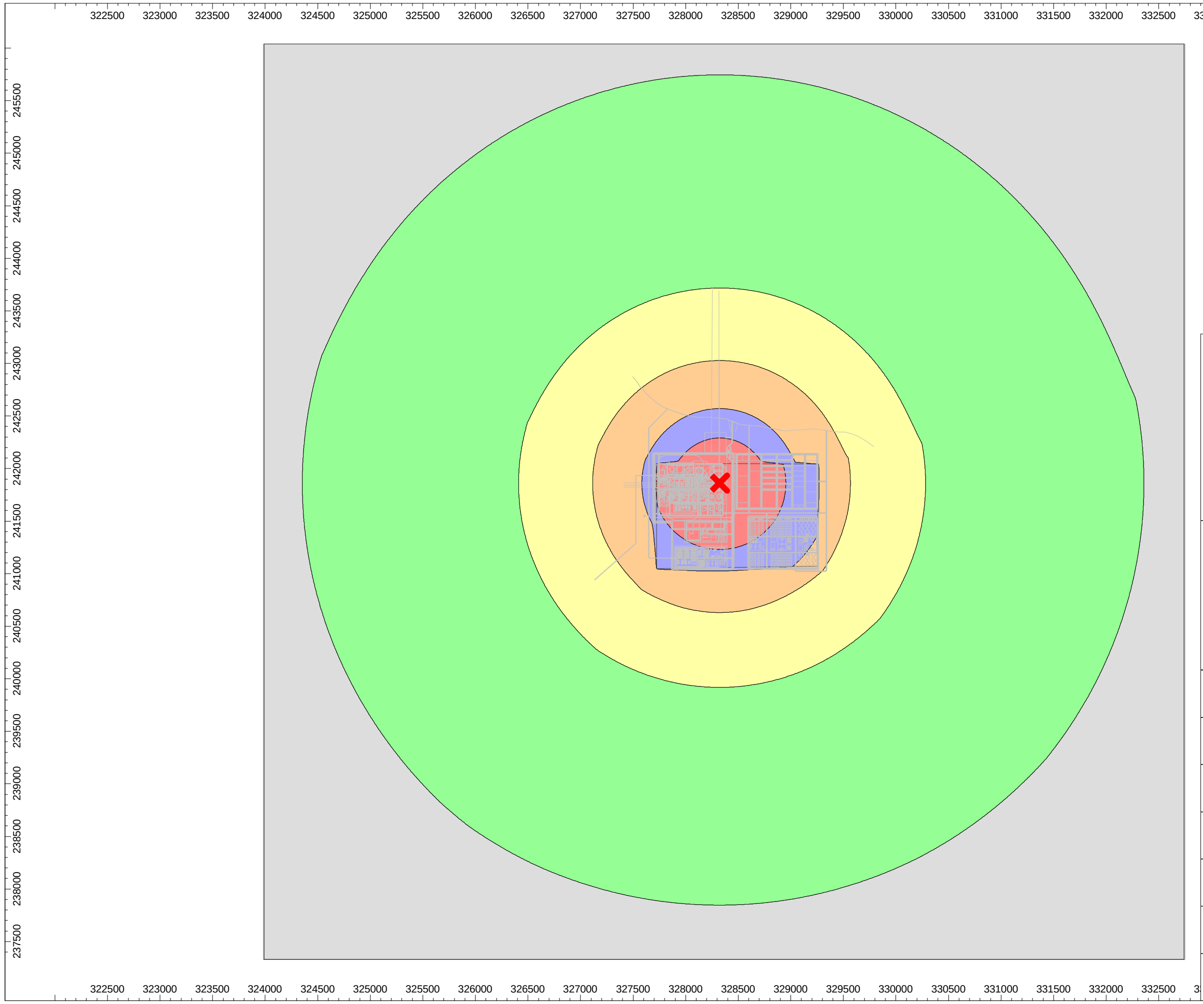
Figure I4-38: NSO-06 Commissioning and Operation Receptor Analysis



Appendix I5: Unplanned Events Results

Appendix I5. Commissioning and Operation Noise Contour Plots

Figure I5.1: Emergency Flaring Noise Contours



Tilenga
CPF ELEVATED FLARE
Noise contours
during Commissioning
and Operation Phase
dB(A) Leq

- ... <= 35.0
- 35.0 < ... <= 45.0
- 45.0 < ... <= 50.0
- 50.0 < ... <= 55.0
- 55.0 < ... <= 60.0
- 60.0 < ...

Noise Band	Daytime Impact	Night-time Impact
<= 35	Negligible	Negligible
35 <= 45		Low
45 <= 50		Moderate
50 <= 55	Low	High
55 <= 60	Moderate	
> 60	High	

The assessment of noise due to the flaring activities is presented in Section 7.8

Figure I5.2: Emergency Flaring Receptor Analysis