Out-of-hours Works Construction Noise and Vibration Impact Statement

Powering Sydney's Future Project

Potts Hill to Alexandria Transmission Cable Project

Report Number 10-1779

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Reference	Status	Date	Prepared	Checked	Authorised
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Table of Contents

GLOSSARY 5

1 PROJECT INFORMATION 12
1.1 Introduction 12

2 OBJECTIVES 13

3 OOHW CONSTRUCTION ACTIVITIES AND TASKS 13

4 SENSITIVE RECEIVERS 14

5 CONSTRUCTION HOURS 14

6 CONSTRUCTION NOISE AND VIBRATION MANAGEMENT LEVELS 15

7 CONSTRUCTION METHODOLOGY - NOISE AND VIBRATION SOURCES 15
7.1 Construction Activities 15
7.2 Noise and Vibration Sources 15
7.2.1 Plant and Equipment at Source Noise Control 15
7.2.2 Correction Factors 15

8 CONSTRUCTION NOISE AND VIBRATION ASSESSMENT 16
8.1 Airborne Noise Assessment 16
8.1.1 Sleep disturbance assessment 17
8.2 Vibration Assessment 18
8.2.1 Minimum Working Distances 18
8.2.2 Human Comfort vibration Assessment 18
8.2.3 Structural Damage Assessment 19

9 MITIGATION MEASURES 19
9.1 Additional Mitigation Measures Matrix 19

10 NOISE AND VIBRATION MONITORING 21
10.1 Plant and Equipment Noise Auditing 21
10.2 Reporting 21
10.3 Inspections 22

11 CONCLUSION 22

TABLES

Table 1 OOHW Scope of Works 14
Table 2 Maximum Plant and Equipment Sound Power Levels 15
Table 3 Number of Receivers Where Noise Levels May Exceed Construction NMLs - $L_{Aeq(15\ minute)}$ 16
Table 4 Number of Receivers Where Noise Levels May Exceed Sleep Disturbance Level 17
Table 6 Number of Residential Buildings Where Vibration Levels May Exceed Human Comfort Vibration Criteria 18

Table 7 AMMM - Airborne Construction Noise 20
Table 8 AMMM - Ground-borne Vibration 21

FIGURES

Figure 1 Project Area Location Plan 12

APPENDICES

Appendix A Predicted Noise Levels $L_{Aeq(15minute)}$ and AMMM Category
Appendix B Predicted $L_{A1(1\ minute)}$ Noise Levels
Appendix C Predicted Human Comfort Vibration Levels - VDV Day
Appendix D Predicted Human Comfort Vibration Levels - VDV Night

Glossary

Term/Acronym	Definition
Acceleration	Acceleration is defined as the rate of change of Velocity of a particle over a period of time and is typically measured in the units of m/sec^2.
Ambient noise	The all-encompassing noise associated within a given environment at a given time, usually composed of sound from all sources near and far.
Amendment Report	The Amendment Report (Powering Sydney's Future: Potts Hill to Alexandria Transmission Cable Project Amendment Report, AECOM dated February 2020) prepared post the EIS being exhibited which describes the design refinements to the Project and identifies any changes to the environmental management and mitigation measures that are proposed to minimise environmental impacts.
AMMM	Additional Mitigation Measures Matrix
Ancillary facility	A temporary facility for construction of the SSI including an office and amenities compound, construction compound, material crushing and screening plant, materials storage compound, maintenance workshop, testing laboratory and material stockpile area.
Annoying Activities	As defined by the Interim Construction Noise Guideline to include: • use of 'beeper' style reversing or movement alarms, particularly at night-time • use of power saws, such as used for cutting timber, rail lines, masonry, road pavement or steel work • grinding metal, concrete or masonry • rock drilling • line drilling • vibratory rolling • rail tamping and regulating • bitumen milling or profiling • jackhammering, rock hammering or rock breaking • impact piling
AS 1055	Standards Australia AS1055–1997™ – Description and Measurement of Environmental Noise
AS2187:2006	Australian Standard AS 2187.2-2006: Explosives - Storage and Use - Use of Explosives
AS2436	Standards Australia AS 2436–2010™ – Guide to Noise and Vibration Control on Construction, Demolition and Maintenance Sites.
AS61672 or AS1259	Standards Australia AS IEC 61672.1–2004™ – Electro Acoustics - Sound Level Meters Specifications Monitoring or Standards Australia AS1259.2-1990™ – Acoustics – Sound Level Meters – Integrating/Averaging as appropriate to the device.
Attenuation	The reduction in the level of sound or vibration.
AVTG	Assessing Vibration – a technical guideline
A-weighting, dBA	The unit of sound level, weighted according to the A-scale, which takes into account the increased sensitivity of the human ear at some frequencies.
BS 6472	British Standard (BS 6472–1992) – Evaluation of Human Exposure to Vibration in Buildings (1 Hz to 80 Hz) dated 1992;

Term/Acronym	Definition
BS 7385	British Standard BS7385: Part 2-1993 - Evaluation and Measurement for Vibration in Buildings Part 2 – Guide to Damage Levels from Ground-borne Vibration, dated 1993.
CCLP	Contractor Community Liaison Plan
CCS	Community Communication Strategy
CEMP	Construction Environmental Management Plan
CMRP	Compliance Monitoring and Reporting Program
CMS	Complaints Management System
CMSS	Construction Managers Site Superintendent
CNVIS	Construction Noise and Vibration Impact Statement
CNVMP	Construction Noise and Vibration Management Plan (CEMP Sub-plan) (this document)
CoA	Conditions of Approval for SSI 8583
Completion of construction	The date upon which construction is completed and all requirements of the Planning Secretary (if any) have been met. If construction is staged, completion of construction is the date upon which construction is completed and all requirements of the Planning Secretary (if any) have been met, in respect of all stages of construction.
Construction	Includes all physical work required to construct the Project, as defined in the CoA
Contractor	Any contractor or subcontractor appointed to the Project
Council	City of Canterbury-Bankstown Inner West Council City of Sydney
COVID-19 Extended Standard Hours	7 am to 6 pm all days
CPIMP	Construction Public Infrastructure Management Plan
CR	Complaints Register
CRT	Community Relations Team
SCRG	Community and Stakeholder Reference Group
DEC	Department of Environment and Conservation (now EPA)
DECC	Department of Environment and Climate Change (now EPA)
DECCW	Department of Environment, Climate Change and Water (now EPA)
Decibel (dB)	A scale for comparing the ratios of two quantities, including sound pressure and sound power. The difference in level between two sounds s1 and s2 is given by 20 log10 (s1 / s2). The decibel can also be used to measure absolute quantities by specifying a reference value that fixes one point on the scale. For sound pressure, the reference value is 20µPa.
DIN4150:3	German Institute for Standardisation – DIN 4150 (1999-02) Part 3 – Structural Vibration - Effects of Vibration on Structures.
DP&I	NSW Department of Primary Industries (now DPIE)
DPIE	NSW Department of Planning, Industry and Environment
ECM	Environmental Control Measure
EES	The DPIE's Environment, Energy and Science Group

Term/Acronym	Definition
EIS	The Environmental Impact Statement titled Powering Sydney's Future: Potts Hill to Alexandria Transmission Cable Project Environmental Impact Statement, prepared by AECOM Australia Pty Limited, dated October 2019, including the Submissions Report and Amendment Report.
EIS CNVIS	The Construction Noise and Vibration Impact Assessment attached as Appendix E to the EIS.
EMR	Independent Environmental Management Representative appointed by TransGrid
EMMM	Environmental Management Mitigation Measures (Chapter 3 of the Amendment Report)
EMS	Environmental Management System
Environment	Includes all aspects of the surroundings of humans, whether affecting any human as an individual or in his or her social groupings
EP&A Act	Environmental Planning and Assessment Act 1979 (NSW)
EP&A Regulation	Environmental Planning and Assessment Regulation 2000 (NSW)
EPA	NSW Environment Protection Authority
EPL	Environment Protection Licence under the POEO Act
ESM	Environment & Sustainability Manager
Fast/Slow Time Weighting	Averaging times used in sound level meters.
Feasible and reasonable	Consideration of best practice taking into account the benefit of proposed measures and their technological and associated operational application in the NSW and Australian context. Engineering considerations and what is practical to build. Reasonable Feasible relates to relates to the application of judgement in arriving at a decision, taking into account mitigation benefits and cost of mitigation versus benefits provided, community views and nature and extent of potential improvements.
Free-Field	Far from the presence of sound reflecting objects (except the ground), usually taken to mean at least 3.5m
Heavy Vehicle	Has the same meaning as in the *Heavy Vehicle National Law*
Heritage item	A place, building, work, relic, archaeological site, tree, movable object or precinct of heritage significance that is listed under one or more of the following registers: the State Heritage Register under the Heritage Act 1977 (NSW), a heritage item registered under a Local Environmental Plan under the EP&A Act, the World, National or Commonwealth Heritage lists under the Environment Protection and Biodiversity Conservation Act 1999 (Commonwealth), and an Aboriginal object or Aboriginal place as defined in section 5 of the National Parks and Wildlife Act 1974 (NSW).
Hertz, Hz	The unit of Frequency (or Pitch) of a sound or vibration. One hertz equals one cycle per second.
HNML	Highly Noise Affected Noise Management Level – 75 dB(A) $L_{Aeq(15\ minute)}$
ICNG	Interim Construction Noise Guideline (OEH, 2009)
Incident	An occurrence or set of circumstances that causes or threatens to cause material harm and which may or may not be or cause a noncompliance.

Term/Acronym	Definition
Infrastructure Approval	SSI project approval for SSI 8583 granted by the Minister for Planning and Public Spaces on 14 May 2020
Land	Has the same meaning as the definition of the term in section 1.4 of the EP&A Act
Landowner	Has the same meaning as "owner" in the *Local Government Act 1993* and in relation to a building means the owner of the building
LGA	Local Government Area. Area of administration of Council.
L90,15minute	A noise level index. The noise level exceeded for 90% of the time over a 15-minute period. L90 can be considered to be the "average minimum" noise level and is often used to describe the background noise.
Leq,15minute	A noise level index called the equivalent continuous noise level over a 15-minutes period T. This is the level of a notional steady sound that would contain the same amount of sound energy as the actual, possibly fluctuating, sound that was recorded.
Lmax,T15minute	A noise level index defined as the maximum noise level during a 15-minute period. Lmax is sometimes used for the assessment of occasional loud noises, which may have little effect on the overall Leq noise level but will still affect the noise environment. Unless described otherwise, it is measured using the 'fast' sound level meter response.
Maximise	Implement all reasonable and feasible mitigation measures to achieve the specified outcome
Minimise	Implement all reasonable and feasible mitigation measures to reduce the impacts of the SSI
Minister	NSW Minister for Planning and Public Spaces, or delegate
Minor	Not very large, important or serious
Monitoring Program	Construction Noise and Vibration Monitoring Program
NCA	Noise Catchment Area
Negligible	Small and unimportant, such as to be not worth considering
NML	Project Specific Noise Management Level as derived from the Interim Construction Noise Guideline (2009)
Noise Level Indices	Noise levels usually fluctuate over time, so it is often necessary to consider an average or statistical noise level. This can be done in several ways, so a number of different noise indices have been defined, according to how the averaging or statistics are carried out.
NPfI	NSW Nosie Policy for Industry (2017)
Non-compliance	An occurrence, set of circumstances or development that is a breach of this approval
NSW Vibration Guideline, the	NSW Department of Environment and Conservation – NSW Environmental Noise Management – Assessing Vibration: a Technical Guideline (the NSW Vibration Guideline), February 2006.
Octave Band	A range of frequencies whose upper limit is twice the frequency of the lower limit.
OEH	Office of Environment and Heritage (now EPA)
OOH	Out of Hours – All periods which are not Standard Construction Hours
OOHW	Out of Hours Works
OOHW Protocol	Out of Hours Work Protocol

Term/Acronym	Definition
POEO Act	Protection of the Environment Operations Act 1997 (NSW)
Planning Secretary	Planning Secretary of the DPIE
PPV	The particles of a medium are displaced from their random motion in the presence of a vibration wave. The greatest instantaneous velocity of a particle during this displacement is called the Peak Particle Velocity (PPV) and is typically measured in the units of mm/s.
Privately-owned land	Land that is not owned by a public agency
Project	Powering Sydney's Future – Potts Hill to Alexandria Transmission Cable Project Construction and operation of a new 330 kilovolt underground transmission cable circuit between the existing Rookwood Road substation in Potts Hill and the Beaconsfield West substation in Alexandria.
Project Area	The area subject to disturbance and/or infrastructure development, as shown on the project layout plans
Proponent	TransGrid
Public infrastructure	Linear and related infrastructure that provides services to the general public, such as roads, railways, water supply, drainage, sewerage, gas and fuel supply, electricity, telecommunications, etc.
RBL	The Rating Background Level for each period is the medium value of the Assessment Background Level values for the period over all of the days measured. There is therefore an RBL value for each period (day, evening and night)
Relevant council	The council of the land on which works are to be carried out
Residence	Existing or approved dwelling
Residential zones	As defined by the relevant Local Environment Plan including Zone R1 General Residential, Zone R2 Low Density Residential, Zone R3 Medium Density Residential, Zone R4 high Density Residential
Respite Period	Any period which highly noise intensive works as defined in CoA E5 are not undertaken
RMS	NSW Roads and Maritime Services
RNP	NSW Road Noise Policy (DECCW 2011)
SCEC	Senior Community Engagement Consultant
Sensitive periods	Period of time determined in consultation with affected sensitive receiver
Sensitive receiver	Includes residences, educational institutions (including preschools, schools, universities, TAFE colleges), health care facilities (including nursing homes, hospitals), religious facilities (including churches), child care centres, passive recreation areas (including outdoor grounds used for teaching), active recreation areas (including parks and sports grounds). Receivers that may be considered to be sensitive include commercial premises (including film and television studios, research facilities, entertainment spaces, temporary accommodation such as caravan parks and camping grounds, restaurants, office premises, and retail spaces) and industrial premises, and others as identified by the Secretary

Term/Acronym	Definition
Sound Power	Sound Power is the rate at which sound energy is emitted, reflected, transmitted or received, per unit time. Unlike sound pressure, sound power is neither room-dependent nor distance-dependent.
Sound Power Level (SWL)	The Sound Power Level is the sound power relative to a standard reference pressure of 1pW ($20x10^{-12}$ Watts) on a decibel scale. The SWL of a simple point source may be used to calculate the SPL at a given distance ® using the following formula: $SPL = SWL – 10 \times Log_{10}(4 \times \pi \times r^2)$ Note that the above formula is only valid for sound propagation in the free-field (see below).
Sound Pressure	Sound, or sound pressure, is a fluctuation in air pressure over the static ambient pressure.
Sound Pressure Level (SPL)	The sound level is the sound pressure relative to a standard reference pressure of 20µPa ($20x10^{-6}$ Pascals) on a decibel scale.
Spoil	All material generated by excavation into the ground
SSI	The State Significant Infrastructure (the Project), as generally described in Schedule 1 of the Infrastructure Approval (SSI 8583)
Standard Construction Hours	7 am to 6 pm Monday to Friday, and 8 am to 1 pm on Saturdays No work Sundays or public holidays
Submissions Report	Powering Sydney's Future: Potts Hill to Alexandria Transmission Cable Project Submissions Report, AECOM dated February 2020. The Submissions Report outlines TransGrid's response to submissions received on the EIS during the public exhibition period, including updates to the environmental management and mitigation measures presented in the EIS.
Sub-plans	Sub Plans to the CEMP requiring the approval the Secretary of the Department of Environment and Planning under Conditions C3 and C7 including traffic and transport, noise and vibration, air quality, vegetation and biodiversity, soil and water, heritage, public infrastructure and waste.
SWMS	Safe Work Method Statement
Taihan	Taihan Electric Australia Pty Ltd, the principal construction contractor responsible for delivering the Project.
TfNSW	Transport for New South Wales
TPIM	Third Party Interface Manager (TPIM), Stakeholder and Community Relations
TransGrid	Proponent of the Project
Underboring	This is a trenchless method for installing cables involving passing the conduits under infrastructure (such as a road or railway corridor) or a watercourse. Underboring could be via thrust boring (also known as micro tunnelling), or horizontal directional drilling.
Vibration Dose, VDV	When assessing intermittent vibration it is necessary to use the vibration dose value (VDV), a cumulative measurement of the vibration level received over an 8-hour or 16-hour period. The VDV formulae uses the RMS Acceleration raised to the fourth power and is known as the Root-mean-quad method. This technique ensures the VDV is more sensitive to the peaks in the acceleration levels. VDVs are typically measured in the units of $m/s^{1.75}$.
VMS	VMS Australia Pty Ltd

Term/Acronym	Definition
WHS Regulation	Work Health and Safety Regulation 2011
Works	All physical activities to construct the Project

1 Project Information

1.1 Introduction

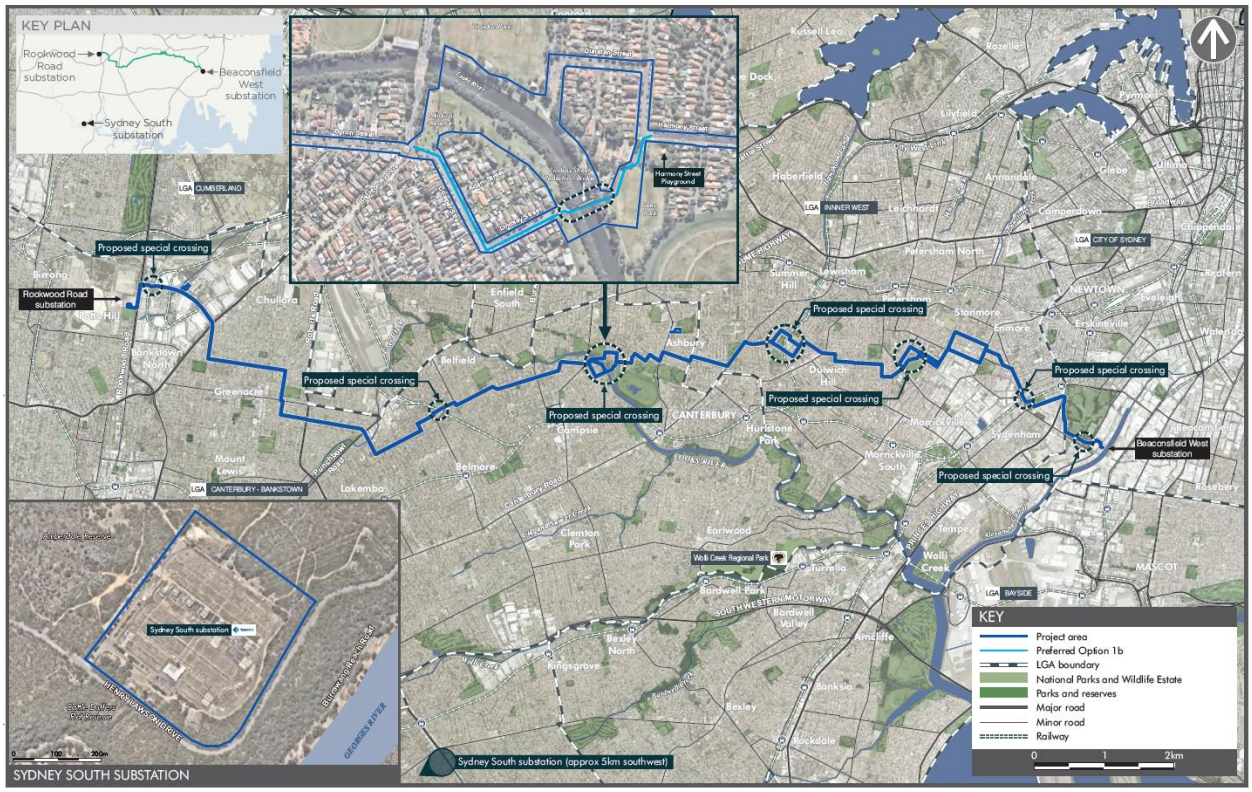
VMS Australia Pty Ltd (VMS) has been engaged by Taihan Electric Australia Pty Ltd (Taihan) to prepare the site specific Construction Noise and Vibration Impact Statement (CNVIS) for the out of hours construction works (OOHWs) of the Potts Hill to Alexandria Transmission Cable Project (the Project) in order to determine the noise and vibration mitigation measures required in accordance with the Construction Noise and Vibration Management Plan (CNVMP) prepared by VMS dated 12 August 2020.

The Powering Sydney's Future - Potts Hill to Alexandria Transmission Cable Project (the Project) involves the construction of 330kV underground cables between TransGrid's Rookwood Road substation in Potts Hill and the Beaconsfield West substation in Alexandria.

The transmission cable circuit would be about 20 kilometres long and would generally be located within existing road reserves, at existing electrical infrastructure sites, within public open space and on previously disturbed areas across three local government areas (LGAs).

An overview of the Project Area is shown in **Figure 1**.

Figure 1 Project Area Location Plan



Source: Amendment Report.

TransGrid is the Proponent of the Project and Taihan is the appointed Contractor. Garde in turn is the Contractor appointed by Taihan for the Civil Works construction. TransGrid is the Principal Contractor for substation works. Roles and responsibilities may be assigned to sub-contractors or TransGrid.

A Construction Noise and Vibration Management Plan (CNVMP) has been prepared to minimise and mitigate potential impacts from noise and vibration generated during the construction of the Project. The noise and vibration mitigation measures in accordance with the CNVMP will be determined based on the impacts predicted from this site-specific Out of Hours Works Construction Noise and Vibration Impact Statement (OOHW CNVIS).

2 Objectives

Section 9.3 of the CNVMP requires that the specific OOHW Construction Noise and Vibration Impact Statement (CNVIS) would be submitted for review before the scheduled start date of the OOHW which may cause adverse noise and vibration impacts. The key objectives of this OOHW CNVIS are to:

- Present an assessment of High Risk OOHW in accordance with the OOHW Protocol for approval by the Planning Secretary.
- Identify noise and vibration sensitive receivers.
- Predict the noise and vibration impacts from the proposed OOHW.
- Based on the predictions, assess the noise and vibration impacts against the objectives set out in the Construction Noise and Vibration Management Plan (CNVMP).
- Where exceedances of the nominated noise and vibration objectives have been predicted, include site specific mitigation measures to reduce noise and vibration impacts.

This OOHW CNVIS has been prepared to identify the sensitive receivers where the CoA E1 Construction NMLs and CoA E2 vibration objectives are likely to be exceeded to determine the required mitigation measures, where noise and vibration monitoring would be undertaken during the Works and provide input to the community and other stakeholders communication in accordance with CoA B1 and CoA B2 Community Communication Strategy (CCS). In addition, this OOHW CNVIS draws guidance from the Construction Noise and Vibration Management Plan (CNVMP, Document Reference: VMS report number 10-1779, dated 12 August 2020).

This OOHW CNVIS is to be read in conjunction with the CNVMP and accompanying OOHW Protocol (Appendix D of CNVIS) and Baseline CNVIS (Appendix B of CNVIS).

This document may be altered during the course of works. Any changes to this document will be submitted to relevant parties for approval prior to implementation.

3 OOHW Construction Activities and Tasks

The OOHW scope of works for this assessment is detailed in **Table 1**.

Table 1 OOHW Scope of Works

Construction Scenario ID	Location	Constriction Activity	Description	Construction Equipment	Rock breaker involved
1	Rookwood Road	Trenching and excavation	Linear progressive works. May occur at multiple locations along the transmission cable route at one time. Steel plates maybe used to temporarily cover trenches.	1 x 13t Excavator, 2 x 10t Trucks, 2 x Concrete agitators, 1 x Small 240V petrol generator, 1 x 1t Roller, 1 x Saw cutter	Yes
2	Muir Road from Rookwood Road to Dasea Street, Including Muir Rd cable bridge				Yes
3	Waterloo Road				No
4	Juno Parade,				No
5	Punchbowl Road				Yes
6	Old Canterbury Road				Yes
7	Sydenham Road, Marrickville From (and including the intersections) Centennial to Brereton and 100m south into Brereton.				No
8	Intersection of Illawarra Road and Addison Road				Yes
9	Enmore Road between Addison Road and Scouller Street				Yes
10	Edgeware Road				Yes
11	Bedwin Road bridge				Yes
12	Camdenville Park				Yes
13	All of May Street				No
14	Princess Highway				No
15	Burrows Road				No

4 Sensitive Receivers

Residences, commercial and community facilities (such as churches and open spaces) are located adjacent to and at varying distances from the Project alignment. The location of noise and vibration sensitive receivers are shown in the Appendix B of the CNVMP.

5 Construction Hours

The Project approved construction hours and the COVID-19 extended construction hours are summarised in Section 6 of the CNVMP.

6 Construction Noise and Vibration Management Levels

The OOHW Noise Management Levels (NMLs) for residential and non-residential properties are nominated and presented in Section 7 of the CNVMP. The Project Site Vibration Management Levels for OOHW are nominated and presented in Section 8 of the CNVMP.

7 Construction Methodology - Noise and Vibration Sources

7.1 Construction Activities

Out of hours trenching and excavation activities will be conducted at various locations and sections along the alignment. The locations of the OOHW are presented in **Appendix A**. Noise and vibration will be generated from OOHW, particularly during excavation and backfilling. The major noise and vibration generated equipment for OOHW are presented in **Table 1**.

7.2 Noise and Vibration Sources

7.2.1 Plant and Equipment at Source Noise Control

Plant and equipment likely to be used during the OOHW are identified in **Table 2** together with the maximum allowable sound levels in accordance with the CNVMP.

Table 2 Maximum Plant and Equipment Sound Power Levels

Plant Item	Maximum Allowable Plant Sound Power Level per Item - dBA	
	$L_{Aeq(15\ minute)}$	$L_{A1(1\ minute)}$
13t Excavator	94	100
10t Truck	103	111
Concrete Agitator	109	115
Small Petrol Generator	103	106
1t Roller	109	115
Saw Cutter	110	113
Rock Breaker	115	123

Note 1: Refer to Appendix C9 of the CNVMP for more details.

7.2.2 Correction Factors

CNVMP require that construction activities which have been proven to be “annoying” have a 5 dB penalty applied to them. In accordance with ICNG and CNVMP, the following activities have been considered as being particularly annoying and as such, a 5 dB correction has been incorporated into the noise modelling process for them.

- use of ‘beeper’ style reversing or movement alarms, particularly at night-time
- use of power saws, such as used for cutting timber, rail lines, masonry, road pavement or steel work
- grinding metal, concrete or masonry
- rock drilling

- line drilling
- vibratory rolling
- rail tamping and regulating
- bitumen milling or profiling
- jackhammering, rock hammering or rock breaking
- impact piling

8 Construction Noise and Vibration Assessment

8.1 Airborne Noise Assessment

Construction noise levels from the OOHW have been predicted at the nearest noise sensitive receivers and assessed against the NMLs identified in **Section 6**.

The predicted numbers of exceedances of the NMLs at noise sensitive receivers due to the OOHW are summarised in **Table 3**. The predicted external noise levels and noise exceedance for the noise affected receiver are shown in **Appendix A**.

The numbers of receivers presented in **Table 3** are split into the following additional management and mitigation measures (AMMM) categories (refer to **Section 9.1**):

- Less than 5 dB above NML - Barely noticeable exceedance of the NML
- 5-15 dB above NML - Noticeably audible exceedance of the NML
- 15-25 dB above NML - Clearly audible exceedance of the NML
- > 25 dB above NML - Intrusive exceedance of the NML
- >75 dBA - Highly Noise Affected Receivers

Table 3 Number of Receivers Where Noise Levels May Exceed Construction NMLs - $L_{Aeq(15\ minute)}$

Construction Scenario ID	Number of Receivers Where Construction NMLs Are Exceeded - AMMM Category (Noise level range)				Highly Noise Affected >75dBA (CoA E5)
	0 to 5 dB (45 to 50 dBA)	5 to 15 dB (50 to 60 dBA)	15 to 25 dB (60 to 70 dBA)	> 25 dB (>70 dBA)	
1	20	38	13	3	Nil
2	19	20	7	3	Nil
3	42	61	44	23	15
4	62	52	39	21	12
5	23	69	45	28	19
6	72	73	39	44	5
7	41	111	92	95	57
8	45	113	59	32	21
9	77	98	42	47	36

Construction Scenario ID	Number of Receivers Where Construction NMLs Are Exceeded - AMMM Category (Noise level range)				Highly Noise Affected >75dBA (CoA E5)
	0 to 5 dB (45 to 50 dBA)	5 to 15 dB (50 to 60 dBA)	15 to 25 dB (60 to 70 dBA)	> 25 dB (>70 dBA)	
10	41	68	35	59	37
11	16	42	31	5	2
12	35	37	35	5	1
13	60	62	21	39	18
14	24	29	20	9	6
15	2	5	8	3	Nil

8.1.1 Sleep disturbance assessment

The predicted numbers of exceedances of the sleep disturbance level ($L_{A1(1\ minute)}$) at noise affected receivers due to the OOHW are summarised **Table 4**. The full set of predicted L_{A1} noise levels and sleep disturbance screening level and NML exceedances for all the noise affected residential receivers are presented in **Appendix B**.

Table 4 Number of Receivers Where Noise Levels May Exceed Sleep Disturbance Level

Construction Scenario ID	Number of Residential Receivers Where Construction Sleep Disturbance Levels May be Exceeded	
	L_{A1} Screening (BG plus 15 dB)	L_{A1} NML (65 dBA)
1	24	3
2	Nil	Nil
3	164	65
4	183	65
5	180	83
6	283	85
7	417	146
8	361	95
9	350	78
10	207	86
11	104	29
12	124	20
13	103	29
14	42	12
15	Nil	Nil

8.2 Vibration Assessment

8.2.1 Minimum Working Distances

Vibration-intensive construction works may include the use of jack hammers, rock breakers and other vibration intensive plant. The minimum working distances of these vibration intensive plants should always be complied with at all time in order to prevent the building damage. The distances are noted as being indicative and are likely to vary depending on the particular item of plant and local geotechnical conditions. The minimum working distances apply to addressing the risk of cosmetic (minor – easily reparable) damage of typical buildings under typical geotechnical conditions.

Where vibration intensive works are required to be undertaken within the specified minimum working distances, vibration monitoring should be undertaken to ensure acceptable levels of vibration are satisfied.

In relation to human comfort, the minimum working distances relate to continuous vibration. For most construction activities, vibration emissions would be intermittent in nature and for this reason, higher vibration levels, occurring over shorter periods may be allowed.

The minimum working distances for the vibration intensive equipment are nominated in CoA E2 (refer to CNVMP Section 8.1). The distances indicate the minimum separation distances where no adverse impacts from vibration intensive works are likely in terms of cosmetic damage to buildings/structures or human comfort.

Reference is to be made the baseline CNVIS presented in Appendix B of the CNVMP to identify which structures (including heritage) require monitoring (refer to **Section 10**) to ensure that the construction related vibration levels remain below the level at which damage can occur.

8.2.2 Human Comfort vibration Assessment

The predicted numbers of exceedances of the preferred and maximum human comfort vibration criteria for vibration sensitive receivers are presented in **Table 5** from the vibration generated by the OOHW. The predicted human comfort vibration levels and exceedance at the vibration sensitive receivers are presented in **Appendix C** and **Appendix D** for daytime and night-time, respectively.

Table 5 Number of Residential Buildings Where Vibration Levels May Exceed Human Comfort Vibration Criteria

Construction Scenario ID	Number of Residential Buildings Where Vibration Levels May Exceed Human Comfort Vibration Criteria			
	Daytime		Night-time	
	Preferred (Barely Noticeable)	Maximum (Noticeable)	Preferred (Barely Noticeable)	Maximum (Noticeable)
1	Nil	Nil	Nil	Nil
2	Nil	Nil	Nil	Nil
3	6	17	8	20
4	13	10	10	18
5	9	18	6	24
6	9	43	7	48
7	14	77	12	89

Construction Scenario ID	Number of Residential Buildings Where Vibration Levels May Exceed Human Comfort Vibration Criteria			
	Daytime		Night-time	
	Preferred (Barely Noticeable)	Maximum (Noticeable)	Preferred (Barely Noticeable)	Maximum (Noticeable)
8	7	19	9	24
9	5	41	8	46
10	7	47	9	51
11	1	Nil	Nil	1
12	1	1	2	2
13	3	16	4	17
14	1	5	0	6
15	Nil	Nil	Nil	Nil

8.2.3 Structural Damage Assessment

The predicted maximum vibration levels for vibration sensitive structures is presented in Baseline CNVIS presented in CNVMP Appendix B.

9 Mitigation Measures

Standard Noise and Vibration Environmental Control Measures (ECMs, refer to CNVMP Table 12) will be implemented for all OOHW activities. OOHW activity specific ECMs will be identified and adopted (refer to CNVMP Section 10.3). Additional Noise Mitigation and Management Measures (AMMM) will be applied to manage residual impacts (refer to CNVMP Section 10.3.1) as presented below.

9.1 Additional Mitigation Measures Matrix

Based on the noise and vibration assessment presented in **Section 8**, additional noise mitigation and management measures will be applied during OOHWs. The CNVMP identifies the level of noise impact which triggers consideration of each additional mitigation measure (reproduced in **Table 6** and **Table 7**).

The potential additional mitigation measures are summarised below, with discussion of their potential applicability to the Project Works. The OOHW CNVIS presents the modelling of impacts of the residual noise, after noise reduction measures are determined, the following additional noise mitigation measures, below, will be considered. During the planning of the works the Community Relations Team (CRT) will liaise with the Project team for the implementation of the selected measures. The objective of these additional noise mitigation measures is to engage, inform and provide Project-specific messages to the community, recognising that advanced warning of potential disruptions can assist in reducing the impact.

- **Periodic Notifications** - Periodic notifications include regular newsletters, letterbox drops or advertisements in local papers to provide an overview of current and upcoming works and other topics of interest.
- **Website** - The Project website would form a resource for members of the community to seek further information, including noise and vibration management plans and current and upcoming construction activities.

- **Project Info-line and Construction Response Line** – The CRT will operate a 1800 community information line. The number provides a dedicated 24-hour contact point for any complaints regarding construction works and for any Project enquiries. All complaints and enquiries will be responded to in accordance with the Contractor Community Liaison Plan (CCLP).
- **Email Distribution List** - An email distribution list would be used to disseminate Project information to interested stakeholders.
- **Signage** - Signage on construction sites would be provided to notify stakeholders of Project details and Project emergency or enquiry information.
- **Specific Notifications (SN)** - Specific notifications would be letterbox dropped or hand distributed to the nearby residences and other sensitive receivers no later than seven days ahead of construction activities that are likely to exceed the noise objectives. This form of communication is used to support periodic notifications, or to advertise unscheduled works.
- **Phone Calls (PC)** - Phone calls may be made to identified/affected stakeholders within seven days of proposed work. For these works considering the large numbers of receivers, phone calls are not likely to be considered a reasonable mitigation measure in all cases, but could be used to inform specific receivers if requested (after notification of the works as above).
- **Individual Briefings (IB)** - Individual briefings may be used to inform stakeholders about the impacts of high noise activities and mitigation measures that will be implemented. The Stakeholder and Community Relations Manager would visit identified stakeholders at least 48 hours ahead of potentially disturbing construction activities. For these works considering the large numbers of potentially affected receivers, individual briefings may not be considered a reasonable mitigation measure in all cases, but could be used for specific receivers if requested (after notification of the works as above).

  If it is not convenient for stakeholder to be available for an individual briefing a phone call (PC) will be offered to provide the briefing.
- **Monitoring (M)** - Regular noise monitoring during construction at sensitive receivers during critical periods would be used to identify and assist in managing high risk noise events. Monitoring of noise would also be undertaken in response to complaints. All noise monitoring would be carried out in accordance with the required standards and procedures.
- **Project Specific Respite Offer (RO)** - Residents subjected to lengthy periods of noise or vibration may be eligible for a Project specific respite offer. The purpose of such an offer is to provide residents with respite from an ongoing impact. An example of a respite offer might be pre-purchased movie tickets. The provision of this measure would be determined on a case-by-case basis.

Table 6 AMMM - Airborne Construction Noise

Time Period		Mitigation Measures Predicted $L_{Aeq(15minute)}$ Noise Level Above Construction NMLs (Predicted Noise Level)			
		0 to 5 dB (45 to 50 dBA)	5 to 15 dB (50 to 60 dBA)	15 to 25 dB (60 to 70 dBA)	> 25 dB (>70 dBA)
OOHW	Mon-Fri (6.00 pm - 10.00 pm)	SN	SN	M, SN	M, IB or PC, RO, SN
	Sat (1.00 pm - 10.00 pm)				
	Sun/Pub Hol (8.00 am - 6.00 pm)				
		0 to 5 dB (45 to 50 dBA)	5 to 15 dB (50 to 60 dBA)	15 to 25 dB (60 to 70 dBA)	> 25 dB (>70 dBA)
OOHW	Mon-Fri (10.00 pm - 7.00 am)	SN	M, SN	M, IB, PC, SN	M, IB, PC, RO, SN
	Sat (10.00 pm – 8.00 am)				
	Sun/Pub Hol (6.00 pm – 7.00 am)				

Table 7 AMMM - Ground-borne Vibration

Time Period		Mitigation Measures Vibration Intensive Operated closer than Maximum VDV Management Level
OOHW	Mon-Fri (6.00 pm - 10.00 pm)	M, IB or PC, RO, SN
	Sat (1.00 pm - 10.00 pm)	
	Sun/Pub Hol (8.00 am - 6.00 pm)	
OOHW	Mon-Fri (10.00 pm - 7.00 am)	M, IB or PC, SN
	Sat (10.00 pm - 8.00 am)	
	Sun/Pub Hol (6.00 pm - 7.00 am)	

10 Noise and Vibration Monitoring

Management and control of noise and vibration impacts shall be monitored and assessed as described below. Noise and vibration monitoring is to be undertaken by suitably qualified persons in accordance with Section 11.6 and Section 11.7 the CNVMP.

Operator-attended measurements are to be undertaken for each stage of construction in order to confirm that the noise and vibration levels in the adjacent community are consistent with the predictions in the OOHW CNVIS. Operator-attended noise measurements would be repeated at a minimum interval of every 2 weeks in order to ensure ongoing compliance.

Operator-attended noise measurements shall be undertaken consistent with the procedures documented in *AS 1055.1-1997 Acoustics - Description and Measurement of Environmental Noise - General Procedures*.

Operator-attended vibration measurements shall be undertaken in accordance with the procedures documented in the OEH's *Assessing Vibration - a technical guideline (2006), AS 2107.2 2006 Explosives – Storage and Use and DIN 4150:Part 3-1999 Structural Vibration - Effects of Vibration on Structures*.

10.1 Plant and Equipment Noise Auditing

Internal compliance auditing of plant and equipment noise emissions would be undertaken via operator-attended measurements of a representative selection of plant and equipment used on-site are to be undertaken. The representative items of equipment are to be regularly monitored to confirm that the operating noise levels of all noise intensive plant items comply with the maximum sound power levels in **Table 2**.

10.2 Reporting

As per the requirements of the CNVMP, noise and vibration monitoring reports are to be submitted to the Project Director (PD), Project Manager (PM), Environment & Sustainability Manager (ESM), Civil Project Managers (CPMs) and Site Managers (SMs) with noise and/or vibration monitoring results and details of affected sensitive receivers within one week of being undertaken or at weekly intervals for continuous monitoring. In the case of noise exceedances, details of the plant or operations causing the exceedances along with corrective action and the status of its implementation are to be supplied.

10.3 Inspections

A log will be used on site to keep an accurate record of OOHWs activities on a daily basis. This shall be used to correlate on-site activities with measured noise and vibration levels and/or complaints. An acoustic consultant may periodically review the proposed monitoring program with the aim to reduce or increase the monitoring depending on monitoring results and community feedback received.

The ESM is to conduct regular site inspections, observing any instances of excessively noisy machinery or key activities that are associated with the demolition works. Noise or vibration records are to be reviewed for potential issues arising from works. Results from the inspection are then to be recorded on an environmental checklist.

11 Conclusion

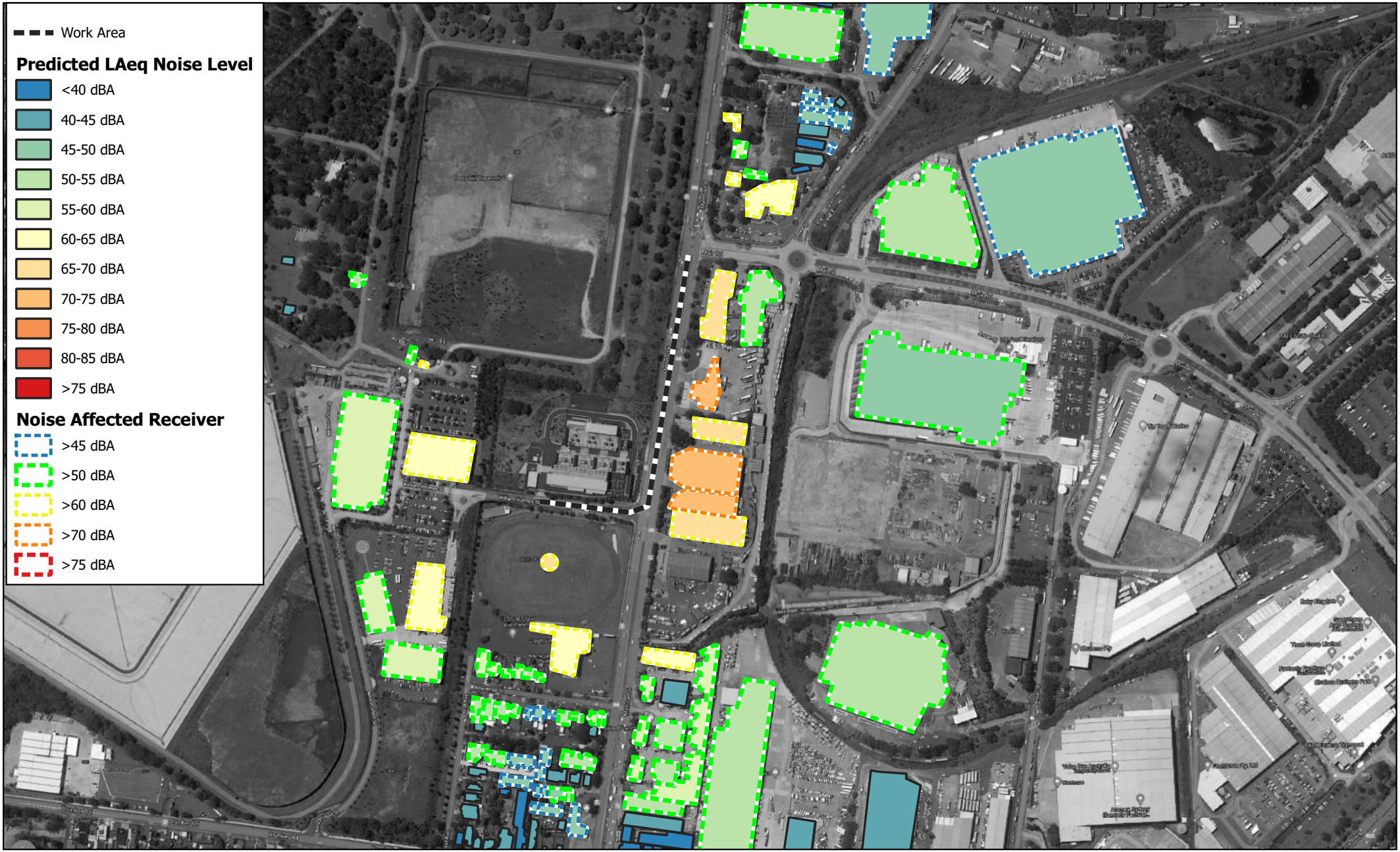
Construction noise and vibration impact assessment for the high risk out of hours construction works associated with the Project have been undertaken. Due the close proximity of adjacent receivers to the construction works, numerous surrounding sensitive receivers are expected to be noise and vibration affected by the OOHW.

Additional noise mitigation measures in accordance with AMMM categories are to be implemented as appropriate for each respective noise sensitive as indicated in the noise and vibration level and exceedance maps presented in **Appendices A** to **D**.

Negotiations would be undertaken with these receivers in order to ensure that appropriate periods of respite are offered during sensitive periods.

Appendix A

Predicted Noise Levels LAeq(15minute) and AMMM Category



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Out of Hours Works - Predicted LAeq Noise Levels
Rookwood Road - Map 1 of 15

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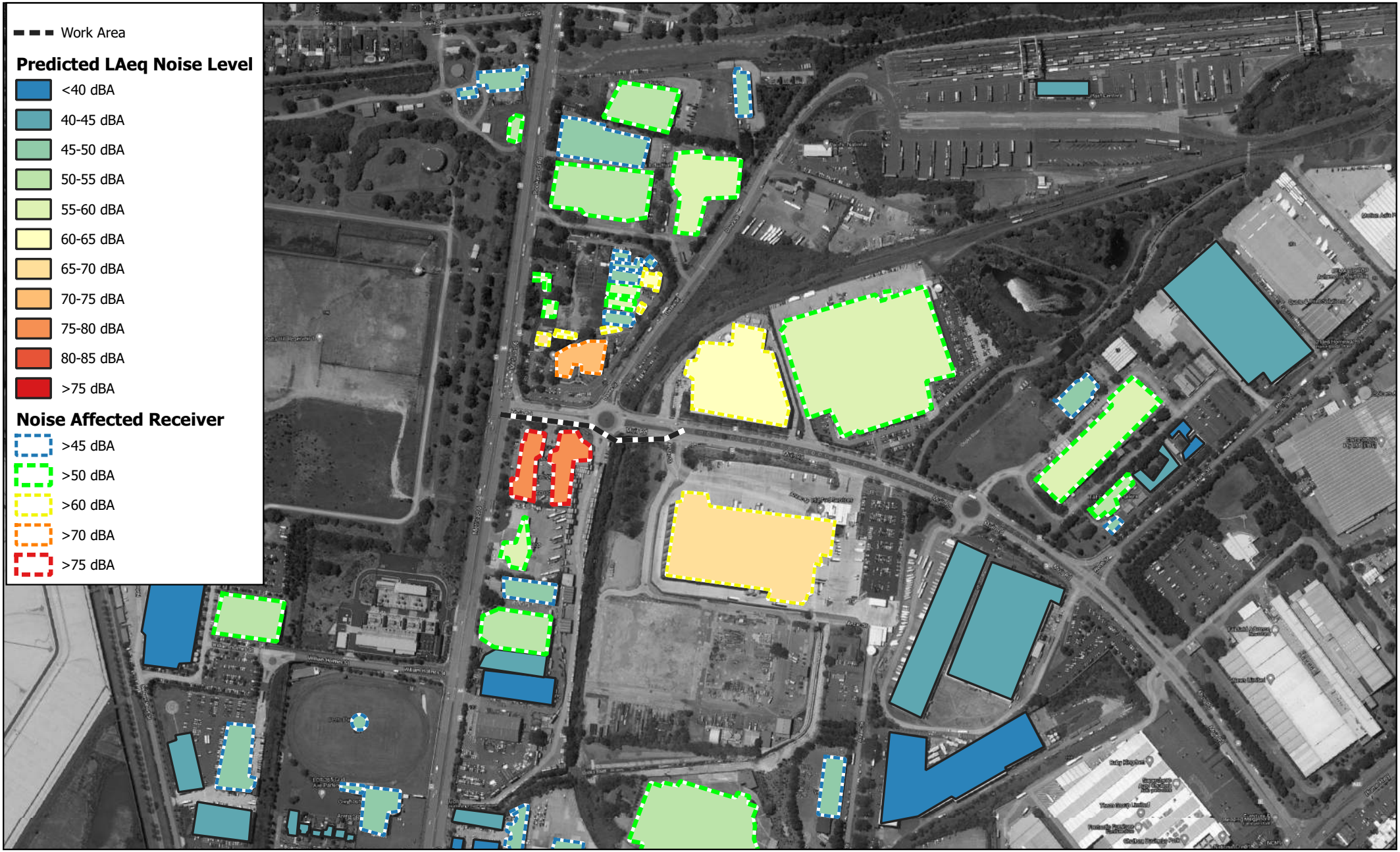

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Muir Road - Map 2 of 15

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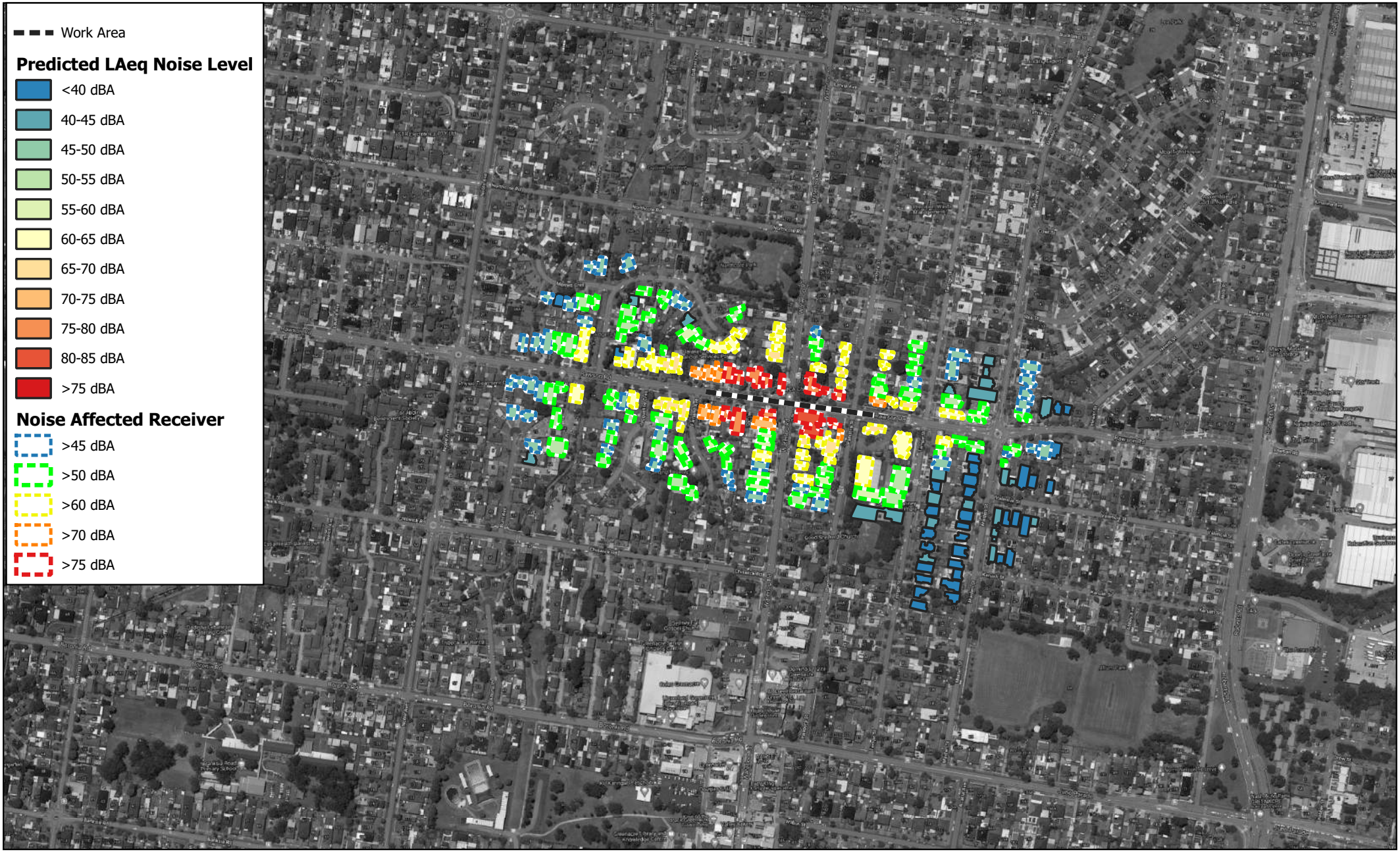

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Out of Hours Works - Predicted LAeq Noise Levels
Waterloo Road - Map 3 of 15

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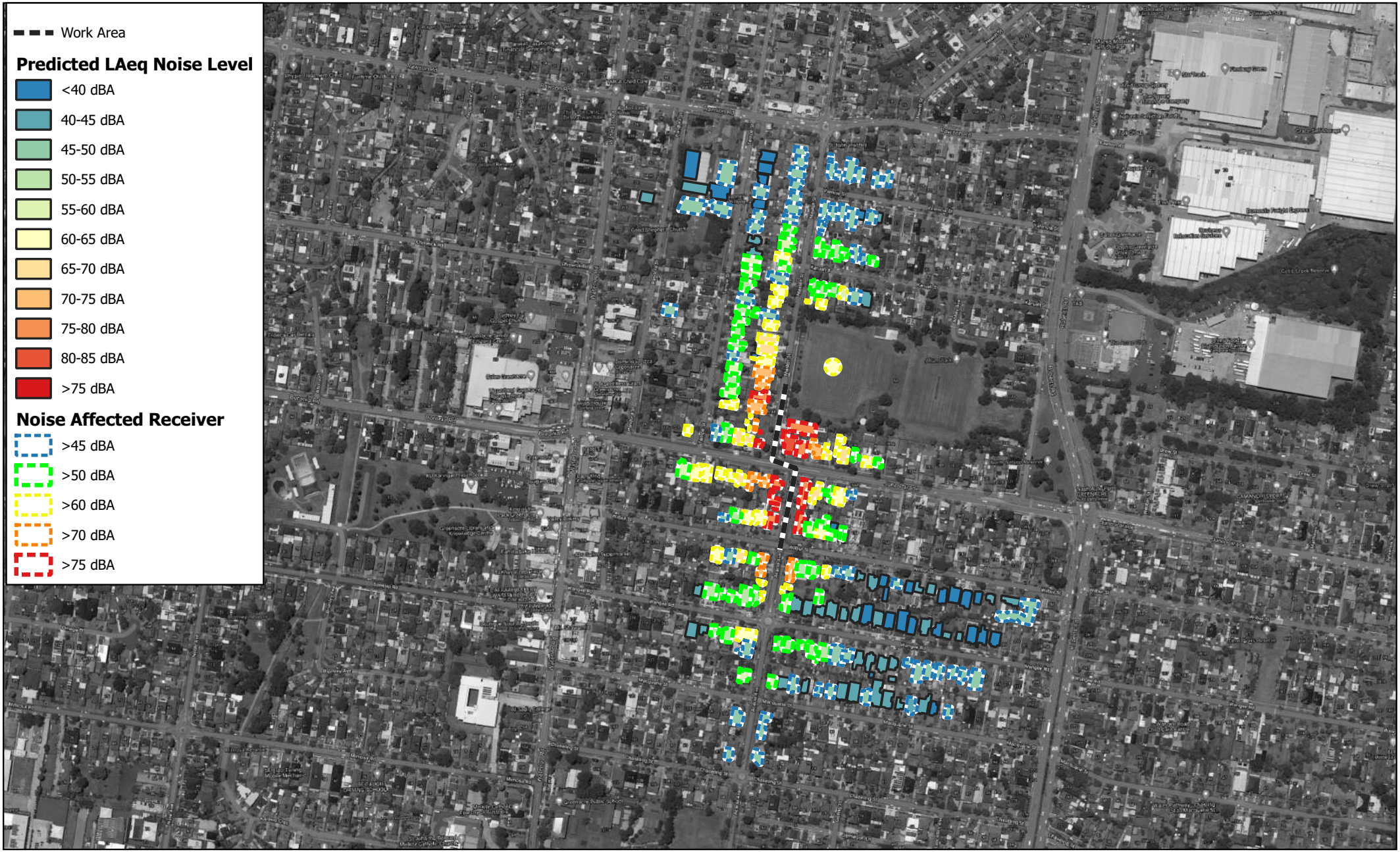

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Juno Parade - Map 4 of 15

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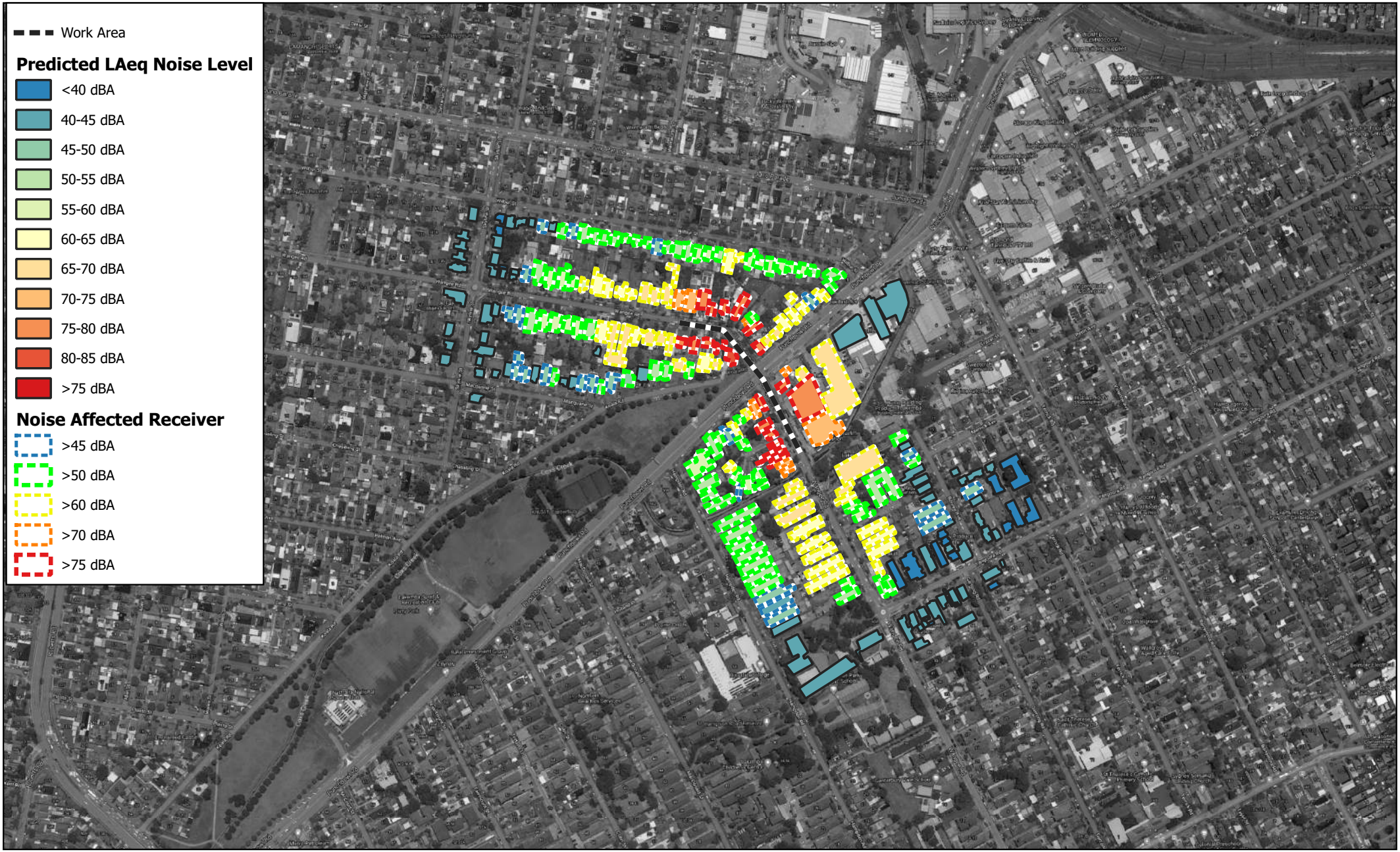

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Out of Hours Works - Predicted LAeq Noise Levels
Punchbowl Road - Map 5 of 15

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Out of Hours Works - Predicted LAeq Noise Levels
Old Canterbury Road - Map 6 of 15

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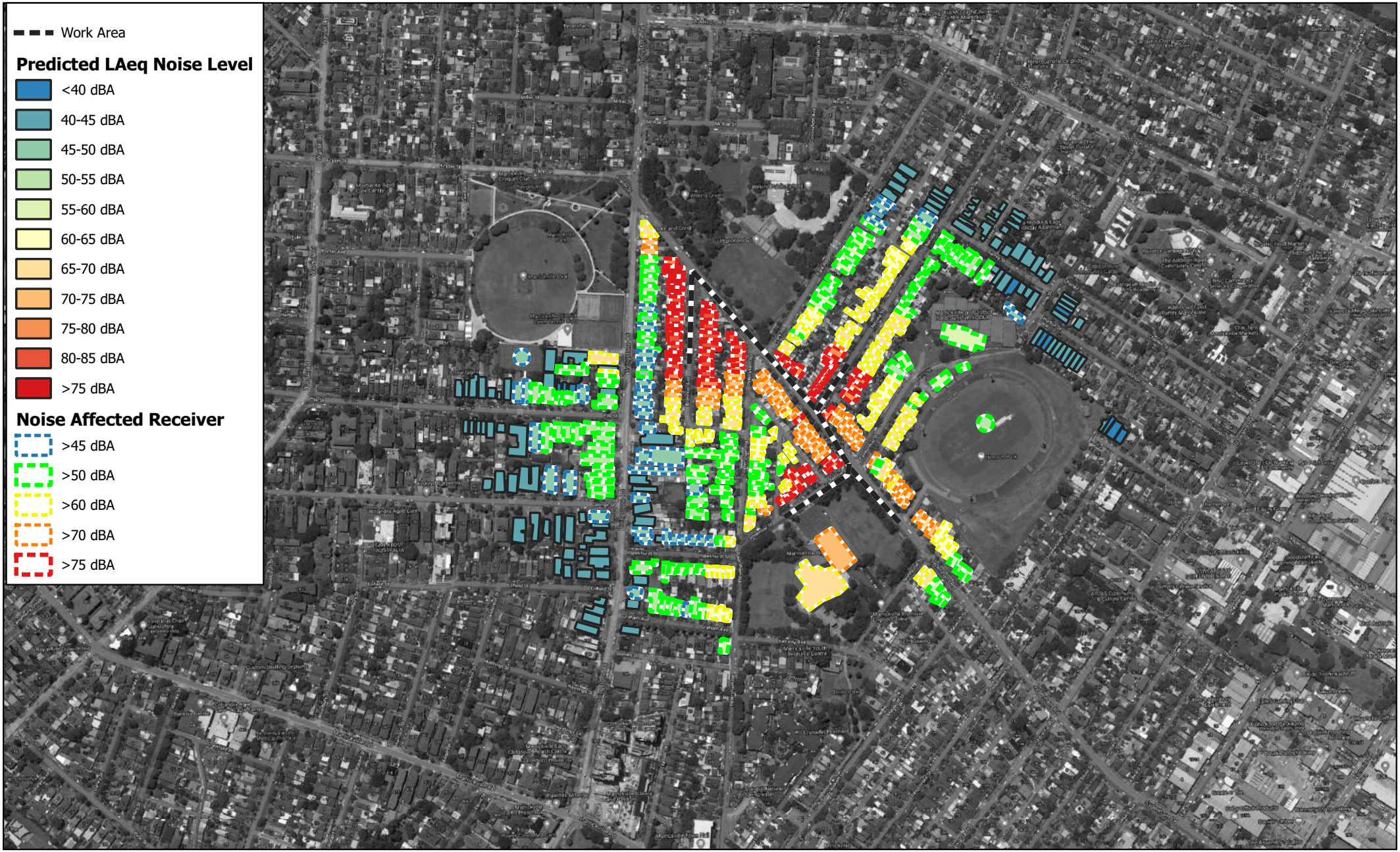

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Out of Hours Works - Predicted LAeq Noise Levels
Sydenham Road - Map 7 of 15

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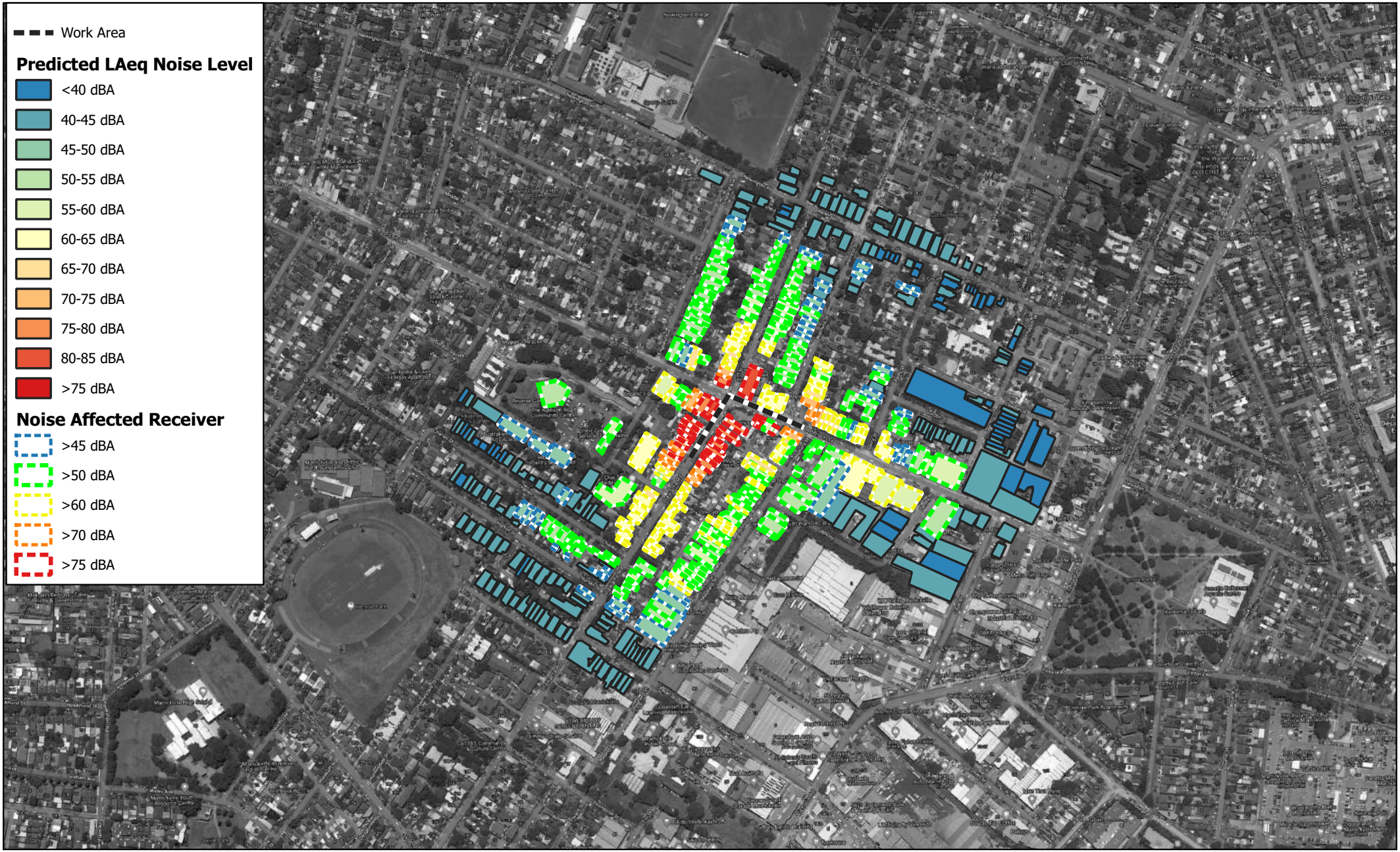

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Out of Hours Works - Predicted LAeq Noise Levels

Intersection of Illawarra Road and Addison Road - Map 8 of 15

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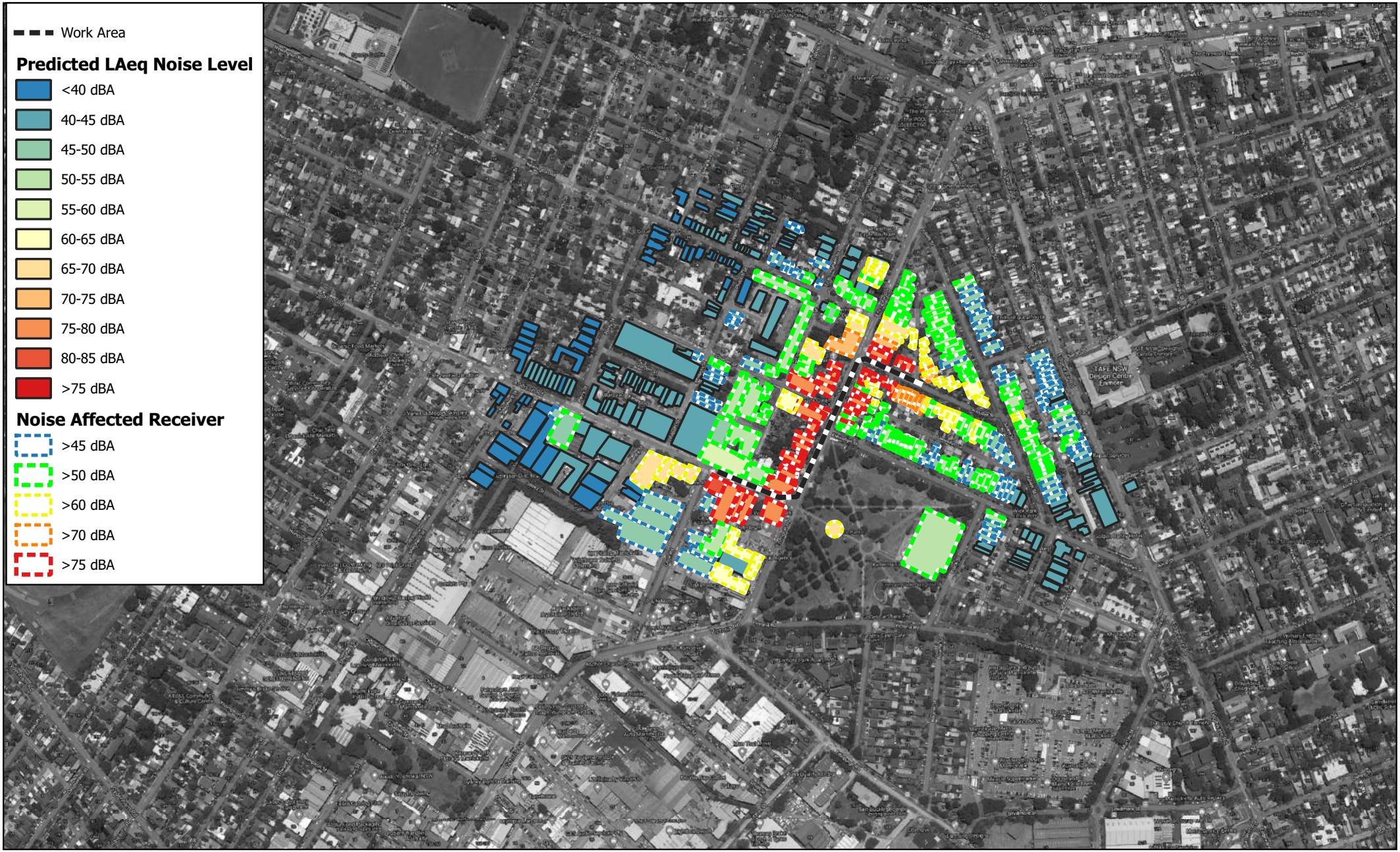

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Out of Hours Works - Predicted LAeq Noise Levels
Enmore Road - Map 9 of 15

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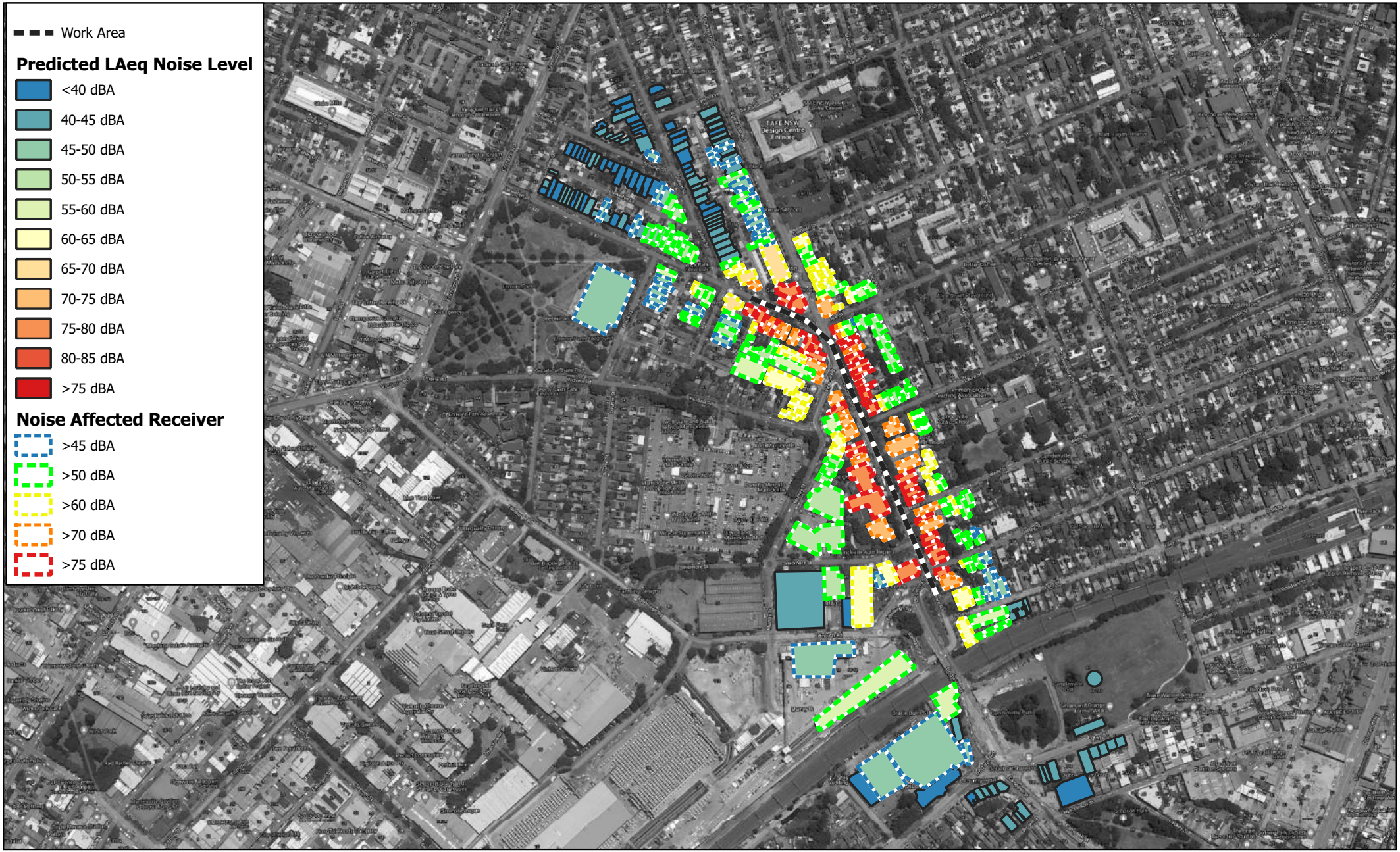

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Out of Hours Works - Predicted LAeq Noise Levels
Edgeware Road - Map 10 of 15

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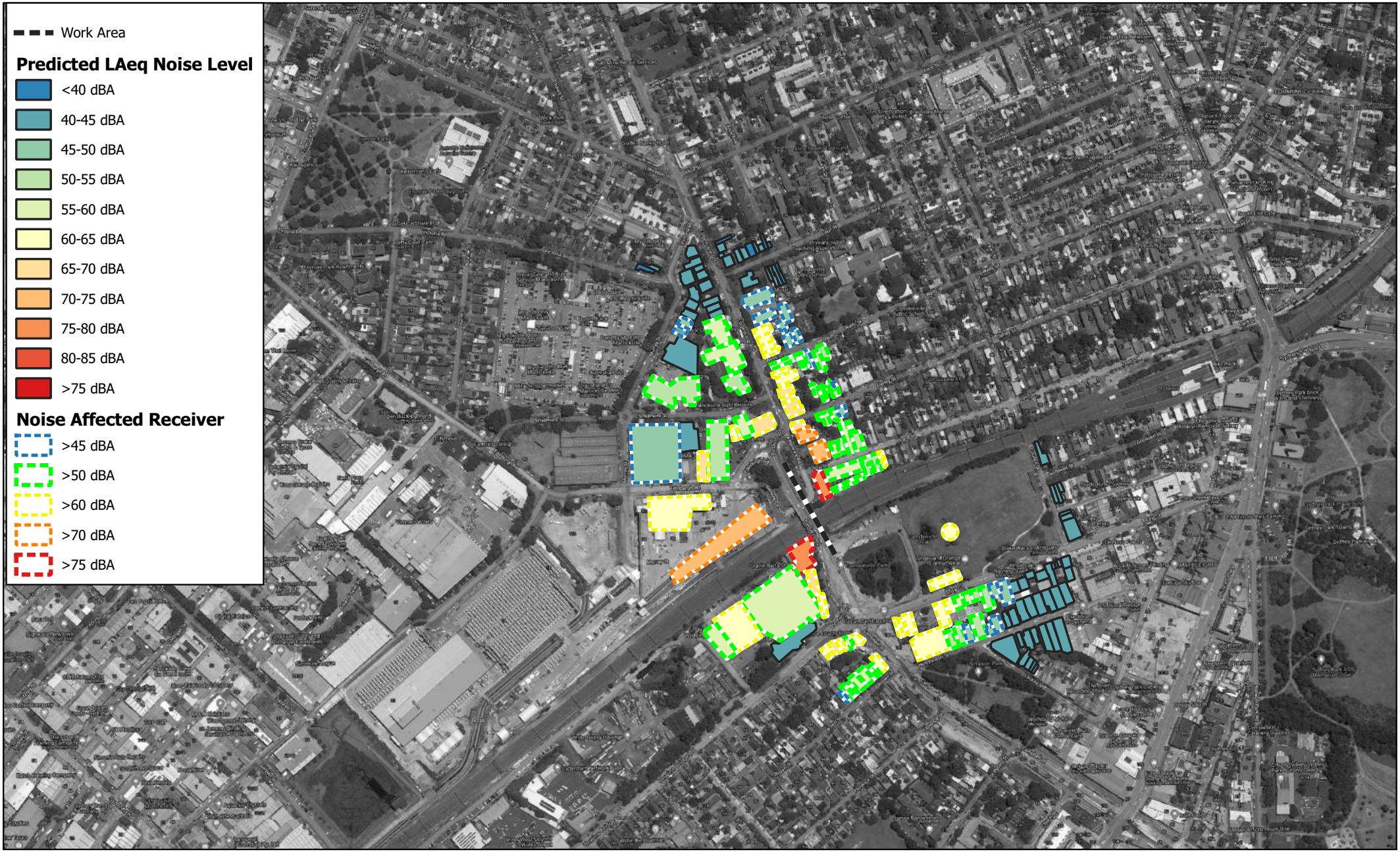

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Out of Hours Works - Predicted LAeq Noise Levels
Bedwin Road Bridge - Map 11 of 15

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Out of Hours Works - Predicted LAeq Noise Levels
Camdenville Park - Map 12 of 15

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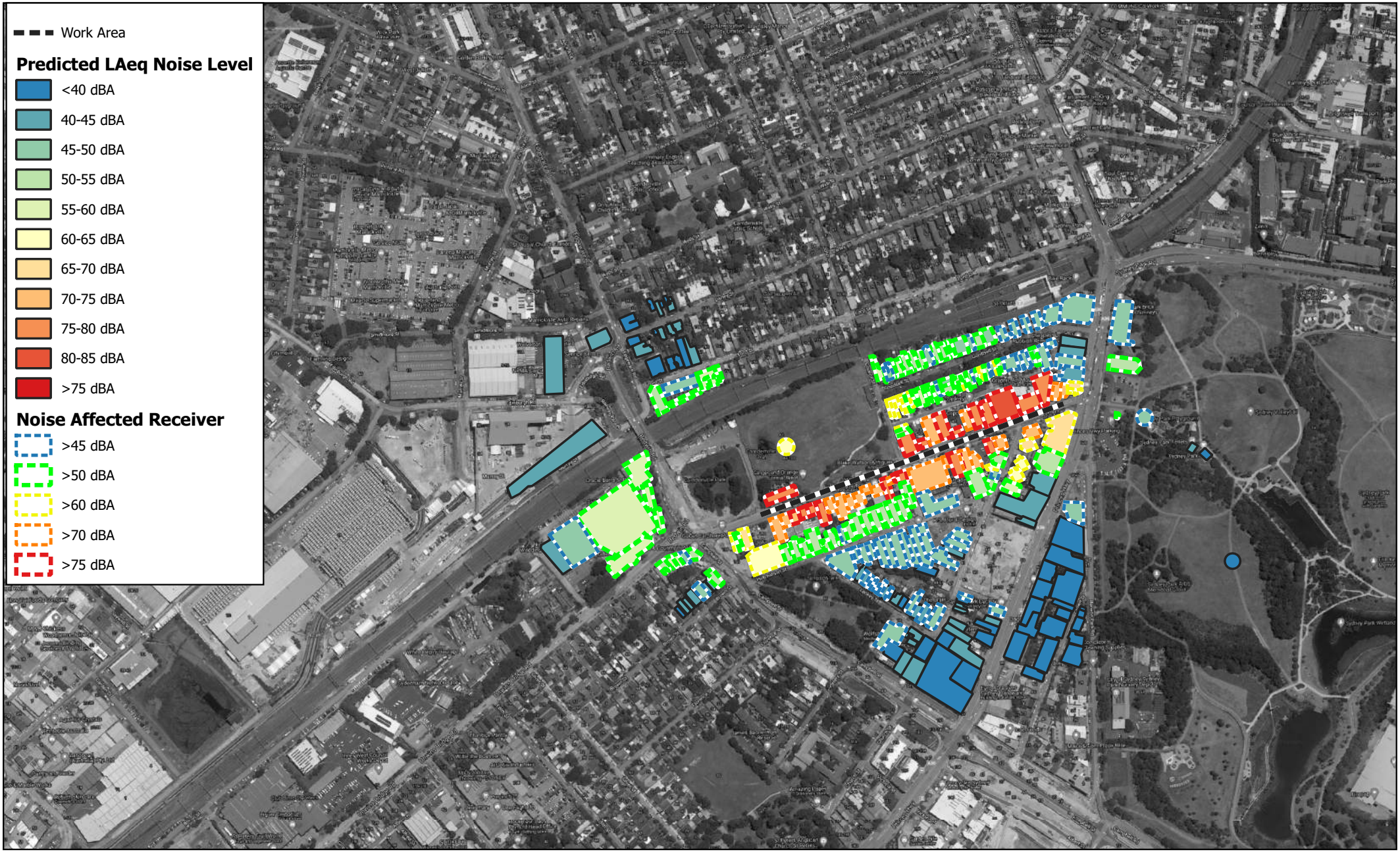

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Out of Hours Works - Predicted LAeq Noise Levels
May Street - Map 13 of 15

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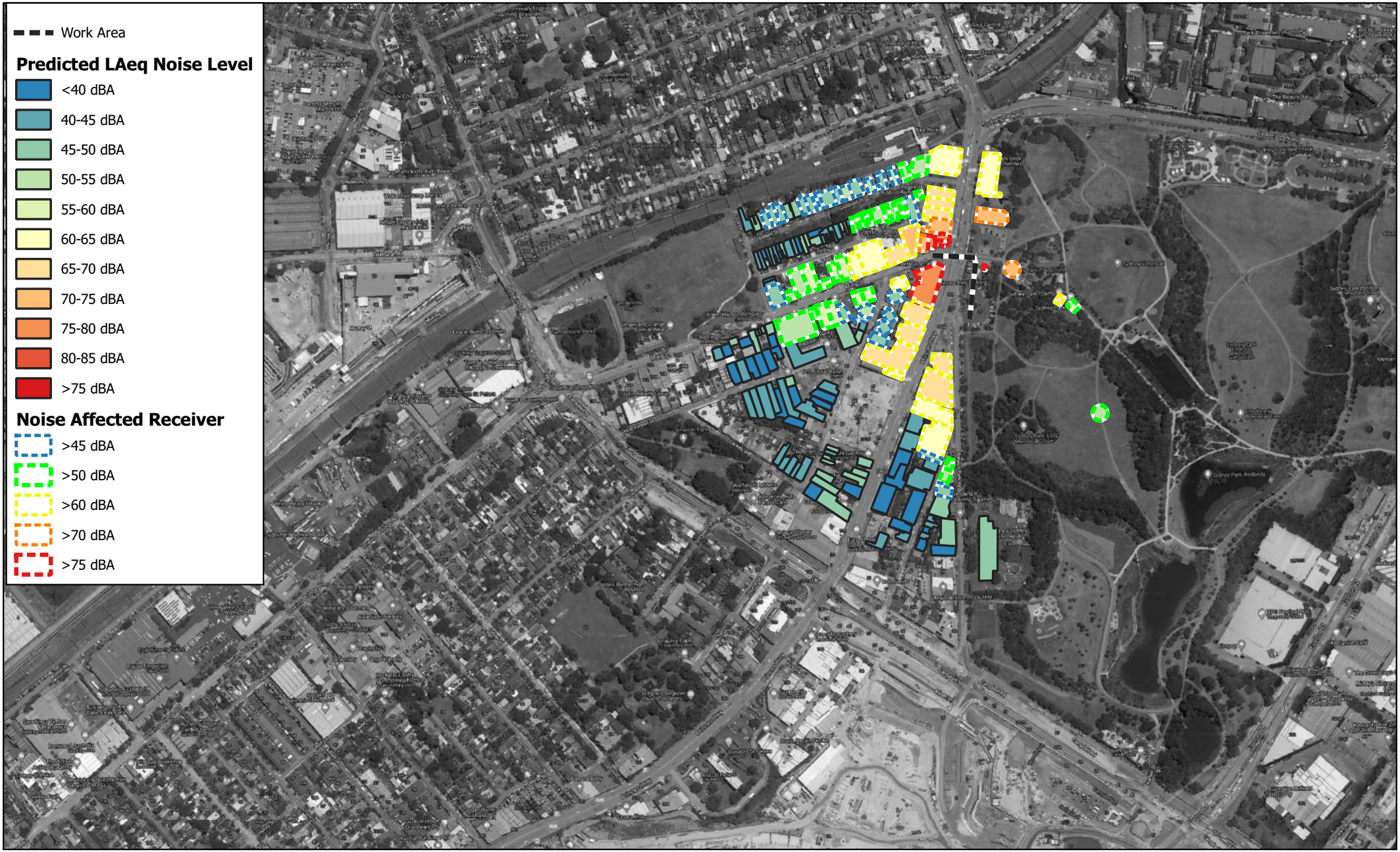

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Out of Hours Works - Predicted LAeq Noise Levels
Princes Highway - Map 14 of 15

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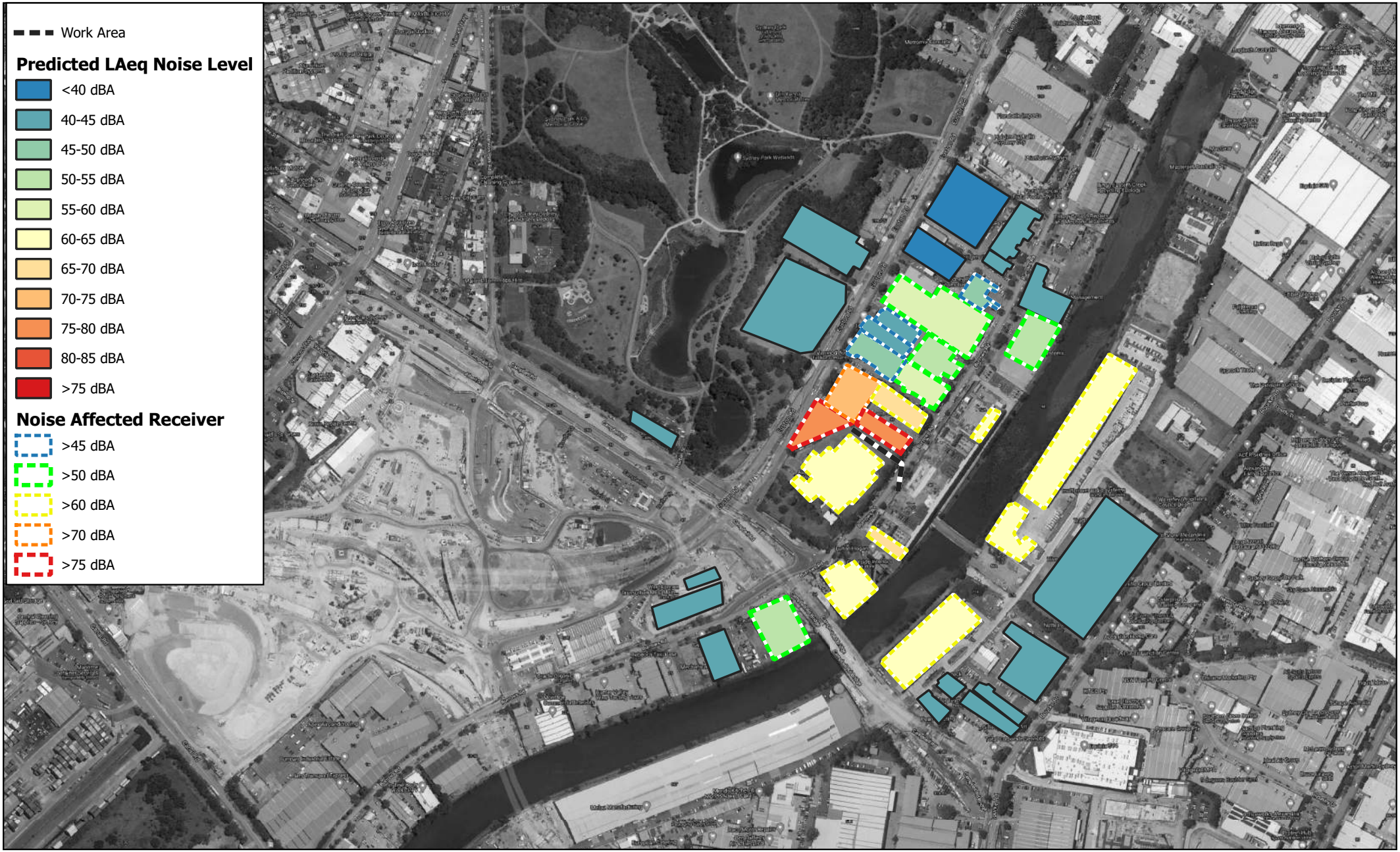

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Out of Hours Works - Predicted LAeq Noise Levels
Burrows Road - Map 15 of 15

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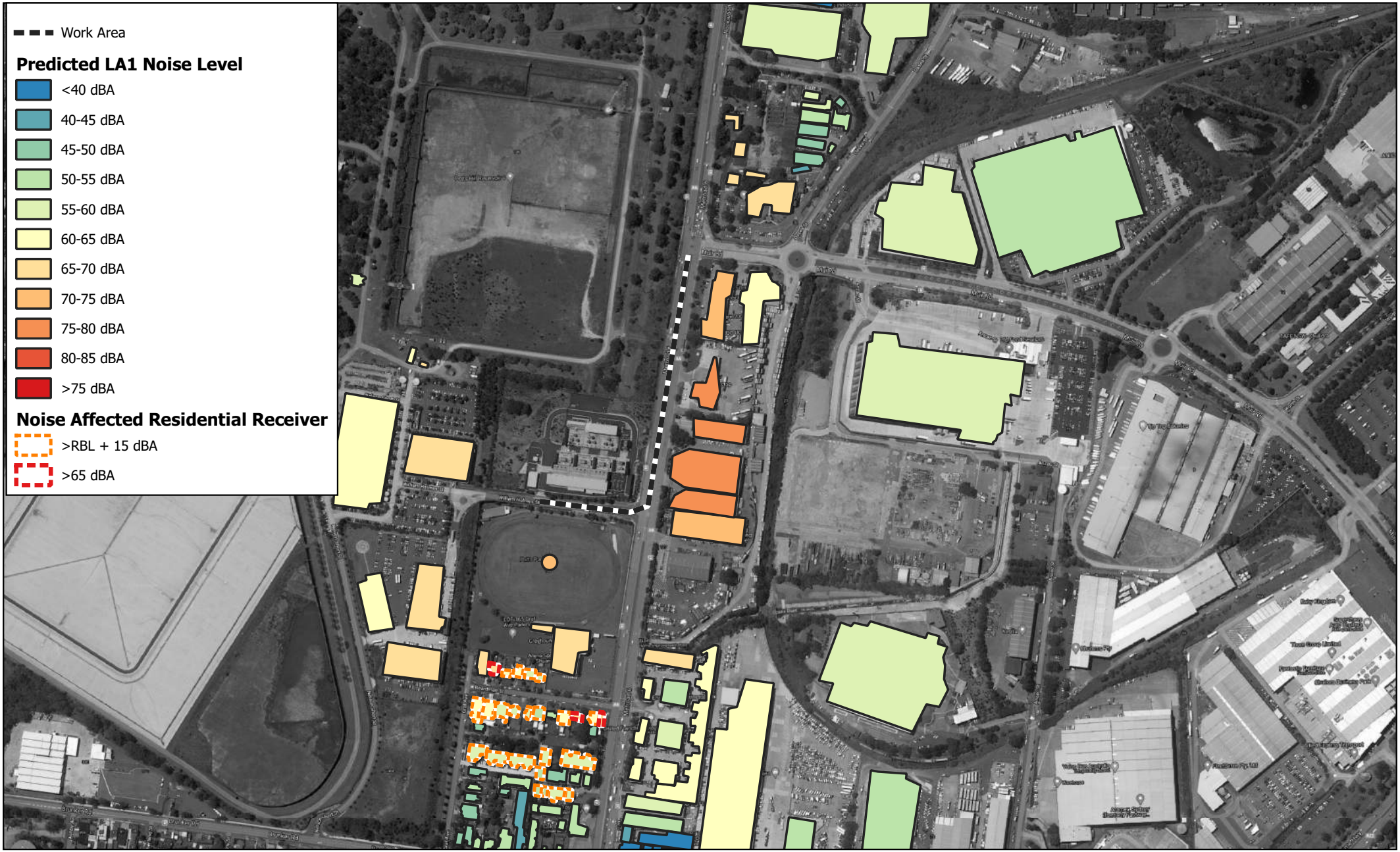
Appendix B

Predicted LA1(1 minute) Noise Levels



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Out of Hours Works - Predicted LA1 Noise Levels
Rookwood Road - Map 1 of 15

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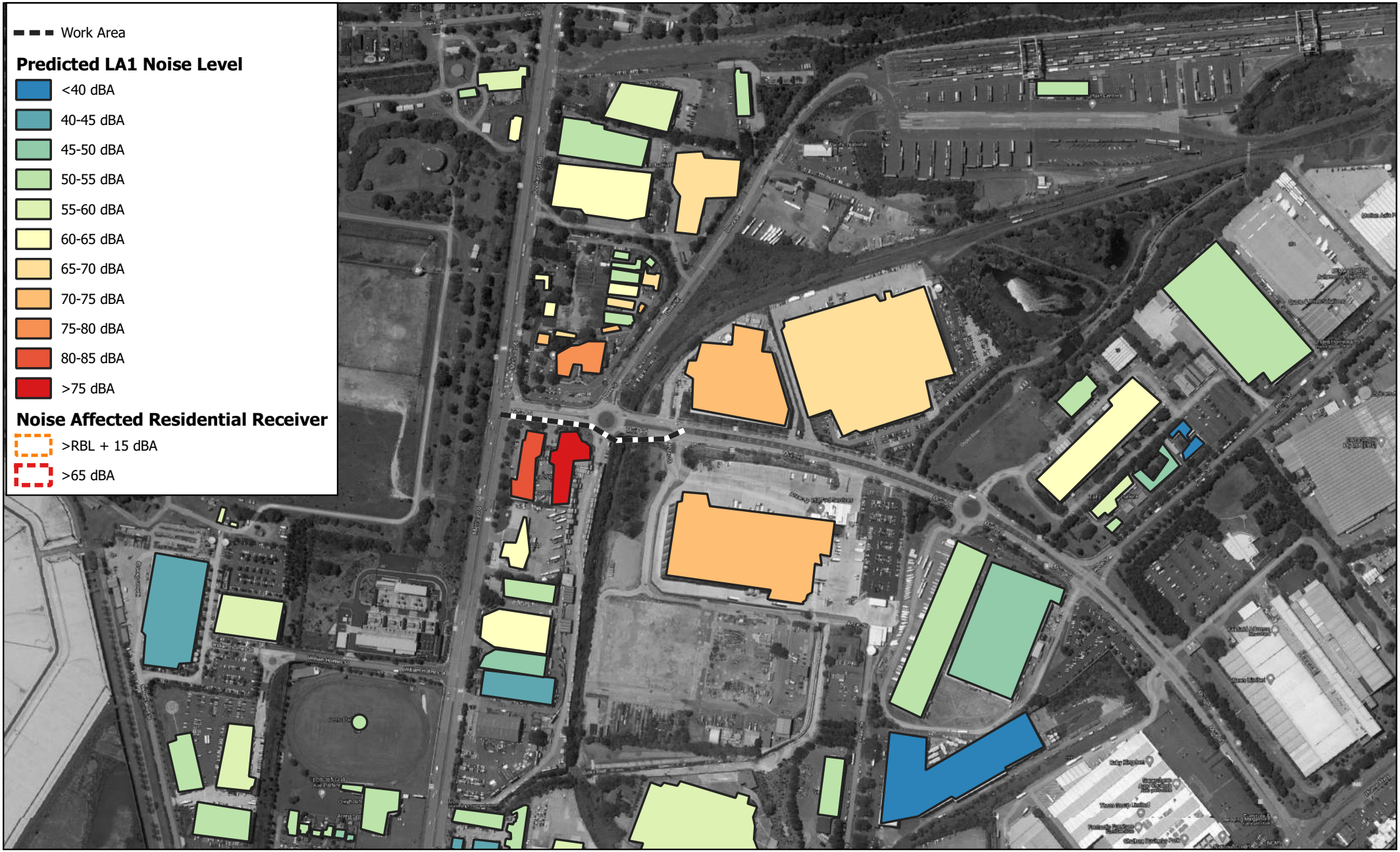

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Out of Hours Works - Predicted LA1 Noise Levels
Muir Road - Map 2 of 15

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Potts Hill to Alexandria Transmission Cable Project

Out of Hours Works - Predicted LA1 Noise Levels
Waterloo Road - Map 3 of 15

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Out of Hours Works - Predicted LA1 Noise Levels
Juno Parade - Map 4 of 15

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Potts Hill to Alexandria Transmission Cable Project

Out of Hours Works - Predicted LA1 Noise Levels
Punchbowl Road - Map 5 of 15

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Potts Hill to Alexandria Transmission Cable Project

Out of Hours Works - Predicted LA1 Noise Levels
Old Canterbury Road - Map 6 of 15

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Out of Hours Works - Predicted LA1 Noise Levels
Sydenham Road - Map 7 of 15

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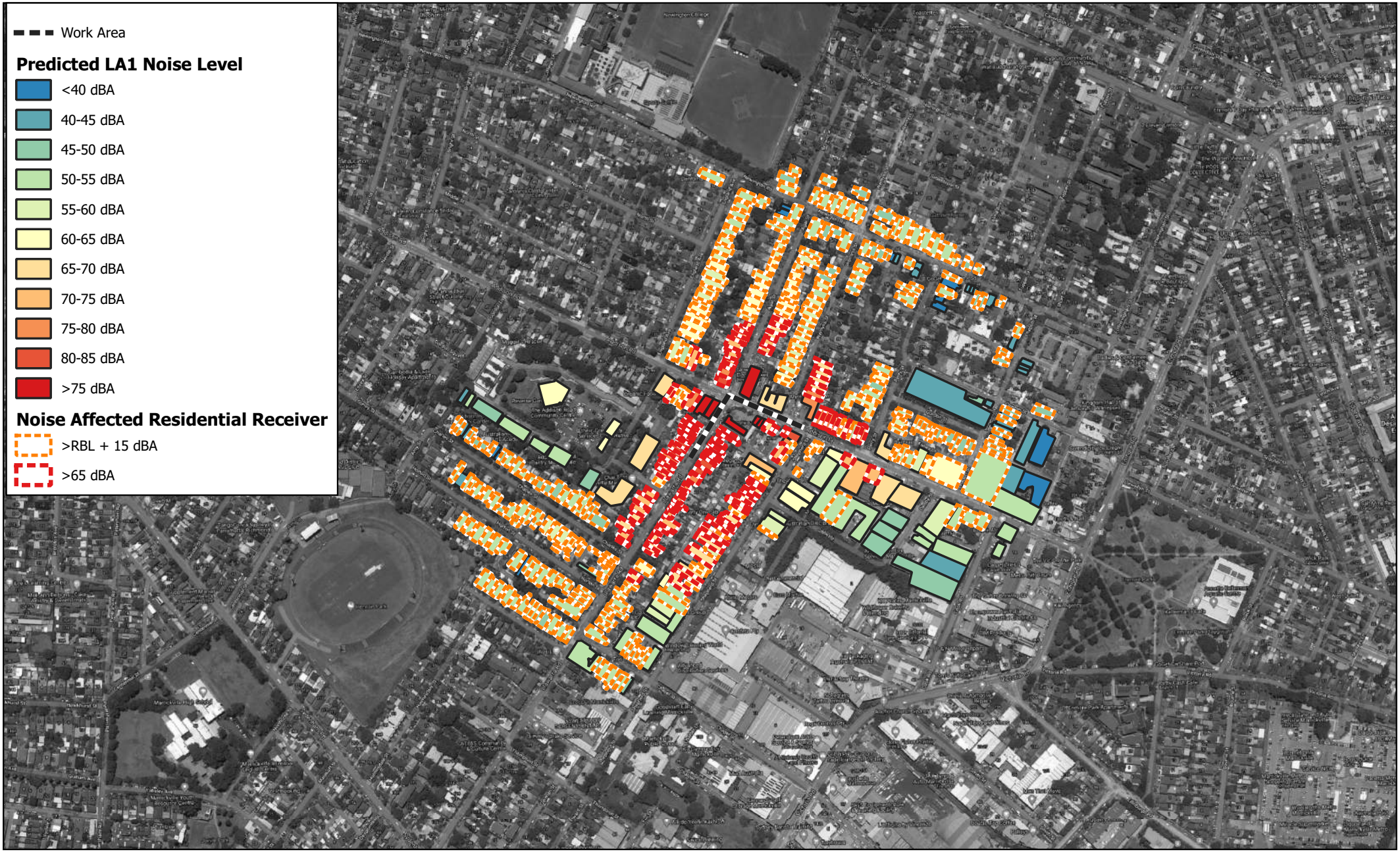

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Potts Hill to Alexandria Transmission Cable Project

Out of Hours Works - Predicted LA1 Noise Levels

Intersection of Illawarra Road and Addison Road - Map 8 of 15

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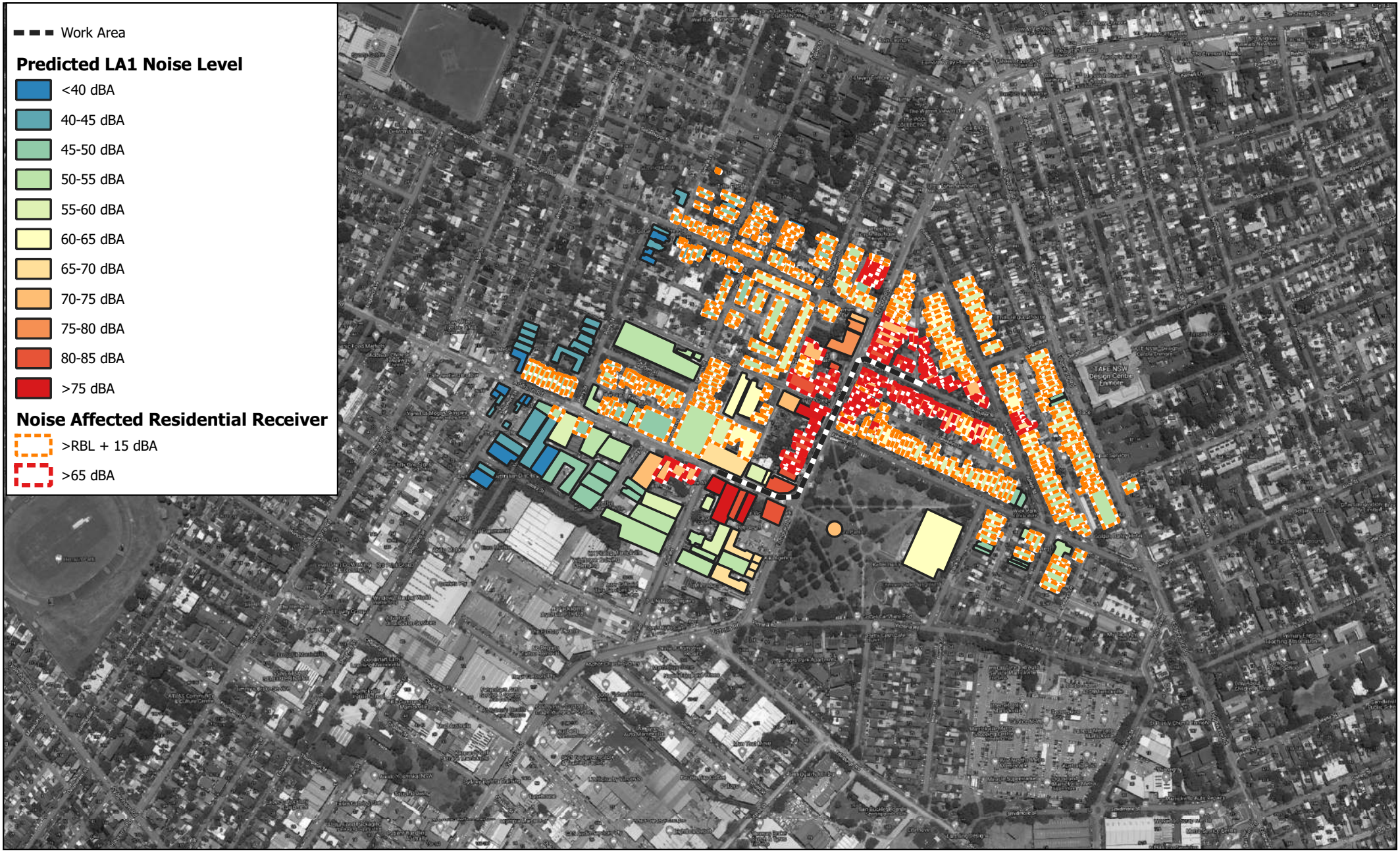

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Potts Hill to Alexandria Transmission Cable Project

Out of Hours Works - Predicted LA1 Noise Levels
Enmore Road - Map 9 of 15

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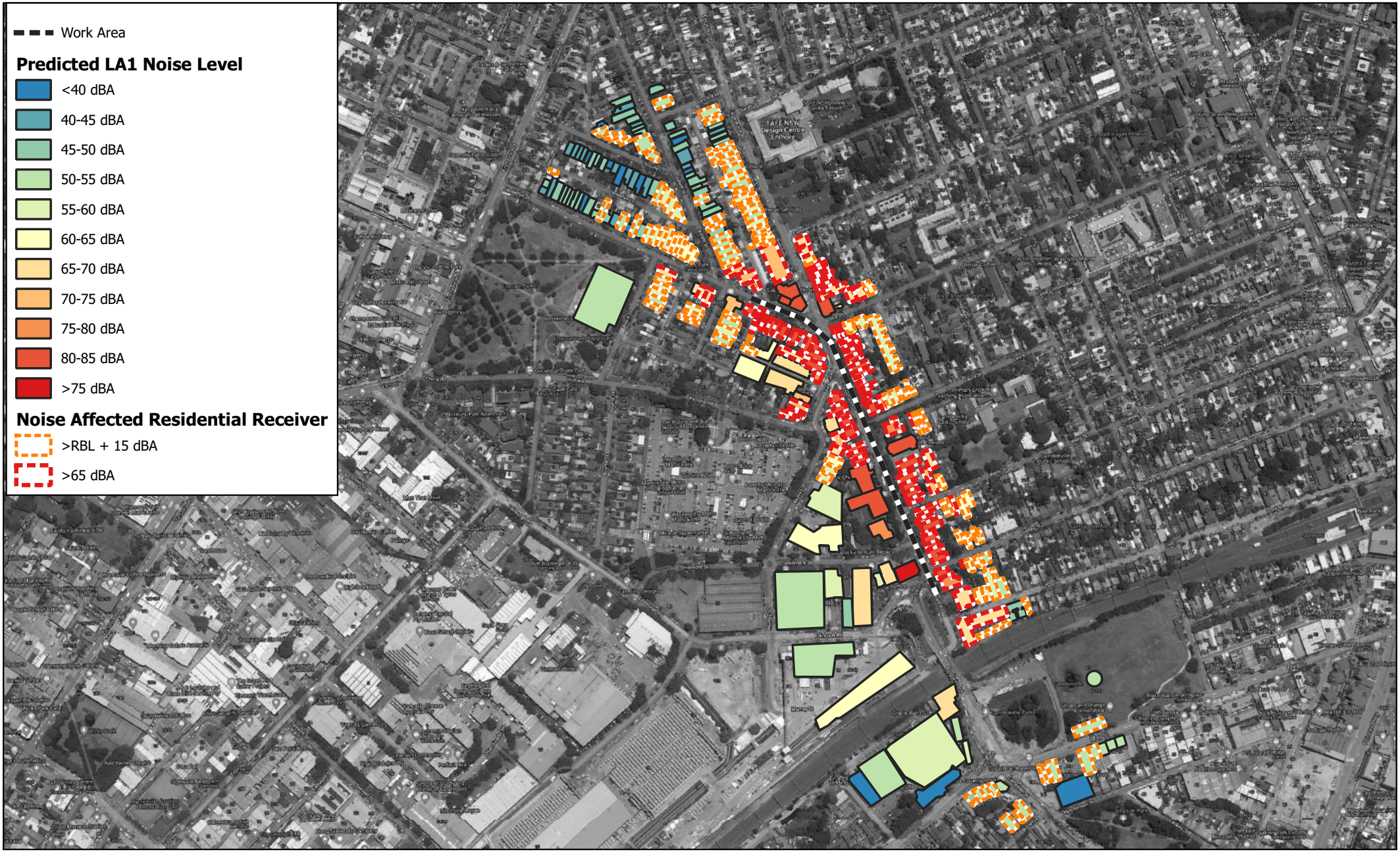

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Out of Hours Works - Predicted LA1 Noise Levels
Edgeware Road - Map 10 of 15

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Potts Hill to Alexandria Transmission Cable Project

Out of Hours Works - Predicted LA1 Noise Levels
Bedwin Road Bridge - Map 11 of 15

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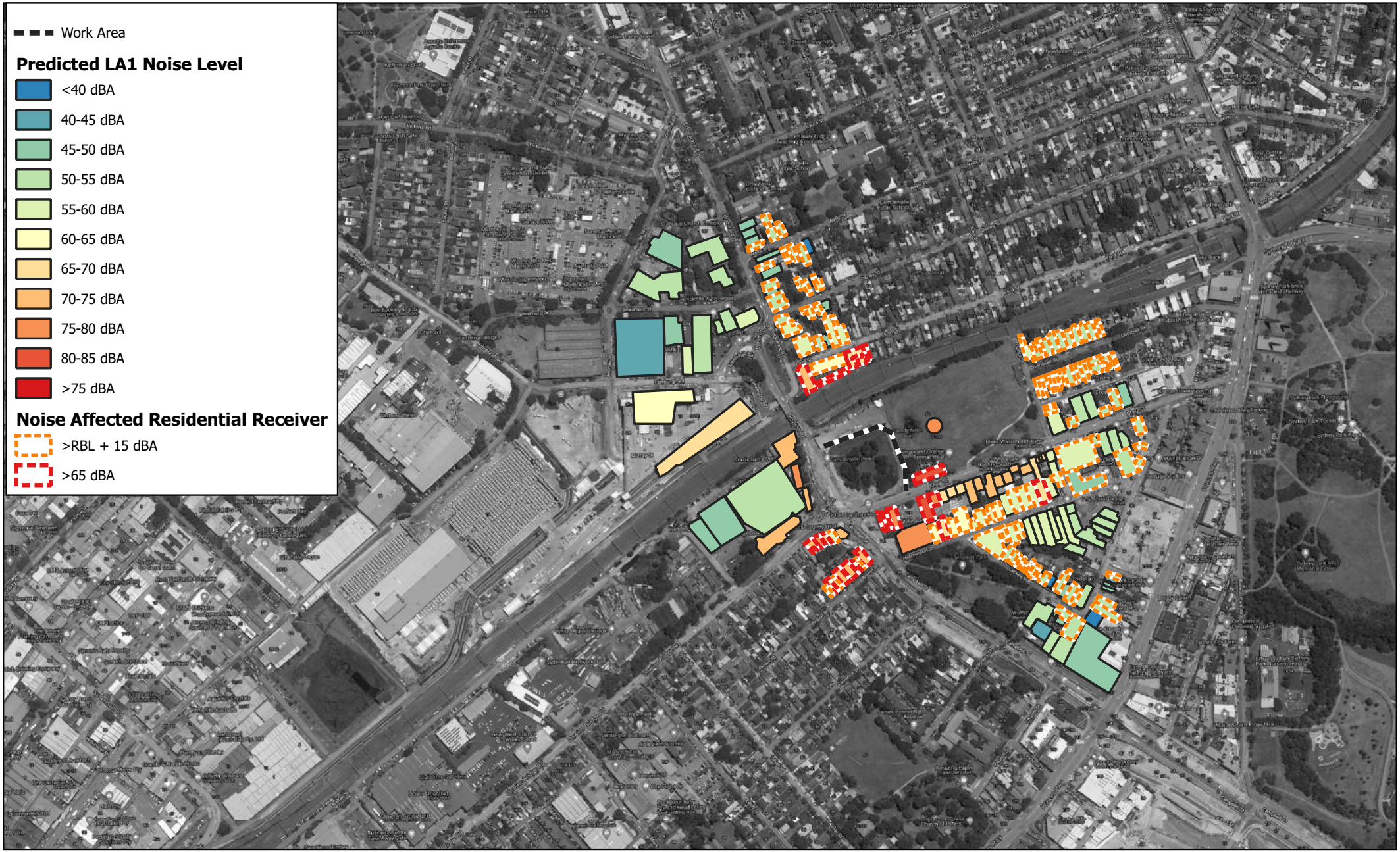

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Projection:	GDA 1994 MGA Zone 56

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Potts Hill to Alexandria Transmission Cable Project

Out of Hours Works - Predicted LA1 Noise Levels
Camdenville Park - Map 12 of 15

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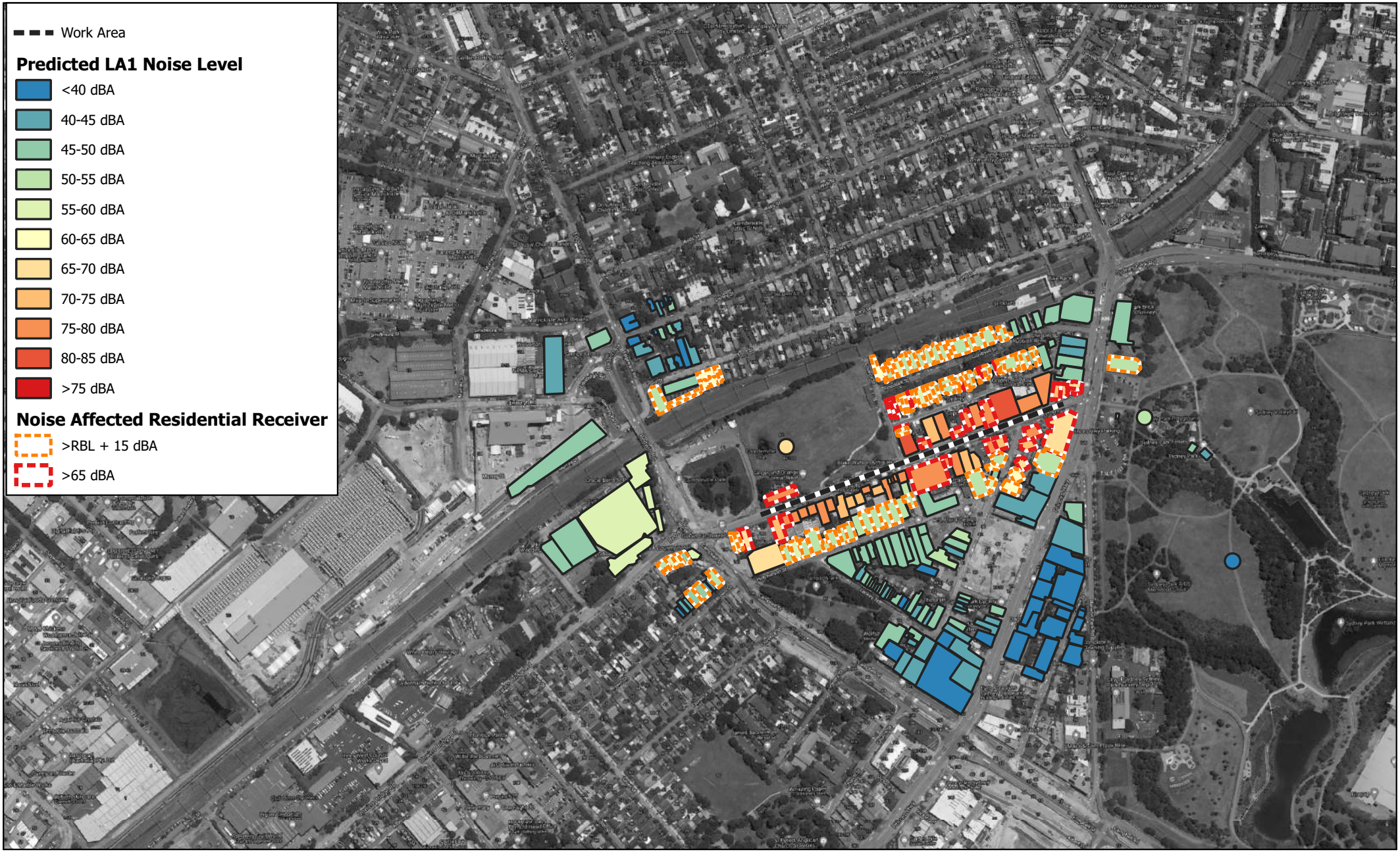

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Potts Hill to Alexandria Transmission Cable Project

Out of Hours Works - Predicted LA1 Noise Levels
May Street - Map 13 of 15

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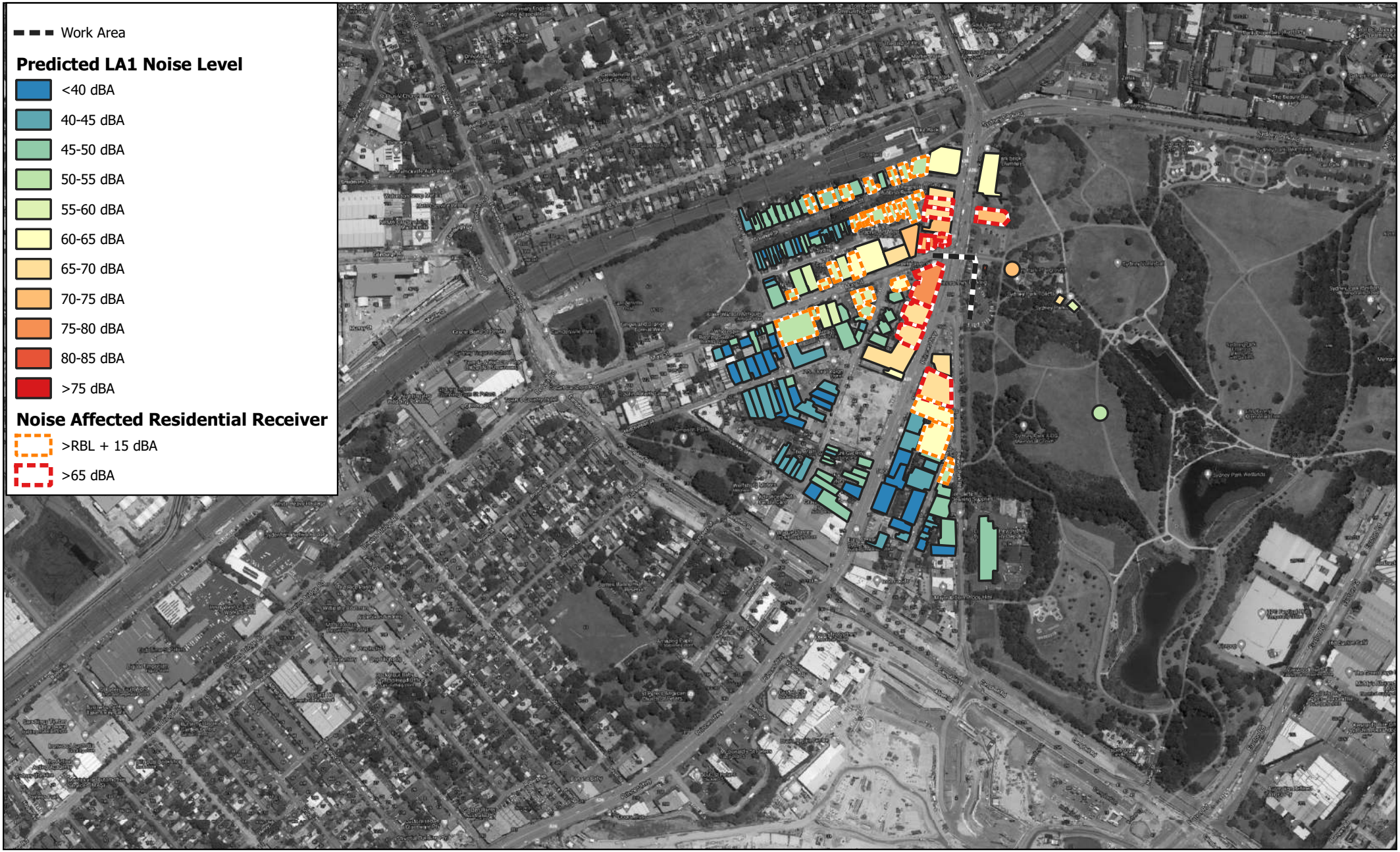

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Projection:	GDA 1994 MGA Zone 56

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Potts Hill to Alexandria Transmission Cable Project

Out of Hours Works - Predicted LA1 Noise Levels
Princes Highway - Map 14 of 15

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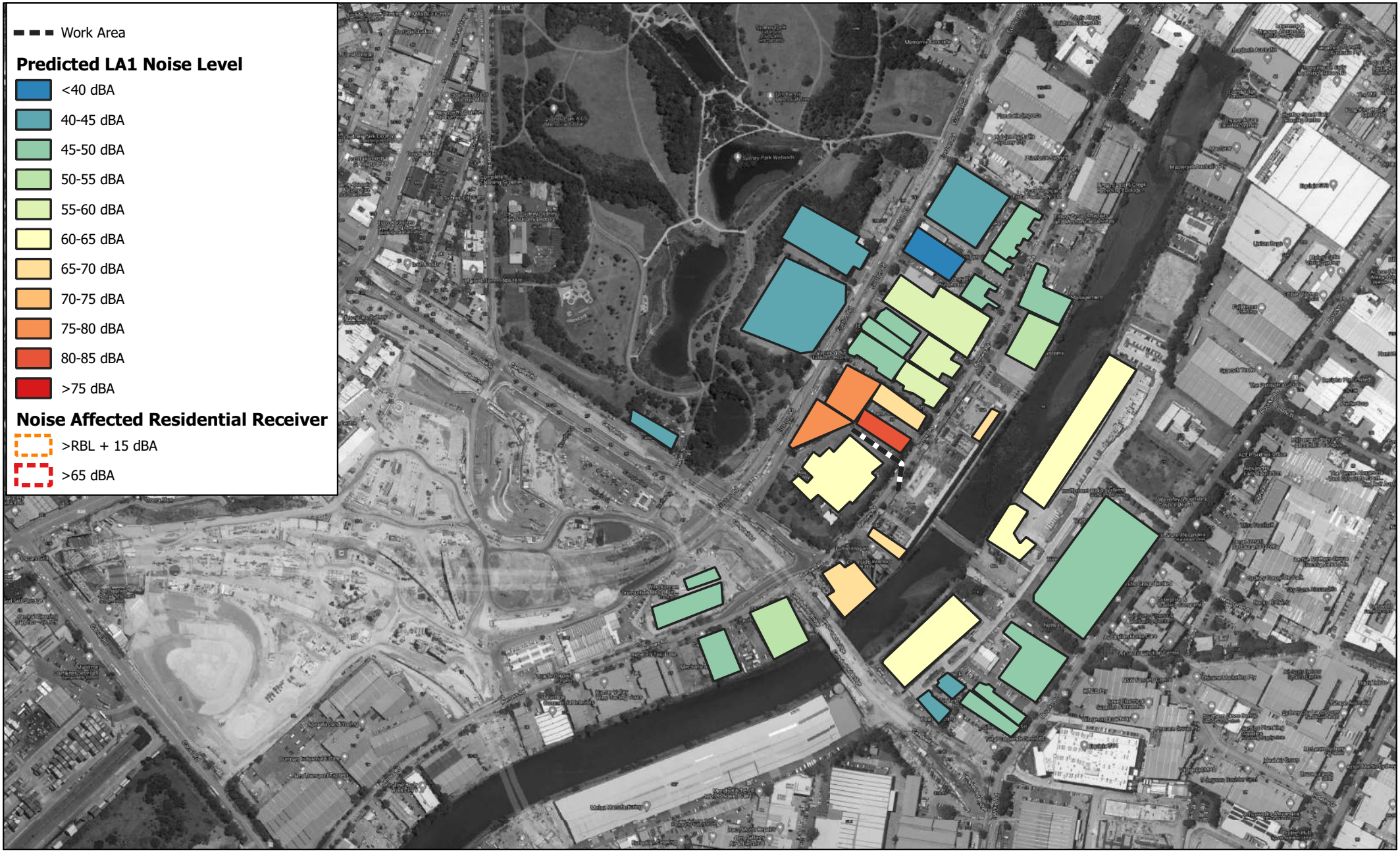

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Potts Hill to Alexandria Transmission Cable Project

Out of Hours Works - Predicted LA1 Noise Levels
Burrows Road - Map 15 of 15

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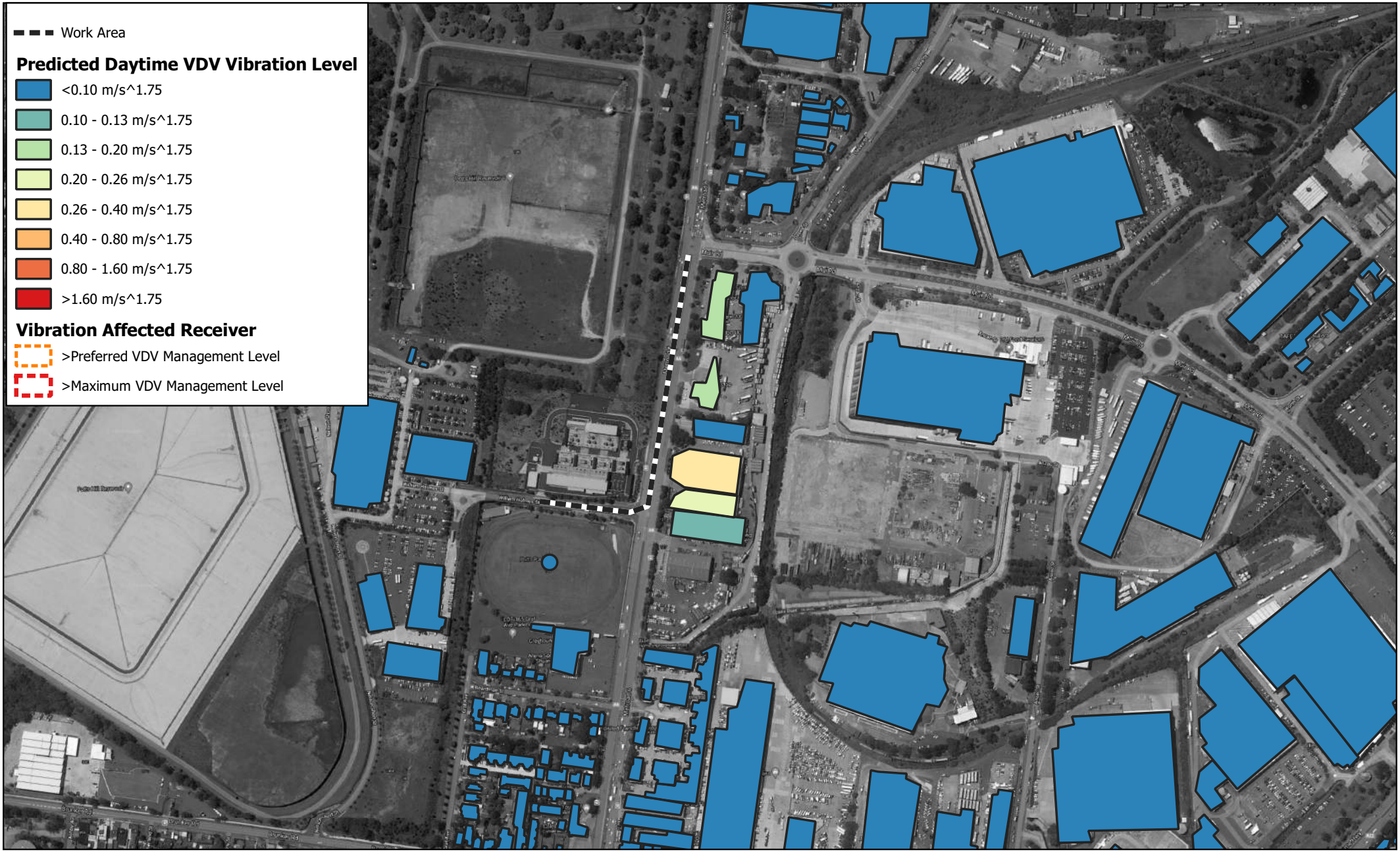
Appendix C

Predicted Human Comfort Vibration Levels - VDV Day



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Projection:	GDA 1994 MGA Zone 56

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Potts Hill to Alexandria Transmission Cable Project

Out of Hours Works

Predicted Daytime VDV Vibration Levels

Rookwood Road - Map 1 of 15

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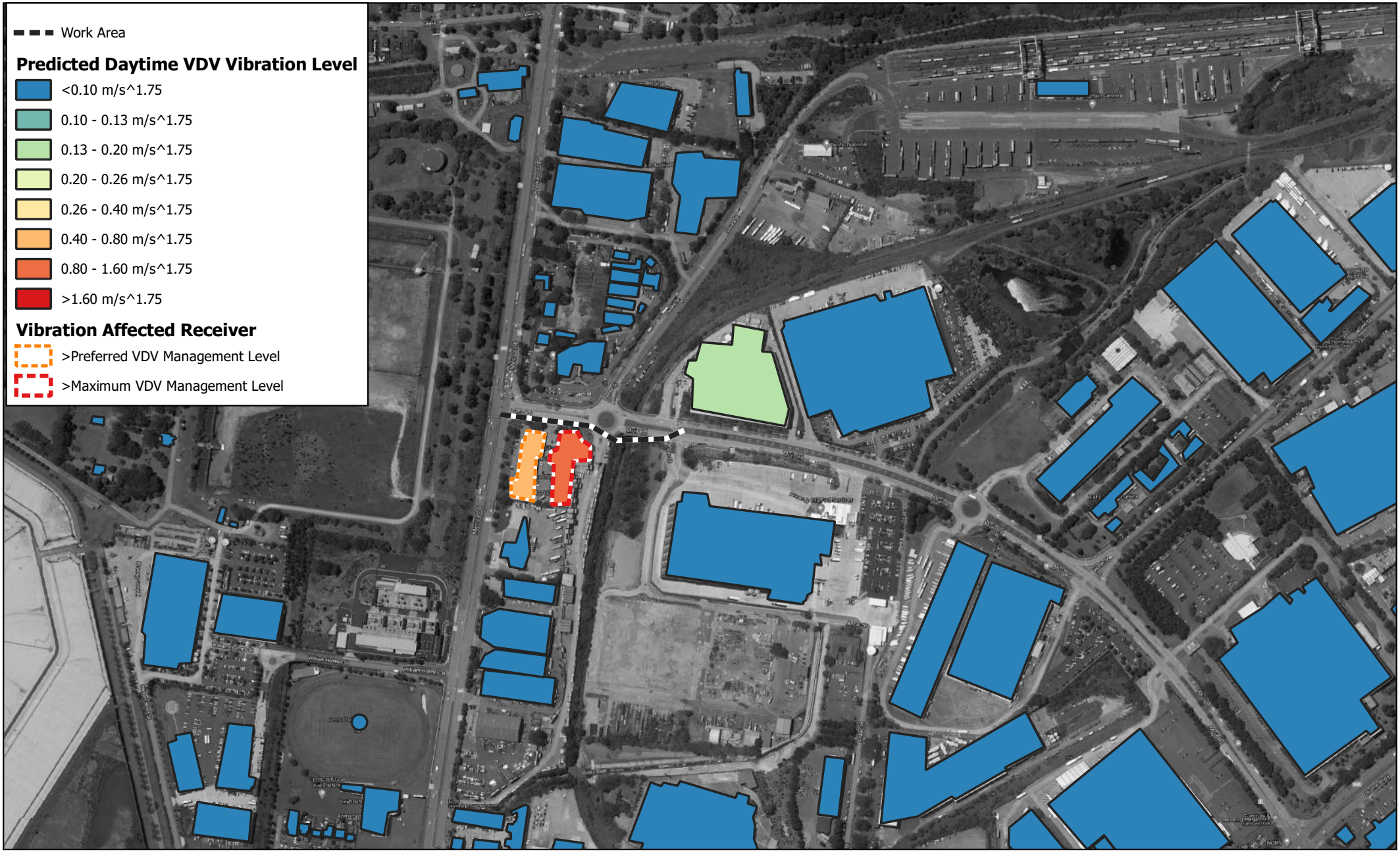

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Projection:	GDA 1994 MGA Zone 56

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Potts Hill to Alexandria Transmission Cable Project

Out of Hours Works

Predicted Daytime VDV Vibration Levels

Muir Road - Map 2 of 15

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Projection:	GDA 1994 MGA Zone 56

0 100 200

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Potts Hill to Alexandria Transmission Cable Project

Out of Hours Works

Predicted Daytime VDV Vibration Levels

Waterloo Road - Map 3 of 15

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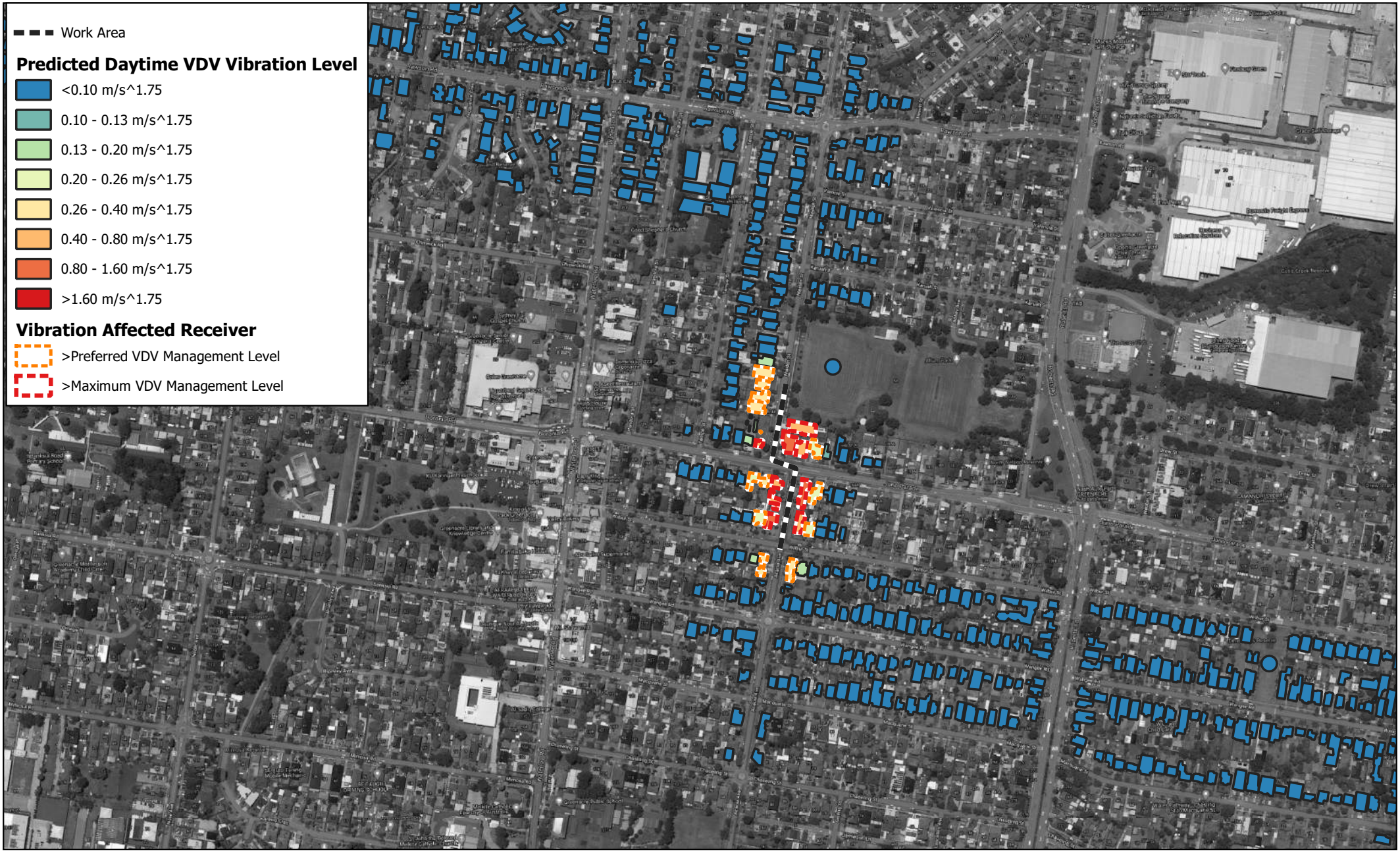

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Potts Hill to Alexandria Transmission Cable Project

Out of Hours Works

Predicted Daytime VDV Vibration Levels

Juno Parade - Map 4 of 15

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Potts Hill to Alexandria Transmission Cable Project

Out of Hours Works

Predicted Daytime VDV Vibration Levels

Punchbowl Road - Map 5 of 15

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Powering Sydney's Future

Potts Hill to Alexandria Transmission Cable Project

Out of Hours Works

Predicted Daytime VDV Vibration Levels

Old Canterbury Road - Map 6 of 15

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Projection:	GDA 1994 MGA Zone 56

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Potts Hill to Alexandria Transmission Cable Project

Out of Hours Works

Predicted Daytime VDV Vibration Levels

Sydenham Road - Map 7 of 15

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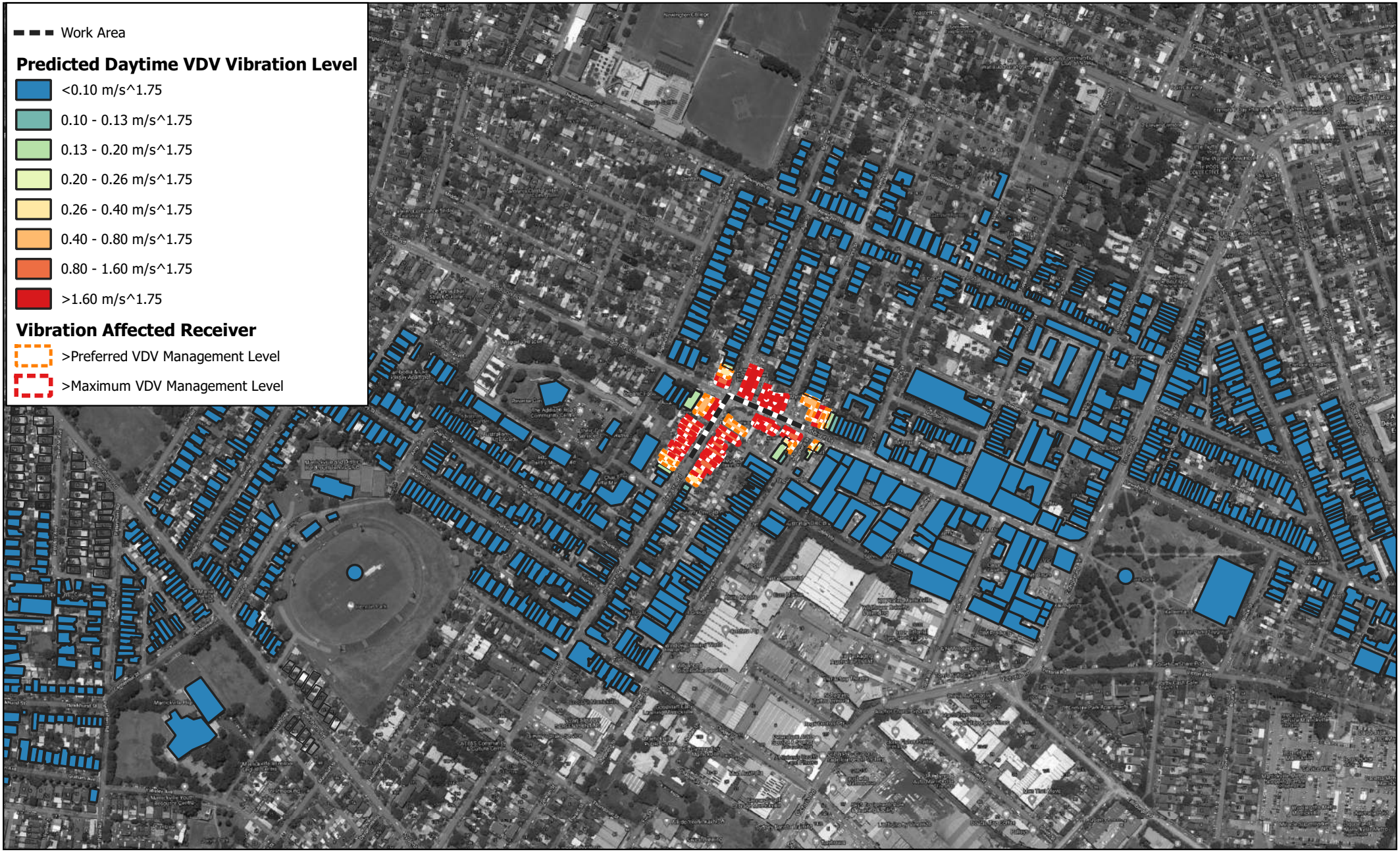

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Projection:	GDA 1994 MGA Zone 56

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Powering Sydney's Future

Potts Hill to Alexandria Transmission Cable Project

Out of Hours Works

Predicted Daytime VDV Vibration Levels

Intersection of Illawarra Road and Addison Road - Map 8 of 15

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Powering Sydney's Future

Potts Hill to Alexandria Transmission Cable Project

Out of Hours Works

Predicted Daytime VDV Vibration Levels

Enmore Road - Map 9 of 15

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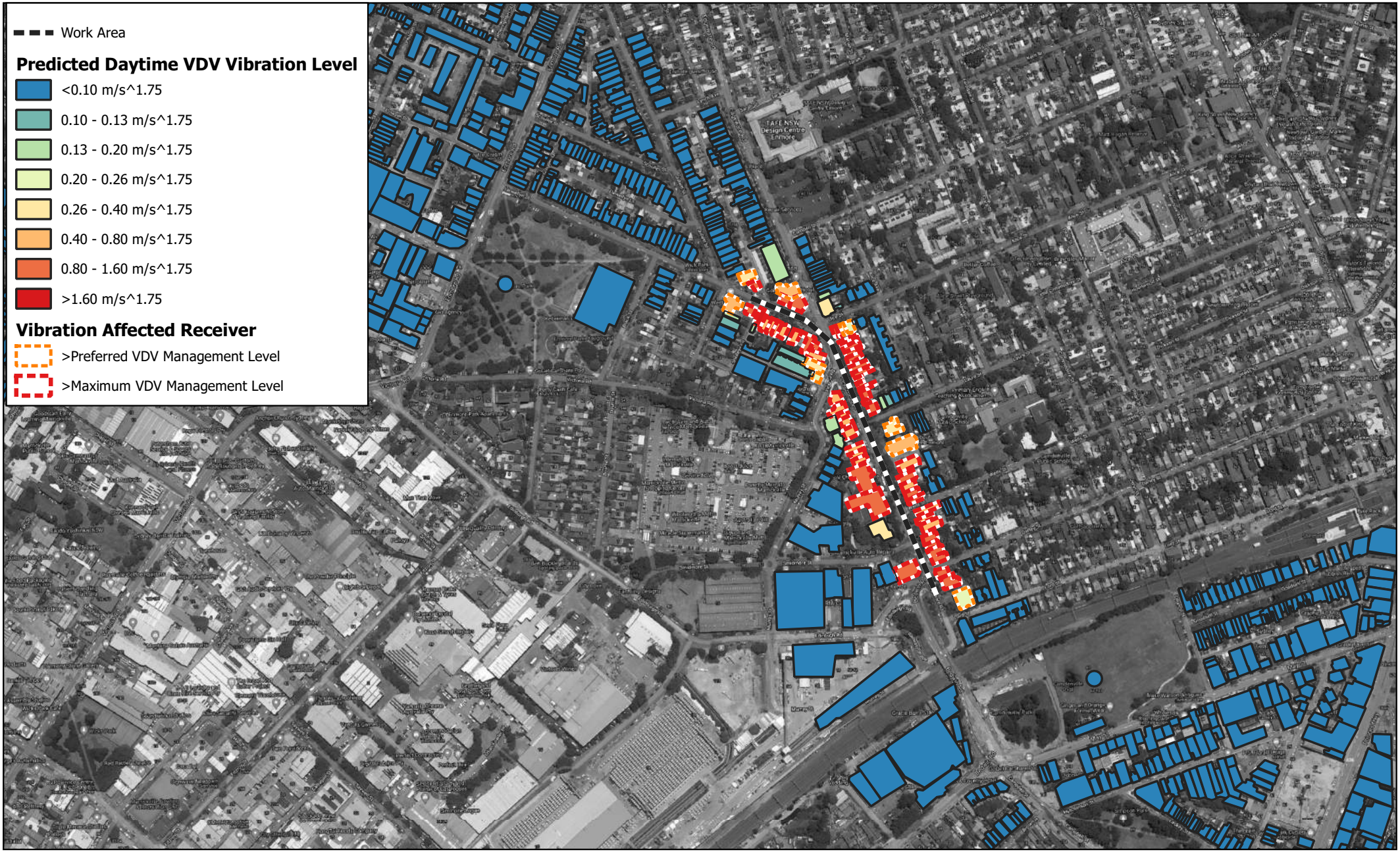

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Projection:	GDA 1994 MGA Zone 56

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Potts Hill to Alexandria Transmission Cable Project

Out of Hours Works

Predicted Daytime VDV Vibration Levels

Edgeware Road - Map 10 of 15

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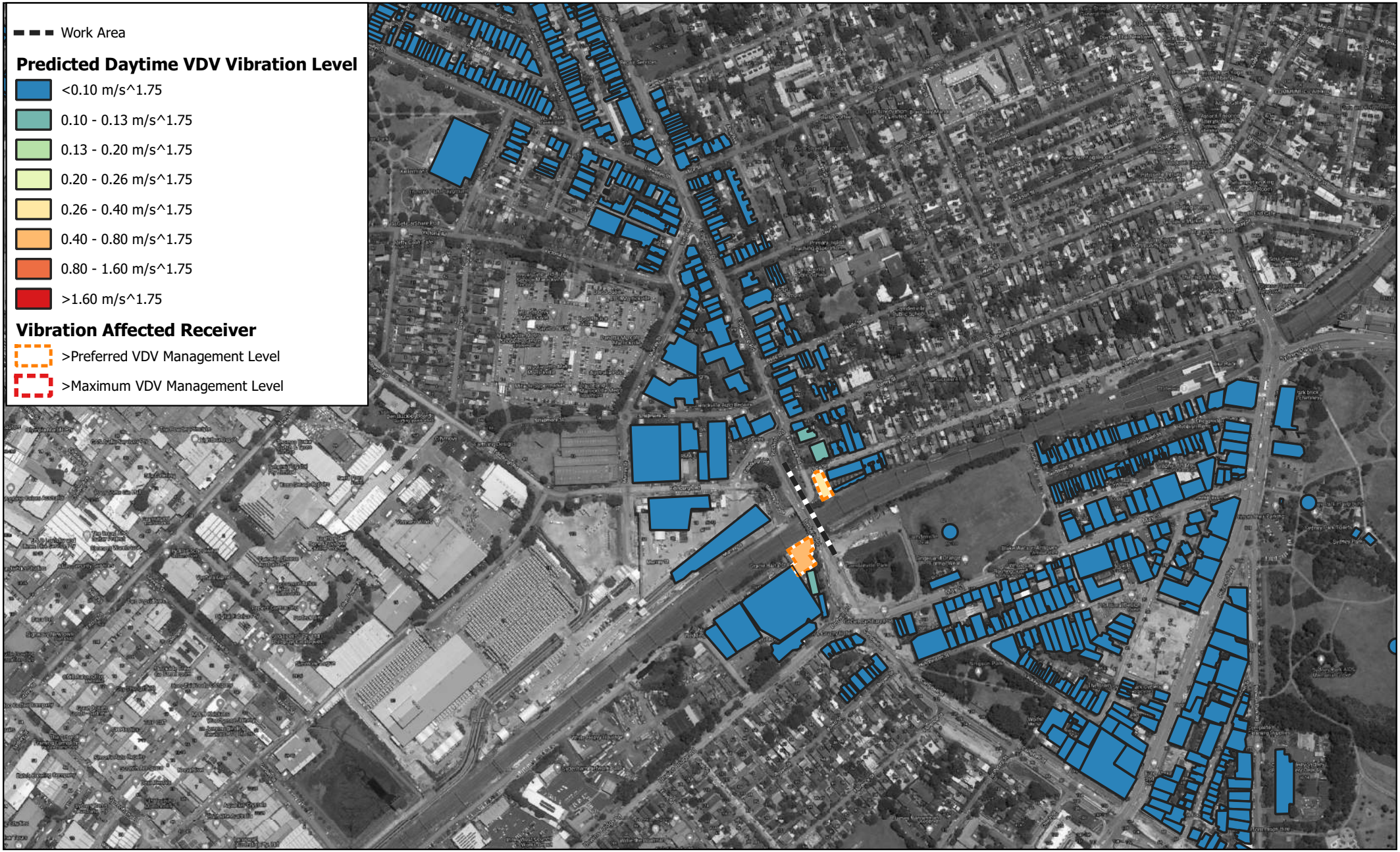

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Projection:	GDA 1994 MGA Zone 56

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Potts Hill to Alexandria Transmission Cable Project

Out of Hours Works

Predicted Daytime VDV Vibration Levels

Bedwin Road Bridge - Map 11 of 15

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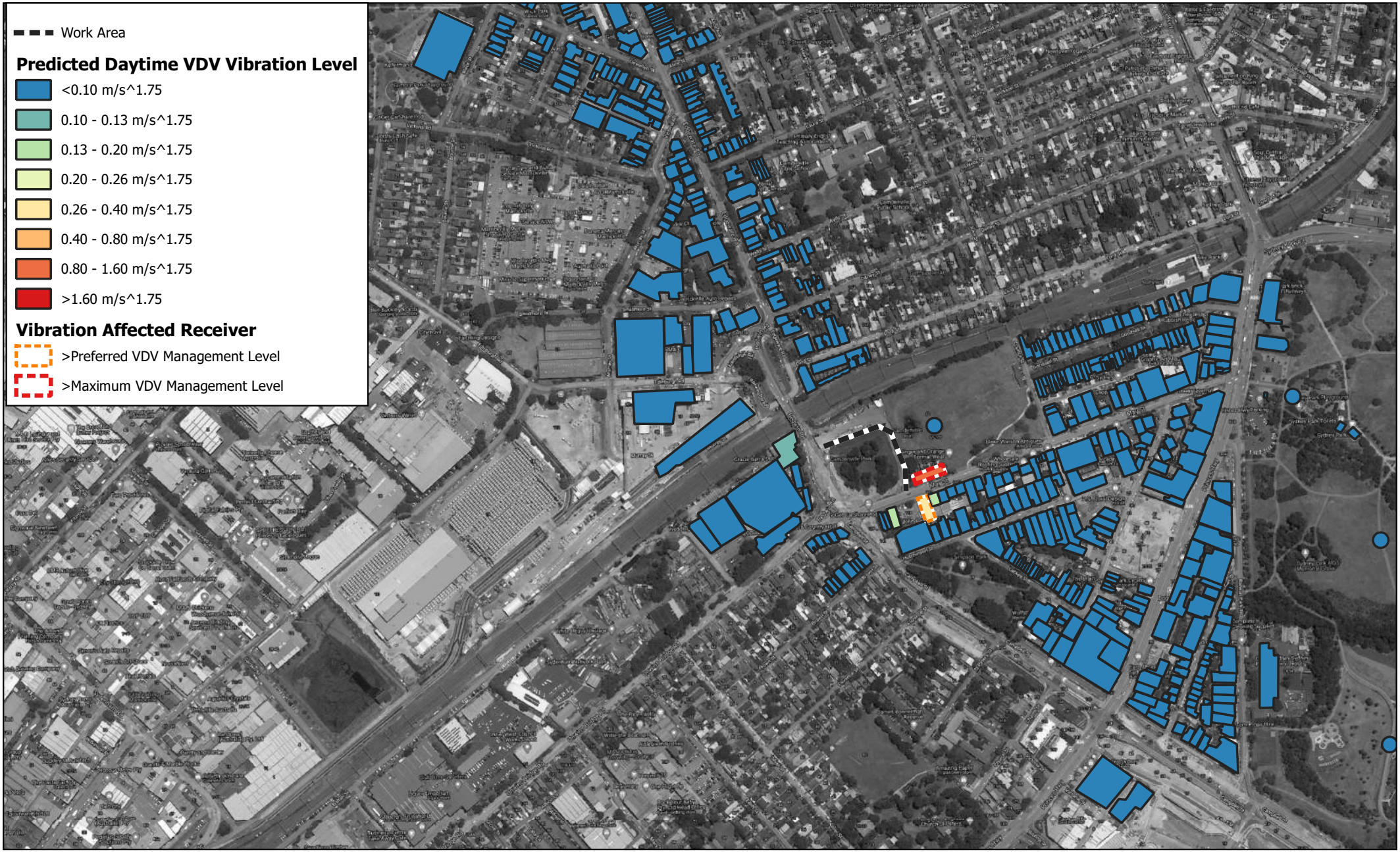

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Projection:	GDA 1994 MGA Zone 56

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Potts Hill to Alexandria Transmission Cable Project

Out of Hours Works

Predicted Daytime VDV Vibration Levels

Camdenville Park - Map 12 of 15

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Potts Hill to Alexandria Transmission Cable Project

Out of Hours Works

Predicted Daytime VDV Vibration Levels

May Street - Map 13 of 15

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Potts Hill to Alexandria Transmission Cable Project

Out of Hours Works

Predicted Daytime VDV Vibration Levels

Princes Highway - Map 14 of 15

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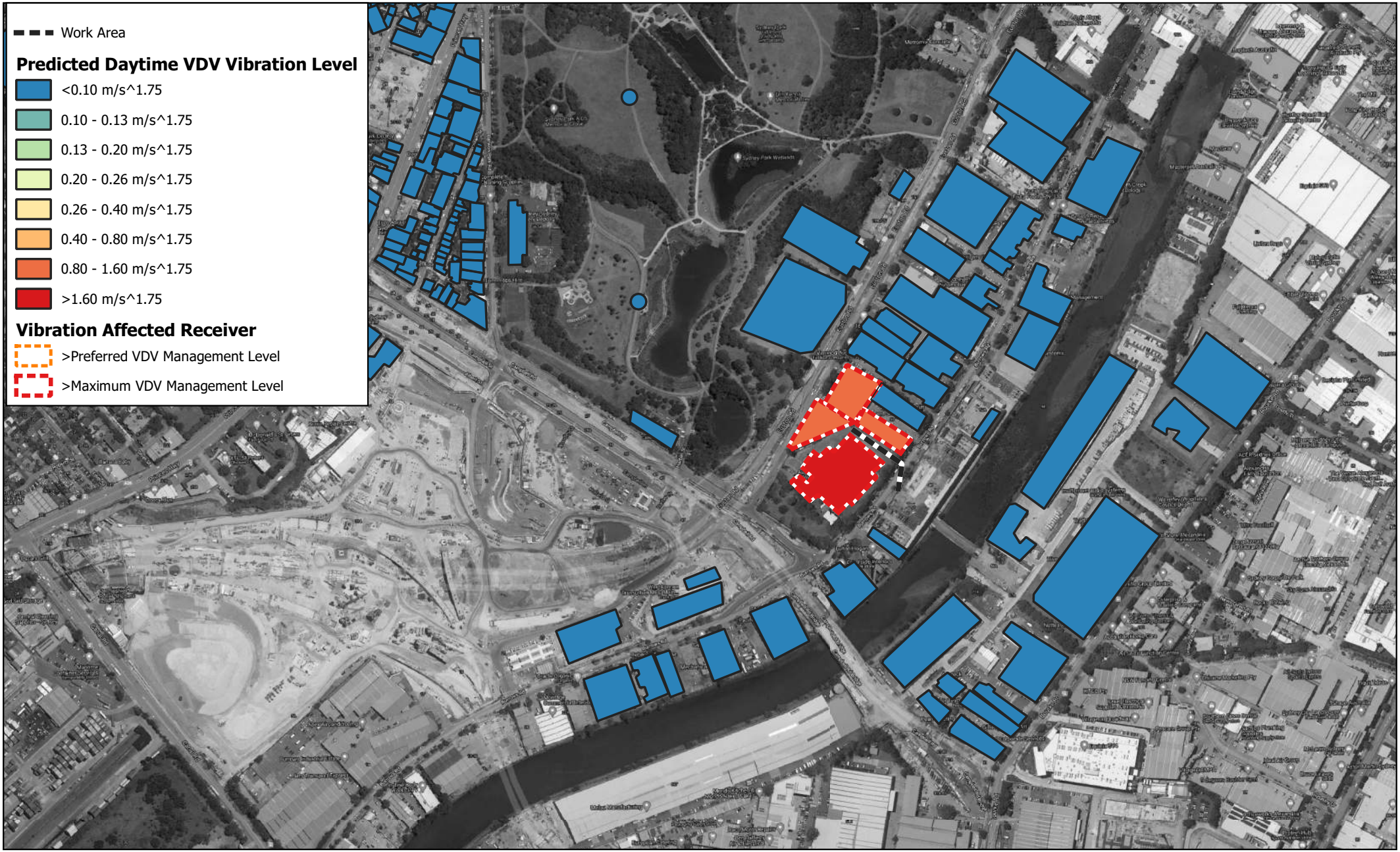

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Potts Hill to Alexandria Transmission Cable Project

Out of Hours Works

Predicted Daytime VDV Vibration Levels

Burrows Road - Map 15 of 15

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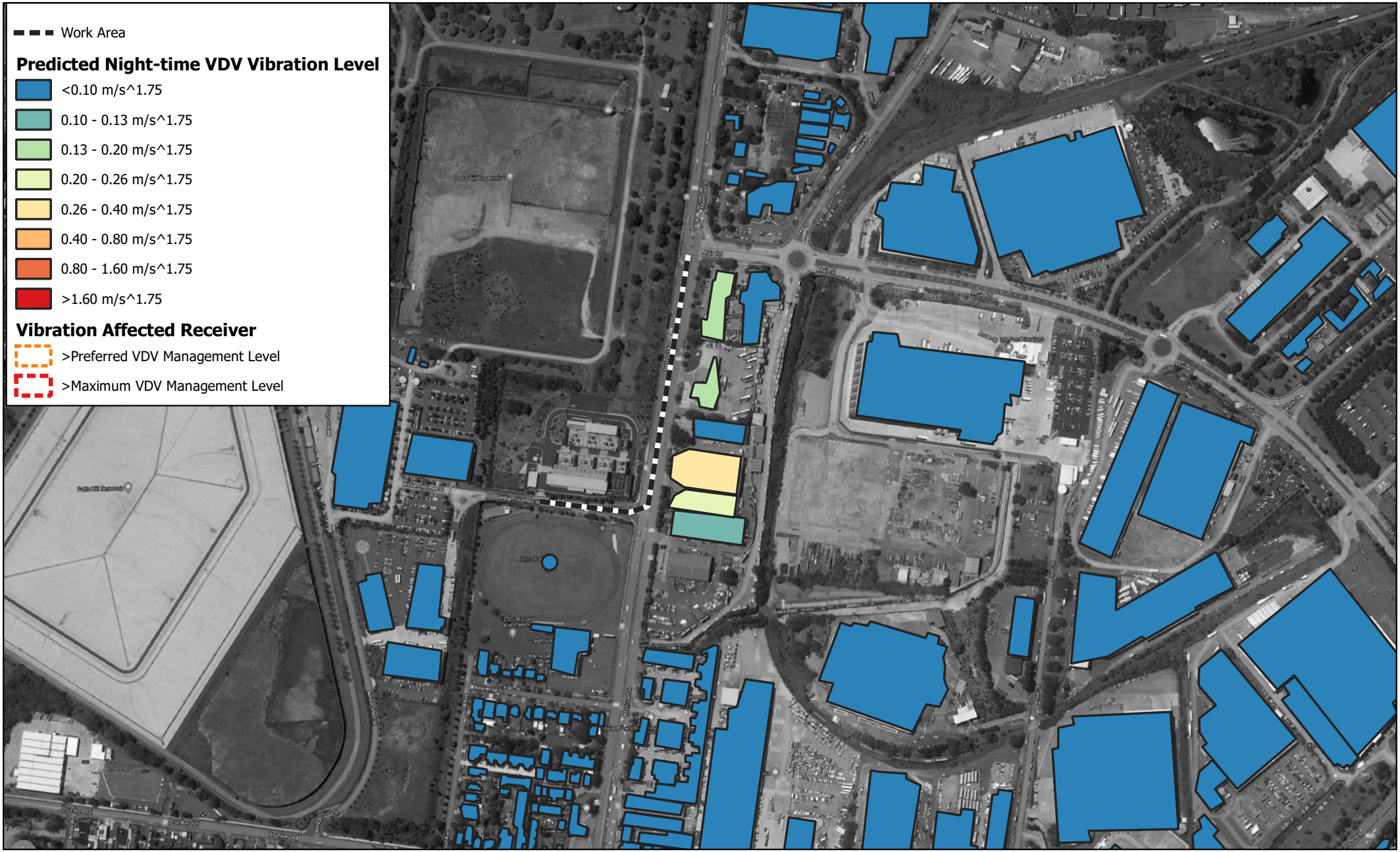
Appendix D

Predicted Human Comfort Vibration Levels - VDV Night



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Projection:	GDA 1994 MGA Zone 56

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Potts Hill to Alexandria Transmission Cable Project

Out of Hours Works

Predicted Night-time VDV Vibration Levels

Rookwood Road - Map 1 of 15

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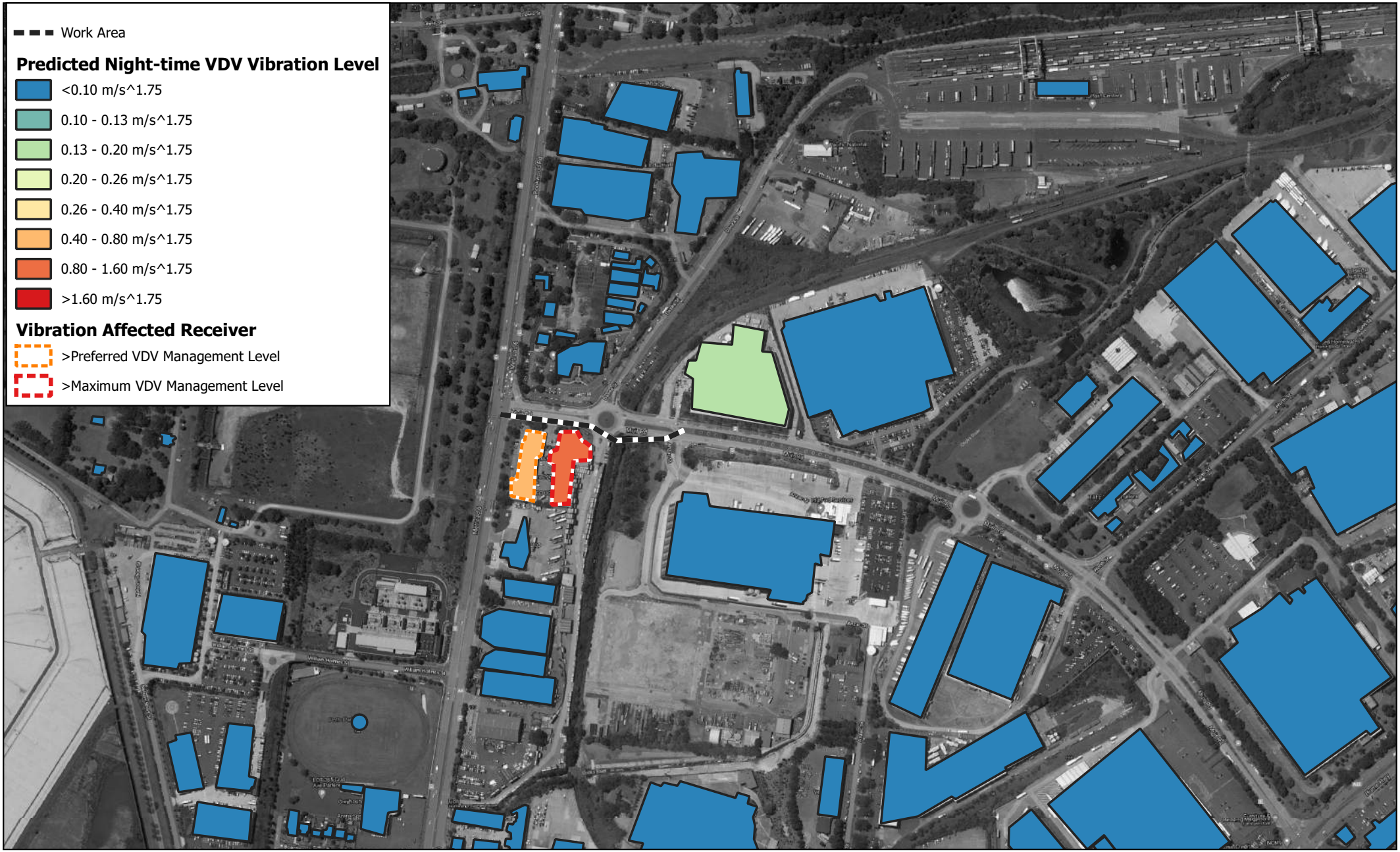

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Projection:	GDA 1994 MGA Zone 56

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Potts Hill to Alexandria Transmission Cable Project

Out of Hours Works

Predicted Night-time VDV Vibration Levels

Muir Road - Map 2 of 15

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Potts Hill to Alexandria Transmission Cable Project

Out of Hours Works

Predicted Night-time VDV Vibration Levels

Waterloo Road - Map 3 of 15

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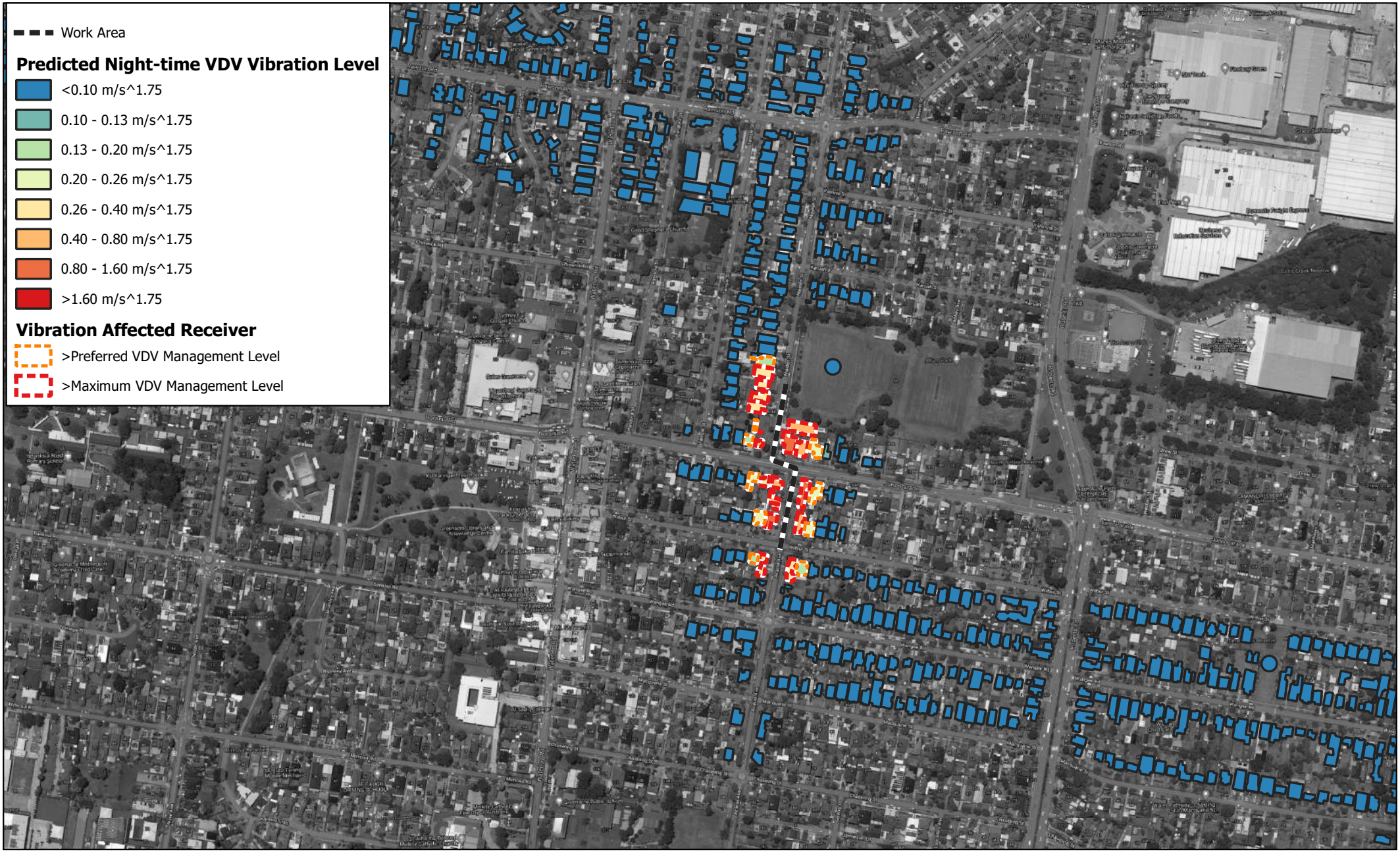

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Out of Hours Works

Predicted Night-time VDV Vibration Levels

Juno Parade - Map 4 of 15

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Potts Hill to Alexandria Transmission Cable Project

Out of Hours Works

Predicted Night-time VDV Vibration Levels

Punchbowl Road - Map 5 of 15

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Potts Hill to Alexandria Transmission Cable Project

Out of Hours Works

Predicted Night-time VDV Vibration Levels

Old Canterbury Road - Map 6 of 15

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Powering Sydney's Future

Potts Hill to Alexandria Transmission Cable Project

Out of Hours Works

Predicted Night-time VDV Vibration Levels

Sydenham Road - Map 7 of 15

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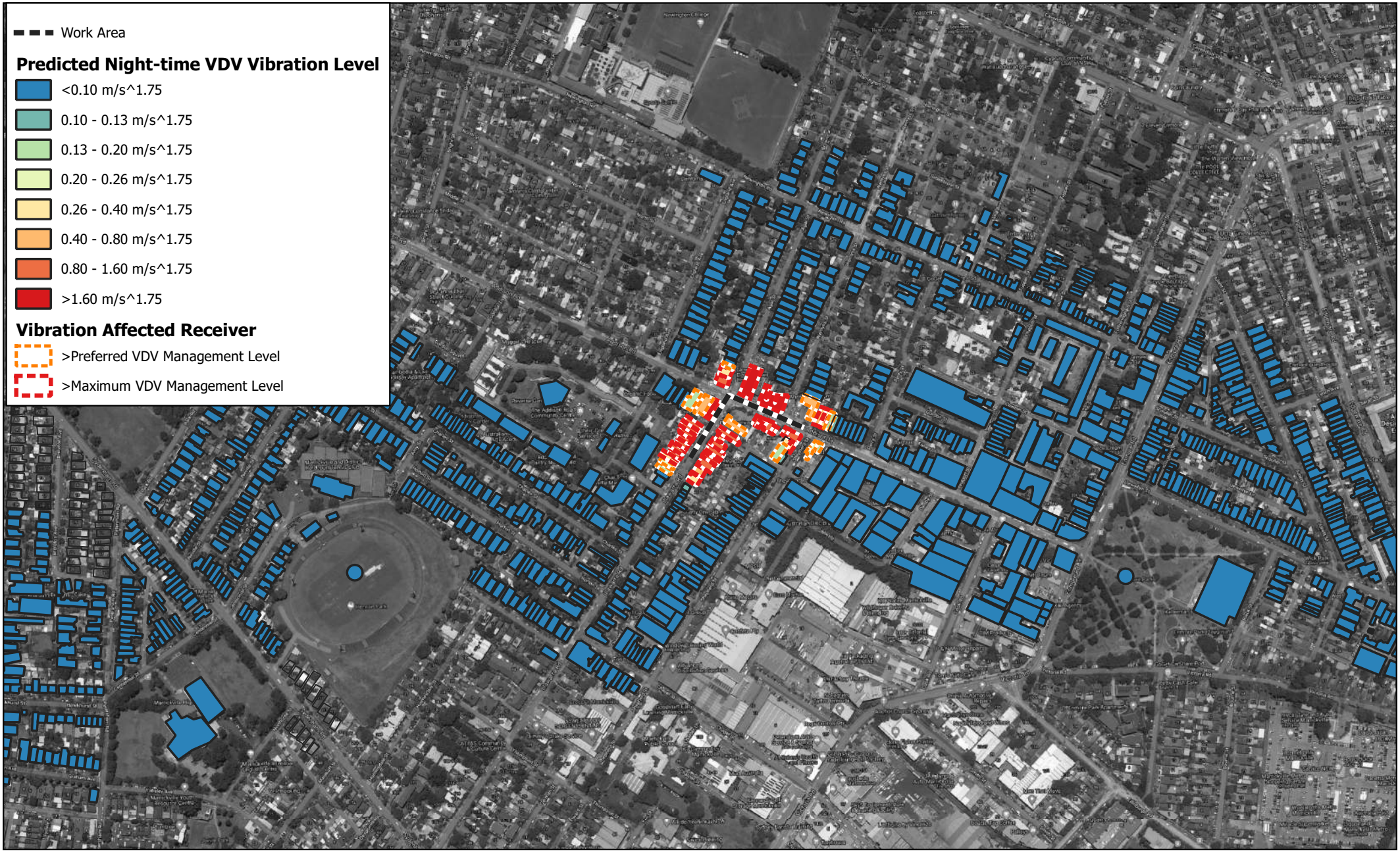

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Powering Sydney's Future

Potts Hill to Alexandria Transmission Cable Project

Out of Hours Works

Predicted Night-time VDV Vibration Levels

Intersection of Illawarra Road and Addison Road - Map 8 of 15

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Potts Hill to Alexandria Transmission Cable Project

Out of Hours Works

Predicted Night-time VDV Vibration Levels

Enmore Road - Map 9 of 15

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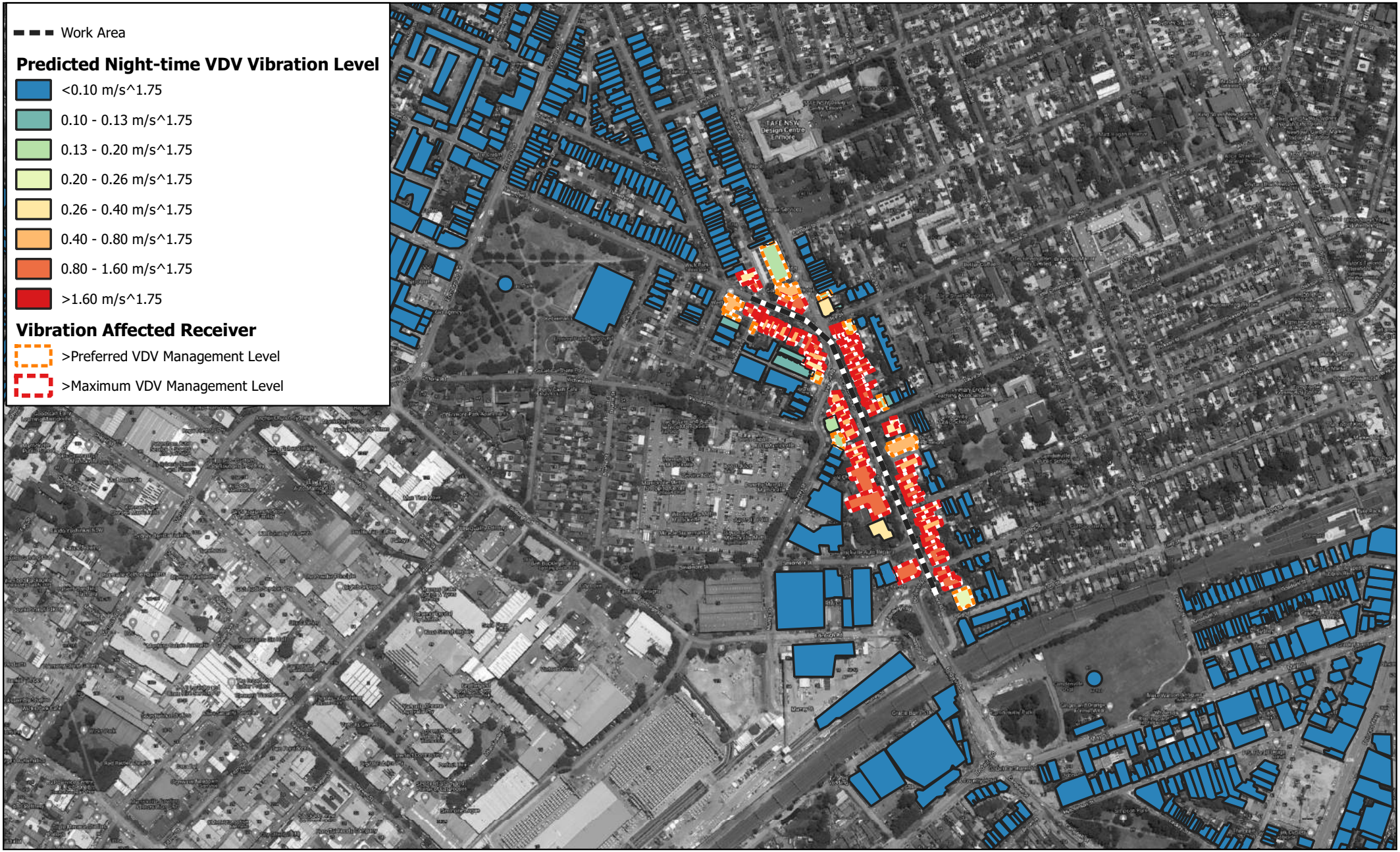

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Potts Hill to Alexandria Transmission Cable Project

Out of Hours Works

Predicted Night-time VDV Vibration Levels

Edgeware Road - Map 10 of 15

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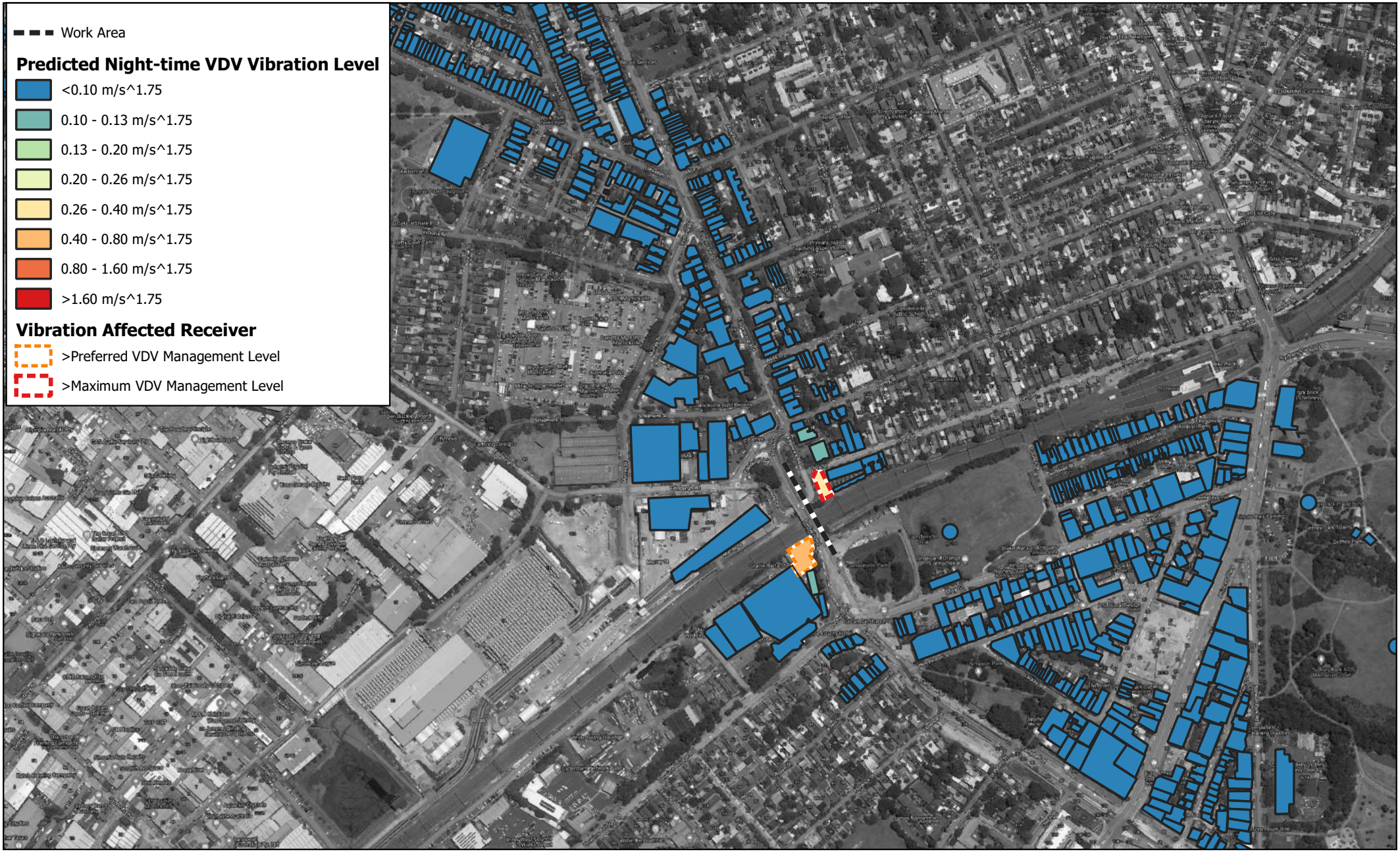

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Bedwin Road Bridge - Map 11 of 15

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Camdenville Park - Map 12 of 15

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May Street - Map 13 of 15

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Princes Highway - Map 14 of 15

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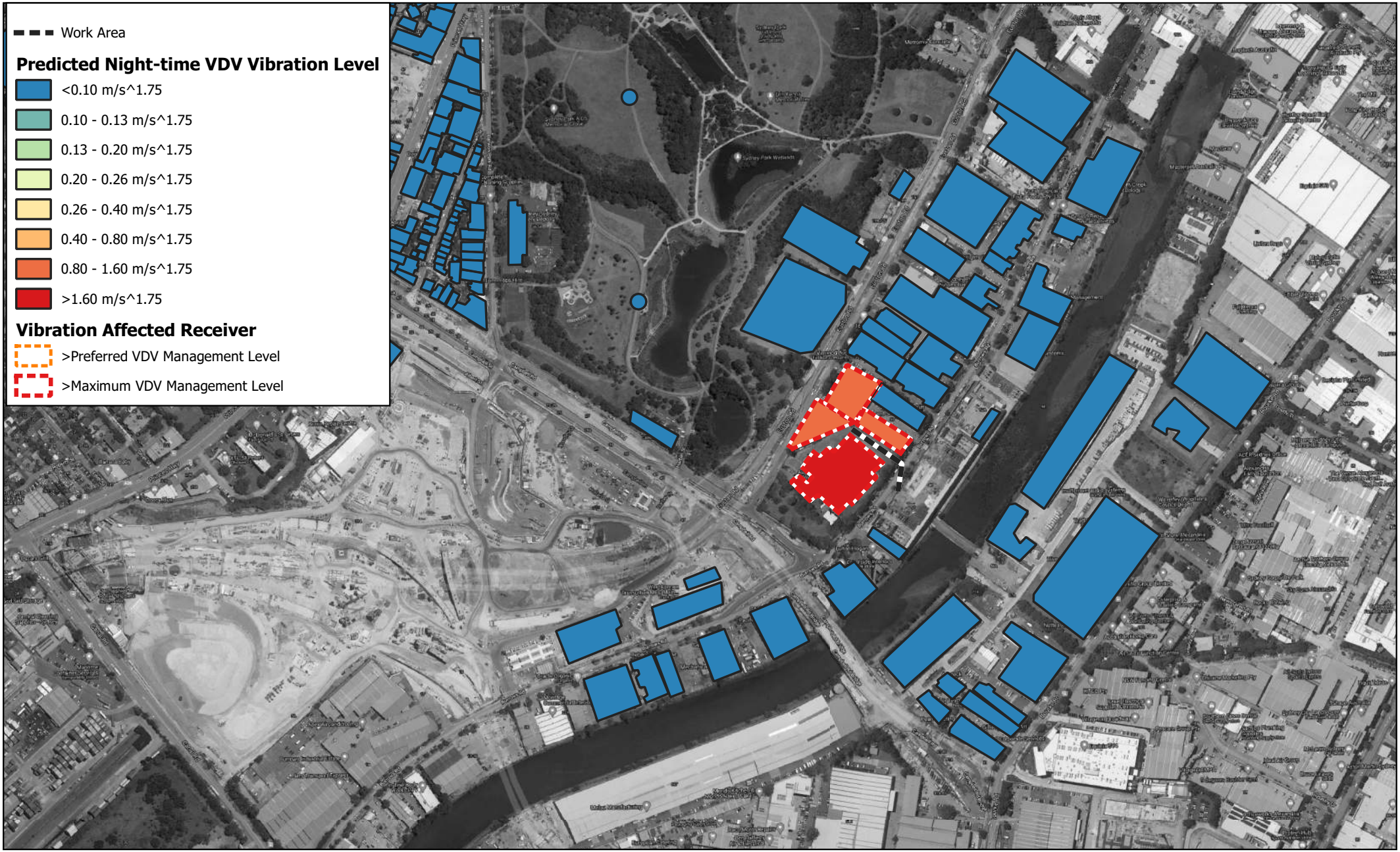

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Out of Hours Works

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Burrows Road - Map 15 of 15

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