Telopea Estate – Stage 1A

Noise Impact Assessment

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1 Introduction

White Noise Acoustics has been engaged to undertake the Noise Impact Assessment of the proposed residential development located at Telopa Estate, Stage 1A.

The proposed project includes a multi-storey residential development including 5 towers up to 13 stories in height.

This assessment includes the acoustic investigation into the potential for noise impacts from the operation of the completed project as well as potential noise impacts from noise sources within the vicinity of the site which predominantly includes traffic noise on surrounding roadways and noise from the future operation of the railway line to the west of the site.

1.1 Development Description

The proposed Stage 1A site is located to the western side of Telopia Estate on Sturt Street. The surrounding receivers to the site include existing and future residential receivers as well as the future Parramatta Light Rail project which is located to the west of the site.

The site location is detailed in Figure 1 below.

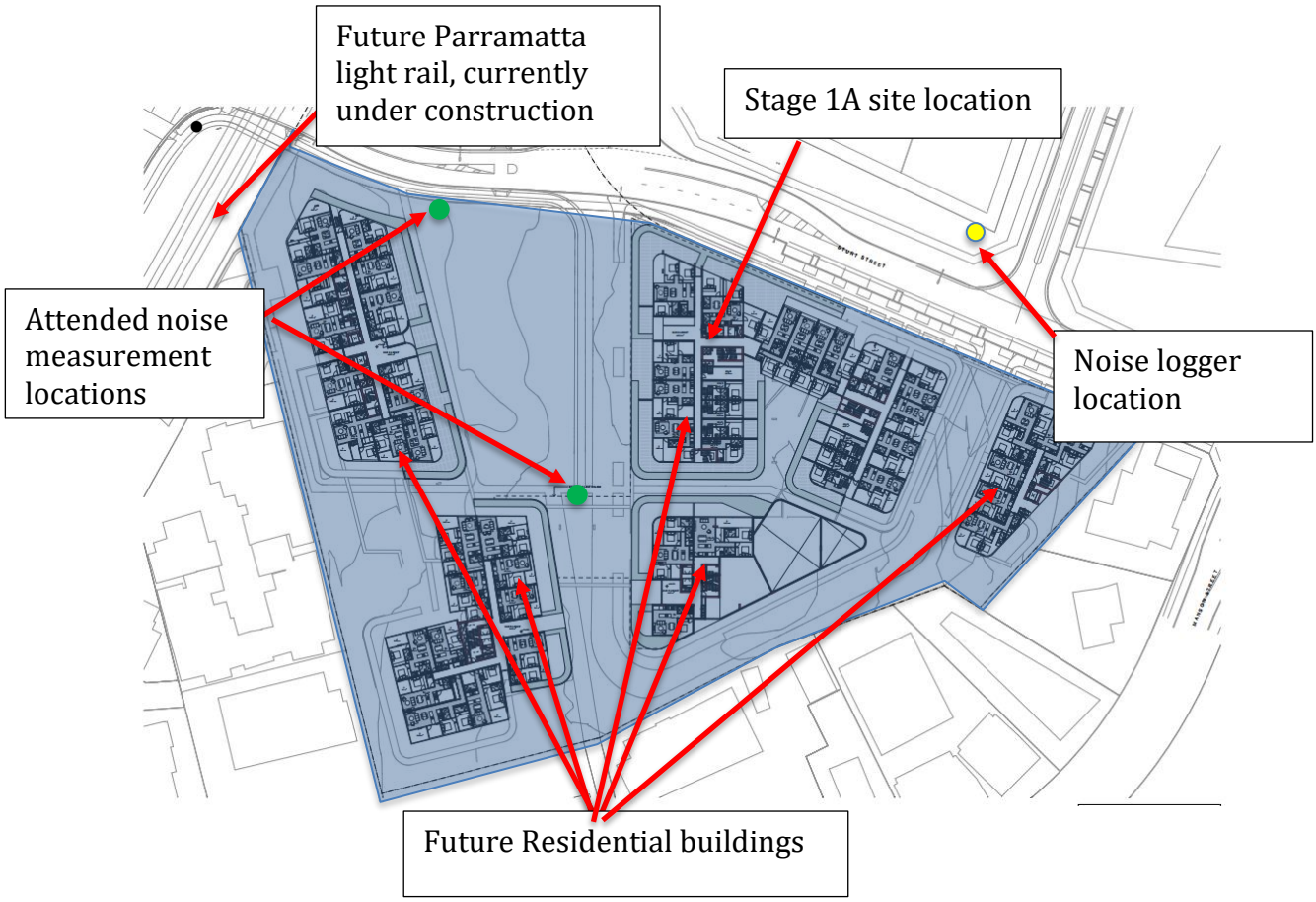


Figure 1 – Telopia Estate Stage 1A development site location

2 Proposed Development

The proposed project is located on the Site 1A of the Telopia Estate site and is located Sturt Street. The site is located within the City of Parramatta local government area.

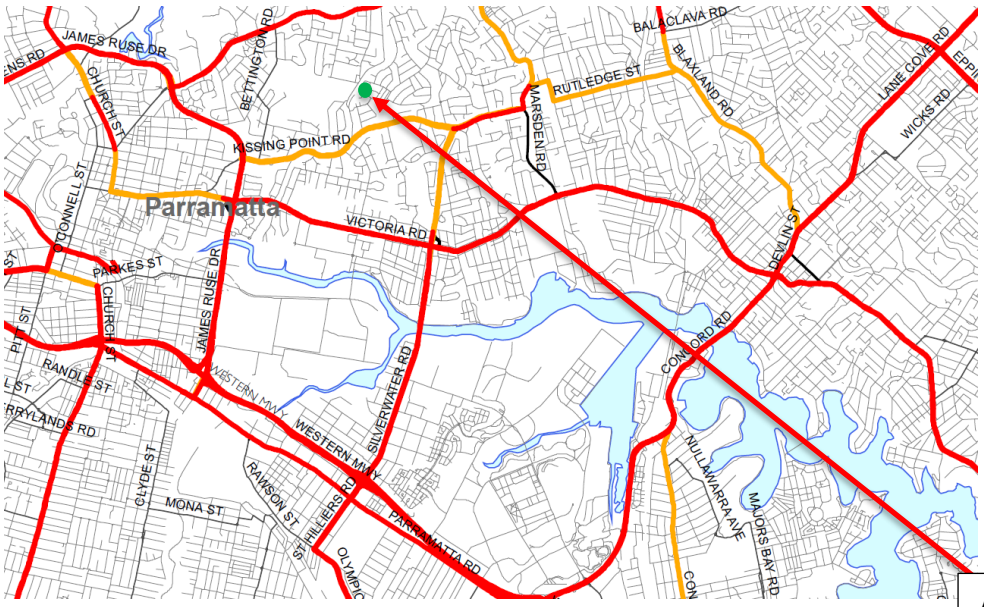
The proposed development will include a multi storey development with the inclusion of 452

3 Existing Acoustic Environment

The Telopia Estate Stage 1A site will be located within a typically residential area which is classified as a Suburban residential area. The existing noise levels are predominantly as a result from traffic noise within the vicinity of the site and the future Parramatta light rail located to the west of the site.

The site is located on roadways which are not defined as a busy road carrying over 40,000 Annual Average Daily Traffic (AADT) number, nor carries over 20,000 AADT as defined in Map 15 of the RTA's *Traffic Volume Maps for Noise Assessment for Buildings on Land Adjacent to Busy Roads*.

See the Figure below which includes the site location included on Map 15 as detailed above.



Approximate location of the site

Figure 2 – Site Location of Map 15 of the RTA's *Traffic Volume Maps for Noise Assessment for Buildings on Land Adjacent to Busy Roads*

3.1 Noise Survey Results

The attended noise survey of the site was undertaken to characterise the acoustic environment within the vicinity of the site.

As part of this assessment an acoustic survey of the existing acoustic environment at the site was undertaken. The survey included attended noise level measurements, during various times of the day on the 4th April, 2020 as well as long term unattended noise logging which was undertaken between the 27th March and the 3rd April, 2020.

Noise logging was undertaken using a ARL EL-215 type noise monitor with serial number 396932 and calibration with calibration number C19465. The noise logger was located to the front of the site as detailed in Figure 1 above. The logger was positioned such that it was in a free field location and façade corrections were not required to be applied as detailed in Figure 1 above.

Attended noise testing was conducted using a Bruel and Kjaer 2236C type meter. The meter was calibrated before and after testing and no significant drift was recorded.

The attended and unattended noise locations were selected to obtain suitable noise levels for the assessment of background noise levels ($L_{90\,(t)}$) as well as the impact from traffic movements ($Leq_{(t)}$). The results of the acoustic survey are detailed in the tables below which have been used as the basis of this assessment.

Table 1 – Results of the Attended Noise Survey at the Site

Measurement Location	Time of Measurement	Recoded Noise level Leq	Background Noise Level $L_{A90,\,15min}$ dB(A)	Comments
Attended noise measurement location, To the north	Day time	59 $L_{eq,\,5min}$ dB(A)	49	Noise level at the site dominated by vehicle movements on surrounding roadways
Attended noise measurement, to the south	Day time period	58 $L_{eq,\,15min}$ dB(A)	48	

Table 2 – Results of the Noise Logging at the Site

Measurement Location	Time of Measurement	Maximum Repeatable $L_{Aeq, 15min}$ dB(A)	Representable Background noise Level (RBL) $L_{A90, 15min}$ dB(A)
Noise logger location, see figure 1 above	Day	51	45
	Evening	43	40
	Night	40	37

4 Internal Noise Level Criteria

Internal noise levels within the future residential occupancies have been based on the relevant noise levels as detailed within the Australian Standard AS2107:2000 *Acoustics - Recommended design sound levels and reverberation times for building interiors*.

The recommended levels for various areas of the project are detailed in the following table. The recommended noise levels for residential dwellings near major roadways detailed within AS2107:2016 have been used as the basis of this assessment.

Table 3 - design Recommended design sound levels and reverberation times

Type of Occupancy/Activity	Design sound level maximum ($L_{Aeq,t}$)
Apartment common areas (e.g. foyer, lift lobby)	55
Residential - Living areas	45
Residential - Sleeping areas (night time)	40
Toilets	55
Note: The relevant time period (t) for all areas detailed is 15 minutes.	

5 Future Impacts from Light Rail

This section of the report details the assessment of potential impacts from the proposed light rail which will be located to the west of the site.

The assessment is based on the magnitudes of noise and vibration generated from the operational Sydney Light Rail located in Haymarket as the likely source of future noise and vibration impacts on the site.

5.1 Internal Noise Level Requirements

Internal noise levels from the operation of the future light rail have been designed to comply with the requirements of the Department of Planning *Development Near Rail Corridor and Busy Roads – Interim Guideline (DNRCBR).*

The DNRCBR includes the following requirements for the relevant design of internal areas of residential developments near busy roads or rail infrastructure, including the following:

> ***For Clauses 87 (Rail) and 102 (Road):***
> *If the development is for the purpose of a building for residential use, the consent authority must be satisfied that appropriate measures will be taken to ensure that the following LA_{eq} levels are not exceeded:*
> - *in any bedroom in the building: 35dB(A) at any time 10pm–7am*
> - *anywhere else in the building (other than a garage, kitchen, bathroom or hallway): 40dB(A) at any time.*

The recommended levels for various areas of the project are detailed in the following table. The recommended noise levels for residential dwellings near major roadways are detailed within AS2107:2016 and DNRCBR have been used as the basis of this assessment.

Table 4 - Design Recommended Internal Sound Levels Department of Planning and AS2107:2016

Type of Occupancy/Activity	Design sound level maximum
Apartment common areas (e.g. foyer, lift lobby)	55 $L_{Aeq\ 15\ min}$
Residential - Living areas	40 $L_{Aeq\ 24\ hour}$
Residential - Sleeping areas (night time)	35 $L_{Aeq\ 9\ hour}$[1]
Toilets	55 $L_{Aeq\ 15\ min}$
Note 1: The relevant time period for bedrooms include the period of 10pm to 7am	

5.2 Vibration Impact Criteria

The potential for vibration impact from the operation of the future light rail located to the north of the site has been assessed for both tactile vibration impact as well as ground borne vibration resulting in structure borne noise.

The suitable criteria for the assessment of tactile vibration and structure borne noise are detailed in the following sections.

5.2.1 Tactile Vibration Impacts

The Department of Planning *Development Near Rail Corridor and Busy Roads – Interim Guideline (DNRCBR)* references to *"Assessing Vibration – A Technical Guideline".*

Vibration effects relating specifically to the human comfort aspects of the project are taken from the guideline titled *"Assessing Vibration – A Technical Guideline"*. (AVTG). The AVTG recommends that habitable rooms should comply with the criteria therein which is in line with the requirements of British Standard BS 6472:1992 "*Evaluation of Human Exposure to Vibration in Buildings (1Hz to 80Hz)*".

The British Standard details suitable criteria for the assessment of intermittent vibrations to prevent adverse impacts on future residence.

Table 5 Intermittent vibration impacts criteria (m/s1.75) 1 Hz-80 Hz, Vibration Dose Values (VDV)

Location	Daytime		Night-time	
	Preferred Values	Maximum Values	Preferred Values	Maximum Values
Residences	**0.20**	0.40	**0.13**	0.26

For the purpose of this assessment the *Preferred Values* detailed in the standard have been used as the criteria.

5.2.2 Structure Borne Noise

The borne vibration is the potential for audible noise to be generated as the result of vibration transferred through the building structure and emanating from the building surfaces (such as walls, ceilings and the like) as audible noise within the future residential dwellings within the development.

Potential structure borne noise impacts as a result of the proposed light rail has been assessed in accordance with the criteria detailed within the DNRCBR which includes the following:

> *Generally, ground borne noise is associated more closely with rail operations than roads. Where buildings are constructed over or adjacent to land over tunnels, ground-borne noise may be present without the normal masking effect of airborne noise.*
>
> *In such cases, residential buildings should be designed so that the 95th percentile of train pass-bys complies with a ground-borne LAmax noise limit of 40dBA (daytime) or 35dBA (night-time) measured using the "slow" response time setting on a sound level meter.*

As the proposed light rail is to be an above ground line and not within a tunnel the requirements for ground borne vibration is not required to be assessed based on the DNRCBR as detailed above.

As the light rail is above ground the impact of airborne noise on the future residence will be greater than the potential for structure borne noise levels. Providing suitable treatments for airborne noise impacts are included in the design of the project and tactile vibration levels comply with the relevant criteria, then all relevant acoustic requirements will be achieved.

5.3 Future Parramatta Light Rail

As part of the assessment of the future light rail which is to be located to the west of the site and is not operational at this time.

The proposed light rail construction within the vicinity of the site includes a strait section of track on a ballasted track. The assessment of potential noise and vibration from the future Parramatta Light Rail (PLR) includes the information included in SLR *Parramatta Light Rail – Stage 1 – Noise and Vibration Impact Assessment* which is included in the PLR EIS.

To assess the potential for noise and vibration from the future operation of the PLR a review of the information in the EIS as well as measurements of operational light rail has been undertaken and are presented in the following sections.

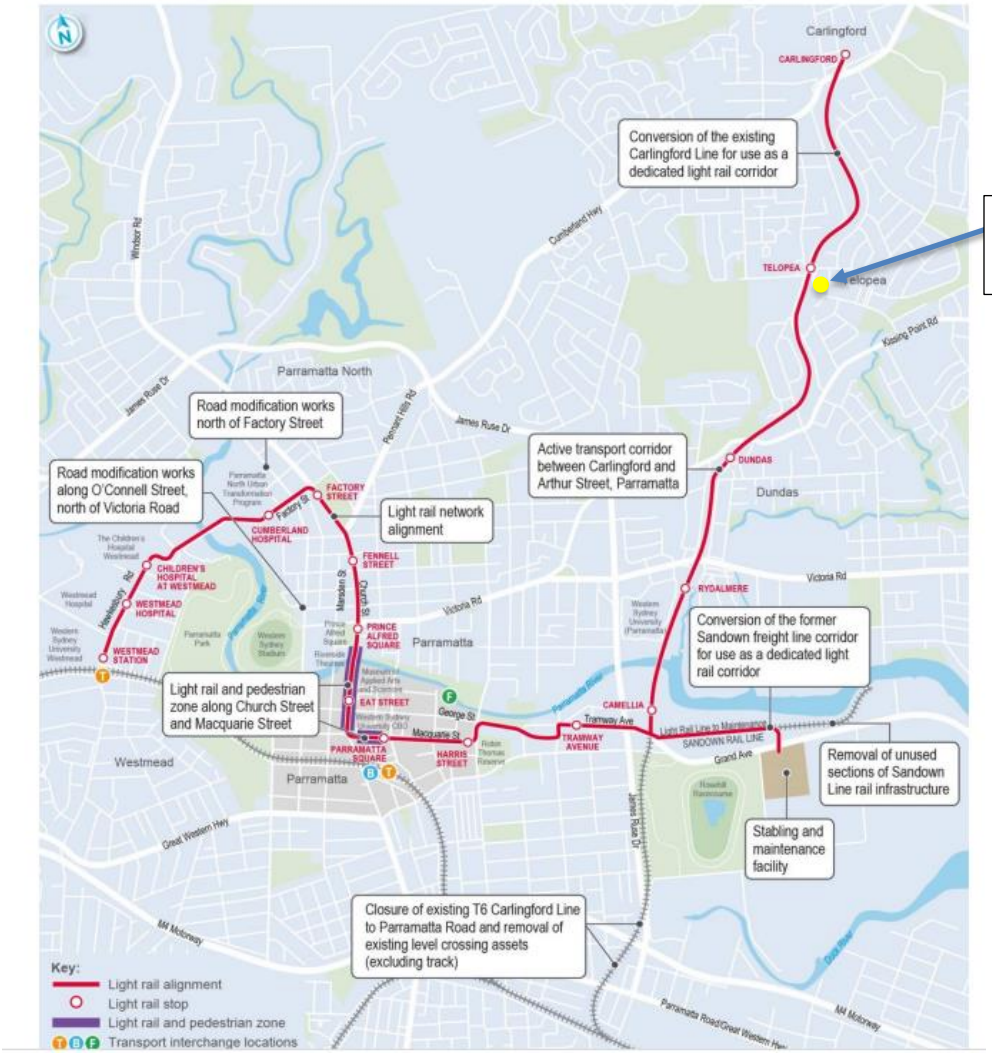
5.3.1 Parramatta Light Rail EIS

As part of the EIS for the Parramatta Light Rail (PLR) submission a noise and vibration assessment has been undertaken by SLR and is detailed in the *Parramatta Light Rail – Stage 1 – Noise and Vibration Impact Assessment* (Report Number 610.16769-R02) and dated 16 August 2017.

The *Parramatta Light Rail – Stage 1 – Noise and Vibration Impact Assessment* includes the assessment of potential for noise and vibration impact from the operation of light rail on surrounding receivers.

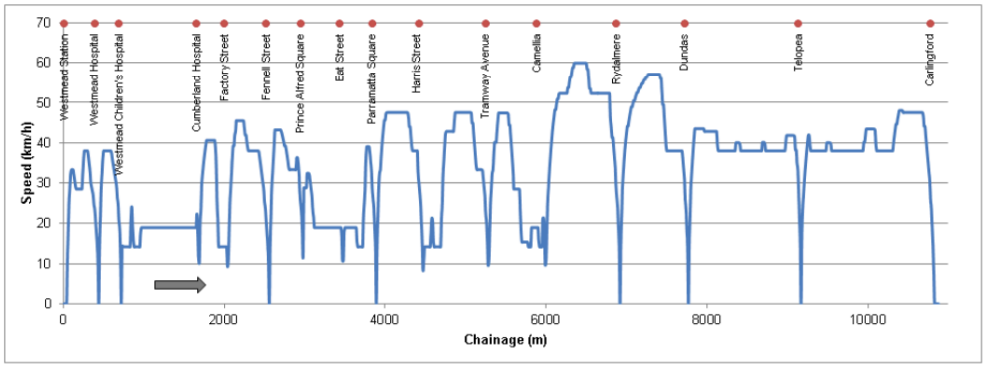
The location of the proposed Telopa Estate, Stage 1A site includes that within the vicinity of the Telopea station as detailed in Figure 1 of the EIS and detailed below.

Figure 1 The Project



The site is located within the vicinity of Telopea station.

Figure 35 of the *Parramatta Light Rail – Stage 1 – Noise and Vibration Impact Assessment* includes details of the expected speed profile of the light rail, as detailed below.

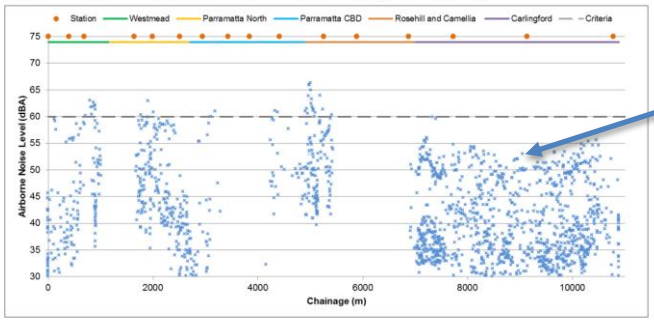
> The speeds along the alignment used for noise modelling purposes in both directions are shown in **Figure 35** and **Figure 36**. It is noted that the speed profiles used in the assessment assume that LRVs are not interrupted at any signalised intersections on the alignment. This approach is conservative, as in reality LRVs would be likely to stop at intersections at times with a resultant reduction in speed (and noise emissions) on both approach and departure from the intersection.
>
> **Figure 35 Speed Profile for the Alignment (Westmead to Carlingford)**
>
> 
>
>
> Note: The chainage (distance) on the x axis has been referenced from the first stop (Westmead) at 0 for display purposes.

Based on the location of the site the expected speed within the vicinity of the site is up to 40-45km/h.

Section 4.5 *Predicted Operational Airborne Noise Levels* of the *Parramatta Light Rail – Stage 1 – Noise and Vibration Impact Assessment* includes the assessment of future operational noise levels on surrounding receivers.

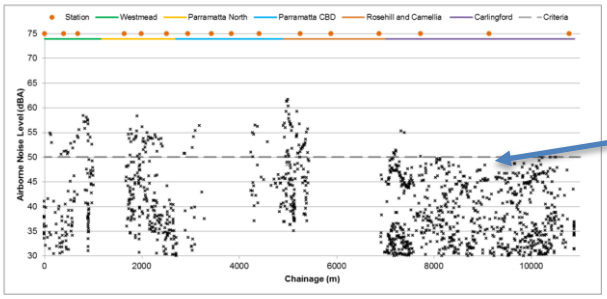
Figures 37 and 38 of the *Parramatta Light Rail – Stage 1 – Noise and Vibration Impact Assessment* includes predicted noise levels from the light rail, which include the following.

Figure 37 Residential Operational Airborne Noise Levels (Daytime $L_{Aeq(15hour)}$)



Predicted operational noise levels for the proposed site

Figure 38 Residential Operational Airborne Noise Levels (Night-time $L_{Aeq(9hour)}$)



Predicted operational noise levels for the proposed site

Based on the information included in the *Parramatta Light Rail – Stage 1 – Noise and Vibration Impact Assessment* and the proposed location of the Telopa Estate, Stage 1A site the predicted operation noise levels on the future dwellings includes the following:

1. Daytime noise levels – Up to 55 dB(A) $L_{eq\ (15\ hr)}$
2. Night time noise levels – Up to 50 dB(A) $L_{eq\ (9\ hr)}$

The assessment of noise impact from the future operation of the Parramatta Light Rail detailed in this report have included the predicted levels included in the *Parramatta Light Rail – Stage 1 – Noise and Vibration Impact Assessment* and detailed in the points above.

Section 5.4 of the *Parramatta Light Rail – Stage 1 – Noise and Vibration Impact Assessment* includes an assessment of potential operation vibration impact on surrounding receivers, details of the vibration assessment are including Table 76 which is included below.

5.4 Predicted Operational Vibration Levels

Table 76 shows indicative vibration dose levels at the nearest sensitive receivers (of all types) to the alignment in each precinct and NCA.

Table 76 Indicative Operational Vibration Dose by Precinct and Noise Catchment Area

Precinct	Noise Catchment Area	Minimum Criteria[1]	Maximum Predicted Operational VDV (m/s$^{1.75}$)	
			Daytime	Night-time
Westmead	NCA01	0.1	<0.01	<0.01
	NCA02	0.1	0.01	0.01
	NCA03	0.1	0.05	0.03
	NCA04	0.1	0.01	0.01
	NCA05	0.1	0.01	0.01
Parramatta North	NCA06	0.1	0.04	0.03
	NCA07	0.1	0.02	0.01
Parramatta CBD	NCA08	0.1	0.01	0.01
	NCA09	0.1	0.02	0.01
	NCA10	0.1	<0.01	<0.01
Rosehill and Camellia	NCA11	0.1	0.01	0.01
	NCA12	0.1	0.01	0.01
	NCA13	0.1	<0.01	<0.01
Carlingford	NCA14	0.1	0.01	0.01
	NCA15	0.1	0.02	0.02
	NCA16	0.1	0.01	0.01
	NCA17	0.1	0.03	0.02
	NCA18	0.1	0.03	0.02
	NCA19	0.1	0.01	0.01

Note 1: Minimum VDV Criteria shown is the minimum for sensitive receivers of any type, in either the daytime or night-time period (see **Table 74**).

No exceedances of the human comfort vibration dose criteria are predicted anywhere adjacent to the alignment.

Suitable assessment locations to the proposed site

Based on the predicted vibration resulting from the operation of the operation of the future Parramatta Light Rail include the following:

1. Daytime – VDV 0.03
2. Night time – VDV 0.02

The predicted VDV of the operation vibration impacts on the surrounding receivers and included in the *Parramatta Light Rail – Stage 1 – Noise and Vibration Impact Assessment* are compliant with the relevant vibration criteria without additional vibration mitigations.

5.3.2 Operational Light Rail Noise and Vibration Testing

To assess potential noise and vibration impacts on the proposed development, measurements of the operational Sydney Light Rail in Haymarket (at a representative location of approximately 20m) has been used as a representative source.

Noise and vibration measurements of the operational Sydney Light Rail have been undertaken at approximately 20m from the tracks, which is a representative location to the Phase 5 development, on Darling Drive Pyrmont as detailed in the figure below. The noise and vibration levels measured at this located have been used as representative levels potentially impacting the site from the operation of the future Parramatta Light rail.

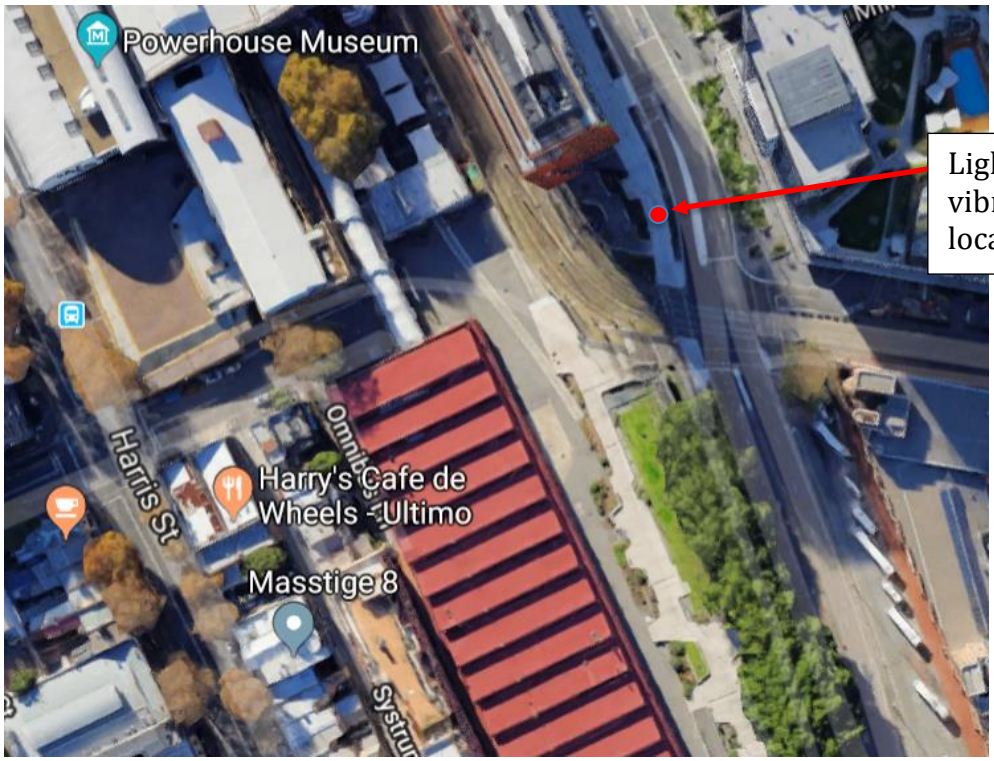


Figure 4 – Light rail noise and vibration location

The results of testing detailed in this section of the report represent future possible noise and vibration impacts of the light rail which is located to the north of the proposed Phase 5 site. Measurements include the noise levels resulting from multiple train pass bys including no less than 8 movements.

In addition to the measurements of light rail operation at Pyrmont noise and vibration testing of a strait section of track has also been undertaken, based on the type of track within the vicinity of the proposed site.

As part of this assessment additional measurements of a light rail installation, including a strait section of track and speed profile as detailed in Figure 35 of the *Parramatta Light Rail – Stage 1 – Noise and Vibration Impact Assessment.*

Sample noise and vibration testing was undertaken on Devonshire Street as detailed in the figure below.

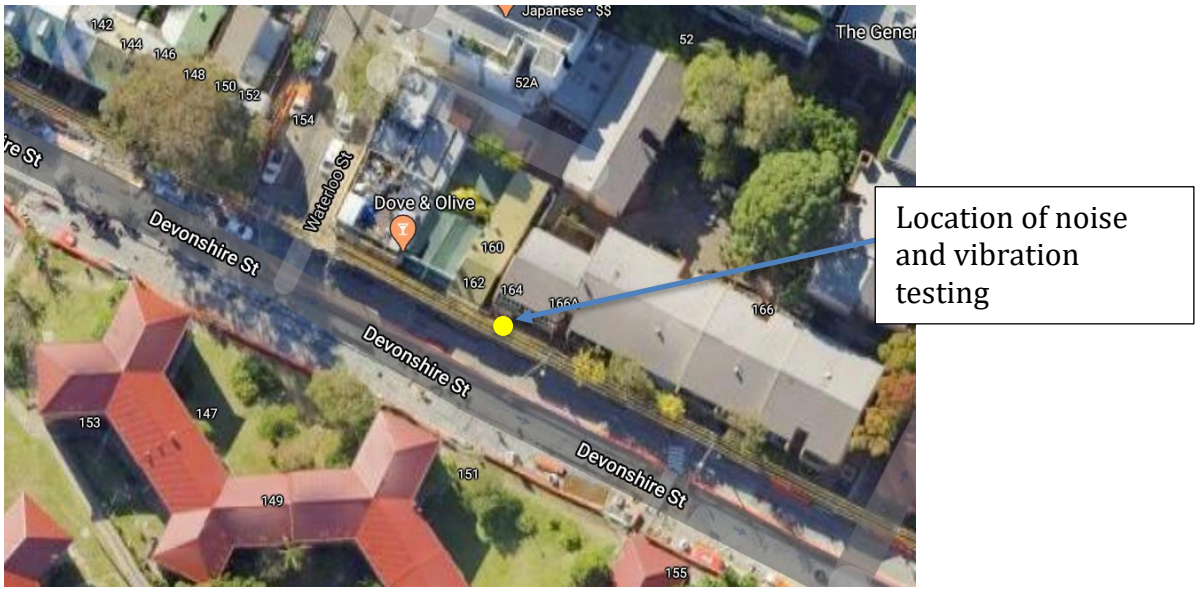


Figure 5 – Light rail noise and vibration location

Noise and vibration measurements of the operational Sydney Light Rail have been undertaken at approximately 10m from the tracks, which is a representative location to the Phase 5 development, on Devonshire Street (including strait tracks) as detailed in the figure above. The noise and vibration levels measured at this located have been used as representative levels potentially impacting the site from the operation of the future Parramatta Light rail.

It is noted that at the site of this report the Dulwich Hill light rail was not operational at the time and therefore representative noise and vibration testing of a track of ballast was not undertaken, which would have been preferred.

5.3.3 Vibration Measurements

This section of the report details the measured vibration levels associated with light rail passbys at the location described in this section of the report.

The assessment included attended vibration measurements conducted on the following occasions:

1. Pyrmont location - 11th October, 2019 between 4pm and 4.45pm. Vibration levels were undertaken using a Svan 958 type vibration meter and analyzer fitted with a triaxial accelerometer. No less than 8 pass bys were measured during the testing.
2. Devonshire Street location – 3rd February 2022, between 3.30pm and 4.40pm including a Svan 958 type vibration meter and analyzer fitted with a triaxial accelerometer. No less than 8 pass bys were measured during the testing.

Obtained vibration levels included a number of light rail passbys, including a period of 45 min which have been used to determine the period vibration exposure for the daytime and night-time periods Vibration Dose Values (VDV) including no less than 8 pass bys at each location.

The results of the vibration level measurements including the calculations for VDV are detailed in the table below.

Table 6 Calculated VDV

Location	Period	Criteria VDV m/s1.75	Calculated VDV m/s1.75
Future Residential Dwellings – Based on Pyrmont Testing	Daytime	**0.20**	**0.05**
	Night-Time	**0.13**	**0.02**
Future Residential Dwellings – Based on Devonshire Testing	Daytime	**0.20**	**0.08**
	Night-Time	**0.13**	**0.03**

Based on the results of the sample light rail measurement and well and the SLR *Parramatta Light Rail – Stage 1 – Noise and Vibration Impact Assessment* included in Section 5.3.1 above no additional acoustic treatment (or building vibration isolation) is required to comply with the relevant standards and ensure a suitable acoustic amenity for future occupants of the development.

5.3.4 Noise Level Measurements

This section of the report details the measured noise levels resulting from the operation of the light rail passbys.

Attended noise testing was conducted using a Bruel and Kjaer 2236C type meter. The meter was calibrated before and after testing and no significant drift was recorded.

Noise levels measurements were undertaken on the following occasions:

1. Pyrmont location - 11th October, 2019 between 4pm and 4.45pm. Vibration levels were undertaken using a Svan 958 type vibration meter and analyzer fitted with a triaxial accelerometer. No less than 8 pass bys were measured during the testing.
2. Devonshire Street location – 3rd February 2022, between 3.30pm and 4.40pm including a Svan 958 type vibration meter and analyzer fitted with a triaxial accelerometer. No less than 8 pass bys were measured during the testing.

The attended and unattended noise locations were selected to obtain suitable noise levels for the assessment of noise impact from the light rail ($Leq_{(t)}$). The results of the acoustic survey are detailed in the table below which have been used as the basis of this assessment.

Table 7 – Light Rail Noise Level Measurements

Measurement Location	Time of Measurement	Recoded Noise level Leq	Comments
20m From the Light Rail in Haymarket	4.15pm – 4.30pm	59 $L_{eq,\ 15min}$ dB(A)	Noise dominated from the movement of light rail.
10m From the Light Devonshire Street	3.30pm – 4.40pm	61 $L_{eq,\ 15min}$ dB(A)	Noise dominated from the movement of light rail.

Providing the recommended acoustic treatments to the building facades and detailed in the following sections of this report are included in the design of the project all relevant acoustic criteria will be achieved and a suitable acoustic amenity for the future dwellings of the project will be achieved.

6 Environmental Noise Intrusion Assessment

This section of the report details the assessment of environmental noise intrusion into the proposed development and the recommended acoustic treatments to ensure the recommended internal noise levels detailed in the Sections above (including traffic noise intrusion) are achieved.

Internal noise levels within the future areas of the development will result from the noise intrusion into the building through the external façade including glass, masonry and other façade elements. Typically, the acoustic performance of building elements including the relatively light weight elements of the building façade, including glass and/or plasterboard constructions, will be the determining factors in the resulting internal noise levels.

Calculations of internal noise levels have been undertaken based on the measured traffic and calculated aircraft environmental noise levels at the site and the characteristics of the building, including window openings, buildings constructions and the like.

6.1 External Glass Elements

The recommended acoustic constructions to the buildings external façade glass elements are detailed in the table below to ensure the recommended internal noise levels detailed above are achieved, with the façade building openings closed.

Calculations include the predicted maximum noise levels which may impact the future building façade elements, including 60 dB(A) Leq daytime and 55 dB(A) L_{eq} night times. The resulting calculations assume faced elements may include sliding doors and the like to façade elements facing the future light rail, internal rooms with hard surfaces in living areas and carpet to bedrooms.

The recommended constructions included below include those to ensure internal noise levels will comply with the required noise level criteria detailed in Section 5.1 above.

Table 8 – External Glass Acoustic Requirements

Façade Orientation	Levels	Room Type	Recommended Glass Construction	Minimum Façade Acoustic Performance[1]
Facing West directly towards future light rail	All Levels	Bedrooms	10.38mm Laminated	Rw 35
		Living Rooms	6.38mm Laminated	Rw 30
		Wet areas	6mm Float/Toughened	Rw 28
All Other Orientations	All Levels	Bedrooms	6.38mm Laminated	Rw 30
		Living Rooms	6.38mm Laminated	Rw 30
		Wet areas	6mm Float/Toughened	Rw 28
Note 1: *The acoustic performance of the external façade includes the installed glazing and frame including (but not limited to) the façade systems seals and frame. All external glazing systems are required to be installed using acoustic bulb seals.*				

The recommended glass constructions detailed in the table above include those required to ensure the acoustic requirements of the project are achieved. Thicker glazing may be required to achieve other project requirements such as structural, thermal, safety or other requirements and is to be advised by others.

6.2 External Building Elements

The proposed external building elements including masonry or concrete external walls and roof are acoustically acceptable without additional acoustic treatment.

Any lightweight external pasteboard walls should be constructed from a construction with a minimum acoustic performance of Rw 50.

6.3 External Roof

The required external roof and ceiling constructions for the project are required to include the following:

1. Concrete external roof construction – no additional acoustic treatments required.
2. Metal deck roof construction – no additional acoustic treatments required.

6.4 External Opening and Penetrations

All openings and penetrations are required to be acoustically treated such that the performance of the building construction is not compromised. This may require lining of duck work behind mechanical service openings/grills, treatments to ventilation opening and the like.

6.5 Alterative Ventilation

The internal design sound levels including the internal noise level requirements of open windows + 10 dB(A) has been assessment.

Based on the measured noise levels at the site, the measured noise levels of the operational light rail and the predicted operational noise levels detailed in the *Parramatta Light Rail – Stage 1 – Noise and Vibration Impact Assessment* internal noise levels within windows open can be achieved and an alternative source of outside air is not required to be included in the design of the project.

7 External Noise Emission Assessment

This section of the report details the relevant noise level criteria for noise emissions generated on the site once completed.

The relevant authority which provides the required noise level criteria for noise levels generated on the site includes the NSW Environmental Protection Authority's (EPA) Noise Policy for Industry (NPI).

7.1 NSW Environmental Protection Authority, Noise Policy for Industry

The NSW Environmental Protection Authority (EPA) Noise Policy for Industry (NPI), previously Industrial Noise Policy, details noise criteria for the control of noise generated from the operation of developments and the potential for impact on surrounding receivers by permanent on site building services such as exhaust fans, condensers and the opening and closing of garage doors.

The NPI includes both intrusive and amenity criteria which are summarised below.

1. Intrusive noise level criteria, The NPI states the following:

   'The intrusiveness of an industrial noise source may generally be considered acceptable if the level of noise from the source (represented by the LAeq descriptor), measured over a 15minute period, does not exceed the background noise level by more than 5 dB when beyond a minimum threshold. This intrusiveness noise level seeks to limit the degree of change a new noise source introduces to an existing environment.'

2. Amenity noise level criteria, The NPfI states the following:

   'To limit continuing increases in noise levels from application of the intrusiveness level alone, the ambient noise level within an area from all industrial noise sources combined should remain below the recommended amenity noise levels specified in Table 2.2 where feasible and reasonable. The recommended amenity noise levels will protect against noise impacts such as speech interference, community annoyance and some sleep disturbance.'

   Project amenity noise level for industrial developments = recommended amenity noise level (Table 2.2) minus 5 dB(A)

   Where the resultant project amenity noise level is 10 dB or more lower than the existing industrial noise level. In this case the project amenity noise levels can be set at 10 dB below existing industrial noise levels if it can be demonstrated that existing industrial noise levels are unlikely to reduce over time.

The LAeq is determined over a 15-minute period for the project intrusiveness noise level and over an assessment period (day, evening and night) for the project amenity noise level. This leads to the situation where, because of the different averaging periods, the same numerical value does not necessarily represent the same amount of noise heard by a person for different time periods. To standardise the time periods for the intrusiveness and amenity noise levels, this policy assumes that the LAeq,15min will be taken to be equal to the LAeq, period + 3 decibels (dB), unless robust evidence is provided for an alternative approach for the particular project being considered.

Project amenity noise level (ANL) is urban ANL (Table 2.1) minus 5 dB(A) plus 3 dB(A) to convert from a period level to a 15-minute level (dB = decibel; dB[A] = decibel [A-weighted]; RBL = rating background noise level).

Noise level used in the assessment of noise emission from the site have been based on the noise level survey conducted at the site and detailed in this section of the report.

Consequently, the resulting noise level criteria are summarised in the table below. The criteria are nominated for the purpose of determining the operational noise limits for the operation of the site including mechanical plant associated with the development which can potentially affect noise sensitive receivers and operational noise levels from the future tenancies. For each assessment period, the lower (i.e. the more stringent) of the amenity or intrusive criteria are adopted. The calculated *Project Amenity Noise Level* includes either the Recommended Amenity Noise Level minus 5 dB(A) plus 3 dB(A) (for a 15minum period) or the measured existing Leq noise level – 10 dB if this is greater as determined by the NPfI.

7.2 Noise Emissions Summary

Based on the requirements of the EPA the resulting noise emissions criteria from the operation of services on the site are detailed in the table below.

Table 9 – External Noise Level Criteria in Accordance with the NSW NPI

Location	Time of Day	Project Amenity Noise Level, $L_{Aeq, period}$ [1] (dBA)	Measured $L_{A90, 15\ min}$ (RBL) [2] (dBA)	Measured $L_{Aeq, period}$ Noise Level (dBA)	Intrusive $L_{Aeq, 15\ min}$ Criterion for New Sources (dBA)
Suburban residences	Day	53	45	51	**46**
	Evening	**43**	40	43	45
	Night[4]	**38**	37	40	42

Note 1: Project Amenity Noise Levels corresponding to "Sub Urban" areas, recommended noise levels.
Note 2: L_{A90} Background Noise or Rating Background Level
Note 3: Project Noise Trigger Levels are shown in bold
Note 4: Noise from the operation of residential condensers are to be inaudible within a neighbouring residential premises

7.3 Noise Impact Assessment

An assessment of noise generated on the site has been undertaken in this section of the report. The assessment of noise levels generated on the site are summarised below:

1. Mechanical Services Equipment –Detailed selections of the proposed mechanical plant and equipment to be used on the site are not available at this time. All future plant and equipment are to be acoustically treated to ensure the noise levels at all surrounding receivers comply with noise emission criteria detailed within this report. Experience with similar projects indicated that it is both possible and practical to treat all mechanical equipment such that the relevant noise levels are achieved. Examples of the possible acoustic treatments to mechanical equipment includes the following:
    a. Basement Supply and Exhaust Fans – location of fans within the building and treated using internally lined ductwork or acoustic silencers.
    b. General supply and exhaust fans – general exhaust and supply fans such as toilet, kitchen, lobby and other small mechanical fans can be acoustically treated using acoustic flex ducting or internal lined ducting.
    c. Air conditioning equipment – The location of contenders within designated plant areas on roof tops, within the basement or individual equipment located on balconies will be acceptable providing noise levels are reviewed and approved prior to installation.

d. Details of the required mechanical services equipment and acoustic treatments to ensure the relevant noise level criteria is achieved will be provided as part of the CC submission of the project.
e. Garage Doors should include panel lift or sliding doors with smooth operation. The tracks should include guides such that metal on metal contact does not occur.
f. All motorised carpark access doors are required to be vibration isolated from the building structure such that internal noise levels within any habitable areas does not exceed 30 dB(A). Where possible roller doors should include panel lift or sliding doors.

8 Conclusion

This report details the Noise Impact Assessment of the proposed Telopia Estate Site 1A development.

This report has included an assessment of existing environmental noise including road traffic noise and future possible noise and vibration impacts from the proposed light rail which will be located to the west of the site.

This report details the required acoustic constructions of the building's façade, including external windows, to ensure that the future internal noise levels comply with the relevant noise levels of the Australian Standard AS2107:2016. Providing the recommended constructions detailed in this report are included in the construction of the project, the required internal noise levels will be achieved.

External noise emissions from the site have been assessed and detailed in accordance with the NSW Environmental Protection Authorities Noise Policy for Industry (previously the Industrial Noise Policy). The future design and treatment of all building services associated with the project can be acoustically treated to ensure all noise emissions from the site comply with the EPA NPfI criteria. Details of the equipment and associated acoustic treatments will be provided as part of the CC submission of the project.

For any additional information please do not hesitate to contact the person below.

Regards

Ben White
Director
White Noise Acoustics

9 Appendix A – Glossary of Terms

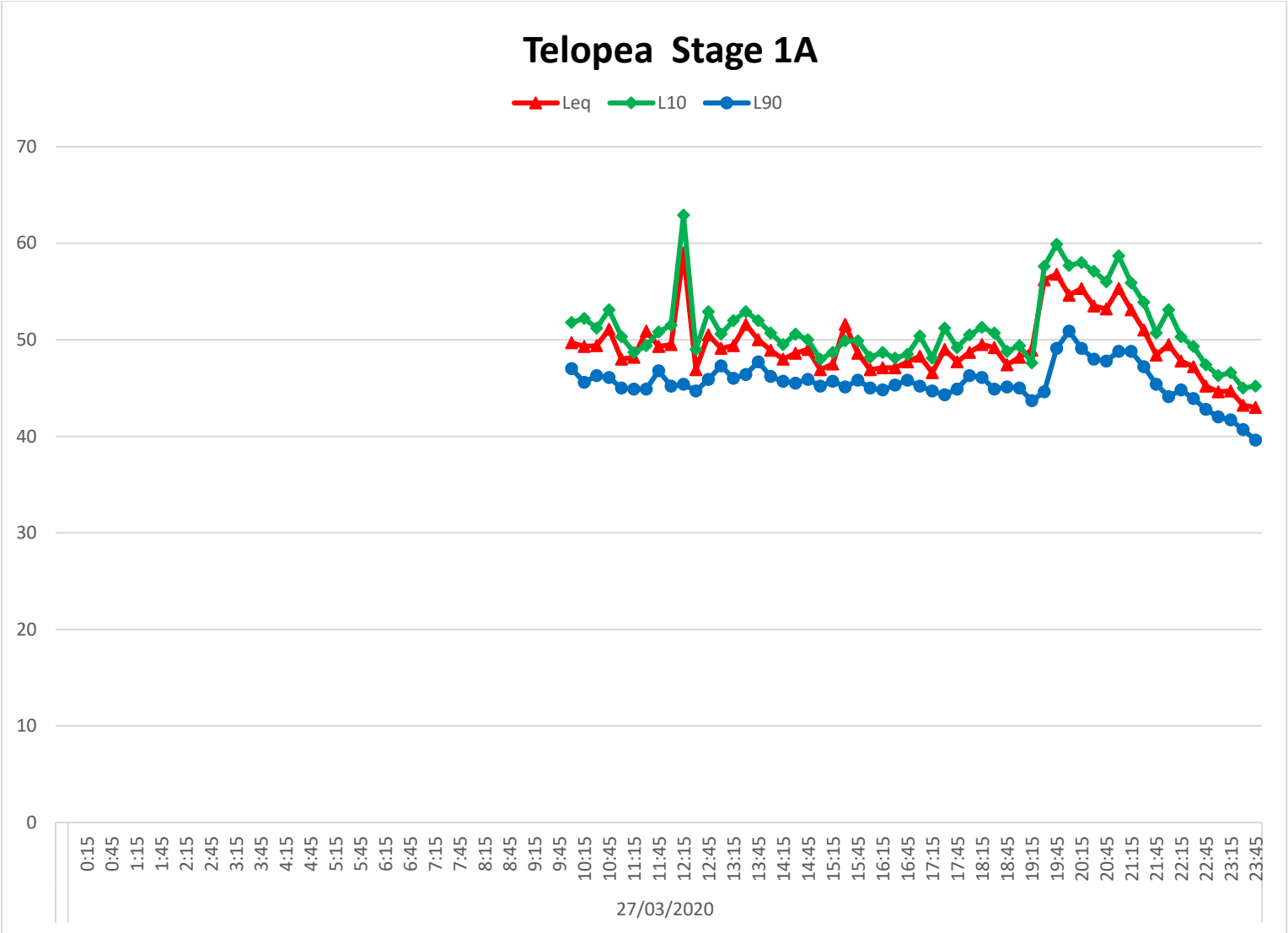
Ambient Sound	The totally encompassing sound in a given situation at a given time, usually composed of sound from all sources near and far.
Audible Range	The limits of frequency which are audible or heard as sound. The normal ear in young adults detects sound having frequencies in the region 20 Hz to 20 kHz, although it is possible for some people to detect frequencies outside these limits.
Character, acoustic	The total of the qualities making up the individuality of the noise. The pitch or shape of a sound's frequency content (spectrum) dictate a sound's character.
Decibel [dB]	The level of noise is measured objectively using a Sound Level Meter. The following are examples of the decibel readings of every day sounds;

0dB	the faintest sound we can hear
30dB	a quiet library or in a quiet location in the country
45dB	typical office space. Ambience in the city at night
60dB	Martin Place at lunch time
70dB	the sound of a car passing on the street
80dB	loud music played at home
90dB	the sound of a truck passing on the street
100dB	the sound of a rock band
115dB	limit of sound permitted in industry
120dB	deafening

dB(A)	*A-weighted decibels* The ear is not as effective in hearing low frequency sounds as it is hearing high frequency sounds. That is, low frequency sounds of the same dB level are not heard as loud as high frequency sounds. The sound level meter replicates the human response of the ear by using an electronic filter which is called the "A" filter. A sound level measured with this filter switched on is denoted as dB(A). Practically all noise is measured using the A filter. The sound pressure level in dB(A) gives a close indication of the subjective loudness of the noise.
Frequency	Frequency is synonymous to *pitch*. Sounds have a pitch which is peculiar to the nature of the sound generator. For example, the sound of a tiny bell has a high pitch and the sound of a bass drum has a low pitch. Frequency or pitch can be measured on a scale in units of Hertz or Hz.
Loudness	A rise of 10 dB in sound level corresponds approximately to a doubling of subjective loudness. That is, a sound of 85 dB is twice as loud as a sound of 75 dB which is twice as loud as a sound of 65 dB and so on
L_{Max}	The maximum sound pressure level measured over a given period.
L_{Min}	The minimum sound pressure level measured over a given period.
L_1	The sound pressure level that is exceeded for 1% of the time for which the given sound is measured.
L_{10}	The sound pressure level that is exceeded for 10% of the time for which the given sound is measured.
L_{90}	The level of noise exceeded for 90% of the time. The bottom 10% of the sample is the L_{90} noise level expressed in units of dB(A).
L_{eq}	The "equivalent noise level" is the summation of noise events and integrated over a selected period of time.
Background Sound Low	The average of the lowest levels of the sound levels measured in an affected area in the absence of noise from occupants and from unwanted, external ambient noise sources. Usually taken to mean the L_{A90} value

Ctr	A frequency adaptation term applied in accordance with the procedures described in ISO 717.
dB (A)	'A' Weighted overall sound pressure level
Noise Reduction	The difference in sound pressure level between any two areas. The term "noise reduction" does not specify any grade or performance quality unless accompanied by a specification of the units and conditions under which the units shall apply
NR Noise Rating	Single number evaluation of the background noise level. The NR level is normally around 5 to 6 dB below the "A" weighted noise level. The NR curve describes a spectrum of noise levels and is categorised by the level at 1000 Hz ie the NR 50 curve has a value of 50 dB at 1000 Hz. The NR rating is a tangential system where a noise spectrum is classified by the NR curve that just encompasses the entire noise spectrum consideration.
R_w	Weighted Sound Reduction Index - Laboratory test measurement procedure that provides a single number indication of the acoustic performance of a partition or single element. Calculation procedures for Rw are defined in ISO 140-2:1991 "Measurement of Sound Insulation in Buildings and of Building Elements Part 2: Determination, verification and application of precision data".
R'_w	Field obtained Weighted Sound Reduction Index - this figure is generally up to 3-5 lower than the laboratory test determined level data due to flanked sound transmission and imperfect site construction.
Sound Isolation	A reference to the degree of acoustical separation between any two areas. Sound isolation may refer to sound transmission loss of a partition or to noise reduction from any unwanted noise source. The term "sound isolation" does not specify any grade or performance quality and requires the units to be specified for any contractual condition
Sound Pressure Level, L_P dB	A measurement obtained directly using a microphone and sound level meter. Sound pressure level varies with distance from a source and with changes to the measuring environment. Sound pressure level equals 20 times the logarithm to the base 10 of the ratio of the rms sound pressure to the reference sound pressure of 20 micro Pascals.
Sound Power Level, L_W dB	Sound power level is a measure of the sound energy emitted by a source, does not change with distance, and cannot be directly measured. Sound power level of a machine may vary depending on the actual operating load and is calculated from sound pressure level measurements with appropriate corrections for distance and/or environmental conditions. Sound power levels is equal to 10 times the logarithm to the base 10 of the ratio of the sound power of the source to the reference sound power of 1 picoWatt
Speech Privacy	A non-technical term but one of common usage. Speech privacy and speech intelligibility are opposites and a high level of speech privacy means a low level of speech intelligibility. It should be recognised that acceptable levels of speech privacy do not require that speech from an adjacent room is inaudible.
Transmission Loss	Equivalent to Sound Transmission Loss and to Sound Reduction Index in terminology used in countries other than Australia. A formal test rating of sound transmission properties of any construction, by usually a wall, floor, roof etc. The transmission loss of all materials varies with frequency and may be determined by either laboratory or field tests. Australian Standards apply to test methods for both situations.

10 Appendix B – Noise Logging Results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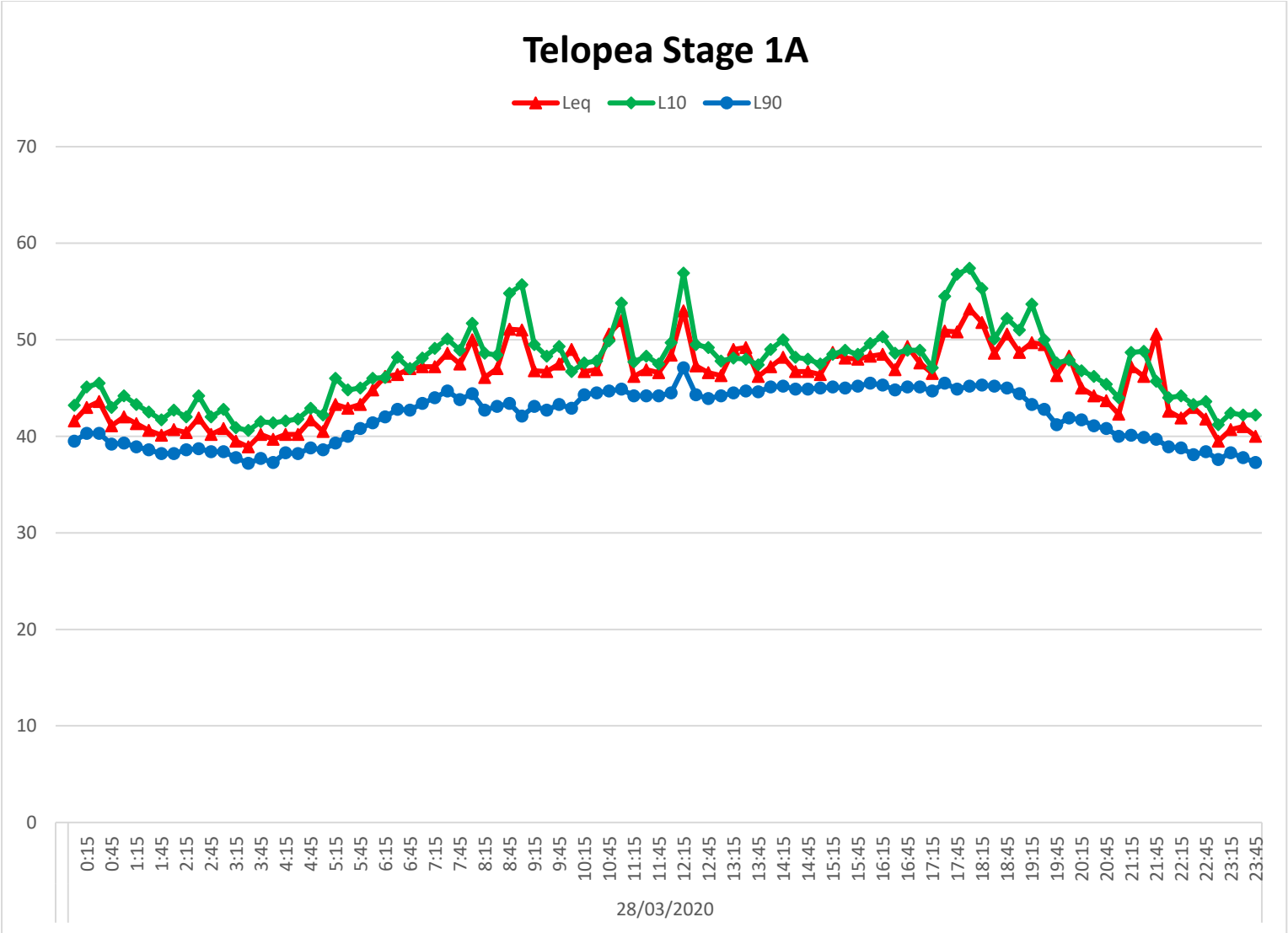
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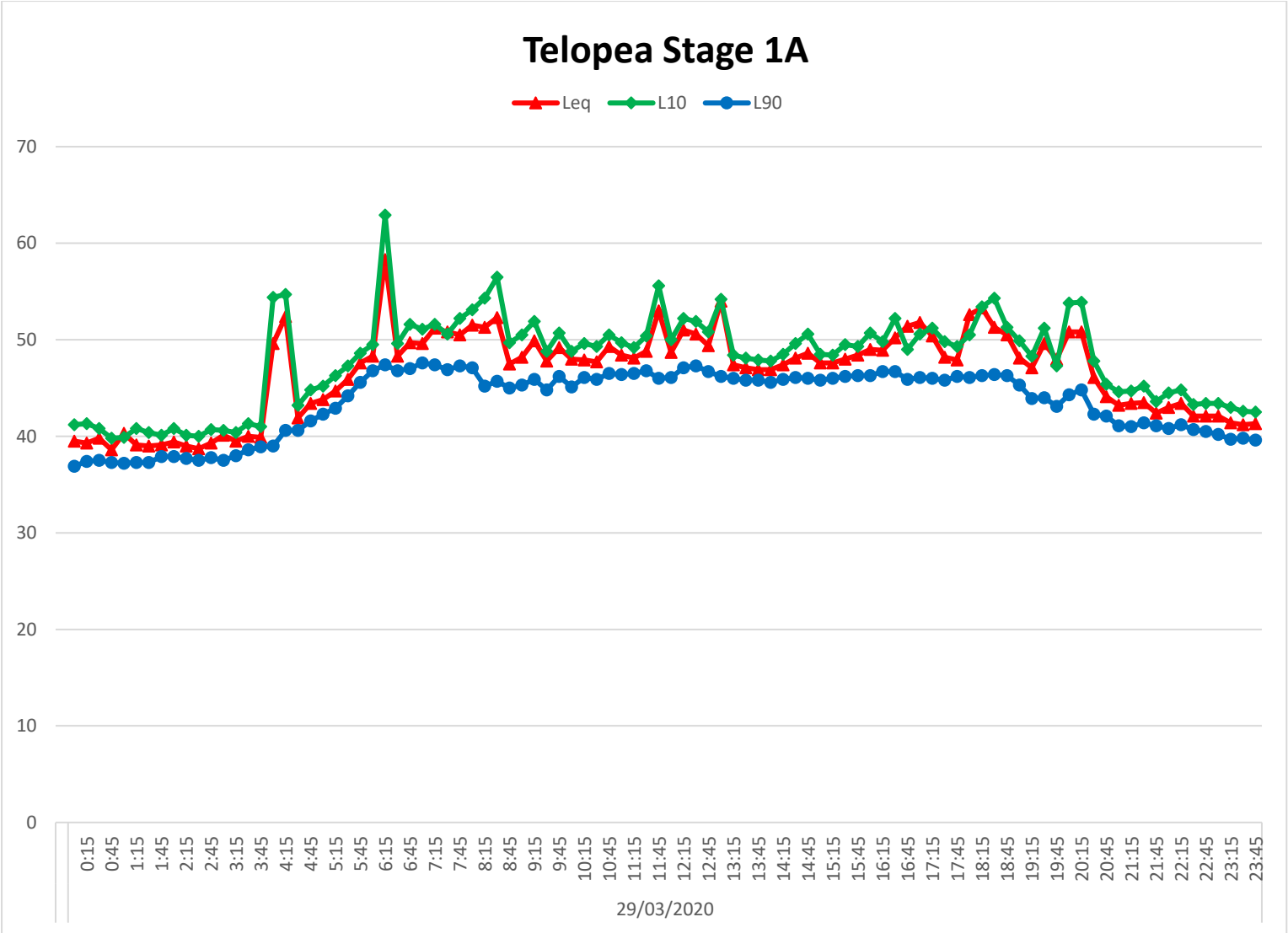
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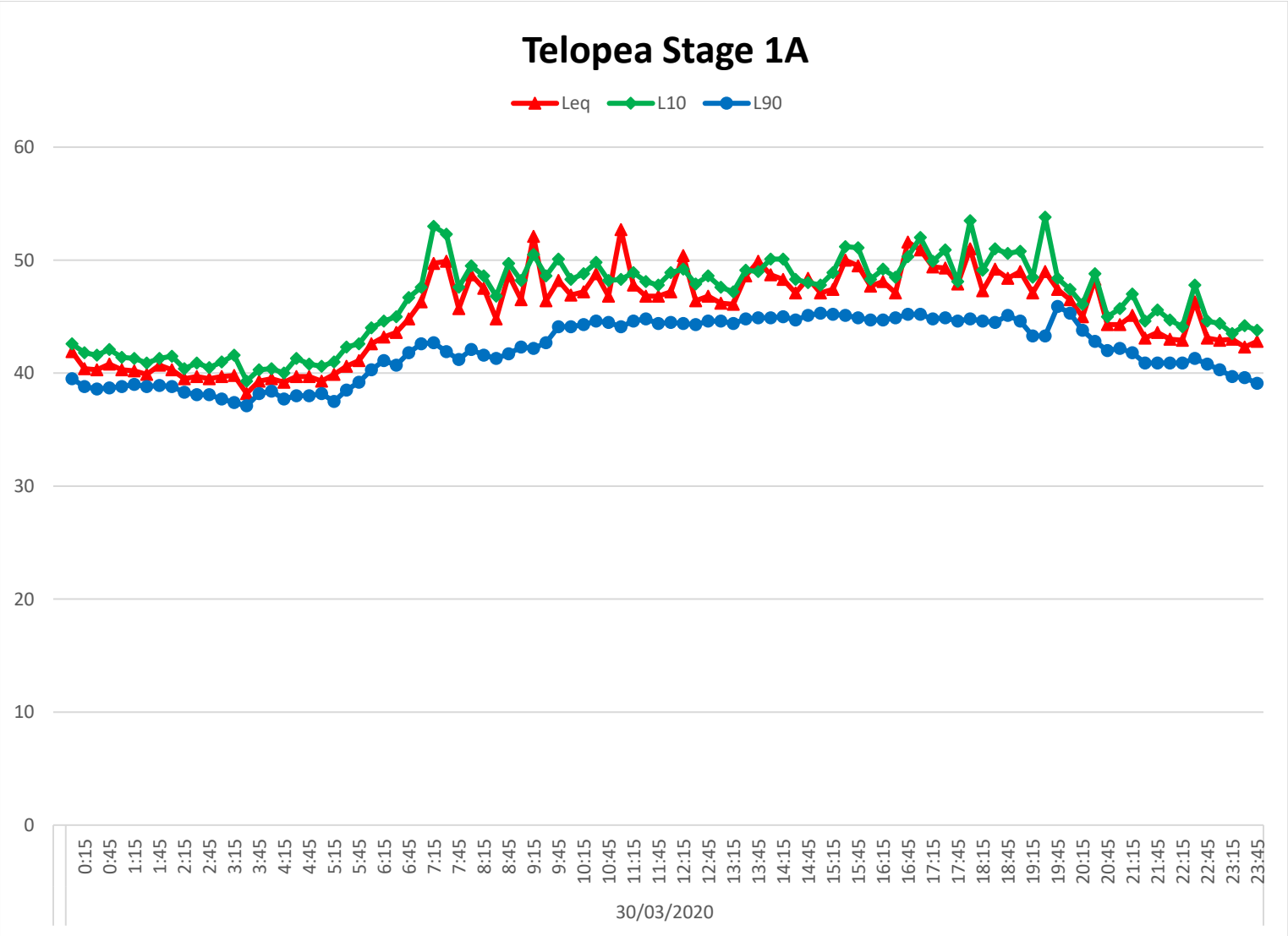
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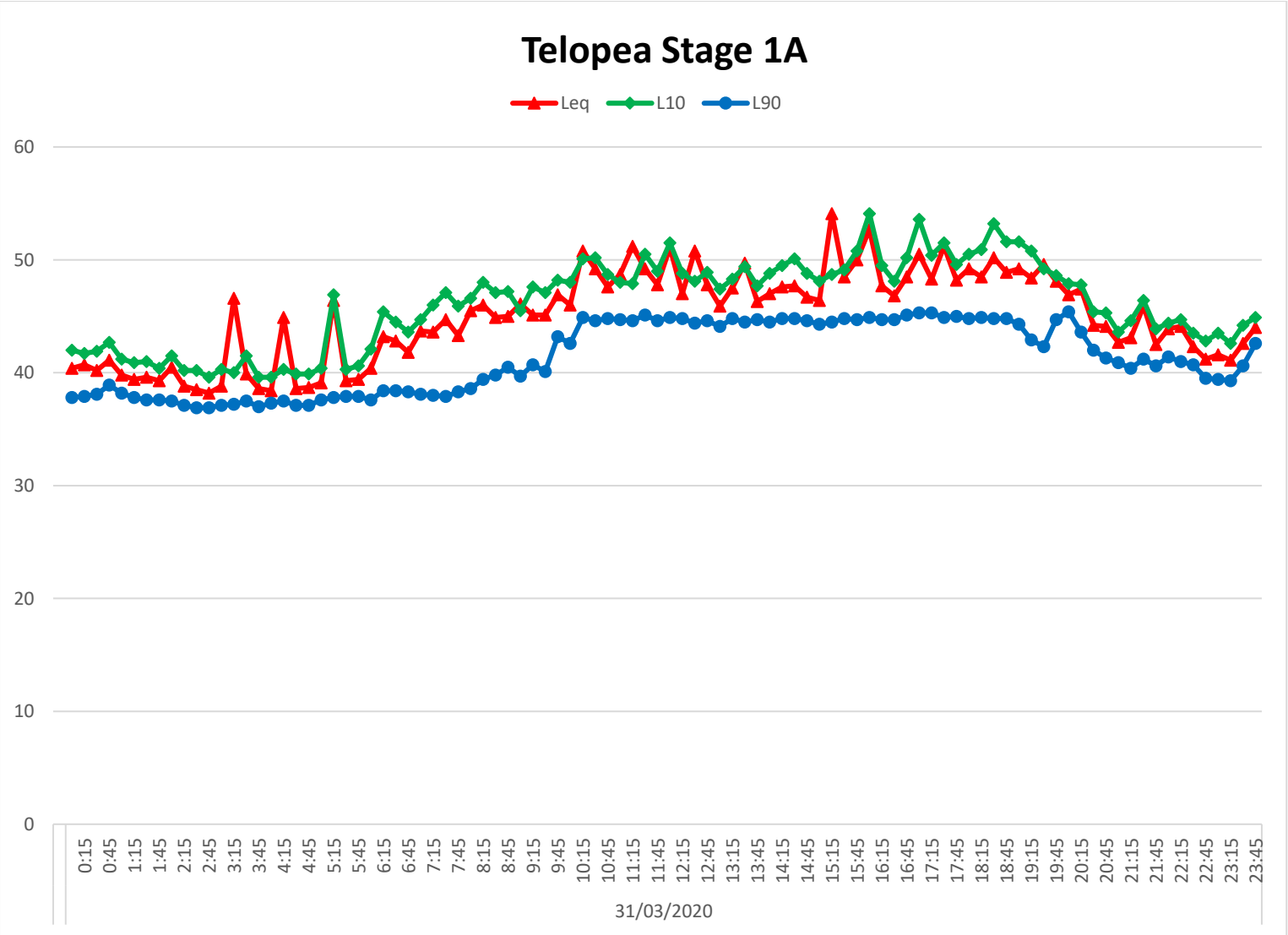
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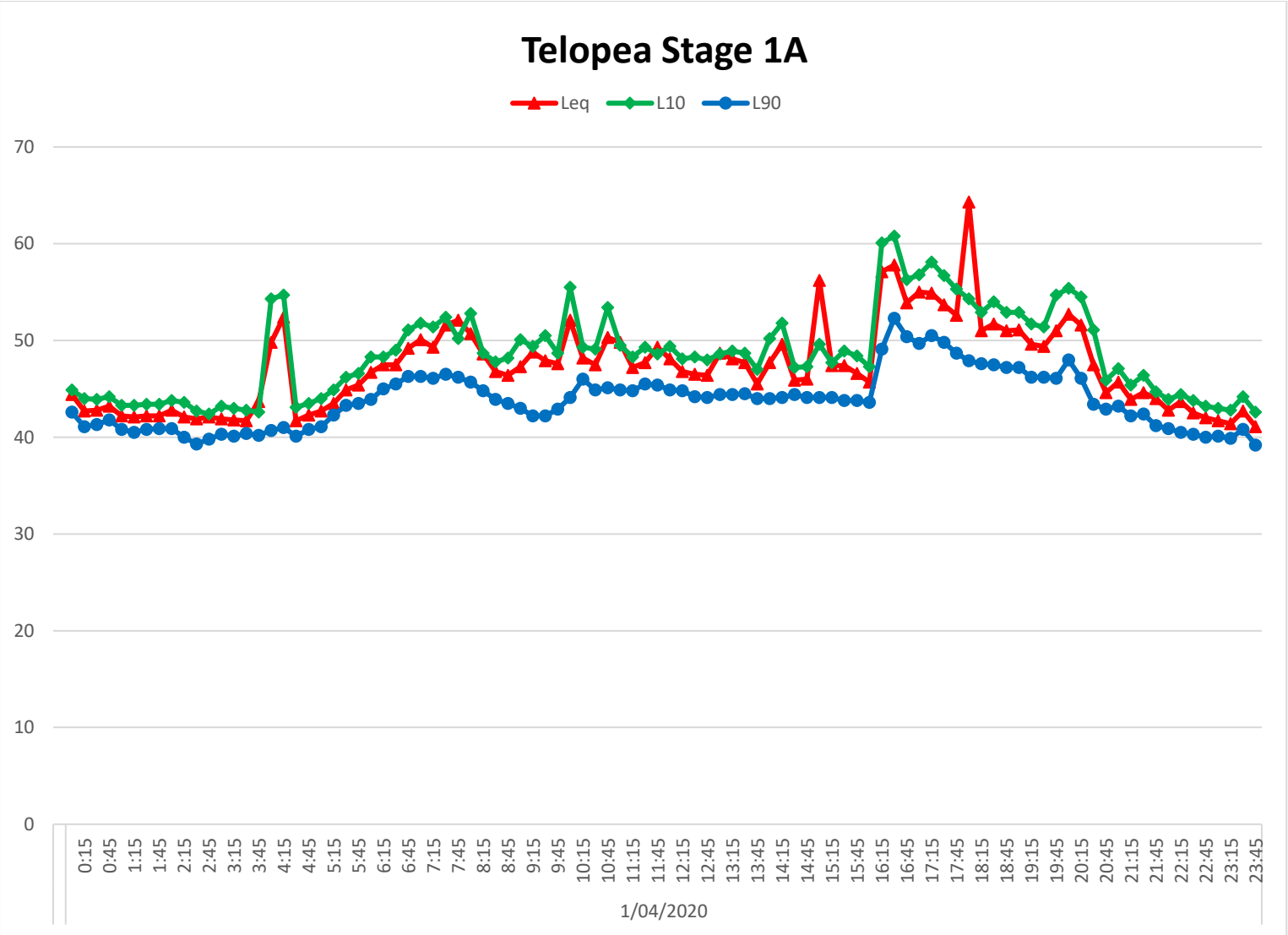
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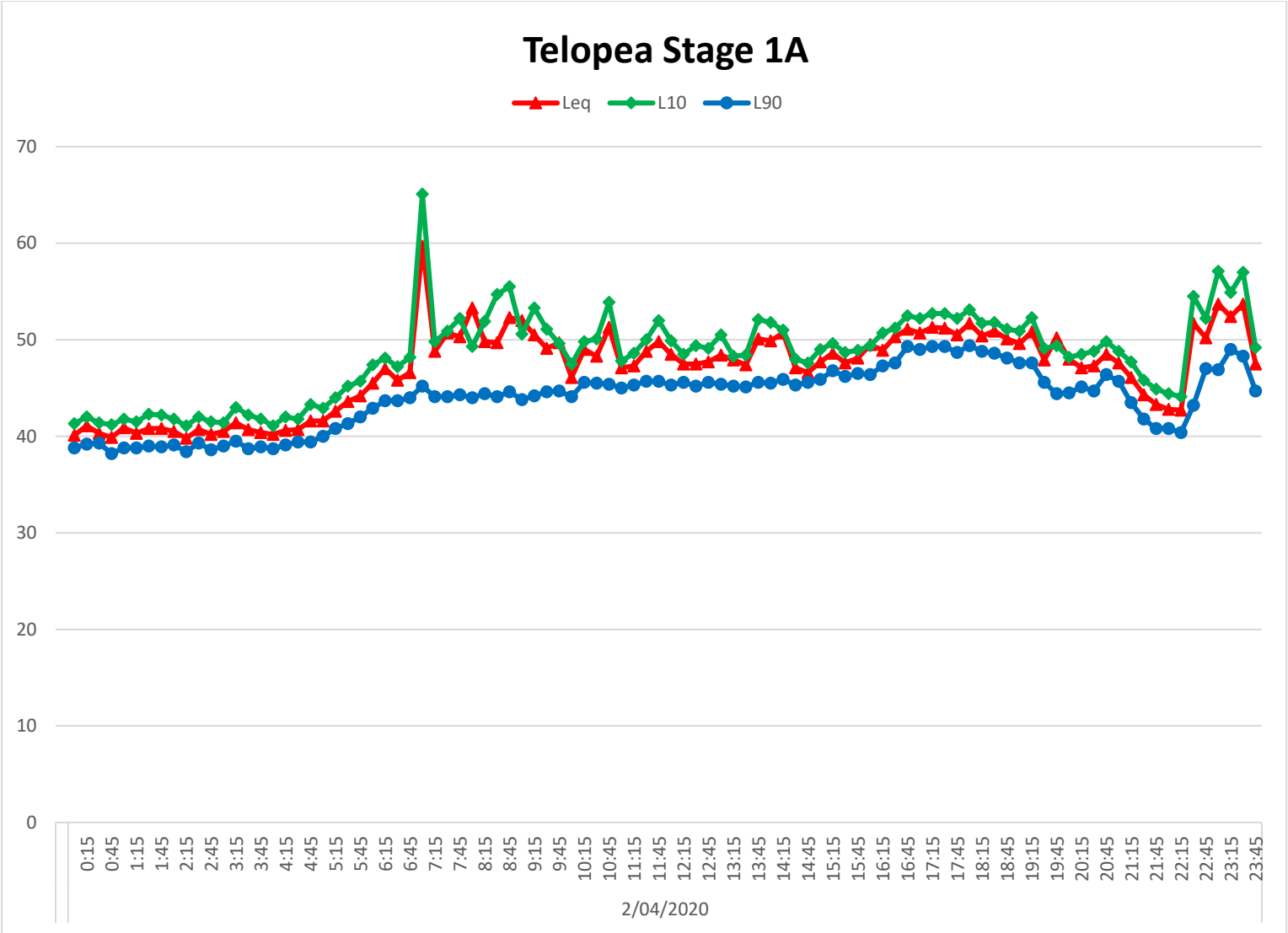
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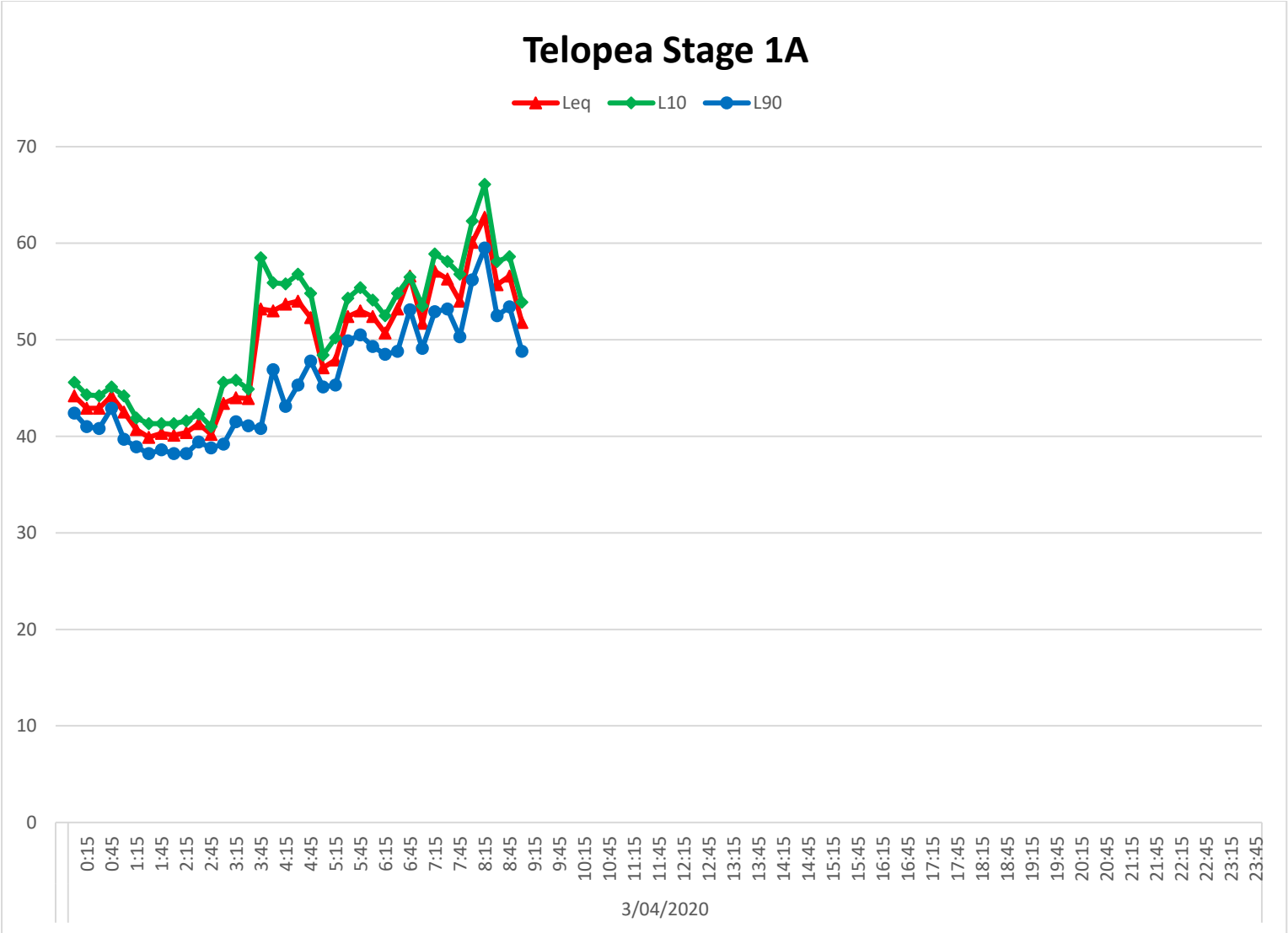
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