



# Ship 'rumble': Rio Class low frequency noise mitigation

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## Port Otago Limited

- Port Chalmers container terminal  
200,000 TEU per year – heavy export cargo
- Part of a network of NZ ports that serve various shipping lines and services.
- Majority of NZ ports recently affected by low frequency vessel noise.
- NZ ports collaborate to identify 'noisy' vessels and engage with the shipping lines.

Photo credit: <http://holidaymapq.com/new-zealand-ports-map/>

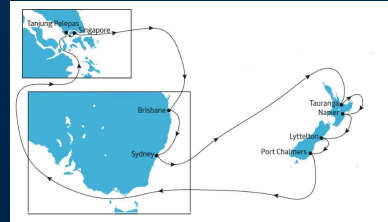
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## Rio's arrived (2018)



- **4100's (prior to 2011)**  
Noisy vessels triggered community frustration, so port embarked on noise mitigation journey.
- **L Class (2011-2018)**  
Quiet vessels, no noise complaints.
- **Rio's (2018 – present)**  
Significant community noise complaints. 5900 TEU vessel with four generators that provide auxiliary power to service ship & operate onboard refrigerated containers.



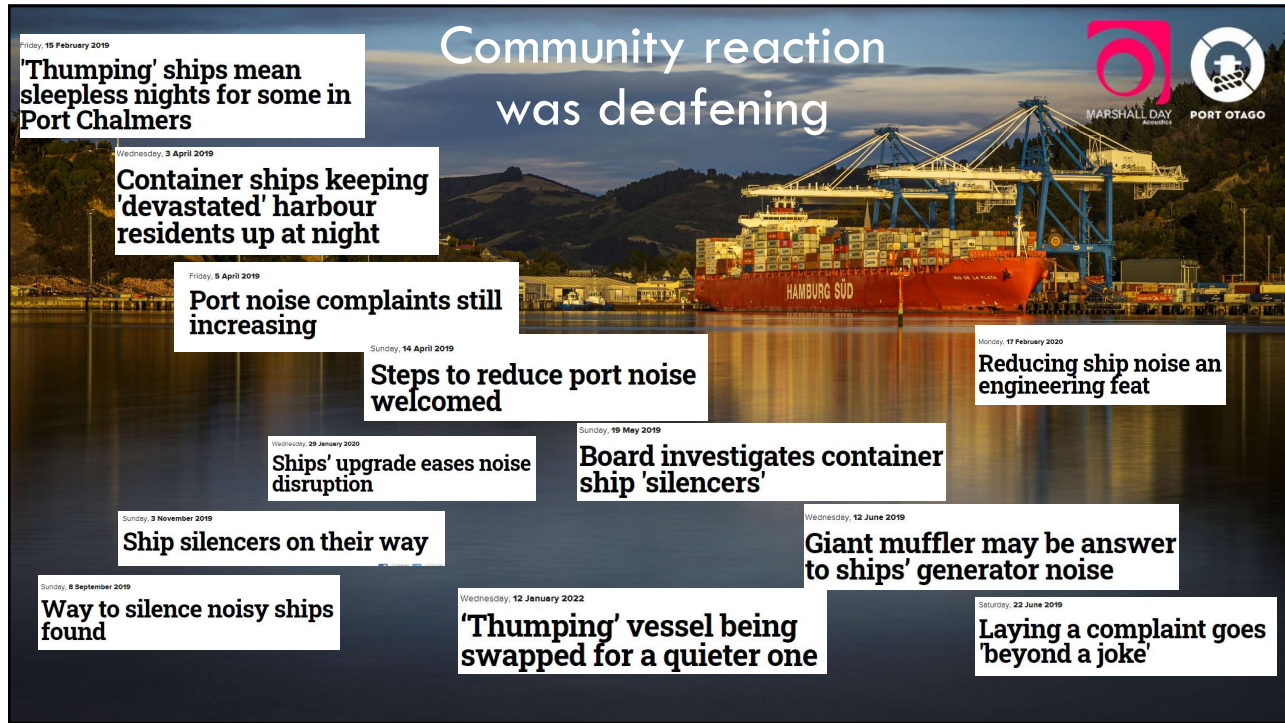
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### Noise Complaints

- A 'rumble' was keeping people awake up to 5 -7km away.
- Other ports on Rio's service were experiencing similar issues.
- Marshall Day Acoustics quantified the noise emissions and identified mitigation and management measures.

Photo : noise monitoring locations

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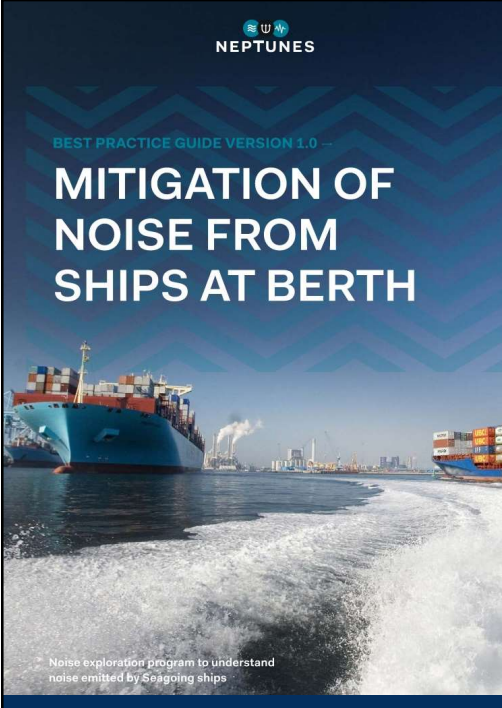



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## NZ Port Noise Standard

- Provides guidance to ensure residential communities can continue to co-exist with ports
- NZ ports have direct control over most noise sources (e.g. log or container handling, reefer towers and tenant activities).
- In other cases, ports must work with infrastructure operators to manage noise indirectly (e.g. road / rail operators and **shipping lines**).
- Success with infrastructure operators when ports act as a collective forum.

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## NEPTUNES

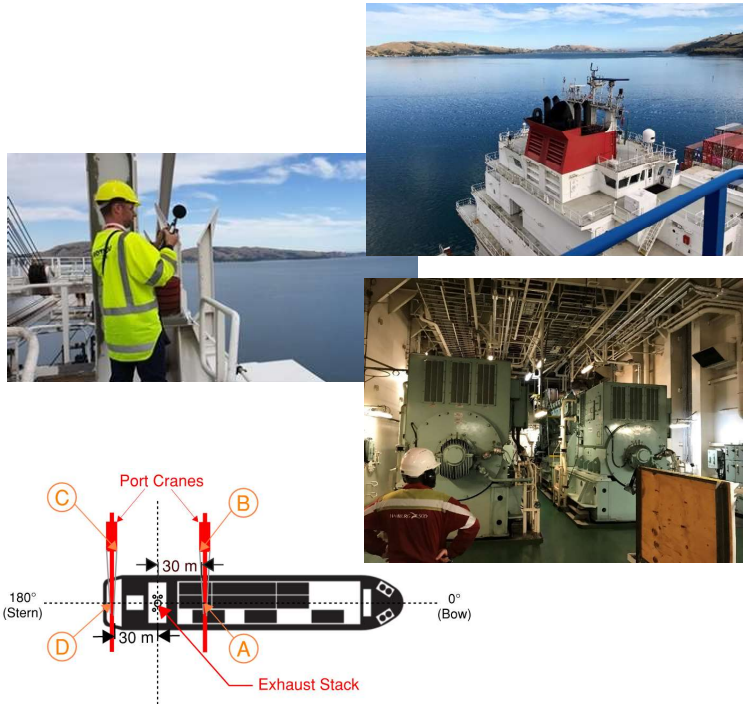
- **A Best Practice Guide:** description of ship generated noise, overview of measurement and classification system, and general mitigation and management measures
- **Measurement Protocol:** a uniform measurement protocol for individual ships at berth
- **Noise Label and Classification system:** a database of certified vessel noise levels and classification

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## Generator 'Rumble'

- Most ship noise complaints relate to low frequency 'rumble' from the exhaust on the auxiliary engines.
- Other noise sources are rarely material (e.g. ventilation fans, reefers, pumps, public address systems, compressors, horns and alarms).
- The 'rumble' was quantified using a simplified measurement procedure. All reports are shared amongst NZ ports via the 'Ship Noise Register'.




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## Rio Noise Levels

- Overall noise levels were 10 – 15 decibels louder than a typical ship.
- The low frequency ‘rumble’ was disproportionately high and audible at considerable distance

Ship	Sound Power Level (dB L <sub>WA</sub> )	
	Overall Level (25 Hz – 4kHz)	Low Frequency Component (25 Hz – 160Hz)
Typical	105 – 115	95 – 105
Rio’s (range)	115 – 122	113 – 119
Rio de Janeiro (pre mitigation)	119	119
Rio de Janeiro (post mitigation)	107	93



## Noise Effects

- Noise complaints are primarily received at night.
- The sound insulation performance of a typical dwelling is much less effective at low frequencies than mid and high frequencies.
- Therefore, the Rio’s were perceived as significantly louder than other container ships inside the bedroom of a typical bungalow overlooking the port.



## Initial Management Measures

- Multiple rounds of noise monitoring and community meetings
- Imposed specific berthing arrangements (location and orientation)
- Trialed various generator configurations and ventilation louvre settings with marginal success
- Reduced the amount of time vessel could spend in port, and no weekend nights in port. This resulted in the vessel at anchor offshore prior to entering port at times, which potentially delayed arrival in Malaysia.
- Community advised of vessels scheduled timing & duration in port via Facebook


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## Maersk Engagement

- Port Otago had support of NZ port forum
- Port Otago CEO, Commercial Manager, & Marine Manager engaged with Maersk in Singapore & Europe
- Maersk were provided the Marshall Day monitoring results and recommendation to install a reactive silencer
- Maersk commissioned a reactive silencer design, which was reviewed by Marshall Day, the vessel class and their insurers
- First reactive silencer installed on the Rio de Janeiro in late 2019
- All six Rio's are now fitted with a reactive silencer.

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## Mitigation

- A reactive silencer was installed on one of the four generators
- Dramatically reduced low frequency noise component
- Residual noise emissions in-line with other typical container ships

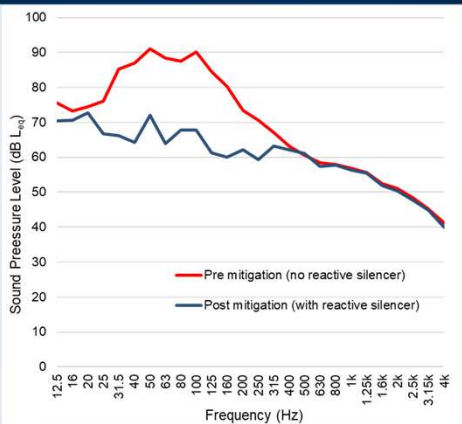


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## Rumble removed

Rio de Janeiro auxiliary generator at 30m behind the exhaust stack




Frequency (Hz)	Pre mitigation (no reactive silencer)	Post mitigation (with reactive silencer)
12.5	75	70
16	78	68
20	80	65
25	82	65
31.5	85	68
40	88	70
50	90	68
63	90	65
80	88	65
100	85	62
125	80	60
160	75	60
200	70	60
250	65	60
315	60	60
400	55	58
500	50	55
630	48	52
800	45	50
1k	42	48
1.25k	40	45
1.6k	38	42
2k	35	40
2.5k	32	38
3.15k	30	35
4k	28	32



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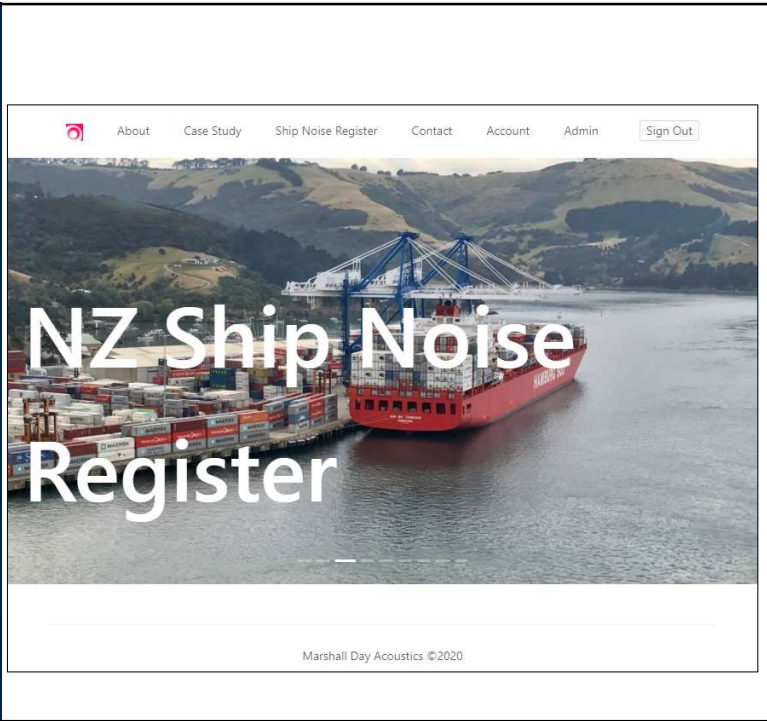
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## Ship Noise Register

Enables:

- Quantification of noise emissions for benchmarking purposes (i.e. is the ship 'normal')
- Identification of noisy ships (i.e. those with a higher likelihood of community response)
- Engagement with vessel owners to encourage noise mitigation (e.g. fitting a reactive silencer)
- Management of berthing arrangements for known noisy ships (e.g. berth location and orientation, timing and duration at berth, generator settings)



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## Ship Noise Specification

Neptunes Noise Label Score is comprised of three parts:

1. The overall sound power level
2. The low frequency component
3. A bonus (availability of a NEPTUNES measurement report)

Where:

- **Negative score:** indicates a high likelihood of community complaints
- **Positive score:** the higher the score, the quieter the ship

Ship	Date Measured	Generator Number	Generator Load	1. Overall Sound Power Level (dB L <sub>90</sub> )	2. Low Frequency Component (dB L <sub>90</sub> (0.5-100))	3. NEPTUNES Noise Measurement Report	NEPTUNES Noise Label Score
Amber (CMA CGM)	28/05/2020	Single (1)	892 kW (36%)	117	116	No	-15
Amber (CMA CGM)	28/05/2020	Split Load (2)	911 kW (18% each)	117	116	No	-15
Monte Rosa	5/07/2020	Single (#2)	1656kW (40%)	122	118	No	-24
Nadi (Maersk)	21/10/2021	Single (1)	660 kW (50%)	114	109	No	2
Nadi (Maersk)	13/05/2021	Unknown	Unknown	113	111	No	-1
Neokastro / Aelala	22/02/2014	-	-	120	116	No	-18
Neokastro / Aelala	3/10/2021	Single (1)	886 kW (37%)	116	110	No	-2
Neokastro / Aelala	27/08/2019	Single (1)	45%	110	107	No	10
Rio Blanco	30/03/2019	Single (1)	80%	116	113	No	-8
Rio de Janeiro	4/03/2019	Split Load (2)	50% each	121	119	No	-25
Rio de Janeiro (pre mitigation)	4/03/2019	Single (1)	60%	119	119	No	-23
Rio de Janeiro (post mitigation)	23/12/2019	Single (1)	2,100 kW	107	93	No	41
Rio de Janeiro	23/12/2019	Split Load (2)	2,100 kW	117	115	No	-13
Rio de la Plata	8/04/2019	Single (1)	3,215 kW (78%)	116	116	No	-14
Rio de la Plata	8/04/2019	Split Load (2)	1,860 kW (45%) and 1,259 kW (47%)	115	115	No	-11
Rio de la Plata	6/04/2019	Single (1)	65%	114	114	No	-8
Rio de la Plata	29/06/2019	Single (1)	50%	108	107	No	12

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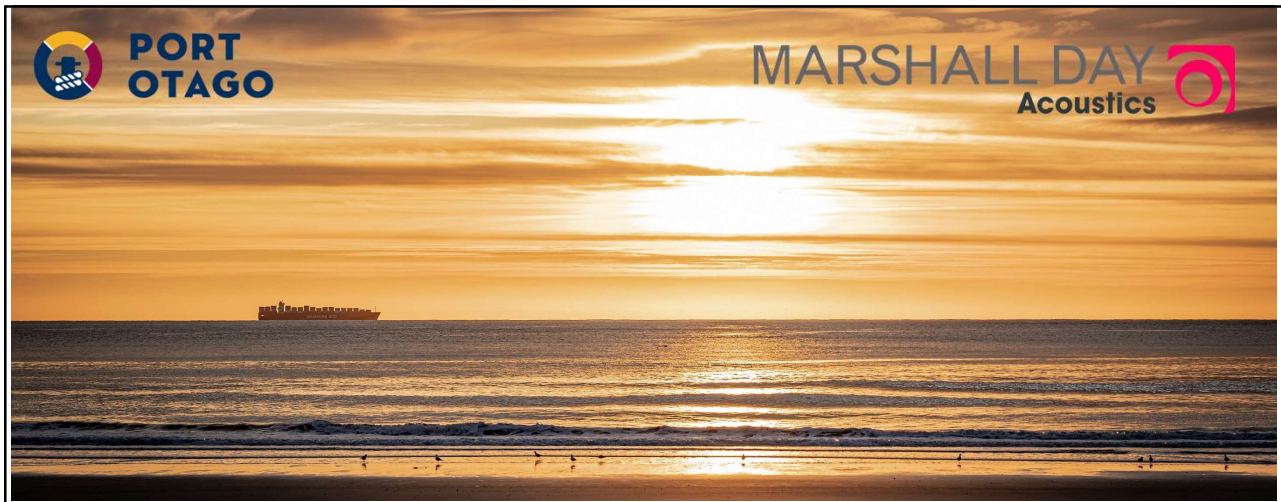




## Conclusions

- Low frequency 'rumble' from ships is avoidable when fitted with a reactive silencer
- A New Zealand Ship Noise Register has been setup to collectively identify existing noisy ships
- Ships entering New Zealand rotation should be fitted with a reactive silencer or achieve a standard noise emission specification (e.g. positive score using the NEPTUNES ESI scoring system)
- Engagement with port communities builds trust and tolerance

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## Questions??

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