BEFORE THE WHANGAREI DISTRICT COUNCIL AND NORTHLAND REGIONAL COUNCIL

IN THE MATTER	of the Resource Management Act 1991
AND	
IN THE MATTER	of a resource consent application by Northport Limited under section 88 of the Resource Management 1991 for a port expansion project at Marsden Point
APPLICATION NO.	APP.005055.38.01 LU 2200107

STATEMENT OF EVIDENCE OF MAHIM KHANNA

(TERMINAL DESIGN AND ALTERNATIVES)

24 August 2023

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INTRODUCTION AND BACKGROUND

1. My name is Mahim Khanna.

2. I work as the Regional Director for TBA Consultancy BV of Netherlands, trading as Portwise. TBA BV (established in 1996) was the precursor to TBA Consultancy BV before its demerger from TBA Group (parent company Konecranes) in Nov 2022. TBA Consultancy BV continues its terminal design and consultancy work, providing the same services.

3. My task is project management, consultancy, and sales activity in Australia, New Zealand, Southeast Asia and South Asia. I have been working full-time under contract and agency agreement for TBA BV since early 2013 and now with TBA Consultancy BV.

4. I am familiar with the application site, having made a comprehensive site visit to the port and the yard area. I have read the relevant parts of the application; submissions; and the Section 42A Report.

Qualifications

5. All my career I have worked in shipping and port areas. I started out as a sea cadet in 1980 and sailed as a Master before coming ashore in 1993. From 1998 to 2010, I worked for Maersk Line (part of AP Moller Group), including as General Manager of Operations for Oceania with overall seaside, ports & and landside responsibility, later I was relocated to Europe as Operations Director and Head of West Mediterranean Liner Operations Cluster. From 2010 to 2013 I was General Manager for PO Shipping Australia Pty Ltd.

6. I qualified as Master Class I and hold an MSc from Plymouth University, UK, a Diploma in Terminal (Ports) Management from Lloyds Marine Academy, UK and a Graduate Diploma in Professional Shipping, Norwegian Shipping Academy, Oslo. I attended A P Moller Terminals “Magnum” training which is a specialized terminal in-house program that ran over 2 years. APM Terminals is one of the top four terminal operators globally with operations in 75 ports worldwide.

Relevant experience

7. TBA BV/TBA Consultancy BV (TBA) is recognized as one of the leading port and terminal consultancy firms, providing design, simulation and related consultancy services to the majority of the large global terminal operators and many regional ports around the world. TBA has worked on over 1,000 projects, including the design and improvement of over 200 terminals in over 75 countries spanning six continents, ranging from 50,000 TEU to

9 million TEU in annual throughput. Project experience includes key port development projects in Europe (Antwerp, London and Rotterdam), the Middle East (Jebel Ali terminals and Khalifa), Asia (Tanjung Pelepas, Tuas, Busan, Manila, Qingdao and Yangshan), North America (Los Angeles-Long Beach, New York-New Jersey and Virginia). TBA has been involved in many of the most innovative terminal designs globally over the last 20 years.

8. In Australia, most large container terminal operators use TBA such as Patrick, DPW Australia, Qube and Pacific National. Further, many port authorities such as NSW Ports and Fremantle Port use TBA services. Similarly, in New Zealand, TBA has supported many ports including the Ports of Auckland, Tauranga, Lyttleton, and Otago.

9. I have been the Project Manager and involved in TBA design, capacity, optimization, and simulation work in Oceania over the last 10 years. Some specific examples include the Port of Tauranga future development and high-density study, Port of Otago development planning, DPW Port Botany future planning, Patrick Port Botany capacity and high-density study, NSW Ports container capacity master planning and many others.

Northport container conceptual design study

10. TBA BV was tasked by Northport to review and create a high-level conceptual layout for Northport to support approximately 500,000 TEUs of container trade. The study included establishing the required berth length and yard area to support container operation (while in some ways an oversimplification, these are the primary infrastructure requirements underpinning the terminal design and capacity) with adequate yard space for storage, requisite ancillary facilities, and efficient road and rail interface.

11. For the conceptual design study, Jeroen Kats[1], TBA Head of Capacity and Planning, was the Project Supervisor and the modelling expert, and I was the Project Manager and consultant. The other key staff involved was Age Dijkstra[2] as the Senior Simulation Engineer. TBA/Portwise team working on Northport was highly experienced with specialized knowledge in terminal design and infrastructure requirements.

[1] Jeroen Kats holds an MSc in Operations Research and has been with TBA/Portwise for over 18 years. He is the Project Director of Portwise and heads the Design and Simulation services team. He is vastly experienced in terminal, design, planning and financial analysis.
[2] Age Dijkstra holds an MSc in Econometrics with a specialization in operations research. He has been with TBA/Portwise for 15 years. He is the Senior Simulation Consultant, lead developer, and custodian of the TRAFALQUAR, VESSEL TRAFFIC and NETWORK simulation model. He has extensive experience in berth simulation worldwide and in Oceania.

Code of Conduct

12. I confirm that I have read the Code of Conduct for Expert Witnesses contained in the Environment Court Practice Note (2023) and I agree to comply with it. In that regard, I confirm that this evidence is written within my expertise, except where I state that I am relying on the evidence of another person. I have not omitted to consider material facts known to me that might alter or detract from the opinions expressed.

ABBREVIATIONS

13. The following abbreviations are used in the Statement of Evidence.

ASC	Automatic Stacking Crane
CRMG	Canti lever Rail Mounted Gantry Crane
MHC	Mobile Harbour Crane
RTG	Rubber Tyre Gantry Crane
RS	Reach Stacker
STS	Ship-to-Shore quay crane
TEU	Twenty-Foot Equivalent Unit
TGS	TEU Ground Slot
TT	Terminal truck

SCOPE OF EVIDENCE

14. In my evidence, I:

(a) Provide an executive summary of my key conclusions;

(b) Outline the scope of Portwise/TBA and my involvement in the project and the methodology for arriving at a conceptual container design for Northport;

(c) Discuss at a high level the variables of port design, infrastructure, and the need for graduated development;

(d) Summarize the operating options available to Northport and recommend the best option based on the study undertaken;

(e) Respond to relevant submissions raised;

(f) Respond to the s42A Report; and

(g) Comment on draft proposed conditions advanced by Northport.

EXECUTIVE SUMMARY

15. TBA created a high-level conceptual plan and a development pathway for container operations at Northport. This included assessing container quay length, yard area and handling equipment. Berth length and capacity were assessed based on dynamic berth simulation and various yard handling options for the proposed container footprint were considered including storage capacity, handling requirement, and operating cost to arrive at the most suitable conceptual design and handling option. The gradual and slow organic growth in container volume and the potential shared use of mobile harbour cranes for other cargoes were some other factors that support the recommended concept design.

16. Summary outcome:

(a) 700m of container quay line is required at the port to be able to berth two expected vessel lengths simultaneously.

(b) Two operational Mobile Harbour Cranes (MHC) and two Ship-to-Shore (STS) cranes are required to support up to berth capacity throughput of up to 650,000 TEUs. Using MHC cranes alone is not considered optimal due to insufficient service levels for large vessels.

(c) After considering various applicable handling options, RTGs are considered the most suitable yard handling option at the end stage for Northport. Reach Stacker (RS), while best suited at the start due to low CAPEX, could not provide the 500,000 TEUs of storage capacity. Rubber Tyre Gantry (RTG) could support the final storage capacity of 650,000 TEUs at days dwell time for import-export cargo. (500,000 TEUs at 10 days dwell time for import-export cargo)

(d) Reach stacker operations transitioning over to RTG is most preferred, as it allows for a slow and gradual increase at the start, but at the final stage, RTG would provide the most optimal operation. The proposed design with RTG can work well in combination with RS and terminal truck operation allowing for a progressive transition to full RTG.

(e) The proposed 700m container quay and adjoining yard as proposed with initial RS operation and later transitioning into RTG is an appropriate, agile and flexible option for adding container operation at Northport.

(f) The proposed new container terminal semi-rectangular yard behind the quay is more efficient and optimal compared to a separated quay and yard configuration.

(g) The proposed yard area to be reclaimed is needed for the proposed container throughput at the final stage. In the initial stages, the available yard will be well utilised with RS operation, and this can allow Northport to gradually grow container volume into a viable container operation without having to invest in high-density and high CAPEX infrastructure at the start (which would likely be uneconomic).

Scope and methodology for the study

17. The overall objective of the TBA study was to develop a high-level conceptual layout and yard footprint for the container facility that offers an appropriate balance between capacity, yard space and cost. Quay line required and quayside handling option (MHC or STS) were to be considered.

18. The following main sequential activities were carried out:

(a) Inputs & design parameters – Detailed information, inputs and existing data were collated from the port. The future operating scenarios and operating requirements were discussed iteratively with Northport staff and senior management, and considerable effort was taken to analyse the available data and use reference information where available to ensure inputs and parameters used for future terminal design were appropriate. This included a detailed analysis of container characteristics and various flow shares (imports, export, transhipment, full and empty flows, reefers), vessel sizes and exchange per vessel, vessel performance requirements, landside handling and service requirements, and dwell time.

(b) Berth and quayside analysis – Detailed berth and quayside analysis was undertaken based on dynamic berth and quayside simulation (using TBA's in-house and world's best-used berth simulation model TRAFALQUAR, described in the following section) to establish berth length and capacity with various crane handling options. The simulation allowed performance testing of the berth based on future operating scenarios with various combinations of MHC and STS cranes. Berth capacity and the required number of cranes were established based on achieved vessel service and acceptable waiting time for various scenarios.

(c) Review of handling options and create high-level layout design – Various future applicable yard handling options and layouts were considered, including the currently used Reach Stacker (RS) and terminal truck (TT) operation and higher container stacking density options; Rubber Tyre Gantry (RTG), Automatic Stacking Cranes (ASC) and Cantilever Rail Mounted Cranes (CRMG). TBA created high-level conceptual layouts to ascertain TEU Ground Slots (TGS) possible for the three best suitable handling options. The high-level layouts considered the space required for quay cranes, made efficient for waterside aprons and traffic flows, land side traffic, gate and ancillary functions.

(d) Static modelling and financial analysis - Static modelling and analysis of the yard and landside was undertaken to determine the storage capacity and yard handling equipment for the three most suitable shortlisted options. A financial analysis was undertaken to evaluate overall CAPEX and OPEX for these options. Static modelling and financial analysis were used to compare the shortlisted options to select the best and most appropriate concept. Consideration was also given to the ultimate terminal design suitable to take advantage of changing and future technological improvements and be environmentally friendly.

(e) Finally, a high-level development trajectory was prepared for the most preferred container handling development which was a combination of Reach Stacker (RS) and RTG and MHC and STS cranes.

19. TBA has applied the broad approach used for Northport and summarised above successfully for many years for all kinds and sizes of terminals, including the latest automated container terminals (APMT MV2, DP World Rotterdam Gateway). This methodology described above is industry best practice and in my experience is suitable for the level of detail required at this stage.

FACTORS AFFECTING BERTH AND PORT LAYOUT, AND THE NEED FOR GRADUATED DEVELOPMENT

Berth analysis

20. A key part of the berth analysis was the use of the dynamic berth simulation model TRAFALQUAR which stands for Traffic Analysis of Quay, Rail and Road (refer to Figure 1 below). The model quantifies key performance characteristics of a container terminal for various scenarios taking into port-specific considerations such as vessel sizes and call sizes expected, weekly arrival pattern including arrival deviations, crane types and number deployed, vessel entry and departure restrictions, etc. to provide a much more

reliable assessment of berth capacity than using static calculation or ‘industry thumb’ rules.

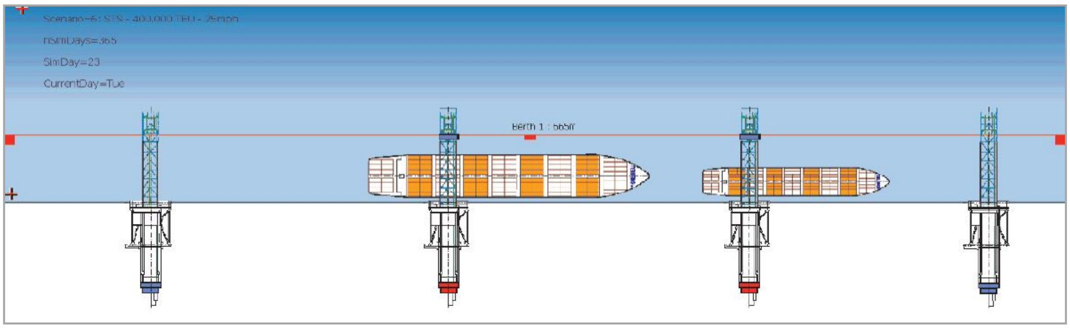

Figure 1: Overview of Trafalquar

21. During the last 15 years, TRAFALQUAR has been used in over 150 projects for more than 60 terminals all over the globe. It is arguably one of the most used models for berth simulation and capacity assessment. A summary of how the TRAFALQUAR model operates is attached as **Annexure 1**.

22. Northport has a semi-diurnal tide cycle with two high and low tides a day. Tidal entry and departure windows depend on the vessel size, draft and wind condition. Vessel entry and departure windows were applied in the simulation based on container ship lengths as agreed with the port team. Wind restrictions were ignored, it is not usual to apply these in simulation.[3]

23. For Northport to berth two vessels of length 300 and 330m together, a 700m container quay line is required allowing for a mooring margin between the vessels. The ability to berth two container vessels together was critical from a service perspective to allow for vessel arrival variations and transit windows at the port.

24. Based on berth performance in the simulation, KPIs for various scenarios were measured. Key determinants of Northport berth capacity were vessel waiting time and overall port time. With a benchmark of a maximum of 5% of vessels waiting for more than 8 hours, the capacity for this terminal was estimated at 650k TEUs with 2 STS and 2 MHC with an overall average crane working 4,400 hours per year. Further details for the Berth Simulation are available in the TBA Report attached to the Application as part of Appendix 2.[4]

[3] In the future, Northport expects wind restrictions being reduced as pilots gain experience in larger vessels and with better tugs transit limitations being reduced.
[4] Appendix 2 ‘Issues and Options Report’ contains as an appendix the TBA report ‘Northport Conceptual Design Study’.

25. Vessel transit and arrival and departure windows are, however, subject to windows, similar to other ports, including Tauranga, and this affects overall port time. The average and maximum port time for the largest vessels was 30 and 43 hours respectively.[5]

Evaluation of applicable handling systems and yard requirement

Initial consideration of handling systems

26. For the proposed Northport container yard expansion, various low and high-density yard and handling options were considered. This included the possible use of Reach Stackers, Straddle Carrier (SC), Automatic Stacking Cranes (ASC) and Canti-lever Rail Mounted Gantry CRMG). SC and CRMG were discarded after initial evaluations as being not suitable for multiple reasons, including that:

(a) SC are low density (maximum 3 high) and do not work well with MHC due to safety reasons.

(b) CRMG have very high and lumpy CAPEX requirements and are used predominantly at transhipment terminals[6].

27. RS, RTG and ASC were the three shortlisted options, shown in Figure 2 below, which were considered in more detail with static modelling.

Figure 2: Considered yard options.

[5] In the future, Northport expects transit windows and wind restrictions to be reduced as pilots gain more experience of larger tonnage and with better and more powerful tugs.
[6] Transhipment terminals mainly transfer cargo from one vessel to another as opposed to servicing the import-export trade and hinterland. They are typically, very large hub ports on main trade lanes. Examples Tanjung Pelepas and Algecriras with over 90% transhipment

Yard capacity requirements

28. The diagram at Figure 3 below illustrates at a high level the factors affecting yard storage capacity.

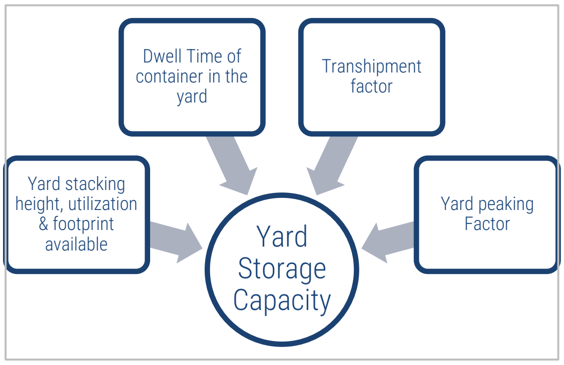

Figure 3: Yard capacity influencing variables

29. The factors as shown in Figure 3 can be summarised as follows:

(a) Maximum stacking height varies based on yard handling equipment. RS can only stack full containers 3 or 4 high and require large separation between stacks for RS and TT to manoeuvre, thus minimizing Terminal Ground Slots (TGS) and the overall maximum stacking capacity. RTG, ASC and CRMG are stacked 5 high with less space required between stacks, which increases yard stacking capacity. Maximum stacking height is further adjusted with a maximum utilization ratio based on yard handling equipment to ensure efficient working performance during operation without having to dig containers from lower tiers.[7]

(b) Dwell time or dwell days refers to the time containers remain in the terminal yard before loading or after discharge. The dwell time for import-export full and empty boxes and transhipment are applied separately.

(c) The transhipment factor refers to unloading containers from one vessel and loading them into another. Transhipment containers have a one-yard visit for two quayside moves, and as a result, less yard stacking capacity is required for transhipment boxes.

(d) Overall yard peaking yard factor allows for the terminal to be able to continue to operate efficiently during operations when yard stack peaks, for seasonality and for the increase in yard volume before vessel arrival and or during discharge of a large vessel.

[7] A benchmark utilization factor of 65% for RS & RTG and 85% for ASC was applied for Northport.

Dwell time

30. In considering storage requirements, acknowledging appropriate dwell time was considered important for Northport to provide an adequate service level to Auckland. Dwell time for import-export cargo in Auckland port is 3-4 days.[8] Import-export cargo dwell time of 7 days was considered the most suitable by the port to provide good service levels and to allow for variations in vessel arrival. Based on what I know of Northport's likely future operations and hinterland requirements, 7-day dwell time considerations are generally appropriate. Post Covid the focus on supply chain resilience has increased and overall there is a trend towards a port-centric logistics model that supports higher dwell time. Storage capacity evaluations with higher (10 days) and lower (4 days) dwell time were also assessed as a sensitivity.

31. In the study, storage capacity for the expanded Northport yard footprint was evaluated for the three most applicable yard options for various dwell times as shown in Figure 4 below. (Further details of specific parameters for various container flows are available in the TBA Report attached to the Application under Appendix 2 [9])

32. RS could not meet the storage requirement of 500,000 TEUs with 7 days dwell time. RTG & ASC could provide the required storage capacity and had a similar capacity. RS option may, however, still be used in the initial growth years.

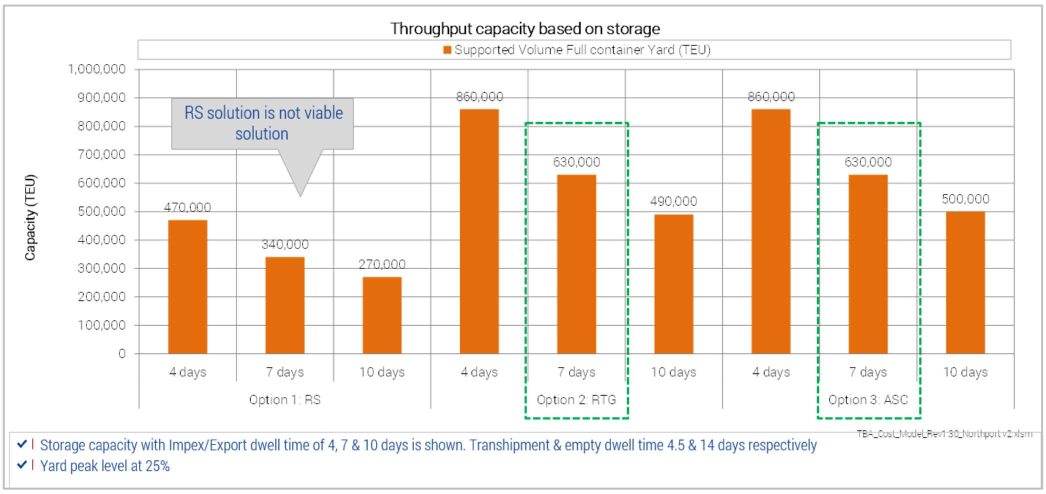

Figure 4: Yard capacity per option

[8] Auckland is space limited with the yard being a key constraint that can be determinantal to the terminal operations and the trade.

[9] Appendix 2 Issues and Options TBA report Northport Conceptual Design Study

Analysis and discussion

33. The evaluation of the yard handling system and conceptual terminal design followed a holistic approach considering handling, storage and operating costs while also meeting the relevant performance requirements – refer to Figure 5 below.

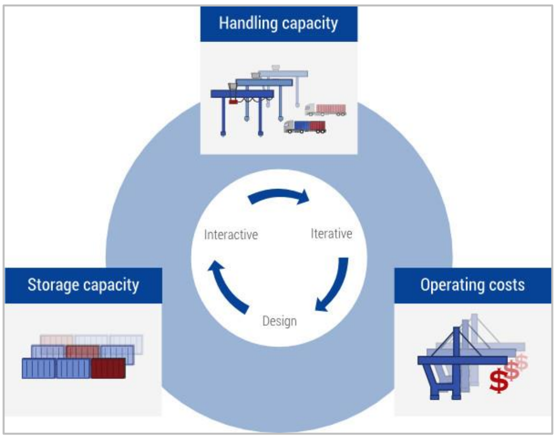

Figure 5: Terminal design is a balancing act between handling, storage capacity, and the financials

34. For the three main selected options described above, a high-level financial comparison including capital and operating costs was undertaken, While the TBA analysis was quantitative, the aim was to provide a relative comparison between different concepts.[10]

35. The high-level financial comparison of the options revealed RS having the lowest CAPEX for 300,000 TEUs with only a slightly higher OPEX per year than RTG. At 650,000 TEUs, however, RTG was the most attractive with a payback period of 4.2 years over RS. ASC had the lowest OPEX per year, but with NZD44M higher CAPEX, it had an unattractive payback. A summary of this high-level financial comparison is shown in Figure 6 below.

[10] For further details refer to the TBA Report attached to the Application as part of Appendix 2.

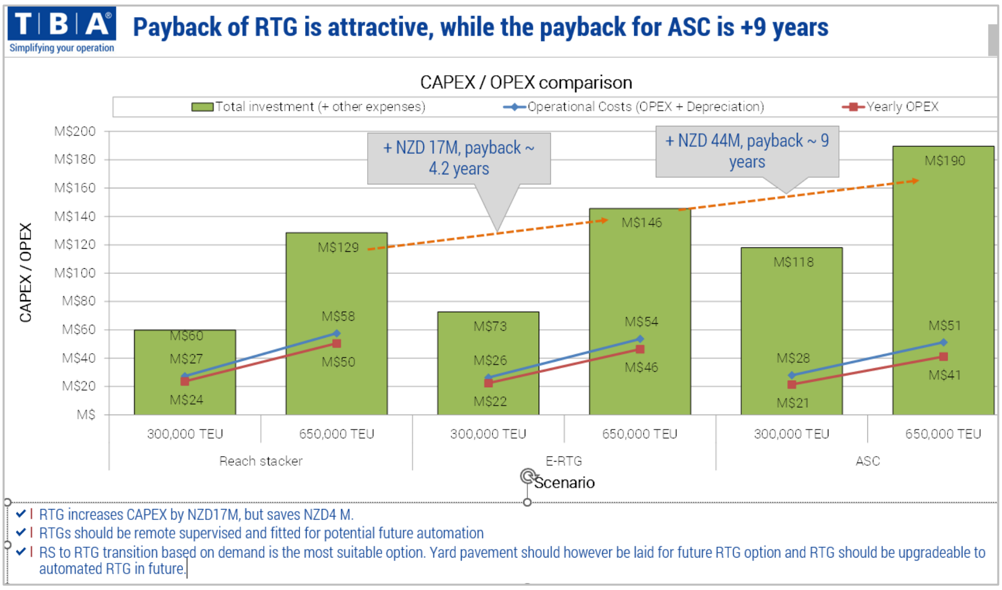

Figure 6: CAPEX and OPEX per year comparison

36. A relevant aspect for Northport was the need to enable its container trade to grow organically, whilst maintaining sufficient area and level of service for its log/bulk goods handling operations. This had the following implications:

(a) The lower CAPEX of MHC and RS initially during the container growth years was attractive.

(b) The potential to share MHCs with other cargoes during the gradual growth in container volume was considered beneficial.

(c) The ability to use terminal trucks on the waterside apron which could intermingle with bulk/break bulk handling trucks was considered desirable.

37. RTGs are globally the most commonly used terminal handling equipment, but traditionally they are manual, fuel-based and often low-technology. In the last few years, however, RTG technology has considerably evolved, with more advanced, remotely operated, remotely supervised and automated RTGs becoming available. Modern RTGs can now benefit from the latest technological improvements. Electric RTGs are now common, supporting environmentally friendly terminal operations. Terminal trucks are progressing toward electric battery-powered operation. Wellington in New Zealand already introduced them. In the mid to long term, fully autonomous trucks are anticipated. The ultimate RTG and TT design is, therefore, for low emissions operation and to take advantage of technological improvements.

38. These aspects informed the preferred terminal configuration that best supported the peak loads, both handling and storage, in a cost-effective manner.

39. Another important element in the mode selection was that an initial RS layout allows for a progressive transition to an RTG high-density layout. Terminal brownfield handling option conversions are generally considered challenging during operations. However, RS to RTG is less so, as RTGs require limited fixed yard infrastructure in comparison with other options such as ASCs, which require fixed rails for handling cranes. While RTGs require strengthening under the runway, both layouts could be aligned as shown in the profile view in Figure 8 below. This layout facilitates smooth truck flow and efficient combined or hybrid operation during the transition. RS and RTG will both use terminal trucks for transport on a similar layout which will ease the transition.

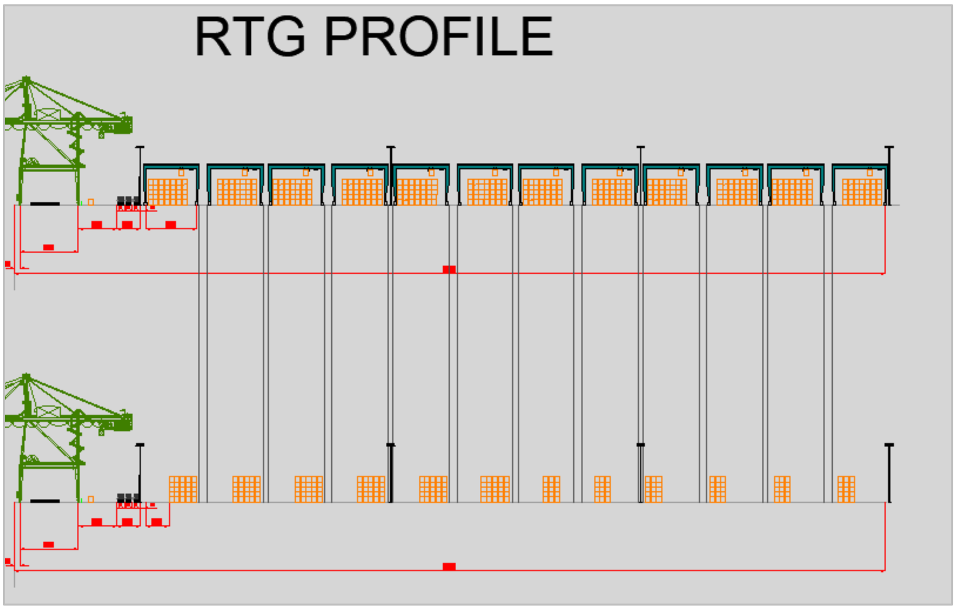

Figure 7: RS to RTG layout transition

40. As Northport plans ahead for growth, it will be important that sufficient 'headroom' is allowed for RTG ordering, installation and related civil works. There is, however, no impediment to this being achieved with proper terminal master planning, which can be undertaken in due course.

41. For completeness, I record that it is most efficient that the terminal yard area is adjacent to the quay. While TBA did not investigate a separate 'quay and yard' option, it is my view that operating on a finger pier, or alternatively moving a part or whole of the container stack area away from the quay, would be significantly less efficient, this is especially relevant for Northport, where we are designing an extension intended to work seamlessly with an existing port, and where gradual and organic growth is anticipated.

In these circumstances, container operation must be efficient both in the early stages, and through its development for it to be viable and realistic in the long term.

42. In my view, a new semi-rectangular yard behind the extended quay (as proposed) integrating with a potential rail line on the landward side is optimal, compared to a separated quay and yard configuration.

Required container yard area size and reclamation

43. From what I know and based on what I observed during my site visit, the existing bulk and log operations are operating well. Northport needs to continue operations as a multi-commodity cargo port throughout the development and later with the proposed container terminal. It is not feasible to simply arrange the container infrastructure on the existing port footprint. Simply put, a new quay is needed, as is the area immediately behind that quay.

44. The proposed yard area is needed for the proposed container throughput at the final stage. During the initial stages, the available yard can be efficiently used with RS operation for low volume and low density which is most cost-effective for such volume. This ‘organic growth’ approach can support Northport to gradually grow container volume without having to commit resources to high-density and high CAPEX infrastructure at the start. Instead, the yard area to be reclaimed will be required for current operations, and for transition planning as the scale of container operations increases over time.

45. The proposed 700m container quay and yard with initial RS operation and later transitioning into RTG is an appropriate, agile and flexible option for adding container operations at Northport to further diversify its cargo base.

46. The final stage conceptual plan is shown in Figure 8 below:

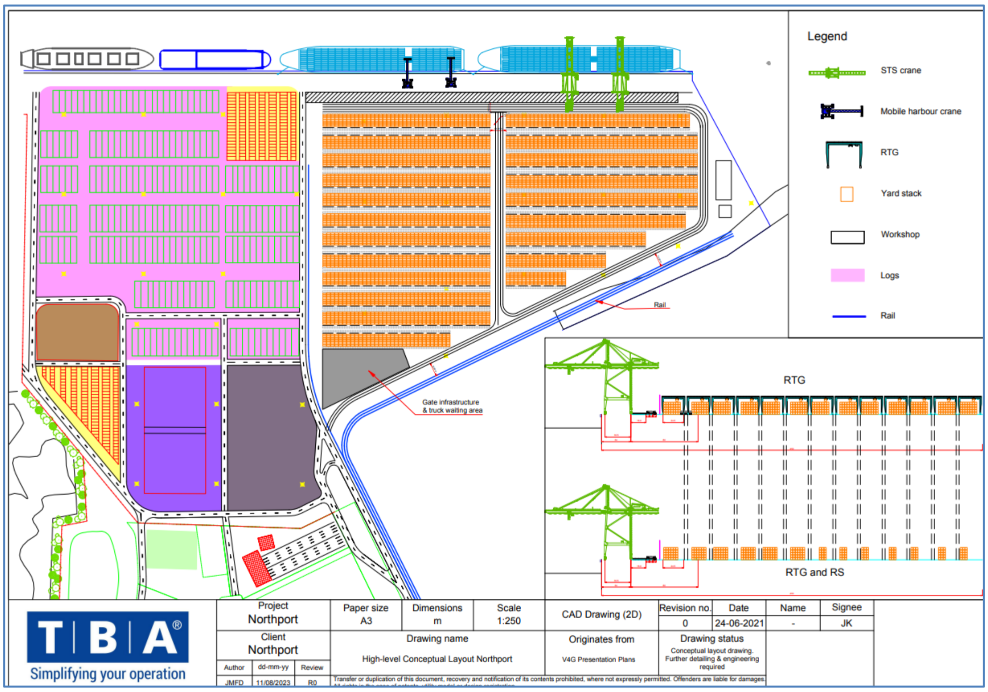

Figure 8: Conceptual plan

PORT BERTH AND DESIGN CONCLUSIONS FOR NORTHPORT

Berth and Quayside conclusions

47. A container quay length of 700m is required to berth two container vessels simultaneously. This is considered a key requirement for container operation.

48. Based on berth simulation outcome and berth analysis, the preferred scenario is:

(a) 700m container quay;

(b) 2 working MHC and 2 STS[11] cranes are required to support 650,000 TEUs.

49. Initially starting with MHCs is recommended as they have a lower CAPEX and they can be shared with other cargoes, without burdening the terminal with the high CAPEX associated with STS cranes in the transitional years while container trade grows.

Yard handling conclusions

50. Starting with RS and terminal trucks transitioning over to RTGs is considered the most suitable yard handling option for Northport. RS and RTGs both use terminal trucks which work smoothly with MHC.

[11] If deploying only MHCs, the service time for the larger vessel was not acceptable. MHCs are favoured for the port in the initial years as they are cheaper than STS cranes and these can be used for other cargo at Northport allowing for container volumes to grow.

51. RS, while best suited initially due to low CAPEX, cannot meet the required 500,000 TEUs storage capacity. RTG can support the final storage capacity of 500,000 to 650,000 TEUs (depending on dwell time) for import-export cargo.

52. RTGs are electric, with options for more advanced remote-controlled, remote-supervised and automated options now being available. RTG terminals can duly benefit from technological improvements. Similarly, electric and battery-powered trucks are now available and in the mid-long term future, fully autonomous vehicles are anticipated.

RESPONSE TO RELEVANT SUBMISSIONS

53. I am not aware of any third-party submissions that raise issues relevant to my discipline that require a response.

RESPONSE TO SECTION 42A REPORT

54. I have reviewed the s42A report insofar as it relates to port design, and including Appendix C15, the Technical Memo 'Port demand and logistics/engineering design and port operations' prepared by Mr Keane of Stantec Australia. I make the following comments in response.

55. I agree with the summary under 5.4 Port Design in the main s42A report: *"Subject to demand and logistics/shipping confirmation, the scale of the berth extension and yard/terminal is otherwise justified based on the forecasts made to date".*

56. Mr. Keane notes:[12]

> *The concept to amend the terminal at a later date from Reachstacker operations to RTG crane terminal operations would be limiting unless infrastructure is invested in initially so as not to reduce capacity and delays through construction if/when forecast capacity and the need to change terminal / stevedoring equipment occurs (noting this is more of a design than an RMA matter).*

57. In principle, I agree with Mr. Keane that forward planning for infrastructure is beneficial. I also concur that this is a master planning / design issue. In my view, with good planning, there is enough yard space within the proposal to plan the transition to final storage capacity container terminal operations and further that, given the gradual growth, this will not impede the development.[13]

[12] At section 5.4.
[13] As noted earlier in my evidence, it is recommended that sufficient headroom be allowed by Northport when planning the RS to RTG transition.

58. Mr. Keane further notes:[14]

> *Section 15.1 of the S92 submission suggests demarcation of areas however the very setting out of areas for container storage, particularly with RTG cranes or similar, mean these areas are not automatically suitable for other uses (subject to design of beams etc), similarly reefer points mean those areas are dedicated to a large degree to refrigerated container storage and have other structures in the way of other uses (i.e. breakbulk for arguments sake)*

59. I agree that the area designated for refrigerated containers has the fixed infrastructure, but would highlight that the expected reefer percentage for Northport is small at approximately 7%.[15]

60. Beyond these issues, the s42A report identified some areas where it would assist if Northport provided further detail. Relevant to my evidence, those include:

(a) **Clarification over the number of cranes proposed** (paragraph 659 of the s42A report): Based on my assessment, up to four working cranes are required, two MHC and two STS cranes. As these numbers have been ascertained and validated with simulation testing, I am confident of the requirements.

(b) **Suggested addition of condition or advice note** (section 8.1 of the Technical Memo included as Appendix C15): it is recommended that a condition or advice note be included as follows:

> *Before construction, provide a thorough staging plan to demonstrate how the terminal at a later date can be modified from Reach stacker operations to RTG crane terminal operations so as not to reduce capacity and delays through construction and avoid the need for additional coastal occupation.*

61. In response, I agree that staging plans will be useful and that this may appropriately be included as a condition of consent or advice note. At this stage, I am comfortable that this transition can occur without unreasonably reducing capacity or delaying construction, and that additional coastal occupation will not be required, However, because these matters will vary materially depending on the detailed design of the original port infrastructure, it is not practicable to undertake that exercise now. What has been done to date, is to prepare a high-level conceptual RS and aligned RTG layout plan and a high-level development trajectory, as illustrated in Figures 9-11 below. It should be recognized that there can be various viable alternatives and pathways for development and transition and what is prepared is only an option.

[14] At section 5.4.
[15] Similar to Auckland.

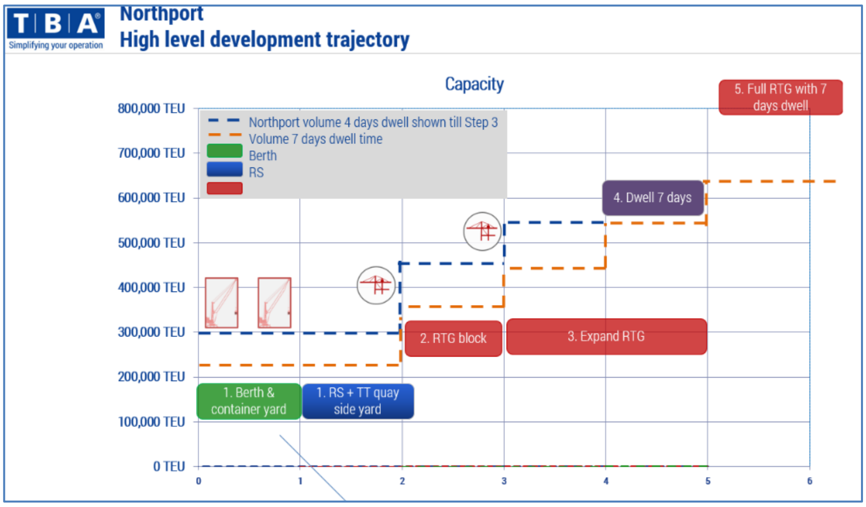

Figure 9: Development trajectory

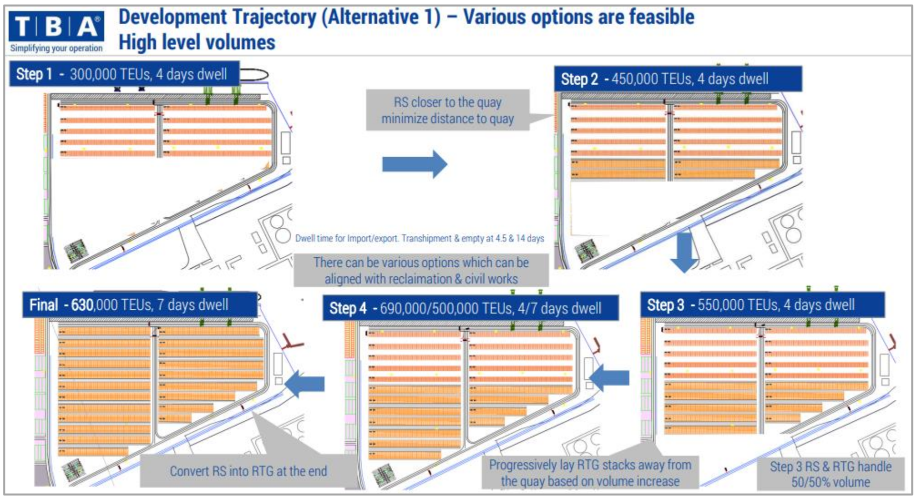

Figure 10:Development pathway - there can various options

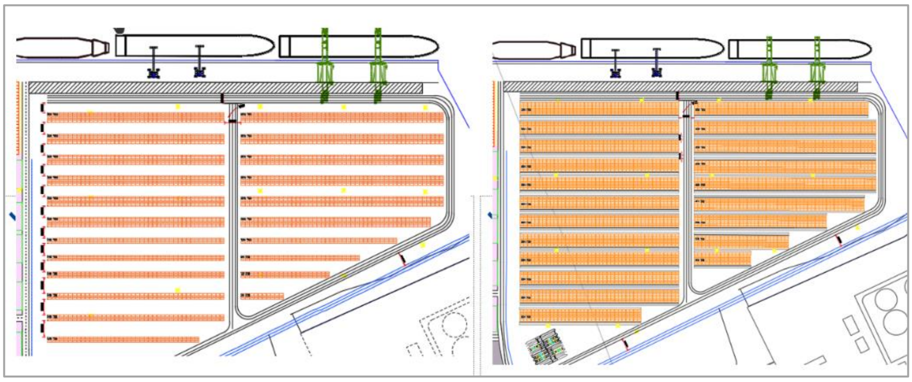

Figure 11: RS & RTG layout with aligned traffic so both can operate in a hybrid mode

COMMENT ON DRAFT PROPOSED CONDITIONS ADVANCED BY NORTHPORT

62. I have reviewed the proposed conditions to be advanced by Northport as attached to Mr Hood's evidence. Insofar as they relate to matters I have addressed and considered, I agree with them. I have no specific comment to make with respect to the various other conditions.

Mahim Khanna
TBA Consultancy BV

24 August 2023

Annexure 1: Summary of how the TRAFALQUAR model operates

(a) Each simulation runs for a 12-month period under various test conditions, multiple runs for each scenario are done to allow for stochastic variations due to vessel arrival delay parameters.

(b) Test conditions for various volume thresholds include anticipated weekly vessel arrival pattern, vessel lengths and exchange per vessel, entry and departure constraints, crane types and productivity, crane numbers and vessel arrival delay pattern.

(c) The model allocates berths and cranes to arriving vessels based on available vacant berth length and available cranes are deployed on vessels.

(d) Limitations including priority of vessels, maximum crane allocations, vessel exchange size, and berth service requirements are considered.

(e) The model measures berth and vessel performance KPIs such as berth occupancy, crane utilization; vessel waiting times for berth, vessel turnaround times, berth productivity achieved etc. Berth performance information is used to establish berth capacity.

(f) Performance testing of the quayside and available length using berth simulation based on post-specific operating conditions provides a more reliable berth assessment.