Riverside Energy Park

Middleton Jetty Operational Review Workshop Note

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CORY
RIVERSIDE ENERGY

Note / Memo

HaskoningDHV UK Ltd.
Maritime & Aviation

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1 Introduction

The Cory Riverside Energy facility at Belvedere is one of the largest energy from waste facilities in the United Kingdom and processes approximately 750,000 tonnes of waste every year. The vast majority of this waste is transported from the City of London to the facility via tugs and barges and offloaded at Middleton Jetty.

Cory Riverside Energy (CRE) has appointed Royal HaskoningDHV (RHDHV) to investigate the options available for increasing the throughput capacity of the Middleton Jetty in order to support extended operational hours at the energy from waste facility.

As part of this study, we have undertaken a review of the current operations at the jetty head (including any key constraints and current throughputs) and held discussions with CRE to understand the likely future changes to operations at the facility. This information has been used to undertake a high-level options study of operational changes that could increase throughput at the jetty (without the need for the current jetty to be extended) and to agree two preferred operational scenarios with CRE which are taken forward for further investigation.

To inform this assessment, an operational review workshop was held at the CRE Belvedere site on 25th September 2017. The workshop was attended by three RHDHV maritime engineers and five members of the CRE team.

The purpose of this note is to summarise the information provided by CRE personnel during the workshop, explain the operational scenarios agreed and to discuss the findings of the operational review for the two agreed scenarios.

It is noted that the operational review focuses on the operations at the Middleton jetty head only and not the wider landside and river logistics network.

2 Current Operations

This section provides an overview of the current operations at the CRE Plant in Belvedere. For further details refer to the completed questionnaire in Appendix 2.

2.1 General

The Middleton Jetty is currently used to import waste containers to supply the Riverside 1 energy from waste plant. The by-product of the combustion process, incinerator bottom ash (IBA), is containerised and exported from the site to the Port of Tilbury. At present, around 49,000 waste containers (plus 10,000 empty IBA containers) and 10,000 IBA containers (plus 49,000 empty waste containers) are imported and exported respectively across the jetty each year.

2.2 Working Hours

The jetty team currently operate a 12-hour shift, 6 days a week (Monday – Saturday) and if required an 8.5hr shift on Sundays (to make up for lost time due to issues such as mechanical downtime). The river operations team (tugs/barges) also work a 12-hour shift; however, this shift starts and finishes in Charlton (upstream of the Middleton Jetty) which reduces the effective working time at Belvedere.

2.3 Vessels

At present, the jetty is limited by the PLA to accommodate 8 barges at any one time (4 large barges and 4 small barges); with tugs used to move the barges between the layby mooring and berths to ensure that the cranes are always 'fed'. The large barges have a capacity of 29-30 containers. The small barges have a capacity of 19 containers. Additional barges are temporarily moored at two standby moorings to the west of the jetty.

2.4 Container Handling

The containers are handled on the jetty by two KONE gantry cranes capable of operating on either side of the jetty head. The cranes offload the containers onto tractor trailer units which then proceed to the tipping bays located in the energy from waste plant, where they offload the waste. They then return to the jetty to reload the empty containers back onto the barge. A second type of container is handled at the berth; these containers are used for the by-product of the combustion process. For this operation, empty containers are offloaded from barges onto tractor trailer units which then proceed to the energy from waste plant where they are filled by a hopper. Once full, the containers are returned to the jetty to be reloaded onto the barge.

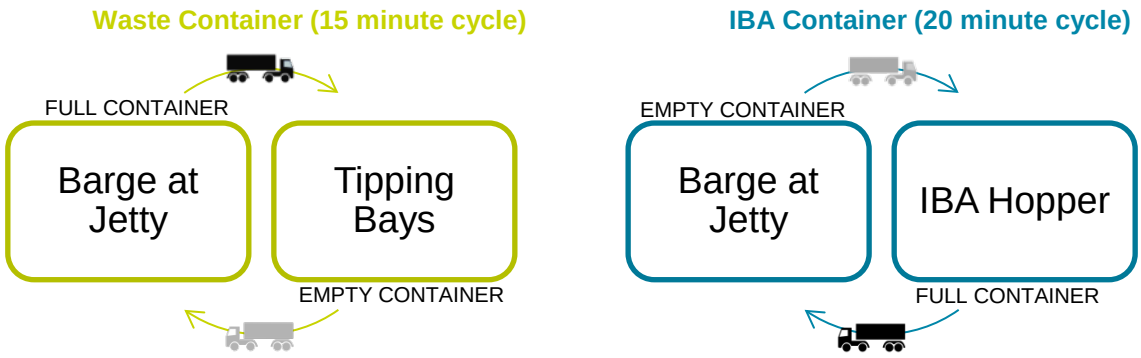

Figure 1: Typical cycle times for the import of waste and export of IBA

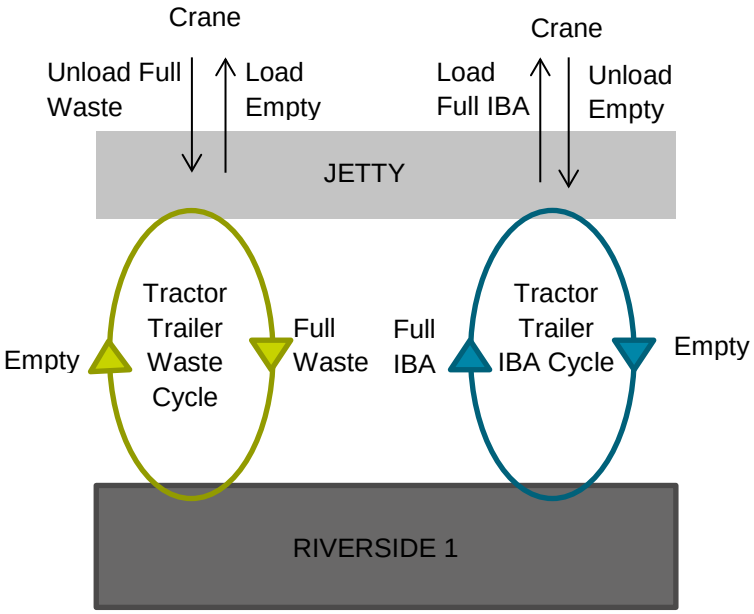

Figure 2: Jetty and landside interaction

At present, around 750ktpa of waste is imported to the Belvedere facility by barge and road, and approximately 187.5ktpa of IBA exported by barge.

3 Future Operations

This section provides an overview of recent changes and plans for the development of the CRE facility at Belvedere. For further details of the current development plans refer to the completed questionnaire in Appendix 2.

3.1 General

There are plans to develop Riverside 2, a new two-line energy from waste plant which, combined with Riverside 1, will form the Riverside Energy Park. This development could lead to an additional 800ktpa of waste imports.

3.2 Working Hours

Planning constraints for the site have recently been revised and 24-hour operations are now permitted.

4 Throughput Improvement Scenarios

During the workshop, various options to increase the throughput levels of the jetty were discussed. These included:

Table 1: Throughput improvement scenario ideas

	Improvement Idea	Decision	
A	Consider increasing the number of tractor trailer units, to service the cranes on a more regular basis.	This will be considered as part of the Base Case, Scenario 1 and Scenario 2.	✔
B	Operate a third crane on the jetty, to increase the number of containers moved across the jetty per hour.	This idea was rejected as the jetty only has two lanes for tractor trailer traffic; it was considered that a third crane would therefore reduce the berth productivity due to additional congestion on the jetty head.	✗
C	Perform double lifting operations.	This idea was not considered viable as the gantry cranes are not setup to undertake tandem lift operations e.g. the containers are rotated 90 degrees when they are raised from the barge. In addition, the jetty geometry does not suit this type of operation.	✗
D	Make use of 40ft containers.	This idea was not considered viable due to the constraints of the jetty geometry and the turning radii that would be required to accommodate longer trailers.	✗
E	To maintain the operational procedures used at present, but operate on a 24hr/day basis. This would mean the river team; jetty team and landside team would all work on a 24hr/day basis.	It was agreed to consider this as part of Scenario 1.	✔
F	To introduce a gantry crane with an outreach capable of unloading double berthed barges at the jetty (e.g. two rows of barges at one berth), with the jetty team and landside team working on a 24hr/day basis, but the river team only working on their current 12hr/day basis.	It was agreed to consider this as part of Scenario 2.	✔

5 Operational Modelling

5.1 Base Case

The 2016 throughput figures provided by CRE were used to setup a basic operational model for the jetty assessment, and to calibrate our understanding of the current operations with the benchmarks for crane movements and tractor trailer cycles currently achieved.

To setup this model, the following parameters were adopted:

- Two gantry cranes are normally in operation.
- Sundays are used to make up for lost time due to crane breakdowns and other downtime such as weather, but are not generally worked; therefore, this time is considered as a buffer only.
- Crane operators work a 12-hour shift with two 40 minute breaks.
- Crane inspections are undertaken quarterly (1 day per crane).
- Subsidiary crane inspections are undertaken monthly in the intermediate months (1/2 day per crane).
- Time lost due to planned crane inspections is made up on Sundays.
- Crane operators typically achieve one container move across the jetty every 2.5 minutes dependent on their level of experience (i.e. 24 moves per hour).
- Within the model one container move is considered as ONE of the following:
    - Unload full waste container from barge onto tractor trailer unit.
    - Unload empty waste container from tractor trailer unit onto the barge.
    - Unload empty IBA container from barge onto tractor trailer unit.
    - Unload full IBA container from tractor trailer unit onto barge.
- At present, typically there are 4-5 tractor trailer units operating per shift.
- Typically one driver will complete 40 cycles (Figure 1) per 12 hour shift.
- The throughputs in the Base Case model were compared with the 2016 throughput figures.

- The waste throughput for 2016 across the jetty was 49,306 containers.
- The IBA throughput for 2016 across the jetty was 10,027 containers.

5.2 Scenario 1: 24 hour operation

Scenario 1 considers maintaining the operations as they are at present, but introducing a second 12-hour shift for the landside, jetty and river teams, to enable a 24 hour/day operation.

Table 2: Scenario 1 – 24-hour shift pattern

Team	Shift Pattern	Breaks per shift	Handover between shifts
Landside	2 x 12 hrs	2 x 40 mins	2 x 20 = 40 mins
Jetty	2 x 12 hrs	2 x 40 mins	2 x 20 = 40 mins
River	2 x 12 hrs	2 x 40 mins	2 x 20 = 40 mins

5.2.1 Basis of model

To setup the Scenario 1 model, the following parameters were adopted:

- The target 'high case' throughput figures for the Riverside Energy Park are as follows:

Table 3: Target throughput figures Riverside Energy Park

	Riverside 1	Riverside 2	Riverside Energy Park
	tpa	tpa	tpa
Total Waste Throughput	785,000	805,000	1,590,000
Total Tonnage Across Jetty	786,250	841,250	1,627,500
Waste by Water	590,000	640,000	1,230,000
Waste by Road	195,000	165,000	360,000
IBA (25% of total waste)	196,250	201,250	397,500

- The average waste container includes 12.5 tonnes of waste.
- The average IBA container includes 18 tonnes of IBA
- From Monday to Saturday, two 12 hour shifts will be worked with two 40 minute breaks per shift.
- A handover period of 2 x 20=40 mins will be required between the two shifts.
- On Sundays, a 12-hour shift will be worked with two 40 minute breaks, providing a 12 hour buffer to make up for unanticipated downtime during the week.
- Due to the reduced buffer and the increased usage of the cranes, an allowance for downtime due to mechanical breakdowns will be considered, two breakdowns per crane per week for duration of 3 hours.
- Due to the reduced buffer, an allowance for downtime due to weather conditions of 6 hours per month will be considered.
- Quarterly crane inspections as per Base Case.
- Subsidiary crane inspections as per Base Case.

- Crane operators are able to undertake one container move across the jetty every 2.5 minutes dependent on their level of experience (i.e. 24 moves per hour).
- There are sufficient tugs in operation during all shifts, to ensure a constant feed of barges to the cranes.
- A range of 4 - 8 tractor trailer units is investigated in the modelling. This range is considered reasonable and congestion resulting from this increase in tractor trailer movements on the jetty head will not be considered as part of this high level study.
- A reduced number of cycles per driver of 31 per 12 hour shift will be considered to account for the longer cycles to the Riverside 2 facility.
- Delays to tractor trailer movements, caused by landside factors are not accounted for within the model (i.e. availability of tipping bays, interaction with road delivered waste, availability of IBA).

5.3 Scenario 2: 24-hour operation, one larger outreach crane

Scenario 2 considers maintaining the daytime operations as they are at present, but introducing a second 12-hour shift for the landside and jetty team only. In this scenario, a single crane with a larger outreach would be introduced with the capability to service double berthed barges on either side of the jetty. The second crane would be the same as used for the current operations (i.e. a single barge outreach). In this scenario, the river team (tugs) would not be available to manoeuvre the barges during the second 12-hour shift. Two sub scenarios will be considered Scenario 2a and Scenario 2b; the difference between these two scenarios is the time when it is assumed that the tugs will arrive at the Belvedere site during the daytime shift to replenish barges at the berths following the night shift.

Table 4: Scenario 2 shift pattern

Team	Shift Pattern	Breaks per shift	Handover between shifts
Landside	2 x 12 hrs	2 x 40 mins	2 x 20=40 mins
Jetty	2 x 12 hrs	2 x 40 mins	2 x 20 =40 mins
River	1 x 12 hrs	2 x 40 mins	N/A

5.3.1 Basis of model

To setup the Scenario 2 model, the following parameters have been adopted:

- The target throughput figures for the Riverside Energy Park are as per Scenario 1 (Table 3).
- The assumed container weights are as per Scenario 1.
- From Monday - Saturday, two 12-hour shifts will be worked with two 40 minute breaks per shift. This shift will be worked by the landside and jetty team only.
- The river operations team will work a 12-hour shift in the daytime only.
- On Sundays, a 12-hour shift will be worked with two 40 minute breaks, providing a 12 hour buffer to make up for unanticipated downtime during the week.
- For Scenario 2a, a period of reduced efficiency of 2 hours 45 minutes will be accounted for, to allow for berthing operations in the morning to supply the cranes with new barges from the layby moorings (2 hours for the tugs to arrive from Charlton plus 45 minutes to manoeuvre 1 barge).
- For Scenario 2b, a period of reduced efficiency of 45 minutes will be accounted for, to allow for berthing operations in the morning to begin supplying the cranes with new barges from the layby moorings. Scenario 2b assumes a tug can be made available at the Belvedere site at the start of the day shift (i.e. 7.00 am).
- A handover period of 2 x 20=40 mins will be required between the two shifts.

- Downtime allowance for weekly crane breakdowns as per Scenario 1.
- Downtime allowance for inclement weather as per Scenario 1.
- Quarterly crane inspections as per Base Case.
- Subsidiary crane inspections as per Base Case.
- Crane operators are able to undertake one container move across the jetty every 2.5 minutes (i.e. 24 moves per hour), when servicing the inner barges.
- To account for the increased time to move a container across the jetty when barges are double berthed, this figure has been increased by 25% to 3.13 minutes for moves undertaken at double outreach.
- There are sufficient tugs in operation, to ensure a constant feed of barges to the cranes during the daytime shift only.
- A range of 4 - 8 tractor trailer units is considered reasonable, congestion resulting from increased tractor trailer movements on the jetty head will not be considered as part of this high level study.
- A reduced number of average cycles per driver of 31 per 12 hour shift will be considered to account for the longer cycles to the Riverside 2 facility.
- Delays to tractor trailer movements, caused by landside factors are not accounted for within the model (i.e. availability of tipping bays, interaction with road delivered waste, availability of IBA).

6 Modelling Results

6.1 Base Case

The Base Case model was based on the assumptions outlined in Section 5.1.

Based on our understanding of current operations, between 4 and 5 tractor trailer units are utilised each 12 hour shift. This equates to one container move across the jetty every 4 and 3.2 minutes per crane, respectively (Table 5).

Table 5: Crane efficiencies required to balance tractor trailer movements

Number of Tractor Trailers	Total Tractor Trailer Cycles Per Day (refer to Figure 1)	Equivalent Total Crane Moves	Containers handled per day (based on 2016 ratio of waste to IBA containers)	Each crane to undertake one move every (mins)
4	160	320	127 waste	4
			33 IBA	
			160 empty	
5	200	400	159 waste	3.2
			41 IBA	
			200 empty	

The benchmark figures provided for the barge unloading/ crane indicate that the crane operators are able to perform one container move across the jetty every 2.5 minutes (24 moves per hour), which suggests that at present, the cranes are not being used at their full capacities due to the rate of supply of containers to the berth by the tractor trailers.

Therefore, the possible container throughputs for the Base Case, Scenarios 1 and 2 will be examined for the operation of:

- 4 tractor trailers (operating simultaneously during a 12 hr shift)
- 5 tractor trailers (operating simultaneously during a 12 hr shift)

- 6 tractor trailers (operating simultaneously during a 12 hr shift)
- 7 tractor trailers (operating simultaneously during a 12 hr shift)
- 8 tractor trailers (operating simultaneously during a 12 hr shift)

Table 6: Base Case Throughputs

Number of tractor trailer units per 12 hr shift	Average time per container move across the jetty (minutes)	Waste import by water (tpa)	Waste import by road (tpa)	IBA export (tpa)	Total tonnage across jetty (tpa)	Total containers across jetty per annum (full waste +full ash + empties)
4	4.0	520,665	85,000	151,416	672,081	100,130
5	3.2	653,868	85,000	184,717	838,585	125,143
6	2.7	777,296	85,000	215,574	992,870	148,320
7	2.3	914,655	85,000	249,914	1,164,569	174,113
8	2.0	1,053,736	85,000	284,684	1,338,420	200,229
Key						
No. of tractor trailers currently operated AND Crane operating at lower efficiency than one move every 2.5 minutes		No. of tractor trailers within 'viable' range AND Crane operating at lower efficiency than one move every 2.5 minutes.		No. of tractor trailers could cause congestion on jetty head OR Crane required to operate at higher efficiency than one move every 2.5 minutes		

The throughputs presented in Table 6, for the 4-5 tractor trailer operation align with the throughputs achieved in 2016.

6.2 Scenario 1: 24-hour operation

Based on the parameters for Scenario 1 outlined in Section 5.2, and the range of 4-8 tractor trailers, the maximum achievable throughputs are as follows:

Table 7: Scenario 1 Throughputs

Number of tractor trailer units per 12 hr shift	Average time per container move across the jetty (minutes)	Waste import by water (tpa)	Waste import by road (tpa)	IBA export (tpa)	Total tonnage across jetty (tpa)	Total containers across jetty per annum (full waste +full ash + empties)
4	5.00	784,225	360,000	286,056	1,070,281	157,262
5	4.00	993,528	360,000	338,382	1,331,910	196,564
6	3.33	1,204,211	360,000	391,053	1,595,264	236,126
7	2.86	1,410,446	360,000	442,611	1,853,057	274,852
8	2.50	1,621,575	360,000	495,394	2,116,968	314,496
Key						
No. of tractor trailers currently operated AND Crane operating at lower efficiency than one move every 2.5 minutes		No. of tractor trailers within 'viable' range AND Crane operating at lower efficiency than one move every 2.5 minutes.		No. of tractor trailers could cause congestion on jetty head OR Crane required to operate at higher efficiency than one move every 2.5 minutes		

To achieve the target throughput figures for Riverside Energy Park (Table 3), **7 tractor trailer units** per 12-hour shift will be required and the average time per container move would be 3.26 minutes.

It is our understanding, that at present, the cranes are able to undertake an average of one container move across the jetty every 2.5 minutes. For more experienced crane operators, this could be reduced to

1.5 minutes. Based on these benchmark figures, the results in Table 7 demonstrate that the supply of containers to the jetty by the landside transport (tractor trailers) dictates the achievable throughputs.

To meet the target throughput of waste for Riverside Energy Park, based on the assumptions stated in Section 5, 7 tractor trailer units would have to be utilised during each 12 hour shift. Note that this figure is heavily dependent on the number of cycles that each driver can achieve per shift, which is a function of the distances to the Riverside 1 and Riverside 2 facilities and delays due to the landside operations (availability of tipping bays etc). Therefore, this factor will require further verification in conjunction with the landside team as the Riverside 2 plans are developed.

Congestion on the jetty head due to increased tractor trailer movements is beyond the scope of this operational review. For the purposes of this assessment, it is assumed that it is reasonable to operate up to 8 tractor trailers simultaneously. This assumption should be verified by discussion with the drivers and/or operations managers. Alternatively, the impacts of increased tractor trailer movements could be investigated by simulation modelling.

The results for Scenario 1 indicate that 24 hour operation could result in a 60% increase in total tonnage across the jetty (waste + IBA) compared to the Base Case, for the same number of tractor trailers. The losses in productivity arise from the handover periods between the two shifts, the downtime accounted for within typical working hours and the reduced number of tractor trailer cycles per driver per shift (to reflect the longer distances travelled to Riverside 2).

6.3 Scenario 2: 24-hour operation, one larger outreach crane

Based on the parameters for Scenario 2 outlined in Section 5.3, and the range of 4-8 tractor trailers, the maximum achievable throughputs are as follows:

Table 8: Scenario 2a Throughputs (2hr 45 min period of reduced efficiency)

Number of tractor trailer units per 12 hr shift	Average time per container move across the jetty (minutes)	Waste import by water (tpa)	Waste import by road (tpa)	IBA export (tpa)	Total tonnage across jetty (tpa)	Total containers across jetty per annum (full waste +full ash + empties)
4	5.00	605,519	360,000	241,533	847,052	123,720
5	4.00	770,340	360,000	282,561	1,052,901	154,650
6	3.33	1,001,057	360,000	341,172	1,560,562	198,077
7	2.86	1,175,925	360,000	384,637	1,560,562	230,886
8	2.50	1,278,814	360,000	410,246	1,689,060	250,193
Key						
No. of tractor trailers currently operated AND Crane operating at lower efficiency than one move every 2.5 minutes		No. of tractor trailers within 'viable' range AND Crane operating at lower efficiency than one move every 2.5 minutes.		No. of tractor trailers could cause congestion on jetty head OR Crane required to operate at higher efficiency than one move every 2.5 minutes		

For Scenario 2a, to achieve the target throughput figures (Table 3), **8 tractor trailer units** per 12-hour shift would be required and the cranes would be required to perform at an efficiency of 2.66 minutes per move.

Table 9: Scenario 2b Throughputs (45 min period of reduced efficiency)

Number of tractor trailer units per 12 hr shift	Average time per container move across the jetty (minutes)	Waste import by water (tpa)	Waste import by road (tpa)	IBA export (tpa)	Total tonnage across jetty (tpa)	Total containers across jetty per annum (full waste +full ash + empties)
4	5.00	696,903	360,000	264,293	961,196	140,870
5	4.00	884,462	360,000	311,167	1,195,628	176,088
6	3.33	1,068,981	360,000	364,321	1,433,302	211,517
7	2.86	1,257,248	360,000	411,237	1,668,485	246,853
8	2.50	1,382,495	360,000	443,508	1,826,003	270,478
Key						
No. of tractor trailers currently operated AND Crane operating at lower efficiency than one move every 2.5 minutes		No. of tractor trailers within 'viable' range AND Crane operating at lower efficiency than one move every 2.5 minutes.		No. of tractor trailers could cause congestion on jetty head OR Crane required to operate at higher efficiency than one move every 2.5 minutes		

For Scenario 2b, to achieve the target throughput figures (Table 3), **7 tractor trailer units** per 12-hour shift would be required and the cranes would be required to perform at an efficiency of 2.97 minutes per move.

Similar to Scenario 1, the achievable throughputs for Scenario 2 are dictated by the supply of containers to the berth by the landside transport (tractor trailers). Based on the assumptions outlined in Section 5.3, the target throughputs for Riverside Energy Park can be achieved in Scenario 2a if 8 tractor trailers are deployed. For Scenario 2b only 7 tractor trailers are required to meet the required throughputs.

The results for Scenario 2a indicate that total tonnage across the jetty could be increased by around 25% compared to Base Case, for the same number of tractor trailer units. The results for Scenario 2b indicate that the total tonnage across the jetty could be increased by around 40%, for the same number of tractor trailer units.

In Scenarios 2a and 2b, the period of reduced productivity, the handover periods, the downtime accounted for and the reduced number of tractor trailer cycles achieved (due to longer travel distances to Riverside 2), all contribute to losses in productivity.

The increase in tonnage across the jetty is not substantial for Scenario 2a; this is primarily due to the period of reduced efficiency (2hrs 45mins). However this Scenario is a truer representation of the 'no night shift' for the river team.

Scenario 2b demonstrates that the inefficiencies of Scenario 2 can be greatly reduced by providing a tug on site at the start of the day shift, to allow the single outreach crane to begin serving the barges.

7 Conclusions and Recommendations

Table 10 below provides a summary of the throughputs for Base Case, Scenario 1 and Scenario 2a and 2b with 4- 8 tractor trailer units in operation.

Table 10: Base Case, Scenario 1, Scenario 2a, and Scenario 2b throughput comparison

Riverside Energy Park (Riverside 1 + Riverside 2), Target Total Waste Throughput: 1,627,500tpa (approximately 241,000 containers)															
Base Case				**Scenario 1**				**Scenario 2a**				**Scenario 2b**			
Tractor Trailers (No.)	**Crane move across jetty (min)**	**Total tonnage across jetty (tpa)**	**Total containers across jetty (full waste +full ash + empties)**	**Tractor Trailers (No.)**	**Crane move across jetty (min)**	**Total tonnage across jetty (tpa)**	**Total containers across jetty (full waste +full ash + empties)**	**Tractor Trailers (No.)**	**Crane move across jetty (min)**	**Total tonnage across jetty (tpa)**	**Total containers across jetty (full waste +full ash + empties)**	**Tractor Trailers (No.)**	**Crane move across jetty (min)**	**Total tonnage across jetty (tpa)**	**Total containers across jetty (full waste +full ash + empties)**
4	4.0	672,081	100,130	4	5.00	1,070,281	157,262	4	5.00	847,052	123,720	4	5.00	961,196	140,870
5	3.2	838,585	125,143	5	4.00	1,331,910	196,564	5	4.00	1,052,901	154,650	5	4.00	1,195,628	176,088
6	2.7	992,870	148,320	6	3.33	1,595,264	236,126	6	3.33	1,560,562	198,077	6	3.33	1,433,302	211,517
7	2.3	1,164,569	174,113	7	2.86	1,853,057	274,852	7	2.86	1,560,562	230,886	7	2.86	1,668,485	246,853
8	2.0	1,338,420	200,229	8	2.50	2,116,968	314,496	8	2.50	1,689,060	250,193	8	2.50	1,826,003	270,478
				≈160% Base Case				≈ 125% Base Case				≈ 140% Base Case			

Key		
No. of tractor trailers currently operated AND Crane operating at lower efficiency than one move every 2.5 minutes	No. of tractor trailers within 'viable' range AND Crane operating at lower efficiency than one move every 2.5 minutes.	No. of tractor trailers could cause congestion on jetty head OR Crane required to operate at higher efficiency than one move every 2.5 minutes

Table 11: Scenario 1, Scenario 2a, and Scenario 2b estimated spare capacity for other containerised products

Scenario 1	**Scenario 2a**	**Scenario 2b**
Spare Capacity (8 tractor trailer)	**Spare Capacity (8 tractor trailer)**	**Spare Capacity (8 tractor trailer)**
73,496 containers (full + empty)	9,193 containers (full + empty)	29,478 containers (full + empty)
36,748 full	4,597 full	14,739 full

To summarise, it is estimated that Scenario 1 (24 hour operation) could increase the tonnage across the jetty by around 60%. The estimated gains for Scenario 2 (one larger outreach crane) are lower, at around 25% - 40% for Scenario 2a and Scenario 2b respectively.

It is possible to achieve the target throughputs for Riverside Energy Park under Scenarios 1, 2a and 2b; it is likely that the number of tractor trailers in operation would need to increase to 8.around 6, 8 or 7 for Scenarios 1, 2a and 2b respectively.

The throughput levels for the Base Case, Scenario 1 and Scenario 2a and 2b are dictated by the number of tractor trailer units serving the cranes. For the purpose of this high-level review it has been assumed that it is viable to operate up to 8 tractor trailers units simultaneously without the operations being limited by congestion. This assumption should be verified by discussion with the drivers and/or operations managers. Alternatively, the impacts of increased tractor trailer movements could be investigated by simulation modelling

Due to increased distances to Riverside 2, the number of cycles per driver achieved during a 12 hour shift has been reduced from 40 to 31. This figure dictates the frequency that the crane is served and therefore directly impacts the achievable throughputs. It is important that this figure is reviewed by the landside team to ensure that these inputs are reasonable, given the typical delays caused by landside interfaces such as the availability of tipping bays and the interaction with the waste delivered by road.

The focus of this operational review is the jetty operation; it has been assumed that during typical operations, there would be sufficient tugs available to replace the barges on berth. It is also assumed that the river team is able to replenish the barges on the layby moorings to meet the target throughputs for Riverside Energy Park. In practice, the river, jetty and landside operations are all interlinked. It may be considered useful to investigate the integration of the river, jetty and landside operations by carrying out full logistic chain simulation.

The operational modelling accounts for various downtime scenarios discussed during the workshop (planned inspections, mechanical failures, weather). In both Scenarios 1 and 2, a 12hr buffer on Sunday night has been provided to allow some contingency to catch up for lost working hours during the week. However, it is important to note that in both these scenarios, the achievable throughputs are heavily reliant on having two working cranes. The cranes onsite are currently approximately 8 years old and it is important to recognise that the reliability of these cranes may decrease as they approach the end of their intended service life. This poses a significant risk to the achievable throughputs. We recommend that the likely downtime of the cranes is one area that is considered further as part of a sensitivity study to investigate the impact of crane reliability.

To achieve the target throughput figures under Scenario 1, 2a and 2b the analysis suggests that up to 8 tractor trailers will be required. These figures suggest that if the high case figures for waste are reached for the Riverside Energy Park, there would only be limited spare capacity to handle other containerised products. This potential ‘spare capacity’ has been estimated and results provided in Table 11.

Appendix 1. Jetty Operational Review Workshop Agenda

HaskoningDHV UK Ltd.
Maritime & Aviation

Agenda

To:	Richard Wilkinson, Andy Pike (Cory Riverside Energy)
Apologies:	
From:	Royal HaskoningDHV
Date of meeting:	25 September 2017
Time:	10.00 to 16.00
Location:	Cory Riverside Energy Facility
Copy:	Ben Hodgkin, Chris Jones, Sarah Barcroft, Tim Fiddimore
Our reference:	M&APB7232A001D0.1
Enclosures	
Classification:	Final

Subject: **Jetty Operational Review Workshop**

Meeting Objectives:

- To define the current marine and jetty unloading operations, including key constraints and throughputs achieved.
- To undertake a high level review of the potential options to enhance operations and increase throughput.
- To identify two preferred operational scenarios to be taken forward in the jetty assessment.
- Confirm timeline and deliverables to be produced for the study.

Item	Time	Description	Lead
1	**10.00- 10.10**	**Introductions**	All
2	**10.10 – 10.30**	**Project Background** Review of the study scope , aims and objectives Outline outcomes of the Operational Review Workshop	RHDHV
3	**10.30 – 11.15**	**Jetty Walkover** Walkover of jetty topsides with Cory Riverside operations team	CRE
4	**11.30 – 12.30**	**Review of Marine and Jetty Unloading Operations** Further discussions with Cory Riverside operations team following jetty walkover to complete the Jetty Operational Review Questionnaire and to define: **Current Operational Practices** o Overview of CRE's general operation o Operational hours o Shift patterns o Achieved container throughputs o Export and import products o Vessel details o Designated areas of the berth	RHDHV

Item	Time	Description	Lead
		o Current berthing and mooring operations o Current crane operations o Uses of the layby moorings o Current means of transporting containers from the berth to the landside area o Constraints o Bottlenecks **Future Operational Changes** o Changes in operational hours and shift patterns o Planned equipment replacements o Target throughputs o Planned uses for other cargoes o Landside plans o Future vessels o Any other known recent/future changes to operations	
	12.30	**LUNCH**	
5	**13.00 – 14.30**	**Operational Improvement Scenarios** Following the mornings review of current marine and jetty unloading operations: o Open discussion to identify potential operational improvements to the marine or jetty operations with the objective to increase throughput (e.g. mitigation for current bottlenecks, increased crane unloading capacity etc.) o Short listing of ideas and discussion on relatives pros/cons of each o Identify two preferred operational scenarios to be taken forward in the assessment of the implications for the jetty (structural, berthing/mooring, service provision, spatial requirements etc.)	RHDHV
6	**14.30 – 15.00**	**Data Review and Gap Analysis** o RHDHV to summarise the data they are currently in possession of from review of own archives. o Cory Riverside to provide an update of data available following issue of data review note by RHDHV. o Identify any outstanding data gaps and actions to either retrieve this information or basis for any assumptions that may be required.	RHDHV CRE RHDHV
7	**15.00 – 15.15**	**Jetty Assessment Deliverables** o Confirm timelines and deliverables to be produced for the study o Requirements for the board meeting and any key	RHDHV

Item	Time	Description	Lead
		information required	
8	**15.15 – 15.45**	**Cargo Import/Export Operations** Discussion on potential options for importing/exporting construction materials / cargo over jetty including; o Cargo size / type o Vessels to be accommodated o Jetty capacity / berth availability o Loading equipment requirements	ALL
9	**15.45 – 16.00**	**Workshop Summary**	RHDHV
10	**16.00**	**Any Other Business**	

Appendix 2. Jetty Operational Review Workshop Questionnaire

Questionnaire

HaskoningDHV UK Ltd.
Maritime & Aviation

To: Cory Riverside Energy
From: Royal HaskoningDHV
Date: 23 October 2017
Copy:
Our reference: M&APB7232N001F0.1
Classification: Final

Subject: Jetty Operational Review Workshop- Questionnaire

1 Current Operations

General	
A general overview of Cory Riverside Energy's overall operation: - Waste sources. - Tug operation and transport of containers to the Cory Riverside site. - Processing of the waste onsite. - By-products of the process that are exported off-site.	- Waste is imported from various London sites, including Cringle Wharf, Walbrook Wharf, Northumberland Wharf and Smugglers Way. - The waste from these wharves is transported to the Belvedere site (Middleton Jetty) by barge using 4 tugs. - These London sites are tidally restricted, once the barges have sufficient water depth to leave these sites there is then a small tidal window available to transit along the River Thames beneath bridge height restrictions. - Only one low tide cycle is used a day to transport barges to Middleton Jetty. - There is a separate contract in place with Bexley Council for road transported waste. - Once the waste barges have reached Middleton Jetty they are then either secured to one of the two layby moorings, or one of the eight jetty berths to await unloading. Waste containers are offloaded by the two jetty gantry cranes onto waiting tractor trailer units, which travel directly to the tipping bays in the waste to energy plant. The empty waste containers are then immediately returned to the jetty and reloaded onto the barges as 'empties'. - The by-product of the incineration process, incinerator bottom ash (IBA) is exported downstream to Tilbury berth 22 for various uses such as a concrete admixture. The return journey from Middleton Jetty to Tilbury is typically 6 hours. The route to Tilbury is not tidally restricted.

Site operational hours (Marine side and landside if different).	**Jetty / Marine Operations:** Mon to Sat: 07.00 – 19.00 Sun: 07.00 – 15.30 (however Sundays are generally only worked to make up for any lost time during the week)
Shift patterns for employees (Marine side and landside if different).	- Typically 3 days on 3 days off. - 2 working shifts of 13 staff per shift - 12 hour shift (including 2 x 40 minute breaks)
Container throughput - Import - Export	**Riverside 1:** <u>Base case (91.3% availability)</u> Total waste throughput 740,000 – 750,000 tpa 25% IBA export 185,000 – 187,500 tpa Road transported waste 75,000 - 85,000 tpa <u>High case (100% availability)</u>Total waste throughput 785,000tpa Road transported waste 195,000 tpa Typical waste container weight 12-14 tonnes Typical IBA container weight 18-19 tonnes 2016 Imported waste 49,306 containers 2016 Exported IBA 10,027 containers 2016 Road delivered waste 62,700 tonnes
Other commodities (e.g. anything other than waste import and by-product export).	None at present.
Marine Operations	
Vessels details i.e. size, capacity or number (if different from attached design criteria) Barges Any other vessels (tugs)	Three waste barge sizes: Small barges (19 containers, 1.5 hours typical unloading time) Large barges (29-30 containers, 2-2.5 hours typical unloading time)
Berth - Areas of berth designated to particular activities (e.g. different berths used for import/ export operations)	Berths 2 and 3 (river side middle berths) are typically used for the IBA exports.
General description of berthing and mooring operations: - Vessel calls (when, how often) - How are the mooring and berthing operations carried out? - How is the mooring and berthing equipment used? - Mooring arrangements	- The barge/tug operation is based on a 12 hour shift (based at Charlton). - Tugs typically arrive at Belvedere between 7.30 – 9.00 am depending on number of barges to be moved in the day. - There is a PLA restriction in place for a maximum of 8 barges to be moored at the jetty at any one time. - The jetty typically accommodates 4 large barges and 4 small barges at a time. - At least 8 barges are typically waiting on either of

	the two layby moorings to replace the barges on the jetty. - Once a barge has been unloaded and loaded with empties, it is replaced by a barge of the same size, this process is undertaken by tug and typically takes 30-45 minutes (it does not hinder the crane operation) - The barges are typically arranged small-large-large–small on both sides of the jetty head (i.e. large barges nearest the middle of the jetty). - Barges are secured to the mooring traveller units (move up and down with the tide without attendance) and a 'slack' line to the topside bollards as a reserve in case of line breakages.
Peaks (e.g. are there higher numbers of vessel calls at a particular time of year or time of the day?)	- There are no significant seasonal peaks. - There are busier times on the berth i.e. when 3-4 tugs are in operation.
General description of the gantry crane operations - Crane efficiency (typical time to unload a barge). - Typical barge unloading and loading patterns.	- Crane moves are typically 1.5 – 2.5 minutes per container, depending on the driver's level of experience and the state of tide. - Barges are unloaded forward to rear or vice versa. - Typically 2-3 breakdowns are experienced on average per week (for both cranes). Mostly minor and quickly repaired. - Cranes are inspected on a quarterly basis (one crane out of action for one day) and monthly basis (1/2 day downtime). - Occasional downtime due to weather conditions (>30mph wind and fog), but this is typically for short periods of time.
General description of the use of the layby moorings (e.g. how many barges can be accommodated)	- There are two layby moorings. - Each layby mooring can hold 8 barges of empties OR 6 barges if one of the barges contains loaded containers.
Landside Operations	
Describe the steps involved in transporting the containers from the berth to the landside area. - Staff involved - Equipment used - Storage on jetty/landside areas - Time	- The landside transportation is undertaken by tractor trailer units. - The operation is continuous, whereby a loaded waste container is offloaded onto a tractor trailer unit, the tractor trailer unit then travels to the tipping bays, discharges its load and then the empty container is taken back to the barge (typically 15 minute cycle time) - Bottlenecks on the landside include delays caused by the T-junction due to conflicts with the road transported waste from Bexley (which has to be turned around in 15 minutes) and the availability of tipping bays.

Constraints	
Describe any known constraints to site operations (planning conditions, noise, navigation channel restrictions etc.)	- Siltation at the berths. - Dredging is undertaken every 12-18 months (nominal impact on operations).
Known Bottlenecks	
Describe any known bottlenecks (e.g. offloading procedure, tidal restrictions, daylight operations, storage capacity).	- Ash container handling (loading of containers by hopper). - Conflicts with the road transported waste. - Availability of tipping bays in the waste to energy plant.

2 Future Operations

Future Operations	
Changes to operational hours.	Potential to operate 24/7.
Changes to staff shifts or numbers.	Potential to align shifts with 24/7 operation. (3, 8hr shifts or 2, 12hr shifts)
Any planned equipment replacement.	2018 planned renovation work to existing fleet of tractor trailer units.
Target container throughput - Import - Export	**Riverside 2 (Riverside Energy Park):** <u>Base case</u> Additional waste throughput 655,000 tpa Additional 25% IBA export Road transported waste TBC <u>High case</u> Additional waste throughput 805,000 tpa Additional 25% IBA export Road transported waste 165,000 tpa
Any plans to use the jetty for other types of cargo.	- CRE want to know the 'art of the possible' - If jetty capacity is available, import/export of containerised goods to supermarkets in central London could be considered.
Any existing plans to modify or expand the landside area.	**Riverside 2:** - New two line plant to the West of the existing Energy from Waste plant.
Any vessel replacement plans and the future vessels if known.	No known changes.
Any additional information	Possible use of the existing jetty for importing construction materials for Riverside 2 construction.

Appendix 3. Base Case Modelling

PROJECT TITLE: Middleton Jetty Assessment

SUBJECT: Base Case 12 hour operation tractor trailers

PROJECT NO: PB7232

PREPARED BY:SB

CHECKED BY: PB

Royal HaskoningDHV
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Calculations

	KEY	
	INPUT	
	INFORMATION ONLY - NOT USED IN CALCULATION	
	OUTPUT	
Landside Approach -Tractor Trailers		
Average tonnage per waste container (12-14)	12.5	tonnes
Average tonnage per IBA container (18-19)	18	tonnes
Ratio of IBA to waste (based on 2016 figures)	0.20	
Working hours		
Actual hours of jetty operation mon-sat (7.00-19.00, 2 x 40min break)	10.67	hours
Current Operation		
4 tractor trailer units operating		
Average number of cycles per truck driver per day	40	cycles per shift
Typical number of trucks in operation	4	No
Waste containers per driver	32	containers per day
IBA containers per driver	8	containers per day
Total waste containers	127	
Total IBA containers	33	
Typical cycle time waste container	15	mins
Typical cycle time IBA	20	mins
Time spent on waste containers	8.0	hours
Time spent on IBA containers	2.7	hours
Total productive time	10.7	hours
Equivalent total crane moves	320	crane moves per day
Actual moves per hour achieved by each crane	15	crane moves per hour
If 4 tractor- trailers are in operation, the crane can be fed every:	4.0	mins

PROJECT TITLE: Middleton Jetty Assessment

SUBJECT: Base case throughput (4 tractor trailers)

PROJECT NO: PB7232

PREPARED BY:SB

CHECKED BY: PB

Royal HaskoningDHV
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Calculations

	KEY	
	INPUT	
	INFORMATION ONLY - NOT USED IN CALCULATION	
	OUTPUT	
	GOAL SEEK	
Throughputs		
Total waste throughput (Riverside 1 + Riverside 2)	605,665	tpa
Waste by water	520,665	tpa
Waste by road	85,000	tpa
Incinerator bottom ash (0.25 *total waste)	151,416	tpa
Average tonnage per waste container (12-14 tonnes)	12.5	tonnes
Average tonnage per IBA container(18-19 tonnes)	18	tonnes
Throughputs		
Waste by water	41,653	containers
Incinerator Bottom Ash (IBA)	8,412	containers
Empties import (for IBA)	8,412	containers
Empties export (for waste)	41,653	containers
Ratio of waste to IBA	0.20	
Total container moves across berth	100,130	containers moves across berth per annum
Working hours		
Actual hours of jetty operation mon-sat (7.00-19.00, 2 x 40min break)	10.67	hours
Sundays (generally only used for catchup)	52.14	days per annum
Downtime for crane inspections (quarterly and monthly- this lost time is made up for on Sundays)	8.00	days per annum
Working days per annum	313	days per annum
Actual working hours per annum	3,337	hours
Cranes		
Number of cranes	2	No.
Actual moves per hour achieved (both cranes in operation)	30.0	moves per hour
Actual moves per hour per crane	15.0	moves per hour
Average time for a productive crane move	4.0	mins

PROJECT TITLE: Middleton Jetty Assessment

SUBJECT: Base case throughput (5 tractor trailers)

PROJECT NO: PB7232

PREPARED BY:SB

CHECKED BY: PB

Calculations

	KEY	
	INPUT	
	INFORMATION ONLY - NOT USED IN CALCULATION	
	OUTPUT	
	GOAL SEEK	
Throughputs		
Total waste throughput (Riverside 1 + Riverside 2)	738,868	tpa
Waste by water	653,868	tpa
Waste by road	85,000	tpa
Incinerator bottom ash (0.25 *total waste)	184,717	tpa
Average tonnage per waste container (12-14 tonnes)	12.5	tonnes
Average tonnage per IBA container(18-19 tonnes)	18	tonnes
Throughputs		
Waste by water	52,309	containers
Incinerator Bottom Ash (IBA)	10,262	containers
Empties import (for IBA)	10,262	containers
Empties export (for waste)	52,309	containers
Ratio of waste to IBA	0.20	
Total container moves across berth	125,143	containers moves across berth per annum
Working hours		
Actual hours of jetty operation mon-sat (7.00-19.00, 2 x 40min break)	10.67	hours
Sundays (generally only used for catchup)	52.14	days per annum
Downtime for crane inspections (quarterly and monthly- this lost time is made up for on Sundays)	8.00	days per annum
Working days per annum	313	days per annum
Actual working hours per annum	3,337	hours
Cranes		
Number of cranes	2	No.
Actual moves per hour achieved (both cranes in operation)	37.5	moves per hour
Actual moves per hour per crane	18.8	moves per hour
Average time for a productive crane move	3.2	mins

PROJECT TITLE: Middleton Jetty Assessment

SUBJECT: Base case throughput (6 tractor trailers)

PROJECT NO: PB7232

PREPARED BY:SB

CHECKED BY: PB

Calculations

	KEY	
	INPUT	
	INFORMATION ONLY - NOT USED IN CALCULATION	
	OUTPUT	
	GOAL SEEK	
Throughputs		
Total waste throughput (Riverside 1 + Riverside 2)	862,296	tpa
Waste by water	777,296	tpa
Waste by road	85,000	tpa
Incinerator bottom ash (0.25 *total waste)	215,574	tpa
Average tonnage per waste container (12-14 tonnes)	12.5	tonnes
Average tonnage per IBA container(18-19 tonnes)	18	tonnes
Throughputs		
Waste by water	62,184	containers
Incinerator Bottom Ash (IBA)	11,976	containers
Empties import (for IBA)	11,976	containers
Empties export (for waste)	62,184	containers
Ratio of waste to IBA	0.19	
Total container moves across berth	148,320	containers moves across berth per annum
Working hours		
Actual hours of jetty operation mon-sat (7.00-19.00, 2 x 40min break)	10.67	hours
Sundays (generally only used for catchup)	52.14	days per annum
Downtime for crane inspections (quarterly and monthly- this lost time is made up for on Sundays)	8.00	days per annum
Working days per annum	313	days per annum
Actual working hours per annum	3,337	hours
Cranes		
Number of cranes	2	No.
Actual moves per hour achieved (both cranes in operation)	44.4	moves per hour
Actual moves per hour per crane	22.2	moves per hour
Average time for a productive crane move	2.7	mins

PROJECT TITLE: Middleton Jetty Assessment

SUBJECT: Base case throughput (7 tractor trailers)

PROJECT NO: PB7232

PREPARED BY:SB

CHECKED BY: PB

Calculations

	KEY	
	INPUT	
	INFORMATION ONLY - NOT USED IN CALCULATION	
	OUTPUT	
	GOAL SEEK	
Throughputs		
Total waste throughput (Riverside 1 + Riverside 2)	999,655	tpa
Waste by water	914,655	tpa
Waste by road	85,000	tpa
Incinerator bottom ash (0.25 *total waste)	249,914	tpa
Average tonnage per waste container (12-14 tonnes)	12.5	tonnes
Average tonnage per IBA container(18-19 tonnes)	18	tonnes
Throughputs		
Waste by water	73,172	containers
Incinerator Bottom Ash (IBA)	13,884	containers
Empties import (for IBA)	13,884	containers
Empties export (for waste)	73,172	containers
Ratio of waste to IBA	0.19	
Total container moves across berth	174,113	containers moves across berth per annum
Working hours		
Actual hours of jetty operation mon-sat (7.00-19.00, 2 x 40min break)	10.67	hours
Sundays (generally only used for catchup)	52.14	days per annum
Downtime for crane inspections (quarterly and monthly- this lost time is made up for on Sundays)	8.00	days per annum
Working days per annum	313	days per annum
Actual working hours per annum	3,337	hours
Cranes		
Number of cranes	2	No.
Actual moves per hour achieved (both cranes in operation)	52.2	moves per hour
Actual moves per hour per crane	26.1	moves per hour
Average time for a productive crane move	2.3	mins

PROJECT TITLE: Middleton Jetty Assessment

SUBJECT: Base case throughput (8 tractor trailers)

PROJECT NO: PB7232

PREPARED BY:SB

CHECKED BY: PB

Calculations

	KEY	
	INPUT	
	INFORMATION ONLY - NOT USED IN CALCULATION	
	OUTPUT	
	GOAL SEEK	
Throughputs		
Total waste throughput (Riverside 1 + Riverside 2)	1,138,736	tpa
Waste by water	1,053,736	tpa
Waste by road	85,000	tpa
Incinerator bottom ash (0.25 *total waste)	284,684	tpa
Average tonnage per waste container (12-14 tonnes)	12.5	tonnes
Average tonnage per IBA container(18-19 tonnes)	18	tonnes
Throughputs		
Waste by water	84,299	containers
Incinerator Bottom Ash (IBA)	15,816	containers
Empties import (for IBA)	15,816	containers
Empties export (for waste)	84,299	containers
Ratio of waste to IBA	0.19	
Total container moves across berth	200,229	containers moves across berth per annum
Working hours		
Actual hours of jetty operation mon-sat (7.00-19.00, 2 x 40min break)	10.67	hours
Sundays (generally only used for catchup)	52.14	days per annum
Downtime for crane inspections (quarterly and monthly- this lost time is made up for on Sundays)	8.00	days per annum
Working days per annum	313	days per annum
Actual working hours per annum	3,337	hours
Cranes		
Number of cranes	2	No.
Actual moves per hour achieved (both cranes in operation)	60.0	moves per hour
Actual moves per hour per crane	30.0	moves per hour
Average time for a productive crane move	2.0	mins

Appendix 4. Scenario 1 Modelling

PROJECT TITLE: Middleton Jetty Assessment

SUBJECT: Scenario 1&2 24 hour operation, tractor trailers

PROJECT NO: PB7232

PREPARED BY:SB

CHECKED BY: PB

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Calculations

	KEY	
	INPUT	
	INFORMATION ONLY - NOT USED IN CALCULATION	
	OUTPUT	
Landside Approach -Tractor Trailers		
Average tonnage per waste container (12-14)	12.5	tonnes
Average tonnage per IBA container (18-19)	18	tonnes
Ratio of IBA to waste (based on 2016 figures)	0.20	
Working hours		
Actual hours of jetty operation mon-sat (7.00-19.00, 2 x 40min break 1 x 20 min handover)	10.33	hours
Current Operation		
4 tractor trailer units operating		
Average number of cycles per truck driver per day	31	cycles per 12 hour shift
Typical number of trucks in operation	4	No
Waste containers per driver	25	containers per shift
IBA containers per driver	6	containers per shift
Total waste containers	99	
Total IBA containers	25	
Typical cycle time waste container	19	mins
Typical cycle time IBA	24	mins
Time spent on waste containers	7.8	hours
Time spent on IBA containers	2.5	hours
Total productive time	10.34	hours
Equivalent total crane moves	248	crane moves per shift
Actual moves per hour achieved by each crane	12	crane moves per hour
If 4 tractor- trailers are in operation, the crane cane be fed every:	5.00	mins

PROJECT TITLE: Middleton Jetty Assessment

SUBJECT: Scenario 1- 24 hour operation

PROJECT NO: PB7232

PREPARED BY:SB

CHECKED BY: PB

Calculations

	KEY	
	INPUT	
	INFORMATION ONLY - NOT USED IN CALCULATION	
	OUTPUT	
	GOAL SEEK	
Scenario 1 - 24 hr working - Target Throughputs		
Throughputs		
Total waste throughput (Riverside 1 + Riverside 2)	1,590,000	tpa
Waste by water	1,230,000	tpa
Waste by road	360,000	tpa
Incinerator Bottom Ash (0.25 *waste)	397,500	tpa
Average tonnage per waste container (12-14)	12.5	tonnes
Average tonnage per IBA container(18-19)	18	tonnes
Waste by water	98,400	containers
Incinerator Bottom Ash	22,084	containers
Empties import (for IBA)	22,084	containers
Empties export (for waste)	98,400	containers
Container moves across berth per annum	240,968	container moves per annum
Working hours		
Actual hours of operation mon-sat (24hrs, 4 x 40min break 2 x 20= 40min handove	20.67	hours
Sundays	52.14	days per annum
Sunday hours (07.00 -19.00, assume 2 x 40 min break)	10.67	hours
Downtime for crane inspections (quarterly and monthly)	85.33	hours per annum
Downtime for breakdowns (assume 2 breakdowns per crane week, 3 hours)	312.00	hours per annum
Downtime for weather (assume 6 hours per month)	72.00	hours per annum
Annual hours Sunday 12 hr shift	556	hours per annum
Actual working hours per annum	6,553	hours per annum
Cranes		
Number of cranes	2	No.
Actual moves per hour achieved (both cranes in operation)	36.8	moves per hour
Actual moves per hour per crane	18.4	moves per hour
Average time for a crane move	3.26	mins

PROJECT TITLE: Middleton Jetty Assessment

SUBJECT: Scenario 1- 24 hour operation (4 tractor trailers)

PROJECT NO: PB7232

PREPARED BY:SB

CHECKED BY: PB

Calculations

	KEY	
	INPUT	
	INFORMATION ONLY - NOT USED IN CALCULATION	
	OUTPUT	
	GOAL SEEK	
Scenario 1 - 24 hr working		
Throughputs		
Total waste throughput (Riverside 1 + Riverside 2)	1,144,225	tpa
Waste by water	784,225	tpa
Waste by road	360,000	tpa
Incinerator Bottom Ash (0.25 *waste)	286,056	tpa
Average tonnage per waste container (12-14)	12.5	tonnes
Average tonnage per IBA container(18-19)	18	tonnes
Waste by water	62,738	containers
Incinerator Bottom Ash	15,893	containers
Empties import (for IBA)	15,893	containers
Empties export (for waste)	62,738	containers
Container moves across berth per annum	157,262	container moves per annum
Working hours		
Actual hours of operation mon-sat (24hrs, 4 x 40min break 2 x 20= 40min handove	20.67	hours
Sundays	52.14	days per annum
Sunday hours (07.00 -19.00, assume 2 x 40 min break)	10.67	hours
Downtime for crane inspections (quarterly and monthly)	85.33	hours per annum
Downtime for breakdowns (assume 2 breakdowns per crane week, 3 hours)	312.00	hours per annum
Downtime for weather (assume 6 hours per month)	72.00	hours per annum
Annual hours Sunday 12 hr shift	556	hours per annum
Actual working hours per annum	6,553	hours per annum
Cranes		
Number of cranes	2	No.
Actual moves per hour achieved (both cranes in operation)	24.0	moves per hour
Actual moves per hour per crane	12.0	moves per hour
Average time for a crane move	5.00	mins

PROJECT TITLE: Middleton Jetty Assessment

SUBJECT: Scenario 1- 24 hour operation (5 tractor trailers)

PROJECT NO: PB7232

PREPARED BY:SB

CHECKED BY: PB

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Calculations

	KEY	
	INPUT	
	INFORMATION ONLY - NOT USED IN CALCULATION	
	OUTPUT	
	GOAL SEEK	
Scenario 1 - 24 hr working		
Throughputs		
Total waste throughput (Riverside 1 + Riverside 2)	1,353,528	tpa
Waste by water	993,528	tpa
Waste by road	360,000	tpa
Incinerator Bottom Ash (0.25 *waste)	338,382	tpa
Average tonnage per waste container (12-14)	12.5	tonnes
Average tonnage per IBA container(18-19)	18	tonnes
Waste by water	79,483	containers
Incinerator Bottom Ash	18,799	containers
Empties import (for IBA)	18,799	containers
Empties export (for waste)	79,483	containers
Container moves across berth per annum	196,564	container moves per annum
Working hours		
Actual hours of operation mon-sat (24hrs, 4 x 40min break 2 x 20= 40min handove	20.67	hours
Sundays	52.14	days per annum
Sunday hours (07.00 -19.00, assume 2 x 40 min break)	10.67	hours
Downtime for crane inspections (quarterly and monthly)	85.33	hours per annum
Downtime for breakdowns (assume 2 breakdowns per crane week, 3 hours)	312.00	hours per annum
Downtime for weather (assume 6 hours per month)	72.00	hours per annum
Annual hours Sunday 12 hr shift	556	hours per annum
Actual working hours per annum	6,553	hours per annum
Cranes		
Number of cranes	2	No.
Actual moves per hour achieved (both cranes in operation)	30.0	moves per hour
Actual moves per hour per crane	15.0	moves per hour
Average time for a crane move	4.00	mins

PROJECT TITLE: Middleton Jetty Assessment

SUBJECT: Scenario 1- 24 hour operation (6 tractor trailers)

PROJECT NO: PB7232

PREPARED BY:SB

CHECKED BY: PB

Calculations

	KEY	
	INPUT	
	INFORMATION ONLY - NOT USED IN CALCULATION	
	OUTPUT	
	GOAL SEEK	
Scenario 1 - 24 hr working		
Throughputs		
Total waste throughput (Riverside 1 + Riverside 2)	1,564,211	tpa
Waste by water	1,204,211	tpa
Waste by road	360,000	tpa
Incinerator Bottom Ash (0.25 *waste)	391,053	tpa
Average tonnage per waste container (12-14)	12.5	tonnes
Average tonnage per IBA container(18-19)	18	tonnes
Waste by water	96,337	containers
Incinerator Bottom Ash	21,726	containers
Empties import (for IBA)	21,726	containers
Empties export (for waste)	96,337	containers
Container moves across berth per annum	236,126	container moves per annum
Working hours		
Actual hours of operation mon-sat (24hrs, 4 x 40min break 2 x 20= 40min handove	20.67	hours
Sundays	52.14	days per annum
Sunday hours (07.00 -19.00, assume 2 x 40 min break)	10.67	hours
Downtime for crane inspections (quarterly and monthly)	85.33	hours per annum
Downtime for breakdowns (assume 2 breakdowns per crane week, 3 hours)	312.00	hours per annum
Downtime for weather (assume 6 hours per month)	72.00	hours per annum
Annual hours Sunday 12 hr shift	556	hours per annum
Actual working hours per annum	6,553	hours per annum
Cranes		
Number of cranes	2	No.
Actual moves per hour achieved (both cranes in operation)	36.0	moves per hour
Actual moves per hour per crane	18.0	moves per hour
Average time for a crane move	3.33	mins

PROJECT TITLE: Middleton Jetty Assessment

SUBJECT: Scenario 1- 24 hour operation (7 tractor trailers)

PROJECT NO: PB7232

PREPARED BY:SB

CHECKED BY: PB

Calculations

	KEY	
	INPUT	
	INFORMATION ONLY - NOT USED IN CALCULATION	
	OUTPUT	
	GOAL SEEK	
Scenario 1 - 24 hr working		
Throughputs		
Total waste throughput (Riverside 1 + Riverside 2)	1,770,446	tpa
Waste by water	1,410,446	tpa
Waste by road	360,000	tpa
Incinerator Bottom Ash (0.25 *waste)	442,611	tpa
Average tonnage per waste container (12-14)	12.5	tonnes
Average tonnage per IBA container(18-19)	18	tonnes
Waste by water	112,836	containers
Incinerator Bottom Ash	24,590	containers
Empties import (for IBA)	24,590	containers
Empties export (for waste)	112,836	containers
Container moves across berth per annum	274,852	container moves per annum
Working hours		
Actual hours of operation mon-sat (24hrs, 4 x 40min break 2 x 20= 40min handove	20.67	hours
Sundays	52.14	days per annum
Sunday hours (07.00 -19.00, assume 2 x 40 min break)	10.67	hours
Downtime for crane inspections (quarterly and monthly)	85.33	hours per annum
Downtime for breakdowns (assume 2 breakdowns per crane week, 3 hours)	312.00	hours per annum
Downtime for weather (assume 6 hours per month)	72.00	hours per annum
Annual hours Sunday 12 hr shift	556	hours per annum
Actual working hours per annum	6,553	hours per annum
Cranes		
Number of cranes	2	No.
Actual moves per hour achieved (both cranes in operation)	41.9	moves per hour
Actual moves per hour per crane	21.0	moves per hour
Average time for a crane move	2.86	mins

PROJECT TITLE: Middleton Jetty Assessment

SUBJECT: Scenario 1- 24 hour operation (8 tractor trailers)

PROJECT NO: PB7232

PREPARED BY:SB

CHECKED BY: PB

Calculations

	KEY	
	INPUT	
	INFORMATION ONLY - NOT USED IN CALCULATION	
	OUTPUT	
	GOAL SEEK	
Scenario 1 - 24 hr working		
Throughputs		
Total waste throughput (Riverside 1 + Riverside 2)	1,981,575	tpa
Waste by water	1,621,575	tpa
Waste by road	360,000	tpa
Incinerator Bottom Ash (0.25 *waste)	495,394	tpa
Average tonnage per waste container (12-14)	12.5	tonnes
Average tonnage per IBA container(18-19)	18	tonnes
Waste by water	129,726	containers
Incinerator Bottom Ash	27,522	containers
Empties import (for IBA)	27,522	containers
Empties export (for waste)	129,726	containers
Container moves across berth per annum	314,496	container moves per annum
Working hours		
Actual hours of operation mon-sat (24hrs, 4 x 40min break 2 x 20= 40min handove	20.67	hours
Sundays	52.14	days per annum
Sunday hours (07.00 -19.00, assume 2 x 40 min break)	10.67	hours
Downtime for crane inspections (quarterly and monthly)	85.33	hours per annum
Downtime for breakdowns (assume 2 breakdowns per crane week, 3 hours)	312.00	hours per annum
Downtime for weather (assume 6 hours per month)	72.00	hours per annum
Annual hours Sunday 12 hr shift	556	hours per annum
Actual working hours per annum	6,553	hours per annum
Cranes		
Number of cranes	2	No.
Actual moves per hour achieved (both cranes in operation)	48.0	moves per hour
Actual moves per hour per crane	24.0	moves per hour
Average time for a crane move	2.50	mins

Appendix 5. Scenario 2a Modelling

PROJECT TITLE: Middleton Jetty Assessment

SUBJECT: Scenario 1&2 24 hour operation, tractor trailers

PROJECT NO: PB7232

PREPARED BY:SB

CHECKED BY: PB

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Calculations

	KEY	
	INPUT	
	INFORMATION ONLY - NOT USED IN CALCULATION	
	OUTPUT	
Landside Approach -Tractor Trailers		
Average tonnage per waste container (12-14)	12.5	tonnes
Average tonnage per IBA container (18-19)	18	tonnes
Ratio of IBA to waste (based on 2016 figures)	0.20	
Working hours		
Actual hours of jetty operation mon-sat (7.00-19.00, 2 x 40min break 1 x 20 min handover)	10.33	hours
Current Operation		
4 tractor trailer units operating		
Average number of cycles per truck driver per day	31	cycles per 12 hour shift
Typical number of trucks in operation	4	No
Waste containers per driver	25	containers per shift
IBA containers per driver	6	containers per shift
Total waste containers	99	
Total IBA containers	25	
Typical cycle time waste container	19	mins
Typical cycle time IBA	24	mins
Time spent on waste containers	7.8	hours
Time spent on IBA containers	2.5	hours
Total productive time	10.34	hours
Equivalent total crane moves	248	crane moves per shift
Actual moves per hour achieved by each crane	12	crane moves per hour
If 4 tractor- trailers are in operation, the crane cane be fed every:	5.00	mins

PROJECT TITLE: Middleton Jetty Assessment

SUBJECT: Scenario 2a- One large outreach crane (target throughputs)

PROJECT NO: PB7232

PREPARED BY:SB

CHECKED BY: RM

Royal HaskoningDHV
Enhancing Society Together

Calculations

	KEY	
	INPUT	
	INFORMATION ONLY - NOT USED IN CALCULATION	
	OUTPUT	
	GOAL SEEK	
Containers		
Average tonnage per waste container (12-14)	12.5	tonnes
Average tonnage per IBA container(18-19)	18	tonnes
Vessel		
Large Barge		
Capacity	30	containers
Small Barge		
Capacity	19	containers
Vessels for short outreach crane		
Large barges	2	No.
Small barges	2	No.
Number of containers	98	No.
Number of crane moves	196	container moves
Crane efficiency	2.66	minutes per move across jetty
Vessels for large outreach crane		
Vessels at short outreach	4	No.
Larges barges	2	No.
Small barges	2	No.
Number of containers	98	No.
Number of container moves	196	No.
Crane efficiency	2.66	minutes per move
Vessels at long outreach	4	No
Larges barges	2	
Small barges	2	
Number of containers	98	
Number of container moves	196	
Factor to account for double outreach	1.25	
Crane efficiency	3.13	minutes per move
Night time Working Hours		
Actual hours of operation mon-sat (12hrs, 2 x 40min break, 2 x 20=40 min handover)	10.00	hours
Hours of operation per annum	3,128.57	hours per annum
Container Movements Nightshift		
Maximum box moves short outreach crane (single outreach)	196	container moves across jetty
Maximum box moves long outreach crane (single outreach)	196	container moves across jetty
Maximum box moves long outreach crane (double outreach)	25	container moves across jetty
Total container moves	417	container moves across jetty
Total containers	209	containers
Ratio of IBA to waste	0.18	
Waste containers	170	containers
IBA containers	39	containers
Daytime Working Hours		
Actual hours of operation mon-sun (12hrs, 2 x 40 min break)	10.67	hours
Handover time (await tugs, rearrange 2 barges on berth, assume 2 tugs available)	2.75	hours
Downtime for crane inspections (quarterly and monthly)	85.33	hours per annum
Downtime for breakdowns (assume 2 breakdowns per crane week, 3 hours)	312.86	hours per annum
Downtime for weather (assume 6 hours per month)	72.00	hours per annum
Normal working operational hours	2,419.39	hours per annum
Long outreach crane operations	1,003.75	hours per annum
Normal working operational hours	6.63	hours
Period of reduced productivity	2.75	hours
Container Movements Dayshift		
Maximum box moves short outreach crane (single outreach)	150	container moves across jetty
Maximum box moves long outreach crane (single outreach)	150	container moves across jetty
Maximum box moves short outreach crane (handover period- single outreach)	-	container moves across jetty
Maximum box moves long outreach crane (handover period- single outreach)	-	container moves across jetty
Maximum box moves long outreach crane (handover period- double outreach)	53	container moves across jetty
Total container moves	352	container moves across jetty
Total containers	176	containers
Ratio of IBA to waste	0.18	
Waste containers	144	containers
IBA containers	33	containers
Downtime (applied to daytime shift)		
Downtime for crane inspections (quarterly and monthly)	85.33	hours per annum
Downtime for breakdowns (assume 2 breakdowns per crane week, 3 hours)	312.00	hours per annum
Downtime for weather (assume 6 hours per month)	72.00	hours per annum
Downtime total	469.33	hours per annum
Equivalent to daytime shift	59	days
Daytime full containers	55,416	containers
Night time full containers	65,297	containers
Total full containers	120,713	containers
Waste containers	98,400	containers
IBA containers	22,313	containers
Waste empties	98,400	containers
IBA empties	22,313	containers
	241,426	containers
Waste tonnes	1,230,000	tpa
IBA tonnes	401,637	tpa
Road	360,000	tpa
Total waste	1,590,000	tpa
Goal seek	0.25	
Double outreach required on both sides of large crane?	ONE SIDE ONLY	

PROJECT TITLE: Middleton Jetty Assessment

SUBJECT: Scenario 2a- One large outreach crane (4 tractor trailers)

PROJECT NO: PB7232

PREPARED BY:SB

CHECKED BY: RM

Calculations

	KEY	
	INPUT	
	INFORMATION ONLY - NOT USED IN CALCULATION	
	OUTPUT	
	GOAL SEEK	
Containers		
Average tonnage per waste container (12-14)	12.5	tonnes
Average tonnage per IBA container(18-19)	18	tonnes
Vessel		
Large Barge		
Capacity	30	containers
Small Barge		
Capacity	19	containers
Vessels for short outreach crane		
Large barges	2	No.
Small barges	2	No.
Number of containers	98	No.
Number of crane moves	196	container moves
Crane efficiency	5.00	minutes per move across jetty
Vessels for large outreach crane		
Vessels at short outreach	4	No.
Larges barges	2	No.
Small barges	2	No.
Number of containers	98	No.
Number of container moves	196	No.
Crane efficiency	5.0	minutes per move
Vessels at long outreach	4	No
Larges barges	2	
Small barges	2	
Number of containers	98	
Number of container moves	196	
Factor to account for double outreach	1.25	
Crane efficiency	5.00	minutes per move
Night time Working Hours		
Actual hours of operation mon-sat (12hrs, 2 x 40min break, 2 x 20=40 min handover	10.00	hours
Hours of operation per annum	3,128.57	hours per annum
Container Movements Nightshift		
Maximum box moves short outreach crane (single outreach)	120	container moves across jetty
Maximum box moves long outreach crane (single outreach)	120	container moves across jetty
Maximum box moves long outreach crane (double outreach)	-	container moves across jetty
Total container moves	240	container moves across jetty
Total containers	120	containers
Ratio of IBA to waste	0.22	
Waste containers	94	containers
IBA containers	26	containers
Daytime Working Hours		
Actual hours of operation mon-sun (12hrs, 2 x 40 min break)	10.67	hours
Handover time (await tugs, rearrange 2 barges on berth, assume 2 tugs available)	2.75	hours
Downtime for crane inspections (quarterly and monthly)	85.33	hours per annum
Downtime for breakdowns (assume 2 breakdowns per crane week, 3 hours)	312.86	hours per annum
Downtime for weather (assume 6 hours per month)	72.00	hours per annum
Normal working operational hours	2,419.39	hours per annum
Long outreach crane operations	1,003.75	hours per annum
Normal working operational hours	6.63	hours
Period of reduced productivity	2.75	hours
Container Movements Dayshift		
Maximum box moves short outreach crane (single outreach)	80	container moves across jetty
Maximum box moves long outreach crane (single outreach)	80	container moves across jetty
Maximum box moves short outreach crane (handover period- single outreach)	33	container moves across jetty
Maximum box moves long outreach crane (handover period- single outreach)	33	container moves across jetty
Maximum box moves long outreach crane (handover period- double outreach)	-	container moves across jetty
Total container moves	225	container moves across jetty
Total containers	113	containers
Ratio of IBA to waste	0.22	
Waste containers	88	containers
IBA containers	24	containers
Downtime (applied to daytime shift)		
Downtime for crane inspections (quarterly and monthly)	85.33	hours per annum
Downtime for breakdowns (assume 2 breakdowns per crane week, 3 hours)	312.00	hours per annum
Downtime for weather (assume 6 hours per month)	72.00	hours per annum
Downtime total	469.33	hours per annum
Equivalent to daytime shift	59	days
Daytime full containers	24,317	containers
Night time full containers	37,543	containers
Total full containers	61,860	containers
Waste containers	48,442	containers
IBA containers	13,418	containers
Waste empties	48,442	containers
IBA empties	13,418	containers
	123,720	containers
Waste tonnes	605,519	tpa
IBA tonnes	241,533	tpa
Road	360,000	tpa
Total waste	965,519	tpa
Goal seek (adjust to 0.25)	0.25	
Double outreach required on both sides of large crane?	ONE SIDE ONLY	

PROJECT TITLE: Middleton Jetty Assessment

SUBJECT: Scenario 2a- One large outreach crane (5 tractor trailers)

PROJECT NO: PB7232

PREPARED BY:SB

CHECKED BY: RM

Royal HaskoningDHV
Enhancing Society Together

Calculations

	KEY	
	INPUT	
	INFORMATION ONLY - NOT USED IN CALCULATION	
	OUTPUT	
	GOAL SEEK	
Containers		
Average tonnage per waste container (12-14)	12.5	tonnes
Average tonnage per IBA container(18-19)	18	tonnes
Vessel		
Large Barge		
Capacity	30	containers
Small Barge		
Capacity	19	containers
Vessels for short outreach crane		
Large barges	2	No.
Small barges	2	No.
Number of containers	98	No.
Number of crane moves	196	container moves
Crane efficiency	4.00	minutes per move across jetty
Vessels for large outreach crane		
Vessels at short outreach	4	No.
Larges barges	2	No.
Small barges	2	No.
Number of containers	98	No.
Number of container moves	196	No.
Crane efficiency	4.0	minutes per move
Vessels at long outreach	4	No
Larges barges	2	
Small barges	2	
Number of containers	98	
Number of container moves	196	
Factor to account for double outreach	1.25	
Crane efficiency	4.00	minutes per move
Night time Working Hours		
Actual hours of operation mon-sat (12hrs, 2 x 40min break, 2 x 20=40 min handover	10.00	hours
Hours of operation per annum	3,128.57	hours per annum
Container Movements Nightshift		
Maximum box moves short outreach crane (single outreach)	150	container moves across jetty
Maximum box moves long outreach crane (single outreach)	150	container moves across jetty
Maximum box moves long outreach crane (double outreach)	-	container moves across jetty
Total container moves	300	container moves across jetty
Total containers	150	containers
Ratio of IBA to waste	0.20	
Waste containers	120	containers
IBA containers	30	containers
Daytime Working Hours		
Actual hours of operation mon-sun (12hrs, 2 x 40 min break)	10.67	hours
Handover time (await tugs, rearrange 2 barges on berth, assume 2 tugs available)	2.75	hours
Downtime for crane inspections (quarterly and monthly)	85.33	hours per annum
Downtime for breakdowns (assume 2 breakdowns per crane week, 3 hours)	312.86	hours per annum
Downtime for weather (assume 6 hours per month)	72.00	hours per annum
Normal working operational hours	2,419.39	hours per annum
Long outreach crane operations	1,003.75	hours per annum
Normal working operational hours	6.63	hours
Period of reduced productivity	2.75	hours
Container Movements Dayshift		
Maximum box moves short outreach crane (single outreach)	99	container moves across jetty
Maximum box moves long outreach crane (single outreach)	99	container moves across jetty
Maximum box moves short outreach crane (handover period- single outreach)	41	container moves across jetty
Maximum box moves long outreach crane (handover period- single outreach)	41	container moves across jetty
Maximum box moves long outreach crane (handover period- double outreach)	-	container moves across jetty
Total container moves	281	container moves across jetty
Total containers	141	containers
Ratio of IBA to waste	0.20	
Waste containers	112	containers
IBA containers	29	containers
Downtime (applied to daytime shift)		
Downtime for crane inspections (quarterly and monthly)	85.33	hours per annum
Downtime for breakdowns (assume 2 breakdowns per crane week, 3 hours)	312.00	hours per annum
Downtime for weather (assume 6 hours per month)	72.00	hours per annum
Downtime total	469.33	hours per annum
Equivalent to daytime shift	59	days
Daytime full containers	30,396	containers
Night time full containers	46,929	containers
Total full containers	77,325	containers
Waste containers	61,627	containers
IBA containers	15,698	containers
Waste empties	61,627	containers
IBA empties	15,698	containers
	154,650	containers
Waste tonnes	770,340	tpa
IBA tonnes	282,561	tpa
Road	360,000	tpa
Total waste	1,130,340	tpa
Goal seek (adjust to 0.25)	0.25	
Double outreach required on both sides of large crane?	ONE SIDE ONLY	

PROJECT TITLE: Middleton Jetty Assessment

SUBJECT: Scenario 2a- One large outreach crane (6 tractor trailers)

PROJECT NO: PB7232

PREPARED BY:SB

CHECKED BY: RM

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Calculations

	KEY	
	INPUT	
	INFORMATION ONLY - NOT USED IN CALCULATION	
	OUTPUT	
	GOAL SEEK	
Containers		
Average tonnage per waste container (12-14)	12.5	tonnes
Average tonnage per IBA container(18-19)	18	tonnes
Vessel		
Large Barge		
Capacity	30	containers
Small Barge		
Capacity	19	containers
Vessels for short outreach crane		
Large barges	2	No.
Small barges	2	No.
Number of containers	98	No.
Number of crane moves	196	container moves
Crane efficiency	3.33	minutes per move across jetty
Vessels for large outreach crane		
Vessels at short outreach	4	No.
Larges barges	2	No.
Small barges	2	No.
Number of containers	98	No.
Number of container moves	196	No.
Crane efficiency	3.3	minutes per move
Vessels at long outreach	4	No
Larges barges	2	
Small barges	2	
Number of containers	98	
Number of container moves	196	
Factor to account for double outreach	1.25	
Crane efficiency	3.33	minutes per move
Night time Working Hours		
Actual hours of operation mon-sat (12hrs, 2 x 40min break, 2 x 20=40 min handover	10.00	hours
Hours of operation per annum	3,128.57	hours per annum
Container Movements Nightshift		
Maximum box moves short outreach crane (single outreach)	180	container moves across jetty
Maximum box moves long outreach crane (single outreach)	180	container moves across jetty
Maximum box moves long outreach crane (double outreach)	-	container moves across jetty
Total container moves	360	container moves across jetty
Total containers	180	containers
Ratio of IBA to waste	0.19	
Waste containers	146	containers
IBA containers	34	containers
Daytime Working Hours		
Actual hours of operation mon-sun (12hrs, 2 x 40 min break)	10.67	hours
Handover time (await tugs, rearrange 2 barges on berth, assume 2 tugs available)	2.75	hours
Downtime for crane inspections (quarterly and monthly)	85.33	hours per annum
Downtime for breakdowns (assume 2 breakdowns per crane week, 3 hours)	312.86	hours per annum
Downtime for weather (assume 6 hours per month)	72.00	hours per annum
Normal working operational hours	2,419.39	hours per annum
Long outreach crane operations	1,003.75	hours per annum
Normal working operational hours	6.63	hours
Period of reduced productivity	2.75	hours
Container Movements Dayshift		
Maximum box moves short outreach crane (single outreach)	119	container moves across jetty
Maximum box moves long outreach crane (single outreach)	119	container moves across jetty
Maximum box moves short outreach crane (handover period- single outreach)	16	container moves across jetty
Maximum box moves long outreach crane (handover period- single outreach)	16	container moves across jetty
Maximum box moves long outreach crane (handover period- double outreach)	34	container moves across jetty
Total container moves	304	container moves across jetty
Total containers	152	containers
Ratio of IBA to waste	0.19	
Waste containers	123	containers
IBA containers	29	containers
Downtime (applied to daytime shift)		
Downtime for crane inspections (quarterly and monthly)	85.33	hours per annum
Downtime for breakdowns (assume 2 breakdowns per crane week, 3 hours)	312.00	hours per annum
Downtime for weather (assume 6 hours per month)	72.00	hours per annum
Downtime total	469.33	hours per annum
Equivalent to daytime shift	59	days
Daytime full containers	42,668	containers
Night time full containers	56,371	containers
Total full containers	99,039	containers
Waste containers	80,085	containers
IBA containers	18,954	containers
Waste empties	80,085	containers
IBA empties	18,954	containers
	198,077	containers
Waste tonnes	1,001,057	tpa
IBA tonnes	341,172	tpa
Road	360,000	tpa
Total waste	1,361,057	tpa
Goal seek (adjust to 0.25)	0.25	
Double outreach required on both sides of large crane?	ONE SIDE ONLY	

PROJECT TITLE: Middleton Jetty Assessment

SUBJECT: Scenario 2a- One large outreach crane (7 tractor trailers)

PROJECT NO: PB7232

PREPARED BY:SB

CHECKED BY: RM

Calculations

	KEY	
	INPUT	
	INFORMATION ONLY - NOT USED IN CALCULATION	
	OUTPUT	
	GOAL SEEK	
Containers		
Average tonnage per waste container (12-14)	12.5	tonnes
Average tonnage per IBA container(18-19)	18	tonnes
Vessel		
Large Barge		
Capacity	30	containers
Small Barge		
Capacity	19	containers
Vessels for short outreach crane		
Large barges	2	No.
Small barges	2	No.
Number of containers	98	No.
Number of crane moves	196	container moves
Crane efficiency	2.86	minutes per move across jetty
Vessels for large outreach crane		
Vessels at short outreach	4	No.
Larges barges	2	No.
Small barges	2	No.
Number of containers	98	No.
Number of container moves	196	No.
Crane efficiency	2.9	minutes per move
Vessels at long outreach	4	No
Larges barges	2	
Small barges	2	
Number of containers	98	
Number of container moves	196	
Factor to account for double outreach	1.25	
Crane efficiency	3.13	minutes per move
Night time Working Hours		
Actual hours of operation mon-sat (12hrs, 2 x 40min break, 2 x 20=40 min handove	10.00	hours
Hours of operation per annum	3,128.57	hours per annum
Container Movements Nightshift		
Maximum box moves short outreach crane (single outreach)	196	container moves across jetty
Maximum box moves long outreach crane (single outreach)	196	container moves across jetty
Maximum box moves long outreach crane (double outreach)	13	container moves across jetty
Total container moves	405	container moves across jetty
Total containers	202	containers
Ratio of IBA to waste	0.19	
Waste containers	165	containers
IBA containers	37	containers
Daytime Working Hours		
Actual hours of operation mon-sun (12hrs, 2 x 40 min break)	10.67	hours
Handover time (await tugs, rearrange 2 barges on berth, assume 2 tugs available)	2.75	hours
Downtime for crane inspections (quarterly and monthly)	85.33	hours per annum
Downtime for breakdowns (assume 2 breakdowns per crane week, 3 hours)	312.86	hours per annum
Downtime for weather (assume 6 hours per month)	72.00	hours per annum
Normal working operational hours	2,419.39	hours per annum
Long outreach crane operations	1,003.75	hours per annum
Normal working operational hours	6.63	hours
Period of reduced productivity	2.75	hours
Container Movements Dayshift		
Maximum box moves short outreach crane (single outreach)	139	container moves across jetty
Maximum box moves long outreach crane (single outreach)	139	container moves across jetty
Maximum box moves short outreach crane (handover period- single outreach)	-	container moves across jetty
Maximum box moves long outreach crane (handover period- single outreach)	-	container moves across jetty
Maximum box moves long outreach crane (handover period- double outreach)	53	container moves across jetty
Total container moves	331	container moves across jetty
Total containers	165	containers
Ratio of IBA to waste	0.19	
Waste containers	135	containers
IBA containers	31	containers
Downtime (applied to daytime shift)		
Downtime for crane inspections (quarterly and monthly)	85.33	hours per annum
Downtime for breakdowns (assume 2 breakdowns per crane week, 3 hours)	312.00	hours per annum
Downtime for weather (assume 6 hours per month)	72.00	hours per annum
Downtime total	469.33	hours per annum
Equivalent to daytime shift	59	days
Daytime full containers	52,148	containers
Night time full containers	63,294	containers
Total full containers	115,443	containers
Waste containers	94,074	containers
IBA containers	21,369	containers
Waste empties	94,074	containers
IBA empties	21,369	containers
	230,886	containers
Waste tonnes	1,175,925	tpa
IBA tonnes	384,637	tpa
Road	360,000	tpa
Total waste	1,535,925	tpa
Goal seek (adjust to 0.25)	0.25	
Double outreach required on both sides of large crane?	ONE SIDE ONLY	

PROJECT TITLE: Middleton Jetty Assessment

SUBJECT: Scenario 2a- One large outreach crane (8 tractor trailers)

PROJECT NO: PB7232

PREPARED BY:SB

CHECKED BY: RM

Calculations

	KEY	
	INPUT	
	INFORMATION ONLY - NOT USED IN CALCULATION	
	OUTPUT	
	GOAL SEEK	
Containers		
Average tonnage per waste container (12-14)	12.5	tonnes
Average tonnage per IBA container(18-19)	18	tonnes
Vessel		
Large Barge		
Capacity	30	containers
Small Barge		
Capacity	19	containers
Vessels for short outreach crane		
Large barges	2	No.
Small barges	2	No.
Number of containers	98	No.
Number of crane moves	196	container moves
Crane efficiency	2.50	minutes per move across jetty
Vessels for large outreach crane		
Vessels at short outreach	4	No.
Larges barges	2	No.
Small barges	2	No.
Number of containers	98	No.
Number of container moves	196	No.
Crane efficiency	2.5	minutes per move
Vessels at long outreach	4	No
Larges barges	2	
Small barges	2	
Number of containers	98	
Number of container moves	196	
Factor to account for double outreach	1.25	
Crane efficiency	3.13	minutes per move
Night time Working Hours		
Actual hours of operation mon-sat (12hrs, 2 x 40min break, 2 x 20=40 min handove	10.00	hours
Hours of operation per annum	3,128.57	hours per annum
Container Movements Nightshift		
Maximum box moves short outreach crane (single outreach)	196	container moves across jetty
Maximum box moves long outreach crane (single outreach)	196	container moves across jetty
Maximum box moves long outreach crane (double outreach)	35	container moves across jetty
Total container moves	427	container moves across jetty
Total containers	214	containers
Ratio of IBA to waste	0.18	
Waste containers	175	containers
IBA containers	39	containers
Daytime Working Hours		
Actual hours of operation mon-sun (12hrs, 2 x 40 min break)	10.67	hours
Handover time (await tugs, rearrange 2 barges on berth, assume 2 tugs available)	2.75	hours
Downtime for crane inspections (quarterly and monthly)	85.33	hours per annum
Downtime for breakdowns (assume 2 breakdowns per crane week, 3 hours)	312.86	hours per annum
Downtime for weather (assume 6 hours per month)	72.00	hours per annum
Normal working operational hours	2,419.39	hours per annum
Long outreach crane operations	1,003.75	hours per annum
Normal working operational hours	6.63	hours
Period of reduced productivity	2.75	hours
Container Movements Dayshift		
Maximum box moves short outreach crane (single outreach)	159	container moves across jetty
Maximum box moves long outreach crane (single outreach)	159	container moves across jetty
Maximum box moves short outreach crane (handover period- single outreach)	-	container moves across jetty
Maximum box moves long outreach crane (handover period- single outreach)	-	container moves across jetty
Maximum box moves long outreach crane (handover period- double outreach)	53	container moves across jetty
Total container moves	371	container moves across jetty
Total containers	185	containers
Ratio of IBA to waste	0.18	
Waste containers	152	containers
IBA containers	34	containers
Downtime (applied to daytime shift)		
Downtime for crane inspections (quarterly and monthly)	85.33	hours per annum
Downtime for breakdowns (assume 2 breakdowns per crane week, 3 hours)	312.00	hours per annum
Downtime for weather (assume 6 hours per month)	72.00	hours per annum
Downtime total	469.33	hours per annum
Equivalent to daytime shift	59	days
Daytime full containers	58,270	containers
Night time full containers	66,826	containers
Total full containers	125,097	containers
Waste containers	102,305	containers
IBA containers	22,791	containers
Waste empties	102,305	containers
IBA empties	22,791	containers
	250,193	containers
Waste tonnes	1,278,814	tpa
IBA tonnes	410,246	tpa
Road	360,000	tpa
Total waste	1,638,814	tpa
Goal seek (adjust to 0.25)	0.25	
Double outreach required on both sides of large crane?	ONE SIDE ONLY	

Appendix 6. Scenario 2b Modelling

PROJECT TITLE: Middleton Jetty Assessment

SUBJECT: Scenario 1&2 24 hour operation, tractor trailers

PROJECT NO: PB7232

PREPARED BY:SB

CHECKED BY: PB

Royal HaskoningDHV
Enhancing Society Together

Calculations

	KEY	
	INPUT	
	INFORMATION ONLY - NOT USED IN CALCULATION	
	OUTPUT	
Landside Approach -Tractor Trailers		
Average tonnage per waste container (12-14)	12.5	tonnes
Average tonnage per IBA container (18-19)	18	tonnes
Ratio of IBA to waste (based on 2016 figures)	0.20	
Working hours		
Actual hours of jetty operation mon-sat (7.00-19.00, 2 x 40min break 1 x 20 min handover)	10.33	hours
Current Operation		
4 tractor trailer units operating		
Average number of cycles per truck driver per day	31	cycles per 12 hour shift
Typical number of trucks in operation	4	No
Waste containers per driver	25	containers per shift
IBA containers per driver	6	containers per shift
Total waste containers	99	
Total IBA containers	25	
Typical cycle time waste container	19	mins
Typical cycle time IBA	24	mins
Time spent on waste containers	7.8	hours
Time spent on IBA containers	2.5	hours
Total productive time	10.34	hours
Equivalent total crane moves	248	crane moves per shift
Actual moves per hour achieved by each crane	12	crane moves per hour
If 4 tractor- trailers are in operation, the crane cane be fed every:	5.00	mins

PROJECT TITLE: Middleton Jetty Assessment

SUBJECT: Scenario 2b- One large outreach crane (target throughputs)

PROJECT NO: PB7232

PREPARED BY:SB

CHECKED BY: RM

Royal HaskoningDHV
Enhancing Society Together

Calculations

	KEY	
	INPUT	
	INFORMATION ONLY - NOT USED IN CALCULATION	
	OUTPUT	
	GOAL SEEK	
Containers		
Average tonnage per waste container (12-14)	12.5	tonnes
Average tonnage per IBA container(18-19)	18	tonnes
Vessel		
Large Barge		
Capacity	30	containers
Small Barge		
Capacity	19	containers
Vessels for short outreach crane		
Large barges	2	No.
Small barges	2	No.
Number of containers	98	No.
Number of crane moves	196	container moves
Crane efficiency	2.97	minutes per move across jetty
Vessels for large outreach crane		
Vessels at short outreach	4	No.
Larges barges	2	No.
Small barges	2	No.
Number of containers	98	No.
Number of container moves	196	No.
Crane efficiency	2.97	minutes per move
Vessels at long outreach	4	No
Larges barges	2	
Small barges	2	
Number of containers	98	
Number of container moves	196	
Factor to account for double outreach	1.25	
Crane efficiency	3.13	minutes per move
Night time Working Hours		
Actual hours of operation mon-sat (12hrs, 2 x 40min break, 2 x 20=40 min handover)	10.00	hours
Hours of operation per annum	3,128.57	hours per annum
Container Movements Nightshift		
Maximum box moves short outreach crane (single outreach)	196	container moves across jetty
Maximum box moves long outreach crane (single outreach)	196	container moves across jetty
Maximum box moves long outreach crane (double outreach)	5	container moves across jetty
Total container moves	397	container moves across jetty
Total containers	199	containers
Ratio of IBA to waste	0.18	
Waste containers	163	containers
IBA containers	36	containers
Daytime Working Hours		
Actual hours of operation mon-sun (12hrs, 2 x 40 min break)	10.67	hours
Handover time (await tugs, rearrange 2 barges on berth, assume 2 tugs available)	0.75	hours
Downtime for crane inspections (quarterly and monthly)	85.33	hours per annum
Downtime for breakdowns (assume 2 breakdowns per crane week, 3 hours)	312.86	hours per annum
Downtime for weather (assume 6 hours per month)	72.00	hours per annum
Normal working operational hours	3,149.39	hours per annum
Long outreach crane operations	273.75	hours per annum
Normal working operational hours	8.63	hours
Period of reduced productivity	0.75	hours
Container Movements Dayshift		
Maximum box moves short outreach crane (single outreach)	174	container moves across jetty
Maximum box moves long outreach crane (single outreach)	174	container moves across jetty
Maximum box moves short outreach crane (handover period- single outreach)	-	container moves across jetty
Maximum box moves long outreach crane (handover period- single outreach)	-	container moves across jetty
Maximum box moves long outreach crane (handover period- double outreach)	14	container moves across jetty
Total container moves	363	container moves across jetty
Total containers	181	containers
Ratio of IBA to waste	0.18	
Waste containers	149	containers
IBA containers	33	containers
Downtime (applied to daytime shift)		
Downtime for crane inspections (quarterly and monthly)	85.33	hours per annum
Downtime for breakdowns (assume 2 breakdowns per crane week, 3 hours)	312.00	hours per annum
Downtime for weather (assume 6 hours per month)	72.00	hours per annum
Downtime total	469.33	hours per annum
Equivalent to daytime shift	47	days
Daytime full containers	57,932	containers
Night time full containers	62,178	containers
Total full containers	120,110	containers
Waste containers	98,400	containers
IBA containers	21,710	containers
Waste empties	98,400	containers
IBA empties	21,710	containers
	240,219	containers
Waste tonnes	1,230,000	tpa
IBA tonnes	390,772	tpa
Road	360,000	tpa
Total waste	1,590,000	tpa
Goal seek	0.25	
Double outreach required on both sides of large crane?	ONE SIDE ONLY	

PROJECT TITLE: Middleton Jetty Assessment

SUBJECT: Scenario 2b- One large outreach crane (4 tractor trailers)

PROJECT NO: PB7232

PREPARED BY:SB

CHECKED BY: RM

Calculations

	KEY	
	INPUT	
	INFORMATION ONLY - NOT USED IN CALCULATION	
	OUTPUT	
	GOAL SEEK	
Containers		
Average tonnage per waste container (12-14)	12.5	tonnes
Average tonnage per IBA container(18-19)	18	tonnes
Vessel		
Large Barge		
Capacity	30	containers
Small Barge		
Capacity	19	containers
Vessels for short outreach crane		
Large barges	2	No.
Small barges	2	No.
Number of containers	98	No.
Number of crane moves	196	container moves
Crane efficiency	5.00	minutes per move across jetty
Vessels for large outreach crane		
Vessels at short outreach	4	No.
Larges barges	2	No.
Small barges	2	No.
Number of containers	98	No.
Number of container moves	196	No.
Crane efficiency	5.0	minutes per move
Vessels at long outreach	4	No
Larges barges	2	
Small barges	2	
Number of containers	98	
Number of container moves	196	
Factor to account for double outreach	1.25	
Crane efficiency	5.00	minutes per move
Night time Working Hours		
Actual hours of operation mon-sat (12hrs, 2 x 40min break, 2 x 20=40 min handover	10.00	hours
Hours of operation per annum	3,128.57	hours per annum
Container Movements Nightshift		
Maximum box moves short outreach crane (single outreach)	120	container moves across jetty
Maximum box moves long outreach crane (single outreach)	120	container moves across jetty
Maximum box moves long outreach crane (double outreach)	-	container moves across jetty
Total container moves	240	container moves across jetty
Total containers	120	containers
Ratio of IBA to waste	0.21	
Waste containers	95	containers
IBA containers	25	containers
Daytime Working Hours		
Actual hours of operation mon-sun (12hrs, 2 x 40 min break)	10.67	hours
Handover time (await tugs, rearrange 2 barges on berth, assume 2 tugs available)	0.75	hours
Downtime for crane inspections (quarterly and monthly)	85.33	hours per annum
Downtime for breakdowns (assume 2 breakdowns per crane week, 3 hours)	312.86	hours per annum
Downtime for weather (assume 6 hours per month)	72.00	hours per annum
Normal working operational hours	3,149.39	hours per annum
Long outreach crane operations	273.75	hours per annum
Normal working operational hours	8.63	hours
Period of reduced productivity	0.75	hours
Container Movements Dayshift		
Maximum box moves short outreach crane (single outreach)	104	container moves across jetty
Maximum box moves long outreach crane (single outreach)	104	container moves across jetty
Maximum box moves short outreach crane (handover period- single outreach)	9	container moves across jetty
Maximum box moves long outreach crane (handover period- single outreach)	9	container moves across jetty
Maximum box moves long outreach crane (handover period- double outreach)	-	container moves across jetty
Total container moves	225	container moves across jetty
Total containers	113	containers
Ratio of IBA to waste	0.21	
Waste containers	89	containers
IBA containers	23	containers
Downtime (applied to daytime shift)		
Downtime for crane inspections (quarterly and monthly)	85.33	hours per annum
Downtime for breakdowns (assume 2 breakdowns per crane week, 3 hours)	312.00	hours per annum
Downtime for weather (assume 6 hours per month)	72.00	hours per annum
Downtime total	469.33	hours per annum
Equivalent to daytime shift	47	days
Daytime full containers	32,892	containers
Night time full containers	37,543	containers
Total full containers	70,435	containers
Waste containers	55,752	containers
IBA containers	14,683	containers
Waste empties	55,752	containers
IBA empties	14,683	containers
	140,870	containers
Waste tonnes	696,903	tpa
IBA tonnes	264,293	tpa
Road	360,000	tpa
Total waste	1,056,903	tpa
Goal seek (adjust to 0.25)	0.25	
Double outreach required on both sides of large crane?	ONE SIDE ONLY	

PROJECT TITLE: Middleton Jetty Assessment

SUBJECT: Scenario 2b- One large outreach crane (5 tractor trailers)

PROJECT NO: PB7232

PREPARED BY:SB

CHECKED BY: RM

Royal HaskoningDHV
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Calculations

	KEY	
	INPUT	
	INFORMATION ONLY - NOT USED IN CALCULATION	
	OUTPUT	
	GOAL SEEK	
Containers		
Average tonnage per waste container (12-14)	12.5	tonnes
Average tonnage per IBA container(18-19)	18	tonnes
Vessel		
Large Barge		
Capacity	30	containers
Small Barge		
Capacity	19	containers
Vessels for short outreach crane		
Large barges	2	No.
Small barges	2	No.
Number of containers	98	No.
Number of crane moves	196	container moves
Crane efficiency	4.00	minutes per move across jetty
Vessels for large outreach crane		
Vessels at short outreach	4	No.
Larges barges	2	No.
Small barges	2	No.
Number of containers	98	No.
Number of container moves	196	No.
Crane efficiency	4.0	minutes per move
Vessels at long outreach	4	No
Larges barges	2	
Small barges	2	
Number of containers	98	
Number of container moves	196	
Factor to account for double outreach	1.25	
Crane efficiency	4.00	minutes per move
Night time Working Hours		
Actual hours of operation mon-sat (12hrs, 2 x 40min break, 2 x 20=40 min handover	10.00	hours
Hours of operation per annum	3,128.57	hours per annum
Container Movements Nightshift		
Maximum box moves short outreach crane (single outreach)	150	container moves across jetty
Maximum box moves long outreach crane (single outreach)	150	container moves across jetty
Maximum box moves long outreach crane (double outreach)	-	container moves across jetty
Total container moves	300	container moves across jetty
Total containers	150	containers
Ratio of IBA to waste	0.20	
Waste containers	121	containers
IBA containers	29	containers
Daytime Working Hours		
Actual hours of operation mon-sun (12hrs, 2 x 40 min break)	10.67	hours
Handover time (await tugs, rearrange 2 barges on berth, assume 2 tugs available)	0.75	hours
Downtime for crane inspections (quarterly and monthly)	85.33	hours per annum
Downtime for breakdowns (assume 2 breakdowns per crane week, 3 hours)	312.86	hours per annum
Downtime for weather (assume 6 hours per month)	72.00	hours per annum
Normal working operational hours	3,149.39	hours per annum
Long outreach crane operations	273.75	hours per annum
Normal working operational hours	8.63	hours
Period of reduced productivity	0.75	hours
Container Movements Dayshift		
Maximum box moves short outreach crane (single outreach)	129	container moves across jetty
Maximum box moves long outreach crane (single outreach)	129	container moves across jetty
Maximum box moves short outreach crane (handover period- single outreach)	11	container moves across jetty
Maximum box moves long outreach crane (handover period- single outreach)	11	container moves across jetty
Maximum box moves long outreach crane (handover period- double outreach)	-	container moves across jetty
Total container moves	281	container moves across jetty
Total containers	141	containers
Ratio of IBA to waste	0.20	
Waste containers	113	containers
IBA containers	28	containers
Downtime (applied to daytime shift)		
Downtime for crane inspections (quarterly and monthly)	85.33	hours per annum
Downtime for breakdowns (assume 2 breakdowns per crane week, 3 hours)	312.00	hours per annum
Downtime for weather (assume 6 hours per month)	72.00	hours per annum
Downtime total	469.33	hours per annum
Equivalent to daytime shift	47	days
Daytime full containers	41,115	containers
Night time full containers	46,929	containers
Total full containers	88,044	containers
Waste containers	70,757	containers
IBA containers	17,287	containers
Waste empties	70,757	containers
IBA empties	17,287	containers
	176,088	containers
Waste tonnes	884,462	tpa
IBA tonnes	311,167	tpa
Road	360,000	tpa
Total waste	1,244,462	tpa
Goal seek (adjust to 0.25)	0.25	
Double outreach required on both sides of large crane?	ONE SIDE ONLY	

PROJECT TITLE: Middleton Jetty Assessment

SUBJECT: Scenario 2b- One large outreach crane (6 tractor trailers)

PROJECT NO: PB7232

PREPARED BY:SB

CHECKED BY: RM

Royal HaskoningDHV
Enhancing Society Together

Calculations

	KEY	
	INPUT	
	INFORMATION ONLY - NOT USED IN CALCULATION	
	OUTPUT	
	GOAL SEEK	
Containers		
Average tonnage per waste container (12-14)	12.5	tonnes
Average tonnage per IBA container(18-19)	18	tonnes
Vessel		
Large Barge		
Capacity	30	containers
Small Barge		
Capacity	19	containers
Vessels for short outreach crane		
Large barges	2	No.
Small barges	2	No.
Number of containers	98	No.
Number of crane moves	196	container moves
Crane efficiency	3.33	minutes per move across jetty
Vessels for large outreach crane		
Vessels at short outreach	4	No.
Larges barges	2	No.
Small barges	2	No.
Number of containers	98	No.
Number of container moves	196	No.
Crane efficiency	3.3	minutes per move
Vessels at long outreach	4	No
Larges barges	2	
Small barges	2	
Number of containers	98	
Number of container moves	196	
Factor to account for double outreach	1.25	
Crane efficiency	3.33	minutes per move
Night time Working Hours		
Actual hours of operation mon-sat (12hrs, 2 x 40min break, 2 x 20=40 min handover	10.00	hours
Hours of operation per annum	3,128.57	hours per annum
Container Movements Nightshift		
Maximum box moves short outreach crane (single outreach)	180	container moves across jetty
Maximum box moves long outreach crane (single outreach)	180	container moves across jetty
Maximum box moves long outreach crane (double outreach)	-	container moves across jetty
Total container moves	360	container moves across jetty
Total containers	180	containers
Ratio of IBA to waste	0.19	
Waste containers	146	containers
IBA containers	34	containers
Daytime Working Hours		
Actual hours of operation mon-sun (12hrs, 2 x 40 min break)	10.67	hours
Handover time (await tugs, rearrange 2 barges on berth, assume 2 tugs available)	0.75	hours
Downtime for crane inspections (quarterly and monthly)	85.33	hours per annum
Downtime for breakdowns (assume 2 breakdowns per crane week, 3 hours)	312.86	hours per annum
Downtime for weather (assume 6 hours per month)	72.00	hours per annum
Normal working operational hours	3,149.39	hours per annum
Long outreach crane operations	273.75	hours per annum
Normal working operational hours	8.63	hours
Period of reduced productivity	0.75	hours
Container Movements Dayshift		
Maximum box moves short outreach crane (single outreach)	155	container moves across jetty
Maximum box moves long outreach crane (single outreach)	155	container moves across jetty
Maximum box moves short outreach crane (handover period- single outreach)	14	container moves across jetty
Maximum box moves long outreach crane (handover period- single outreach)	14	container moves across jetty
Maximum box moves long outreach crane (handover period- double outreach)	-	container moves across jetty
Total container moves	338	container moves across jetty
Total containers	169	containers
Ratio of IBA to waste	0.19	
Waste containers	137	containers
IBA containers	32	containers
Downtime (applied to daytime shift)		
Downtime for crane inspections (quarterly and monthly)	85.33	hours per annum
Downtime for breakdowns (assume 2 breakdowns per crane week, 3 hours)	312.00	hours per annum
Downtime for weather (assume 6 hours per month)	72.00	hours per annum
Downtime total	469.33	hours per annum
Equivalent to daytime shift	47	days
Daytime full containers	49,388	containers
Night time full containers	56,371	containers
Total full containers	105,759	containers
Waste containers	85,518	containers
IBA containers	20,240	containers
Waste empties	85,518	containers
IBA empties	20,240	containers
	211,517	containers
Waste tonnes	1,068,981	tpa
IBA tonnes	364,321	tpa
Road	360,000	tpa
Total waste	1,428,981	tpa
Goal seek (adjust to 0.25)	0.25	
Double outreach required on both sides of large crane?	ONE SIDE ONLY	

PROJECT TITLE: Middleton Jetty Assessment

SUBJECT: Scenario 2b- One large outreach crane (7 tractor trailers)

PROJECT NO: PB7232

PREPARED BY:SB

CHECKED BY: RM

Calculations

	KEY	
	INPUT	
	INFORMATION ONLY - NOT USED IN CALCULATION	
	OUTPUT	
	GOAL SEEK	
Containers		
Average tonnage per waste container (12-14)	12.5	tonnes
Average tonnage per IBA container(18-19)	18	tonnes
Vessel		
Large Barge		
Capacity	30	containers
Small Barge		
Capacity	19	containers
Vessels for short outreach crane		
Large barges	2	No.
Small barges	2	No.
Number of containers	98	No.
Number of crane moves	196	container moves
Crane efficiency	2.86	minutes per move across jetty
Vessels for large outreach crane		
Vessels at short outreach	4	No.
Larges barges	2	No.
Small barges	2	No.
Number of containers	98	No.
Number of container moves	196	No.
Crane efficiency	2.9	minutes per move
Vessels at long outreach	4	No
Larges barges	2	
Small barges	2	
Number of containers	98	
Number of container moves	196	
Factor to account for double outreach	1.25	
Crane efficiency	3.13	minutes per move
Night time Working Hours		
Actual hours of operation mon-sat (12hrs, 2 x 40min break, 2 x 20=40 min handove	10.00	hours
Hours of operation per annum	3,128.57	hours per annum
Container Movements Nightshift		
Maximum box moves short outreach crane (single outreach)	196	container moves across jetty
Maximum box moves long outreach crane (single outreach)	196	container moves across jetty
Maximum box moves long outreach crane (double outreach)	13	container moves across jetty
Total container moves	405	container moves across jetty
Total containers	202	containers
Ratio of IBA to waste	0.19	
Waste containers	165	containers
IBA containers	37	containers
Daytime Working Hours		
Actual hours of operation mon-sun (12hrs, 2 x 40 min break)	10.67	hours
Handover time (await tugs, rearrange 2 barges on berth, assume 2 tugs available)	0.75	hours
Downtime for crane inspections (quarterly and monthly)	85.33	hours per annum
Downtime for breakdowns (assume 2 breakdowns per crane week, 3 hours)	312.86	hours per annum
Downtime for weather (assume 6 hours per month)	72.00	hours per annum
Normal working operational hours	3,149.39	hours per annum
Long outreach crane operations	273.75	hours per annum
Normal working operational hours	8.63	hours
Period of reduced productivity	0.75	hours
Container Movements Dayshift		
Maximum box moves short outreach crane (single outreach)	181	container moves across jetty
Maximum box moves long outreach crane (single outreach)	181	container moves across jetty
Maximum box moves short outreach crane (handover period- single outreach)	-	container moves across jetty
Maximum box moves long outreach crane (handover period- single outreach)	-	container moves across jetty
Maximum box moves long outreach crane (handover period- double outreach)	14	container moves across jetty
Total container moves	376	container moves across jetty
Total containers	188	containers
Ratio of IBA to waste	0.19	
Waste containers	153	containers
IBA containers	35	containers
Downtime (applied to daytime shift)		
Downtime for crane inspections (quarterly and monthly)	85.33	hours per annum
Downtime for breakdowns (assume 2 breakdowns per crane week, 3 hours)	312.00	hours per annum
Downtime for weather (assume 6 hours per month)	72.00	hours per annum
Downtime total	469.33	hours per annum
Equivalent to daytime shift	47	days
Daytime full containers	60,132	containers
Night time full containers	63,294	containers
Total full containers	123,426	containers
Waste containers	100,580	containers
IBA containers	22,847	containers
Waste empties	100,580	containers
IBA empties	22,847	containers
	246,853	containers
Waste tonnes	1,257,248	tpa
IBA tonnes	411,237	tpa
Road	360,000	tpa
Total waste	1,617,248	tpa
Goal seek (adjust to 0.25)	0.25	
Double outreach required on both sides of large crane?	ONE SIDE ONLY	

PROJECT TITLE: Middleton Jetty Assessment

SUBJECT: Scenario 2b- One large outreach crane (8 tractor trailers)

PROJECT NO: PB7232

PREPARED BY:SB

CHECKED BY: RM

Calculations

	KEY	
	INPUT	
	INFORMATION ONLY - NOT USED IN CALCULATION	
	OUTPUT	
	GOAL SEEK	
Containers		
Average tonnage per waste container (12-14)	12.5	tonnes
Average tonnage per IBA container(18-19)	18	tonnes
Vessel		
Large Barge		
Capacity	30	containers
Small Barge		
Capacity	19	containers
Vessels for short outreach crane		
Large barges	2	No.
Small barges	2	No.
Number of containers	98	No.
Number of crane moves	196	container moves
Crane efficiency	2.50	minutes per move across jetty
Vessels for large outreach crane		
Vessels at short outreach	4	No.
Larges barges	2	No.
Small barges	2	No.
Number of containers	98	No.
Number of container moves	196	No.
Crane efficiency	2.5	minutes per move
Vessels at long outreach	4	No
Larges barges	2	
Small barges	2	
Number of containers	98	
Number of container moves	196	
Factor to account for double outreach	1.25	
Crane efficiency	3.13	minutes per move
Night time Working Hours		
Actual hours of operation mon-sat (12hrs, 2 x 40min break, 2 x 20=40 min handove	10.00	hours
Hours of operation per annum	3,128.57	hours per annum
Container Movements Nightshift		
Maximum box moves short outreach crane (single outreach)	196	container moves across jetty
Maximum box moves long outreach crane (single outreach)	196	container moves across jetty
Maximum box moves long outreach crane (double outreach)	35	container moves across jetty
Total container moves	427	container moves across jetty
Total containers	214	containers
Ratio of IBA to waste	0.18	
Waste containers	175	containers
IBA containers	39	containers
Daytime Working Hours		
Actual hours of operation mon-sun (12hrs, 2 x 40 min break)	10.67	hours
Handover time (await tugs, rearrange 2 barges on berth, assume 2 tugs available)	0.75	hours
Downtime for crane inspections (quarterly and monthly)	85.33	hours per annum
Downtime for breakdowns (assume 2 breakdowns per crane week, 3 hours)	312.86	hours per annum
Downtime for weather (assume 6 hours per month)	72.00	hours per annum
Normal working operational hours	3,149.39	hours per annum
Long outreach crane operations	273.75	hours per annum
Normal working operational hours	8.63	hours
Period of reduced productivity	0.75	hours
Container Movements Dayshift		
Maximum box moves short outreach crane (single outreach)	207	container moves across jetty
Maximum box moves long outreach crane (single outreach)	207	container moves across jetty
Maximum box moves short outreach crane (handover period- single outreach)	-	container moves across jetty
Maximum box moves long outreach crane (handover period- single outreach)	-	container moves across jetty
Maximum box moves long outreach crane (handover period- double outreach)	14	container moves across jetty
Total container moves	429	container moves across jetty
Total containers	214	containers
Ratio of IBA to waste	0.18	
Waste containers	175	containers
IBA containers	39	containers
Downtime (applied to daytime shift)		
Downtime for crane inspections (quarterly and monthly)	85.33	hours per annum
Downtime for breakdowns (assume 2 breakdowns per crane week, 3 hours)	312.00	hours per annum
Downtime for weather (assume 6 hours per month)	72.00	hours per annum
Downtime total	469.33	hours per annum
Equivalent to daytime shift	47	days
Daytime full containers	68,413	containers
Night time full containers	66,826	containers
Total full containers	135,239	containers
Waste containers	110,600	containers
IBA containers	24,639	containers
Waste empties	110,600	containers
IBA empties	24,639	containers
	270,478	containers
Waste tonnes	1,382,495	tpa
IBA tonnes	443,508	tpa
Road	360,000	tpa
Total waste	1,742,495	tpa
Goal seek (adjust to 0.25)	0.25	
Double outreach required on both sides of large crane?	ONE SIDE ONLY	