SPECIALIST ASSESSMENT – ENGINEERING DEGREE OF DIFFICULTY CRITERION

PALMERSTON NORTH REGIONAL FREIGHT HUB MULTI CRITERIA ANALYSIS AND DECISION CONFERENCING PROCESS

PREPARED FOR KIWIRAIL

June 2020

Palmerston North Economic Hub
Engineering Degree of Difficulty Criteria
Summary Note (Workshop 2 pre-work)

1 Introduction

This note provides a summary record of the scoring developed for the Multi Criteria Assessment (MCA) process for the site selection of the KiwiRail Palmerston North Economic Hub site.

This note considers only the Engineering Degree of Difficulty (EDOD) criteria. The assessment and scoping builds on the discussion and advice from Workshop 1 (meeting date 31/08/19) and the 'MCA Criteria – Attachment 2'.

The methods employed in determining an EDOD score for each site have been agreed through liaison by the members of the EDOD assessment team, as an appropriate and reasonable methodology that follows a robust and repeatable process. It does not purport to be the only method of assessment or to be exhaustive in terms of Engineering Difficulty related items that could be incorporated for consideration.

It is expected that further detailed assessment will be undertaken as the process develops and more information becomes available. The assessment undertaken to date has been high level using currently available information and the judgement of a number of technical specialists.

The individuals that have completed this EDOD assessment are:

- Engineering Lead: Jamie Povall, Principal Engineer (Major Projects), MSc(Eng), CEng, CPEng, CMEngNZ, IntPE
- Geotechnical: Andy Mott, Principal Engineering Geologist, BSc (Geol/Geomorph), MSc (Geotech), FGS, CGeol (UK)
- Contamination: Ilze Rautenbach, Senior Environmental Scientist – MPhil (Environmental Man) & BSc Hons (Conservation Ecology)
- Drainage: Alistair Osborne, Senior Hydraulic Modeller, MSc (Hons)
- Other significant engineering complexities: Mike Skelton, Senior Transportation Engineer, BE(civil), MEngNZ

2 Refinement of EDOD sub-components

The overall EDOD category is broad and is made up from a number of factors or 'sub-components' to be considered which all have a bearing on overall engineering complexity. During Workshop 1, these were recorded, broadly, as being:

- Geotechnical
- Stormwater & Groundwater
- Contaminants
- Significant temporary works
- Utility services

Through further post Workshop 1 liaison with the EDOD assessment team, these sub-elements were refined, for assessment, as follows:

Sub-component	Individual attributes
Geotechnical	Geological Age: Taken from GNS Qmaps
	Earthworks relating to geomorphological features within the sites
Contamination	Presence of known contaminated land
	Expected difficulty of remediation
	Risk of discharges to the environment
Drainage	Through drainage within the site itself (excluding wider catchment flooding)
	Assessment if suitable space within the site for on site treatment
Other significant engineering complexities	Impact on existing roading network
	Presence and complexity of existing power transmission lines
	Overall site contours and complexity associated with layout of the new facility

This refinement was undertaken by the EDOD team on the basis of what the group determined were the key items to be considered at this stage; as well as also removing any aspects where the team did not feel it was appropriate to include (generally due to lack of clarity or information – for example *significant temporary works such as temporary structures and haul roads* was not included for consideration due to lack of information at this early stage, and *Utility Services* was considered too generic, when power transmission lines were agreed by the team as being the key consideration).

Further, the group also considered other Criteria being assessed (by others) and refined the EDOD criteria to seek to avoid duplication where possible. The Drainage criterion used in EDOD has specifically excluded wider catchment flooding and considered only 'within' site stormwater drainage; it is understood wider catchment flooding is considered within the Resilience criterion.

Each sub-component was led by an individual technical specialist with appropriate knowledge in that area.

3 Explanation of sub-components

3.1 Geotechnical

This sub-component has two attributes: Geological Age and Earthworks.

Geological Age is taken from GNS Qmaps and is based on age, deposition etc and is a gross generalization. Older deposits have been assumed, at this early stage, to generally have better engineering properties because this is normally the case with NZ geological conditions.

Earthworks relates to key geomorphological features within sites eg. gullies and former river meanders which are likely to contain recent soft material, possible settlement issues and/or extensive filling.

The Geotechnical lead has also proposed a weighting between these two Geotechnical attributes; the impact of gullies /meander bends (within Earthworks) is assessed to be approximately 1.5x more sensitive than geological age due to confidence (ie. these features are visible) and degree of engineering likely to be required.

Assumptions

- The size of the Kiwirail Hub means that it will lie over different ground conditions so an average has been assumed. Site specific ground investigation in later project stages will better define ground engineering properties.
- Percentages of coverage are high level visual estimates.
- Gullies and meander bend scores assume these features contain recent, soft sediment.
- Earthworks includes localised gullies and steep gradients and does not include large scale gradients required for Kiwirail operations. This is covered in engineering complexities assessment below.
- Seismic and liquefaction are covered in resilience.

Limitations

- The most significant limitation is in the variable nature of the ground (particularly sites 5-8). Gravel deposits could exist next to silt or even organic material with highly variable engineering properties and characteristics.

3.2 Contamination

A high-level contaminated land comparative assessment was undertaken for the long list options.

In order to establish the criteria in relation to contamination for the nine proposed land parcel options the following attributes were used:

Presence of known contaminated land
This was determined by viewing the current available information from the three Councils in the area. HRC and MDC provided information from their respective HAIL databases. No relevant contaminated land information was provided by PNCC and therefore the HRC information was relied on for sites in Palmerston North City. Properties are categorized as either i) HAIL sites, ii) contamination confirmed, or iii) remediated. The Councils have not provided any in-depth information regarding the nature of activities at each HAIL site. A total of 18 potentially contaminated sites have been identified distributed over the Site options. Six of these HAIL sites fall just on or immediately outside the boundaries of the option areas. They have been included in the contamination risk assessment exercise due to the type of activity in each case and the fact that risks could arise by way of migration of contaminants.

Remediation difficulty
The exact methodologies and costs required for any remediation will be determined by the type and severity of the contamination found within each of the potentially contaminated sites in or adjacent to each land parcel option. These matters will only be able to be quantified by way of soil sampling and analysis at the various identified HAIL sites.

The required remediation will also differ depending on the proposed layout of the freight hub and where each type of rail-related activity is to take place. It could be that any identified contaminated area(s) will ultimately be covered in hard stand material, thus ensuring that the exposure pathway between contamination and potential site receptors is incomplete and any risk is therefore negated.

Risk with respect to soil contamination
The level of risk regarding soil contamination will vary from site to site. A fuel storage tank for example might be well contained with no contamination occurring; on the other hand, however, any leakages could potentially cause soil and/or groundwater contamination through contaminant migration. Stormwater runoff from the airport surfaces may also give rise to contamination of the surrounding area if proper mitigation measures are not included. Each site or activity therefore needs to be assessed and scored separately.

The assessor did not propose any weighting between these three sub-attributes as the level of information available at the time was not in-depth enough to differentiate the attributes.

Limitations

- It is recommended that for properties where either a medium or high contamination risk has been identified that further investigations be conducted due to the risk that may be posed to human health and/or the environment as a result of the proposed works. Further future investigations / mitigations are recommended for the Short List Options going forward. Taking into consideration that each of the identified HAIL sites is fairly small (except for the airport in Site 2) in relation to the overall size of the Project area required, the risk and impacts should be fairly localized, and thus easily managed and contained.

- It is important to note that there is still overall uncertainty about individual activities taking place on each potential Site. It is thus recommended that preliminary site investigations (PSIs) be carried out on the short list options in order to better determine the risk of contamination across the sites and the potential impacts that there may be on the environment. For some of these locations, as indicated by PSI findings, there may be a need for targeted soil sampling and analysis as represented by a detailed site investigation (DSI).

3.3 Drainage

A high-level assessment of drainage within the possible sites was undertaken, and which specifically excluded consideration of wider catchment flooding (noting this aspect is being considered within the Resilience Criterion).

The assessment has considered two attributes:

Impact of the site on existing drainage which has considered the existing stream channels and drains within the site boundary only, and the likely effect (complexity) of manging (relocating/re-routing/piping) for the site development in future.

Space availability for on-site treatment of site runoff to consider whether there was any obvious relative difference between the sites for on site treatment opportunities.

The Drainage lead has considered there was no real material difference between any of the sites for on site treatment and on this basis determined a significant attribute weighting of 90% for Impact on Existing Drainage, and 10% to Space Availability

Assumptions

- The drainage channels provided in the in the background topographical map of the ArcGISOnline workspace and the KiwiRail NIWA Rivers layers are an adequate representation, for the purposes of this assessment, of drainage channels in the vicinity of the potential KiwiRail PN Hub sites.
- The KiwiRail Bridges layer provided in the ArcGISOnline workspace is an adequate representation, for the purposes of this assessment, of the rail-channel crossing in the vicinity of the potential KiwiRail PN Hub sites.
- The primary form of onsite stormwater treatment will be sedimentation ponds.

Limitations

- The development and nature of an onsite stormwater collection system has not been considered as there is insufficient information available at this stage.
- Alternative stormwater treatment systems (alternative to sedimentation ponds) have not been considered.
- The magnitude of regular and flood flow in drainage channels passing through the proposed sites has not been considered or assessed in detail. That is, anecdotal reporting and visual inspection of available photographs have been used to consider flow in the drainage channels.

3.4 Other significant engineering complexities

This sub-component includes three attributes:

Effect of roading network: considering the impact of the site layout on existing roads. This part of the assessment included determining the importance of the road effected based on the road classification and traffic volumes (using the One Network Road Classification (ONRC) system). No consideration of road diversions, closure or bridges / underpasses was included given this information is not yet known.

Power transmission lines: which has considered each sites impacts on existing transmission lines including general level of impact and the expected level of complexity with the transmission lines (i.e. how much of the site in in conflict, and the anticipated difficulty in managing / re-routing any lines). This will need further consideration and input by individuals with very specialist knowledge in this space.

Site Contours: this focuses on the overall quantum of works (bulk earthworks) likely to achieve a broadly flat site prior to construction. This is distinct from Geotechnical Earthworks attribute which focuses on specific geomorphological features and the associated complexity. This attribute is also considering contours generally across the entire site, as opposed to the track grade for rail operation.

The lead for this section has proposed a weighting as follows across the 3 attributes: 40% Roading, 40% Transmission lines, 20% Site contours. This weighting was agreed by the team to be used based on the team's collective view of the relative level of complexity of each attribute.

Assumptions:

- **Roads:**
  - Road network integrity assumed to remain.
  - Major roads heavy traffic less easy to move /relocate expect other major services in road corridor so considered of greater significance
  - Local principal road. Reroute road likely to have services including deeps drains and pole lines, moderate significance

- Minor local road. Stop rather than reroute, lower significance

- **Transmissions lines:**
  - Difficulty increases with the number of transmission lines affected on a site.
  - All lines can be relocated or moved to minimise site impact.
  - Transverse crossing preferred to longitudinal
  - Relocated lines will remain within the rail site. (minimise unknown property risks)

- **Contours**.
  - Rail yard are typically shaped so that wagons cannot run away so they are graded very flat (considered max 0.5%)
  - Construction difficulty increases with increasing gradient along length of site
  - Difficulty increased with extent of site "unevenness".

Limitations:

- **Roads**
  - Transport network effects not considered
  - No detail of services located in road reserve that may be affected

- **Transmission Lines:**
  - Relative costs of different tower/pole and line configurations not considered.
  - Impact of operational clear zones (from electrical installations) not considered. NZECP 34:2000 provides detail information.

- **Contours:**
  - Based on coarse contours provided.
  - Makes no allowance for variance in soil conditions for foundations.

4 Scoring

4.1 Final Scoring (Unweighted sub-components)

Scoring of each attribute within the sub-component category was undertaken by each lead. This was then conferenced with the EDOD team, along with any proposed attribute weightings, to explain rationale and basis for scoring, including challenge and revision of scores if deemed necessary.

The finalised sub-component scoring is shown below. This is the final 'baseline' scoring for each sub-component items inclusive of any attribute weighting within that sub-component. As an example, Site 1 for 'Other Engineering' has a score of 2.4. This is the combined score given to this site for 'Other Engineering' considering the three attributes that have been assessed, namely *Road Network, Power Transmission Lines* and *Site Contours,* along with the associated weightings applied as described in Section 3.4.

In this baseline unweighted scenario there is no weighting applied to the sub-components i.e. Geotech, Contaminated Land, Drainage and Other Engineering Complexity as they are all considered of equal importance (I,.e. as there are 4 sub-components, each is worth 25%).

Based on the overall scoring for each Site, a Rank was also applied to determine which was most preferable (Rank 1) and least preferable (Rank 9) in terms of the EDOD criteria. Site 9 was assessed as the current site but with an expanded footprint (as per the concept provided as part of the workshop briefing and shown in the ArcGIS mapping tool).

UNWEIGHTED (EQUAL WEIGHT 25%)						
Site	Geotech	Other Engineering	Contam. Land	Drainage	TOTAL	RANK
1	3	2.4	2	3	2.6	4
2	2.5	3.2	3	3.9	3.15	8
3	4	4	2	3.9	3.475	9
4	5	2.2	1	3.9	3.025	7
5	3	2.4	1	2.1	2.125	1
6	3	3	1	2.1	2.275	3
7	4.5	1.8	1	3.9	2.8	5
8	4.5	3.2	1	3	2.925	6
9	2.5	2.2	3	1.2	2.225	2

4.2 Weighting Systems

A number of weighting systems were devised by the EDOD team to acknowledge that some of the Sub-components were considered to be of greater importance in terms of engineering complexity. The selection of the weighting is somewhat arbitrary and subjective, so a number of weighting systems were tested, rather than relying on a single system.

The team agreed to use the 'unweighted' system (i.e. where all 4 sub-components are considered equally) along with 4 different weighting systems. Generally, the 'Geotech' and 'Other Engineering' sub-components were considered to be of greater consequence and so were weighted higher than Drainage and Contaminated land. Both Drainage and Contaminated Land were generally weighted lower because the EDOD team did not think either of these sub-components were resulting in the levels of engineering related difficult of the scale of Geotech or Other Engineering.

Testing with multiple weighting systems also provides a sensitivity test to the scoring to determine how each of the 9 sites scored and were ultimately ranked against the EDOD criteria. The weighting system is shown below.

WEIGHTING SYSTEMS					
Weightings	Geotech	Other Engineering	Contam Land	Drainage	Check
UW	0.25	0.25	0.25	0.25	1.00
A	0.35	0.35	0.15	0.15	1.00
B	0.5	0.3	0.1	0.1	1.00
C	0.4	0.4	0.05	0.15	1.00
D	0.3	0.25	0.2	0.25	1.00

4.3 Weighting Adjusted Scoring

The scoring with the weighting systems A through D is shown below, along with the Rank of each site (Rank 1 being most preferred):

WEIGHTING A						
Site	Geotech	Other Engineering	Contam Land	Drainage	TOTAL	RANK
1	1.05	0.84	0.3	0.45	2.64	4
2	0.875	1.12	0.45	0.585	3.03	6
3	1.4	1.4	0.3	0.585	3.685	9
4	1.75	0.77	0.15	0.585	3.255	7
5	1.05	0.84	0.15	0.315	2.355	2
6	1.05	1.05	0.15	0.315	2.565	3
7	1.575	0.63	0.15	0.585	2.94	5
8	1.575	1.12	0.15	0.45	3.295	8
9	0.875	0.77	0.45	0.18	2.275	1

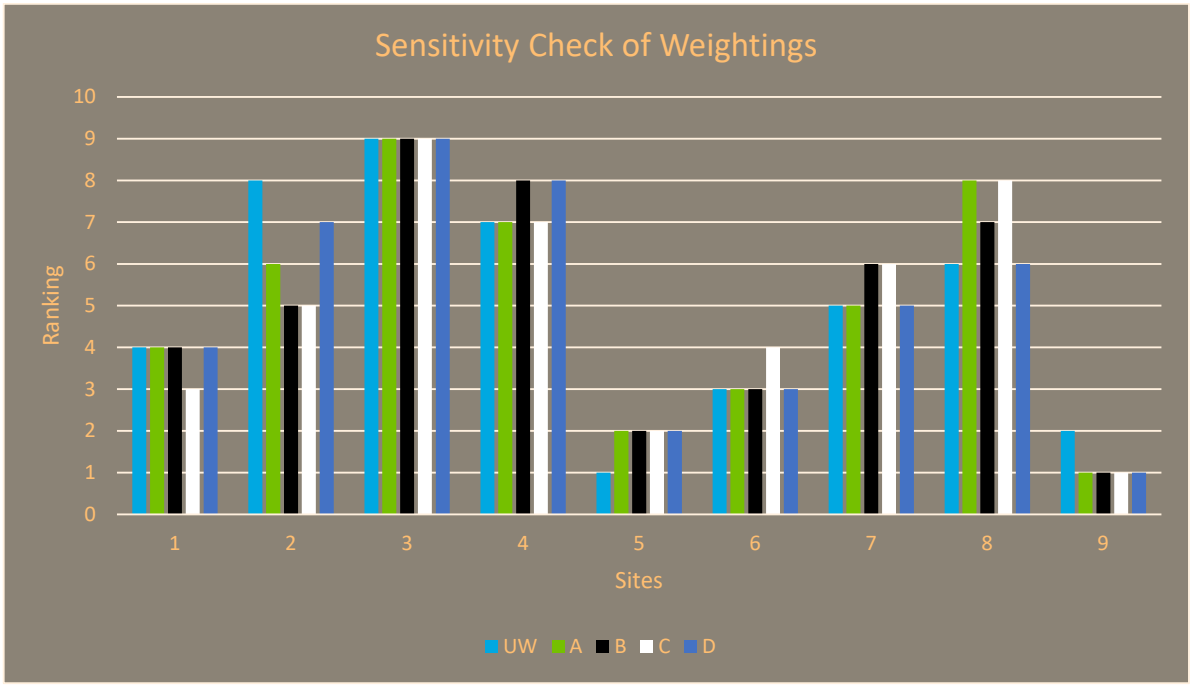
WEIGHTING B						
Site	Geotech	Other Engineering	Contam Land	Drainage	TOTAL	RANK
1	1.5	0.72	0.2	0.3	2.72	4
2	1.25	0.96	0.3	0.39	2.9	5
3	2	1.2	0.2	0.39	3.79	9
4	2.5	0.66	0.1	0.39	3.65	8
5	1.5	0.72	0.1	0.21	2.53	2
6	1.5	0.9	0.1	0.21	2.71	3
7	2.25	0.54	0.1	0.39	3.28	6
8	2.25	0.96	0.1	0.3	3.61	7
9	1.25	0.66	0.3	0.12	2.33	1

WEIGHTING C						
Site	Geotech	Other Engineering	Contam Land	Drainage	TOTAL	RANK
1	1.2	0.96	0.1	0.45	2.71	3
2	1	1.28	0.15	0.585	3.015	5
3	1.6	1.6	0.1	0.585	3.885	9
4	2	0.88	0.05	0.585	3.515	7
5	1.2	0.96	0.05	0.315	2.525	2
6	1.2	1.2	0.05	0.315	2.765	4
7	1.8	0.72	0.05	0.585	3.155	6
8	1.8	1.28	0.05	0.45	3.58	8
9	1	0.88	0.15	0.18	2.21	1

WEIGHTING D						
Site	Geotech	Other Engineering	Contam Land	Drainage	TOTAL	RANK
1	0.9	0.6	0.4	0.75	2.65	4
2	0.75	0.8	0.6	0.975	3.125	7
3	1.2	1	0.4	0.975	3.575	9
4	1.5	0.55	0.2	0.975	3.225	8
5	0.9	0.6	0.2	0.525	2.225	2
6	0.9	0.75	0.2	0.525	2.375	3
7	1.35	0.45	0.2	0.975	2.975	5
8	1.35	0.8	0.2	0.75	3.1	6
9	0.75	0.55	0.6	0.3	2.2	1

4.4 Assessment of Site Rankings

The graph below displays the overall ranking for each site based upon the Unweighted (UW) and 4 weighting systems (A through D).



Generally, there is close alignment of the ranking given to a site irrespective of the weighting system used, for example Site 9 is Rank 1 (most preferred) in 4 of 5 systems, and Site 3 is consistently Rank 9 (least preferred). There are some minor fluctuations particularly in Site 2 and Site 8 based on the weighting systems used, though the variability is fairly limited.

4.5 Overall scoring

To determine an overall score for each site in accordance with the pre-set MCA requirements of scores 1-5 the EDOD team agreed a suitable method was to consider the overall rank applied to each site through the 5 approaches (Unweighted and A to D weightings) and use these to determine the final EDOD score for each site.

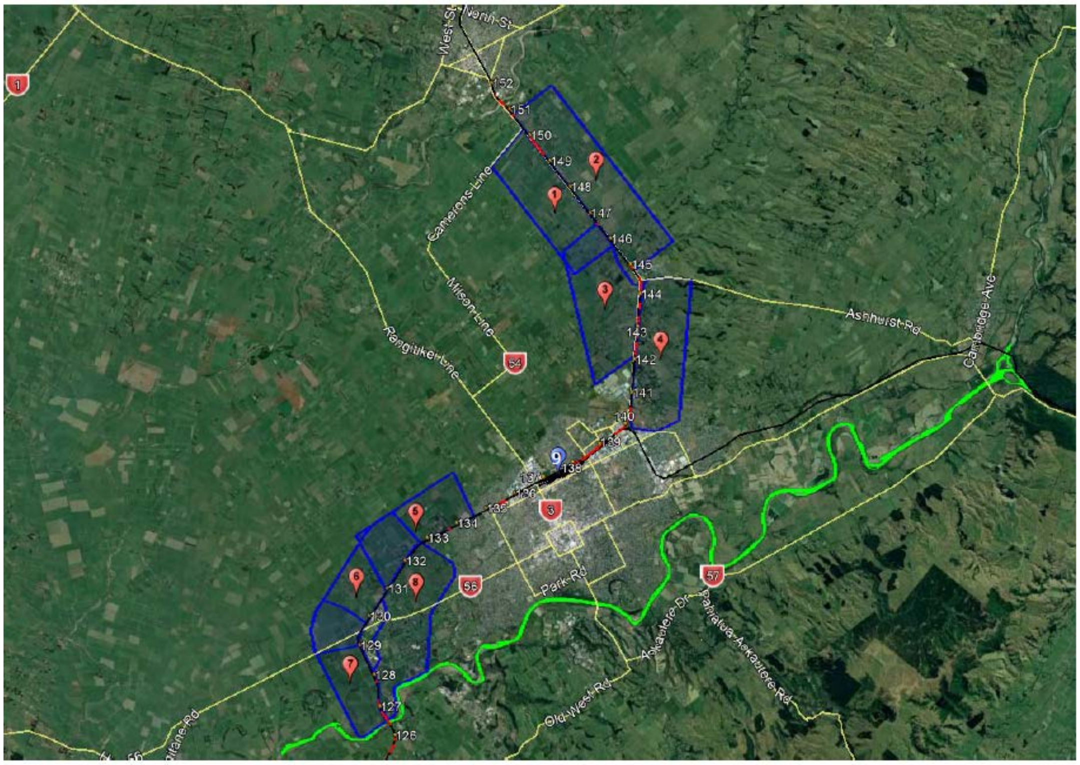
The 5 rankings for each site were summed and then scaled to provide an overall score for each site. The scaling factor used was the number of sites (9 total), rounded to zero decimal places. This has therefore

provided a final scaled site score between 1-5 for each of the 9 sites. The final results for overall EDOD score for each site is shown below:

FINAL EDOD SCORING							
Site	UW	A	B	C	D	Total	**Scaled score**
1	4	4	4	3	4	19	**2**
2	8	6	5	5	7	31	**3**
3	9	9	9	9	9	45	**5**
4	7	7	8	7	8	37	**4**
5	1	2	2	2	2	9	**1**
6	3	3	3	4	3	16	**2**
7	5	5	6	6	5	27	**3**
8	6	8	7	8	6	35	**4**
9	2	1	1	1	1	6	**1**

The EDOD team collectively considered whether the final scoring was a reasonable and representative score for each site based on the assessments and given the individual sub-components and different weightings. The team agreed that, on balance, the scoring was appropriate and adequately represented an overall EDOD score for each of the 9 sites being assessed.

Rev. No.	Date	Description	Prepared By	Checked By	Reviewed By	Approved By
1	22/09/19	Final DRAFT prior to MCA	Jamie Povall	Mike Skelton, Andy Mott, Alistair Osborne, Ilze Rautenbach	Karen Bell	Karen Bell
2	23/09/19	Update to Site 9 Contam Score (by IR)	Jamie Povall	Mike Skelton, Andy Mott, Alistair Osborne, Ilze Rautenbach	Karen Bell	Karen Bell


West St
North St
Cameron Line
Ashhurst Rd
Cambridge Ave
Park Rd
Old West Rd
Aokautere Dr
Pahiatua-Aokautere Rd
152
151
150
149
148
147
146
145
144
143
142
141
140
139
138
135
134
133
132
131
130
129
128
127
126
1
2
3
4
5
6
7
8
9
54
56
57

Palmerston North Economic Hub
Engineering Degree of Difficulty Criteria Addendum

1 Introduction

This note provides a summary record of the scoring developed for the Multi Criteria Assessment (MCA) process for the site selection of the KiwiRail Palmerston North Economic Hub site.

During Workshop 2, participants acknowledged that having a specific site to assess within the areas identified could potentially result in changes to the scores presented at Workshop 2.

As a result, after Workshop 2, the masterplan was applied to the area options assessed in Workshop 2, and sites within those areas identified. The rail connection was included on the refined options, and the implications for connecting to the North Island Main Trunk line were identified.

There are two layout options for areas 1 and 2 (Options 1a, 1b, 2a, 2b). Three layouts were originally developed for area 3, however only one layout was taken forward for assessment because the others did not meet the project objectives. Area 4 could only accommodate one layout option. There were significant constraints at the ends of areas 5 and 6, therefore the parts of these two areas without the constraints were combined to create site 5.

Sites in areas 7, 8 and 9 were not identified as these areas were fatally flawed at Workshop 2.

The individuals that have completed this EDOD assessment are:

- Engineering Lead: Jamie Povall, Principal Engineer (Major Projects), MSc(Eng), CEng, CPEng, CMEngNZ, IntPE
- Geotechnical: Andy Mott, Principal Engineering Geologist, BSc (Geol/Geomorph), MSc (Geotech), FGS, CGeol (UK)
- Contamination: Ilze Rautenbach, Senior Environmental Scientist – MPhil (Environmental Man) & BSc Hons (Conservation Ecology)
- Drainage: Alistair Osborne, Senior Hydraulic Modeller, MSc (Hons)
- Other significant engineering complexities: Mike Skelton, Senior Transportation Engineer, BE(civil), MEngNZ

2 EDOD Sub-components

The same EDOD sub-components were used as per the previous assessment:

Sub-component	Individual attributes
Geotechnical	Geological Age: Taken from GNS Qmaps
	Earthworks relating to geomorphological features within the sites
Contamination	Presence of known contaminated land
	Expected difficulty of remediation
	Risk of discharges to the environment
Drainage	Through drainage within the site itself (excluding wider catchment flooding)
	Assessment if suitable space within the site for on site treatment
Other significant engineering complexities	Impact on existing roading network
	Presence and complexity of existing power transmission lines
	Overall site contours and complexity associated with layout of the new facility

Given the sites were smaller in scale than previously, where possible to do so a more targeted assessment was undertaken for the EDOD assessment. For example, a more comprehensive assessment of the impact on the road network and anticipated changes was conducted to further inform the 'Other significant engineering complexities' assessment. Similarly, additional consideration was undertaken for the overall contours and site grading on the new layouts.

3 Scoring

3.1 Key scoring notes

3.1.1 Geotech

Both of the Site 1 options are now scored a 2, given their smaller area and lack of gullies. Previously Site 2 was scored a 3, but 2A has been reduced to a 2 based on the new layout and no gullies. Site 3C was scored a 3 (previously Site 3 was a 4). Site 4 retains the score of 5. Site 5 also retains previous score of 3.

3.1.2 Contaminated Land

All sites now scored a 1, other than Site 2A due to known HAIL site and impact of airport contaminants.

3.1.3 Drainage

A full update to the drainage scoring as completed based on the new footprints.

Key changes to the drainage scores were Site 2A, now scored a 3 (previously 4), on the basis of drainage effects now being less significant ion the reduced site.

Site 3C was also now scored a 3 (previously site 3 was scored a 4 but noting this site has moved significantly, with an expected reduction in drainage complexity).

3.1.4 Other engineering complexity

Due to the new concept footprints, considerably more detailed assessment was possible for this sub-component (and attributes). More comprehensive work was completed for all attributes; roading impacts, transmission lines and contours. This resulted in some significant changes to scoring. A general summary is supplied below:

Site 1A complexity was increased due to primarily transmission line issues and site contours.
Site 1B complexity was increased due to roading impacts and site contours.
Site 2A complexity was increased due to major implications for the roading network.
Site 2B complexity was fairly consistent with the previous assessment stage.
Site 3C complexity reduced due to no significant concerns with transmission lines or site contours, though the roading impacts were deemed highly complex.
Site 4 complexity was fairly consistent with the previous assessment stage.
Site 5 complexity was fairly consistent with the previous assessment stage (no significant complexity issues with roading, transmission lines or site contours)

3.2 Final Scoring (Unweighted sub-components)

Scoring of each attribute within the sub-component category was undertaken by each lead. This was then conferenced with the EDOD team, along with any proposed attribute weightings, to explain rationale and basis for scoring, including challenge and revision of scores if deemed necessary.

The finalised sub-component scoring is shown below. This is the final 'baseline' scoring for each sub-component item inclusive of any attribute weighting within that sub-component, but with no weightings between the 4 overall sub-components i.e. Geotech, Contaminated Land, Drainage and Other Engineering Complexity are all considered of equal importance (I,.e. as there are 4 sub-components, each is worth 25%).

Based on the overall scoring for each Site, a Rank was also applied to determine which was most preferable (Rank 1) and least preferable (Rank 7) in terms of the EDOD criteria.

UNWEIGHTED (EQUAL WEIGHT 25%)						
Site	Geotech	Other Engineering	Contam Land	Drainage	TOTAL	RANK
1a	0.5	1.05	0.25	0.75	2.55	4
1b	0.5	0.9	0.25	0.75	2.4	2
2a	0.5	1	0.75	0.75	3	7
2b	0.75	0.85	0.25	0.975	2.825	5
3c	0.75	0.75	0.25	0.75	2.5	3
4	1.25	0.45	0.25	0.975	2.925	6
5	0.75	0.55	0.25	0.525	2.075	1

3.3 Weighting Systems

A number of weighting systems were previously devised by the EDOD team. Given the additional detail now known for the sites, weighting system A was agreed to most appropriate, on the basis of providing greatest importance (i.e. weight) to items likely to create the most engineering complexity, which was the 'Other Engineering' items (roading impacts, transmission lines and site contours):

WEIGHTING SYSTEMS					
Weightings	Geotech	Other Engineering	Contam Land	Drainage	Check
UW	0.25	0.25	0.25	0.25	1.00
A	0.25	0.5	0.1	0.15	1.00

3.4 Weighting Adjusted Scoring

The scoring with the weighting systems A applied is shown below:

WEIGHTING A					
Site	Geotech	Other Engineering	Contam Land	Drainage	TOTAL
1a	0.5	2.1	0.1	0.45	3.15
1b	0.5	1.8	0.1	0.45	2.85
2a	0.5	2	0.3	0.45	3.25
2b	0.75	1.7	0.1	0.585	3.135
3c	0.75	1.5	0.1	0.45	2.8
4	1.25	0.9	0.1	0.585	2.835
5	0.75	1.1	0.1	0.315	2.265

3.5 Proposed MCA scoring

To determine an overall score for each site in accordance with the pre-set MCA requirements of scores 1-5 the EDOD team discussed the relative differences in the level of complexity between each of the sites and applied an overall professional judgment to determine the following scores for each of the sites.

Site	MCA SCORE
1a	4
1b	3
2a	4
2b	4
3c	3
4	3
5	1

In terms of the EDOD assessment, Site 5 is considered to be significantly less complex than the other sites and therefore warrants a score of 1 due to the margin of difference. Sites 1B, 3C and 4 all perform very similarly and so are scored 3, with the remaining sites scored a 4 due to even greater levels of complexity.

The EDOD team collectively considered whether the final scoring was a reasonable and representative score for each site based on the assessment. The EDOD team do acknowledge that there is a level of professional judgement that needs to be applied in weightings and scoring. The team agreed that, on balance, the scoring was appropriate and adequately represented an overall EDOD score for each of the sites being assessed.

Rev. No.	Date	Description	Prepared By	Checked By	Reviewed By	Approved By
1	17/10/19	EDOD team draft – Concept F assessments	Jamie Povall	Mike Skelton, Andy Mott, Alistair Osborne, Ilze Rautenbach	Karen Bell	Karen Bell

Palmerston North Economic Hub
Engineering Degree of Difficulty Criteria
Summary Note - Shortlisted Options

1 Introduction

This note provides a summary record of the scoring developed for the Multi Criteria Assessment (MCA) process for the site selection of the KiwiRail Palmerston North Economic Hub site.

This note records the updated assessment and scoring carried out on the 3 shortlisted sites.

The sites assessed were named as: 2A, 3C and 4.

The individuals that have completed this EDOD assessment are:

- Engineering Lead: Jamie Povall, Principal Engineer (Major Projects), MSc(Eng), CEng, CPEng, CMEngNZ, IntPE
- Geotechnical: Andy Mott, Principal Engineering Geologist, BSc (Geol/Geomorph), MSc (Geotech), FGS, CGeol (UK)
- Contamination: Ilze Rautenbach, Senior Environmental Scientist – MPhil (Environmental Man) & BSc Hons (Conservation Ecology)
- Drainage: Alistair Osborne, Senior Hydraulic Modeller, MSc (Hons)
- Other significant engineering complexities: Mike Skelton, Senior Transportation Engineer, BE(civil), MEngNZ

2 Process

At this shortlisting stage, it has been possible for the team to conduct more in-depth assessment and analyses of the likely engineering complexity of the 3 sites.

In previous stages the following engineering aspects were considered:

- Contaminated land
- Earthworks
- Ground conditions / features
- Drainage
- High capacity power lines
- Roading impacts

However, these were completed at a fairly high level by the assessors, and combined using weighting systems to derive a score.

At this shortlist stage, a more in-depth assessment has been undertaken as follows:

- Roading: a proposed road network plan was produced for each option which included: new road links, new intersections or grade-separations, existing road upgrades, road closures, level crossing closures. The roading network layouts were developed solely to respond to the hub location to address the effects created by the hub footprint and to provide hub access. Wider network aspirations such as the potential freight ring road were not considered.

- Structures: any new grade separation structures (over rail/road) were also included.

- Drainage: Within site drainage was considered and assessed, as well as requirements within and around the site perimeter to manage wider catchment effects onto the hub footprint. This included a high level catchment analysis, assessment of interruptions to existing watercourses and requirements in

terms of stream diversions and piping through the footprint. This included determining approximate locations of diversion channels and culverts as well as sizing. The assessment also considered location and sizing of stormwater treatment.

- Services (interrupted & required): existing services affected by the proposed hub footprint were identified. Additionally, new servicing requirements for water, wastewater and firefighting requirements for the hub were determined and assessed in terms of requirements for connecting into existing infrastructure.

- Earthworks volumes: At this more detailed stage, a Digital Elevation Model (1m DEM) was created for the existing site and then for the proposed hub finished surface level of the pad, to determine earthworks implications between the two surfaces. To do this, a proposed finished surface level for the yard was determined, using the required track grades supplied, to best manage the total volume of earthworks and the balance between cut and fill. Refer to additional comments regarding the main line interface in Section 3. It is noted that the entire hub itself has been assumed as an entirely flat elevation with zero grade through the entirety of the site.

- Environmental controls: Based on the site area of earthworks, the erosion and sediment control requirements were able to be estimated for the site works.

- Contamination remediation: Based on the known contaminated sites and likely requirements for remediation.

The shortlist assessment has included a greater level of detailing of the requirements, meaning that an initial high level rough order cost estimate for the required works could be produced. This is beneficial because it means that there is no need to continue weighting the different components of complexity as done in the earlier Workshop 2 assessment as all are discussed in the same terms (i.e. in terms of dollar costs).

It should be noted that this scoring summary note does not include any reference to the absolute dollar value cost estimates which is intentionally omitted in order to avoid setting expectations or being misinterpreted. The estimate to date is simply for comparative purposes only and would not be appropriate to be considered in absolute terms.

3 Items not included in costing

Some items have not bene included in the shortlisted sites assessment costing. This is either because they are consistent across all sites, fairly minor in terms of overall effect of simply because the EDOD team do not have sufficient information at this stage to assess.

- Land costs for roading / drainage
- Landscaping
- Traffic Management requirements
- Anything above hub pad construction (building, tracking, signalling, internal roading etc)
- Main line works
- Retaining
- Ground improvements
- Some service requirements (power and fibre)

Of particular note here are works to the main line. In setting the pad level for the three sites, a comprehensive exercise was undertaken to fix the pad level to suitable elevation in order to manage the earthworks. The track level through the hub itself is fixed at a grade of 0.0%, while the pullback extents must be no greater than +/- 0.5%. By complying with these requirements, there is a fixed allowable envelope for the pad level, in order to be able to reconnect to the main line and the extents of the pull backs.

In order to reduce extremely significant earthworks volumes but to still provide the hub and pullback grades within the allowable limits some vertical realignment of the mainline track elevation would be required. This will need further assessment as the technical work continues. At this stage no costs have been included for main line track re-levelling.

4 Assessment

The engineering works described in Section 2 above were itemized and then associated costs were allocated based upon the identified quantities or rough order costs to derive an engineering works cost for each site (i.e. a single cost estimate for each location). From the engineering works cost estimate developed for each of these 3 sites it is possible compare and contrast the cost differences in the type or quantum of engineering works that are likely to be required. The key differences are summarized below:

4.1 Site 2

Environmental requirements considered about equal across all sites for Erosion and Sediment control measures relates to earthworks areas.

Earthworks and pavement requirements were lowest cost at this site because of the flatter topography.

Ground improvements for contaminated land considered for this site for the aerodrome land use.

Drainage requirements least significant at this site because of the topography and existing drainage channels.

Requirements for only one minor structure at this site.

Service relocations most significant at this site due to the high capacity transmission lines as well as the effects on the MDC water bores.

Local roading costs were mid-range for this site in terms of estimated physical works costs.

Overall this was estimated to be marginally the lowest cost site.

4.2 Site 3

Environmental requirements considered about equal across all sites for Erosion and Sediment control measures relates to earthworks areas.

Earthworks and pavement requirements were greatest cost at this site.

Drainage requirements most significant at this site, significantly greater requirements than Site 2.

Requirements for only one structure at this site, but fairly complex and large span so greater cost.

Moderate costs for service relocations and new services, primarily due to the gas main diversion and interruption to the bulk water supply and bores.

Local roading costs were lowest for this site.

Overall estimated to be marginally highest cost site.

4.3 Site 4

Environmental requirements considered about equal across all sites for Erosion and Sediment control measures relates to earthworks areas.

Earthworks and pavement requirements were mid-range for this site.

Drainage requirements mid-range at this site.

Requirements for two simple structures at this site.

Lowest costs for service relocations and new services, primarily due to no impact on existing water or wastewater. Gas main diversion requirement.

Local roading costs were highest for this site.

Estimated to be mid-range overall cost.

5 Scoring

The scoring provided for each site was agreed by the EDOD team, using the overall cost estimate developed for each of the 3 sites and comparing the relative difference between each. The agreed scoring is as follows:

	Score
Site 2	**2**
Site 3	**3**
Site 4	**3**

The justification for a lower score being provided to Site 2 is:

- Lowest overall physical works estimate, albeit only ~9% less than the highest cost site
- Significantly less earthworks for Site 2 compared to the other two sites (0.5 million cubic metres)
- Anticipated lesser complexity associated with any main line vertical realignment

Rev. No.	Date	Description	Prepared By	Checked By	Reviewed By	Approved By
1	21/11/19	EDOD Shortlisting Scoring	Jamie Povall	Mike Skelton, Andy Mott, Tom Kerr, Ilze Rautenbach	Karen Bell	Karen Bell