WestNet Rail Pty Ltd

Pricing of Track Infrastructure

- Forrestfield to Kalgoorlie
- Kalgoorlie to Leonora
- Kalgoorlie to Esperance
- Kwinana to Bunbury Inner Harbour

Report

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A Unit Rates

1. Introduction

WestNet Rail Pty Ltd commissioned GHD Pty Ltd (GHD) to determine current unit rates for components of track infrastructure on the following nominated routes:

- Forrestfield - Kalgoorlie
- Kalgoorlie - Leonora
- Kalgoorlie – Esperance
- Kwinana – Bunbury Inner Harbour

Each of the above routes comprises a number of sub-sections.

The components of track infrastructure investigated in each sub-section included the following:

- Rail
- Sleepers (concrete, steel and timber), including fastenings
- Ballast
- Turn-outs
- Bridges
- Culverts
- Level crossings
- Railway embankment and formation capping

The directives set by WestNet Rail for the valuation of rail infrastructure are as follows:

- Adopt MEERA (Modern Engineering Equivalent Replacement Asset) principles, ie replacement value of current design standards of existing infrastructure,
- Adopt current best practices for construction.
- Adopt the most economical construction packages for each group of track component, thereby achieving lowest (economical) costs and pricing discounts based on economies of scale.
- Adopt a “greenfields” approach for the determination of track construction, ie the rates are to exclude the costs of construction work being carried out under rail or other traffic (this has particular relevance to bridges and culverts)
- Allowance for wastage
- Goods and Services Tax (GST) to be excluded from the rates
- Profit and overhead recovery of a contractor to be excluded (WestNet to account for these).

2. Infrastructure Data Provided

WestNet Rail provided the following:

- track specifications for each of the four routes, including rail weight, sleeper type and spacings, ballast depth and profile, and turnout types:
- spreadsheet summaries of data for each route Sub-Section, and
- population registers for bridges, culverts and level crossings.

In the case of the population registers, GHD made the assumption that the data was correct and appropriate for use in the valuations.

Specific data is described in Sections 5-13 incl for each component of track.

3. Pricing Methodology

3.1 Principles Adopted

GHD has complied with WestNet Rail's directives for the determination of the unit rates, as discussed in Section 1 "Introduction" of this report.

The unit rates adopted have been based upon open market costs of undertaking the work, and not WestNet Rail's costs.

The unit rates adopted for the valuation are based upon an average replacement cost of each asset class using the most economic parcel of work. This economic parcel of work has been established to spread the overheads incurred in establishing work teams over a parcel of construction work that maximises the assets created without incurring excessive overhead cost that results from small parcels of work.

The unit costs adopted include:

- The cost of materials (including estimated volume discounts);
- Transport of materials to site
- Allowance for material wastage;
- Costs of contract direct labour for infrastructure installation;
- Plant and Equipment for construction and installation;
- Allowance for the remoteness of sites from Perth and other regional centres.

GHD has considered the implication of the unit replacement cost rates for each respective location (sub-section) of each of the four nominated routes.

The basis of GHD's valuation is November 2002.

3.2 Construction Strategy & Assumptions

For the purpose of this valuation a contracting strategy has been assumed as follows:

- That proven, reliable and modern technologies and construction techniques are utilised for all facets of the project.
- That the lines are built without traffic and that in the case of the sub-sections between Forrestfield and Avon Yard on the Forrestfield Kalgoorlie line, the twin track are built as twin tracks, i.e. there is no construction under traffic and no temporary works are necessary.
- That there are no scheduling issues or delays related to land acquisition, cultural clearance or as a result of environmental or other external factors.
- That construction takes place in a period of average weather conditions i.e. rainfall and wet day averages apply.

- That there are no other major competing railways or civil projects in Western Australia which would cause a shortage of materials or construction resources which may impact adversely on time and cost.
- That railway contracts involve track lengths of at least 100km, and that non railway infrastructure is similar to that currently existing.
- That specialist railway contractors would view the projects as sufficiently large that they would invest in specialist track laying and other capital
- That the construction of a number of 100km long track sections concurrently does not impact on the cost or duration of each individual project (this is a theoretical exercise and it is considered inappropriate to apply resource or other similar restrictions to such an exercise which would impact on time or cost).
- That design work and other preparatory work would be undertaken in advance
- That any restrictions and regulations such as the Governments purchasing policy which may in any way hinder timely, cost effective implementation would not be applied if they led to higher project costs.
- That there are no major project delays as a result of latent conditions.
- That issues such as construction water are addressed well in advance of the start of construction.
- That long delivery or standard materials may be pre-ordered by the Principal and supplied as a free issue (or as a series of novated supply contracts).

3.3 Methodology

3.3.1 Earthworks and Track Construction

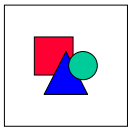
The cost of construction of the 1.5m high embankment and formation capping is derived as a cost per km of track. The cost of track components (rail, sleepers, ballast and track laying) are derived from the material supply costs, transport of materials and installation, and also derived as a cost per km of track.

It has been assumed that the rail, sleepers and ballast will be pre-ordered and supplied by the Principal. Railway contractors' unit costs of track construction therefore excluded the cost of materials on site.

For sections of twin track, the total cost is derived for the wider embankment and capping, and for both tracks, and then divided by the aggregate length of single track in the sub-section to obtain the equivalent cost per km of single track.

3.3.2 Civil Structures

The total cost of civil structures (bridges, culverts and level crossings) in any one sub-section of a line is computed and then divided by the total length of single track in that section, thus giving an equivalent cost per km of single track.



In the case of culvert materials, it has been assumed that the Principal would supply and deliver these to site, such that the contractor would only be responsible for the installation. The unit rates for culverts were based on this approach.

For sections of twin track, the total cost is derived for the wider bridges, the longer culvert lengths and the longer level crossings, and then divided by the aggregate length of single track in the sub-section to obtain the equivalent cost per km of single track.

3.3.3 Overall Cost per Kilometre of Track

For each sub-section of a route, the total cost per km of track is derived by the addition of the cost of all track components and the equivalent cost of civil structures.

3.4 Remoteness Factors

The cost of bridge construction and culvert installation in remote areas from Perth has been determined applying a “remoteness factor” to the value of the respective item as constructed in Perth. The factors adopted are included in Appendix A.

The factors take the following into account:

- the increased cost of engaging labour (living away allowances etc)
- the increased cost of mobilisation and demobilisation of the construction camp, and plant and equipment
- the cost of providing accommodation and storage facilities in the remote locations
- the increased cost of non-productive time (lost time during travelling to site etc) and associated delay cost
- the cost of support services associated with distance from Perth or other regional centres in WA.

4. Transport of Materials

4.1 General

The unit costs for transport by rail of bulk track materials (rail, sleepers, ballast) and precast culvert units have been obtained from Mr John Purcell of ARG. The rates include loading, unloading, stacking, watering (in the case of ballast) etc. The rates for the various components are given below:

4.2 Rail

The cost of transporting rail in 110m lengths is $0.10 per t-km.

The cost of transporting rail material varies depending on the number of rails in the track structure (3 for dual gauge, and 2 for standard gauge), and the distance of the site from the flash butt welding facility at Midland.

4.3 Concrete Sleepers

The cost of transporting concrete sleepers is $0.10 per t-km.

The cost of transporting sleepers to the work site is based on despatch from either Midland or Kwinana.

4.4 Steel Sleepers

The cost of transporting concrete sleepers is $0.10 per t-km.

The cost of transporting sleepers to the work site is based on despatch from either Kalgoorlie or Midland.

4.5 Timber Sleepers

The cost of transporting concrete sleepers is $0.12 per t-km.

It is assumed that timber sleepers would need to be transported to the sites from Perth or Bunbury.

The unit cost for timber sleepers is higher than concrete sleepers due to the greater volume (lower density) of timber.

4.6 Ballast

The cost of transporting ballast is $0.10 per t-km.

The cost of transporting sleepers varies depending on the distance of the supply source. Sources of ballast are Perth, Bunbury and Kalgoorlie.

Transport of ballast can account for a significant proportion of the cost for trackwork. For example, in sub-sections of track midway along the Forrestfield - Kalgoorlie line, the cost of ballast per km of track has been computed as $107,000, nearly double the supply cost in Perth.

4.7 Precast Culvert Units

The cost of transporting precast pipe and box culvert units is $0.12 per t-km, and is based on despatch of the units from either Midland or Kwinana.

The precasters' prices for supply include for delivery to Midland or Kwinana.

The unit cost for transport of precast culvert units is higher than concrete sleepers due to less efficient stacking ability of culvert sections (pipes in particular).

5. Rail

5.1 Specification

WestNet Rail has specified the track structure as follows:

- 60 kg plain carbon rail on the Forrestfield - Kalgoorlie route.
- 50 kg plain carbon rail on the 3 other routes.

5.2 Process

Rail is supplied by OneSteel and delivered by rail in 27.5m lengths to the flash butt welding facility in Midland (the only such facility in WA). These are welded into 110m lengths, ie 3 no. “factory” welds per 110m long rail, and transported to site by special work trains.

The 110m lengths are fused together using “thermit” site welds, ie approximately 9 no. per km of rail.

5.3 Rates

OneSteel’s price for each rail weight includes for delivery to Midland. The rates for the supply, factory welding and site welding rail are included in Appendix A.

OneSteel also supplied a price to deliver rail to Kalgoorlie. However, in the case of track laying in the line sections at Kalgoorlie, it was found that it is more economical to transport rail to Midland from the east, to factory weld the 27.5m lengths into 110m lengths, and to transport the rail back to Kalgoorlie, than to offload the 27.5m lengths in Kalgoorlie and to thermit weld the 27.5m lengths on site. This is due to the relative cost of factory vs field welding.

6. Sleepers

6.1 Specification

WestNet Rail has specified the track structure as follows:

Dual Gauge and Standard Gauge concrete sleepers at 1500 per km on the Forrestfield - Kalgoorlie route.

Standard Gauge timber and steel (1:4) sleepers at 1640 per km on the Kalgoorlie - Leonora route.

Standard Gauge timber and steel (1:2) sleepers at 1500 per km on the Kalgoorlie - Esperance route.

Narrow Gauge concrete sleepers at 1500 per km on the Kwinana - Bunbury Inner Harbour route.

6.2 Process

It has been assumed that concrete sleepers will be fabricated in Perth and delivered by road transport to Midland or Kwinana. The rail shoulders will be cast into the sleepers, and supplementary fastening items will be supplied separately and installed on site.

Timber sleepers, although specified as the replacement material for the Leonora and Esperance routes, are not likely to be available for use in major track construction in the future. For the purposes of these costings, it has been assumed that timber sleepers would be available, and would be delivered in the first instance to Perth, for despatch by rail to the relevant sites.

Steel sleepers are supplied by OneSteel. Uninsulated sleepers are required in general track construction, and insulated sleepers are used on either side of level crossings.

6.3 Rates

Prices for concrete sleepers were obtained from CSR Humes. This precast company has recently completed a supply contract for concrete sleepers for the Koolyanobbing-Kalgoorlie Upgrade project, and therefore the quoted prices can be used with confidence. CSR included the cost of the shoulders in their prices.

Prices for supplementary fastening items were obtained from Pandrol Systems.

Prices for timber sleepers are not readily available, and could not be obtained. For the purposes of the costings, the supply price to WestNet Rail from recent period supply contracts has been used, and marked up to account for escalation.

Prices for steel sleepers, including the fastenings, were obtained from OneSteel.

The rates for sleepers are given in Appendix A.

7. Ballast

7.1 Specification

WestNet Rail has specified the track structure as follows:

Minimum ballast depth below underside of concrete sleepers is 300mm, for the Forrestfield -Kalgoorlie and Kwinana - Bunbury Inner Harbour routes.

Minimum ballast depth below underside of timber sleepers is 200mm and 250mm, for the Kalgoorlie - Leonora and the Kalgoorlie - Esperance routes respectively.

The WestNet Rail standard cross sections for the ballast profiles for different configurations of track were provided to GHD. Sketches prepared for the track ballast showing the minimum ballast depths and associated cross sectional areas of ballast are included in Appendix A.

The volume of sleepers is deducted from the gross volume of ballast per km.

A wastage factor of 5% has been assumed. This is based on a large contract, and would be higher for smaller contracts.

7.2 Process

Ballast is loaded onto rail trucks, watered, and railed to site. The work trains are used to spread the ballast in an initial “pass” comprising approximately one third of the total volume, and a final pass for the tamping and surfacing of the track by track laying machines.

7.3 Rates

There are a number of suppliers of ballast with quarries in different commercial centres in WA as follows:

- Perth - Pioneer Construction Materials and CSR Construction Materials
- Bunbury - Pioneer Construction Materials, CSR Construction Materials and Giacci
- Kalgoorlie - Pioneer Construction Materials, CSR Construction Materials and Roche Mining.
- Esperance - CSR Construction Materials

The rates and quantities of ballast are given in Appendix A. The supply rate varies from $13/t (in Bunbury) to $28/t (in Esperance).

The cost of supply at locations on the 4 nominated routes depends to a large extent on the transportation cost. For sites located equidistant from the above quarries, cost

comparisons were carried out to determine which source of supply would be the most economical.

In reality, it has been suggested by one of the suppliers that for a contract of such magnitude (100km of track construction) it would be worth establishing new (additional) quarries closer to the construction sites.

8. Turnouts

8.1 Specification

For the purposes of determining the replacement costs of turnouts, WestNet Rail has nominated the relevant specifications to comprise 1 :12 / 60 kg turnouts with tangential switch blades, on concrete bearers. This applies to both standard and narrow gauge track.

It was established that for dual gauge track, only 1:16 turn-outs are manufactured.

8.2 Process

Rail and fastenings for turn-outs are normally delivered by road transport on semi-trailers, and the concrete bearers on B-Doubles.

8.3 Rates

Prices for turn-outs were requested from TKL and from VAE. Only VAE responded.

VAE's quoted prices for delivery to Perth are as follows:

Standard Gauge:	$114,000
Narrow Gauge:	$112,000
Dual Gauge:	$197,000

Transportation costs to site have been estimated as follows:

Standard Gauge:	$6,000 (average for all sites)
Narrow Gauge:	$6,000 (average for all sites)
Dual Gauge:	$3,000 (sites are closer to Perth)

The cost of turn-out installation have been obtained from contractors (John Holland and Barclay Mowlem) and the assumed rates are as follows:

SG / NG:	$60,000
Dual Gauge:	$80,000

Due to high number of dual gauge turn-outs in the Forrestfield - Midland sub-section, the cost of turn-outs (equivalent to $509,000 per km of single track) significantly affects the overall rate for trackwork in this sub-section.

Costs in other sub-sections of the other routes account for between 5% and 15% of the total cost per km for track.

The adopted rates for turnouts are included in Appendix A.

9. Track Laying

9.1 Specification

The cost for track laying is based on WestNet Rail's standard track specifications.

9.2 Rates

Railway contractors approached to provide costings and estimates for track laying were reluctant to disclose their pricing strategies. However, the following information was obtained and used as the basis for determining the cost of track laying:

9.2.1 John Holland

The unit costs applicable to track laying in or near the Perth metro region is as follows:

Dual Gauge track:	$119,650/km
Standard Gauge track (conc sleepers):	$ 96,200/km
Narrow Gauge track:	$ 93,820/km
Standard Gauge track (1:2 steel)	$ 86,730/km
Standard Gauge track (1:4 steel)	$ 83,980/km

These costs have been built up from base costs for each process of the track laying operation, including bottom ballast, sleepers, rail, top ballast, tamping and final surfacing.

For remote locations, an additional cost of between 5% and 10% should be applied, depending on the locality or amenity of the construction camp.

9.2.2 Barclay Mowlem

The above rates have been confirmed by the range of rates advised by Barclay Mowlem, based on recent (undisclosed) contracts carried out by this company.

10. Bridges

10.1 Specification

Replacement bridges have been assumed to have the following widths:

Twin track dual gauge - 8.0m (combined bridge assumed)

Single track standard gauge - 4.0m

Single track narrow gauge - 3.6m

10.2 Bridge Categories

Past experience has shown that the cost of railway bridges designed to accommodate the current 300-A-12 loading as specified in the Australian Bridge Design Code, can vary from approximately $2,300/m² to approximately $3,400/m2, depending on the complexity of the foundations and of the magnitude of the span lengths.

WestNet Rail's rail bridges are currently designed for "M250" loadings (equivalent to 250-A-12, or 25t axle loads). Some older M160 bridges on the Kwinana - Bunbury Inner Harbour have been strengthened to M250, or replaced to M300.

Bridges which cross permanent watercourses generally require piled foundations, which adds substantially to the cost of the structures.

Only rail bridges and footbridges over rail are included in the population registers, and considered in the costings. Road over rail bridges are not included in the registers, and are therefore excluded from the valuations.

For the purposes of the costings, the rail bridges listed in the Bridge Population Registers have been split into 3 basic categories, namely "simple", "medium" and "complex", depending on the span lengths, and associated type of construction.

As the few steel footbridges listed in the Registers comprise steel spans of less than 16m, it was not necessary to separate them into different categories.

Note: The rail bridge over the Great Eastern Highway at Km 3.0 (approx) is not included in the register, but is included in the valuation.

10.3 Rates

The unit rates for the three categories are given in Appendix A. These rates are specifically related to a "greenfield" construction approach.

11. Culverts

11.1 Specification

Replacement culverts are to provide the same size and number of openings as those which exist in the population registers.

Reinforced concrete box culverts (RCBC's) and reinforced concrete pipes (RCP's) are to be designed to accommodate the equivalent of M300 loading. This requires the RCP's to be Class 4.

All culverts are to include an end treatment comprising a headwall, wingwalls and an apron slab at each of the inlet and outlet ends.

The end treatment quantities are based on the preparation of a design "model", with the geometry of members derived as a function of the culvert size. The following assumptions were included in the design of the end treatments, regardless of culvert size:

- Plan Geometry — At right angle to track
- Embankment slope — 1.5 (horiz) to 1 (vert)
- Thickness of apron slab — 150mm
- Length of apron slab — 1.75 times overall headwall height
- Wingwall deflection — 2:1 (26°)
- Headwall height above culvert — 300mm
- Headwall thickness — 0.125 times culvert height (or pipe diameter)
- Wingwall thickness — 0.1 times culvert height (or pipe diameter)
- Reinforcement density — 120kg/m³

11.2 Culvert Categories

Culvert types within the population registers for the four routes include the following:

- Precast concrete box culverts (RCBC's)
- Insitu concrete box culverts
- Reinforced concrete pipe culverts (RCP's)
- Corrugated steel pipe culverts (CSP's)

For the purposes of the costings, the culverts within each respective sub-section of line are split between "boxes" (precast or insitu), and "pipes" (RCP's or CSP's). The costs of these are then based on the assumption that the "boxes" will be replaced with precast RCBC's and base slab units, and the "pipes" will be replaced with RCP's.

11.3 Rates (Culverts)

Prices for the supply of RCBC's (including base slabs) and RCP's were obtained from CSR Humes and Rocla. Although Rocla culverts were shown to be more economical in the smaller size openings (<1200mm x1200mm RCBC's, and <900mm dia RCP's), the overall pricing structure advised by CSR Humes was found to be more economical.

The adopted rate for culverts are given in Appendix A, and are based on the following build-up:

- Material cost, supplied to Midland or Kwinana
- Labour and plant costs to install in Perth, assuming a factor of 0.8 times material cost for RCBC's, and 1.1 times material cost for RCP's.
- Transport costs to site
- Labour and plant costs to install on site, using remoteness factors (as shown in Appendix A) applied to the labour and plant costs for installation in Perth.

The above method and assumptions, which have assumed a "greenfield" approach, have been tested against actual supply and installation costs for RCBC's and RCP's incurred by John Holland in a "brownfield" situation. As would be expected, the "brownfield" costs were found to be significantly higher.

11.4 Rates (End Treatments)

The rate adopted for the insitu reinforced concrete in the headwalls, wingwalls and apron slabs is $1,000/m. This rate accounts for the disproportionate amount of steel reinforcement and formwork for thin concrete members, and the relatively small pours, and includes for the supply and installation of all permanent materials (concrete, reinforcement, joints etc) in the works, and all temporary works such as excavations, shoring, formwork etc.

The costs of end treatments at each respective site have been derived by escalating the "Perth" costs by the corresponding remoteness factor (refer Appendix A).

The resulting costs using this method and assumptions, have also been tested against actual recent costs of insitu concrete construction of end treatments, and found to be appropriate.

12. Level Crossings

12.1 Specification

The standard of level crossings are nominated in the population data as supplied to GHD.

12.2 Rates

The costs of the supply and installation of surfacing materials as listed in the population data are added to the cost of each type of specified level crossing.

The rates for surfacing materials are given in Appendix A.

13. Railway Earthworks

13.1 Specification

WestNet Rail has specified the railway embankment geometry as follows:

Height of embankment	1.27m (excludes 0.23m thick formation capping).
Formation capping	0.23m thick
Overall embankment height	1.5m (permitted by the Regulator)
Batters	1.5 (horiz) to 1 (vert)

Sketches showing the WestNet Rail standard cross sections for the railway embankment for single and twin track are included in Appendix A.

13.2 Process

The “replacement” embankment is assumed to be constructed within a “greenfield” environment.

The fill required for the embankment is assumed to be imported, rather than obtained from cut to fill.

It should be noted that construction water can be a significant issue in much of the Goldfields area.

13.3 Rates

A rate of $17.00/m³ has been used throughout all sub-sections of all four routes for the construction of the railway embankment. This rate accounts for the cost of the haulage of materials and water, compaction in layers etc. It was assumed that there are no locations where long mass hauls of material would be required.

A rate of $8.50/m² for the 230mm thick formation capping has been used throughout.

These rates are consistent with those from recent contracts, and also consistent with rates advised by John Holland.

The valuation of earthworks is a very significant component of the overall track cost, and is arguably the most difficult to estimate accurately.

14. Summary

GHD has prepared unit rates for all components of track infrastructure on the four nominated routes. The rates have been market tested and are believed to be a fair representation of the value of each component.

Appendix A

Unit Rates

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