



Jemena Gas Networks

Cost Estimation Methodology

Review of JGN Methodology

19 June 2014

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Cost Estimation Methodology – Review of Scope Allowances

Report prepared by Evans & Peck Pty Ltd for Jemena Ltd.

Revision

Date	Comments	Undertaken by
28 April 2014	Preliminary draft	E. Mudge, M. Quinnell
4 June 2014	Final Draft	E. Mudge, M. Quinnell
19 June 2014	Final	E. Mudge, M. Quinnell

Declaration

Sections 1 to 4, 6 & 7 Prepared by: Evan Mudge

I have read, understood and complied with the Federal Court of Australia's Practice Note CM 7 – Expert Witness in Proceedings in the Federal Court of Australia.

The opinions contained in this report are based wholly or substantially on the specialised knowledge gained through the training, study and experience outlined in the Curriculum Vitae that is attached in Appendix B.

Signature:



Evan Mudge, Associate, Evans & Peck Pty Ltd

Section 5 Prepared by: Michael Quinnell

I have read, understood and complied with the Federal Court of Australia's Practice Note CM 7 – Expert Witness in Proceedings in the Federal Court of Australia.

The opinions contained in this report are based wholly or substantially on the specialised knowledge gained through the training, study and experience outlined in the Curriculum Vitae that is attached in Appendix B.

Signature:



Michael Quinnell, Senior Associate, Evans & Peck Pty Ltd

Executive Summary

Jemena Gas Networks (JGN) is required to submit its Access Arrangement proposal to the Australian Energy Regulator (AER) for the 2015/16 to 2019/20 regulatory control period by the end of June 2014. Evans & Peck was engaged to review JGN's capital cost estimation methodology and provide expert opinion on JGN's use of scope allowances to develop its capital expenditure forecast.

In this report Evans & Peck first outlines the requirements of National Gas Rules (NGR) 74 and 79(1)(a) which essentially require that JGN's cost estimation methodology produces:

- a forecast or estimate of capital expenditure that would be incurred by a prudent service provider acting efficiently, in accordance with good industry practice to achieve the lowest sustainable cost of providing services; and,
- a forecast or estimate that is arrived at on a reasonable basis and represents the best forecast or estimate possible in the circumstances.

We then outline the cost estimation methodology that has been used to develop the capital expenditure forecast, noting the scope allowance factors that are considered in this report are only applied to projects that are estimated using the Project Estimating Model (PEM), which account for approximately 20% of the total JGN capital expenditure forecast.

In the remainder of the report Evans & Peck:

- Assesses whether JGN's cost estimation methodology will produce a forecast or estimate of capital expenditure for the 2015-20 access arrangement period that complies with rule 79(1)(a) and rule 74*
- Provides an opinion on whether JGN's method of applying a scope allowance to forecast labour and materials costs for projects at the early stages of JGN's gating system is appropriate and in accordance with rule 79(1)(a) and rule 74;*
- Provides an estimate (or range of estimates) of the appropriate scope allowance factor(s) to apply to JGN's labour and materials estimates at a project level*
- Provides the Expert's opinion on whether the scope allowance factor(s) applied by JGN to forecast labour and materials estimates for the 2015-20 access arrangement period produces forecasts that are consistent with rules 74 and 79(1)(a).*

To address the terms of reference, Evans & Peck has considered four key questions.

Does JGN's capital cost estimation methodology satisfy the requirements of NGR 74 and 79?

We assessed whether JGN's cost estimation methodology will produce a forecast that complies with the NGRs and noted that:

- the basis of the project estimates is stated in the JGN estimating manual and a transparent breakdown of project costs by stage is provided in the PEM for each project;
- JGN consistently applied the cost estimation methodology across the sampled projects;
- JGN is unable to comprehensively forecast the final scope for all projects at Stage 1, as certain scope items are not fully defined until additional design, site investigation and consultation work has been completed in the latter stages; and,
- this additional scope relates to items that are expected to be incurred, and without an appropriate allowance, would expose JGN to a material risk of under-recovery.

Therefore Evans & Peck is of the opinion that JGN's capital cost estimating methodology satisfies the requirements of National Gas Rules 74 and 79(1)(a).

Is JGN's application of a scope allowance appropriate?

Evans & Peck considered whether JGN's method of applying a scope allowance to forecast labour and materials costs for projects at the early stages of JGN's gating system is appropriate and in accordance with the NGRs and noted that:

- projects cannot be fully scoped at the strategic estimate stage (stage 1) as the scope arising from more detailed design, consultation and site investigation has not been fully defined;
- JGN has made an allowance for an adjustment to account for the expected scope that arises from these factors in the form of the scope allowance;
- a review of JGN's historical performance confirms that there is a significant gap between stage 2 and 3 project estimates and the actual outturn costs;
- the size of the historical gap between stage 2 and 3 project estimates and the actual outturn costs exceeds the expected impact of the process improvements that have been implemented during the current regulatory control period;
- in the absence of the scope allowance, JGN would be exposed to a systemic understatement of costs across its project portfolio that cannot be accounted for by diversification;
- no other factors are applied in the cost estimating process at a project or portfolio level that account for the scope that is addressed by the scope allowances.

Therefore Evans & Peck is of the opinion that JGN's method of applying scope allowances at the early stages of the gating process is appropriate and in accordance with NGR 74 and 79(1)(a).

What value of scope allowance is appropriate for JGN's forecast capex?

Evans & Peck has provided a range of estimates of the appropriate scope allowance factor to apply to JGN's labour and materials estimates at a project level, including an outline of the methodology used and information sources that have been used. We have also presented a comparison of the contribution of the JGN scope allowance factors at a portfolio level with the range of scope allowance factor contributions that are derived from the appropriate project level scope allowance factors.

Based on our factual findings that:

- the JGN capital expenditure forecast attempts to predict actual outturn project costs based on cost estimates prepared between gate 0 and 1;
- JGN's scope allowance factors are applied at a line by line level at a value of 10% to internal resources and 30% to externally contracted resources;
- a project level scope allowance factor can be calculated from the line by line scope allowance factors applied;
- similar infrastructure delivery and utility operators make allowance for uncertainty for scope identified in project delivery;
- a range of estimates of scope allowance factors can be estimated from publically available information, confidential sources and our experience as professional cost estimators;
- the range of estimates for appropriate scope allowance factors can be established as ranging between 12.5% and 27.5% for different types of projects;
- when the composition of JGN's portfolio is taken into account a weighted average scope allowance of between 17.8% and 22.8% is consistent with accepted good industry practice for the estimation of scope growth at stage 1 estimates to actual outturn costs,

Evans & Peck is of the opinion that a weighted average scope allowance factor of between 17.8% and 22.8% is the appropriate scope allowance factor to apply to JGN's labour and materials estimates at a project level.

Is the resulting forecast consistent with the NGR requirements?

Evans & Peck has considered whether the scope allowance factor(s) applied by JGN to forecast labour and materials estimates for the 2015-20 access arrangement period produces forecasts that are consistent with NGRs and notes that.

- Evans & Peck has previously concluded:
 - that JGN's capital cost estimating methodology satisfies the requirements of NGR 74 and 79(1)(a);
 - that JGN's method of applying scope allowances at the early stages of the gating process is appropriate and in accordance with NGR 74 and 79(1)(a);
 - that a weighted average scope allowance of between 17.8% and 22.8% is consistent with accepted good industry practice for the estimation of scope growth at stage 1 estimates to actual outturn costs
- the total value that is attributable to JGN's scope allowances is \$34.9m or 21.5% of the total \$162.2m base estimate for projects derived from the PEM, which falls within the range identified by Evans & Peck.

Therefore Evans & Peck is of the opinion the scope allowance factor(s) applied by JGN to forecast labour and materials estimates for the 2015-20 access arrangement period are appropriate to produce forecasts that are consistent with rules 74 and 79(1)(a).

1 Introduction

Jemena Gas Networks (JGN) is required to submit its Access Arrangement proposal to the Australian Energy Regulator (AER) for the 2015/16 to 2019/20 regulatory control period by the end of June 2014.

The AER's Access Arrangement determination effectively sets the prices that JGN can charge for gas distribution services. The forecast capital expenditure for the period is a key input to determining prices, as it defines the changes in the value of the asset base on which JGN's total revenue allowance (and subsequently prices) is calculated. Evans & Peck was engaged to review JGN's capital cost estimation methodology and provide expert opinion on JGN's use of scope allowances based on the requirements of National Gas Rules (NGR) 74 and 79 that:

- (e) *Assesses whether JGN's cost estimation methodology will produce a forecast or estimate of capital expenditure for the 2015-20 access arrangement period that complies with rule 79(1)(a) (being a forecast or estimate of capital expenditure that would be incurred by a prudent service provider acting efficiently, in accordance with good industry practice to achieve the lowest sustainable cost of providing services) and rule 74 (being a forecast or estimate that is arrived at on a reasonable basis and represents the best forecast or estimate possible in the circumstances);*
- (f) *Provides an opinion on whether JGN's method of applying a scope allowance to forecast labour and materials costs for projects at the early stages of JGN's gating system is appropriate and in accordance with rule 79(1)(a) and rule 74;*
- (g) *Provides an estimate (or range of estimates) of the appropriate scope allowance factor(s) to apply to JGN's labour and materials estimates at a project level. In providing this estimate, the Expert will:*
 - (i) *outline the methodology that it uses to calculate the estimate(s), or range of estimates, of the appropriate scope allowance factor(s) and the information and data reviewed in calculating those estimate(s);*
 - (ii) *consider whether the estimate(s) of, or range of estimates for, the appropriate scope allowance factor is sensitive to the nature of projects being undertaken in a particular regulatory period;*
 - (iii) *identify any alternative estimates that may be calculated to account for any identified sensitivity;*
- (h) *Provides the Expert's opinion on whether the scope allowance factor(s) applied by JGN to forecast labour and materials estimates for the 2015-20 access arrangement period produces forecasts that are consistent with rules 74 and 79(1)(a).*

In preparing the report, the Expert will:

- *consider the relevant provisions in the Rules and the Law relating to forecast capital expenditure;*
- *consider possible alternative methods and approaches to cost estimation methodology and estimating the scope allowance, including those previously considered, or commented on, by the AER and other regulators;*
- *use robust methods and data in producing any estimate(s);*
- *follow the guidelines set out in Annexure A of this letter.*

The remainder of this report is structured to address these Terms of Reference as follows:

Section 2: Outlines the requirements for cost estimating processes identified in NGR 74 and 79 and JGN's cost estimating processes.

Section 3: Assesses whether JGN's cost estimation methodology satisfies the requirements for cost estimating processes identified in NGR 74 and 79.

Section 4: Provides Evans & Peck's opinion on whether JGN's method of providing a scope allowance to forecast labour and materials costs for projects at the early stages of JGN's gating system is appropriate and in accordance with rules 74 and 79(1)(a) .

Section 5: Provides an estimate (or range of estimates) of the appropriate scope allowance factor(s) to apply to JGN's labour and materials estimates at a project level.

Section 6: Provides Evans & Peck's opinion on whether the scope allowance factor(s) applied by JGN to forecast labour and materials estimates produces forecasts that are consistent with rules 74 and 79(1)(a).

Section 7: Summarises Evans & Peck's opinions and concludes the report.

2 Cost Estimation Methodology Overview

In order to assess whether JGN's cost estimation methodology satisfies the requirements of the NGR and National Gas Law (NGL), it is necessary to define the specific requirements that must be satisfied and to provide an overview of JGN's cost estimating methodology. Therefore this section provides a summary of:

- (a) the requirements of the NGR and NGL; and,
- (b) Evans & Peck's understanding of JGN's cost estimation methodology.

For the avoidance of any doubt, this information is provided for context and to ensure completeness in this report.

2.1 NGR Requirements

Rule 72 of the NGR requires JGN's access arrangement proposal to include the projected capital base over the access arrangement period, including a forecast of conforming capital expenditure for the period (1 July 2015 to 30 June 2020) and the basis for the forecast.

Rule 79 sets out when capital expenditure is considered to be "conforming capital expenditure":

79 New capital expenditure criteria¹

- 1) *Confirming capital expenditure is capital expenditure that conforms with the following criteria:*
 - (a) *the capital expenditure must be such as would be incurred by a prudent service provider acting efficiently, in accordance with accepted good industry practice to achieve the lowest sustainable cost of providing services;*
 - (b) *the capital expenditure must be justifiable on a ground stated in subrule (2).*
- 2) *Capital expenditure is justifiable if:*
 - (a) *the overall economic value of the expenditure is positive; or*
 - (b) *the present value of the expected incremental revenue to be generated as a result of the expenditure exceeds the present value of the capital expenditure; or*
 - (c) *the capital expenditure is necessary:*
 - (i) *to maintain and improve the safety of services; or*
 - (ii) *to maintain the integrity of services; or*
 - (iii) *to comply with a regulatory obligation or requirement; or*
 - (iv) *to maintain the service provider's capacity to meet levels of demand for services existing at the time the capital expenditure is incurred (as distinct from projected demand that is dependent on an expansion of pipeline capacity); or*
 - (d) *the capital expenditure is an aggregate amount divisible into 2 parts, one referable to incremental services and the other referable to a purpose referred to in paragraph (c), and the former is justifiable under paragraph (b) and the latter under paragraph (c).*

¹ National Gas Rules, Section 79

The forecast of conforming capital expenditure for the 1 July 2015 to 30 June 2020 period must also satisfy rule 74, as follows:

74 Forecasts and estimates²

- 1) *Information in the nature of a forecast or estimate must be supported by a statement of the basis of the forecast or estimate.*
- 2) *A forecast or estimate:*
 - (a) *must be arrived at on a reasonable basis; and*
 - (b) *must represent the best forecast or estimate possible in the circumstances.*

In making its determination on the revisions to JGN's access arrangement, the AER is required to do so in a manner that will or is likely to contribute to the achievement of the National Gas Objective. The National Gas Objective is set out in section 23 of the NGL as follows:

The objective of this Law is to promote efficient investment in, and efficient operation and use of, natural gas services for the long term interests of consumers of natural gas with respect to price, quality, safety, reliability and security of supply of natural gas.³

The AER must also take into account the revenue and pricing principles in section 24 of the NGL in determining whether JGN's forecast capital expenditure complies with the requirements of the NGL and the NGR and is consistent with any criteria in the NGL and the NGR. The revenue and pricing principles include:

- 2) *A service provider should be provided with a reasonable opportunity to recover at least the efficient costs the service provider incurs in—*
 - (a) *providing reference services; and*
 - (b) *complying with a regulatory obligation or requirement or making a regulatory payment.*
- 3) *A service provider should be provided with effective incentives in order to promote economic efficiency with respect to reference services the service provider provides. The economic efficiency that should be promoted includes—*
 - (a) *efficient investment in, or in connection with, a pipeline with which the service provider provides reference services; and*
 - (b) *the efficient provision of pipeline services; and*
 - (c) *the efficient use of the pipeline.*
- ...
- 5) *A reference tariff should allow for a return commensurate with the regulatory and commercial risks involved in providing the reference service to which that tariff relates.*
- 6) *Regard should be had to the economic costs and risks of the potential for under and over investment by a service provider in a pipeline with which the service provider provides pipeline services.⁴*

² National Gas Rules , Section 74

³ National Gas Law, Section 23

⁴ National Gas Law, Section 24

2.2 JGN Cost Estimation Methodology

To prepare the capital expenditure estimates that are used for the Access Arrangement submission, JGN has taken account of the different types of work undertaken by the business and applied a range of estimating processes, as appropriate to each. These are broadly:

- Project based forecasts – used where a specific project can be identified and estimated using JGN’s Project Estimating Model (PEM) and supporting processes.
- Unit Cost x Forecast Quantity – used for high volume, lower value work where the quantity is best forecast at a ‘macro’ level, or based on historical trends, as specific projects cannot be identified at this time (e.g. meter renewals and upgrades and most market expansion expenditure).
- ‘Other’ expenditure, representing non-distribution and land acquisition expenditure that is estimated in accordance with the preparation of the expenditure plans for these categories.
- Mine subsidence works are also estimated using the PEM but the majority of costs are recovered outside the Access Arrangement capex allowance.

The relative proportion of the proposed Access Arrangement capital expenditure is illustrated in Figure 2-1.

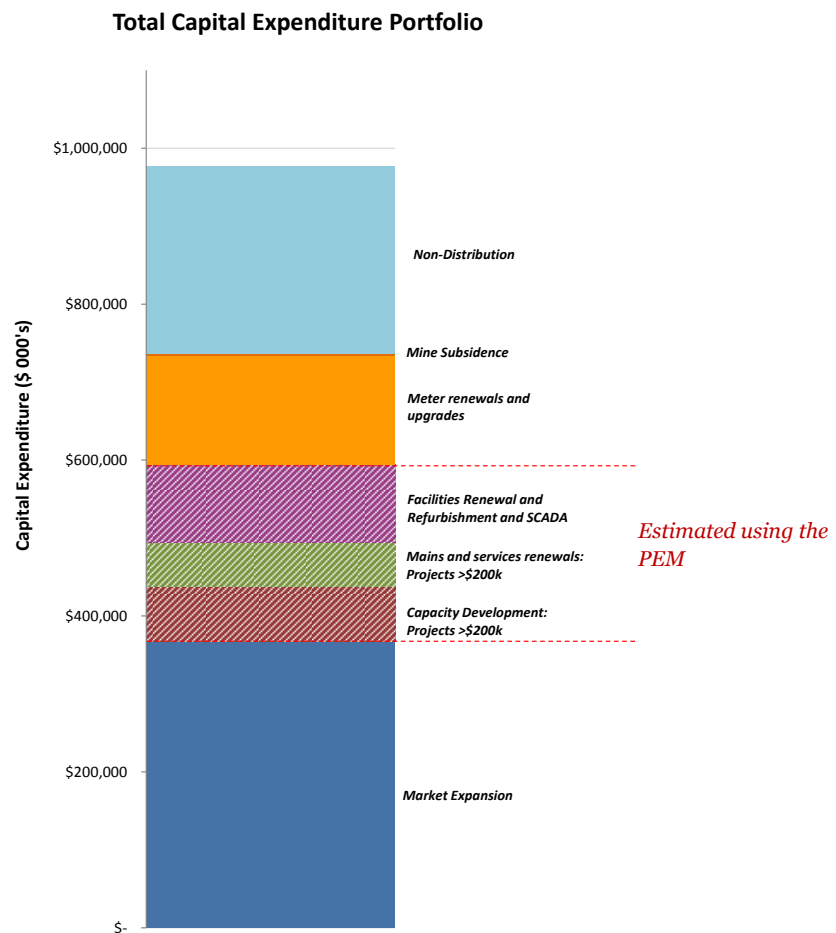


Figure 2-1: Proportion of JGN forecast capex portfolio

Source: Evans & Peck Analysis of JGN Data⁵

⁵ JGN Spreadsheet, AA15 - JGN Capex Forecast Model - v13 - 13 May 14 (full view).xlsb

Evans & Peck's assessment is focused on project based forecasts, as this is where JGN applies the PEM methodology and scope allowances to account for the uncertainty in scope between the scope included in the early stage estimates, that are necessarily used for regulatory purposes, and the actual scope that is expected to be required in practice once detailed planning and design work is completed closer to the actual delivery date for the project.

The project based forecasts are developed in accordance with the governance arrangements outlined in JGN's 'gating' process⁶, which specifies the decision points where a project estimate and the underlying need is reviewed and budget approval is sought to proceed with further development and delivery of the project. These estimates are prepared in accordance with JGN's project estimating methodology that is incorporated into the PEM spreadsheets and explained in the Estimating Manual⁷.

These key processes are summarised in sections 2.2.1 and 2.2.2, below.

2.2.1 Governance ('Gating') Process

JGN's 'Gating' Process⁸ describes the decision gates that a project must pass through to gain budget approval to progress to the next stage of work. There are three decision gates that must be satisfied prior to the commitment to undertake the physical construction work. These are:

- Decision Gate 1 – Estimate Based on Strategic/Concept Design and Desktop Assessment
- Decision Gate 2 – Estimate Based on Front End Engineering Design and Site Specific Assessment
- Decision Gate 3 – Estimate Based on Detailed Design, Tender Responses and Site Specific Approvals

This is reflected in the structure of JGN's estimates in the PEM, where 'Stage 1' relates to the work required to reach 'Decision Gate 1'. In the same way, 'Stage 2' and 'Stage 3' relate to Decision Gates 2 and 3, respectively.

For the purposes of preparing its Access Arrangement forecasts, Evans & Peck understands that most estimates have been prepared to a notional 'gate 1' level of detail which reflects the preliminary nature of the estimate.

Stage 1: Assessment

During stage 1 (assessment stage) JGN reviews potential project options in response to an opportunity brief and feasibility assessment for each project. This stage targets a 50% confidence level⁹ and recommends a preferred option to address the particular project driver. Due to the large number of projects, and taking into account resource and time constraints, JGN does not complete a detailed site investigation during the preparation of these estimates.

The approaches that are used to prepare stage 1 estimates are outlined below:

- (a) JGN Mains Maps are used to determine tie-in points to the existing network;
- (b) Google Earth is used to plot and quantify the proposed route;

⁶ Jemena Gas Networks, Estimating Manual, Appendix B

⁷ *ibid*

⁸ *ibid*, Appendix B

⁹ Evans & Peck notes that JGN uses the term 'confidence level' as an indicator of the extent to which the estimate has been developed. A 50% confidence level represents an early stage estimate based on limited information (hence requires a greater degree of scope adjustment), whilst a 90% confidence level represents a fully developed estimate that is largely ready for delivery.

- (c) JGN's schedules of rates from current contracts are used to estimate the cost of laying mains, identifying obstacles and quantifying restoration amounts;
- (d) published 2014 council rates are used to estimate permanent restoration costs;
- (e) consistent assumptions on timing and duration are made for the requirements, definition, mobilisation, and handover phases; and
- (f) assumptions on timing of the construction and commissioning phases are made based on the project complexity and JGN's experience with similar works.

The stage 1 estimating process does not take into account:

- (a) site visits;
- (b) detailed design;
- (c) stakeholder consultation;
- (d) potholing and geotechnical surveys; and
- (e) dial before you dig information.

For the purpose of JGN's Access Arrangement forecast, no allowance for escalation, margin and project contingency has been applied to the base estimates.

However, due to the uncertainty in project scope, JGN has applied a scope allowance to the base estimate produced in the PEM in order to align the estimate with the expected outturn cost for the project. This factor accounts for the uncertainty in scope between early stage estimates and actual outturn costs based on JGN's historical experience.

A 10% adjustment is applied to internal costs (primarily JGN labour), while a 30% adjustment is applied to materials and contract costs. JGN has identified that the lower adjustment factor for internal costs reflects the higher degree of control over the scope and cost of internal resources.

Stage 2: Requirements

Upon completion of Stage 2, a much greater degree of design and site specific investigation has been completed to reduce the uncertainty in scope. At this stage the estimate is refined to account for the higher degree of project definition in order to satisfy the requirements of Decision Gate 2 and produce a notional 70% confidence level estimate.

The additional steps completed during stage 2 to reduce the degree of scope uncertainty are:

- (a) cCompletion of preliminary and front end engineering design;
- (b) allocation of budget;
- (c) approval of safety and environmental scope;
- (d) completion of site visit, site survey, services search, integrity digs, and geotechnical testing;
- (e) preparation of a project implementation plan;
- (f) notification provided to councils and other stakeholders; and
- (g) appointment of internal staff and project team (including the project manager, project engineers, commercial manager, construction supervisor, design co-ordinator, commissioning manager).

Essentially Stage 2 enables the project requirements to be more fully defined on the basis of the initial engineering design and project/site specific investigations and analysis.

Stage 3: Definition

Upon completion of Stage 3, the project is fully defined, with all drawings and specifications completed. Tendered contractor quotes have been obtained which further reduces the scope uncertainty with respect to the specific external resources and activities that are required to deliver the project. As a result, the project estimate is updated to satisfy JGN's requirements for a notional 90% confidence level for Decision Gate 3.

The additional steps completed during stage 3 to reduce the degree of scope uncertainty are:

- (a) land access arrangements in place;
- (b) external approvals obtained;
- (c) detailed design has been completed;
- (d) HAZOP, construction hazards and other risk and safety management studies completed;
- (e) preferred tenderer recommendation; and
- (f) procurement of long lead items commenced.

Essentially Stage 3 develops the project to the point where contracts can be signed and construction can commence.

Stages 4, 5, 6, 7: Mobilisation, Construction, Commissioning, Handover

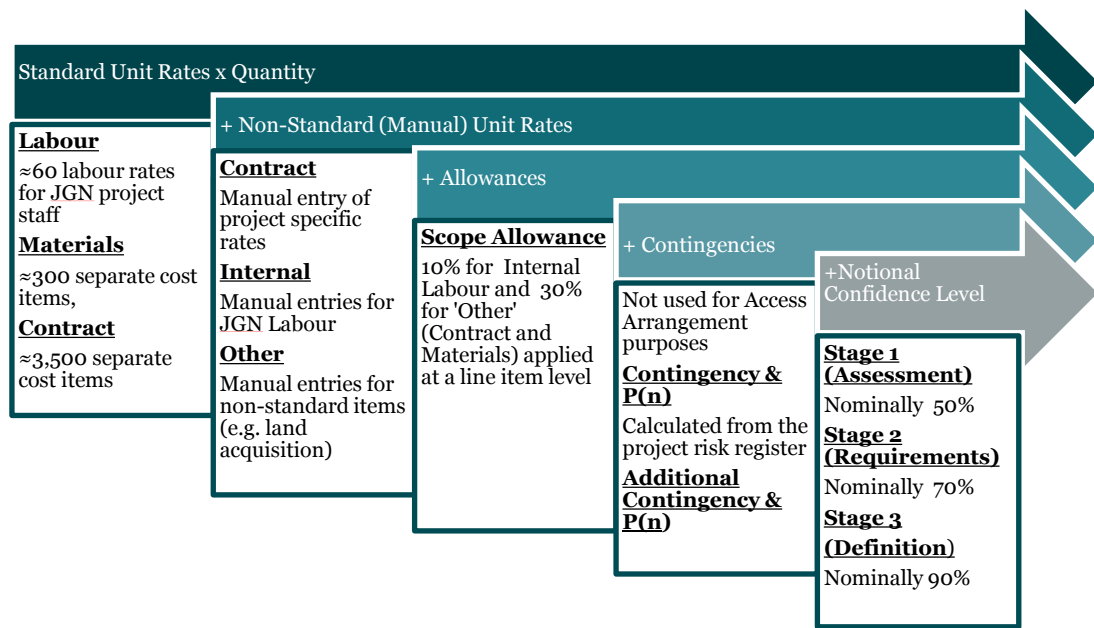
During the delivery of the project in Stages 4, 5, 6 and 7, the scope and cost of the project is managed in accordance with JGN's project management processes and the provisions of the contracts. As the project progresses, any remaining uncertainties surrounding the project scope are reduced as the project converges to the actual construction cost.

2.2.2 Project Estimating Methodology

JGN’s project estimating methodology for project based work is outlined in its Estimating Manual¹⁰ and is summarised in Figure 2-2 below. The PEM is an excel spreadsheet which is used by JGN to ensure that the project estimating methodology is implemented consistently across the business and to provide consistency in the way in which project estimates are presented.

Evans & Peck understands that for the purposes of preparing its Access Arrangement forecasts, JGN has not included any allowance for project risks or contingency that would otherwise be addressed through the specific calculation of ‘Contingency’ and ‘Additional Contingency’ allowances, as allowed for in the PEM¹¹. JGN uses these for internal project management purposes to manage contingent risks across the portfolio of capital works, as explained in the user guide for the PEM¹².

Figure 2-2: JGN Project Estimating Methodology



Source: Evans & Peck Summary

¹⁰ ibid, Section 4, Appendix A – User Guidelines for Project Control Templates

¹¹ Jemena Gas Networks, Project Estimating Model, Worksheet. Evans & Peck notes that three of the projects analysed are still in progress. The forecast outturn cost for those projects includes a contingency allowance (at a project level) based upon JGN’s project specific assessment of delivery risks and variability in suppliers’ quotes.

¹² Jemena Gas Networks, Estimating Manual, Appendix A – User Guidelines for Project Control Templates

3 Does JGN's capital cost estimation methodology satisfy the requirements of NGR 74 and 79?

This section provides Evans & Peck's analysis and opinion on whether JGN's cost estimation methodology produces a forecast or estimate of capital expenditure for the 2015-20 access arrangement period that complies with rule 79(1)(a) and rule 74.

3.1 Rule 74 Requirements

As outlined in section 2.1, Rule 74 places specific requirements on forecasts or estimates that are provided as part of JGN's Access Arrangement submission. These are:

- 1) *Information in the nature of a forecast or estimate must be supported by a statement of the basis of the forecast or estimate.*
- 2) *A forecast or estimate:*
 - (a) *must be arrived at on a reasonable basis; and*
 - (b) *must represent the best forecast or estimate possible in the circumstances¹³.*

The following sections 3.1.1 to 3.1.3 provide Evans & Peck's assessment of whether JGN's cost estimation methodology satisfies these requirements.

3.1.1 Supported by a statement of the basis for the forecast or estimate

The forecast capex that is covered by Evans & Peck's review is estimated using the JGN PEM and includes an adjustment factor to adjust the base estimate to account for the additional scope that is expected to be identified during further design development, site investigation and procurement activities.

The JGN cost estimating process is described in the Estimating Manual¹⁴, with further detail regarding the specific application of the methodology within the PEM included in a separate user guide¹⁵. Evans & Peck understands that individual models are maintained for each project and has sighted individual models for a selection of projects¹⁶. We found that these models aligned with the processes outlined in the user guide for the PEM, however some verbal clarifications with the estimators were necessary to establish the underlying source for some individual line items that were entered as 'manual' rates.

On this basis, Evans & Peck considers that JGN's project estimates satisfy the requirements of Rule 74 (1).

¹³ National Gas Rules, Rule 74

¹⁴ Jemena Gas Networks, Estimating Manual,

¹⁵ *ibid* Appendix A – User Guidelines for Project Control Templates

¹⁶ Auburn PRS Easement Valuation; Cecil Park CDP, JGN Northern Trunk Heating; Kensington Stage 4 Rehabilitation; Belmont CDP; Licence 1 Horsley Park to Wilton Integrity Digs; Licence 3, 7, 8a Integrity Digs; Haberfield PRS Upgrade; Northern Primary Main Stage 1; Prestons Edmonson Park Secondary Kookaburra Rd CDP

3.1.2 Arrived at on a reasonable basis

In Evans & Peck's opinion, JGN's cost estimating process is typical for infrastructure projects, taking into account the nature of the work and the scale of projects that are typically undertaken by JGN. As illustrated in Figure 2-2, JGN's project estimates are based on a bottom up assessment of the quantities of work required to complete a project multiplied by unit rates that are obtained from either a 'standard' unit rate database that reflects existing (or recent) contract rates or an alternative source for 'manual' unit rates.

In cases where a 'manual' unit rate is used, Evans & Peck's discussions with JGN estimators identified that these are generally based on contract costs that have not yet been incorporated into the standard cost library, actual costs from a similar project, suppliers quotations, or published unit rates (e.g. by council area for reinstatement works).

Due to the strategic nature of the stage 1 estimates that are used for the purposes of JGN's Access Arrangement, the full range of planning and investigation activities that are necessary to provide a comprehensive scope for projects have not been completed. Therefore two scope adjustment factors¹⁷ have been applied to account for the additional scope that is expected to be arise following further planning work and completion of relevant investigations. These scope adjustment factors ensure that:

- (a) the total capex forecast across the projects is not over or understated; and,
- (b) the accuracy with which individual scope adjustment factors can be determined is not over or understated.

Evans & Peck recognises that JGN's estimation of scope adjustment factors at the portfolio level (through the use of the two standard figures) and application at the line item level (by applying the default values by cost type) provides a reasonable approach to establish project specific adjustment factors. Whilst we consider that the approach itself is reasonable and consistent with practices of comparable businesses within the utility and infrastructure industry, our assessment of the specific figures applied by JGN is outlined in section 5.

Based on our factual findings that:

- JGN's costs are based on a transparent bottom up build of quantities and costs;
- JGN's cost estimation methodology is considered to be reasonable and was found to have been applied consistently across the sampled projects; and
- the scope adjustment factors are applied line by line in a manner that establishes a project specific adjustment for the expected gap between the base 'Stage 1' estimate and the expected outturn cost,

Evans & Peck considers that JGN's project estimates satisfy the requirements of Rule 74 (1)(a).

3.1.3 Represent the best forecast or estimate possible in the circumstances

For the purpose of preparing the forecast capital expenditure for its access arrangement submission, JGN must forecast the specific projects that it expects to undertake over the 2015/16 to 2019/20 regulatory control period. This necessarily requires the assessment of project needs that extend well beyond the timeframe considered under JGN's normal capital program planning processes. As a result there is a much greater volume of projects that are required to be assessed in order to prepare the Access Arrangement forecast. This is coupled with a lower level of confidence in the suitability of information that is available to support estimates. Site conditions, stakeholder

¹⁷ 10% for internal labour and 30% for contract (materials and contract labour) costs.

issues, project scope, the underlying need for the project and environmental assessment requirements may change significantly prior to execution of projects, particularly for projects forecast in the latter years of the period.

Due to these constraints, Evans & Peck agrees with JGN's position that it is not practicable or efficient to prepare fully scoped and detailed estimates for the projects that are included in its capital expenditure forecast. On this basis there is a need to truncate the assessment process at a point which remains efficient in terms of the extent of (potentially redundant) design and investigative work that is completed and the accuracy of the total forecast.

In our opinion, the Stage 1 estimate represents an appropriate point to prepare estimates for projects that are forecast to be completed on a five to seven year horizon as much of the site investigation and design work conducted during stage 2 could not reasonably be completed at this time (for example, stakeholder consultation) or would otherwise need to be repeated closer to the execution date (surveys, site conditions) in order to support a detailed scope of works for inclusion in a tender package.

Based on our factual findings that:

- we consider that JGN's cost estimation processes are reasonable and have been applied consistently across the sampled projects;
- the number of project estimates required for Access Arrangement purposes is significantly greater than would typically be required for normal capital program planning purposes, resulting in time and resource constraints;
- progressing estimates to stage 2 or further would result in duplication of planning, design and investigation costs; and
- the approach adopted by JGN to estimate projects is transparent, based on a bottom up estimating approach using known unit rates and quantities, and making allowance for the expected additional scope that will be identified as the project progresses through the decision gates.

Evans & Peck considers that JGN's project estimates satisfy the requirements of Rule 74 (2)(b).

3.2 Rule 79 Requirements

As outlined in section 2.1, rule 79 places specific requirements on new capital expenditure that is proposed as part of JGN's Access Arrangement submission. These are:

- 1) *Conforming capital expenditure is capital expenditure that conforms with the following criteria:*
 - (a) *the capital expenditure must be such as would be incurred by a prudent service provider acting efficiently, in accordance with accepted good industry practice to achieve the lowest sustainable cost of providing services;*
 - (b) *the capital expenditure must be justifiable on a ground stated in subrule (2).*

We note that subrule (2) provides the bases on which capital expenditure can be justified. As these factors (economic assessment, compliance, meet demand) relate to issues that are addressed in business case (or equivalent) processes rather than the cost estimating process alone, Evans & Peck's assessment only considers rule 79(1)(a).

The following sections 3.2.1 to 3.2.3 provide Evans & Peck's assessment of whether JGN's cost estimation methodology satisfies the requirements of Rule 79(1)(a).

3.2.1 Prudent Service Provider Acting Efficiently

With respect to cost estimating processes, Evans & Peck considers that a prudent service provider, acting efficiently would ensure that:

- (a) estimates are prepared on a consistent basis;
- (b) unit costs and underlying assumptions are comparable between projects and between alternative options;
- (c) project scope is developed to a level that is appropriate to support the required business decisions;
- (d) allowance is made for additional scope that is expected to be required once the planning, design and site investigation processes are completed; and
- (e) all estimating allowances, escalation factors, risk mitigation measures and any separate contingency allowances are designed and applied to ensure that the business does not over or understate its total capex requirements.

For the stage 1 estimates that have been used for regulatory purposes two key factors are important; the accuracy of the overall dollars (as this is ultimately the forecast that the AER will consider) and the consistency in process between projects (to ensure that comparisons between projects/options can be made on a reasonable basis). Based on our review of JGN's cost estimation methodology, we note that:

- (a) all project estimates have been prepared using the project estimation model, as described in the Estimating Manual;
- (b) unit costs have been obtained from a database of 'standard' costs (schedule of rates) or from other transparent and reasonable sources (manual rates);
- (c) the project estimates have been prepared to Stage 1, which provides a reasonable degree of confidence in the base estimate that is suitable for medium term business planning purposes;
- (d) the scope allowance factor makes provision for items that are expected to be required to complete the project but will not be identified until detailed design and site investigations have occurred.
- (e) escalation factors and risk mitigation measures are specifically identified in the estimation process, with project specific contingencies set to zero for Access Arrangement purposes.

On this basis, Evans & Peck considers that JGN's project estimates reflect a prudent service provider acting efficiently.

3.2.2 Accepted Good Industry Practice

Evans & Peck's opinion on accepted good industry practice has been formed on the basis of our experience in reviewing and advising on cost estimating processes used by regulated network businesses as well as across other infrastructure industries. With regard to the AER's recent determinations and guidelines, we note that the AER:

- (a) considers portfolio level cost estimating risk allowances to be appropriate for transmission businesses but not for distribution businesses¹⁸;
- (b) expects businesses to demonstrate the basis for any estimating factors that are used¹⁹;
- (c) expects that estimating processes and accuracy will improve over time as businesses address shortfalls in their estimating processes; and
- (d) does not consider that the inclusion of project level contingencies to account for events that are contingent in nature (i.e. events that could, but may not, occur) are appropriate as these risks are common across the industry²⁰ (and therefore implicitly reflected in the WACC).

Regarding point (d), Evans & Peck notes that the scope adjustment factors that are applied in JGN's project estimates differ from a project level contingency as the allowance does not cover events that are contingent in nature, but provides for scope that has not been fully defined due to the stage of the estimate in the gating process.

To make a comparison between JGN's scope adjustment factors and the processes used by other businesses to account for the limited scope definition for projects at preliminary stages of development it is important to recognise that allowance for this scope can be made in different ways. For example in other businesses, industries and cost estimating applications, this component of the estimate is often referred to as 'inherent risk' and is either:

- included as part of a broader overall 'contingency' allowance;
- accounted for through the use of 'blended' or averaged unit rates that account for the variation between similar work on different projects;
- applied indirectly as an allowance for additional quantities for each line item;
- applied indirectly through the application of other estimating allowances (e.g. scope factors, risk factors, brownfield/greenfield factors); or,
- applied via the application of a distribution used as an input to a probabilistically determined total cost value.

Given that the adjustment for scope can be applied in a number of different ways, we consider that JGN's relatively simple treatment of its scope allowance is transparent and appropriate given the information that is available to the business at this time. Whilst a more complex stochastic approach could be attempted, this would typically require a greater variety of assumptions, and whilst each constituent assumption could be made on a defensible basis, it would provide limited assurance that the approach as a whole yields a more accurate total figure than the more straightforward methodology applied by JGN. Regardless of the specific approach adopted, the reasonableness of the total value attributable to scope allowances is ultimately tested by the extent

¹⁸ AER, Better Regulation Explanatory Statement - expenditure forecast assessment guideline, November 2013 p. 58-60 (Whilst the AER's publication refers to electricity networks, the same principle remains applicable to gas distribution networks).

¹⁹ *ibid*

²⁰ *ibid*

to which project outturn costs align to the original estimates. This is the approach that we have taken in sections 4 and 5.

With regard to the cost estimating process, Figure 3-1 shows that the structure of JGN’s cost estimates are generally aligned to the structure for cost estimates outlined by Evans & Peck in the DoIT Best Practice Cost Estimation Standard²¹ produced for the federal government for road and rail projects. Whilst we note that this standard was prepared, and has been applied predominately within the transport industry, the general structure of infrastructure cost estimates and the approach to addressing scope issues is common across many sectors. Given the broad acceptance of this standard by Australian governments and within the Australian infrastructure industry, we consider that it provides a reasonable basis to assess ‘accepted good industry practice’ with respect to cost estimation. Further discussion on the practices within regulated networks and other infrastructure industries is provided in section 5.

Evans & Peck’s review of JGN’s cost estimation methodology, along with the inclusion of scope adjustment factors demonstrates that project estimates are structured in accordance with accepted good industry practice.

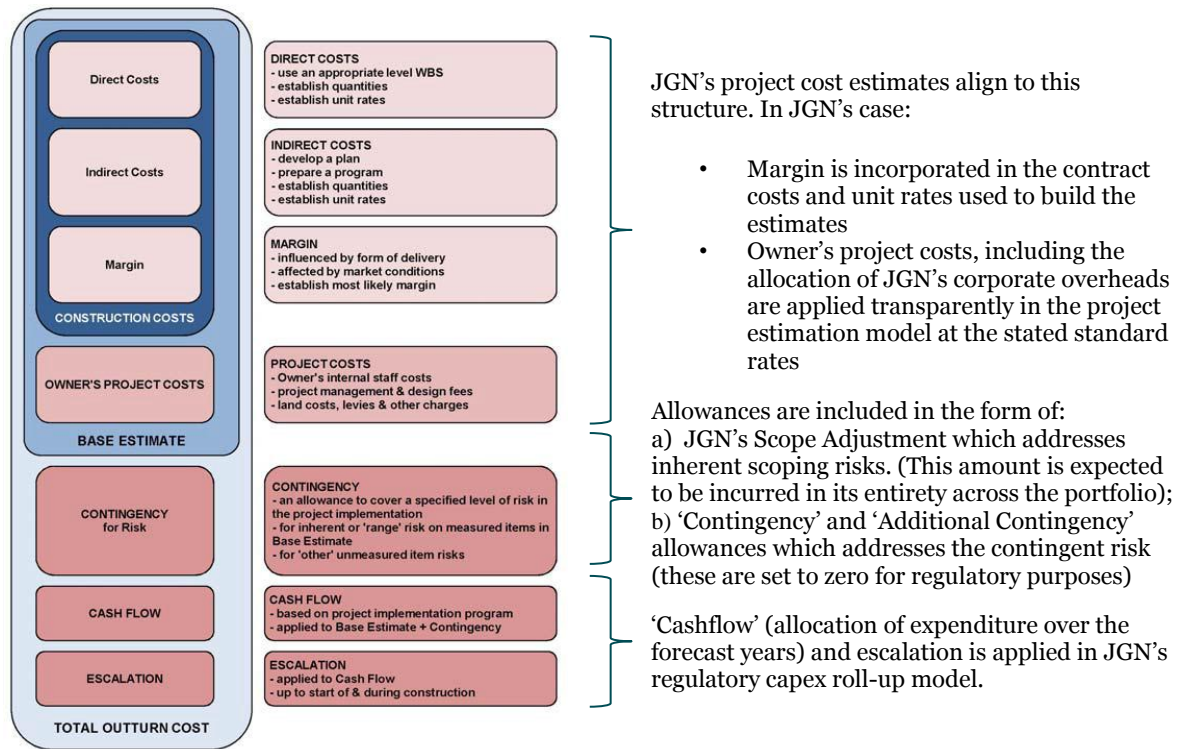


Figure 3-1: Comparison of JGN Cost Estimate Structure to 'Best Practice Cost Estimating Standard'^{22 23}

Source: Evans & Peck

²¹ Evans & Peck, Best Practice Cost Estimation for Publicly Funded Road and Rail Construction (prepared for Department of Infrastructure, Transport, Regional Development and Local Government)

²² *ibid* p. 28.

²³ Evans & Peck notes that the use of the term 'contingency' in this guideline refers to an amount that is comprised of both the inherent risk (which is analogous to JGN's Scope Allowance) as well as the contingent risk (which is analogous to JGN's 'Contingency' and 'Additional Contingency'). We note that JGN has set the contingent risk components to zero for access arrangement purposes.

3.2.3 Lowest Sustainable Cost of Providing the Services

Finally, Rule 79(1)(a) requires that capital expenditure must be consistent with a service provider aiming to deliver the lowest sustainable cost of providing the services. In this regard, Evans & Peck reiterates that estimating processes themselves are limited to ensuring that there is no systemic over or understatement of costs and that the efficiency of decisions is ultimately demonstrated by justification provided by the business case (or equivalent) processes (which are outside the terms of reference for this report).

Notwithstanding the above, and noting the controls that have been put in place, we are of the view that JGN's cost estimation methodology supports a fair comparison of options for the purpose of supporting prudent and efficient investment decisions. These controls include:

- (a) project estimates have been prepared by a limited number of estimators;
- (b) estimates are based on a transparent bottom up build of project costs;
- (c) consistency between costs can be demonstrated through:
 - (i) reference to standard rates included in spreadsheets used to prepare the estimates;
 - (ii) use of contract rates that have been agreed in accordance with JGN's procurement policies (these represent the majority of the 'manual' rates used);
 - (iii) common processes to estimate lengths/volumes between projects;
 - (iv) the preparation of project estimates using a common format and process (the PEM);
- (d) scope has been determined based on a bottom up assessment of project scope;
- (e) no allowance for contingent events has been applied to project estimates; and
- (f) cost escalation has been consistently applied across the portfolio in the JGN Capex roll up model that is used for Access Arrangement purposes.

On the basis that JGN's project cost estimation methodology supports efficient capital expenditure investment decisions, Evans & Peck considers that the cost estimation methodology supports JGN's provision of services at the lowest sustainable cost.

3.3 Conclusion

Evans & Peck has considered whether JGN's cost estimation methodology produces a forecast or estimate of capital expenditure for the 2015-20 access arrangement period that complies with rule 79(1)(a) and rule 74 of the National Gas Rules.

Based on our factual findings that:

- JGN is required to submit a Capital Expenditure forecast covering all projects that are expected to be required in the period to 2019/20;
- the basis on which the project estimates have been prepared is stated in the Estimating Manual and a transparent breakdown of project costs by stage is provided in the PEM for each project;
- JGN consistently applied the cost estimation methodology across the sampled projects;
- JGN is unable to comprehensively forecast the final scope for all projects at Stage 1, as certain scope items are not fully defined until additional design, site investigation and consultation work has been completed; and
- this additional scope relates to items that are expected to be incurred, and without an appropriate allowance, would expose JGN to a material risk of under-recovery,

and assuming that:

- each of JGN's projects are justified on the basis of Rule 79 subrule 2;
- JGN's business case (or equivalent process at gate 1) demonstrates that selected options represent the most efficient option;
- JGN's processes are implemented consistently across all forecast projects,

Evans & Peck concludes that:

- 1) **JGN's cost estimation methodology (including the use of the scope adjustment allowance) is supported by a statement of the basis for the forecast, is arrived at on a reasonable basis and represents JGN's best estimate in the circumstances;**
- 2) **JGN's cost estimation methodology (including the use of the scope adjustment allowance) reflects the costs that would be incurred by a prudent service provider acting efficiently, in accordance with accepted good industry practice to achieve the lowest sustainable cost of providing services.**

Therefore Evans & Peck is of the opinion that JGN's capital cost estimating methodology satisfies the requirements of NGR 74 and 79(1)(a).

4 Is JGN's application of a scope allowance appropriate?

This section provides Evans & Peck's analysis and opinion on whether JGN's method of applying a scope allowance to forecast labour and materials costs for projects at the early stages of JGN's gating system is appropriate and in accordance with rules 74 and 79(1)(a).

As noted in section 3.2.2, Evans & Peck considers that JGN's cost estimating process, as applied to projects that are estimated using the PEM, is consistent with accepted good industry practice. This section expands on our previous assessment to outline the issues that give rise to the scope uncertainty and describe the measures that JGN has taken to address these issues.

Evans & Peck highlights that the question addressed in this section specifically relates to JGN's application of a scope allowance within the cost estimation methodology. This is a separate question to whether the quantum of the scope adjustment included in JGN's access arrangement forecasts is appropriate (which is considered in section 5).

To answer the question of whether JGN's method of applying of a scope allowance is appropriate or not, we consider:

- whether there is a demonstrable gap between JGN's previous forecasts and the outturn costs for projects;
- to what extent has any gap been addressed by changes to JGN's cost estimation process since the preparation of JGN's previous forecasts;
- to what extent is JGN able to diversify project risks across its portfolio; and
- to what extent has JGN made any specific allowance to address this scope at either a project or a portfolio level.

Where a clear need for a scope allowance can be established from historical information, Evans & Peck considers that only the residual amount remaining after correcting for process changes and opportunities to diversify risks across the forecast capital expenditure portfolio is appropriate.

Once these factors have been taken into account, we consider that the application of a residual scope allowance for project based expenditure is appropriate and is also in accordance with the requirements of NGR 74 and 79(1)(a). Where the application of a scope allowance is supported by the historical analysis, Evans & Peck then considers in section 5 whether the specific factors applied by JGN to the forecast capex portfolio are reasonable.

To establish whether there was a historical gap between the previous forecasts and the outturn costs for the same projects, Evans & Peck compared the outturn costs for a range of completed projects against the value recorded for the project in the AER decision and against JGN's earliest decision gate approval for the project that provided a suitably detailed breakdown of costs (typically gate 2 or 3). The gate 2 or 3 approval figures were used in preference to the figures used for the previous Access Arrangement as they could be compared on a consistent basis²⁴.

Evans & Peck notes that the gate 2/3 estimates used for the historical analysis represent a later stage to the gate 0/1 estimates that have been used for access arrangement purposes. Therefore our historical analysis will understate the appropriate value for the forecast capex portfolio. Section 5 of this report considers what value for the scope allowance is appropriate for gate 0/1 estimates.

²⁴ The previous Access Arrangement estimates would have required several adjustments to account for different historical treatment and the translation of the outcome of the AER's final decision (made at a total capex and total opex level) on the capex of each project.

4.1 Comparison to Historical Gate 2 or 3 Estimate

Evans & Peck obtained a data set from JGN that included 82 projects with a total approved Stage 2 or Stage 3 estimate of \$91.8m (\$Real 2010) and an outturn cost of \$115.0m (\$Real 2010). This represents a 25% increase over the stage 2 and 3 estimates (inclusive of overheads, margin and historical allowances for risk and contingency). The stage 2 and 3 estimates were used because they were more readily available for the project set and provided a breakdown of the estimated costs at an appropriate level of granularity. These projects are listed in Table 4-1, with a breakdown of the split between the cost categories shown graphically in Figure 4-1

Table 4-1 JGN Stage 2/3 Estimate v Outturn cost (\$m Real 2010)

Project ID	Project description	Stage 2/3 Estimate (\$m)	Actual Cost (\$m)
M31321*	Penrith Primary Mains & Emu Plains PRS		[c-i-c]
MDPOTS	Central West HP Fac Upgrades / Marsden-Dubbo POTS Upgrade		
M35619	Wakehurst Parkway CDP		
M27029*	Installation of Albion Pak TRS		
M47512	Warringah – Pittwater Rehab (Sector 2)		
M25610	Installation of Riverwood PRS		
M28159	Smithfield-Liverpool Rehab (Sector 1)		
Rocky Ponds	Mine Subsidence Mitigation – Rocky Ponds		
M30043	Rouse Hill Secondary CDP Stage 1		
M10505	L8 Piggings Facilities		
M27524*	Installation of Lane Cove PRS		
M45834	Oran Park Stage 1 CDP		
M23028	Gosford The Entrance CDP Stage 2		
M21413	Gosford TRS Upgrade		
M37077	Kensington 2kPa CDP Stage 3		
M45029	Wyong TRS Upgrade		
M43539	Kurri Kurri 30kPa Network CDP		
M30398	Harrington Park Mains Interconnection		
M31073	Kensington 2kPa Mini Rehab Sector 2		
M36039	Orange CDP (Peisley St)		
M31726	Newcastle MP1 (Part 2 – rehabilitation)		
M28166	Southern Highlands Secondary CDP (Stage 1)		
M31570	Dapto Koonawarra CDP		
M39953	Warringah (Sector 3) Rehabilitation		
M32035	Wollongong North CDP Stage 2 (Mini Rehab)		
M31573	Horsley CDP Stage 1		
M40571	Warringah 15” Main Stage 1 CDP		
M30265	Rutherford (1050-210 kPa) CDP (Largs)		

Project ID	Project description	Stage 2/3 Estimate (\$m)	Actual Cost (\$m)
M29935	Raby CDP		[c-i-c]
M36099	Woolooware Capacity Development Project		
M35867	Boolaroo CDP Stage 1		
M43945	Kurri Kurri 210kPa CDP		
M40572	Warringah 15" Main Stage 2 CDP		
M54614	East Bowral CDP (Hardens Rd)		
M42096	Macquarie Park CDP (Byfield St)		
M35870	Caringbah South CDP		
M45042	Eastern Creek TRS Pig Launcher		
M43074	Brookvale SRS Upgrade		
M30243	Wollongong 210kPa CDP		
M29982	BERALA (RAILWAY PDE) CDP		
M35512	Hornsby 210kPa Network Capacity Development Stage 2		
M36157	Burraneer-Woolooware Rd CDP		
M39938	STRATHFIELD STH-CROYDON PK CDP		
M39786	Pymont (Bridge Rd) CDP		
M29717	Dee Why CDP (Headland Rd)		
M41934	Haymarket 7kPa CDP – Section 1 of 3		
M41935	Haymarket 7kPa CDP – Section 2 of 3		
M41926	Strathfield CDP Section 1		
M30249	Cordeaux Heights CDP (Cordeaux Rd)		
M29913	Ruse Capacity Development Project		
M42019	Elanora Heights CDP – Marinna Rd		
M41747	Canley Heights CDP		
M47259	Faulconbridge Reinforcement		
M41936	Haymarket 7kPa CDP – Section 3 of 3		
M30253	Kariong CDP (Curringa Rd)		
M30116	Young Capacity Development Project (Moppity Rd)		
M30150	Mittagong/Willow Vale CDP (Wilson Dr)		
M41928	Strathfield CDP Section 2		
M30246	Wollongong North CDP Stage 1		
M43735	Mt Pritchard – Pritchard St CDP		
M43939	WOLLONGONG 7KPA (NORTHERN SECTION) CDP		
M44171	Forbes CDP (Johnson St – Part 1)		
M41929	Strathfield CDP Section 3		
M35318	GRIFFITH CDP (100KPA CUST – TARAC DIST)		
M43072	FAULCONBRIDGE SRS CDP – PARKES CRES		

Project ID	Project description	Stage 2/3 Estimate (\$m)	Actual Cost (\$m)
M30288	Enfield South / Canterbury CDP (SRS)		[c-i-c]
M58554	Goulburn CDP (Newton St)		
M30293	Belmore CDP (SRS)		
M30004	Loftus – Engadine CDP Stage 2		
M43943	NEWCASTLE MP1 CHARLESTOWN CDP		
M30235	Aberglassyn Capacity Development Project (Denton Park Dr)		
M41930	Strathfield CDP Section 4		
M40171	SYDNEY 7KPA-PARK ST CDP		
M41120	BURWOOD RD-BELMORE CDP-CGB 7KPA		
M30146	Griffith / Collina (210kPa) Capacity Development Project		
M44668	Shellharbour 2011 Security of Supply		
M59669*	Wyong River Bank Stabilisation		
M41118*	Waterloo Rd CDP – CGB 7kPa		
M39114*	Replacement of Braemar SRS		
M41931*	Strathfield CDP Section 5		
M32032*	Kanahooka CDP		
M52269*	BOWRAL BONG BONG ROAD (STAGE 1)		
	Total	91.838	115.051

* project excluded from the analysis

Source: *Evans & Peck Summary of JGN Data*²⁵

Evans & Peck notes that the raw cost information needs to be adjusted for different treatment of overheads and other components of the estimates between the Gate 1 estimates and the actual costs. In order to calculate an appropriate adjustment factor for forecast capital expenditure, we also consider that the historical sample should be adjusted to take account of the process improvements that have been put in place during the current regulatory control period. The effect of these factors is discussed in sections 4.1.1 and 4.1.2 below.

4.1.1 Current Methodology

Over the current regulatory control period, JGN has refined the approach taken to develop capital expenditure forecasts for the purpose of its Access Arrangement submission. The previous approach was to forecast capex at higher level for gate 0 or gate 1 estimates, largely based on reference costs (or planning estimates) for similar projects that included an implied allowance for items that could not be scoped at stage 1. Whilst this approach was generally appropriate for common project types, there were a small number of cases where the actual costs varied significantly from the amount included in the access arrangement forecast that JGN has sought to address through specific improvements to the process.

These process improvements have aimed to achieve greater consistency in the process used to derive stage 1 estimates and are summarised as follows:

²⁵ JGN Spreadsheet, 07-Feb-2014 31092164_1_Evans & Peck Summary of JGN Data.xlsx

1) **Development of the PEM.**

The PEM establishes a common format and process for costing projects at any stage of the project lifecycle. The model ensures that a consistent bottom up approach is applied to develop the gate 1 estimates that are used for the Access Arrangement. In turn this ensures that estimates take into account as much project specific information as is available to estimate scope directly rather than relying on a top down reference forecast to make an appropriate allowance for project specific factors (on average). This approach provides a stage 1 estimate that is more similar in preparation to the historical stage 2 or 3 estimates.

2) **Introduction of scope allowances**

As part of the change to a more 'bottom up' estimation process, JGN necessarily included an allowance to account for the scope that can not be fully defined at a stage 1 level (as detailed design, consultations and site investigations have not been carried out). These costs were implicitly included in the planning estimates that were previously used to derive the Access Arrangement capital expenditure forecast.

Evans & Peck notes that as our historical analysis only considers the scope allowance that is required from stage 2 and 3 to the outturn cost, it will inherently understate the allowance that is required between stage 1 estimates and the outturn cost. Therefore we have considered what allowance would be appropriate for a stage 1 estimate in section 5 of this report.

3) **Improvements to the land acquisition and access process**

A significant proportion of the variance between the stage 2 and 3 estimates and the outturn costs for projects related to the historical approach that was taken to estimate land acquisition and access costs for projects, which tended to significantly understate actual costs²⁶. Therefore JGN has refined its approach to estimating land access costs for the next regulatory control period. Consequently the effect of its historical understatement should be excluded from the analysis of historical variance.

Evans & Peck considers that each of these process improvements is reasonable and likely to improve the accuracy of estimates at both a project and a total portfolio level by addressing the historical sources of variance between estimated and outturn costs. In particular, the use of a bottom up estimate at stage 1 ensures that all known project information is incorporated into the project estimate and the allowance for additional scope can be evaluated explicitly rather than simply being implied through a high level reference or planning forecast. We expect that this will facilitate further improvements in JGN's estimating processes in the future.

Therefore the gap between JGN's previous forecasts and actual outturn costs has been addressed by three material changes in cost estimating process. Two of these (the use of the PEM for Stage 1 estimates and the associated introduction of scope allowances) relate primarily to the gap between stage 1 estimates and outturn costs, which cannot be fully reflected in our historical analysis. Consequently, our historical assessment has taken the changes in land acquisition into account and calculated the historical scope adjustment factors that are implied between the stage 2 and 3 estimates provided and actual outturn costs. Section 5 separately considers what value for scope allowance is applicable for stage 1 estimates.

4.1.2 Exclusions

To ensure that the overall variance was not overstated by the inclusion of project issues that had been addressed by process improvements, inconsistent data or issues that were otherwise unlikely

²⁶ For example, Installation of Albion Park TRS; Installation of Lane Cove PRS

to recur, Evans & Peck reviewed JGN's description of project variances and excluded nine projects as follows:

- One project²⁷ was excluded on the basis that it had not reached practical completion and therefore the reported 'actual cost' does not represent the full outturn cost;
- Two projects²⁸ were excluded on the basis that the variance was predominately due to higher land acquisition issues and site constraints. These issues have been addressed through improved processes for land acquisitions and site access;
- Six projects²⁹ were excluded on the basis that no detailed estimates were available and therefore the inclusion of these projects would simply increase the difference between the total estimate and the outturn cost.

Evans & Peck has not excluded projects in cases where the variance (either positive or negative) was simply due to issues that developed from a clearer definition of scope as the project progressed through the planning stages as JGN is still exposed to these issues. Furthermore, we consider that this approach is conservative on the basis that:

- it will tend to overcorrect for land access issues as the exclusion of the entire project assumes that the variance is entirely due to land issues, when in practice it also includes other components; and,
- the exclusion of the total project assumes that the revised processes will be 100% effective in avoiding significant variation in costs due to land issues.

As a result, the percentage gap between historical stage 2 and 3 estimates and the actual cost that is calculated by Evans & Peck is inherently lower than could otherwise be argued.

4.1.3 Findings

We also note that there is a significant difference in the overheads that are included in the stage 2 and 3 estimates and the actual costs, as well as specific historical allowances for risk and contingency that were identified in the stage 2 and 3 estimates. This can be seen in Figure 4-1 which illustrates that the increase in 'Labour', 'Other Costs' and 'Overhead Costs' was partially offset by a reduction in margin and specific provisions for risk allowance and contingency.

On the basis that:

- the PEM applies overheads in a transparent manner and this is calculated after the application of scoping allowances to base costs;
- any reduction in margin is a business risk that JGN is best placed to manage and it is therefore appropriate that JGN retains this exposure; and,
- no specific risk allowance and contingency factors (other than the scoping allowances considered in this report) have otherwise been applied for the purposes of forecasting JGN's Access Arrangement capex.

Evans & Peck has excluded the Overheads, Margin, Risk Allowance and Contingency components from the calculation of the historical gap between stage 2 & 3 estimates and the actual costs. This is consistent with the application of the scope allowances to base 'Labour' and 'Other Costs' in the JGN PEM.

²⁷ Penrith Primary Main & Emu Plains PRS

²⁸ Installation of Albion Park TRS; Installation of Lane Cove PRS

²⁹ Wyong River Bank Stabilisation; Waterloo Rd CDP - CGB 7kPa; Replacement of Braemar SRS; Strathfield CDP Section 5; Kanahooka CDP; Bowral Bong Bong Road (STAGE 1)

[c-i-c]

Figure 4-1: Breakdown of Variance Between Stage 2 & 3 Estimates and Actual Costs

Source: Evans & Peck

Figure 4-2 shows the result of this calculation is that an 11.6% scope adjustment for JGN labour and a 10.3% scope adjustment for materials and contract costs ('other costs') between a stage 2 or 3 estimate and the actual outturn cost is supported by historical data.

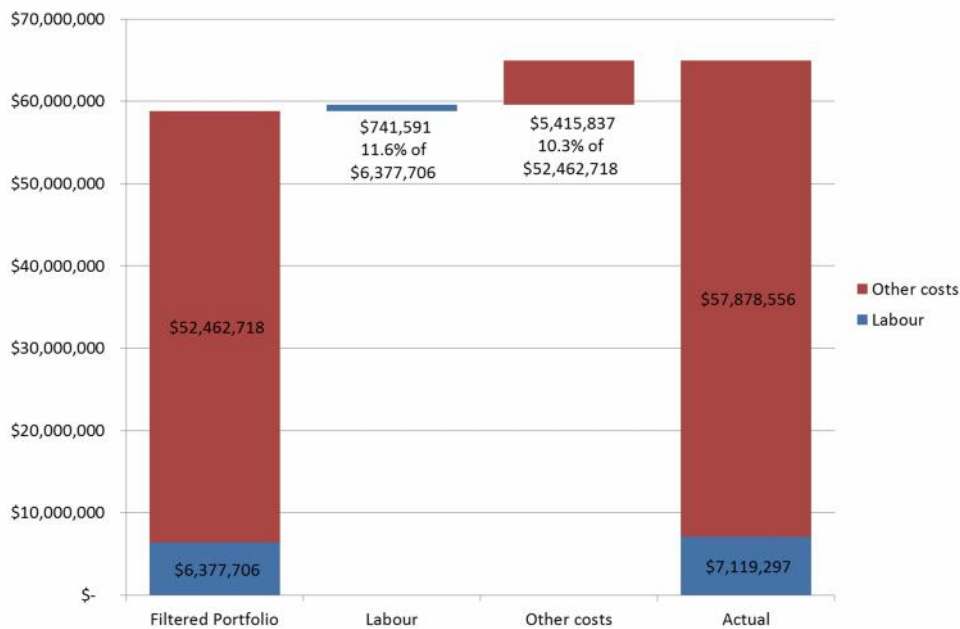


Figure 4-2: Historical Gap Between Stage 2 & 3 Estimates and Actual Costs

Source: Evans & Peck

On this basis, Evans & Peck considers that there is a demonstrable gap between JGN's previous stage 2 and 3 forecasts and the outturn costs for projects, when corrected for process improvements relating to land acquisition and access.

Furthermore we note that the 10% allowance that is applied by JGN to internal labour costs is marginally below the 11.6% figure that is supported by our historical analysis whilst the 30% allowance that is applied to external costs is significantly higher than the calculated 10.3% figure.

This is explained by the fact that the 30% allowance is applied to stage 1 estimates and the additional scoping that has occurred in decision stages 2 and 3 to better define the scope through design development, site investigations and stakeholder consultation. More specifically, stage 2 estimates have the benefit of a more detailed engineering design and site investigations, whilst stage 3 estimates have the benefit of tender responses. Therefore there is significantly less uncertainty with regard to scope, particularly with respect to external costs, in the stage 2 or 3 estimates than at stage 1.

With respect to the historical analysis, Evans & Peck notes:

- a) that there is a clear historical bias towards underestimates;
- b) compared to gate 0/1 estimates, gate 2/3 estimates have significantly reduced scoping uncertainty, particularly with respect to external costs (as detailed design and contractor pricing has been obtained)
- c) the Access Arrangement forecast is based on gate 0 and gate 1 estimates, which entail a greater degree of inherent scoping uncertainty.

Therefore JGN's 30% allowance for external costs that is applied to gate 0 and 1 estimates is consistent with our historical analysis, as gate 0/1 estimate scope allowances must be greater than the values calculated from our historical analysis of stage 2/3 estimates to project outturn costs.

4.2 Diversification Opportunities

Whilst our historical analysis found that there is a demonstrable gap between JGN's stage 2 and 3 estimates and outturn costs, and that this gap cannot be fully attributed to factors that have been addressed through process improvements during the current regulatory control period, Evans & Peck recognises that it is also necessary to assess the extent to which scoping uncertainties can be diversified across the portfolio.

The nature of any project portfolio is such that there is the opportunity to address some cost estimation uncertainty through diversification across multiple projects. This relies on the assumptions that:

- 1) The estimated value is the 'average' expected outturn cost;
- 2) Some projects will be over the forecast cost, whilst others will be under; and
- 3) The dollar value of cost overruns will be similar to the dollar value of the cost underruns.

Therefore diversification opportunities are limited when there is a bias in the estimates, such that the estimated values systemically understate or overstate the expected outturn cost. Common reasons for systemic understatement is the omission of an allowance for scope items that have not yet been fully defined, whilst systemic overstatement typically results from the inclusion of contingencies to account for events or scope that may or may not be required in practice.

In JGN's case, Evans & Peck notes that the stage 1 estimates are prepared on the basis of the information that is available at the time. For the purposes of the Access Arrangement, this necessarily occurs well in advance of the 'normal' two-year capital program planning cycle and as a result, there is limited design, site investigation and committed contract pricing information available for most of the projects.

Therefore the bottom up estimates are based on the known information, which includes amounts for the expected (planning) scope, for design costs and for site investigations but does not directly include for the additional scope that will be defined through these activities (as this scope is unknown at stage 1). As a result, JGN's stage 1 estimates will systemically understate the costs of the projects where no scope allowance (or alternative adjustment such as a specific 'contingency' to address the gap between estimated and outturn costs) is included.

On the basis that JGN's scope allowances are necessary to correct for a systemic understatement of outturn costs, and that JGN has not applied any specific contingencies or other adjustment to account for this understatement, Evans & Peck considers that the risks that are addressed by the scope allowances are one-sided in nature and therefore JGN is not able to diversify them across its project portfolio.

4.3 Portfolio Cost Estimation Risk Adjustment

Given that the historical analysis demonstrates that there is a bias towards underestimation of project costs (when the scope adjustment is excluded), an alternative to the application of scope adjustment factors would be the calculation of a global adjustment that can be applied to address the uncertainties arising from the cost estimation process. This can take the form of:

- 1) a general 'contingency' that covers both inherent risks and makes allowance for (probability weighted) contingent risks; or,
- 2) two factors that separately disaggregate the inherent and contingent risk components, with the inherent risks (including the scope uncertainties) addressed in the cost estimates for individual projects and the contingent risks addressed at a portfolio level.

In JGN's case, no allowance for contingent risk has been included, which is consistent with the AER's position that portfolio cost estimation risk adjustments are only considered to be appropriate for transmission businesses³⁰.

Notwithstanding the above, a reasonable allowance must be made to provide for the risks that are inherent in the cost estimating methodology and the data that is used to estimate project costs. To this end, the scope allowance is the specific adjustment within JGN's access arrangement methodology that accounts for the inherent difference between the estimate and the outturn costs.

On this basis, Evans & Peck considers that JGN has not made any other specific allowance to address this scope at either a project or a portfolio level. As there is no other factor in the JGN estimating process that addresses this scope uncertainty, we consider that the inclusion of JGN's scope allowances is reasonable.

4.4 Conclusion

Evans & Peck's has considered whether JGN's method of applying a scope allowance to forecast labour and materials costs for projects at the early stages of JGN's gating system is appropriate and in accordance with rule 79(1)(a) and rule 74.

Based on our factual findings that:

- projects cannot be fully scoped at the strategic estimate stage (stage 1) as the scope arising from more detailed design, consultation and site investigation has not been fully defined;
- JGN has made an allowance for an adjustment to account for the expected scope that arises from these factors;
- a review of JGN's historical performance confirms that there is a significant gap between stage 2 and 3 project estimates and the actual outturn costs that demonstrates a systemic understatement of costs (in the absence of a scope adjustment);
- the size of the historical gap between stage 2 and 3 project estimates and the actual outturn costs exceeds the expected impact of the process improvements that have been implemented during the current regulatory control period;
- in the absence of the scope allowance, JGN would be exposed to a systemic understatement of costs across its project portfolio that can not be accounted for by diversification;
- no other factors are applied in the cost estimating process at a project or portfolio level that account for this scope uncertainty; and
- the figures calculated in the historical analysis were based on gate 2/3 estimates which will understate the scope allowance required for the gate 0/1 estimates that are used to prepare JGN's forecast capex,

and assuming that:

- JGN's outturn costs are efficient based on the application of its reasonable project management and governance processes;
- the variance between JGN's previous forecasts and outturn costs is primarily driven by increased scope rather than real increases in, or a historical understatement of, prices;

³⁰ AER, Better Regulation Explanatory Statement - expenditure forecast assessment guideline, November 2013 p. 58-60

- all of the variance in projects affected by land acquisition issues relates to land acquisition or access for the purpose of determining exclusions (this will tend to overstate the effectiveness of process improvements in our analysis);
- the process improvement measures will be effective in avoiding all variance arising from the land, not simply reducing the exposure (this will tend to overstate the effectiveness of process improvements in our analysis),

Evans & Peck concludes that:

- 1) **there is a demonstrable requirement for a factor to adjust for unforeseeable scope increases to align the forecast capex with the expected outturn costs.**
- 2) **the historical gap between stage 2 and 3 estimates and outturn costs is in the order of 11% when corrected for the process improvements that have been implemented for the preparation of JGN's Access Arrangement forecasts.**
- 3) **the historical analysis understates the value that would need to be applied to JGN's forecast capex as it is based on more developed stage 2/3 estimates rather than the stage 0/1 estimates that are used to support the access arrangement. (The appropriate scope allowance for the forecast capex is considered in section 5)**
- 4) **no other allowance is made in the form of a project specific or portfolio level adjustment to account for this expected scope uncertainty, leading to a one sided risk exposure that cannot be diversified across the broader capex portfolio.**
- 5) **the scope allowance acts as a proxy for expected scope items that are defined through more detailed design and further site investigations that cannot reasonably be undertaken at stage 1.**
- 6) **the use of a scope allowance in these circumstances is consistent with a prudent service provider acting efficiently to achieve the lowest sustainable cost of services.**

Therefore Evans & Peck is of the opinion that JGN's method of applying scope allowances at the early stages of the gating process is appropriate and in accordance with NGR 74 and 79(1)(a).

5 What value of scope allowance is appropriate for JGN's forecast capex?

This section provides Evans & Peck's estimate (or range of estimates) of the appropriate scope allowance factor(s) to apply to JGN's labour and materials estimates at a project level.

As noted in section 4.2.3, Evans & Peck considers that:

- a) JGN's method of applying scope allowances is appropriate and in accordance with NGR 74 and 79(1)(a);
- b) there is a demonstrable gap between JGN's previous estimates and the project outturn costs;
- c) the appropriate scope allowance for JGN's forecast capex at gate 0/1 would be larger than the factors calculated in the historical analysis of gate 2/3 estimates due to the greater scope uncertainty at earlier stages

This section considers publically available information, confidential sources and our experience as professional cost estimators, to identify an appropriate range of estimates of the value for scope adjustment factors applicable for stage 1 estimates used in the JGN capital expenditure forecast

To calculate a range of the appropriate scope allowance factor(s), we consider:

- The relevant sources of information and data that need to be reviewed in calculating the estimates and the necessary methodology required to form our opinion;
- Whether the range of estimates is sensitive to the nature of the projects being undertaken in a particular regulatory period?
- Whether any alternative estimates can be calculated to account for any identified sensitivity?

In this section we present our opinion of appropriate scope allowance factors to apply at a project level in order to form an independent view on whether the factors that are applied in the JGN PEM are reasonable. In section 6, we provide an opinion on whether the scope allowance factors that are applied by JGN produce forecasts that are consistent with AER rules 74 and 79(1)(a) with reference to the variance between the total value attributable to scope adjustment factors in the JGN capital expenditure forecast and the reasonable range for scope adjustment factors identified through our analysis.

5.1 Methodology and information & data reviewed

In accordance with the Terms of Reference, the following sections 5.1.1 and 5.1.2 outline the methodology that we have used to calculate the range of estimates of the appropriate scope allowance factor to apply at a project level and the information and data reviewed in calculating our range of estimates.

5.1.1 Methodology

In order to determine the range of estimates for scope allowance factors Evans & Peck has adopted the following methodology. The methodology is focused on producing a range of estimates at the project level, rather than varying or even uniform allowances for individual internal labour and contracted works estimate line items respectively. This is due to the appropriateness of specific scope allowance factors being affected to a greater extent by the scope risk exposure arising from the nature of the works and delivery setting of the projects, rather than whether the project elements are delivered through internal resources or are externally contracted. After arriving at a range of estimates at the project level, we then assess appropriateness of the JGN scope allowance at the portfolio level.

- 1) Review of JGN estimating processes and tools and confirm practicality of calculating a project level scope allowance factor, including verification of ability to reasonably compare with industry examples, when considered with experienced cost estimating judgement.
- 2) Review publically available and confidential industry base estimate adjustment values, deriving from this research project risk exposure types via application of experienced cost estimating judgement, and selecting appropriate adjustment values (including margins of error) to account for project uncertainty at the point of stage 1 estimate preparation.
- 3) Assess the sub-components of the JGN capital expenditure forecast estimated via application of the PEM, reviewing the nature of the work in each sub-component via reference to projects initially selected as representative of each sub-component. Subsequently, analyse the quantum of risk, in terms of capital cost delivery uncertainty that each representative project is exposed to, from a review of the PEM for each project.
- 4) Place the JGN capital expenditure forecast representative projects on the generic scale of infrastructure and utility projects and identify the most appropriate upper and lower bound values for the appropriate scope allowance adjustment to the base estimate.

5.1.2 Information and Data reviewed

In order to establish a range of estimates of appropriate scope allowance factors at the project level, we have reviewed both JGN estimating process materials and tools as well as a range of reference material to source information we have drawn on to identify accepted industry good practice for scope adjustment approaches and to support our view of an appropriate range of values for scope allowance factors.

For the JGN estimating process, we have reviewed the JGN Estimating manual and the PEMs for the six projects that our review of the JGN portfolio has led us to conclude represent the range of work undertaken by JGN:

- Cecil Park CDP;
- Kensington Stage 4 rehab;
- Auburn PRS easement valuation;
- Northern trunk heating;
- Wollongong Primary Main integrity digs; and
- Licence 3,7,8A Pigging & Validation digs.

For the reference material drawn on to identify accepted good industry practice for scope adjustment approaches, we have reviewed:

- a) a range of publically available information, such as prior AER determinations and pricing determinations from other regulatory bodies, along with supporting consultant reports;
- b) infrastructure delivery organisations estimating manuals, including those of Transend, Transgrid, Sydney Water, NSW Road and Maritime Services, Hunter Water, NSW Health Infrastructure, Qld Department of Main Roads;
- c) government agency budgeting guidelines, including those from NSW Department of Transport and Commonwealth Department of Infrastructure and Transport;
- d) Evans & Pecks knowledge of the practice of utilities with similar capital expenditure portfolios; and
- e) previous advice that Evans & Peck has provided to infrastructure businesses, government departments and jurisdictional regulators, including the Queensland Competition Authority, Infrastructure NSW, the Independent Pricing and Regulatory Tribunal, Victorian Department of Treasury and Finance and Commonwealth Department of Infrastructure and Transport.

5.2 Range of estimates for appropriate scope allowance factors for JGN's Forward Capex Portfolio

By applying the methodology described in section 5.1.1 we identify in this section a range of estimates of the appropriate scope allowance factors to apply to JGN's labour and materials estimates at the project level. Each method step is addressed in turn in the section 5.2.1 to 5.2.3, presenting evidence collected, any analysis undertaken, our reasoning drawn from the evidence and analysis. Section 5.4 summarises our findings.

5.2.1 Review of estimating tools and project level scope allowance factor

We reviewed an initial selection of PEM in order to familiarise ourselves with the specifics of the estimating process as applied via the PEM and confirm that the models relate to stage 1 estimates. We verified that a total project level scope allowance factor, derived from application of a 10% allowance to JGN's internal labour costs and 30% allowance to external costs, can be calculated. This can be reduced to a weighted average scope allowance factor for each project.

The JGN Estimating Manual was also reviewed in order to confirm that the application of a project level scope allowance factor within the JGN estimating process, as applied via use of the PEM, is analogous to the practice within the broader infrastructure delivery and utilities industry of applying what can be termed a "base estimate adjustment", in the form of a percentage mark up to the estimated project cost derived from an identified set of base assumptions (commonly referred to as an estimate of "base costs"), to account for uncertainty in project scoping and delivery.

What we term here a "base estimate adjustment", is variously known within the infrastructure delivery and utilities industry as 'contingency allowances', 'base risk allocation', 'scope creep allowance', or 'project estimate uncertainty allowance'. These various terms are not consistent in their objectives and indeed the objective and definition of some commonly used terms are changing over time. For example, the term "contingency" is now commonly being used to refer to an allowance for the differential between the most likely project cost outcome and an unlikely, near worst case, cost outcome. Previously it regularly referred to an entire risk allowance in excess of an estimate based on a set of anticipated conditions. For these reasons, care and experienced judgement are required when making comparisons to other examples of base estimate adjustment values.

We note that due to these differences in nomenclature, a direct comparison of JGN's scope allowance to all other examples of the application of a base estimate adjustment in similar infrastructure and utility sectors requires careful interpretation of the available information in the context of how they are used by each organisation.

From our review we have concluded that the magnitude of the scope allowance that is applied in the PEM is broadly comparable to examples drawn from similar and related sectors, when considered in parallel with more specific insight gained from E&P's own cost estimating experience. This experience has led us to an opinion that, when a 50% confidence level is being considered at an early project phase estimate, the total financial value of future scope changes is the predominate contributor to project out turn cost uncertainty. Unit rate or price increases and contingent risk events do not form a significant component of total project out turn cost uncertainty until later project phases, or if cost estimates with a greater confidence of not being exceeded are being considered.

5.2.2 Analysis of information and data reviewed

We have reviewed relevant project estimating and budgeting practice documentation and guidance to collate a data source of base estimate adjustment values. We have supplemented this information with our experience as professional cost estimators which includes exposure to a large range of confidential information sources.

The main reference sources are described in section 5.1.2, with the relevant data presented in Figure 5-1. The principal concept demonstrated by Figure 5-1 is that, for an estimate made at a particular stage in a project life-cycle, the greater the level of confidence that the estimate will not be exceeded, the greater the base estimate adjustment must be. We note that the scope allowance factors that are applied by JGN are reasonable when compared to the adjustments that are applied by other infrastructure owners to their preliminary (early stage) estimates.

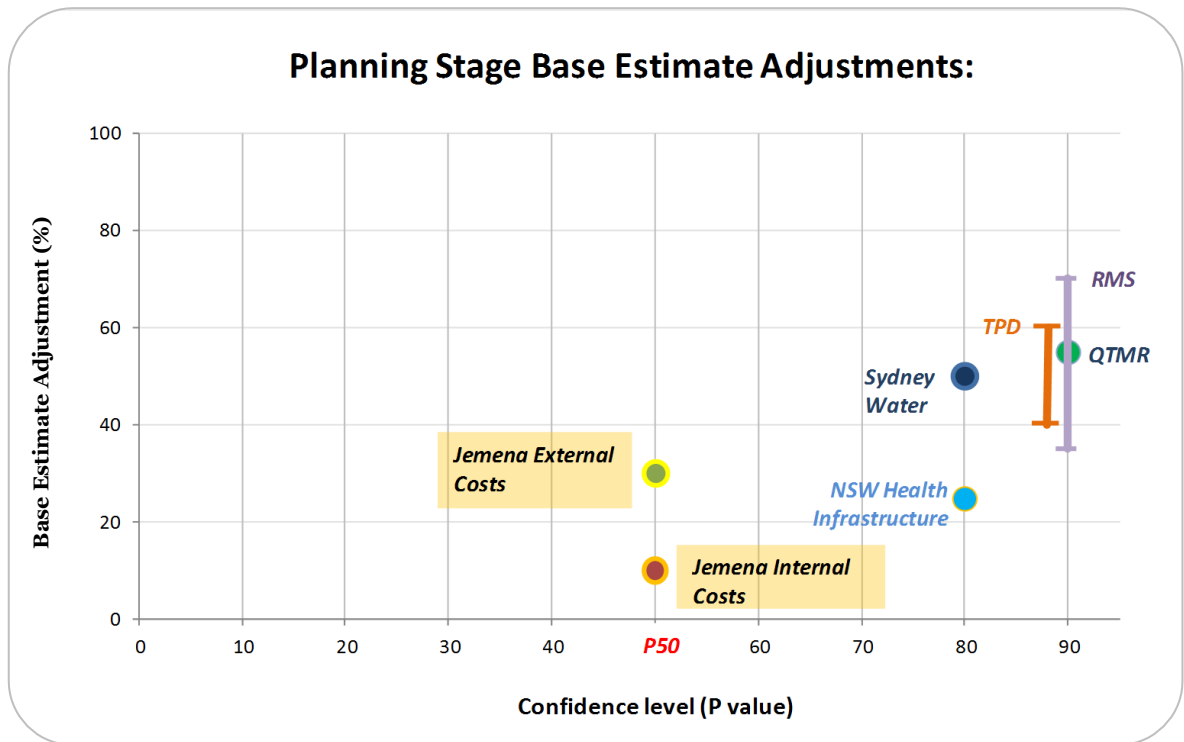


Figure 5-1 : Planning Stage Base Estimate Adjustments from Standards^(31, 32, 33)

It is our view that, based on our previous knowledge of this budgeting guidance and the provision of project cost estimating services to a large number of infrastructure owners and delivery agencies, these base estimate adjustment values are applied to base project cost estimates to account for uncertainty in project scoping throughout the project phases.

Figure 5-1 illustrates that JGN estimates are presented on a more aggressive basis (higher likelihood of an overrun) than is typical in the broader utilities and infrastructure industries. Due to scoping uncertainties in early stage estimates a higher scope allowance is required wherever a greater probability of delivering the project within budget is required. In accordance with this relationship, the magnitude of JGN's scope allowance factors is consistent with the trend in factors applied by other infrastructure owners.

³¹ QTMR is the Queensland department of Transport and Main Roads

³² RMS is the NSW Roads and Maritime Services

³³ TPD is the NSW Transport Projects Division

We also note that the lower values applied for health infrastructure projects reflect the typically lower cost risk exposure of building projects. In contrast, utility and transport networks are exposed to a greater degree of route uncertainty, variability in environment (ground conditions) and co-ordination with other infrastructure.

The raw data for base estimate adjustment values gathered from the above sources comprises data and guidance relevant to a range of project planning and delivery phases, typically termed “project approval gateways” or “decision points”. Whilst all raw information has been presented to provide context to our opinion, only those values applicable to the early gateway, typically described as feasibility, initiation/inception or strategic estimate are relevant to the JGN regulatory forecast and therefore only these have been considered in forming our opinion of an appropriate range of scope allowance factors.

We have considered the raw data presented in in Figure 5-1 along with the following additional evidence sources:

- relevant previous pieces of confidential advice on project uncertainty that we have provided to infrastructure delivery and utility industry clients; and
- general advice on project uncertainty provided to infrastructure owners and jurisdictional infrastructure regulators, including non-confidential advice to Queensland Competition Authority and the Independent Pricing and Regulatory Tribunal.

From this consideration of the available evidence, we have prepared a list of project risk exposure types and an opinion of the associated delivery uncertainty. This opinion is presented in the form of an appropriate base estimate adjustment value and is displayed in Table 5-1. The table displays five project types that represent a similar risk profile to the work that is typically undertaken by JGN.

Only the level of uncertainty existing at initiation phase, relevant to JGN stage 1 estimates, is presented in Table 5-1. However for completeness, base estimate adjustment values targeting both median cost result outcomes and conservative cost result outcomes are presented.

Table 5-1 : Base Estimate adjustment values for comparable project types

Project Type	Description	Gateway 1 Initiation	
		Median	Conservative
Type A	Predominately pipelay with misc mechanical works, includes traffic control & restoration	22.5%	30.0%
Type B	Predominately pipe rehab of uncertain qty, with misc mechanical works, includes traffic control & restoration	25.0%	35.0%
Type C	Pipe inspection with traffic control & restoration	15.0%	20.0%
Type D	Mechanical large value supply and installation	17.5%	25.0%
Type E	Land and easement valuation and purchase	10.0%	15.0%

On account of the experienced professional judgement required to be exercised in the selection, for each project risk exposure type, of an appropriate base estimate adjustment value to account for project uncertainty at project initiation phase, we have included in Table 5-1 a potential “margin of error”. In effect, application of the margin of error to the initially selected value creates upper and lower bound values for potential base estimate adjustment values for each project risk exposure type. When viewed as a continuum of project risk exposure types, the selected values form a generic scale of base estimate adjustment values caused by project scoping uncertainty, that attempts to capture only future scope adjustment impacts.

5.2.3 Review of Capex Components and Analysis of Delivery Uncertainty

We have taken the disaggregation of the JGN capital expenditure forecast included in section 2.2 and further disaggregated it where sub-components exist, which occurs in the *Stay in Business (SIB) - Facilities and SCADA*, component. This further disaggregation is presented in Figure 5-2

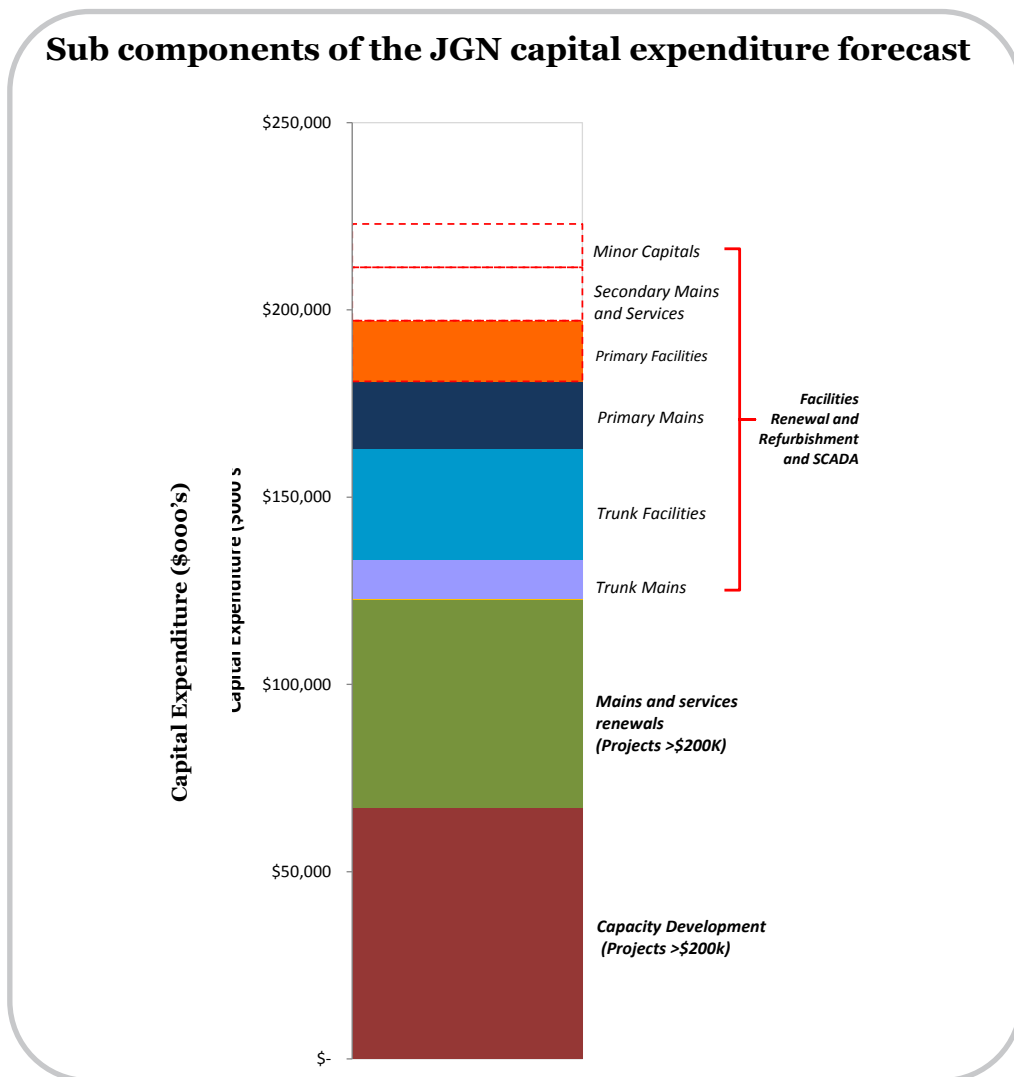


Figure 5-2: Sub components of the JGN capital expenditure forecast³⁴

³⁴ Expenditure forecast calculated in ‘regulatory years (RY)’ from the 13 May 2014 Capex Forecast Model.

It can be seen that the *SIB - Facilities and SCADA* component has a total of 6 sub components, 4 of which are included in the JGN capital expenditure forecast via application the PEM. *The Mains and Services Renewal* and Growth Capacity Development components do not have identified sub-components, however although the entire value of works included in the JGN capital expenditure forecast under these components has not been estimated via the PEM, a very high percentage has been and only the works relating to this high percentage has been assessed in this report.

Through the selection and review of 6 representative projects, one for each sub component that has been estimated by JGN using the PEM, we have assessed the nature of the works and services broadly undertaken in each subcomponent. The objective was to identify the quantum of scope growth risk, arising from capital cost uncertainty that each representative project is exposed to, from a review of the relevant PEM.

We have selected our representative projects after applying the following process:

- Liaison with JGN Estimating Manager as to the overall nature of the capital portfolio and the types of projects categorised into the respective sub-components;
- Internal liaison with senior Evans & Peck staff with significant experience in gas networks generally and JGN assets in particular;
- Review of project descriptions in the JGN capital forecast;
- Assessment of the individual work items of the selected projects and comparison with the general nature of the respective sub-component; and
- An assessment of a further project from the sub components with a significant total value, to ascertain that the initially selected project was not an abnormal project within the respective sub-component.

In undertaking our assessment of the quantum of scope growth risk, we have identified the risk drivers based on our experience as infrastructure project cost estimators and advisors. This is summarised in Table 5-2 which presents the 6 sub-components of the JGN capital expenditure forecast along with:

- The selected representative projects;
- Our conclusions as to the nature of the works and services broadly undertaken in each subcomponent; and
- Our qualitative assessment of the quantum of scope growth risk arising from each identified risk driver.

Table 5-2: JGN capital forecast sub components evaluation of scope growth risk exposure

Sub-component	Representative Project	Type	Broad nature of works and services undertaken	Final scope dependant on design process outcomes	Underground works causing exposure to latent conditions	Interaction with community and stakeholders	Exogenous hazards predominate	Estimate quantities dependant on desktop assessment	Requires external authority sign off on completed work	Linear rather than central, construction site	Overall Outcome
Growth Capacity Development	Cecil Park CDP	A	Predominately pipelay with misc mechanical works, includes traffic control & restoration								High
Mains and Services Renewal	Kensington Stage 4 Rehab	B	Predominately pipe rehab of uncertain qty, with misc mechanical works, includes traffic control & restoration								Extreme
Primary Facilities	Auburn PRS Easement valuation	E	Land and easement valuation and purchase								Very Low
Trunk Facilities	Northern Trunk Heating	D	Mechanical large value supply and installation								Moderate
Primary Mains	Wollongong Primary Main integrity digs	C	Pipe inspection with traffic control & restoration								Low
Trunk Mains	Licence 3,7,8A Piggig & Validation digs	C	Pipe inspection with traffic control & restoration								Low

5.2.4 Identify Upper and Lower bounds for base estimate adjustment

After establishing a generic scale of base estimate adjustment values based on project scoping uncertainty in section 0 and assessing the scope creep risk exposure of the JGN capital expenditure forecast sub-components, via reference to representative projects, in section 5.2.3, we have identified upper and lower bounds for base estimate scope adjustments for the sub-components JGN capital expenditure forecast.

It was demonstrated in section 5.2.1 that base estimate scope adjustments, as commonly implemented in infrastructure delivery and utilities, are analogous to project level scope allowance factors. The upper and lower bounds for the sub-components of the JGN capital expenditure forecast displayed in Table 5-3 therefore represent our view of appropriate scope allowance factors to apply to JGN's labour and materials estimates at a project level.

Table 5-3: Appropriate project level scope allowance factors

Sub-component	Representative Project	Project Risk Type	Evans & Peck Assessment	
			Lower	Upper
Growth Capacity Development	Cecil Park CDP	A	20.0%	25.0%
Mains and Services Renewal	Kensington Stage 4 Rehab	B	22.5%	27.5%
Primary Facilities	Auburn PRS Easement valuation	E	7.5%	12.5%
Trunk Facilities	Northern Trunk Heating	D	15.0%	20.0%
Primary Mains	Wollongong Primary Main integrity digs	C	12.5%	17.5%
Trunk Mains	Licence 3,7,8A Pigging & Validation digs	C	12.5%	17.5%

Although a comparison of the appropriate JGN project level scope allowance factors presented in Table 5-3 is informative, it does not of itself allow an opinion to be formed as to whether the scope allowance factors applied by JGN to its forecast labour and material estimates produce an overall forecast that is consistent with rule 74 and 79(1)(a). This is primarily due to the fact that JGN's forecast capex portfolio is not evenly weighted across the sub-components identified in Table 5-2..

It is therefore necessary to examine the total contribution of the JGN scope allowance factors at a portfolio level and compare this to the overall contribution of the range of appropriate project level scope allowance factors from Table 5-3. This analysis is summarised in Table 5-4, with the appropriateness of the contribution to JGN's total capital expenditure forecast considered in section 6.

Table 5-4 displays the sub-components scope allowance factor included in the JGN capital expenditure forecast and Evans and Peck’s assessment of appropriate project level scope allowance factors, along with a weighted average for both, based on the contribution of the sub-components to the JGN capital expenditure forecast total.

Table 5-4: Weighted average of project level scope allowance factors ³⁵

JGN Capital Expenditure Forecast			JGN Weighted Scope Adjustment				Evans & Peck Assessment				
Sub -Component	Value (\$000's)	% of total	PEM "At Risk" %	Base	Adjust. (\$)	Adjust. (%)	Scope allowance factor		Adjustment		
							Lower	Upper	Base	Lower Bound	Upper Bound
Growth Capacity Development (Projects >200k)	\$ 66,995	34%	17%	\$ 55,606	\$ 11,389	20%	20%	25%	\$ 55,606	\$ 11,121	\$ 13,901
Main & Service pipe replacement & upgrades (Projects >200k)	\$ 55,774	28%	19%	\$ 45,177	\$ 10,597	23%	23%	28%	\$ 45,177	\$ 10,165	\$ 12,424
Primary Facilities	\$ 16,197	8%	20%	\$ 12,958	\$ 3,239	25%	8%	13%	\$ 12,958	\$ 972	\$ 1,620
Trunk Facilities	\$ 29,568	15.0%	18%	\$ 24,246	\$ 5,322	22%	15%	20%	\$ 24,246	\$ 3,637	\$ 4,849
Primary Mains	\$ 17,972	9%	15%	\$ 15,276	\$ 2,696	18%	13%	18%	\$ 15,276	\$ 1,910	\$ 2,673
Trunk Mains	\$ 10,600	5%	16%	\$ 8,904	\$ 1,696	19%	13%	18%	\$ 8,904	\$ 1,113	\$ 1,558
Total	\$197,106	100%		\$162,166	\$34,940				\$162,166	\$28,917	\$37,026
Total JGN Capex					\$197,106					\$191,084	\$199,192
Total Base Estimate Adjustment						21.5%				17.8%	22.8%

It is important to note that the data used to determine the Capex breakdown and sub components was derived from the 13 May 2014 Capex Forecast. Although the majority of projects had been included in the Capex Forecast Model by this version, some projects in ‘Mains and Services’ had yet to be estimated using the PEM. These projects are in the later years of the AA period and the Gate 0 estimates in the Opportunity Brief have been based upon historical costs for similar projects.

³⁵ JGN has used pre-existing fields in the PEM, labelled “at Risk (%)”, to input the scope factor allowance of 10% or 30% as appropriate for each line item of the model. The relevant outputs from the PEM are the total estimated cost (“Value (\$000’s)”) which includes the value of the scope adjustment, and the amount of the scope adjustment expressed as a percentage of total cost (“PEM ‘At Risk’ %”). The value of the scope adjustment (“Adjust (\$)”) is therefore the total estimated cost multiplied by the scope adjustment expressed as a percentage of total cost; the base cost (“Base”) is the total estimated cost less the value of the scope adjustment; and the weighted average scope factor allowance (“Adjust %”) is the value of the scope adjustment divided by the base cost.

5.2.5 Findings

In section 5.2.4 we have presented our range of estimates of the appropriate scope allowance factors to apply to JGN's labour and material estimates at a project level and assessed the contribution to the JGN capital expenditure forecast on a weighted average basis. We have found that a range of scope allowance factors between 17.8% and 22.8% is considered to be appropriate when applied at a portfolio level.

We note that JGN's approach of using common scope allowance factors across different project types is considered to be reasonable; however this means that at an individual project level the values attributable to scope allowance factors may not always reflect the specific cost that will be incurred by that project. Similarly, at a line item level we note that the application of a single value for internal labour and for externally contracted work (such as materials, plant and specialised equipment) is unlikely to provide the specific cost that will be incurred for that line item.

However, Evans & Peck considers that to amend the JGN's approach so that it applies a more varied suite of factors (at a specific line item level or uniformly across a project type) would contribute to additional complexity in the forecasting process and would ultimately require a greater volume of assumptions to be made and justified. This is typically a challenging and problematic task as it requires an estimator to know enough about individual projects to be able to prepare a robust set of project specific assumptions that also remains consistent across each individual project in the forecast capex portfolio. This level of estimating effort is neither practical nor efficient for the purpose of preparing early stage estimates for Access Arrangement purposes.

Whilst Evans & Peck recognises that there are alternative and potentially more analytically robust approaches to allow for this scope uncertainty at a project or line item level, we also recognise that it is the total value attributable to scope allowance factors in the JGN capital expenditure forecast that is most relevant to JGN's regulatory determination, as the AER will make a determination based on the total capex.

In this respect, we acknowledge that for some line items, such as specialist equipment, JGN's approach of applying a 30% scope factor is likely to overstate the total cost uncertainty for that line item, whilst for other line items, such as pipeline rehabilitation and customer reconnection, JGN's approach is likely to understate the expected scope allowance. However, these counteracting over and understatements may occur in different projects. For this reason, Evans & Peck considers that JGN's scope allowances are best assessed on a total value basis across the portfolio of projects that have been estimated using the PEM. This assessment is considered in section 6.

5.3 Sensitivity of findings

This section considers whether the range of estimates for the appropriate scope allowance factors is sensitive to the nature of the projects being undertaken in a particular regulatory period and identifies any alternative estimates that may be calculated to account for any sensitivity.

Scope allowance factors at a project level are dependent on the nature of the work being undertaken and the exposure to additional scope that will be defined during subsequent stages of planning and delivery. Our methodology has included identifying a different range of estimates for projects of varying asset types and delivery context. It is therefore a consequence that the range of estimates for the appropriate scope allowance factors is sensitive to the nature of the projects being undertaken in a particular regulatory period.

To test our findings for this sensitivity, we reviewed additional projects from the sub-components that contribute most heavily to the JGN capital expenditure forecast. We found that selection of alternative representative projects would not materially alter our opinion of an appropriate total

value attributable to scope allowance factors. However, the appropriate total value is sensitive to the mix of projects within the capital expenditure forecast.

For example, our review of the representative projects found that projects with a significant proportion of specialist mechanical and E&IC equipment are likely to have a higher project level scope allowance factor than necessary for the delivery risk exposure they face. However, if projects of this nature, such as those categorised as Stay in Business - Trunk Facilities projects, were tripled in value while holding all other components constant, (which would be an extreme case scenario in terms of weighted average sensitivity) so that the Stay in Business - Trunk Facilities projects increased from 15% to 35% of the capital expenditure forecast, the alternative applicable range of estimates for the total value attributable to scope allowance factors, would be 17.2% to 22.2% (as compared to the 17.8% to 22.8% identified in section 5.2.4)

Given that a change to JGN's forecast capex portfolio of this magnitude is highly unlikely to occur in practice, we consider that the range that has been estimated in section 5.2.4 forms an appropriate basis for the assessment against the total value attributable to JGN's scope allowance factors contained in section 6.

5.4 Conclusion

Evans & Peck provided estimates of the appropriate scope allowance factor to apply to JGN's labour and materials estimates at a project level, including an outline of the methodology used and information sources that have been used. We have also presented a comparison of the contribution of the JGN scope allowance factors at a portfolio level with the range of scope allowance factor contributions that are derived from the appropriate project level scope allowance factors.

We have also considered whether the range of estimates for the appropriate scope allowance factor is sensitive to the nature of projects being undertaken in a particular regulatory period and calculated an alternative estimate that represents an extreme distortion to the composition of the projects portfolio.

Based on our factual findings that:

- the JGN capital expenditure forecast attempts to predict actual out turn project costs based on cost estimates prepared between gate 0 and 1;
- JGN's scope allowance factors are applied at a line by line level at a value of 10% to internal resources and 30% to externally contracted resources;
- a project level scope allowance factor can be calculated from the line by line scope allowance factors applied;
- similar infrastructure delivery and utility agencies make allowance for uncertainty in project delivery;
- a range of estimates of scope allowance factors can be selected from publically available information, confidential sources and our experience as professional cost estimators

and assuming that:

- the project level scope allowance factors calculated are analogous to allowances for uncertainty in project scoping and delivery applied throughout industry;
- these allowances for uncertainty in project scoping and delivery applied throughout industry are fairly represented by what we have generically termed base estimate adjustment values;

- the projects reviewed are representative of the nature of the work and quantum of delivery uncertainty of the components and sub-components from which they are drawn;
- the rates and quantities of project line items captured in the PEM are the estimators base forecast of anticipated actual rates and quantities and do not already include an undisclosed allowance (hence the base forecast understates the most likely values),

Evans & Peck concludes that:

- 1) **the estimates for appropriate scope allowance factors can be established as ranging between 12.5% and 27.5% for different types of projects.**
- 2) **when the composition of JGN's portfolio is taken into account a weighted average scope allowance of between 17.8% and 22.8% is consistent with accepted good industry practice for the estimation of scope growth at stage 1 estimates to actual outturn costs**
- 3) **the range of estimates for appropriate scope allowance factors scope allowance factors in the JGN capital expenditure forecast is sensitive to the nature of projects being undertaken in a regulatory period, however the magnitude of potential variability in the mix of project types in the JGN capital expenditure forecast is unlikely to alter the identified range by more than 0.6% in either direction**

Therefore Evans & Peck is of the opinion that a weighted average scope allowance factor of between 17.8% and 22.8% is the appropriate scope allowance factor to apply to JGN's labour and materials estimates at a project level

6 Is the resulting forecast consistent with the NGR requirements?

In section 3 of this report, Evans & Peck concluded that JGN's cost estimation methodology satisfies the requirements of NGR 74 and 79(1)(a). In reaching this conclusion, we accepted that JGN's use of scope allowances is a reasonable method of addressing the inherent gap between the scope that can be defined at an early stage in the gating process and the scope that will be required to deliver the project. Essentially section 3 concluded that the methodology was sound but does not consider whether the specific factors that are applied by JGN are consistent with the rules.

Therefore this section provides Evans & Peck's opinion on whether the scope allowance factor(s) applied by JGN to forecast labour and materials estimates for the 2015-20 access arrangement period produces forecasts that are consistent with rules 74 and 79(1)(a).

To answer the question of whether the scope allowance factors that are applied by JGN are consistent with the rules, we consider:

- What scope allowance factors have been applied by JGN?
- The total value attributable to the factors in JGN's forecast project portfolio?
- The extent to which this is consistent with our expectations based on our assessment of appropriate scope allowance factors that is included in section 5?

On the basis that the AER is required to approve a total capex allowance for the purposes of the Access Arrangement, we consider that the scope allowance factors are consistent with the rules where the total value attributable to JGN's scope allowance factors is reasonably aligned with our expectations based on publically available information, confidential sources and Evans & Peck's experience as cost estimators.

6.1 JGN scope allowance factors

As noted in section 2.2, JGN has applied two scope allowance factors within its cost estimation process. These are:

- 10% to the base estimate for internal labour line items; and,
- 30% to the base estimate for 'other costs', which represent material and contract costs.

Evans & Peck notes that there is limited explanation of the basis for these specific figures in JGN's cost estimation documentation and discussions with JGN cost estimators identified that they are essentially policy figures that reflect the business' best estimate of the cost that should be allowed to accommodate the additional scope that is expected to be defined through the detailed design, consultation and site investigation activities that have not yet been undertaken.

JGN also noted that the lower 10% figure was adopted for internal costs than external costs as JGN retains a much greater degree of control over these costs and therefore it was considered reasonable to make a smaller allowance for additional scope for internal labour. With regard to the 30% figure, we also note that Evans & Peck's high level review in section 5 has identified that scope allowances of this magnitude are appropriate for early stage estimates in the infrastructure industry and on this basis we consider that factors of this magnitude are reasonable within JGN's overall estimating methodology.

In addition, our assessment of the historical gap in section 4.1.3 between the JGN's previous stage 2 and 3 estimates and the actual outturn costs identified that a figure in the order of 11% for both Labour and Other Costs was supported by JGN's historical experience. As the historical analysis was based on later stage 2/3 estimates, compared to the stage 0/1 estimates used for access arrangement purposes, a higher factor would reasonably be expected for earlier stage 1 estimates due to the lower degree of design and site investigation that has been undertaken at the preliminary stage.

On the basis of these facts Evans & Peck is able to conclude that JGN's use of the 10% and 30% scope allowances is consistent with our expectations based on accepted good industry practice.

In order to establish:

- that the use of these scope allowance factors produces a forecast that is consistent with the rules; and,
- noting that there is limited quantitative information in JGN's estimating documentation to directly support the derivation of these figures,

the following sections consider whether the total value arising from these figures is reasonable and aligns with our expectations.

6.2 Total value of scope allowances

As outlined in section 5, the total value of the scope allowances comprises \$34.9m of the total \$197.1m in estimates that have been sourced from the PEM. This represents approximately 21.5% of the \$162.2m base estimate for these projects, which in turn represent a subset of the total portfolio that is covered by JGN's Access Arrangement capital expenditure forecast

6.3 Comparison to Evans & Peck's expectations

In section 5 Evans & Peck concluded that a total value attributable to scope allowance factors of between 17.8% and 22.8% is consistent with accepted good industry practice, based on our assessment of publically available information, confidential sources and Evans & Peck's experience as cost estimators. Across the \$162.2m base estimate for the portfolio of projects that have been estimated using the PEM, this equates to a total cost that is attributable to the scope allowance of between \$28.9m and \$37.0m. Taking the midpoint of this range results in a figure of \$33.0m which is within 6% of JGN's total scope allowance value of \$34.9m.

In the context of a total capital expenditure forecast in the order of \$980m, the \$1.9m difference between the JGN total and the Evans & Peck midpoint estimate represents a variance in the total capex of approximately 0.2%, whilst the \$6.0m difference between the JGN total and the Evans & Peck lower bound estimate represents a variance in the total forecast capex of approximately 0.6%.

Therefore Evans & Peck is of the opinion that the total value of the scope allowances applied by JGN is in accordance with accepted good industry practice and any adjustment to the specific scope allowances within the reasonable range of values that has been estimated by Evans & Peck results in a relatively immaterial change to the total capital expenditure forecast included in JGN's Access Arrangement.

On this basis, and noting our conclusion on the JGN cost estimation methodology in section 3.3, we consider that the scope allowance factor(s) applied by JGN to forecast labour and materials estimates for the 2015-20 access arrangement period is appropriate to produce forecasts that are consistent with rules 74 and 79(1)(a).

6.4 Conclusion

Evans & Peck has considered whether the scope allowance factor(s) applied by JGN to forecast labour and materials estimates for the 2015-20 access arrangement period produces forecasts that are consistent with rules 74 and 79(1)(a).

Based on our factual findings that:

- Evans & Peck has previously concluded:
 - in section 3.3 that JGN’s capital cost estimating methodology satisfies the requirements of NGR 74 and 79(1)(a);
 - in section 4.4 that JGN’s method of applying scope allowances at the early stages of the gating process is appropriate and in accordance with NGR 74 and 79(1)(a);
 - in section 5.4 a weighted average scope allowance of between 17.8% and 22.8% is consistent with accepted good industry practice for the estimation of scope growth at stage 1 estimates to actual outturn costs;
- the total value that is attributable to JGN’s scope allowances is \$34.9m or 21.5% of the total \$162.2m base estimate for projects derived from the PEM and that this percentage falls within the reasonable range identified by Evans & Peck,

and observing that:

- the total variance of between 0.2% to 0.6% of the total capital expenditure forecast that arises between the JGN total and the Evans & Peck midpoint and lower bound estimates, is of limited materiality,

Evans & Peck concludes that:

- 1) **an overall weighted average allowance factor of between 17.8% and 22.8% is appropriate for the portfolio of work identified by JGN;**
- 2) **the 10% and 30% factors that are applied by JGN equate to a 21.5% adjustment for which falls toward the centre of the range;**
- 3) **the variation arising for the application of Evans & Peck’s midpoint estimate represents a value that is in the order of 0.2% of the total capital expenditure forecast and 0.6% of the total capital expenditure forecast for the lower bound forecast;**
- 4) **a variation of this magnitude is not material to our assessment of whether the scope allowance factors applied by JGN produce forecasts that are consistent with rules 74 and 79(1)(a).**

Therefore Evans & Peck is of the opinion the scope allowance factor(s) applied by JGN to forecast labour and materials estimates for the 2015-20 access arrangement period are appropriate to produce forecasts that are consistent with rules 74 and 79(1)(a).

7 Conclusion

This report has presented Evans & Peck's assessment of JGN's cost estimation methodology against the requirements of NGR 74 and 79(1)(a), with a specific focus on the application of the scope allowances in project estimates that have been developed using the PEM. For convenience, this section restates our conclusions from the preceding sections along with our resulting opinion.

In section 3 we assessed whether JGN's cost estimation methodology will produce a forecast or estimate of capital expenditure for the 2015-20 access arrangement period that complies with rule 79(1)(a) and rule 74 and concluded that:

- 1) JGN's cost estimation methodology (including the use of the scope adjustment allowance) is supported by a statement of the basis for the forecast, is arrived at on a reasonable basis and represents JGN's best estimate in the circumstances;
- 2) JGN's cost estimation methodology (including the use of the scope adjustment allowance) reflects the costs that would be incurred by a prudent service provider acting efficiently, in accordance with accepted good industry practice to achieve the lowest sustainable cost of providing services;

Therefore Evans & Peck is of the opinion that JGN's capital cost estimating methodology satisfies the requirements of NGR 74 and 79(1)(a).

In section 4 we considered whether JGN's method of applying a scope allowance to forecast labour and materials costs for projects at the early stages of JGN's gating system is appropriate and in accordance with rule 79(1)(a) and rule 74 and concluded that:

- 1) there is a demonstrable requirement for a factor to adjust for unforeseeable scope increases to align the forecast capex with the expected outturn costs.
- 2) the historical gap between stage 2 and 3 estimates and outturn costs is in the order of 11% when corrected for the process improvements that have been implemented for the preparation of JGN's Access Arrangement forecasts.
- 3) the historical analysis understates the value that would need to be applied to JGN's forecast capex as it is based on more developed stage 2/3 estimates rather than the stage 0/1 estimates that are used to support the access arrangement.
- 4) no other allowance is made in the form of a project specific or portfolio level adjustment to account for this expected scope uncertainty, leading to a one sided risk exposure that cannot be diversified across the broader capex portfolio.
- 5) the scope allowance acts as a proxy for expected scope items that are defined through more detailed design and further site investigations that cannot reasonably be undertaken at stage 1.
- 6) the use of a scope allowance in these circumstances is consistent with a prudent service provider acting efficiently to achieve the lowest sustainable cost of services.

Therefore Evans & Peck is of the opinion that JGN's method of applying scope allowances at the early stages of the gating process is appropriate and in accordance with NGR 74 and 79(1)(a).

In section 5 we provided a range of estimates of the appropriate scope allowance factor to apply to JGN's labour and materials estimates at a project level. In providing this estimate we concluded that:

- 1) the range of estimates for appropriate scope allowance factors can be established as ranging between 12.5% and 27.5% for different types of projects.
- 2) when the composition of JGN's portfolio is taken into account a weighted average scope allowance of between 17.8% and 22.8% is consistent with accepted good industry practice for the estimation of scope growth at stage 1 estimates to actual outturn costs.
- 3) the range of estimates for appropriate scope allowance factors in the JGN capital expenditure forecast is sensitive to the nature of projects being undertaken in a regulatory period, however the magnitude of potential variability in the mix of project types in the JGN capital expenditure forecast is unlikely to alter the identified range by more than 0.6% in either direction.

Therefore Evans & Peck is of the opinion that a weighted average scope allowance factor of between 17.8% and 22.8% is the appropriate scope allowance factor to apply to JGN's labour and materials estimates at a project level

In section 6, we considered whether the scope allowance factor(s) applied by JGN to forecast labour and materials estimates for the 2015-20 access arrangement period produces forecasts that are consistent with rules 74 and 79(1)(a) and concluded that:

- 1) an overall weighted average adjustment factor of between 17.8% and 22.8% is appropriate for the portfolio of work identified by JGN.
- 2) the 10% and 30% factors that are applied by JGN equate to a 21.5% adjustment for which falls toward the centre of the range.
- 3) the variation arising for the application of Evans & Peck's midpoint estimate represents a value that is in the order of 0.2% of the total capital expenditure forecast and 0.6% of the total capital expenditure forecast for the lower bound forecast.
- 4) a variation of this magnitude is not material to our assessment of whether the scope allowance factors applied by JGN produce forecasts that are consistent with rules 74 and 79(1)(a).

Therefore Evans & Peck is of the opinion the scope allowance factors applied by JGN to forecast labour and materials estimates for the 2015-20 access arrangement period are appropriate to produce forecasts that are consistent with rules 74 and 79(1)(a).

Evans & Peck has made all the inquiries that Evans & Peck believes are desirable and appropriate and no matters of significance that Evans & Peck regards as relevant have, to Evans & Peck's knowledge, been withheld from the Court.

Appendix A

List of Referenced Documents

1. National Gas Rules
2. JGN Spreadsheet, AA15 - JGN Capex Forecast Model - v13 - 13 May 14 (full view).xlsb
3. Jemena Gas Networks, Estimating Manual (incl. Appendices)
4. Jemena Gas Networks, Project Estimating Model, Worksheet
5. Evans & Peck, Best Practice Cost Estimation for Publicly Funded Road and Rail Construction (prepared for Department of Infrastructure, Transport, Regional Development and Local Government)
6. JGN Spreadsheet, 07-Feb-2014 31092164_1_ Evans & Peck Summary of JGN Data.xlsx
7. AER, Better Regulation Explanatory Statement - expenditure forecast assessment guideline, November 2013

Appendix B

Curriculum Vitae

Evan Mudge & Michael Quinnell

Evan Mudge

Associate

Overview

Evan is an experienced energy industry professional who has provided strategic consulting services to infrastructure clients across the Australia-Pacific region relating to major project investments, economic regulation, strategic asset management, risk management and project/capital governance frameworks.

Evan has worked extensively with economic regulators and network business throughout Australia, New Zealand and the South Pacific. This has included roles for the Australian Energy Regulator (NSW Transmission, SA & Qld Distribution Determinations), the Economic Regulatory Authority of WA (Review of Horizon Power's Funding Arrangements), the Independent Public Business Corporation of Papua New Guinea (Review of Ramu System). In addition Evan has provided regulatory advice to most Australian electricity networks in relation to the development and support of aspects of their regulatory proposals.

Areas of Expertise

Regulatory Advice

Risk Analysis

Asset Strategy

Project Analysis and Evaluation

Cost Advisory

Business Case Preparation

Capital Program Review

Project Management

Relevant Experience

Evans & Peck – Associate

2012 to present

Manage the preparation of a TNSP's responses to the AER's Regulatory Information Notices.

Review and update the Asset Management Plan and associated documentation for a gas distribution business. (confidential client)

Advisory services to a gas distribution network regarding cost estimating processes. (confidential client)

Benchmarking assessment of transmission networks serving the NEM states, identifying relative capex, opex, reliability and historical development drivers. Presentation to the executive and board to support the strategic planning process. (confidential client)

Assessment of relative expenditure performance, asset intensity and the infrastructure burden placed on customers for each network serving the national electricity market (NSW DNSP client).

Explanation of the relative reliability performance trends of Australian electricity networks. Included comparison of different policy drivers and jurisdictional influences on reliability in each of the eastern states (NSW DNSP client)

Development of solar thermal commercialisation strategy and risk management plan for an Australian renewable energy technology developer.

Parsons Brinckerhoff, Strategic Consulting – Consultant

2008 – 2012

Program management of the preparation of the non-system IT expenditure and regulatory

Relevant Experience

justification for a NSW DNSP client's regulatory proposal.

Economic Regulatory Authority of Western Australia. Review of the Funding Arrangements for Horizon Power (2010). Review of transmission, distribution, non-network capex and associated governance, risk management and investment prioritisation processes.

ActewAGL Distribution, Access Arrangement submission for the ACT gas distribution network. Regulatory advice relating to asset management plan, cost benchmarking and project justification, including review of \$200m capex portfolio

Australian Energy Regulator, Ergon Energy Revenue Determination (2010). Reviewed Ergon Energy's corporation initiated augmentation capex portfolio

Australian Energy Regulator, ETSA Utilities Revenue Determination (2009-2010). Reviewed ETSA Utilities' proposed \$2.2b capex portfolio.

Australian Energy Regulator, TransGrid Revenue Determination (2008), Reviewed TransGrid's proposed \$2.6b capex portfolio for the NSW electricity transmission network.

Western Power Access Arrangement (2008), Reviewed selected projects included in Western Power's proposed capital works portfolio in preparation for its Access Arrangement submission.

Due Diligence Investigation of Generation Assets (2009), Technical due diligence investigation of open cycle gas turbine and process integrated industrial cogeneration power station sites to inform the due diligence process for their potential acquisition.

Providing business case advice and analysis to support strategic initiatives such as Ausgrid's successful bid for the \$100m Federal Smart Grid Smart City program funding, investigating the optimal ownership model for electricity network communications assets in the NBN and providing an independent review of project costs for the largest transmission line project in WA (\$300m).

Due diligence evaluation of generation assets and associated contractual arrangements to support potential acquisition, including review of fuel supply arrangements for the NSW governments Gentrader divestment for a top tier energy generator-retailer.

Advising Papua New Guinean Independent Public Business Corporation on a remedial strategy to address generation and transmission reliability issues affecting the economic development of the Lae, Madang and Highlands regions of the country.

Energy (electricity, gas, carbon, network) procurement advice for major infrastructure operations such as Sydney Airport, Fremantle Ports, Sydney Metro Authority and major generation facilities.

Gridx Power – Business Analyst and Commercial Manager

2007 – 2008

Negotiating fuel pricing arrangements, power purchase agreements, capital contributions, tariffs, equipment procurement and financing arrangements for innovative cogeneration/trigeneration (heat/power/cooling) projects;

Quantifying the financial, carbon and energy efficiency benefits and development of business case to facilitate investment decision making for the business/finance partners and clients;

Optimisation of plant operation and equipment sizing (electricity/thermal and export sales) for optimal commercial and risk management outcomes;

Development of pricing and contract terms in conjunction with the client's consultants to facilitate acceptable trade-offs between technical efficiency and commercial viability;

Monitoring wholesale and retail gas and electricity markets to ensure tariffs, operating

Relevant Experience

schedules and business model remained viable in increasingly volatile markets;
Providing input to regulatory matters regarding proposed changes to National Electricity Rules.

Bassett Applied Research (AECOM) – Research Engineer

2006 – 2007

Advanced analysis of energy and carbon efficient building design initiatives using advanced numerical modelling techniques. Complex acoustical and vibration analysis to facilitate environmental planning and assessment requirements for major infrastructure projects

GHD Mining and Industry – Mechanical Engineer

2004 - 2005

Project management, project controls and engineering design for large mining and industrial projects such as steel mills, coal mines, gold mines, mining equipment and cement works.

Qualifications

Bachelor of Engineering (Hons 1) (Mechanical), University of Technology Sydney

Master of Applied Finance, Macquarie University

Overview

19 years' experience in the construction and utilities industries, with a focus on the delivery and operation of water and power infrastructure, assessment of capital portfolio planning and governance and provision of advice related to project budgeting and risk contingency assessment. Specific areas of knowledge include:

- Capex estimating and budget forecasting, including contingency assessment
- Risk identification, assessment & modelling
- Project commercial and financial administration
- Operate and maintain cost assessments and payment structures
- Project governance and compliance reporting
- Head Contract administration for both contractor and owner
- Asset Fair Value assessments
- Preparation of concept designs and value analysis
- Partnering and Alliance relationships

Areas of Expertise

Project and contingency governance

Estimate Risk Assessment

Major Contract Administration

Contract & Compliance Management

Business Case Advice

Fair Value Assessments

Public Sector Comparator Preparation

Opex Cost Estimates and Advice

Relevant Experience

Senior Associate

Evans & Peck Pty Limited

(2009 – present)

- Capital cost estimating process review
- Contingency setting and governance advice
- Risk based estimating – assessment, modelling and training
- Major D&C Contract administration
- Claim and dispute management
- Financial and commercial advice
- O&M contract requirements and commercial frameworks

Relevant Experience

- Asset replacement cost assessments and Fair Value Assessments

Key projects include:

- Infrastructure NSW Contingency review of major projects
- Electricity Transmission project estimating and portfolio risk reviews
- Water O&M Contract payment structure Expert Advice
- IPART Local Infrastructure Benchmarking
- SWC water filtration agreements plant valuation and O&M cost assessments
- Gosford/Wyong water & sewer Fair Value assessments
- QGC CSG water treatment O&M documentation
- SWC Coastal STP and Inland WFP Replacement cost estimates
- Sydney's Desalination Plant

Senior Consultant / Associate

(2004 - 2009)

- Contract compliance management
- Construction schedule review
- Cost Engineering
- Risk modelling & assessment
- Alliance TOC Review
- Public Sector Comparator preparation
- Litigation support
- Office relocation project management

Key projects include:

- Sydney's Desalination Plant
- Camellia RWS Public Sector Comparator
- Evans & Peck Sydney office relocation
- Brunswick Area Sewerage Scheme
- Rouse Hill STP
- Shoalhaven Transfer Scheme
- Hoxton Park Recycled Water Scheme
- SWC Priority Sewerage Program
- SWC Sewer Overflow Abatement Program
- SWC Coastal STP Fair Value assessments
- Googong Water Treatment Plant

Relevant Experience

Civil Design Engineer

United KG Pty Limited

(2002 - 2004)

Design Package Leader for Civil and Structural works for Yass 330/132kV Electrical Substation Reconstruction.

Prepared submission and reviewed external consultant's contribution for a successful Expression of Interest for the Byron Bay Sewerage Augmentation.

Performed various design coordination functions and prepared and review drawings for Penrith STP Stage 8 Upgrade.

Member of Project team for preparation of concept design and preliminary costing leading to development of P80 estimate for stage 1 schemes of Sydney Water's Priority Sewerage Program.

Member of project team that reviewed Coalcliff Village servicing options and planning team for MWS scheme.

Key projects include:

- Penrith STP
- Yass 330 KV Substation
- Priority Sewerage Program

Project Engineer

Kilpatrick Green Pty Limited

(2000 - 2002)

Project Engineer for Design or Detail Design and Construct Contracts for sewerage projects including STP's. Involved in all phases of project delivery from the start of the tendering period, through post tender negotiations, construction and commissioning. Specialist tasks included management of the operation of a sewerage scheme including proving of STP performance as well developed concept design for Reinforced Concrete Bioreactor tank.

Key projects include:

- South Windsor STP Augmentation, NSW
- Vincentia Sewerage Upgrade, NSW
- Corindi Sewerage Scheme, NSW

Site Engineer

(1997 - 2000)

Site Engineer for Design & Construct contracts and Construction only of augmentation works to a variety of Sewage Treatment Plants (STP). Works covered all civil, mechanical & process disciplines. Also a role as Design Project Leader for insulation work for the reduction of aircraft noise from Sydney Airport

Michael Quinnell

Senior Associate

Relevant Experience

Key projects include:

- Brendale WWTP, QLD
- Sydney Aircraft Noise Insulation Project (SANIP)
- East Lismore STP, NSW
- Orange STP, NSW

Site Engineer

CDM Services Pty Limited

(1995 - 1996)

Site Engineer for a building and metalwork company. Worked on numerous projects, either in the role of the main contractor or subcontractor to large construction companies

Key projects include:

- Goldsborough Mort Redevelopment
- MCA “Puppy” Project

Work History

- 2009 - Current Senior Associate, Evans & Peck Pty Ltd
- 2004 – 2009 Associate/Senior Consultant, Evans & Peck Pty Ltd
- 2002 – 2004 Civil Design Engineer, United KG Pty Limited
- 1997 – 2002 Site/Project Engineer, Kilpatrick Green Pty Limited
- 1995 – 1996 Site Engineer, CDM Services Pty Limited

Qualifications

- 2004 Masters of Engineering Science (Water and Wastewater Treatment), UNSW
- 1998 MBT Certificate in Project Management, UNSW
- 1991-1994 Bachelor of Civil Engineering, UNSW

Affiliations

- Member, Engineers Australia
- Chartered Practising Engineer (CPEng)

Conference Papers

- The performance of risk based estimating in the NSW water sector, Ozwater 13

Appendix C

Terms of Reference

Background

Pursuant to the provisions of the National Gas Law (**Law**) and National Gas Rules (**Rules**), JGN is currently preparing revisions to the access arrangement that applies to its gas distribution network during the period 1 July 2010 to 30 June 2015. JGN is required to submit the revisions that it proposes to this access arrangement to the Australian Energy Regulator (**AER**) for consideration on or before 30 June 2014. The revised access arrangement will apply during the period 1 July 2015 to 30 June 2020.

Rule 72 of the Rules requires an access arrangement proposal to include the projected capital base over the access arrangement period, including a forecast of conforming capital expenditure for the period (1 July 2015 to 30 June 2020) and the basis for the forecast.

Rule 79 sets out when capital expenditure is considered to be “conforming capital expenditure”:

79 New capital expenditure criteria

- (1) Confirming capital expenditure is capital expenditure that conforms with the following criteria:
 - (a) the capital expenditure must be such as would be incurred by a prudent service provider acting efficiently, in accordance with accepted good industry practice to achieve the lowest sustainable cost of providing services;
 - (b) the capital expenditure must be justifiable on a ground stated in subrule (2).
- (2) Capital expenditure is justifiable if:
 - (a) the overall economic value of the expenditure is positive; or
 - (b) the present value of the expected incremental revenue to be generated as a result of the expenditure exceeds the present value of the capital expenditure; or
 - (c) the capital expenditure is necessary:
 - (i) to maintain and improve the safety of services; or
 - (ii) to maintain the integrity of services; or
 - (iii) to comply with a regulatory obligation or requirement; or
 - (iv) to maintain the service provider’s capacity to meet levels of demand for services existing at the time the capital expenditure is incurred (as distinct from projected demand that is dependent on an expansion of pipeline capacity); or
 - (d) the capital expenditure is an aggregate amount divisible into 2 parts, one referable to incremental services and the other referable to a purpose referred to in paragraph (c), and the former is justifiable under paragraph (b) and the latter under paragraph (c).

As the forecast of conforming capital expenditure for the 1 July 2015 to 30 June 2020 period is a forecast, rule 74 is also relevant. It provides:

74 Forecasts and estimates

- (1) Information in the nature of a forecast or estimate must be supported by a statement of the basis of the forecast or estimate.
- (2) A forecast or estimate:
 - (a) must be arrived at on a reasonable basis; and
 - (b) must represent the best forecast or estimate possible in the circumstances.

In making its determination on the revisions to JGN's access arrangement, the AER is required to do so in a manner that will or is likely to contribute to the achievement of the national gas objective. The national gas objective is set out in section 23 of the Law as follows:

The objective of this Law is to promote efficient investment in, and efficient operation and use of, natural gas services for the long term interests of consumers of natural gas with respect to price, quality, safety, reliability and security of supply of natural gas.

The AER must also take into account the revenue and pricing principles in section 24 of the Law in determining whether JGN's forecast capital expenditure complies with the requirements of the Law and the Rules and is consistent with any criteria in the Law and the Rules. The revenue and pricing principles include:

- (2) A service provider should be provided with a reasonable opportunity to recover at least the efficient costs the service provider incurs in—
 - (a) providing reference services; and
 - (b) complying with a regulatory obligation or requirement or making a regulatory payment.
- (3) A service provider should be provided with effective incentives in order to promote economic efficiency with respect to reference services the service provider provides. The economic efficiency that should be promoted includes—
 - (a) efficient investment in, or in connection with, a pipeline with which the service provider provides reference services; and
 - (b) the efficient provision of pipeline services; and
 - (c) the efficient use of the pipeline....
- (5) A reference tariff should allow for a return commensurate with the regulatory and commercial risks involved in providing the reference service to which that tariff relates.
- (6) Regard should be had to the economic costs and risks of the potential for under and over investment by a service provider in a pipeline with which the service provider provides pipeline services.

In this context, the independent expert opinion of Evans & Peck (**Expert**), as a suitably qualified independent expert, is sought on JGN's capital expenditure forecasting process (i.e., its cost estimation methodology), in particular the application of a scope allowance to project estimates.

Terms of reference

The Expert will provide an opinion report that:

- (a) Assesses whether JGN's cost estimation methodology will produce a forecast or estimate of capital expenditure for the 2015-20 access arrangement period that complies with rule 79(1)(a) (being a forecast or estimate of capital expenditure that would be incurred by a prudent service provider acting efficiently, in accordance with good industry practice to achieve the lowest sustainable cost of providing services) and rule 74 (being a forecast or estimate that is arrived at on a reasonable basis and represents the best forecast or estimate possible in the circumstances);
- (b) Provides an opinion on whether JGN's method of applying a scope allowance to forecast labour and materials costs for projects at the early stages of JGN's gating system is appropriate and in accordance with rule 79(1)(a) and rule 74;

- (c) Provides an estimate (or range of estimates) of the appropriate scope allowance factor(s) to apply to JGN's labour and materials estimates at a project level. In providing this estimate, the Expert will:
- (i) outline the methodology that it uses to calculate the estimate(s), or range of estimates, of the appropriate scope allowance factor(s) and the information and data reviewed in calculating those estimate(s);
 - (ii) consider whether the estimate(s) of, or range of estimates for, the appropriate scope allowance factor is sensitive to the nature of projects being undertaken in a particular regulatory period;
 - (iii) identify any alternative estimates that may be calculated to account for any identified sensitivity;
- (d) Provides the Expert's opinion on whether the scope allowance factor(s) applied by JGN to forecast labour and materials estimates for the 2015-20 access arrangement period produces forecasts that are consistent with rules 74 and 79(1)(a).

In preparing the report, the Expert will:

- consider the relevant provisions in the Rules and the Law relating to forecast capital expenditure;
- consider possible alternative methods and approaches to cost estimation methodology and estimating the scope allowance, including those previously considered, or commented on, by the AER and other regulators;
- use robust methods and data in producing any estimate(s);
- follow the guidelines set out in Annexure A of this letter.

Form of the report

In addition to following the above terms of reference and the guidelines in Annexure A, the Expert will provide an independent expert report that:

- is of a professional standard capable of being submitted to the AER;
- contains a section summarising the Expert's experience and qualifications, and attaches the Expert's curriculum vitae (preferably in a schedule or annexure);
- identifies any person and their qualifications, who assists the Expert in preparing the report or in carrying out any research or test for the purposes of the report;
- summarises JGN's instructions and attaches these term of reference;
- includes an executive summary which highlights key aspects of the Expert's work and conclusions; and
- (without limiting the points above) carefully sets out the facts that the Expert has assumed in putting together his or her report, as well as identifying any other assumptions made, and the basis for those assumptions.

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