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Report for Chorus

UCLL and UBA FPP further draft determination submission – PUBLIC

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1 Introduction

On 2 July 2015, the Commerce Commission published the further draft determination for its final pricing principles (FPP)[1] for the unbundled bitstream access (UBA) service and the unbundled copper local loop (UCLL) service.

Analysys Mason has been commissioned by Chorus to review and comment on the model and documentation underlying this further draft determination. This report provides a summary of our investigations into several different aspects of the determination and is set out as follows:

- Section 1.1 summarises the documents that we have reviewed as part of our investigations
- Section 2 addresses to the modelled access networks
- Section 3 comments on the build parameters and costs assumed in the model
- Section 4 sets out our findings in relation to the UBA model
- Section 5 provides our thoughts on opex
- Section 6 discusses non-recurring costs.
- Section 7 provides findings on the FWA modelling used as part of the FTTH model
- Section 8 provides a summary list of the issues and changes we recommend

The authors of this report have read the High Court code of conduct for expert witnesses and have complied with its requirements when completing this report.

Data that is confidential (i.e. can only be read by those who have signed the confidentiality undertakings) has been indicated by CI and the scissor symbol '✂' and has been deleted in the PUBLIC version.

1.1 Reference documents

Figure 1.1 below summarises the list of the documents that we will refer to in this report. All of these documents are available on the Commerce Commission's website and were published in July 2015. We provide a short name for each document, which we will use to refer to it throughout the report for simplicity. Where we need to refer to an earlier version of a report, such as those issued in December 2014, we will prefix their name with "December 2014".

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1 http://www.comcom.govt.nz/regulated-industries/telecommunications/regulated-services/standard-terms-determinations/unbundled-copper-local-loop-and-unbundled-bitstream-access-services-final-pricing-principle/

Figure 1.1: Documents referred to in this report [Source: Analysys Mason, 2015]

Title	Short name	URL
Report for Chorus: UCLL and UBA FPP draft determination submission – PUBLIC[2]	Analysys Mason submission February 2015	http://www.comcom.govt.nz/dmsdocument/12915
Chorus submission on draft determinations for UBA and UCLL services 20 February 2015	Chorus Submission February 2015	http://www.comcom.govt.nz/dmsdocument/12915
Report for Chorus: UCLL and UBA FPP draft determination cross-submission – PUBLIC[3]	Analysys Mason cross-submission March 2015	http://www.comcom.govt.nz/dmsdocument/13122
Chorus cross submission on draft determinations for UBA and UCLL services 20 March 2015	Chorus Cross-submission March 2015	http://www.comcom.govt.nz/dmsdocument/13122
Model Specification (public version)	Model specification	https://login.filecloud.co.nz/shares/folder/32248963d1ab3a/?folder_id=61
Model Reference Paper (public version)	Reference paper	As above
Model Documentation (public version)	Model documentation	As above
Implemented modelling changes (public version)	TERA model changes document	As above
Analysis of industry comments following draft determination	TERA review of submissions	As above
Draft FPP briefing presentation	Commission briefing	http://www.comcom.govt.nz/dmsdocument/13397
Draft pricing review determination for Chorus' unbundled copper local loop service	UCLL draft determination	http://www.comcom.govt.nz/dmsdocument/13373
Draft pricing review determination for Chorus' unbundled bitsream access service	UBA draft determination	http://www.comcom.govt.nz/dmsdocument/13392
Beca FPP Corridor Cost Analysis Response to Submissions	BECA review of submissions	http://www.comcom.govt.nz/dmsdocument/13375
Beca FPP Corridor Cost Analysis, report 3	Beca report 3	http://www.comcom.govt.nz/dmsdocument/13394

Figure 1.2 below summarises the list of modelling-related materials referred to in this report. We provided a short name for each of the Excel files as well, which we will use to refer to these files as well. We will be referring to the Excel files with the short names provided in the list below. Analysys Mason also has access to the confidential versions of these Excel files, but we refer to the public versions unless we state otherwise.

[2] Document named "Analysys Mason submission on behalf of Chorus for UBA and UCLL services draft determinations 20 February 2015" Ref: 2002396-81

[3] Document named "Analysys Mason on behalf of Chorus on draft determinations for UBA and UCLL services 20 March 2015" Ref: 2002396-123

Figure 1.2: List of modelling materials referred to in this report [Source: Analysys Mason, 2015]

Title	Short name	URL
PUBLIC-ComCom - Access network - v8.0.accdb	(Public) Access database	https://login.filecloud.co.nz/shares/folder/32248963d1ab3a/?folder_id=56
PUBLIC-ComCom - Access network cost model - v8.0.xlsb	(Public) Access model	As above
PUBLIC-ComCom - Inputs for trenches - v8.0.xlsx	(Public) Trench inputs file	As above
PUBLIC_Commission - UBA model v8.0.xlsb	(Public) UBA model	As above
PUBLIC-ComCom-Price trends v8.0.xlsx	(Public) Price trends calculation	As above
Public_TSO_Cluster_Polygons.zip	(Public) TSO polygons	https://login.filecloud.co.nz/shares/folder/32248963d1ab3a/
CI-ComCom-OPEX model v8.0.xlsm	(Confidential) opex model	–
CI_ComCom - UBA model v8.0	Confidential UBA Model	–
CI_ComCom-UBA Inputs v8.0	Confidential UBA Model Inputs	–
CI_ComCom - UBA model v5.1	Confidential UBA Model December 2014	–
CI_ComCom-UBA Inputs v1.0	Confidential UBA Model Inputs December 2014	–
Beca-report-FPP-corridor-cost-analysis-of-trenching-and-ducting-rates-in-NZ-28-May-2015.XLSX	(Public) Beca trench cost analysis	http://www.comcom.govt.nz/dmsdocument/13372

All of the Excel files referred to in this report are used in the calculation of the costs of UBA and UCLL services. The flow of information between the files is illustrated below in Figure 1.3.

In particular, we also show the opex file which is only available as a confidential file.

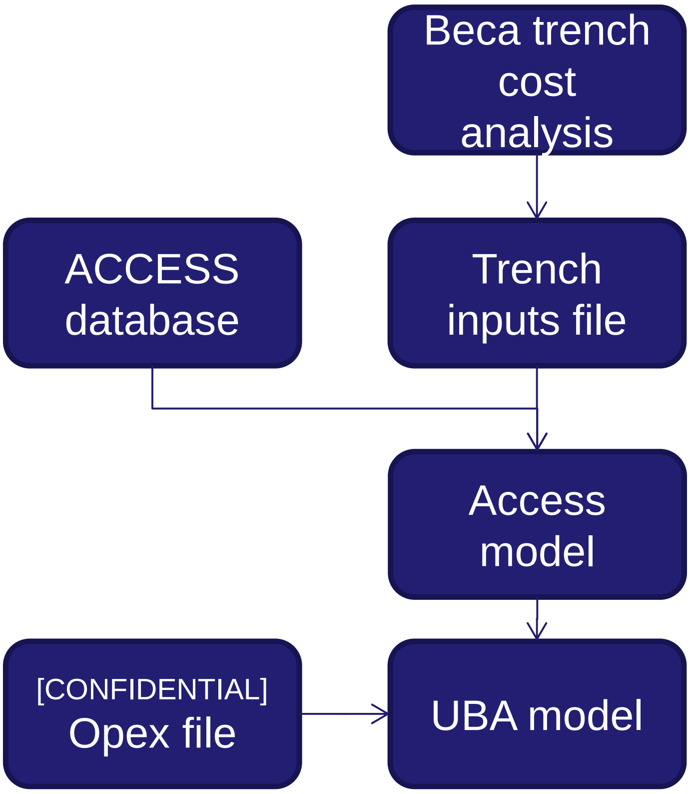


Figure 1.3: Flow of cost calculations in the draft model [Source: Analysys Mason, 2015]

The Beca trench cost analysis file provides the unit cost of trenching for each soil category used in the draft model. The outputs of the Beca trench cost analysis are used in the trench inputs file, which estimates the unit cost of trenching for each ESA. The Access database, which uses a combination of queries and Visual Basic for Applications (VBA) subroutines, calculates the asset counts of all the modelled access networks based on the geographic data (obtained from Chorus/CoreLogic and then pre-processed). The outputs of both the trench input file and Access database are used in the Access model, which calculates the investment and the annual cost of the modelled access networks. The outputs of the Access model feeds into the UBA model that calculates the final unit costs of UCLL and UBA services.

2 Investigations related to the modelled access networks

2.1 Network laterals are incorrectly excluded

Our understanding of the current modelling of assets from the road trench to the building is shown below in Figure 2.1. In particular:

- Street trenches are assumed to lie along the edge of the metalled road surface, since the road width assumed is that of the estimated metalled surface
- An estimated length of vertical cabling is included in the modelled cost base, going from the edge of the building to the edge of the metalled road surface
- No trench or ducting is currently included for this part of the network. This includes any trenches:
  - — within a property boundary (green dotted outline)
  - — between the property boundary and the edge of the metalled road surface (i.e. across pavements and verges/berms, white dotted outline)
  - — where a subscriber-dedicated road crossing is required (red dotted outline).

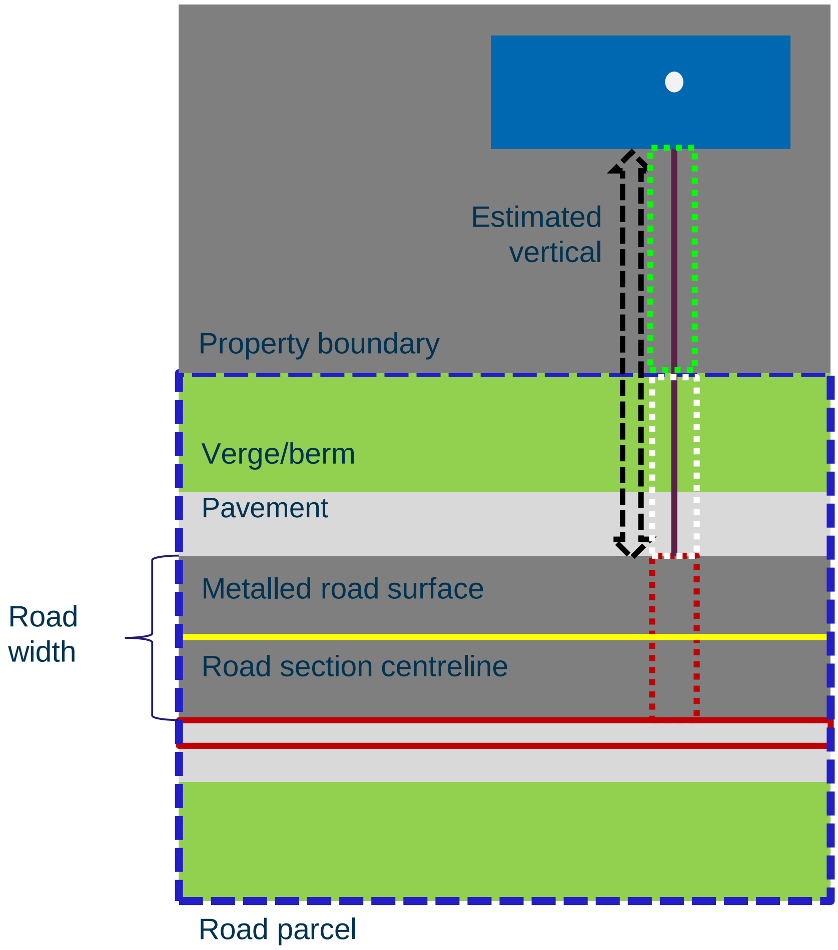


Figure 2.1: Understanding of modelling of assets related to the network from the road trench to the building, as shown for a building requiring a road crossing [Source: Analysys Mason, 2015]

At the moment, therefore, lateral trenches are not included in the cost model. The purpose of laterals is to connect the road network trench to the property boundary.

In the TERA model, this would effectively be the part shown by the white dotted outline, shown in Figure 2.1 above.

Laterals are not part of the lead-in. They should therefore not be assumed to be included within the lead-in trench (and therefore should not be excluded from the model on the basis that lead-in assets are covered by the installation charge).

We recommend that the Commission revise the model in a consistent way. On the basis that the road trench runs beside the metalled surface of the road in the current model, we recommend the Commission calculate the length of trench required from the metalled surface of the road to the edge of the property boundary. This trench length should then be included for each building passed by the modelled network.

Since the Commission has access to datasets for the road parcels, road centrelines, road widths and building locations, this length can be calculated for each building by:

- Step 1: Mapping each building onto its nearest road parcel (length)
- Step 2: Mapping that new point further to its nearest road centreline
- Step 3: Subtracting half of the road width from the length of the line derived in Step 2.

This is illustrated below in Figure 2.2 below.

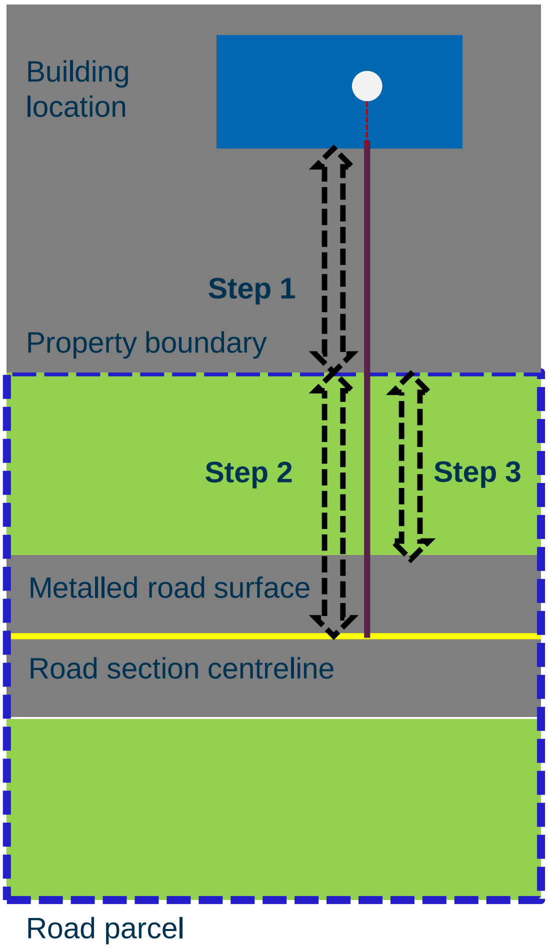


Figure 2.2: Calculation of lateral trench length [Source: Analysys Mason, 2015]

2.2 Optimisation of exchange areas

Picking the closest exchange by road for each road segment is likely to cause some exchange boundaries to be set in a way that a real operator would not choose because although it may be superior to a straight-line based ("Voronoi polygon") approach, it will still not take all major geographical constraints into account when setting the limits of the exchange areas (notably features such as sea/rivers, mountains, railways). Using the real exchange areas will naturally take these constraints into account.

2.3 Lead in assets on rights-of-way

On page 3 of the TERA review of submissions, it is stated that "It may be the case that for some lead-ins, a single trench can be used to connect different buildings (e.g. imagine two buildings next to each other) and therefore sharing may need to be taken into account for lead in trenches. The model has been updated accordingly."

We have investigated this new trench sharing implementation, which is encoded in the SOURCE BUILDINGS table. We illustrate the example for three buildings shown below from the geodata. Their ID_BUILDING values are shown below for reference.

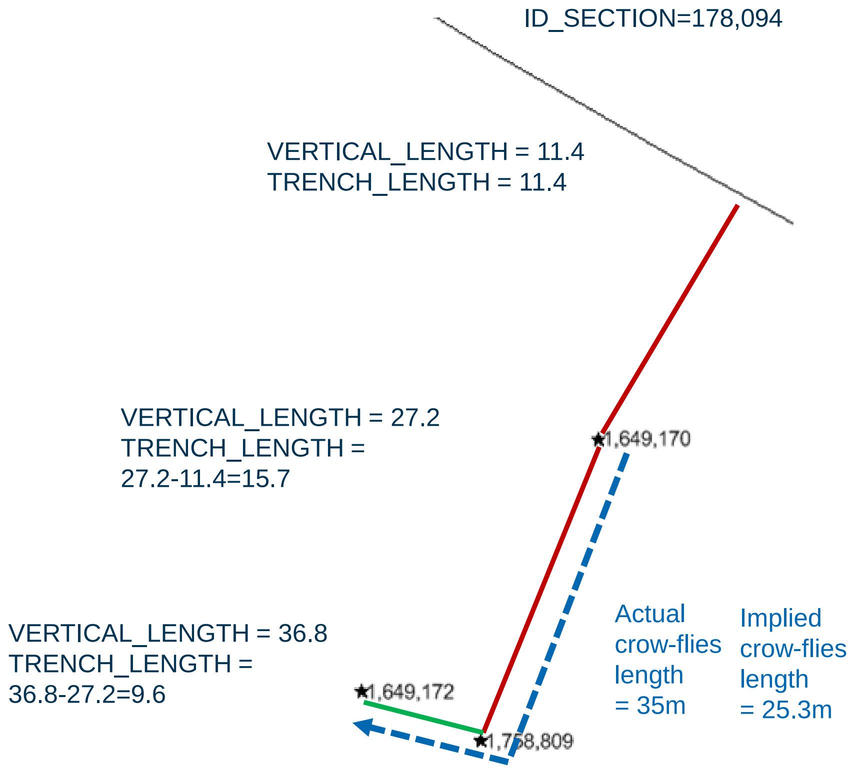


Figure 2.3: Illustration of trench sharing inputs for vertical trenches (all three points have the same PARENT_TRENCH value, equal to 1,649,172) [Source: Commission geodata, 2015]

The SOURCE BUILDINGS table in the Access Database includes a new field called "TRENCH LENGTH", a value which is pre-calculated (i.e. it is not calculated in the database as far as we can identify –which is a process transparency issue).

We have identified two issues with this implementation.

First, the trench required is being systematically under-estimated. The error is that the model calculated distance appears to be the difference between the (original) VERTICAL_LENGTH values even if these two verticals are not collinear. This formula would only be correct in those cases where the buildings are all in a straight line perpendicular to the road section: however, this formula is being used for a wider set of premises when this is not the case. For example, in the example above, the amount of trench required to join the three buildings to each other via two indirect lead-ins (dotted blue line) is calculated as 25.3 m (15.7 m+9.6 m) in the current model, compared to approximately 35 m which would be required in reality (assuming a "daisy chain" of straight line links).

The TRENCH_LENGTH values should be made more accurate, by using the co-ordinates of the points to derive an appropriate "daisy chain" based on crow-flies length.

The full set of corrections for this example is summarised below.

Figure 2.4: Summary of length values (metres) and corrections for the lead-in shown above [Source: Analysys Mason, 2015]

BuildingID	Current TRENCH_LENGTH	Current VERTICAL_LENGTH	Corrected TRENCH_LENGTH	Corrected VERTICAL_LENGTH
1,649,172	36.8-27.2=9.6	36.8	10.0	36.3+10.0=46.2
1,758,809	27.2-11.4=15.7	27.2	24.9	11.4+24.9=36.3
1,649,170	11.4	11.4	11.4	11.4
TOTAL (rounded, 1dp)	**36.8**	**75.4**	**46.3**	**93.9**

We have identified over 600,000 buildings that lie on 255,000 shared lead-ins (the remainder are standalone lead-ins) and undertaken this correction of TRENCH_LENGTH for those cases.[4] Making this correction increases the total TRENCH_LENGTH by 1,280 kilometres (a 9.4% increase in TRENCH_LENGTH).

Second, as a direct consequence of the first issue, since the TRENCH_LENGTH is under-estimated for the indirect lead-ins, the vertical lengths are also under-estimated, since the vertical distance now needs to be measured along the shared trench route. This can be fixed by recalculating the vertical length for all buildings on an indirect lead-in using the corrected trench lengths. The corrections increase the vertical length in the full Access database by 2,270 kilometres (a 9.9% increase in VERTICAL_LENGTH overall).

2.4 The mapping of buildings to road segments is not always correct and this is leading to material underestimation of horizontal network asset counts

In Section 2.5 of the Analysys Mason submission February 2015, Analysys Mason noted that the mapping of buildings to road segments was incorrect.

The example we provided (shown below in Figure 2.5) illustrated a road section in Kaukapakapa (KPA) ESA and all of the buildings allocated to this road section. As shown below, there are 11 buildings allocated to the road section. However, two of these buildings were closer to other road sections shown in grey.

[4] This data can be provided to the Commission if it desires

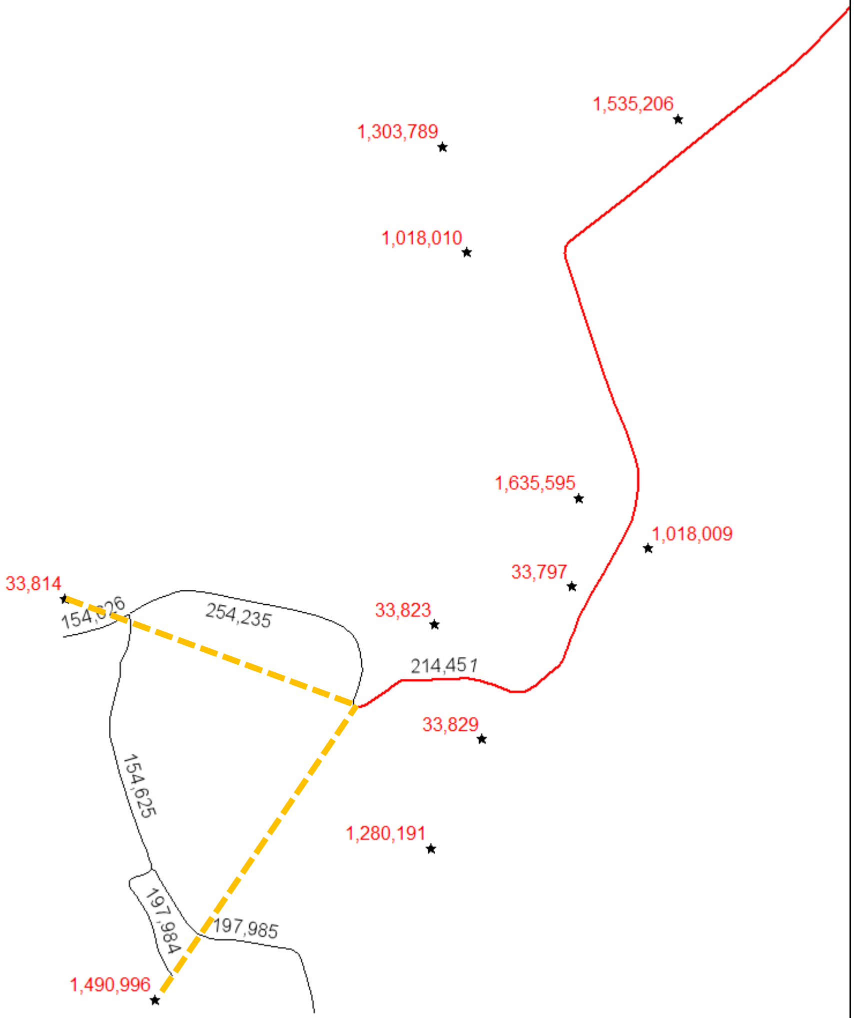


Figure 2.5: Illustration of odd allocations of buildings to road section in the KPA ESA; the road section in interest is in red line, road section identifiers are in black text and building identifiers are in red text [Source: Analysys Mason, 2015]

On page 5 of the TERA review of submissions, TERA stated that "this point has been assessed and no change is needed." No rationale is given. We have investigated this issue further, since we believe that this issue is a material one, particularly since a significant amount of infrastructure related to the vertical length is now excluded from the modelled cost.

We have used the road sections and building locations provided by the Commerce Commission and the mapping of road sections/buildings to ESAs as in the July 2015 Access database. Within each ESA, we have then mapped each building to its closest road section using MapInfo. Our calculation leads to 17% of the 1.815 million building locations being allocated to a different road section compared to the model. Our calculation leads to a 9% increase in the length of road sections with one or more addresses on it (equivalent to 8.2 million metres of additional road sections, though not all of this road will necessarily need horizontal distance in the modelling). In particular, there is a 13% increase in road section length within TSO areas that are not served by FWA (equivalent to 4.9 million metres of road sections).

We can provide a shapefile of the line segments between each building and its nearest road section (including the mapping of ID_SECTION and ID_BUILDING) to enable the Commission to review this if this is useful.

2.5 Some calculated trenches are excluded from the model

When we compare the outputs in the tables PROCESS SECTION MODELLING and CU/FB UG MODELLING, we have found that some trenches are excluded. For example, we have identified in PROCESS SECTION MODELLING that there are more than one hundred road sections where LENGTH_TRENCH_CROSS_DISTR_FB >0 but SIZE_TRENCH_CROSS_FB=0. We think that this is an error and suggest that, in the queries SELECT HOR TRENCHES CU/FB, that the use of ">=1" is replaced by ">=0".

3 Investigations related to the build parameters

3.1 The trenching costs derived by BECA are not representative of actual costs in New Zealand

As described in Section 3.3 of the Analysys Mason submission February 2015, the unit trench costs resulting from Beca's analysis are grossly underestimating actual project digging costs in New Zealand. Our analysis of Chorus' own project digging costs (covering their significant UFB and RBI-related deployments in recent years across a mix of urban and rural projects), resulting from competitive procurement processes, indicate significantly higher costs per metre than those estimated by Beca.

This data, and our accompanying analysis, has since been submitted to the Commission. We strongly recommend that the Commission take proper account of this significant body of real-world, New Zealand telecoms-specific information. In particular, the data from the UFB digging projects can offer the Commission significantly improved data as to how trench costs build up in urban areas, including costs such as arborist activities, consents and traffic management.

We have undertaken a more detailed comparison of Chorus costs of trenching compared to those used in the December 2014 and July 2015 releases of the Commission's model. In particular, we have adjusted both our analysis of the Chorus data and the TERA model so that they are as comparable as possible. We describe this below, where we:

- Set out the average costs of trenching derived using our previous analysis of Chorus data
- Describe our calculation of comparable average costs of trenching using the TERA model
- Consider how the differences in the two averages can be reconciled
- Recommend changes that the Commission should make to the modelling assumptions.

Average values derived using Chorus information

In the data and accompanying analysis submitted to the Commission, the average cost of trench derived was **[CNZCI:**NZD✂✂**]** per metre. This was calculated by considering the unit costs per metre derived on an ESA-by-ESA basis, then blended by CSA, based on analysis of Chorus cost data from a large set of UFB and RBI projects. The average is weighted based on the route metre in Chorus' actual trench network split by both ESA and feeder/distribution for their national copper network.

The Chorus information captured costs of:

- Trenching, reinstatement and drilling/thrusting
- Additional width for those trenches containing multiple ducts
- Installation of the first duct (but not duct material costs)
- Traffic management and costs of arborists

- Laterals.

The Chorus information excluded other costs of underground infrastructure, including the costs of installing additional ducts, all duct material costs, manholes and cabling.

We do not believe that the Beca trench analysis considers the costs of laterals (which form part of the "vertical" trench in the TERA model. In the Chorus information, the costs of laterals were included in the costs but the corresponding metres of lateral trench were not included in the trench metre volumes. To compare on a like-for-like basis, these lateral costs need to be excluded from the Chorus data. The UFB dataset separates out the costs of laterals: analysis of this dataset indicates that laterals comprise **[CNZCI:**✂%✂**]** of the total trench-related cost. If we adjust our previous average of **[CNZCI:**NZD✂✂**]** per metre to exclude laterals on the same basis, then this gives an average of **[CNZCI:**NZD✂✂**]** per metre. We believe this average is best for comparison with the values within the TERA model and will be used for the remainder of Section 3.1.

Constructing a comparable average value from the TERA model

To compare this real New Zealand cost data to the unit cost in the TERA model, we have adapted the model to:

- Exclude vertical lead-ins and laterals
- Include only the installation of the first duct
- Represent a network passing all buildings in New Zealand using a predominantly underground network.

The specific adaptions applied are summarised below.

Figure 3.1: Summary of adjustments made to the TERA model files [Source: Analysys Mason, 2015]

File	Adjustment
Access database	Set all vertical lengths to zero
Access database	All buildings are passed by the network (i.e. TSO and non-TSO locations are included, all in-fill is also included)
Beca trench cost analysis	Duct installation cost only included for the first duct. No duct material costs are included.
Trench inputs file	The table for "Geotype length per MDF" uses the length of road sections by soil type (and urban/rural in the July 2015 model) from the Access database, since a national network is being considered
Access model, "MDF data" worksheet	• 0% of cost is allocated to leased lines • 5% of lead-in and distribution is aerial[5] • 0% of feeder is aerial • 0% of underground infrastructure is shared

[5] This is consistent with page 10 of the TERA review of submissions, which states that the real network consists of approximately 5% of aerial.

File	Adjustment
Access model	The copper network is considered for our calculation and we only consider the costs and metres of trench assets allocated to the lead-in, distribution, feeder, FWA and Core_DSLAM categories

We have then calculated three different cases:

- Using the December 2014 model release
- Using the July 2015 model release
- Using the July 2015 model release, having made corrections to the Beca trench cost analysis and trench input file as we describe later in this document (see Figure 8.1 and Figure 8.2).

Consideration of these like-for-like averages

When we compare the average cost of trench in the December 2014 and July 2015 versions of the TERA model, we can see from Figure 3.2 that the net change of all the assumptions is a *reduction* in the average cost of trenching, when calculated according to the assumptions in Figure 3.1 above (i.e. a copper network passing all buildings, with 5% aerial, excluding vertical trenches, only including installation for the first duct, excluding all other duct/cable/manhole costs).

One reason for this reduction is the introduction of the mole ploughing trench method, which is assumed by TERA to be significantly cheaper than methods like chain digging and directional drilling.

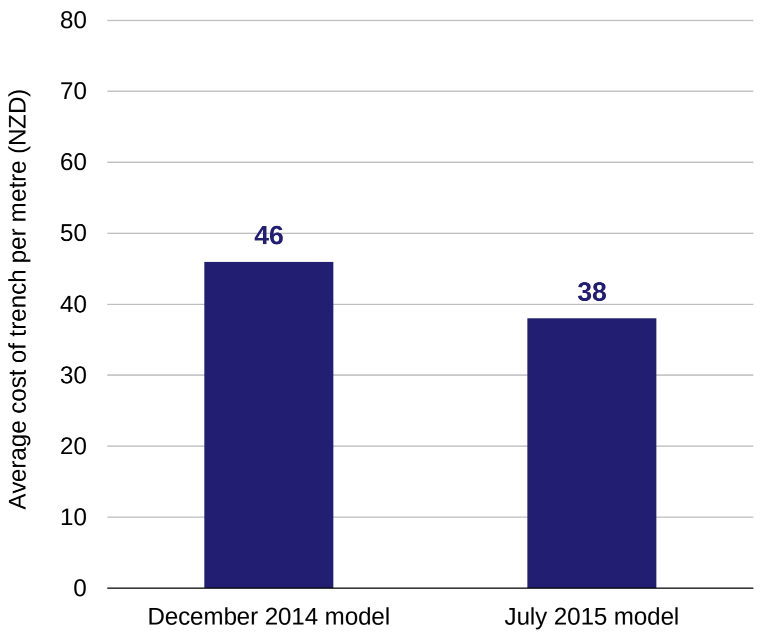


Figure 3.2: Comparison of average trench costs implied in the two releases of the TERA model [Source: Analysys Mason, 2015]

As can be seen below in Figure 3.3 the cost per trench metre in the July 2015 model is significantly lower **([CNZCI:✂✂]** lower) than that derived from our analysis of Chorus' actual cost information.

[CNZCI:✂✂]

Figure 3.3: Comparison of average trench costs implied in the July 2015 TERA model versus Chorus information [Source: Analysys Mason, 2015]

As described in Sections 3.2-3.5, we have identified several errors, omissions and inputs that could be improved in the Beca trenching inputs. For example, on the *Dir.Drilling* worksheet, we observe that directional drilling of a 150mm drill hole costs NZD31 per metre, covering drilling, entry/exit trenches, installation of the first duct and consenting costs (excluding traffic management and overheads). The Chorus data indicates a basic drilling/thrusting cost of **[CNZCI:**NZD✂✂**]** per metre across all UFB projects (including installation of the first duct but excluding overheads, laterals, reinstatement, traffic management and arborist costs).

Changes that would approximately match the experience of Chorus, as shown in the trenching cost file provided to the Commission, would include the following changes:

- Set 'Urban Buildups'!C27 and C3 = **[CNZCI:**NZD✂✂**]** which would correct the average base trenching rate (50mm duct)
- Set 'Chain Trench'!F30 and F4 = **[CNZCI:**NZD✂✂**]** which would correct the average base trenching rate (50mm duct)
- Set 'Dir.Drilling'!E32 and E4 = **[CNZCI:**NZD✂✂**]** which would correct the average base drilling rate (50mm duct).

When we make the changes described above, and address the points raised in Sections 3.2-3.5, the difference between the unit costs of trenching is reduced, as shown below in Figure 3.4. Again, these average costs of trench per metre are based on the assumptions set out in Figure 3.1 above.

[CNZCI:✂✂]

Figure 3.4: Comparison of average trench costs implied in the July 2015 TERA model with our adjustments implemented versus Chorus information [Source: Analysys Mason, 2015]

There remain other costs that we believe are not currently being captured in the Beca trench inputs file, such as costs of arborists and service company overheads that would lead to further increases.

Conclusion

The adjustments we suggest below to the Beca trench file and trench inputs file that we recommend in Figure 8.1 and Figure 8.2 materially reduce the substantial gap in the average unit cost of trenching between the TERA model and the real world costs.

To be clear, these adjustments are separate from the issue described in Section 2.1 (i.e. the exclusion of laterals).

3.2 The current use of the Beca trenching costs in the model is incorrect

Even if the Commission continues to use the BECA trenching costs (which we do not agree with), then we believe that the way these are used in the model is incorrect.

In particular, the methodological choice is that the cheapest trenching method in an area is always applied[6] and the way Beca's outputs are used is inconsistent with their recommendations, as described below.

Use of cheapest trenching method

On the *Trenching inputs (w ducting) b* worksheet of the trench inputs file, for each soil type and duct size the costs of several trenching methods are presented. The cheapest[7] one is then carried forward into the model. This does not reflect real-world deployments at all, as it is not always possible to use the cheapest.

For example, in the urban trenching section of the aforementioned worksheet, there are three trenching methods included: open trenching, directional drilling and thrusting. Directional drilling is always the cheapest method for trenches with 1–3 ducts and therefore the model is implicitly assuming that all such routes use directional drilling.

In Beca report 3 (page 7), Beca themselves state that "Directional boring can be used in a wide variety of conditions but is not the optimal method in all conditions".

Chorus have real-world evidence that this is not the case, as shown in the actual cost information submitted to the Commission. Using the trench information supplied by Chorus to the Commission, which comes from the information gathered in relation to 1162 UFB projects (primarily in urban areas), **[CNZCI:✂%✂]** of the route metres in these projects are normal trenching, with the remainder being either directional drilling or thrusting.

Therefore, it is clear that one cannot assume that the cheapest trenching method can always be used. In the particular case of the urban trenching costs (i.e. on the *Trenching inputs (w ducting) b*

[6] Due to an error in a formula, the second cheapest is used in some parts of the Trenching inputs (w ducting) b sheet, where for the softest soil types, the formulae exclude the mole plough method, which means the second cheapest is actually carried forward

[7] See previous footnote

worksheet), we propose that the cost used is not the minimum, but rather 0.75 × cheapest trench cost + 0.25 × open trenching cost, reflecting the real-world data we have gathered within the UFB project.

We would also propose that a similar modification is used for rural trenching costs on the *Trenching inputs (w ducting)* worksheet, since the cheapest methods are usually mole ploughing and chain digging. As described below, Beca state that these trenching methods cannot be used where there are existing underground services, which will include some rural routes. We therefore propose that the cost used on this worksheet, where mole ploughing/chain digging are present, is 0.75 × cheapest trench method cost + 0.25 × open trenching cost.

Inconsistent implementation of Beca's recommendation

In Beca report 3, Beca make the following recommendations:

- Page 4: Chain digging is "not suitable in urban environments, rocky soil (types 4 & 5) and un-consolidated soils" and "cannot be used cost effectively where existing underground services are present"
- Page 5: Mole ploughs are "not suitable in urban environments or for harder soil types" and "cannot be used cost effectively where existing underground services are present".

In the current trench inputs file, the *Trenching inputs (w ducting) b* worksheet is intended to be used for trenching in modelled urban routes (which will also have existing underground services present), but still includes options for both chain digging and mole ploughing. Based on Beca's recommendations, there should be **no** instances of either of these trenching methods on this worksheet.

Incorrect/complete calculations

We note that TERA include reinforcement/reinstatement costs on the worksheet to be used for TERA's definition of urban areas (Trenching inputs (w ducting) b). However, we believe that the reinstatement costs (though not reinforcement) should also be included in the urban trenching costs on the sheet used for TERA's definition of rural areas (Trenching inputs (w ducting)). This is because urbanised roads in rural areas will likely be paved and therefore reinstatement will be required.

3.3 Several drill hole/trench dimensions assumed by BECA are not physically possible

We have identified several additional errors in the file that should be corrected to prevent unnecessary underestimation of the costs

First, the inputs in cells 'Buildups 100dia'!B34:B49 (trench depths for open trenching in soil type 1) are not consistent with cells 'Buildups 100dia'!B7:B22 and 'Buildups 100dia'!B61:B76 (equivalent inputs for Type 2 and Type 4 respectively). The entries in 'Buildups 100dia'!B34:B49 should be aligned with the other two sets of inputs.

Second, the assumed drill hole diameters for the installation of 110mm duct in column C of the *Dir.Drilling* worksheet in the Beca trench cost analysis have several flaws.

We illustrate the current Beca 110mm duct drill hole assumptions in Figure 3.5 below for the seven cases assumed in the calculation. Where the Beca assumption is not physically possible, we highlight these drill holes by red rings. Where they are possible, or where we have a more appropriate diameter, we highlight these with green rings. Where we think the assumption is physically possible, but not reasonable, we highlight these with yellow rings.

In particular, the assumption that two 110mm ducts can fit into a 150mm drill hole (shown by the thicker red ring below) is incorrect.

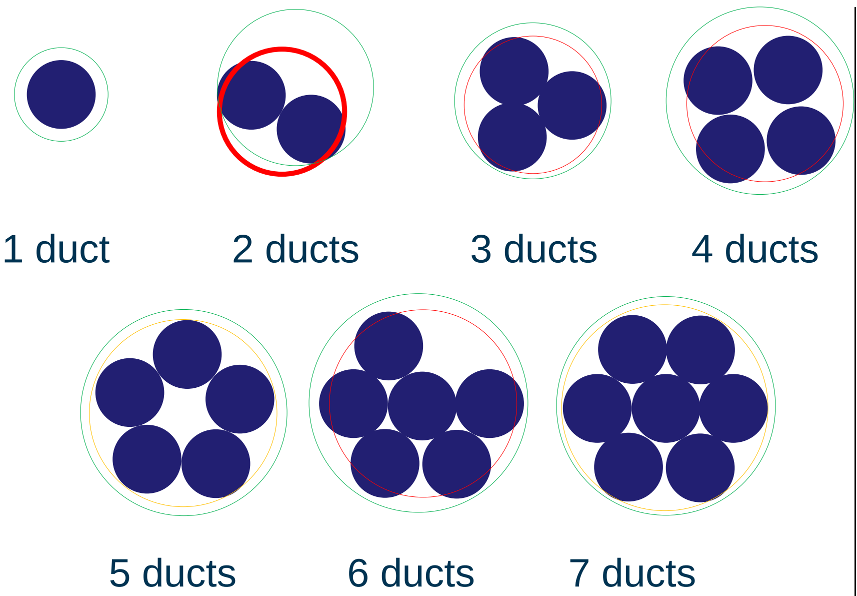


Figure 3.5: Illustration of drill hole assumptions used by Beca for 110mm ducts (physically impossible assumptions shown in red) [Source: Analysys Mason, 2015]

We therefore recommend that the changes summarised in Figure 3.6 below should be made. The assumptions for five ducts and seven ducts, although possible, lead to tightly packed drill holes. The five duct case, assuming they were arranged in the pentagonal configuration shown above, would fit tightly in a 0.297 metre drill hole, whilst the seven duct case fits exactly into the assumed 0.330 metre drill hole. We think it is reasonable to increase the diameter size for these cases as shown below, since otherwise there is a risk of duct damage upon installation into such tight fitting drill holes.

Ducts	Cell reference	Current value (metres)	Revised value (metres)
2	C37	0.20	0.25
3	C38	0.22	0.25
4	C39	0.25	0.30
5	C40	0.30	0.33
6	C41	0.30	0.35

Figure 3.6: Changes to be made to the Dir.Drilling worksheet [Source: Analysys Mason, 2015]

7	C42	0.33	0.35

3.4 The harmonic weighting calculation is still not being applied correctly

In Section 5.2.3.2 of the model documentation, TERA set out their method of using “harmonic” weights to derive the distribution of small, medium, large, very large and very very large ducts. The formula displayed in this section, as well as the surrounding text, clearly indicate that it is intended for a harmonic weighting to be used. Also, on row 58 of the *Soil-specific trenching costs* worksheet in the trench inputs file, it states that “Computations are made through an harmonic average.”

However, the implementation on row 64 of this worksheet uses an “exponential harmonic” weighting.

It is obvious that the intention is to model a harmonic weighting, not an exponential harmonic. Therefore, cells G64:P64 should be corrected accordingly (for example, cell G64 should have the formula “=1/G60” rather than “=EXP(-G60)”.

3.5 Exclusion of arborist costs

On page 9 of the TERA model changes document, TERA state “No data has been provided for arborist costs.” This is incorrect: arborist costs were provided to the Commission and TERA in the file **[CNZCI:✂✂]**, submitted as part of the Section 98 response.

Chorus have also submitted the underlying trenching data for actual digging projects for the UFB and RBI initiatives, as described in Annex A of the Analysys Mason cross-submission March 2015. The data for the UFB-related projects separates out costs for arborist-related activities.

3.6 HFC demand being included

We note that there are only two other countries that we are aware that consider demand on HFC networks in the context of a cost model of access networks. These are in Denmark and Norway. In both cases, the HFC demand included is restricted to that served by the HFC network owned by the incumbent operator. This is not the situation in New Zealand as Chorus does not own the HFC network.

3.7 Pole rental capitalisation

The way in which the power company pole rental charges are turned into an assumed capex has been done using the December model WACC. This is inconsistent. Aligning the WACC in this calculation to the new lower value will remove the inconsistency.

4 UBA model

4.1 Update to unit costs

4.1.1 Fees and management uplift calculation is incorrectly applied

TERA has made the following errors when including the cost of “fees and management” to the indirect unit cost for the active electronics:

- The cost uplift is not applied at all to either DSLAM racks or switch racks
- The cost uplift is applied incorrectly to DSLAM subracks (the lack of brackets means it is only applied to the last item in the list of indirect cost items)

4.1.2 Design and test is omitted

TERA has also not included any cost relating to the *design and test* of the new network, nor the *commissioning* of the new assets. We suggest an additional markup should be added to the “asset cost including installation” to cover this design and test effort.

4.1.3 Direct unit costs are incorrect for certain items

The purchase cost of a switch rack is not included at all (this is listed in the s98 response **[CNZCI: ✂ ✂]**.

TERA has selected the *indoor* variant of VDSL line card *without integrated splitter* for use in *cabinets* and the *outdoor* variant of VDSL line card *with integrated splitter* for use in exchanges. Chorus has confirmed that the cost difference between these two types of cards is driven by the integrated splitter functionality. We recommend that TERA uses the *with-integrated splitter* card for both exchanges and cabinets (or adds a separate asset for the splitters, with additional costs).

TERA has selected an earlier generation of switch fabric module (SFM-3, not SFM-4). SFM-4 is the up to date variant currently being deployed by Chorus. We recommend that TERA updates its switch unit costs to consider SFM-4.

TERA has not included either the direct or indirect cost of IOM switch cards, which are required to mount MDA cards in the switch subracks, as indicated in the s98 response.

4.1.4 2014 cost data is used as 2013 data without taking price trends into account

We note that TERA takes 2014 cost data from s98, labels this as 2013, and then reduces these costs by one year of price trend to represent “2014” values for use in the model. We believe this to be an error: TERA should use the 2014 values in the s98 with no adjustment.

4.2 Traffic dependence

The model has also been updated to consider the traffic being carried in the dimensioning of the SFP ports at DSLAMs, which in turn drive the equivalent SFP ports at the first data switch. TERA do not then consider whether the subrack chassis have sufficient capacity to hold the required number of ports. In 2020, three ports per sub-rack are required in one exchange location: we understand that the Alcatel Lucent 7302 chassis used by Chorus has a maximum capacity of two ports.

TERA do not consider whether the RSP ports on the first data switch provide sufficient capacity for the aggregated traffic from the DSLAM. When the model is set to 2020, the RSP ports do not provide sufficient capacity.

4.3 Spare capacity in DSLAMs and FDS

In TERA Review of Submissions, TERA state, in response to WIK's section333, that they have updated the model to include additional spare capacity. However, in the TERA Model Changes Document there is no mention of change to spare capacity. The overall levels of spare capacity mentioned by WIK are reasonable. We recommend that spare be included e.g. by using 20% in the UBA model Assets sheet Column I ("local spares") for the relevant exchange and cabinet line cards.

4.4 Errors relating to handover connections

Specific issues have been identified in TERA's modelling of handover connections.

Error in RSP port gradient formula

Implementation of modelling options for selecting the RSP gradient has an error in the formula and is currently not functioning as designed. The UBA model has the option of modelling the cost based on former prices, speed or cost. There is an error in the formulae which results in the speed gradient not functioning correctly: when the speed gradient is selected the RSP gradient for costs are calculated. We suggest a correction in Figure 8.7 below.

10G handover cost differential

The calculation in Parameters!I124 is distorted by being based on a switch fully populated with cards supporting just a single 10G port, when 2x10G cards are available.

Cost of handover connection

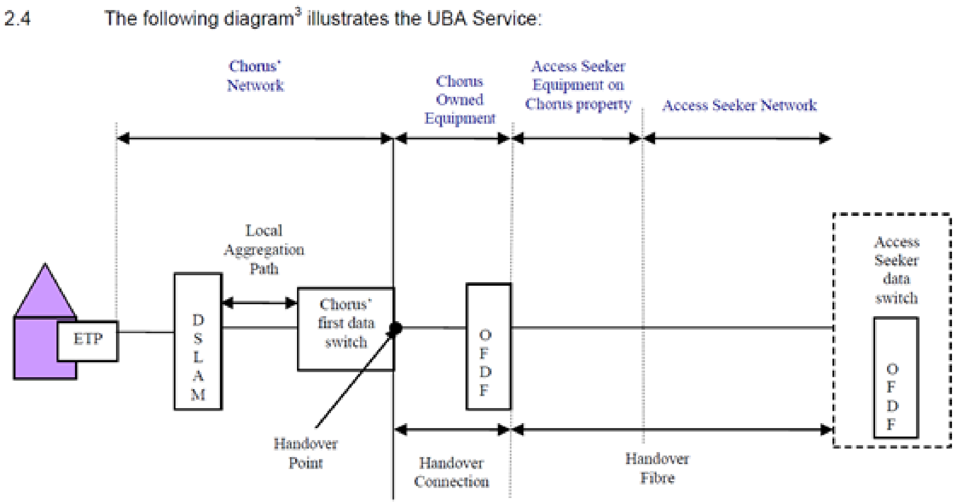
The costs used to calculate the handover connection do not include all the assets required to allow a handover connection.

The current version of the STD defines a handover connection as the Chorus Owned Equipment and includes:

- the port on the relevant data switch;
- the optical fibre from the port to Chorus' OFDF; and
- the OFDF.

This is shown in Figure 4.1.

Figure 4.1: Scope of UBA and associated services [Source: Commerce Commission, 2015]



TERA include only a share of the switch costs in the handover connection, and omit the costs of the fibre cables from the FDS to the OFDF and the costs of the OFDF itself.

5 Opex

5.1 The use of short-term Eircom LFI data to drive New Zealand costs is inappropriate

On page 10 of the TERA review of submissions, TERA state that “When setting the target LFI, the following formula is used: Target LFI NZ = Target LFI Ireland x real LFI NZ / real LFI Ireland.”

We observe that this is not what was implemented in the first version of the model in December 2014. As described in the December 2014 model documentation, the target LFI in Ireland for a hypothetical operator is 8%[8]. As described in the Commission’s UCLL decision, Chorus’ actual LFI is 15.8%.[9] The target LFI in New Zealand in the draft model was 9.9%[10]. As a result, the value used by TERA for the “actual” LFI in Ireland must have been (8%× 15.8%)/9.9% = 12.8%. Therefore, since full-year data was not available at the time, it appears TERA took the full-year target of “A maximum fault rate of 12.8 line faults per 100 lines” as quoted by ComReg in the report referenced by TERA, rather than (for example) estimating a full-year actual fault rate based on a forecast of the not-yet-available data.[11]

For the July 2015 release of the model, TERA has full-year data for Eircom’s fault rate for the period Q3 2013–Q2 2014. This included the highest quarterly fault rate for Eircom since the first reports were published in Q2 2008, as shown below in Figure 5.1 below.

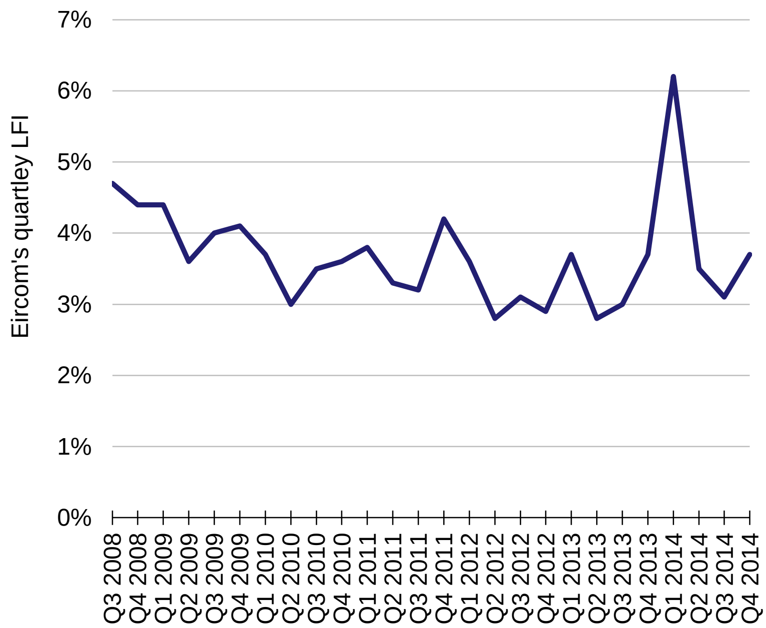


Figure 5.1: Eircom quarterly LFI since Q2 2008 [Source: ComReg regular reporting, 2015]

[8] See http://www.comcom.govt.nz/dmsdocument/12784, page 126

[9] See http://www.comcom.govt.nz/dmsdocument/12771, page 79

[10] See http://www.comcom.govt.nz/dmsdocument/12784, page 132

[11] See footnote 22 of the December 2014 model documentation, where “ComReg 14/44, page 9” is cited

TERA has changed its calculation and used the actual fault rate for the period Q3 2013–Q2 2014 to drive the calculation of target LFI in New Zealand. This is despite this actual fault rate for Eircom being strongly affected by a single exceptional period and as a result the highest rolling average since early 2009, as shown by the light blue line in Figure 5.2 below.

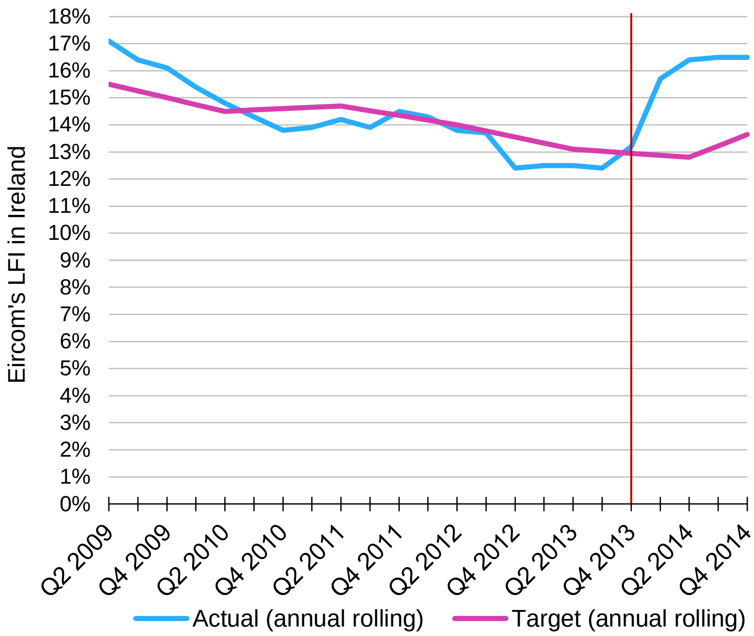


Figure 5.2: Rolling average annual LFI for Eircom [Source: ComReg regular reporting, 2015]

This approach leads exceptional events that induce higher network maintenance costs for a limited period in Ireland to induce lower modelled network maintenance costs (and therefore wholesale prices) for a much longer period in New Zealand. The effects of such exceptional events ought to be disregarded in any case; second, it is unreasonable to view exceptional poor performance in Ireland as implying lower costs in New Zealand.

We suggest that the Commission should revert to using 12.8% as the relevant "actual" figure for Eircom.

5.2 Correction for additional aerial deployment in the aerial opex

We support the implementation of a correction to the maintenance opex to reflect the high proportion of aerial deployment modelled for New Zealand, as described in page 10 of the TERA review of submissions. We believe TERA has underestimated the size of this effect.

TERA has responded to our data by noting that a confidential source indicates that Aerial LFI = Underground LFI + 4.0%. A 4.0% x (47% - 5%) adjustment has then been added to the current target LFI to account for increased use of aerial deployments as compared to the real network.

The use of a confidential (and not independently verifiable) benchmark is not transparent.

The data we presented from analysis of ARMIS data indicated that the total annual cost of maintenance of the aerial network per kilometre was materially higher than for underground (ducted or buried) network. The per-kilometre per annum figure we extracted for aerial cable was 167% of the buried figure. Using these figures, a move from a 5% to a 47% aerial network would be expected to lead to a 27% increase in the annual maintenance cost based on the change in the blended average maintenance cost per kilometre, given by

$$[(47\%\times1.67) + (53\%\times1.00)] / [(5\%\times1.67) + (95\%\times1.00)].$$

Another analysis by NERA of similar but earlier ARMIS data suggested that a 42% increase in the use of aerial would result in an even higher increase in the annual maintenance cost.

These increases in cost are equivalent to increases in the target LFI which are larger than those of TERA (a multiplier of 127% rather than 111%for TERA).

The result of TERA's processing of their single confidential data point is lower than would be implied by the transparent ARMIS data. Given that the ARMIS data we have analysed includes the three largest US players, this will be an average over a significant number of US states[12] and is in our view likely to be a better estimate of the size of the effect than data from a single confidential country.

5.3 A non-labour opex trend of 0% nominal is too low for floorspace and power assets

0% nominal is a low forecast for non-labour opex, especially for floorspace costs (property fit-outs, buildings and land) and power assets. We note that for the latter case, the TERA model uses a positive cost trend to depreciate the power assets, so it is likely that a similar positive trend should be applied to non-labour power opex e.g. on the Energy allocation worksheet of the opex model.

[12] We note that the Commission has previously included US state-level data as part of its benchmarks.

6 Non-recurring charges (NRC)

6.1 TERA overall approach

In selecting an approach of "Chorus costs with efficiency adjustments", TERA's explicit assumption in its NRC methodology paper is that Chorus "may" be asking for "inefficient/redundant tasks" from service companies.[13] TERA does not say that there "are" actual inefficiencies in Chorus processes; it provides no direct evidence of any inefficient or redundant task. It simply assumes there "may" be inefficiencies and that comparing total process duration with other countries is an appropriate way to adjust for those potential inefficiencies.

This high level comparison is not a sound basis for efficiency adjustments. A proper adjustment would start by comparing the processes used in NZ (between the processes used by the Service Companies when serving Chorus and other New Zealand operators such as the LFCs) or potentially in different countries and then understand the source of any differences in processes identified. Process difference can be driven by a number of factors. Some differences could come from factors outside of Chorus control such as for instance specific NRC requirements (imposed by statute, local planning requirements, or by the Commission). Other differences could come from existing Chorus network architecture and/or IT systems (e.g. more automated processes may only be possible with significant investment in advanced IT systems, and the FPP modelling would need to be consistent between the processes assumed and the IT spending). Once such differences had been taken into account, then the other sources could be used to consider efficiency.

Instead, TERA simply assumes that the processes are comparable with a set of benchmark countries (which appear to have been selected purely on the grounds of availability of data). This is not a robust approach: the approach they have adopted does not in one key dimension (time taken) directly focus on the costs required in New Zealand.

6.2 The task duration benchmarks are not done robustly and result in unreasonable efficiency adjustments

We agree that transport costs and labour costs reflect the local nature of each country and cannot easily be benchmarked. In fact, the data provided by Chorus shows that there are variations even within New Zealand (e.g. different labour rates and travel times in different CSA zones).

13 ""However, those tasks may not always correspond to the most efficient process today: indeed, the content of the service codes which service companies are required to carry out may include some inefficient process. Therefore, assessing the time spent to complete those tasks, through an international indexation, safeguards against inefficient/redundant tasks being asked of by Chorus to service companies, and then charged to alternative operators.", 'TERA UBA and UCLL non-recurring charges methodology ' page 13

TERA's NRC benchmark only compares processes on one dimension (total process duration) without taking other factors into account

Comparing only one dimension (such as task duration) when costs can be affected by multiple interacting factors introduces risk. A good example of the risk involved comes from the potential trade-off between task duration and labour costs. It is possible that some of the operators in TERA's benchmarks have decided to use more experienced labour that take less time to perform certain tasks but cost more (or have invested in superior but more expensive tools which reduce time taken). Another difference may be in quality: if jobs are not completed carefully then over time the LFI will increase.

The Commission should be extremely careful in making adjustment to task duration given that the benchmark only takes into account one of the parameters (ie time).

If TERA is seeking to benchmark times excluding travel time, then it needs to select inputs that also exclude travel time

TERA states (UBA and UCLL NRC methodology paper p23)

> For some countries, transport time is included in the data. It was not always possible to extract from available data the time that really corresponds to effective labour at the exchange/customer premises. As a consequence, the times presented in the analysis are sometimes higher than effective required labour time, which seems to be a conservative approach for the assessment of service companies' direct costs[18]

This approach just makes the data set much less useful. If the Commission is seeking to use other countries data on task times excluding travel time, TERA should select those countries which can contribute data on this specific narrow point and reject the others.

If that reduces the benchmark to just one or two countries then this properly illustrates the paucity of the data being used.

TERA's NRC adjustment is biased toward cost under-recovery and is highly dependent on outliers

For each service code, TERA selects the lowest total process duration in the benchmarked countries and then uses that value to set the non-travel time task duration for the HEO NRCs. This biases the adjustment towards cost under-recovery as it means that the adjusted operator is assumed to be able to take the least time anywhere in the world (noting that no attempt has been made to examine reasons for New Zealand-specific timings e.g. network architectures or type of equipment).

It also means that the result is very dependent on the value of the country with the lowest total process duration (i.e. it uses outliers). In fact, a review of TERA's model shows that the lowest total process duration always comes from one of two countries (**CI:[✂✂]** or Country A). Increasing the sample size has not had the effect desired by the Commission ("By increasing the sample size to include multiple international service companies we can more accurately assess task time efficiency of local service companies.”) [14]

An approach that is less dependent on outliers would be to modify the task duration adjustment to be based on the median total process duration. We note the Commission’s reasoned preference for using median values in other benchmarking exercises such as the IPP, and recommend that it adopt the median in this case (we note that it would be essential to exclude from the sample countries where the travel time is included, as we recommend above).

If the current NZ actual value is below the median, then a pragmatic solution would be to view the current value as efficient and adopt the current NZ value.

6.3 Lack of transparency

Country A is not identified, and its appropriateness (and indeed the original source of the data) is unverifiable. This is particularly troublesome as in the current situation, data from this country is sometimes setting the time required and hence the price.

6.4 Hourly rate calculation

In terms of the hourly rates used in the calculation of core NRCs, we agree with the use of the labour rates provided by Chorus in the Service companies’ costs sheet.

6.4.1 Variation over time

The model does not seem to include a provision for Labour Cost Index adjustment of the labour part of the core NRCs. Either the price of core NRCs should increase over time (in line with the Labour Cost Index) or the price of core NRCs should be set for the next regulatory period so that the effect of the future labour cost index is captured in the price for the period.

6.5 Service company overheads and Chorus overhead

We agree with the use of the actual service company overhead as a mark-up to be included in the cost of NRCs.

The way the Chorus overhead has been calculated will result in an under-estimate as the new lower charges (based on lower time estimates) will lead to less revenue for NRC and thus the dollar amount of overhead recovered with the new charges will be lower.

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[14] ‘Further-draft-pricing-review-determination-for-Chorus-unbundled-copper-local-loop-service-2-July-2015’ paragraph 600

6.6 Use of LFC data

TERA has recommended that if the resulting figure is lower than that suggested by similar LFC data, the LFC data should act (in effect) as a floor. This is a pragmatic approach.

6.7 Specific issues applying only to specific draft NRC

6.7.1 No fault found

The benchmark countries do not provide clear benchmarks for similar tasks for similar products, with a variety of tasks/products (**[CI:✂✂]**) in a small number of countries, and with a widely varying range of time values.

There are also alternatives not taken into account in the benchmark file such as the **[CI:✂✂]** which are on the face of it no less relevant than the products selected.

Given the wide variation in the nature of the services and the time taken we recommend to use the local New Zealand values (e.g. derived from the service company charges).

6.7.2 Abortive end user site visit / Cancellation charge post truck roll

The benchmark is based purely on the administrative part of order processing for a particular product and country **[CI:✂✂]** and ignores the cost of the truck roll itself. If the Commission does not want to use NZ costs, then a superior benchmark within the TERA data set might be the Danish leased line charge for "Postponement fee, at point of delivery"; the travel element could be based on average NZ costs for a site visit.

It may also be useful for the Commission to understand how the service companies currently charge for these events. We understand that the current charging mechanism is for the service company to charge as if the ordered job had been executed.

7 Fixed wireless access

7.1 The assumed site sharing with mobile operators should not apply to all the costs

The Commission is assuming site sharing. We take this to include tower and physical infrastructure (concrete pad, fence, access construction, AC power installation etc) costs, which can in suitable cases be effectively shared with multiple operators.

However, in the model, all the costs of the FWA site are divided by three - including the costs associated with antennas, feeders, combiners, electronics and resilient power supplies. These costs will not in practice be shared with mobile operators who will use their own electronics, antennas, etc.

The model also uses a single lifetime and price trend for the FWA site assets, even though in the documentation active and passive assets are given different price trends (see for example TERA model specification figure 37). We suggest the passive assets only should be shared divided by the number of sharing operators and the active assets should be modelled as unshared. We suggest that a separate "FWA unshared elements" asset type be added.

7.2 FWA electronics are currently omitted

On review of the source of the relevant CI model input, we note that the model cost input figure for the FWA base station has not included the highly material costs of: the cabinet, DC power supply, battery, and RAN electronics (i.e. **[CI:✂✂]** have been omitted); the status of antenna/feeder/combiner costs is unclear.

7.3 The FWA network modelled by the Commission does not have sufficient coverage

As we have previously submitted, the modelled FWA network needs to be able to deliver both a specified level of capacity (assumed by the Commission to be 22Mbit/s / sector) and deliver to the desired service boundary (in this case, the road segments now assumed by the Commission to use FWA) using the assumed quantity of spectrum.

The way in which the FWA modelling now works assumes FWA is used to serve a small percentage of users with line lengths to MDFs or active cabinets of greater than 5.3km, spread over a very large number of MDF areas which are distributed throughout New Zealand. This is combined with a modelling approach based on assumed perfect utilisation of the assumed 22Mbit/s per sector, which leads to a modelled number of base stations required. The number of base stations derived is however far too low, because it does not take the need for coverage into account. Constraints due to radio propagation limit the practical size of the area covered by each base station and taking this into account will lead to a significant increase in the number of FWA base stations required to serve the road sections identified by the Commission's modelling.

7.3.1 Illustration

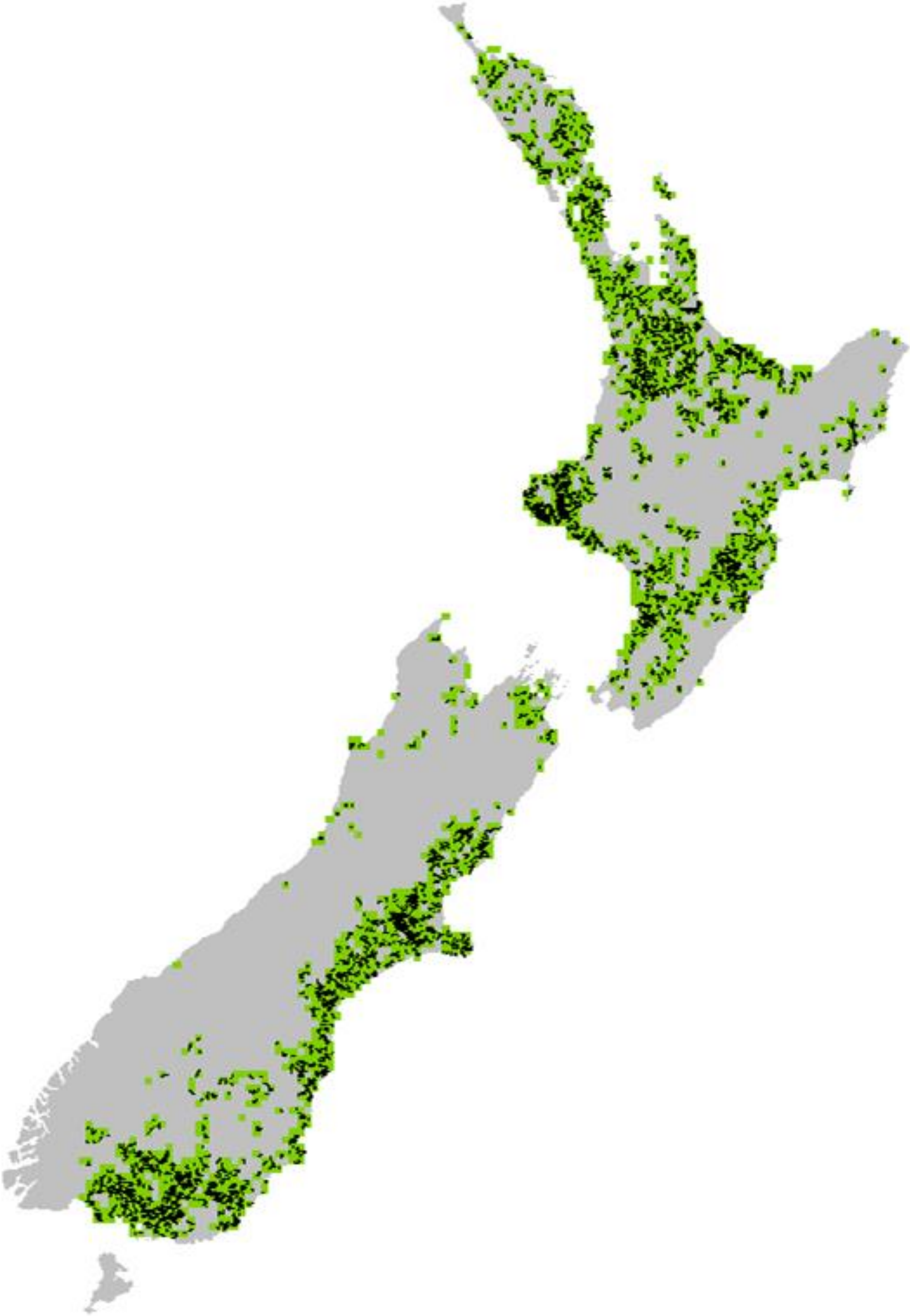
We have cross-referenced the data in the SOURCE SECTIONS table in the Access database with the Commission geographic data, to understand the distribution of road sections served by FWA. As can be seen below, these road sections are distributed across a very large fraction of the country. The small number of FWA radio sites assumed in the model could not serve these widely dispersed road sections.

To attempt to quantify this, we have overlaid a grid over the road sections to give a very rough proxy of the number of sites required. Based on our own estimates of the possible practical coverage area of a FWA site in rural New Zealand for an operator seeking to provide a high level of coverage of premises, we have tested a grid size of 8km×8km. Figure 7.1 indicates the results, which requires 1447 grid squares to cover the road sections (implying of order 1447 base stations would be required). This is significantly higher than the number of FWA sites modelled by the Commission.

In order to be able to assume FWA can serve these end-users, the Commission should significantly increase the number of base stations.

Figure 7.1: Illustration of FWA-served road sections overlaid by 8km×8km grid squares [Source: Analysys Mason, 2015. Black lines are road segments served by FWA in the model, Green areas are 8km×8km grid

squares containing at least a part of one FWA-served road segment in the model. Grey areas are land areas containing no such FWA-served segments]



7.4 The assumed site sharing with two mobile operators is unrealistic in practice

The modelling now assumes the use of FWA in a large fraction of the land area of New Zealand, unlike the previously modelled case, in which FWA was only used in the RBI area.

For the RBI area, we understand that mobile operators rarely had existing coverage in this highly rural segment of the country, and it was potentially attractive for several of them to gain shared access to the new RBI sites to provide their own additional coverage.

In the revised model many of the areas where FWA will be used will be within areas with existing mobile coverage. As a result it is necessary to ask whether two existing mobile operators will in fact be keen to share FWA sites as we understand that existing mobile operators in New Zealand are in the vast majority of cases not co-located on the same towers. We believe assuming sharing with one other operator (on average) would be more realistic.

7.5 Spectrum costs should be the opportunity costs

We have previously submitted (in our draft determination cross-submission, 5.7) that the correct cost to use for the spectrum is the opportunity cost.

Neither TERA nor the Commission has addressed this point.

Instead the Commission have pro-rated the cost of the spectrum based on the number of FWA customers served (as a fraction of all UCLL demand). This is an incorrect approach.

It is no longer possible for other stakeholders to argue that FWA is only used in rural areas. Given the wide geographic coverage area of the FWA use now assumed by the Commission, use for FWA would essentially prevent this spectrum being used for other services in New Zealand.

The user who would be denied the use of the spectrum would be (in all likelihood) a mobile operator. We know the amount mobile operators were prepared to pay for the use of similar quantities of spectrum in similar bands. So the cost should be, as a minimum, the full NZD88 million indicated in the public Access model (although we have previously indicated that this value should be higher) rather than the pro-rated cost[15].

7.6 The opportunity costs of the spectrum are better estimated by the recent auction results than the reserve on a future auction

The opportunity cost is likely better estimated by the price paid for similar spectrum at auction than the reserve set for the band in question.

[15] Our argument for a higher assumed spectrum cost is made in Section 6.4 of our February 2015 report, see http:// www.comcom.govt.nz/dmsdocument/12915

The reserve price is wrong in principle as an estimate of the opportunity cost because the choice of reserve does not change the expected competitive auction result. The reserve could even be zero, but that does not mean the opportunity cost is zero. Conversely, the reserve could be set too high.

If the reserve had been set by a process of estimating the value, then this might be close to the required opportunity cost. However the reserve itself is still not necessarily the opportunity cost, as in practice reserve prices may be set slightly below the estimated value (e.g. to ensure that the spectrum could be put into use even allowing for possible regulatory error).

7.7 The modelled sites will not serve 100% of premises

As we have previously submitted, a fraction of the premises notionally served by FWA will in fact not be so served due to factors that are either omitted or only treated statistically in the propagation models (local clutter, shelter belts, etc.) and will require remedial measures (such as deployment of FTTH or remotely sited antennas).

TERA say in their review of submissions: "It is assumed that the modelling based on Vodafone's RBI sites provides a good estimate of costs per Mbps for the FWA network, relevant to the actual coverage modelled". This is an unsuitable assumption, because the Vodafone RBI sites are not obliged to cover 100% of premises, and we believe are not in fact capable of serving 100% of premises due to a variety of factors (e.g. shelter belts, local hills, etc.).

One way to implement the required change to the model would be to include an additional asset type representing additional capital expenditure needed to provide coverage for a small fraction of the FWA served end-users. This could be based on costs for a specific type of intervention (e.g. a pole-mounted antenna outside the shelter belt and a 30m trench and cable to lead in to the premise).

This argument is strengthened by the Commission's assumptions about site sharing. Commercial mobile networks do not attempt to guarantee to serve each and every site. If they did, they would be much more costly to build. To assume, as the Commission does, that there will be significant amounts of site sharing with mobile operators is to assume that the base station locations used for FWA are (effectively) the same as would be chosen by the mobile operators (because the Commission assumes that 2 mobile operators will want to collocate on every such FWA site[16]). This makes it more likely that the resulting FWA coverage will have similar properties to the mobile network coverage (i.e. will not guarantee to serve every last location as this is commercially unattractive to mobile operators).

[16] If the FWA operator chooses to build enough sites to provide coverage at every single desired premise, the mobile operators will only want to share a fraction of the FWA sites

7.8 FWA backhaul assets are deployed even in the FTTN/copper model

On page 9 of the TERA review of submissions, it is stated that "The model includes some FWA assets as the FWA sites exist even if they are not used. These links should be part of the fibre leased lines that has not been provided by Chorus."

However, the FWA sites do not exist in the copper network; to the extent that there are mobile/RBI sites served by leased lines, this has been allowed for in the allocation of 5% of assets to leased lines, so retaining the unused FWA sites and explicitly dimensioning fibre to serve them is double-counting part of this allocation.

A simple fix can be added to the queries used in the copper calculation to remove the FWA sites (or, alternatively, remove all but one FWA site in to allow the calculation to continue to run smoothly).

7.9 Scaling of FWA fibre assets is incorrect

In the fibre calculation in the Access model, the scaling of FWA assets by the number of FWA sites used as a proportion of those modelled in the Access database (e.g. in cells Inventory!F1823:ABC1908 for example; there are others) is too crude. At the moment, this leads to a more than 1000 kilometres of trench being removed. However, where the trench is being used for other purposes, this cost should not be removed but should instead be re-allocated to the other network layers, since the trench is still required even if FWA is not present.

By analysing the table PROCESS SECTION MODELLING, we have established that FWA fibre is present in 4174 kilometres of major side trenches, with 2067 kilometres allocated to FWA. However, only 940 kilometres of these trenches are FWA-only. Therefore, no more than 46% of trenches should be removed from the FWA cost calculation; the remainder need to be reallocated. Removing 46% would be the absolute maximum: i.e. if *all* the FWA sites served by the FWA-only trenches were not required, an extremely unlikely situation.

7.10 FWA is used in a way inconsistent with the assumptions about demand

The Commission assumes that the modelled FTTH network takes all the demand from FTTN/copper, LFC, and HFC networks; we maintain our objection to this (see section 3.6 above). However, part of its logic (in Model Reference paper 2.5.1, 2.5.2) is the superior performance of FTTH. If it makes this assumption, then the Commission should not use FWA in any areas covered by Chorus UFB, non-Chorus LFC or HFC networks, because the modelled FWA solution is inferior to all of these.

7.11 Improving the FWA modelling

Beyond our objection to the use of FWA as incapable of providing the required service, we have noted a number of serious issues with the FWA modelling:

- It serves premises which today have access to superior options (notably, HFC and UFB)
- It does not fully account for the costs of serving these premises in terms of the RAN assets, the nature of the assets at those base station sites that are shared with other operators, the full opportunity cost of the spectrum used, and the additional expenditure needed to ensure 100% of the assumed sites can be reached.
- A number of errors in the calculation need to be corrected
- It serves small numbers of very widely dispersed premises, leading to large numbers of base stations being required to provide the coverage needed.

A superior approach which could be implemented within a modified version of the Commission's framework would be to:

- Exclude the use of FWA in areas where HFC or UFB are available
- Correct errors and include all relevant FWA costs including the RAN assets and the opportunity cost of the spectrum as discussed above
- Define an assumed level of coverage for a base station consistent with real performance for a network with the appropriate parameters such as tower height and the target level of coverage of sites (noting the need to add capex to deal with the percentage of unserved sites). Extract a resulting assumed coverage area per base station and the size of grid cell that would match this area (e.g. 8*8km).
- Based on a threshold (set by a side investigation calibrated by the FWA costs) such as a minimum of 30 premises per grid cell, test whether the number of premises on road segments with range >5.3km from the serving cabinet or exchange in each grid cell is high enough to merit the use of FWA in that area and exclude the use of FWA in such grid cells which fail this test. Following this, note the number of remaining grid cells and include in the cost model a minimum of 1 base station per grid cell in which there are sufficient FWA-served premises

We note that this approach assumes a national level choice of MEA is being made because it does not attempt to ascribe the FWA base station costs to particular MDFs.

8 Summary

In this section, we provide a set of tables describing the detailed corrections that we believe should be made to the model in order to implement a number of the changes recommended above. Some, would require more wide-ranging changes that are not easily summarised here. Corrections are summarised by model file.

Beca trench cost analysis file

Figure 8.1 states the corrections required to the Beca trench cost analysis file, as described in Sections 3.1 and 3.2.

Figure 8.1: Summary of corrections to the Beca trench cost analysis file if it continues to be used [Source: Analysys Mason, 2015]

Section	Reference	Description of correction
3.1	Urban Buildups!C27 and C3	Change value to **[CNZCI:** NZD✂✂**]**
3.1	Dir.Drilling!E32 and E4	Change value to **[CNZCI:**NZD✂✂**]**
3.1	'Chain Trench'!F30 and F4	Change value to **[CNZCI:**NZD✂✂**]**
3.1	'Urban Buildups'!G3, G27	Adjust value to **[CNZCI:**NZD✂✂**]**
3.2	'Buildups 100dia'!B34:B49	Paste 'Buildups 100dia'!B7:B22 into the cells to align inputs
3.3	Dir.Drilling!C37:C42	Revise assumed drill hole diameters as shown in Figure 3.6

Trench inputs file

Figure 8.2 states the corrections required to the trench inputs file, described in Section 3.2 and 3.4.

Figure 8.2: Summary of corrections to the trench inputs file [Source: Analysys Mason, 2015]

Section	Reference	Description of correction
3.2	"Trenching inputs (w ducting)" worksheet, rows 67 and 73	Add in reinstatement cost into these rows i.e. add ('Trenching inputs (w ducting) b'!$C$109-'Trenching inputs (w ducting) b'!$C$112) to the formula
3.2	"Trenching inputs (w ducting) b" worksheet, rows 67 and 73	Replace the use of "+$C$109" with "+$C$112" (since the reinstatement cost is already included on the "Trenching inputs (w ducting)" worksheet: only the reinforcement cost is required
3.2	"Trenching inputs (w ducting)" worksheet, rows 71 and 77	Amend formulae to be a blend of 75% of the minimum cost method and 25% of open trenching

Section	Reference	Description of correction
3.2	"Trenching inputs (w ducting) b" worksheet, rows 13/19/26/32/38/43/71/77	Amend formulae to be a blend of 75% of the minimum cost method and 25% of open trenching
3.2	"Trenching inputs (w ducting) b" worksheet, rows 9/10/15/16/22/23/28/29	Ensure these values for mole ploughing and chain digging are not included in the trenching cost calculation at all (we recommend removing them entirely from this sheet)
3.2	"MDF-specific trenching costs" worksheet, cells Q31:ABH31	Correct formula to use 'Geotype per MDF'!$Y$743:$Y$1462
3.2	Geotype per MDF worksheet, cells G743:M1462 and Q1464:W1464	Extend cell references in SUM()/INDEX() functions to row 1462
3.2	Geotype per MDF worksheet, cells AV743:AV1464	Correct formula to return zero when dividing by zero
3.4	Soil-specific trenching costs worksheet, cells G64:P64	Amend formulae to model a harmonic weighting, not an exponential harmonic (for example, cell G64 should have the formula "=1/G60" rather than "=EXP(-G60)"

Access database

Figure 8.3 states the corrections required to the Access database.

Figure 8.3: Summary of corrections to the Access database [Source: Analysys Mason, 2015]

Section	Reference	Description of correction
2.3	Table SOURCE BUILDINGS Field TRENCH_LENGTH	Correct the values for those buildings on shared lead-ins. The revised values based on the calculation discussed for each value of ID_BUILDING can be provided on request.
2.3	Table SOURCE BUILDINGS Field VERTICAL_LENGTH	Correct the values for those buildings on shared lead-ins. The revised values based on the calculation discussed for each value of ID_BUILDING can be provided on request.
2.4	Table SOURCE BUILDINGS Field ID_SECTION and others	Correct the mapping of buildings to road segments. A mapping of ID_BUILDING to ID_SECTION can be provided on request.
2.5	Query: SELECT HOR TRENCHES CU Query: SELECT HOR TRENCHES FB	Replace the use of ">=1" by ">=0" in the SQL of this query
3.1	Table SOURCE BUILDINGS Module Dimensioning at the building level	Calculate the portion of the vertical length corresponding to the lateral trench using road parcels, road centrelines and road widths, to derive a trench path from the side of the road to the edge of the property boundary Revise the VBA to ensure the lateral trench is included in the asset counts

Section	Reference	Description of correction
7.8	Query SELECT FWA SITES PER MDF	When running the copper model calculation, remove all FWA sites by modifying this query so that no FWA backhaul links are deployed. The existing query should be left unchanged for the fibre network calculation

Cost inputs

Figure 8.4 states the corrections required to the confidential cost inputs file.

Figure 8.4: Summary of corrections to the cost inputs file [Source: Analysys Mason, 2015]

Section	Reference	Description of correction
3.7	'Unit costs calculation'!J30	Align the WACC used in the pole rental capitalisation calculation
4.1.1	'Q 6.17.12 (d) Install Costs', cells I10 and I28	Amend the formulae to include the cost uplift (i.e. multiply with the cell I5)
4.1.1	'Q 6.17.12 (d) Install Costs'!I27	Change the formula to be =(D27+D26+D29+D30+D31)*I5

Access model

Figure 8.5 states the corrections required to the Access model.

Figure 8.5: Summary of corrections to the Access model [Source: Analysys Mason, 2015]

Section	Reference	Description of correction
7.1	Assets worksheet, row 134	Use this spare asset to be the "FWA base station dedicated active equipment" asset. Include a lifetime of 7 years and a price trend of –5%. Calculate the unit cost assuming the asset is unshared. Extend relevant ranges / formulae elsewhere in the model to pick up this asset as an FWA cost.
7.4	Assets worksheet, cell S120	Change the formulae to be =POWER(1+N120,PRM_Year-P120)*L120 i.e. remove the scaling by FWA customers
7.4	Dashboard worksheet, cell H19	Change value to 2
7.9	Import from the ACCESS worksheet, cells N2942:N3661	Ensure the formulae to $N$3663/$DS$2931 to calculate the ratio S (where $N$3663 is the sites required according to the modelling and $DS$2931 is the number of sites in the Access database)
7.9	Inventory!L309:ABC309	Use the table PROCESS SECTION MODELLING from the Access database to calculate the proportion (P_i) of FWA trenches that are FWA-only for each ESA. For each ESA, set the values in the corresponding cell cells on the Inventory sheet to be $1-(P_i \times (1-S))$
7.9	Inventory!L1823:ABC1823	Set equal to Inventory!L309:ABC309

UBA inputs model

Correction of direct unit costs discussed in Section 4.1.3 result from correction in the Confidential UBA Inputs model, summarised in Figure 8.6, which should then be passed through to the Confidential UBA model.

Figure 8.6: Summary of corrections to the Confidential UBA Inputs model [Source: Analysys Mason, 2015]

Section	Reference	Description of correction
Correcting inclusion of uplift for fees and management in indirect cost		
4.1.1	'Q 6.17.12 (d) Install Costs'!I27	Change to =(D27+D26+D29+D30+D31)*I5
4.1.1	'Q 6.17.12 (d) Install Costs'!I28	Change to =D39*I5
4.1.1	'Q 6.17.12 (d) Install Costs'!I10	Change to =D15*I5
Design and test costs		
4.1.2	(various possible locations)	Apply markup for design and test costs
Correcting inclusion of rack purchase cost (as well as uplift for fees and management in rack indirect cost)		
4.1.3	'Q 6.17.12 (d) Install Costs'!I10	Change to =(D15+D16)*I5
Correcting xDSL cabinet line card		
4.1.3	'Equipment per year'!AB43	Change to ='Equipment per year'!AB48
Correcting FDS software version		
4.1.3	'20140919 B3_C_Q 6 ESS7 pricing'!C3	Change value to **[CI:**NZD✂✂**]**
4.1.3	'20140919 B3_C_Q 6 ESS7 pricing'!C5	Change value to **[CI:**NZD✂✂**]**
4.1.3	'Q 6.17.1 - 3 (2)'!D86	Change value to **[CI:**NZD✂✂**]**
4.1.3	'Q 6.17.1 - 3 (2)'!D87	Change value to **[CI:**NZD✂✂**]**
4.1.3	'Input – Assets'	Add asset for IOM card with capacity 2 MDA and appropriate unit cost based on data in 'Q 6.17.1 - 3 (2)'
4.4	'Input – Assets'	Add asset for 2x10G card, with capacity 2 10G SFP and appropriate unit cost based on data in 'Q 6.17.1 - 3 (2)';

UBA model

Figure 8.7 states the corrections required to the UBA model.

Figure 8.7: Summary of corrections to the UBA model [Source: Analysys Mason, 2015]

Section	Reference	Description of correction
3.6	Dashboard!H24	Remove HFC demand from the input parameter
4.3	'Assets'!I11,'Assets'!I18	Change input values from 0% to 20%
4.4	'Parameters'!J122	Change formula to =IF(Dashboard!$H$49=List!$H$28,Parameters!G122,IF(Dashboard!$H$49=List!$H$29,Parameters!H122,Parameters!I122))
4.4	'Parameters'!J124	Change formula to =IF(Dashboard!$H$49=List!$H$28,Parameters!G124,IF(

Section	Reference	Description of correction
		Dashboard!$H$49=List!$H$29,Parameters!H124,Parameters!I124))
4.1.3	Various	Add logic to provision IOM cards
4.4	Various including Parameters!I124	Add logic to provision 2*10G cards where appropriate; Incorporate 2*10G card cost (added into UBA cost inputs) into revised calculation of cost of fully loaded rack in UBA model

Opex model

Figure 8.8 states the corrections required to the confidential opex model.

Figure 8.8: Summary of modifications to the opex model [Source: Analysys Mason, 2015]

Section	Reference	Description of correction
5.1	Parameters!BA20:BA21	Update calculation of these two values to use Eircom target LFI of 12.8% rather than 16.4%
5.2	Parameters!BA20:BA21	Update calculation of these two values to adjust for increased aerial deployment based on a multiplier of 1.27 rather than the current value.
5.3	Parameters!I25:I26	Review which dependents of these cells assume a positive trend versus a 0% trend. In particular, on the Energy allocation worksheet, the energy costs should increase with a positive trend (which could be achieved by setting cells J12:J18 to 1 for instance).