

A Errors in the Analysys Model

While some of the errors in the Model used by the ACCC (**the Analysys Model**) are fundamental to its design, Telstra believes that at a minimum those errors which can be corrected, should be.

The corrected Analysys Model produces the following costs for 2008/09:

ULLS (Zone A)		ULLS (Zone B)		OTA	
Original	Corrected	Original	Corrected	Original	Corrected
\$21.62	\$28.48	\$59.39	\$94.39	0.69 cents	0.83 cents

WLR

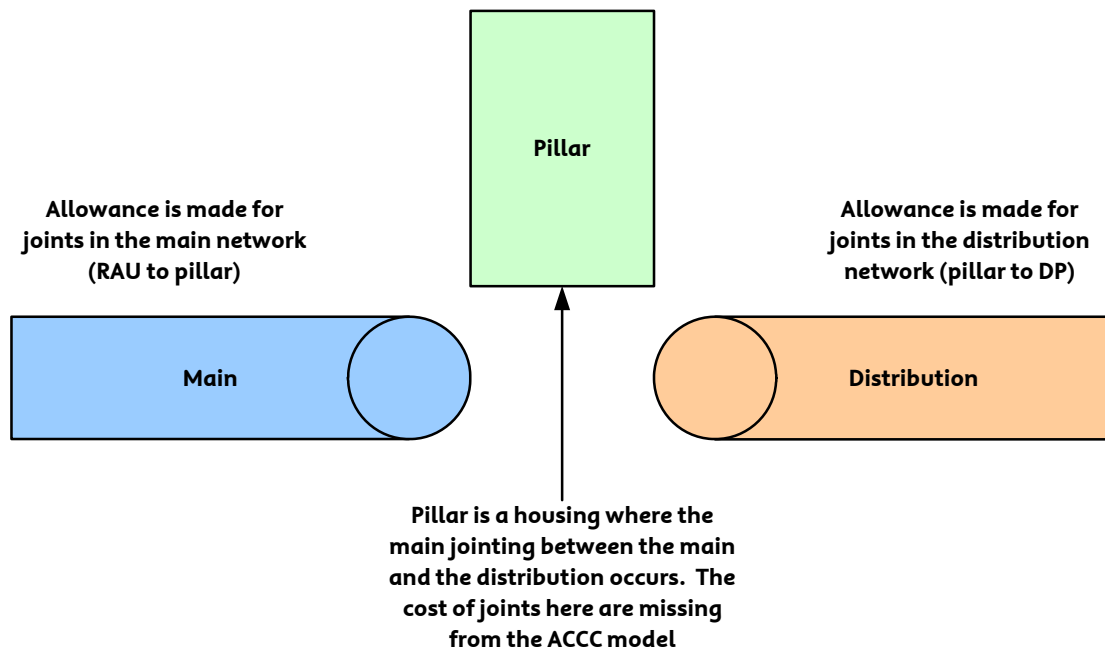
WLR (Band 1)		WLR (Band 2)		WLR (Band 3/4 Clustered)		WLR (Bands 3/4 Spread)	
Original	Corrected	Original	Corrected	Original	Corrected	Original	Corrected
\$8.46	\$9.95	\$20.26	\$24.59	\$33.83	\$45.77	\$56.79	\$81.66

Error 1: The Analysys model does not include the joints that would be required to connect the distribution copper cables or main copper cables to pillars¹

What is the error?

- 1 The Analysys Model includes costs for three types of copper cable joints:
 - (a) Joints required to connect customers to the copper cable network, sized by reference to the size of the cable being used (**demand joints**);
 - (b) Joints required at points in the network to connect copper cables to each other where a distribution cable run exceeds the maximum hauling distance for copper cables (**distribution distance joints**); and
 - (c) Joints required at points in the network to connect copper cables to each other where a main cable run exceeds the maximum hauling distance for copper cables (**main distance joints**).
- 2 However, no provision is made in the Analysys Model for joints to connect each of the copper main cable and the distribution cable to a pillar or large pair gain system (**LPGS**). Below is an illustration of the joints in question.

¹ Error 1 in Telstra's letter dated 31 July 2009 to the ACCC (**31 July Letter**).



- 3 In some locations copper cables are jointed to a LPGS rather than to a pillar. This typically occurs where the copper has to run long distances from the customer's premises to the local exchange.

Identification of the error in the Analysys Model

- 4 That these joints have been excluded from the calculations in the Analysys Model is clear from the model documentation, which states at page 78:

“Joints and branching kits

The joints for copper sheath are calculated for the following cases:

- *DP >> Pillar (demand) – where a sheath spurs off of the principle distribution sheath. The size of the joint is dependent on the size of the downstream spur cable*
- *DP >> Pillar (distance) – where the maximum haul distance for the distribution network is exceeded, the whole sheath is jointed*
- *Pillar >> RAU (distance) – where the maximum haul distance for the main network is exceeded, the whole sheath is jointed.*

The number of branch kits is also calculated.”

- 5 There is no mention in the model documentation of joints at the pillar. Below is further detail from the Analysys Model which demonstrates that no joints for connection to the pillar are included.
- 6 Figure 1 is an excerpt from the Analysys Model that identifies the types of copper cable joints that the model assumes will be required in building a network.²

² Analysys Model, Costs.xls, TA.Access, rows 68 – 74, columns V and Z.

Figure 1

	A	B	C	D
7	Asset calculation			
8		Access asset group	Assets	Unit
9				
67	58	Cable	Copper main: 1200	sheath metres
68	59	Cable	Joints: 2	#
69	60	Cable	Joints: 10	#
70	61	Cable	Joints: 30	#
71	62	Cable	Joints: 50	#
72	63	Cable	Joints: 100	#
73	64	Cable	Joints: DP >> pillar (distance)	#
74	65	Cable	Joints: Pillar >> RAU	#
75	66	Cable	Joints: Branching kits	#
76	67	Cable	Fibre: NTP >> next node	sheath metres

- 7 Demand joints (joints for connecting customers to the network) are shown on lines 68 through 72 by cable size. Distance joints in the distribution network (Joints:DP>>pillar (distance)) and distance joints in the main network (Joints:Pillar>>RAU) are found on lines 73 and 74, respectively.
- 8 The calculation of the number of each type of joint identified in the Analysys Model and in the supporting model documentation confirms that no provisions are made for joints on either side of the pillar.³
- 9 Below at Figure 2⁴ is a further demonstration of the workings in the Analysys Model to illustrate how the model fails to include joints to connect distribution and main cables to the pillars.

Figure 2

	B	C	D	E	F
2				Geotype 1	Geotype 2
3		Copper deployment type (1=URBAN, 2=RURAL)		1	1
7	Access SIOs			52,693	224,435
8	Copper			33,750	26,671
256	Joints				
257	Joints				
258	DP >> pillar (demand)		pairs	33,750	26,671

- 10 The number of demand joints (line 258) is based directly on the number of copper services in operation (SIOs) (line 8). Consequently there is no provision for joints at the pillar (or joints at the points in the network where the cable gauge changes, as discussed at paragraphs 40 and following below).
- 11 The number of distance joints required is also calculated in the CAN module of the Analysys Model. Figure 3 is an excerpt from the Access worksheet in the CAN module of the Analysys Model:

³ The Analysys Model also does not include joints to connect different gauges of cable. This error is discussed at paragraph 40 below.

⁴ Analysys Model, CAN module, Access worksheet.

Figure 3

	A	B	C	D	E	I	
2		This sheet calculates the total number of network assets required in the access network			Geotype 1	Geotype 5	
3		Copper deployment type (1=URBAN, 2=RURAL)			1	1	
200		Copper network					
209		Copper sheath					
210		Copper sheath distances				538,677	64,772,301
214		DP >> next node	meters		246,089	30,357,721	
215		Pillar >> LE	meters		162,929	15,970,887	
261		Joints					
262		Joints					
264		DP >> pillar (distance)	full joints (not individual pairs)		805	78,775	
265		Pillar >> RAU	full joints (not individual pairs)		283	29,265	
267		Joint parameters					
269		DP >> pillar (distance)	meters per joint		305.83	385.37	
270		Pillar >> RAU	meters per joint		575.94	545.72	

- 12 The number of distribution distance joints (i.e. line 264) is calculated by dividing the total cable sheath distance between the distribution points serving the customers and the pillar (line 214) by the maximum allowable distance between distribution cable joints as set by the model (line 269). The number of main distance joints (i.e. line 265) is similarly calculated by dividing the total sheath distance between the pillar and the local exchange (line 214) by the maximum allowable distance between main cable joints as set by the model (line 269). Again, the calculation of the distance joint costs provides no provisions for the cost of joints on either side of the pillar.

Why should the error be fixed?

- 13 If there are no joints at either side of the pillar to connect each of the distribution and main cables, there will be no service on those lines. The inclusion of joints is therefore an engineering necessity, not a matter of discretion.
- 14 Paragraphs 7.25 to 7.31 of the Lordan CAN Report confirm that, as a matter of engineering necessity, joints are required at pillars.

How can the error be fixed?

- 15 To fix the error involves two steps, as follows:
- first, identify the number of 100 pair distribution cables that terminate on the customer side of the pillars or LPGS; and
 - secondly, identify the number of 400 pair main cables that are used to connect pillars to the exchanges.
- 16 A 100 pair joint is required to join each 100 pair distribution cable to the pillar or LPGS and a 400 pair joint is required to joint each 400 pair main cable to the pillar. Once the above total of 100 pair cables, and consequently joints, and the above total of 400 pair cables, and consequently joints, is identified, those totals need to be added to the other quantities of 100 and 400 pair joints in the Ansys Model, to derive a new total number of joints.

Identifying the number of 100 pair joints required

- 17 In order to identify the 100 pair joints required at the customer side of the pillar or LPGS, it is necessary to first determine the average number of SIOs that

terminate at all the pillars and LPGSs for each geotype. The following excerpt (Figure 4) from the Access worksheet of the CAN module of the Analysys Model identifies the lines containing this information:⁵

Figure 4

	B	C	D	E	F	G	H
	Analysys			Geotype 1	Geotype 2	Geotype 3	Geotype 4
	Copper deployment type (1=URBAN, 2=RURAL)			1	1	1	1
42	Pillars & LPGS						
43	Copper SIOs			33,750	26,671	1,929,222	2,731,955
44	Connected to LE			1,051	3,740	47,917	70,120
45	Connected to pillars			32,699	22,931	1,775,685	2,243,209
46	Connected via LPGS			-	-	105,620	418,626
49	Clusters			99	92	5,696	9,333
50	Pillar/ LE			99	92	5,307	7,662
51	Pillars at LE			3	14	144	244
52	Other pillars			96	78	5,163	7,418
53	LPGS			-	-	389	1,671
396	Pillar & LPGS parameters			note: feeds core workbook. Parameters are calculated to include % copper served by pillar and LPG			
397	Average number of copper SIO per pillar (excluding exchange)			352	342	374	368
398	Average number of copper SIO per LPGS			-	-	4,959	1,635
399	Average number of copper SIO per cluster (LE & LPGS) (L 43 / L 49)			341	290	339	293

- 18 Lines 43 to 46 identify all of the SIOs served by copper cable for each geotype. The total number of copper SIOs are identified by reference to the type of connection required (i.e. pillars, local exchange (LE) or LPGS). A joint will be required wherever a copper distribution cable terminates. The total number of SIOs served by copper cable is found on line 43. Lines 51 to 53 identify the total number of “clusters” (i.e. serving areas) in each geotype divided between those that are provided service through copper fed pillars (i.e. lines 50 to 52) and those that are connected to the local exchange through the use of LPGS (line 53). The total combined number of pillars and LPGS is identified on line 49.
- 19 The average number of copper SIOs for all serving areas (i.e. clusters served by pillars and LPGS) for each geotype is at line 399⁶. The information on this line can be used to calculate the minimum number of 100 pair copper distribution cables terminating at every pillar and LPGS within each geotype.
- 20 The first step is to determine the average number of 100 pair cables that are connected to each pillar within each of the geotypes. This is determined by identifying the minimum number of 100 pair cables required to serve the average copper cable demand by cluster shown on line 399 in figure 1. Note that demand is served in increments of 100 pairs per cable. Therefore, if the demand requires the use of 3 fully utilised cables (i.e. 300 SIOs) with some additional demand that is less than 100 SIOs, the total number of cables required is 4. For instance, the average number of cables required in geotype 3 is 4, 3 of which are fully utilised and serve 300 of the average 339 SIOs in each cluster, plus 1 for the 39 additional SIOs in each cluster. Further, this is the minimum number of 100 pair cables necessary to serve this demand for two reasons. First, distribution cables are not filled to maximum capacity; engineering criteria dictate that a “fill factor” be employed, when provisioning facilities, to provide flexibility in the network necessary to meet fluctuations in demand. Secondly, distribution cables branch out from the pillar in different directions; and demand is not necessarily evenly spread in all directions. Consequently not all distribution cables terminating at the pillar are filled to maximum capacity.

⁵ Revised Analysys Model, CAN module, Access worksheet.

⁶ The average number of copper SIOs per cluster or serving area (Figure 1, line 399) was added to the model in order to calculate the number copper joints required. The average number of copper cable fed SIO per cluster is calculated by dividing the total copper fed SIOs for each geotype (Figure 1, line 43) by the total number of Clusters in each geotype (Figure 1, line 49).

- 21 The total number of 100 pair cables that need to be terminated on the distribution side of pillars or LPGS in each geotype is then derived by simply multiplying the average number of 100 pair cables connected to each pillar by the total number of clusters or serving areas in each geotype. For geotype 3, the total number of 100 pair copper cables connected to the distribution side of pillars and LPGSs is 22,784 and is derived by multiplying the average number of cables required to serve each pillar (i.e. 4) by the total number of clusters in the geotype (i.e. 5696).
- 22 The total number of 100 pair joints that are required for connections on the distribution side of the pillar or LPGS is equal to the number of 100 pair cables that terminate on the pillar or LPGS. That total is added to the quantity of other 100 pair distribution joints to arrive at the revised total number of 100 pair joints required to connect the cables to the pillar or LPGS.

Identifying the number of 400 pair joints required

- 23 Identifying the number of 400 pair main joints required to connect cables on the other side of the pillar is a much simpler calculation. It is a calculation that needs to be performed for pillars but not LGPs because, there are no copper joints on the main network side of LPGS. LPGS are connected to the exchange using fibre cables.
- 24 The Analysys Model assumes that each pillar fed cluster is connected to the exchange using a single 400 pair main cable. Since one 400 pair cable serves each pillar fed cluster located outside the exchange the total number of cables required is equal to the total number of clusters connected to the local exchange through copper main cables (Figure 4, line 52).
- 25 The final step is to adjust the quantities of 100 pair cable distribution joints and 400 pair main cable joints to include the amounts identified above. Figure 5 is an excerpt from the Analysys Model which identifies all of the types of copper joints incorporated into the model.⁷

Figure 5

	B	C
2		
3		
		Copper deployment type (I=UR)
373	Joints: 2	#
374	Joints: 10	#
375	Joints: 30	#
376	Joints: 50	#
377	Joints: 100	#
378	Joints: DP >> pillar (distance)	#
379	Joints: Pillar >> RAU	#

- 26 Lines 373 to 377 identify joints where customer services are connected to the distribution network. The joints on lines 378 and 379 are distribution and main cable distance joints. If the Analysys Model is to be fixed to address the absence of joints at pillars/LPGS, then the additional copper joints should be added to the distance joints since both pillar and distance joints are found in increments of identically sized cables (i.e. 100 and 400 pair for distribution and main respectively).

⁷ Analysys Model, CAN module, Access worksheet.

- 27 Three sets of calculations by geotype then need to be changed in the Analysys Model to include the cost of copper joints at the pillar or LPGS, as follows:
- A row needs to be added to the Analysys Model which calculates by geotype the average number of copper SIOs terminating at pillars/LPGS in each cluster;
 - The quantity of 100 pair copper joints on the distribution side of LPGS/pillars needs to be calculated and incorporated into the calculation of the total number of 100 pair copper cable distribution joints; and
 - The quantity of 400 pair copper joints on the main side of pillars, located outside of the local exchange, needs to be calculated and incorporated into the calculation of the total number of 400 pair main copper cable joints.
- 28 Telstra has amended the Analysys Model and at Figure 6 below is an excerpt from the revised Access worksheet showing the lines that were added or revised to incorporate the costs of copper joints at the pillar and LPGS:⁸

Figure 6

	B	C	D	E	F	G	H
2	Analysys			Geotype 1	Geotype 2	Geotype 3	Geotype 4
3	Copper deployment type (1=URBAN, 2=RURAL)			1	1	1	1
43	Copper SIOs			33,750	26,671	1,929,222	2,731,955
49	Clusters			99	92	5,696	9,333
50	Pillar/ LE			99	92	5,307	7,662
51	Pillars at LE			3	14	144	244
52	Other pillars			96	78	5,163	7,418
53	LPGS			-	-	389	1,671
256	Joints						
257	Joints						
258	DP >> pillar (demand)	pairs		33,750	26,671	1,929,222	2,731,955
259	DP >> pillar (distance)	full joints (not individual pairs)		1,196	1,044	89,307	140,046
260	Pillar >> RAU	full joints (not individual pairs)		379	234	29,719	49,440
396	Pillar & LPGS parameters <i>note: feeds core workbook. Parameters are calculated to include % copper served by pillar and LPGS</i>						
397	Average number of copper SIO per pillar (excluding exchange)			352	342	374	368
398	Average number of copper SIO per LPGS			-	-	4,959	1,635
399	Average number of copper SIO per cluster (LE & LPGS) (L.43 / L.49)			341	290	339	293

29 The formulas or lines that were added to the model (line 399) or revised (lines 259 and 260) to account for joints at pillars/LPGS are highlighted in dark green in Figure 6 and the revised model.

30 The first step was to add a line (i.e. line 399) to calculate the average SIO per cluster (including clusters attendant to LPGS). The new formula on line 399 for each geotype is:

$$\text{If}(\text{Number of Clusters (L.49)} = 0, 0, \text{Copper SIOs (L. 43)} / \text{Number of Clusters}).$$

The formula simply divides the total lines in a geotype by the number of clusters or serving areas in each geotype to determine the average number of lines for each cluster in each geotype. Note that if there are no copper lines in a geotype or cluster the answer is set to 0.

31 The second step is to calculate the number of 100 pair copper joints on the customer side (i.e. distribution side) of a pillar/LPGS for each geotype and add that to the distance joints on line 259 of the Access worksheet.⁹ The formula for

⁸ Revised Analysys Model, CAN module, Access worksheet.

⁹ Analysys Model, CAN module, Access worksheet.

calculating 'DP>>pillar (distance)' joints on line 259 of the Access worksheet prior to any revisions is:

$$=IF(E264=0,0,ROUND(E214/E264,0))$$

Or, in words,

$$=IF(DP>>pillar (Distance) metres per joint = 0, 0, ROUND(Copper sheath distance DP>>next node / DP>>pillar (Distance) metres per joint))$$

- 32 This formula calculates the number of distribution distance joints required by dividing the sheath distance for copper distribution cables (Copper sheath distance DP>>next node) by the average maximum hauling distance for copper distribution cables (DP>>pillar (Distance) metres per joint). To incorporate copper joints on the customer side of pillars/ LPGS the formula was revised as follows:

$$=IF(E264=0,0,ROUND(E214/E264,0)+**ROUNDUP(E399/100,0)*E49**)$$

- 33 As shown, the first portion of the formula (not bold) is unchanged. It is the second portion (bold) of the formula that has been added to incorporate joints on the customer side of pillars/LPGSs into the total quantity of 100 pair distribution joints. This formula can be restated as follows:

$$+ ROUNDUP(Average number of customers per cluster / 100, 0) * Number of Clusters$$

- 34 In other words the average number of SIOs per cluster is divided by 100 and rounded up to the next whole number to determine the average number of 100 pair cables, and consequently the average number of 100 pair joints, that would be required to serve the average demand in each cluster. The average number of 100 pair joints is then multiplied by the total number of clusters in each geotype to determine the total number of 100 pair joints in the geotype needed to terminate 100 pair copper cables at a pillar or LPGS. The number of joints required to connect copper distribution cables to the pillar/LPGS is then added to the distance joints to identify the total distribution (i.e. DP>>Pillar) pillar and distance joints required.

- 35 The final step is to determine the total quantity of copper joints on the main side of pillars (i.e. side facing the local exchange) that needs to be incorporated into the model and then include that in the count of other main copper cable joints. The existing formula in the model for calculating main cable joints is:

$$=IF(E265=0,0,ROUND(E215/E265,0))$$

or

$$=IF(Pillar>>RAU metres per joint = 0, 0, ROUND(Copper sheath distances Pillar>> LE / Pillar>>RAU metres per joint, 0))$$

- 36 This formula calculates the number of main distance joints required by dividing the sheath distance for copper main cables (Copper sheath distance Pillar>>LE) by the average maximum hauling distance for copper main cables (LE / Pillar>>RAU metres per joint, 0). To incorporate copper joints on the local exchange side of pillars into the model the formula was revised as follows:

$$=IF(E265=0,0,ROUND(E215/E265,0)+E52)$$

- 37 As shown, the first portion of the formula (not bold) is unchanged. It is the second portion of the formula that has been added to incorporate main joints on the local exchange side of the pillar into the total quantity of 400 pair main copper cable joints. The second portion of the formula can be restated as follows:

+ Number of Clusters Other pillars

- 38 As discussed above, in the model design one 400 pair cable is used to connect every pillar located outside the exchange to the exchange. The number of 'Clusters Other pillars' is the number of pillars located outside of the exchange building. Therefore, the number of 400 pair copper cable joints that are needed to connect main copper cables to pillars located outside the exchange is the same as the number of pillars located outside the exchange (i.e. Clusters Other pillars). The number of joints required to connect copper main cables to the pillar/LPGS is then added to the distance joints to identify the total main (i.e. Pillar >> LE) pillar and distance joints required.

Overall effect of fixing the model

- 39 Telstra has fixed the model in the manner described above, which has the effect of adding in the costs of the missing pillar and LPGS joints (at the rates for vendor costs that are already specified in the Analysys Model which, for reasons Telstra has given elsewhere, are unrealistically low). The effect on the access prices is set out below:

ULLS (Access cost per line per month)		Wholesale line rental (WLR) Access cost per line per month				PSTN OTA	
Zone A	Zone B	Band 1	Band 2	Band 3/4 (clustered)	Band 3/4 (spread)	All areas	
Analysys Model	\$21.62	\$59.39	8.46	20.26	33.83	56.79	0.69
Fix	\$21.67	\$59.44	8.49	20.30	33.89	56.85	no material effect
Difference 0.05		0.05	0.03	0.05	0.06	0.06	0.00

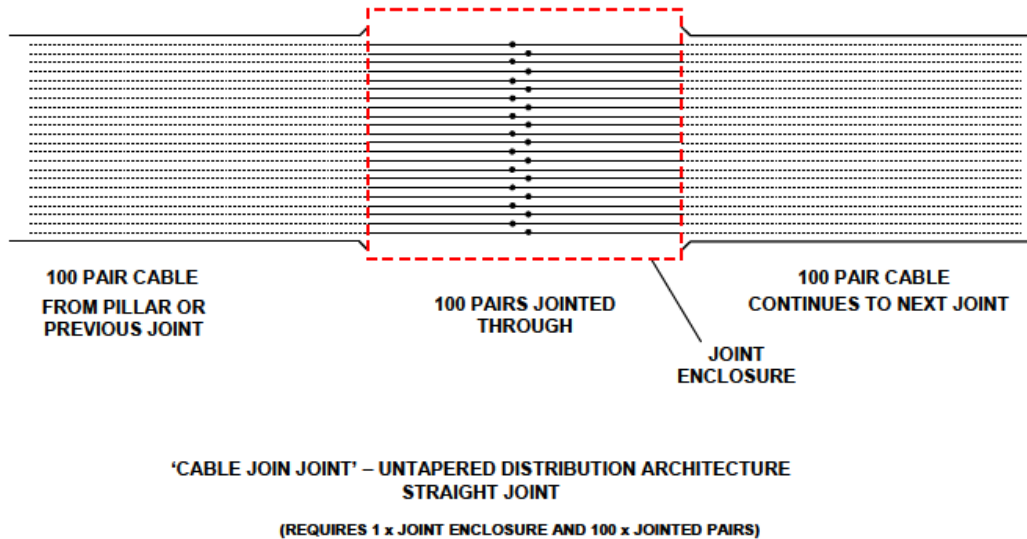
Error 2: The Analysys Model does not take into account the fact that joints and pits/manholes are required to connect one gauge of cable to a different gauge of cable¹⁰

What is the error?

- 40 The explanation of the treatment of joints in the Analysys Model as set out in paragraphs 1-12 above also indicates that the Analysys Model does not include the costs of joints required for connecting two different gauges of copper.

¹⁰ Error 10 in the 31 July Letter.

- 41 The Report Regarding Customer Access Network Architecture dated 8 October 2009 by Craig Lordan (**the Lordan CAN Report, Submission Supporting Documents, Volume 1, Document 1.10**) at paragraphs 8.3-8.9 explains that joints are required to connect two cables of different gauges. The joint includes connectors for each of the wires and a housing to enclose the connectors and exposed wires. Even if the change in gauge occurs at a pillar, two joints are required to connect the two separate cables to the tails of the pillar.¹¹ Below is a diagram illustrating a joint used to connect two cables of different gauges:



- 42 In addition to a joint, if the change of gauge does not occur at a pillar, a pit or manhole is required to access the cables which are to be connected and the joint. This is explained at paragraphs 8.10 to 8.16 of the Lordan CAN Report. Pits or manholes are required to enable access to the joints for repairs or fault rectification because a high proportion of faults occur at the joints.¹² Below is a photo of a number of cables jointed together in a P9 pit built to enable access to the joints.¹³



¹¹ See paragraph 8.3-8.9 of the Lordan CAN Report, **Submission Supporting Documents, Volume 1, Document 1.10**.

¹² See paragraph 8.10-8.16 of the Lordan CAN Report, **Submission Supporting Documents, Volume 1, Document 1.10**.

¹³ The various gauges of cable and the dimensions of pits/manholes are explained in the [Plitz No. 1 Statement].

- 43 The Analysys Model does not take account of the need for a joint and a manhole or pit to enable the two cables to be connected.

How can the error be fixed?

- 44 The Analysys Model relies on an excel file (Cable gauge determination.xls) to determine what gauges of cable are needed in the distribution and main network. Part of that calculation (the output of which is set out in columns H to M in the “Pillar” worksheet of the file) calculates the distance of the cable run, by cable gauge, for each pillar, RAU and LPGS. This information can be used to determine how frequently cable runs must change from one gauge to another. When the gauge of cable must be changed in a cable run, each cable must be jointed. A pit or manhole must also be included at each location where a joint is required.

Materiality of the error

- 45 The “Pillar” worksheet of the “Cable gauge determination.xls” file shows that there are 3998 copper pillars, in the ESAs sampled for the Analysys Model, that are used to calculate the distance of cable runs by cable gauge. Each row in the “pillar” worksheet represents a separate pillar. The Analysys Model uses 400 pair main cables to connect these pillars to the local exchange, therefore, there are 3998 main cable runs from pillar to local exchanges in the sampled ESAs. For each of these cable runs, non-zero amounts in rows H, I and J of the “pillar” worksheet indicate how much 0.4, 0.6 or 0.9 gauge copper main cable, respectively, is needed for each main cable run. Of these cable runs, 1808 (45%) are determined by the Analysys Model to require a change from one gauge of cable to another.¹⁴
- 46 This indicates that an additional joint plus a pit or manhole is required for 45% of main cable runs in the Analysys Model. The corrected (see next error) cost of a single 400 pair joint in the Analysys Model is \$700; and the cost of a #9 Pit, the smallest pit, which can accommodate jointing of 400 pair cable, in the Analysys Model is \$4,600.
- 47 This error can be fixed by including as inputs into the Analysys Model the costs of the joints and the pit or manhole.

Error 3: The cost of 400 pair joints include only the costs of jointing 100 (not 400) pairs¹⁵

What is the error?

- 48 The Analysys Model uses 400 pair copper cables in constructing the main copper cable network but only takes into account the cost of jointing 100 pair copper cables. All 400 pairs need to be jointed.
- 49 The Analysys Model uses only 400 pair copper cables in constructing the main copper cable network as illustrated in line 65 of the excerpt from the TA.Access worksheet below at Figure 7.¹⁶

¹⁴ This is calculated by counting the number of rows (in columns H, I and J) that require a non-zero length of at least 2 cable gauges.

¹⁵ Error 2 in the 31 July Letter.

¹⁶ Analysys Model, Costs.xls, TA.Access, rows 67 – 79, columns V and Z.

Figure 7

	C	D	H	V	Z
7					
8			Assumption: Core cost follows the		
9	Assets	Unit	Unit capex (AUD) (Option 1 prices)	Geotype 1	Geotype 5
59	Copper main: 2	sheath metres	2	-	-
60	Copper main: 10	sheath metres	4	-	-
61	Copper main: 30	sheath metres	5	-	-
62	Copper main: 50	sheath metres	6	-	-
63	Copper main: 100	sheath metres	8	-	-
64	Copper main: 200	sheath metres	12	-	-
65	Copper main: 400	sheath metres	21	162,929	15,970,887
66	Copper main: 800	sheath metres	37	-	-
67	Copper main: 1200	sheath metres	54	-	-
74	Joints: Pillar >> RAU	#	400	283	29,265

50 Also shown above in Figure 7 is the cost of joints for main copper cables (line 74, Column H). The main network runs from the pillar to the local exchange (RAU). The cost of jointing all cables on these main cable segments in the model is \$400 per joint. Below at Figure 8 is another excerpt from the Analysys Model showing the how the \$400 cost for a main copper cable network joint is derived:¹⁷

Figure 8

	B	C	D	E	F	G	H
1	Analysys		ACCESS UNIT COSTS				
104	Capital cost inputs: jointing copper cable			Jointing rate per pair	Joint Enclosure Cost	Number of pairs	Total unit cost (AUD per joint)
105							
112	Joints: Pillar >> RAU			1.00	300	100	400

51 The total cost of jointing a 400 pair main cable therefore comprises:

- (a) \$300 for the joint enclosure (column F, line 112); plus
- (b) \$100 cost of jointing. This cost is derived by taking the cost of jointing a single pair (column E, line 112) and multiplying it by the number of pairs jointed (Column G, line 112).

52 In the Analysys Model (see Figure 8 above) the number of pairs being jointed is 100, yet there are actually 400 pairs because the model uses a 400-pair cable to connect a pillar to an RAU. That means 300 pairs have not been jointed. This is a simple mathematical error. The mathematical error results in the exclusion of equipment costs. The practical effect of the error is that 75% of customers as modelled by the Analysys Model would have no service. The full 400 pairs must therefore be jointed to provide service.

¹⁷ Analysys Model, Costs.xls, UnitCost.Access worksheet.

How can the error be fixed?

- 53 The error can be fixed by including the additional vendor costs of each of the extra joints required for the 400 pairs. Telstra has fixed the model by adding in the additional number of pairs that need to be jointed in Column G, line 112 in figure 8 above (i.e. 400 pairs rather than 100 pairs) (as shown in Figure 9).

Figure 9

	B	C	D	E	F	G	H
1	Analysys		ACCESS UNIT COSTS				
104	Capital cost inputs: jointing copper cable			Jointing rate per pair	Joint Enclosure Cost	Number of pairs	Total unit cost (AUD per joint)
105	Joints: Pillar >> RAU			1.00	300	400	700
112							

- 54 The effect of correcting this error on the access prices (at the rates for vendor costs specified in the Analysys Model which, as noted above, Telstra challenges) is set out below:

	ULLS (Access cost per line per month)		Wholesale line rental (WLR) Access cost per line per month				PSTN OTA
	Zone A	Zone B	Band 1	Band 2	Band 3/4 (clustered)	Band 3/4 (spread)	All areas
Analysys Model	21.62	59.39	8.46	20.26	33.83	56.79	0.69
Fix	21.68	59.42	8.48	20.31	33.90	56.84	no material impact
Difference	0.06	0.03	0.02	0.05	0.07	0.05	0.00

Error 4: The Analysys Model does not include the cost of joints needed to join fibre cables together¹⁸

What is the error?

- 55 The Lordan CAN Report explains at section 7 that both fibre splicing joints and modular joints are required for joining fibre cables.¹⁹
- 56 The Analysys Model however, contains no provisions for the cost of jointing fibre cables together. At Figure 9 below is an excerpt from the TA.Access worksheet in the Cost module of the Analysys Model. This page calculates the total cost of the CAN network. There is no line item dedicated to calculating the cost of fibre joints.

¹⁸ Error 9 in the 31 July Letter.

¹⁹ Submission Supporting Documents, Volume 1, Document 1.10.

Figure 9

	A	C	D	V	Z
7	Asset calculation			Equipment purchased	
9		Assets	Unit	Geotype 1	Geotype 5
15	6	Fibre termination point (E1)	#	182	2,329
18	9	LPGS equipment	#	-	1,453
19	10	LPGS MDF	#	-	1,453
21	12	Fibre splicing chamber	#	103	197
76	67	Fibre: NTP >> next node	sheath metres	41,376	1,026,464
77	68	Fibre: Link on fibre rings (pillar to pillar)	sheath metres	64,583	-
78	69	Fibre: Pillar >> LE (non-ring deployment)	sheath metres	-	5,128,681
79	70	Fibre: LPGS >> LE (non-ring deployment)	sheath metres	-	11,801,006
80	71	Wireless BTS site acquisition, prep and construction	#	-	-

- 57 Telstra raised this error with the ACCC by letter dated 4 March 2009. In response (letter dated 11 March 2009), the ACCC quoted the following passage from the Analysys documentation:

“No jointing is calculated for fibre cabling deployed, as the cost of fibre access is not as critical to the declared access services. Fibre jointing costs should be included with the fibre material and installation costs in the cost inputs.”

- 58 Analysys excluded the cost of fibre jointing in the access network on the basis that it is not critical to the declared access services. However, this is incorrect, as fibre costs are included in the Analysys Model’s calculation of the cost of the OTA and LCS services. The Analysys documentation quoted by the ACCC indicates that fibre material jointing costs should be included in the fibre material and installation costs.
- 59 The cost of fibre cables is entered into the Analysys Model on a “per metre of cable” basis, and joints are typically costed on a “per joint” basis. The Lordan CAN Report (paragraphs 7.19-7.23) demonstrates that there is really no way of adding the cost of fibre joints to the per metre cost of cable, without knowing how many joints are required in the network per length of fibre cable.
- 60 That is, because the model does not count the number of fibre joints required in the CAN, it is not possible to accurately add the cost of joints to the cost of cables without making a range of adjustments to the model.

How can the error be fixed?

- 61 There are over 142 million metres of fibre cable in the CAN in the current version of the Analysys Model. The Analysys Model can be fixed by including fibre joints in the CAN where cables merge, at pillars or LPGS, at building terminals fed by fibre, at the exchange and where the fibre cable reaches a maximum distance between joints.
- 62 Telstra has considered whether it can adjust the Analysys Model to correct this error. The programming underlying the model is complex. To fix the error requires rewriting parts of that programming, which requires an understanding of the existing model that Telstra does not have. Analysys and the ACCC, the parties who developed the model, are the only parties that have this understanding, and the fix would need to be carried out by either of those parties. The TEA model and documentation details the logic that is required to accurately and sufficiently provision fibre joints in the CAN.

- 63 Telstra submits that this error is likely to have a material effect as the cost of fibre jointing represents a significant element of the cost of fibre deployment in the access network. For instance, when the TEA model is run for basic service (so that fibre is provisioned instead of copper for cable runs greater than [TC1 c-i-c commences] [CIC [TC1 c-i-c ends]], it provisions, on average, a fibre joint or branch kit every [TC1 c-i-c commences] [CIC [TC1 c-i-c ends] of fibre cable. Applying this to the length of fibre in the Analysys model, would mean that there are [TC1 c-i-c commences] [CIC [TC1 c-i-c ends] fibre joints and branch kits missing in the Analysys Model. The cost of fibre joints ranges from almost [TC1 c-i-c commences] [CIC [TC1 c-i-c ends] for a 6 fibre strand joint to over [TC1 c-i-c commences] [CIC [TC1 c-i-c ends] for a 120 fibre strand joint. The cost of these joints and pits or manholes required to house the joints missing from the Analysys Model is substantial.

Error 5: The Analysys model excludes the cost of distribution cable, trenching and conduit required from a customer's boundary to the serving pit²⁰

What is the error?

- 64 The CAN provisioned by the Analysys Model does not provide connectivity between customer locations and the pillar or LPGS, because the ACCC eliminated key network components.
- 65 The original release of the Analysys Model contained several design flaws. Amongst other faults, the model did not have an adequate serving pit design and failed to provide either a means for the network to serve both sides of the street or for lead-ins to gain access to distribution conduit. The modellers addressed these flaws in a subsequent release of the model (Workshop Version) by incorporating a Serving Pit Architecture into the model in place of the original network design.
- 66 The ACCC intentionally omitted the Serving Pit Architecture from the current release of the model (Version 0.92); yet failed to address the significant ramifications of this omission. The net result of the ACCC's action is an error, which renders the network represented by Version 0.92 of the model incapable of providing access to customer locations, because essential network elements are missing.
- 67 While property owners are obliged to provide an open trench for the placement of lead-in cable and conduit across their property, the trenching, conduit and cable between the DP and the property boundary form part of the distribution network – and they are dug at the same time as the distribution cable trenches and not on a customer by customer basis at the time of connection.
- 68 Further, none of the plant and equipment that is included in the Serving Pit Architecture resides on customers' properties.²¹ All of the plant and equipment which comprises the Serving Pit Architecture in the Analysys Model is intended to be located on public property or utility right of way in or along side of the street and not on customer's premises.

²⁰ Error 19 in the 31 July Letter.

²¹ Note: The plant and equipment which comprises the local serving pit to property boundary architecture classification is alternatively labelled 'PB >>> serving pit,' 'PB>>DP/serving pit,' 'Property boundary>>> DP/FDP,' or Property boundary>>>DP in the CAN module Version 0.92. All of these labels refer to the same plant and equipment.

- 69 The Analysys Model does not include any of the costs incurred in building the network from the DP to the customer's boundary. Telstra submits that these costs need to be included in the Analysys Model. While the ACCC has, in previous determinations, considered that some of the cost of the lead-in cable is recovered from the customer connection charge, this does not mean that distribution network trenching and conduit should be excluded. Exclusion of distribution network trenching and conduit costs is an error. It is not even appropriate to exclude the total cost of the lead-in. The correct approach is to include the full costs of connecting customers to the network and then subtract the amount of revenue that is considered to have been recovered from any customer connection charges.
- 70 The [TC1 c-i-c commences] [CIC] [TC1 c-i-c ends] Statement describes the process and equipment used between the property boundary and the DP. The Attenborough Report (**Submission Support Documents, Volume 1, Document 1.2**) explains why the costs of the trenches, conduit and cable between the property boundary and the DP should be included and that the costs should be included and the difference between the new connection and reconnection charges offset against these costs.

Background to error

- 71 The initial release of the Analysys model placed distribution cable and conduit down the middle of the street:
- (a) without providing a means to serve both sides of the street;
 - (b) without allowing for access to the distribution conduit, and
 - (c) without providing sufficient pits to allow lead-ins to be jointed to the distribution cable.
- 72 Telstra brought this flaw to the ACCC's attention in its letter dated 23 March 2009 and its 1 April 2009 Initial response to the ACCC's Cost Model, as follows:

"Since the Model is unburdened by practical considerations and engineering guidelines, such as the need to serve houses on both sides of a street, it can place the serving pit at a point which minimises the distance from the pillar, rather than a point which physically enables access to all of the lead-ins serving customer locations within the cluster. The ACCC's Model simply assumes that lead-ins make their way from customers' property boundaries into the middle of the street, or across the street to the other side, somehow find their way into conduit (there is no pit at the FDP, so there is no conduit access), and run an unspecified distance down the street to the serving pit. All of this occurs without a joint or a pit."
(Initial response to the ACCC's Cost Model, Section C3)

"The failure to serve both sides of the street is a major flaw in the design of DP clusters. Since all addresses are mapped to the middle of the street, the Model does not distinguish between addresses on opposite sides of the street. As measured by the Model, a house on one side of the street may be the same airline distance from a serving pit as a house on the other side. The lead-in serving one of those houses, however, must cross the street to reach the pit, a practical reality, resulting in real cost, not recognized by the Model.

The ACCC's Model only provisions one distribution cable down any street. This can be seen in attachments 1, 2, 4, 6 and 10. This standard design is perfectly acceptable as long as the Model makes provisions for serving houses on both sides of the street. The ACCC's Model makes no such provision, which effectively means

the network designed by the Model is only capable of serving half the homes and buildings in its serving territory (those houses on only one side of the street)."
(Initial response to the ACCC's Cost Model, Section D4)

73 The ACCC and Analysys sought to address these design flaws in a subsequent release of the model (the workshop version) with the introduction of a 'local serving pit to property boundary architecture' ("Serving Pit Architecture"). This design change remains in the official release of the Analysys Model, Version 0.92.

74 This new "Serving Pit Architecture" is designed to:

- (a) provide for the placement of conduit and cable from property boundaries to DPs (where cables can be jointed); and
- (b) provide network to serve both sides of the street.

75 This "Servicing Pit Architecture" is described in section 6.3 of the Fixed LRIC Model Documentation Version 2.0, as follows:

"Trench network

The trench network from exchange to DP is deployed on one side of the road – the geoanalysis does effectively model the network in the centre of the road, but we believe that this does not cause a material error. We assume an equal probability that locations served will be on the side of the road where the trench is routed or on the opposite side of the road. In reality, there may be occasions where there is some bias of locations to one side of the road the trench would likely be deployed on that side of the road. We have not identified any evidence to suggest this would have a material impact over the whole of the access network.

► *Trench network (PB >> DP)*

For the architecture for the trench network from a customer location to a DP, we assume that a serving pit (SP1) is deployed at the DP location. In those cases where the DP serves more than 1 location, a road crossing and a second serving pit (SP2) is deployed in certain situations, as shown below."

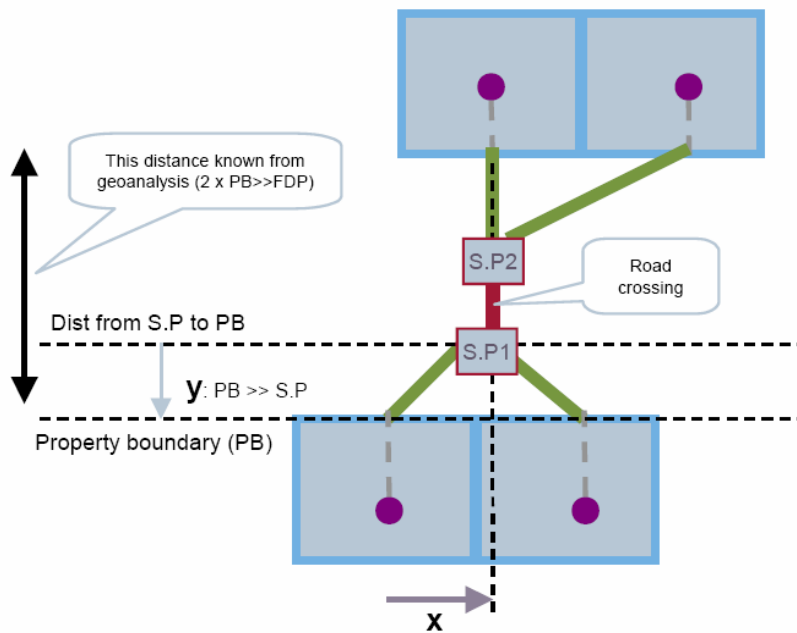


Figure 6.3:
Structure of a DP cluster
[Source: Analysys]

- 76 In the diagram above, the Serving Pit Architecture consists of S.P1; S.P2, the green lines and the red line. The ACCC/Analysys design change to introduce the Serving Pit Architecture modified the way distances from the property boundary to the serving pit are measured in the model.
- 77 The original model design placed the FDP (Final Drop Point) in the middle of the street directly in front of each customer location. The distribution network ran at a 90 degree angle from the property boundary to the FDP and then ran parallel to the property boundary from the FDP to the DP. The model measured the aggregate trench/conduit distances between the property boundary to the FDP and from the FDP to the DP for all locations. The results of these measurements are at lines 79 and 80 of the Access tab of the original version of the CAN module released by the ACCC (Version 0.6), as illustrated below in Figure 10.²²

²² Note: The plant and equipment which comprises the local serving pit to property boundary architecture classification is alternatively labelled 'PB >>> serving pit,' 'PB>>DP/serving pit,' 'Property boundary>>> DP/FDP,' or Property boundary>>>DP in the CAN module Version 0.92. All of these labels refer to the same plant and equipment.

Figure 10

			Geotype 1	Geotype 2	Total
75	Trench network				
76	Distance uplift for slope effect (trench and cable)	0%	<i>Input.distance.uplift.slope</i>		
77	Trench				
78	Incremental trench distances	meters	195,862	210,621	326,511,648
79	Property boundary >> FDP/DP	meters	64,830	43,700	71,435,535
80	FDP >> DP	meters	35,583	31,404	43,532,286
81	DP >> next node	meters	88,552	126,548	200,963,905
82	Pillar/ LPGS >> LE	meters	4,979	4,305	10,573,340
83	Link on fibre rings (pillar to pillar)	meters	1,918	4,663	6,581
85	Check: total road distance in ESAs	km	242	502	1,875,047
86	Trench as a % of road	excludes 'Property boundary >> FDP'	54%	33%	14%
87	Trench network parameters				
88	Property boundary >> FDP/DP	per location - copper & fibre	6.51	6.12	
89	FDP >> DP	per location - copper & fibre	3.57	4.40	
90	DP >> next node	per DP	17.14	31.39	
91	Pillar/ LPGS >> LE	per pillar & fibred LPGS	63.02	69.44	<i>Geotype.av.distance.t</i>
92	Link on fibre rings (pillar to pillar)	per fibre pillar (inc fibre LPGS) +	22.56	65.68	
94	Trench by duct size		195,862	210,621	326,511,648
95	28	meters	-	-	-
96	24	meters	-	-	-
97	20	meters	-	-	56
98	16	meters	-	-	315

- 78 The copper sheath distances for property boundary to FDP and from the FDP to DP are also calculated in the Access tab of the CAN module on lines 128 and 129, although these lines are not displayed on the screen above.
- 79 The introduction of the Serving Pit Architecture modifies the routing of the “property boundary” to “serving pit” trenching, conduit and cable, and consequently modifies the calculation of the property boundary to serving pit distances. The results of the new distance calculations can be seen on lines 115 to 121 of the Access tab of the current CAN module (Version 0.92 – see Figure 11 below). The total property boundary to serving pit distance is displayed on line 115 of that same page. Note: the distances shown on the screen above reflect the correct settings for the Serving Pit Architecture settings on CAN.xls, In.Demand, Cells 55N and 76N-76Q.
- 80 The Serving Pit Architecture also includes road crossings, which are necessary to enable the CAN to serve both sides of the street. The measurements of road crossing distances are seen on lines 122 to 128 of the same page.

Figure 11

	A	B	C	D	E	F	U		
1	Analysys		ACCESS NETWORK						
2	This sheet calculates the total number of network assets required in the access network						Geotype 1	Geotype 2	Total
110	Trench network								
111	Note: this parameter affects the access network distances (accounting for the								
112	Distance uplift for slope effect (trench and cable)		0%	Input: distance, uplift, slope					
113	Trench								
114	Incremental trench distances		meters		306,872	325,206	415,325,576		
115	PB >> serving pit		meters		80,503	66,022	80,745,671		
116	Main DP cluster		meters		79,575	65,366	80,115,019		
117	1		meters		3,562	3,233	2,025,586		
118	2		meters		16,367	13,087	4,580,041		
119	3		meters		19,789	13,408	25,429,688		
120	4		meters		39,857	35,638	48,079,704		
121	Isolated FDPs		meters		928	656	630,652		
122	Road crossing		meters		52,513	36,230	50,606,724		
123	Main DP cluster		meters	Proportion of DF	47,401	32,872	45,311,066		
124	1		meters	50%	19,622	16,552	21,628,448		
125	2		meters	75%	13,480	8,035	4,222,342		
126	3		meters	88%	6,809	3,388	9,577,783		
127	4		meters	94%	7,490	4,897	9,882,493		
128	Isolated FDPs		meters	50%	5,113	3,359	5,295,658		
129	FDP >> DP		meters		45,391	40,061	47,650,265		
130	DP >> next node		meters		121,933	170,518	223,747,797		
131	Pillar/ LPGS >> LE		meters		3,413	4,819	12,564,446		
132	Link on fibre rings (pillar to pillar)		meters		3,118	7,555	10,673		
133									
134	Check: total road distance in ESAs		km		242	502	1,875,047		

- 81 The new Serving Pit Architecture also modifies the measurement of copper sheath distances from property boundary to serving pit. As seen in Figure 12 below, the new calculations are performed in the Access tab of the CAN module on line 212. It is noteworthy that the copper sheath from the FDP to the DP on line 213 has been removed from the model. This is because the original design, which ran cable through the FDP as described in paragraph 70, has been modified by the introduction of the Serving Pit Architecture.

Figure 12

		Geotype 1	Geotype 2	Total
Copper network				
NTPs at customer premises		<i>note: fibre connections also have a 2-p</i>		
NTP: 2-pair wall socket		12,773	9,157	7,851,136
NTP: 10-pair building termination		11,345	7,987	7,741,273
NTP: 30-pair building termination		1,295	1,022	96,671
NTP: 50-pair building termination		95	116	10,319
NTP: 100-pair building termination		38	32	2,874
		-	-	-
Copper sheath				
Copper sheath distances		581,167	511,002	589,397,931
NTP >> Property boundary	meters	39,134	23,070	46,663,437
Property boundary >> FDP/ DP	meters	133,016	102,253	131,352,395
FDP >> DP	meters	-	-	-
DP >> next node	meters	246,089	286,883	331,342,219
Pillar >> LE	meters	162,929	98,796	80,039,879
Copper sheath parameters				
NTP >> Property boundary	per copper location & fibre local	3	3	
Property boundary >> DP	per copper location & fibre local	10	11	
FDP >> DP	per copper loc	<i>Note: unused, as distance is derived from trench network</i>		
DP >> next node	per DP	37	56	
Pillar >> LE	per pillar	1,697	1,251	
Sheath distance by cable size (lead-in)				
2		172,150	125,323	178,015,832
10		152,906	109,310	175,695,935
		17,457	13,987	2,040,177

Introduction of error

- 82 The Serving Pit Architecture was added to the model’s network design to address the flaws in the model’s original design, which are described above in paragraphs 71-72 by establishing a rational serving pit design, placing conduit between the serving pit and customer locations and providing a means to serve both sides of the street. However, the ACCC, inexplicably, introduced a new, more significant error, in the latest release of its model (Version 0.92). The ACCC eliminated the investment for trenching, conduit and cable associated with the newly introduced Serving Pit Architecture. This error not only reinstates the model’s original design flaws (i.e. a dearth of serving pits, no means to serve both sides of the street and no access to conduit); it renders the model’s network design completely incapable of reaching customer locations, because fails to reinstate the cable routing inherent in the model’s original design, running cable from the property boundary through the FDP to the DP (i.e. it does not replace the cable in CAN.xls, Access, line 213).
- 83 The unit cost for conduit and cable associated with the Serving Pit Architecture is omitted from the Network equipment investment cost table on the UnitCost.Access tab of the Cost module. (The basic equipment cost inputs for conduit and cable from the property boundary to the serving pit – cells 141E and 149E – have been left blank, as illustrated in Figure 13 below.)
- 84 Note: line 149 includes the total copper cable necessary for both the NTP to property boundary and property boundary to serving pit segments of the CAN. As is explained below, the cable required for each of these segments is separately identified elsewhere in the Analysys Model.

Figure 13

The screenshot shows an Excel spreadsheet with the following data:

Access asset group	Assets	Assumptions	Basic equipment cost (AUD)	Spares uplift (%)	Installation uplift (%)	Individual cost
130	Duct: 28	Use urban as baseline cost and	641	-%	-%	
131	Duct: 24		601	-%	-%	
132	Duct: 20		541	-%	-%	
133	Duct: 16		361	-%	-%	
134	Duct: 12		301	-%	-%	
135	Duct: 8		181	-%	-%	
136	Duct: 6		150	-%	-%	
137	Duct: 4		105	-%	-%	
138	Duct: 2		89	-%	-%	
139	Duct: 1		60	-%	-%	
140	Duct: 1 road-crossing		60	-%	-%	
141	Duct: 1 (PB >> DP/ Serving pit)		-	-%	-%	
142	Pits: PF28	Concrete pits	4,000	-%	15%	
143	Pits: PF20	Concrete pits	4,000	-%	15%	
144	Pits: PF12	Concrete pits	4,000	-%	15%	
145	Pits: P9	Concrete pits	4,000	-%	15%	
146	Pits: P6	50% plastic, 50% plastic-colarise	1,330	-%	15%	
147	Pits: P5	25% plastic, 25% plastic-colarise	620	-%	15%	
148	Pits: P5 road crossing		620	-%	15%	
149	Copper lead-in: 2	Use 0.4mm as baseline cost, and	-	-%	-%	
150	Copper lead-in: 10		4	-%	-%	
151	Copper lead-in: 30		5	-%	-%	
152	Copper lead-in: 50		6	-%	-%	
153	Copper lead-in: 100		8	-%	-%	

85 As a result, the total capital cost included in the model for the portion of the CAN that extends from the customer’s property boundary to the serving pit, is zero. (The capital costs for trenching, conduit and cable associated with the Serving Pit Architecture are listed in Cells 33J and 41J of Cost.xls, TA.Access.) This is illustrated in Figure 14 below.

Figure 14

Access asset group	Assets	Unit	Total capex (AUD)	Annualised capex cost (AUD)	Opex cost (AUD)
30	Duct Duct 2	metres	2,375,512,958	177,701,919	4,917,830
31	Duct Duct 1	metres	9,652,096,660	722,031,883	19,981,960
32	Duct Duct 1 road-crossing	metres	2,889,619,879	216,160,049	5,982,150
33	Duct Duct: 1 (PB => DP/ Serving pit)	metres	-	-	-
34	Duct Pits: PF28	#	3,079,189	272,771	6,580
35	Duct Pits: PF20	#	17,744,614	1,571,912	37,960
36	Duct Pits: PF12	#	416,395,945	36,886,555	890,880
37	Duct Pits: P9	#	1,598,272,315	141,583,413	3,419,530
38	Duct Pits: P6	#	1,924,405,818	170,474,043	4,117,300
39	Duct Pits: P5	#	2,546,516,425	225,583,890	5,448,320
40	Duct Pits: P5 road crossing	#	1,282,617,502	113,621,040	2,744,180
41	Cable Copper lead-in: 2	sheath metres	-	-	-
42	Cable Copper lead-in: 10	sheath metres	5,688,670	626,442	169,050
43	Cable Copper lead-in: 30	sheath metres	829,602	91,357	24,650
44	Cable Copper lead-in: 50	sheath metres	233,318	25,693	6,930

- 86 Further, the model also excludes the costs of the alternative to the Serving Pit Architecture that was included in the original version of the model, the cable from the FDP to the DP. Even though the original design failed to provide trench, conduit and cable from the customer’s property boundary to the FDP, it did provision cable from the FDP to the DP. That cable was removed in the Workshop Version of the model because it was replaced by the Serving Pit Architecture. The ACCC has now removed both the Serving Pit Architecture and the FDP to DP cable, thereby taking a step backward from the original release of the model.
- 87 The FDP to DP cable is located on line 213 of CAN.xls, Access. As can be seen in Figure 15 below no cable is provisioned in the total column (Cell 213U). The note on line 219 explains that this category of cable is “unused, as distance is derived from trench network.” Unfortunately, the trench network has been omitted by the ACCC.

Figure 15

			Geotype 1	Geotype 2	Total
199	Copper network				
202	NTPs at customer premises	note: fibre connections also have a 2-p	12,773	9,157	7,851,136
203	NTP: 2-pair wall socket		11,345	7,987	7,741,273
204	NTP: 10-pair building termination		1,295	1,022	96,671
205	NTP: 30-pair building termination		95	116	10,319
206	NTP: 50-pair building termination		38	32	2,874
207	NTP: 100-pair building termination		-	-	-
209	Copper sheath				
210	Copper sheath distances		581,167	511,002	589,397,931
211	NTP >> Property boundary	meters	39,134	23,070	46,663,437
212	Property boundary >> FDP/DP	meters	133,016	102,253	131,352,395
213	FDP >> DP	meters	note: does not app	-	-
214	DP >> next node	meters	246,089	286,883	331,342,219
215	Pillar >> LE	meters	162,929	98,796	80,039,879
216	Copper sheath parameters				
217	NTP >> Property boundary	per copper location & fibre local	3	3	
218	Property boundary >> DP	per copper location & fibre local	10	11	
219	FDP >> DP	per copper loca	Note: unused, as distance is derived from trench network		
220	DP >> next node	per DP	37	56	
221	Pillar >> LE	per pillar	1,697	1,251	
222	Sheath distance by cable size (lead-in)				
223	2		172,150	125,323	178,015,832
224			152,906	109,310	175,695,935

How can the error be fixed

- 88 The error can be rectified by replacing the basic equipment costs for the trench, conduit and cable components of the Serving Pit Architecture. The basic equipment cost of for trenching and conduit can simply be replaced in Cost.xls, UnitCost.Access, Cell 141E.
- 89 Reinstating the costs for distribution cable, however, requires an additional step. Since the model combines the total copper cable necessary for both the NTP to property boundary portion of the CAN and the property boundary to serving pit portion of the CAN (Cost.xls, UnitCost.Access, line 149), these two segments must be separately identified, before it is possible to replace the copper distribution cable required for the property boundary to serving pit portion of the CAN. This is easily accomplished by moving the distribution cable required for the property boundary to serving pit portion of the CAN from line 149 of Cost.xls, UnitCost.Access to line 158 (2 pair copper distribution).
- 90 Once the distribution cable required for the property boundary to serving pit portion of the CAN is included in Cost.xls, UnitCost.Access, line 158, the investment associated with this cable can be reinstated into the model.

Corrections made to the model

- 91 The default unit cost for property boundary to serving pit trenching (Duct: 1 (PB>>DP/Serving pit)) is found on Cost.xls, UnitCost.Access, Cell 22H. This amount has been reinstated as the default input on Cost.xls, UnitCost.Access, Cell 141E, as seen in Figure 16 below.

Figure 16

	A	B	C	D	E	F	G
1	Analysys		ACCESS UNIT COSTS				
2	This sheet contains the unit costs (capex and opex) for access network elements and the capex and opex trends						
3	nominal AUD						
4	Modelled year 2009						
136	19	Duct	Duct: 6		150	-%	-%
137	20	Duct	Duct: 4		105	-%	-%
138	21	Duct	Duct: 2		89	-%	-%
139	22	Duct	Duct: 1		60	-%	-%
140	23	Duct	Duct: 1 road-crossing		60	-%	-%
141	24	Duct	Duct: 1 (PB >> DP/ Serving pit)		31	-%	-%
142	25	Duct	Pits: PF28	Concrete pits	4,000	-%	15%
143	26	Duct	Pits: PF20	Concrete pits	4,000	-%	15%
144	27	Duct	Pits: PF12	Concrete pits	4,000	-%	15%
145	28	Duct	Pits: P9	Concrete pits	4,000	-%	15%
146	29	Duct	Pits: P6	50% plastic, 50% plastic-colarised	1,330	-%	15%
147	30	Duct	Pits: P5	25% plastic, 25% plastic-colarised	620	-%	15%
148	31	Duct	Pits: P5 road crossing		620	-%	15%
149	32	Cable	Copper lead-in: 2	Use 0.4mm as baseline cost, and a	-	-%	-%
150	33	Cable	Copper lead-in: 10		4	-%	-%
151	34	Cable	Copper lead-in: 30		5	-%	-%
152	35	Cable	Copper lead-in: 50		6	-%	-%
153	36	Cable	Copper lead-in: 100		8	-%	-%
154	37	Cable	Copper lead-in: 200		12	-%	-%
155	38	Cable	Copper lead-in: 400		21	-%	-%
156	39	Cable	Copper lead-in: 800		38	-%	-%
157	40	Cable	Copper lead-in: 1200		55	-%	-%
158	41	Cable	Copper dist: 2		2	-%	-%
159	42	Cable	Copper dist: 10		4	-%	-%
160	43	Cable	Copper dist: 30		5	-%	-%
161	44	Cable	Copper dist: 50		6	-%	-%

- 92 As can be seen above the unit cost for 2 pair distribution cable is already included in the default inputs on Cost.xls, UnitCost.Access, Cell 158E. Consequently, all that is necessary to reinstate the cost of property boundary to serving pit distribution cable is to move that quantity of cable from the 2 pair copper lead-in category (line 149) to the 2 pair copper distribution category (line 158).
- 93 The classification of property boundary to serving pit copper sheath (Property boundary>>FDP/DP) has been corrected in CAN.xls, Access in Figure 17 below. The array formulae covering Lines 224 and 235 have been changed so that property boundary to serving pit copper sheath is now included in 2 pair distribution copper sheath rather than 2 pair lead-in copper sheath.

Figure 17

	A	B	C	D	E	F	G	H
1	Analysys				ACCESS NETWORK DIMEN			
2	This sheet calculates the total number of network assets required in the access network							
3	Copper deployment type (1=URBAN, 2=RURAL)							
4	Note: unused, as distance is derived from trench network							
5	FDP >> DP		per copper loca		37	56	53	
6	DP >> next node		per DP		1,697	1,251	2,630	
7	Pillar >> LE		per pillar					
8	Sheath distance by cable size (lead-in)				38,926	22,948	4,652,293	
9	2				34,575	20,015	4,549,772	
10	10				3,947	2,561	90,070	
11	30				289	291	9,235	
12	50				115	80	3,216	
13	100				-	-	-	
14	200				-	-	-	
15	400				-	-	-	
16	800				-	-	-	
17	1200				-	-	-	
18	Sheath distance by cable size (distribution only)				394,855	397,696	49,617,429	8
19	2				133,291	97,961	24,677.717	3
20	10				15,217	12,534	488,533	
21	30				1,114	1,424	50,091	
22	50				443	392	17,442	
23	100				244,789	285,385	24,383,645	4
24	200				-	-	-	
25	400				-	-	-	
26	800				-	-	-	
27	1200				-	-	-	
28	Sheath distance by cable size (main only)				162,929	97,545	13,579,955	2

- 94 The formulae for 2 pair copper sheath lead-ins and distribution cable have been corrected as follows:

Original formula line 224 (2 pair copper lead-in):

$$= \text{cable.size.dist.NTP.FDP}*(\text{E211:T211}+\text{E212:T212})+\text{cable.size.dist.FDP.DP}*\text{E213:T213}$$

Corrected formula line 224:

$$= \text{cable.size.dist.NTP.FDP}*(\text{E211:T211})+\text{cable.size.dist.FDP.DP}*\text{E213:T213}$$

Original formula 235 (2 pair copper distribution):

$$= \text{cable.size.dist.DP.node}*\text{E214:T214}$$

Corrected formula 235:

$$= \text{cable.size.dist.NTP.FDP}*(\text{E212:T212}) + \text{cable.size.dist.DP.node}*\text{E214:T214}$$

- 95 The original formula for line 224 equalled the sum of the length of 2 pair copper sheath included in Lines 211, 212 and 213. The corrected formula for line 224 equals the sum of the length of 2 pair copper sheath included in Lines 211 and

213. Line 212 (the metres of copper sheath in the Property boundary >> FDP/DP portion of the CAN) has been removed from the equation.
- 96 The original formula for line 235 equalled the length of 2 pair copper sheath included in line 214. The corrected formula equals the sum of the length of 2 pair copper sheath included in Lines 212 and 214. Line 212 (the metres of copper sheath in the Property boundary >> FDP/DP portion of the CAN) has been added to the equation.
- 97 The net impact of the changes made to correct the model is to move all 2 pair copper sheath in the property boundary to serving pit portion of the CAN from line 224 (2 pair copper lead-ins) to line 235 (2 pair copper distribution). Since the unit cost of 2 pair copper distribution is already included in the default model inputs, this change reinstates the cost of 2 pair copper sheath, from the property boundary to the serving pit, in the model.
- 98 Once the full costs of connecting customers to the network are captured in the model, the amount of revenue that is considered to have been recovered from any customer connection charges should be subtracted. Telstra recovers a \$299 (incl. GST) connection charge for customer connections that require network to be installed and a \$125 (incl. GST) connection charge for customer connections that do not require network to be installed. The difference, excluding GST, of \$158.19 can be considered as the revenue that Telstra collects that contributes to the network costs incurred when connecting customers (refer to the report of Nigel Attenborough, **Submission Supporting Documents, Volume 1, Document 1.2**).²³

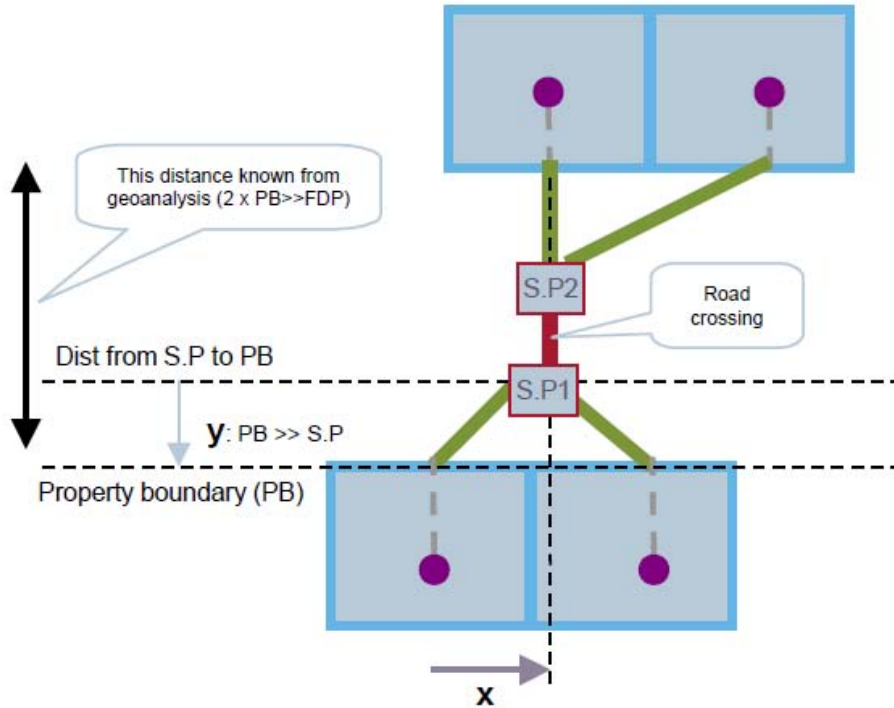
Error 6: The Analysys Model provides for road crossings to serve homes on the opposite side of the street from the distribution pit but does not provision sufficient cable inside the road crossing conduit to enable the cable to reach the opposite side²⁴

What is the error?

- 99 Below is a diagram of the distribution pit architecture used in the Analysys Model. The network is built on one side of the road with a distribution pit serving from one to four customer locations. The model provides for trenching and conduit for the cable from the distribution pit to the other side of the road but does not provision sufficient length of cable sheath to serve the homes on the opposite side.

²³ \$158.19 = (\$299-\$125)/1.1GST.

²⁴ Error 5 in the 31 July Letter.



- 100 The amount of trench and conduit needed in the CAN is calculated on lines 111 – 172 of the Access tab of the CAN cost module (Figure 18). The necessary road crossing trench and conduit is calculated on lines 122 – 128 of the same page.

Figure 18

Microsoft Excel - CAN

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Anal

G3 [=deployment.type]

Analysis		ACCESS NETWORK			U	
This sheet calculates the total number of network assets required in the access network		Geotype 1	Geotype 2	Total		
111	Trench network	Note: this parameter affects the access network distances (accounting for the				
112	Distance uplift for slope effect (trench and cable)	0%	Input.distance.uplift.slope			
113	Trench					
114	Incremental trench distances	meters	306,872	325,206	415,325,576	
115	PB >> serving pit	meters	80,503	66,022	80,745,671	
116	Main DP cluster	meters	79,575	65,366	80,115,019	
117	1	meters	3,562	3,233	2,025,586	
118	2	meters	16,367	13,087	4,580,041	
119	3	meters	19,789	13,408	25,429,688	
120	4	meters	39,857	35,638	48,079,704	
121	Isolated FDPs	meters	928	656	630,652	
122	Road crossing	meters	52,513	36,230	50,606,724	
123	Main DP cluster	meters	Proportion of DF	47,401	32,872	45,311,066
124	1	meters	50%	19,622	16,552	21,628,448
125	2	meters	75%	13,480	8,035	4,222,342
126	3	meters	88%	6,809	3,388	9,577,783
127	4	meters	94%	7,490	4,897	9,882,493
128	Isolated FDPs	meters	50%	5,113	3,359	5,295,658
129	FDP >> DP	meters		45,391	40,061	47,650,265
130	DP >> next node	meters		121,933	170,518	223,747,797
131	Pillar/ LPGS >> LE	meters		3,413	4,819	12,564,446
132	Link on fibre rings (pillar to pillar)	meters		3,118	7,555	10,673
133						
134	Check: total road distance in ESAs	km		242	502	1,875,047
135	Trench as a % of road	excludes PB and road crossing distan		72%	44%	15%

Ready

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Road Crossing Error ...

Microsoft Excel - CAN

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- 101 As can be seen in cell 122U, the Analysys Model provisions 50,606,724 metres of road crossing trench and conduit. The model, however, fails to provision sufficient cable inside the road crossing conduit. The amount of copper cable needed in the CAN is calculated on lines 200 – 254 of the Access tab of the CAN module (Figure 19). The copper sheath distances are calculated on lines 210–215 of that worksheet.

Figure 19

			Geotype 1	Geotype 2	Total
Copper network					
202	NTPs at customer premises	note: fibre connections also have a 2-p	12,773	9,157	7,851,136
203	NTP: 2-pair wall socket		11,345	7,987	7,741,273
204	NTP: 10-pair building termination		1,295	1,022	96,671
205	NTP: 30-pair building termination		95	116	10,319
206	NTP: 50-pair building termination		38	32	2,874
207	NTP: 100-pair building termination		-	-	-
Copper sheath					
210	Copper sheath distances		581,167	511,002	589,397,931
211	NTP >> Property boundary	meters	39,134	23,070	46,663,437
212	Property boundary >> FDP/ DP	meters	133,016	102,253	131,352,395
213	FDP >> DP	meters	-	-	-
214	DP >> next node	meters	246,089	286,883	331,342,219
215	Pillar >> LE	meters	162,929	98,796	80,039,879
Copper sheath parameters					
217	NTP >> Property boundary	per copper location & fibre loc	3	3	
218	Property boundary >> DP	per copper location & fibre loc	10	11	
219	FDP >> DP	per copper loc	Note: unused, as distance is derived from trench network		
220	DP >> next node	per DP	37	56	
221	Pillar >> LE	per pillar	1,697	1,251	
Sheath distance by cable size (lead-in)					
223			172,150	125,323	178,015,832
224	2		152,906	109,310	175,695,935
225	10		17,457	13,987	2,040,177
226	30		1,278	1,589	220,576
227	50		509	437	59,144

- 102 As can be seen on the Access tab of the Can Module, the asset categories for cable sheath (lines 210 – 215) differ somewhat from the trench and conduit asset categories (lines 115, 122, 129 - 1132).

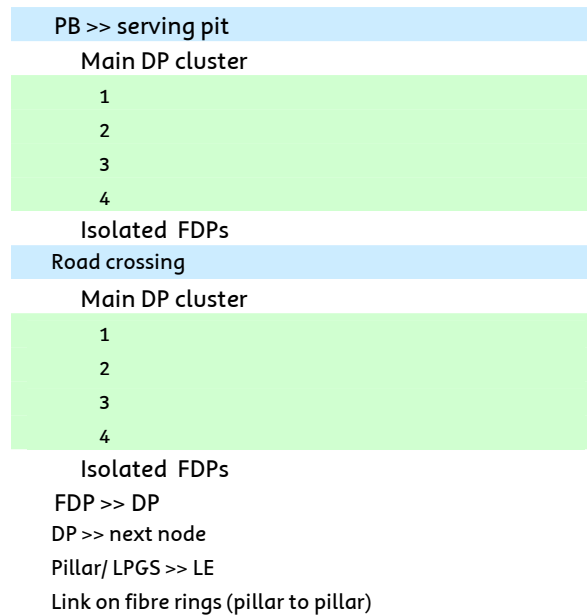
- 103 Copper sheath is divided into the following categories:

Copper sheath distances

- NTP >> Property boundary
- Property boundary >> FDP/ DP
- FDP >> DP
- DP >> next node
- Pillar >> LE

- 104 Trench and conduit is divided into the following categories:

Incremental trench distances



- 105 The asset categories for copper sheath include NTP>>Property boundary, which is not included as an asset category for trench and conduit (NTP is Network Termination Point). There is no NTP>>Property boundary asset category for trench and conduit, because the model is premised upon the assumption that property owners are obliged to provide this trench. The service provider must install cable in the trench from the property boundary to the network termination point on the side of the customer's house, however, which is why there is a copper sheath asset category for NTP>>Property boundary.
- 106 Both copper sheath and trench/conduit have asset categories for:
- (a) Property boundary >> FDP/ DP (i.e. PB >> serving pit)
 - (b) FDP >> DP
 - (c) DP >> next node
 - (d) Pillar >> LE.
- 107 Trench/conduit, however, has an asset category for Road Crossing, which is not included as an asset category for copper sheath. It appears that the copper sheath for Road Crossing is included in the Property boundary >> FDP/ DP asset category. A comparison of the distance that the model calculates for copper sheath in the Property boundary >> FDP/ DP asset category with the distances calculated for trench and conduit in both the PB >> serving pit and Road crossing categories supports this proposition.
- 108 The total copper sheath distance for PB to Serving Pit (Access worksheet in CAN.xls, cell 212U) is 131,352,395 metres. The total trench and conduit distance for PB to Serving Pit (cell 115U) is 80,745,671 metres. The total trench and conduit distance for Road crossing (Access worksheet, CAN.xls, cell 122U) is 50,606,724 metres.
- 109 The total copper sheath distance for Property Boundary to Serving Pit in the model is equal to the total trench and conduit distance for property Boundary to Serving Pit plus the total trench and conduit distance for Road Crossing, as follows:

$$131,352,395 = 80,745,761 + 50,606,724$$

- 110 Since the copper sheath distance for PB to Serving Pit is at least equal to the trench and conduit distance for PB to Serving Pit, the model includes a copper sheath distance for Road Crossing, which is equal to the Trench and conduit distance for Road Crossing (or less).
- 111 However, since all Road Crossings in the model serve at least one customer location and many Road Crossings in the model serve multiple customer locations, and since each customer location in the model is connected to the Serving Pit by a unique copper sheath,²⁵ the model's network design requires a greater length of copper sheath than conduit for road crossings. Consequently, since the model provisions a length of copper sheath, which is at most equal to total Road Crossing Trench and conduit distance, the model does not include sufficient copper sheath to serve road crossings.

How can the error be fixed?

- 112 The total distance of copper sheath required for road crossings is equal to the average number of copper sheaths needed to cross the road for each size DP Cluster times the number of DP Clusters of that size times the average distance per road crossing. (The distance of copper sheath required for Isolated DPs must also be included; and it is calculated by the same formula.) The model already calculates the number of DP Clusters of each size at Access, Can.xls, lines 71 -74 and the number of Isolated FDPs at Access, Can.xls, line 69. The Model also calculates the average distance per road crossing at Access, Can.xls, line 142. The average number of sheaths needed to cross the road for each size DP Cluster is not in the model however; so this must be calculated.
- 113 The model assumes an equal probability that customer locations are on the same side of the street as the distribution plant as they are on the opposite side of the street, i.e. a location has a 50% probability of being on each side of the street, as follows:

“Assuming that in a main DP cluster locations are equally likely to be on the side of the road of the DP-Pillar trench or on the other side, a road crossing is not required $1/(2^n)$ times, where n is the number of locations in the main cluster. As an example, where there are two location in a cluster 1 in 4 occasions both of those locations are on the side of the road with the trench.” (FLRIC Model Documentation – Version 2.0 Page 74)

- 114 Further, since each location in a cluster is served by a unique sheath, the average number of sheaths required for road crossings for each size cluster is equal to the average number of locations on each side of the street for each size cluster.²⁶

²⁵ Fixed LRIC Model Documentation Version 2.0, Figure 5.1, page 39.

²⁶ The model assumes Isolated FDPs (IFDPs) are on the opposite side of the road from the distribution plant 50% of the time.

Size DP Cluster	Ave Number of Copper Sheaths per DP Cluster	Notes
1	.5	
2	1	
3	1.5	Third location is on opposite side 50% of time. Average probability assuming 2+2, 1+3, 3+1 and 4+0 configurations.
4	2	
		See Footnote ²⁷
IDP	.5	

115 Since the model already calculates the total Road Crossing trench distance and that calculation is based upon the total number of Road Crossings, it is easier to calculate Road Crossing Sheath distance from the Average Number of Sheaths per Road Crossing rather than the Average Number of Sheaths per DP Cluster. This figure can easily be determined by dividing the Average Number of Sheaths per DP Cluster by the ratio of Road Crossings per DP Cluster.

Size DP Cluster	Ave Number of Copper Sheaths per DP Cluster	Road Xing per DP Cluster	Average Number of Copper Sheaths per Road Xing
1	.5	.5	1.0
2	1	.75	1.33
3	1.5	.875	1.71
4	2	.938	2.13
IFDP	.5	.5	1.0

116 The total metres of copper sheath required for road crossings is the total metres of road crossing trench times the average number of sheathes per road crossing. As demonstrated in the above chart, the average number of sheaths per road

²⁷ The model assumes Isolated FDPs (IFDPs) are on the opposite side of the road from the distribution plant 50% of the time.

crossing is equal to the average number of copper sheaths per DP cluster divided by the road crossings per DP cluster. Consequently:

$$\text{Total road crossing copper sheath} = (\text{Total road crossing trench}) * (\text{Average number of copper sheaths per road crossing}) = (\text{Total road crossing trench}) * (\text{Average number of copper sheaths per DP cluster}) / (\text{Average number of road crossings per DP cluster})$$

Corrections to the Model

117 As explained above, the model includes both the total copper sheath distance for Property Boundary to Serving Pit and the total copper sheath distance for Road Crossing in the Property boundary >> FDP/ DP asset category. (Access, CAN.xls, line 212)

118 The copper sheath distances for Property Boundary to Serving Pit and Road Crossings, which are included on this line, are equal to the trench and conduit distances calculated by the model for Property Boundary to Serving Pit and Road Crossing respectively.

119 The model was corrected (see Figure 20) as follows. The original formula for LINE 212G (for geotype 3) in the model was:

$$=G218*(G\$20+G\$21)*(1+Input.distance.uplift.slope)$$

And the formula for line 218G is:

$$G218G = (G\$115+G\$122)/(G\$20+G\$21)$$

Consequently the original formula for line 212G can be stated as:

$$= (G\$115+G\$122)*(1+Input.distance.uplift.slope)$$

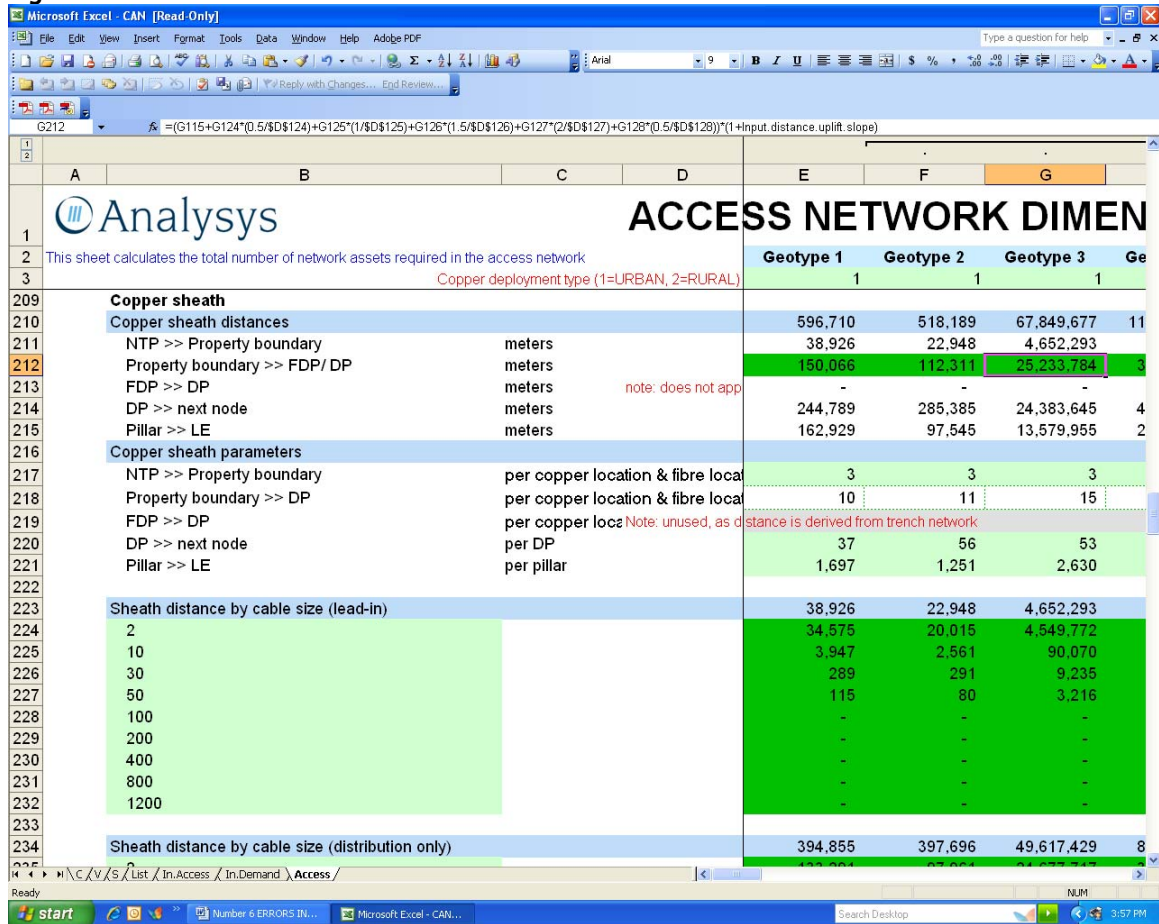
120 Lines G115 and G122 are the trench distance for property boundary to serving pit and the trench distance for road crossings respectively.

121 The formula for line 212 (for geotype 3) has been corrected as follows:

$$=(G115+G124*(0.5/\$D\$124)+G125*(1/\$D\$125)+G126*(1.5/\$D\$126)+G127*(2/\$D\$127)+G128*(0.5/\$D\$128))*(1+Input.distance.uplift.slope)$$

122 G115 remains unchanged from the original formula and is equal to the sheath distance necessary to serve property boundary to serving pit. The remainder of the formula is the corrected formula for road crossing sheath. It is the sum of the product of the road crossing trench distances for the various sizes of DP clusters (plus isolated FDPs) times the (Average number of copper sheaths per DP cluster) / (Average number of road crossings per DP cluster).

Figure 20



What is the effect of fixing the error?

123 The effect on access prices of fixing this error is set out below:

	ULLS (Access cost per line per month)		Wholesale line rental (WLR) Access cost per line per month				PSTN OTA
	Zone A	Zone B	Band 1	Band 2	Band 3/4 (clustered)	Band 3/4 (spread)	
Restored duct/cable baseline	\$22.62	\$59.82	8.65	21.19	34.97	57.64	0.69
Fix	\$22.68	\$59.82	8.66	21.24	35.02	57.67	0.69
Difference 0.06		0.00	0.01	0.06	0.05	0.04	0.00

Note: the comparison above is not from the Analysys Model with default settings but from a version of the model that corrects error 5 – that is, it includes the ducts/cables necessary for the serving pit architecture.

Error 7: The serving pit architecture is inconsistent with the distribution network architecture used in the geoanalysis and access network module

What is the error?

- 124 The Analysys Model uses a customer access network design and adopts the calculations for the network assets required to serve all locations within Australia as set out in separate workbooks, which comprise the ‘geoanalysis and access network’ module. This module contains a detailed calculation of the network assets required to serve a sample of over 800,000 locations within Australia. The asset volumes required for this sample are then scaled up in order to determine the asset volumes required for a full nationwide deployment.
- 125 However, the “active modules” in the Analysys Model (i.e. the Core, CAN and Cost modules) utilise an access network design that is inconsistent with the network design generated in the geoanalysis and access network module, when the ACCC’s settings for Serving Pit Architecture options are utilised. As explained below, the result is that the physical locations of key network structure points in the access network used in the CAN module of Analysys Model are different from the locations of those same points established in the geoanalysis and access network module. Despite this, the active modules of the Analysys Model then rely on the average distances, pillar clusters and DP clusters, which are generated in the geoanalysis and access network module, without regard to the difference in the access network design. The result is that the Analysys Model incorrectly calculates and underestimates the average distance from a property boundary to a serving pit used in the cost calculation so that the cost of Serving Pit Architecture is understated even when Error 6 is corrected.
- 126 The ACCC documentation states:
- “The design of the access network is generated using parameters determined from detailed Excel and geographical information system (GIS) modeling work performed in external workbooks and database files, as described in section 4 and 5 and Annexes A_F. All of these files comprise the ‘geoanalysis and access network’ module.” (FLRIC section 2.2 page 5)*
- “The geoanalysis and access network module completes a detailed calculation of the network assets required to serve a sample of over 800 000 locations within Australia. The asset volumes required for this sample are then scaled up in order to determine the asset volumes required for a full nationwide deployment.” (FLRIC section 2.2.1 page 6)*
- 127 The measurement of distances between customer locations and access network structure points is a significant part of the calculation of required network assets, as it determines trench length. Trench length is one of the primary drivers of access network costs. The model calculates average distances between network structure points (e.g. FDP>>DP and DP>>next node) in the geoanalysis and access network module. The ACCC documentation states as follows:
- “Therefore, we mapped locations onto their nearest street point which we call the final drop point (FDP), as shown in Figure 4.9. We then calculate the trench and cable length required to reach the exchange from the final drop point (FDP).” (FLRIC section 4.2.3)*
- “FDP-DP links use the modified Prim algorithm to form the trench network within a DP cluster and calculate the number of pairs required to reach end-customer locations. ... The (non-repeated) trench required to*

connect all the points to the DP is calculated.” (FLRIC section 5.3.2 page 50)

“The modified Dijkstra algorithm uses a pre-calculated mesh of trench linkages to join DPs to their parent pillar. The pre-calculation and subsequent algorithm proceed by:

- for each pair of DP clusters, identifying a point within each cluster that produce the shortest link between the two DPs*
- creating a fully meshed set of lowest proxy cost linkages between DPs using these points. These links can form a ‘daisy-chain’ via other DPs and assume that the trench within the DP clusters has been laid*
- using the Dijkstra algorithm to select the least proxy cost subset of linkages that allow each DP to be joined back to the pillar.” (FLRIC section 5.3. page 51)*

- 128 As explained in the above quote, the geoanalysis and access network module of the Analysys Model provisions cable, trench and conduit routes by calculating the shortest distance between DPs. DPs are the fundamental building block of the network designed by the Analysys Model. They are the points where all demand joints are done and they are the points that define the distribution routes from customer location back to the pillars. Further, all of the trench distances used in the model, except for the pillar to exchange segment, are calculated using the geo-coordinates of DPs; and even the pillar to exchange routes use DPs in their design.
- 129 Parts of the “active modules” can, however, be inconsistent with the assumptions in the geoanalysis and access network module, if the Serving Pit Architecture ‘Options’ are exercised as is done in the ACCC’s default inputs. Cell 55N and cells 76N-76Q of the In.Demand tab of the CAN module allow the user the “option” to change the Serving Pit Architecture. Specifically, they allow the user to change the location of the DPs from where they are placed by the geoanalysis and access network module and to change assumptions about the location of the FDP and the calculation of average property frontage from the assumptions made in the geoanalysis and access network module. If these options are exercised, the physical location of key network structure points used in the CAN module can be quite different from the physical location of those same network structure points in the geoanalysis and access network module. Moving the physical placement of DPs, the basic building block of the model’s access network design, and FDP, the final drop point that is used to calculate the trench and cable length required to reach the exchange, after all of the distance measurements are performed and average distances between structure points are calculated in the geoanalysis and access network module would invalidate the results of the network design process and render the calculation of network assets required to serve all study locations meaningless.
- 130 The option to move the serving pit (i.e. the DP) is found in CAN.xls, In.Demand, Cell 55N. Placing a 1 in this cell leaves the DP in the location it was placed in the geoanalysis and access network module. Placing a 2 in the cell moves the DP to the “location closest to demand-weighted centre of the cluster.” The option to change the average width of a property boundary is found in CAN.xls, In.Demand, Cells 76N – 76Q. The average width of a property boundary used in the model is actually the average distance between FDPs. Consequently, this

option changes the average distance between FDPs.²⁸ Placing 100% in one of these cells leaves the average distance between FDPs as it was calculated in the geoanalysis and access network module. Placing a percentage less than 100 in one of these cells will reduce the average distance between FDPs from what was calculated in the geoanalysis and access network module. The ACCC's default options can be seen in Figure 21 below.

Figure 21

	Distance of pits from property boundary	Average distance between locations in DP cluster	Road crossing distance	Average distance PB >> serving pit - by size of main DP cluster				Length of
				1	2	3	4	
57								
58	1.00	8.98	11	1.00	2.80	3.40	5.92	
59	1.00	11.46	10	1.00	3.41	4.21	7.47	
60	1.00	9.52	15	1.00	2.93	3.58	6.26	
61	1.00	10.87	15	1.00	3.26	4.02	7.09	
62	1.00	13.89	17	1.00	4.01	5.01	8.97	
63	1.00	14.80	16	1.00	4.23	5.31	9.54	
64	1.00	17.93	18	1.00	5.01	6.35	11.49	
65	1.00	-	20	1.00	1.00	1.00	1.00	
66	1.00	-	27	1.00	1.00	1.00	1.00	
67	1.00	17.83	23	1.00	4.99	6.31	11.43	
68	1.00	-	18	1.00	1.00	1.00	1.00	
69	1.00	-	26	1.00	1.00	1.00	1.00	
70	1.00	-	25	1.00	1.00	1.00	1.00	
71	1.00	-	18	1.00	1.00	1.00	1.00	
72	1.00	-	-	-	-	-	-	
73	1.00	-	-	-	-	-	-	
74	ave dist road cross, ave dist serving pit, ave dist serving pit, ave dist serving pit, ave dist serving pit per location (Option 1 lin							
75	Option 2 lin							
76	Proportion of property boundary width built to (A): 50% 50% 50% 50%							
77	100% = build to centre of property							

131 An option in the model to deploy an alternative network architecture will only work if it coordinates changes in the external geoanalysis and access network module with changes in the active modules (i.e. the Core, CAN and Cost modules). The design options in the Version 0.92 of the model, however, change the location of primary network structure points, after the access network has been designed and distances between structure points have been measured in the geoanalysis and access network module. Such a design change would require the geoanalysis and access network module to be rerun; the network to be re-designed and distances to be re-measured; however, the model fails to do this.

132 To calculate the necessary assets for network deployment using one network design, and then use a different network design, when tabulating the costs of network assets, is not a valid computation of costs. These design 'options,' which serve to invalidate the results of the geoanalysis and access network module, must be removed from the model.

²⁸ The distances are found in CAN.xls, In.Demand, Cells 57L – 73L. Since these distances are measure after the FDPs have been mapped into the middle of the street, they are effectively equal to one half of the average width of a property boundary, because the model contains one FDP per house and houses are on both sides of the street.

How can the error be fixed?

- 133 The error can be fixed by using a network design in the active modules of the Analysys Model that is the same as that used in the geoanalysis and access network module. Cell 55N and cells 76N-76Q of the In.Demand tab of the CAN module allow the user to change the Serving Pit Architecture. These options introduce error and inconsistency into the model and should be removed. In order for the Analysys Model to be internally consistent, the serving pits (DPs) must remain in the location they are placed by geoanalysis (i.e. Cell 55N must remain set at Option 1); and the property boundary width must remain unchanged from the measurements made in geoanalysis (i.e. Cells 76N – 76N must remain set at 100%).

Corrections to the Model

- 134 The calculation of the average distance from the property boundary to the serving pit (PB >> serving pit) by size of DP cluster has been modified to remove the options to move the location of the serving pit and change the average property boundary width. This distance is calculated by geotype in CAN.xls, In.Demand, Lines 58 – 73, Columns N – V. The formulae for “Length of individual link” in Lines 58 – 73, Columns S – V have been modified as shown in the following example:

The original formula for the length of the third link in a DP cluster in geotype 4 was:

=IF(\$D61=0,0,IF(\$D61=2,\$K61,IF(\$N\$55=1,SQRT(\$K61^2+(\$L61*\$P\$76+\$L61)^2),SQRT(\$K61^2+(\$L61*\$P\$76)^2))))

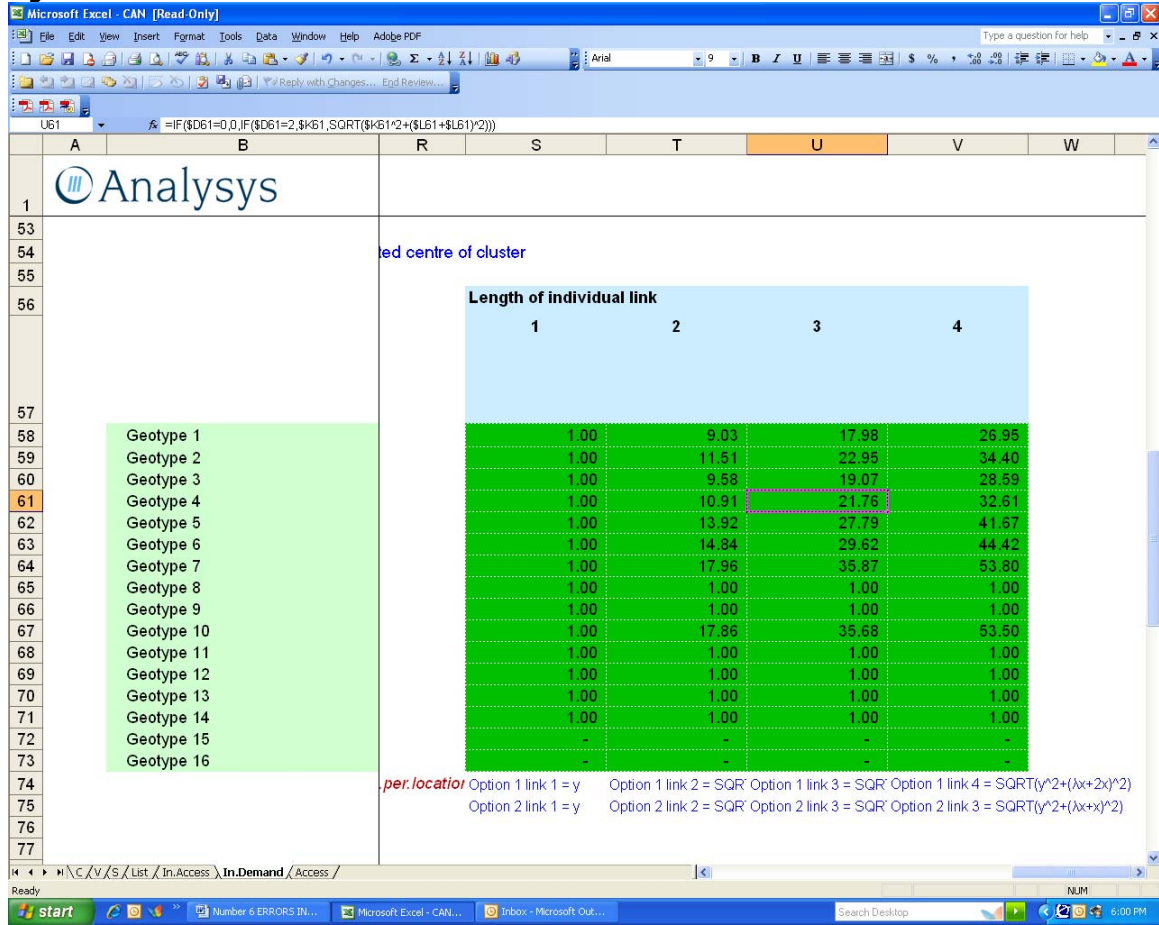
The corrected formula for the length of the third link in a DP cluster in geotype 4 is:

=IF(\$D61=0,0,IF(\$D61=2,\$K61,SQRT(\$K61^2+(\$L61+\$L61)^2)))

- 135 As can be seen the following changes have been made to the original formula in the corrected version:
- (a) no change has been made to the first part of the formula related to \$D61;
 - (b) the If Statement related to N55 has been removed and only the N55=1 version of the formula has been retained;
 - (c) the (N55 does not equal 1) option has been removed; and
 - (d) P\$76 has been removed.
- 136 The original formula, with the portions that have been removed highlighted in yellow is reproduced below.

=IF(\$D61=0,0,IF(\$D61=2,\$K61,IF(\$N\$55=1,SQRT(\$K61^2+(\$L61*\$P\$76+\$L61)^2),SQRT(\$K61^2+(\$L61*\$P\$76)^2))))

Figure 22



137 The net result of the changes is that the DP/serving pit location remains where it is placed by geanalysis (N55 always equals 1) and the property boundary width remains as measured by geanalysis (line 76N - 76Q always equals 100%).

138 The effect on the access prices of correcting this error is set out below:

	ULLS (Access cost per line per month)		Wholesale line rental (WLR) Access cost per line per month				PSTN OTA
	Zone A	Zone B	Band 1	Band 2	Band 3/4 (clustered)	Band 3/4 (spread)	All areas
Restored duct/cable baseline	\$22.62	\$59.82	8.65	21.19	34.97	57.64	0.69
Fix	\$23.87	\$59.76	8.83	22.35	36.26	58.33	0.69
Difference 1.25		(0.06)	0.19	1.16	1.28	0.69	0.00

Error 8: The Analysys model assumes that IEN and CAN cables share the same trench but it fails to dimension the trench and pits to a size that would fit both networks;²⁹ and the model overestimates the cost of CAN trench, conduit and pits attributable to the Core Network

What is the error?

- 139 The Analysys Model assumes that IEN and CAN cables can both be placed in the same trench. It calculates the cost of the CAN trenches, conduit and pits without regard to the fact that they need to house IEN infrastructure, and then, because it assumes IEN cables and duct can be placed in the CAN trench without incurring any additional cost, it allocates a proportion of the cost of the CAN trenches and pits to IEN services.
- 140 The assumption that IEN and CAN cables can share the same trench is incorrect (for the reasons set out in the Lordan Report at section 5). However, even accepting this assumption, the Analysys Model provisions a CAN trench, conduit and pits at sizes that only allow provide enough capacity for CAN cables. It therefore fails to take account of the additional costs required to dig a trench and place conduit configurations large enough to fit both IEN and CAN cables. This error results in trenching and conduit costs being understated. Further, there is an error in the calculation of the proportion of CAN trench costs allocated to the IEN.
- 141 These errors have the effect of significantly understating the total trench, conduit, pit and manhole costs required to house the shared network, while simultaneously overstating the portion of the total trenches, conduits, pits and manholes costs that are allocated away from the CAN to the Core network. The combination of errors thus results in significant understatement of the cost of the CAN.
- 142 The calculation of the dollar impact of sharing trench, pit and manhole costs between the Core and CAN networks is found in the Cost module of the Analysys Model.³⁰ Ratios that identify the proportion of the CAN trench, conduit, pit and manhole costs³¹ that is to be allocated to the Core network are applied to the sum of the total annualised capital costs (per geotype)³² and the total direct operating expenses (per geotype)³³ for 'duct' (including the conduit and trench costs) and pits and manholes to derive the quantum of shared costs that will be attributed to the Core network).³⁴
- 143 Figure 23 is a snapshot of the calculations in the TA.Access worksheet in the Cost module that determine the shared trench costs that are allocated to the Core model for geotypes 1 and 5. (Only those portions of the TA.Access worksheet where the calculation of the cost of 'ducts' and 'pits and manholes' for geotypes 1 and 5 are shown in this figure. Similar calculations for all the other geotypes are also included on this worksheet but have been hidden in Figure 23 in order to show results from the total calculations.)

²⁹ Error 7 in the 31 July Letter.

³⁰ Analysis Model, Costs.xls, TA.Access, rows 22 – 40, columns M, DT - EI.

³¹ Analysis Model, Costs.xls, TA.Access, rows 22 – 40, columns -CL - DA.

³² Analysis Model, Costs.xls, TA.Access, rows 22 – 40, columns BD - BS.

³³ Analysis Model, Costs.xls, TA.Access, rows 22 – 40, columns BU - CJ.

³⁴ Analysis Model, Costs.xls, TA.Access, rows 22 – 40, columns M, DT - EI.

Figure 23

	A	B	C	BD	BH	BU	BY	CL	CP	DT	DX
1	Analysys										
7	Asset calculation			Annualised capex cost per geotype (AUD)		Opex cost per geotype (AUD)		% of trench and duct cost allocated to core (%)		Trench and duct cost allocated to core (AUD)	
8	Access asset group	Assets		Geotype 1	Geotype 5	Geotype 1	Geotype 5	Geotype 1	Geotype 5	Geotype 1	Geotype 5
22	Duct	Duct: 28		-	-	-	-	4%	12%	-	-
23	Duct	Duct: 24			52,491		1,453	4%	12%		(6,603)
24	Duct	Duct: 20		4,597	305,884	127	8,465	4%	12%	(178)	(38,478)
25	Duct	Duct: 16		1,472	648,396	41	17,961	4%	12%	(57)	(81,640)
26	Duct	Duct: 12		25,205	3,300,133	698	91,330	4%	12%	(975)	(415,138)
27	Duct	Duct: 8		31,888	2,579,121	882	71,376	4%	12%	(1,234)	(324,439)
28	Duct	Duct: 6		43,411	6,666,268	1,201	184,487	4%	12%	(1,679)	(838,580)
29	Duct	Duct: 4		212,721	15,856,891	5,887	438,834	4%	12%	(8,229)	(1,994,709)
30	Duct	Duct: 2		205,900	25,343,857	5,698	701,382	4%	12%	(7,965)	(3,188,117)
31	Duct	Duct: 1		456,644	90,841,691	12,637	2,514,010	4%	12%	(17,664)	(11,427,382)
32	Duct	Duct: 1 road-crossing		224,304	23,156,658	6,209	806,900	-%	-%	-	-
33	Duct	Duct: 1 (PB >> DP/ Serving pit)		-	-	-	-	-%	-%	-	-
34	Duct	Pits: PF28		-	17,423	-	421	4%	12%	-	(2,184)
35	Duct	Pits: PF20		3,020	256,374	73	6,192	4%	12%	(118)	(32,140)
36	Duct	Pits: PF12		142,380	6,994,281	3,439	168,927	4%	12%	(5,489)	(876,826)
37	Duct	Pits: P9		511,706	17,577,797	12,359	424,541	4%	12%	(19,726)	(2,203,610)
38	Duct	Pits: P6		199,763	14,606,051	4,825	352,767	4%	12%	(7,701)	(1,831,063)
39	Duct	Pits: P5		239,414	18,956,168	5,782	457,832	4%	12%	(9,229)	(2,376,408)
40	Duct	Pits: P6 road crossing		140,591	23,469,182	3,396	566,830	-%	-%	-	-

144 As illustrated above, the ‘% of trench and duct cost allocated to core’ in columns CL and CP is applied to the sum of ‘Annualised capex cost per geotype’ (columns BD and BH) and ‘Opex cost per geotype’ (columns BU and BY) to derive the ‘trench and duct costs allocated to core’ (columns DT and DX). These are negative amounts which are then included in the calculation of the total cost of the customer access network (i.e. Total cost per geotype),³⁵ thereby reducing the CAN cost by these amounts.

145 It can be seen in Figure 23 above that the majority of the duct costs allocated to the Core network in this way is associated with conduit runs that consist of a single duct (line 31). In addition, a significant portion of the pit and manhole costs allocated to the Core network are for number 5 and number 6 pits. This is problematic, since by definition any trench shared between the CAN and Core Networks will contain more than 1 duct, because the model always provisions 2 ducts for IEN cables. As discussed below, the cost of trench, conduit, pits and manholes increase dramatically when additional conduits are added to the configuration to accommodate the IEN.

146 The sharing ratios for each geotype (e.g. Columns CL and CP above) are derived from the “Inputs.Access” worksheet of the Cost module.³⁶ They are the sums of the ratios for determining the portion of:

- (a) trench sharing within the CAN between the copper cable distribution and main networks and the fibre cable main network (i.e. intra CAN sharing between the copper and fibre portions of the CAN); and
- (b) trench sharing between the CAN and IEN.

147 The costs associated with the fibre main cable network and the IEN are removed from the CAN costs in the Analysys Model in the proportion identified below in Figure 24.

³⁵ Analysis Model, Costs.xls, TA.Access, rows 22 – 40, columns FS - GH.

³⁶ Analysis Model, Costs.xls, Inputs.Access, rows 137-155, columns D - S.

Figure 24

	A	B	D	H
137		Proportion of Access costs allocated to Core		
138		CAN Asset	Geotype 1	Geotype 5
139	13	Duct: 28	3.76%	12%
140	14	Duct: 24	3.76%	12%
141	15	Duct: 20	3.76%	12%
142	16	Duct: 16	3.76%	12%
143	17	Duct: 12	3.76%	12%
144	18	Duct: 8	3.76%	12%
145	19	Duct: 6	3.76%	12%
146	20	Duct: 4	3.76%	12%
147	21	Duct: 2	3.76%	12%
148	22	Duct: 1	3.76%	12%
149	25	Pits: PF28	3.76%	12%
150	26	Pits: PF20	3.76%	12%
151	27	Pits: PF12	3.76%	12%
152	28	Pits: P9	3.76%	12%
153	29	Pits: P6	3.76%	12%
154	30	Pits: P5	3.76%	12%
161				
162		Proportion for modern network deployment		
163		CAN Asset	Geotype 1	Geotype 5
164	13	Duct: 28	-%	9%
165	14	Duct: 24	-%	9%
166	15	Duct: 20	-%	9%
167	16	Duct: 16	-%	9%
168	17	Duct: 12	-%	9%
169	18	Duct: 8	-%	9%
170	19	Duct: 6	-%	9%
171	20	Duct: 4	-%	9%
172	21	Duct: 2	-%	9%
173	22	Duct: 1	-%	9%
174	25	Pits: PF28	-%	9%
175	26	Pits: PF20	-%	9%
176	27	Pits: PF12	-%	9%
177	28	Pits: P9	-%	9%
178	29	Pits: P6	-%	9%
179	30	Pits: P5	-%	9%
213				
214		Proportion for core using access		
230		Proportion of trench & duct allocated to core for IEN usage	4%	4%

148 As illustrated above, the 3.76% and 12% sharing factors for Geotypes 1 and 5, respectively, are determined by summing the ratio for the proportion of the total CAN that is attributable to fibre fed main network facilities (i.e. Proportion of modern network deployment – lines 164 - 179) and the proportion of the CAN trench that will be attributable to sharing with the IEN (line 230).³⁷ For example, the percent of trench and duct costs allocated to the core network for geotype 5 (i.e. 12% – line 148) is a combination of the proportion of the total cost attributable to the fibre main and interexchange networks (i.e. 12% = 9% + 4% x (1 – 9%)).

149 The calculation of these ratios includes errors that grossly overstate the costs properly allocated to the Core network. In addition, the cost of the CAN trench, pits and manholes which is being shared is understated due to the implied assumption that the trench costs incurred to deploy an access network would

³⁷ In calculating the composite ratio, the proportion of the trench that is allocated to CAN, because it is attributable to the fibre main network, is removed from the total trench costs used to determine the proportion of the trench attributable to IEN. For Geotype 5 the formula for calculating the composite 12% sharing is 9% + 4% x (1 – 9%). A different set of ratios for determining the proportion of trench attributable to fibre main cables is used when the Multiple Service Access Node (MSAN) option is selected in order to model a next generation network (NGN).

provide a trench and conduit structure sufficient to house both CAN and IEN ducts. Each is discussed separately below.

Proportion of CAN trench, duct and pit costs attributed to sharing with the IEN

150 In calculating the cost of the shared CAN trench that is to be allocated to the IEN, the Analysys Model assumes that two additional IEN conduits can be placed into the trenches designed solely to accommodate the CAN distribution ducts without any increase in trenching costs. The costs for distribution trenches are determined based on the number of distribution conduits that will be accommodated in the trench. The model identifies the amount of costs to allocate to the IEN by applying a sharing ratio to the CAN trench costs without any adjustment to trench costs to account for the placement of two additional ducts in each trench.

151 At Figure 25 below is the calculation of the total capital costs for CAN trench, ducts and pits prior to any allocation of costs to the Core network for geotypes 1 and 5.³⁸

Figure 25

	A	C	H	V	Z	AM	AQ
7	Asset calculation		Equipment purchased			Capex cost per geotype (AUD)	
	Assets		Unit capex (AUD) (Option 1 prices)	Geotype 1	Geotype 5	Geotype 1	Geotype 5
9							
22	13	Duct: 28	663	-	-	-	-
23	14	Duct: 24	621	-	1,211	-	701,702
24	15	Duct: 20	559	119	7,904	61,447	4,089,042
25	16	Duct: 16	373	56	24,622	19,672	8,675,761
26	17	Duct: 12	311	1,160	151,938	336,942	44,116,057
27	18	Duct: 8	187	2,410	194,922	426,278	34,477,596
28	19	Duct: 6	155	4,007	615,254	580,316	89,114,434
29	20	Duct: 4	108	27,584	2,056,223	2,843,643	211,974,359
30	21	Duct: 2	92	31,612	3,891,060	2,752,461	338,795,781
31	22	Duct: 1	62	106,908	21,267,577	6,104,394	1,214,368,510
32	23	Duct: 1 road-crossing	62	52,513	6,826,067	2,998,494	389,765,171
33	24	Duct: 1 (PB >> DP) Serving pit)	-	38,012	7,402,497	-	-
34	25	Pits: PF28	4,600	-	43	-	196,686
35	26	Pits: PF20	4,600	7	629	34,094	2,894,092
36	27	Pits: PF12	4,600	349	17,164	1,607,267	78,955,330
37	28	Pits: P9	4,600	1,256	43,137	5,776,419	198,427,951
38	29	Pits: P6	1,529	1,475	107,841	2,255,036	164,881,226
39	30	Pits: P5	713	3,791	300,123	2,702,643	213,987,771
40	31	Pits: P5 road crossing	713	2,226	371,575	1,587,072	264,933,185

152 The unit costs (Column H) are applied to the equipment volumes (column V and Z) to derive the total capital costs or investment in ducts and pits (i.e. Columns AM and AQ).³⁹ For example, the total cost for placing single duct in geotype 5 (line 31) is \$62.37 per metre x 21.3 million metres = \$1.2 billion dollars. As will be discussed later, the cost of ducts and pits increases significantly as the number of ducts and the size of the pits increases.

³⁸ Analysis Model, Costs.xls, TA.Access, rows 22 – 40.

³⁹ The calculation of the total investment by geotypes for other bands is also derived in the TA.Access worksheet in the Cost module of the Analysys Model. The cost for every geotype is derived by multiplying the unit capex (rows 22-44, column H) times the Equipment purchased for each geotype (row 22-44, columns V – AK) to derive the total Capex cost per geotype (row 22-44, columns AM-BB) prior to sharing between networks.

153 The total investment for each geotype is then used to calculate the annual capital (Annualised capex cost per geotype)⁴⁰ and operating costs (Opex cost per geotype)⁴¹ for each geotype. Below at Figure 26 is a portion of the TA.Access worksheet from the Cost module that shows the results of these calculations for geotypes 1 and 5.

Figure 26

	A	C	I	A	AM	AR	B	BD	BH	B	BU	BY
7	Asset calculation				Capex cost per geotype (AUD)		Annualised capex cost per geotype (AUD)		Opex cost per geotype (AUD)			
8	Assets		Opex as % of capex	note: factors in option 2 (rural prices)		Geotype 1	Geotype 5	Geotype 1	Geotype 5	Geotype 1	Geotype 5	
9												
22	Duct: 28		0%	-	-	-	-	-	-	-	-	-
23	Duct: 24		0%	-	148,320	-	52,491	-	1,453	-	-	-
24	Duct: 20		0%	61,447	1,577,435	4,597	305,884	127	8,465	-	-	-
25	Duct: 16		0%	19,672	2,103,322	1,472	648,996	41	17,961	-	-	-
26	Duct: 12		0%	336,942	7,857,625	25,205	3,300,133	698	91,330	-	-	-
27	Duct: 8		0%	426,278	11,817,554	31,888	2,579,121	882	71,376	-	-	-
28	Duct: 6		0%	580,316	23,869,434	43,411	6,666,268	1,201	184,487	-	-	-
29	Duct: 4		0%	2,843,643	66,280,678	212,721	15,856,891	5,887	438,834	-	-	-
30	Duct: 2		0%	2,752,461	133,469,617	205,900	25,343,857	5,698	701,382	-	-	-
31	Duct: 1		0%	6,104,394	362,351,705	456,644	90,841,691	12,637	2,514,010	-	-	-
32	Duct: 1 road-crossing		0%	2,998,494	97,672,657	224,304	29,156,658	6,208	806,900	-	-	-
33	Duct: 1 (PB >> DP/ Serving pit)		0%	-	-	-	-	-	-	-	-	-
34	Pits: PF28		0%	-	54,114	-	17,423	-	421	-	-	-
35	Pits: PF20		0%	34,034	1,515,185	3,020	256,374	73	6,192	-	-	-
36	Pits: PF12		0%	1,607,267	26,353,399	142,380	6,994,281	3,439	168,927	-	-	-
37	Pits: P9		0%	5,776,419	60,174,497	511,706	17,577,797	12,359	424,541	-	-	-
38	Pits: P6		0%	2,255,036	57,933,098	199,763	14,606,051	4,825	352,767	-	-	-
39	Pits: P5		0%	2,702,643	64,324,751	239,414	18,956,168	5,782	457,832	-	-	-
40	Pits: P5 road crossing		0%	1,587,072	64,681,132	140,591	23,469,182	3,396	566,830	-	-	-

154 The operating costs (Opex costs) are derived by applying the operating expense ratio (Opex as % of capex) to the total capitalized costs. The operating expense for single duct systems in geotype 5 of \$2.5 million (line 31, column BY) is derived by taking the operating expense factor of .21%⁴² times the total investment of \$362.4 million. The annualized capital expense (column BH) is also derived from the total investment using a tilted annuity calculation.⁴³

155 As previously explained, allocation factors are then applied to the sum of annualised capital expense (capex) and operating expense amounts to derive the amount of trench, duct and pit costs that will be allocated to the Core network (see Figure 27). The amount allocated is the total ratio that reflects both intra CAN (sharing between CAN fibre and CAN copper) and sharing between the CAN and the IEN. These sharing ratios are identical across all sizes of pits and ducts. Figure 27 identifies the sharing ratios for ducts and pits for geotypes 1 to 7. All trenches in each geotype are shared proportionately regardless of the quantity of CAN ducts that are placed in the trench.

⁴⁰ Analysis Model, Costs.xls, TA.Access, rows 22 – 40, columns BD – BS.

⁴¹ Analysis Model, Costs.xls, TA.Access, rows 22 – 40, columns BU – CJ.

⁴² In the model the operating expense ratios are displayed as the nearest percent so .20% shows up as 0%.

⁴³ The tilted annuity calculation is (Capex cost x (Weighted average cost of capital (WACC) – (annual price change + Tilt Adjustment)) / (1 – (((1 + Annual price change + Tilt Adjustment) / (1 + WACC)) ^ Economic life))). For 1 Duct conduit systems in geotype 5 this calculation is (\$362.4M x (10.77% – (1.66% + 3%))) / ((1 + 1.66% + 3%) / (1 + 10.77%) ^ 35)) or \$90.8M. Each variable is found in the following column of the TA.Access W/S: Tilt adj – col F; Annual price change – col E; economic life – col G; WACC – col D, line 5.

Figure 27

	A	C	CL	CM	CN	CO	CP	CQ	CR
6									
7	Asset calculation		% of trench and duct cost allocated to core (%)						
8		Assets	Geotype 1	Geotype 2	Geotype 3	Geotype 4	Geotype 5	Geotype 6	Geotype 7
9									
22	13	Duct: 28	4%	4%	7%	10%	12%	18%	17%
23	14	Duct: 24	4%	4%	7%	10%	12%	18%	17%
24	15	Duct: 20	4%	4%	7%	10%	12%	18%	17%
25	16	Duct: 16	4%	4%	7%	10%	12%	18%	17%
26	17	Duct: 12	4%	4%	7%	10%	12%	18%	17%
27	18	Duct: 8	4%	4%	7%	10%	12%	18%	17%
28	19	Duct: 6	4%	4%	7%	10%	12%	18%	17%
29	20	Duct: 4	4%	4%	7%	10%	12%	18%	17%
30	21	Duct: 2	4%	4%	7%	10%	12%	18%	17%
31	22	Duct: 1	4%	4%	7%	10%	12%	18%	17%
32	23	Duct: 1 road-crossing	-%	-%	-%	-%	-%	-%	-%
33	24	Duct: 1 (PB >> DP/ Serving pit)	-%	-%	-%	-%	-%	-%	-%
34	25	Pits: PF28	4%	4%	7%	10%	12%	18%	17%
35	26	Pits: PF20	4%	4%	7%	10%	12%	18%	17%
36	27	Pits: PF12	4%	4%	7%	10%	12%	18%	17%
37	28	Pits: P9	4%	4%	7%	10%	12%	18%	17%
38	29	Pits: P6	4%	4%	7%	10%	12%	18%	17%
39	30	Pits: P5	4%	4%	7%	10%	12%	18%	17%

156 There is a significant problem with this approach. Single duct trenches and number 5 pits are not designed to accommodate conduit configuration comprising more than a single duct.⁴⁴ Assuming that a single duct trench is shared between the CAN and IEN understates the costs of the trenches and pits because:

- (a) the cost of conduit (including trenching) increases as the number of ducts placed in the trench is increased; and
- (b) larger conduit systems require the placement of larger pits and manholes. The cost of pits and manholes also increases significantly as the size increases.

157 The smallest conduit configuration that could accommodate both CAN and IEN cables would have 4 ducts. As the excerpt from the Analysys model in Figure 28 shows, every interoffice conduit run has two ducts:

Figure 28

	A	D	E	F
24	Network equipment investment costs in 2007 (AUD)			<i>Note: Adjusting</i>
25		Assets	Assumption	Basic equipment cost (AUD)
26				
68	42	LE-PoC: Duct	Cost of 2x100mm conduit deployed in open trench	59
94	68	PoC-LAS: Duct	Cost of 2x100mm conduit deployed in open trench	59
131	105	LAS-TNS ring: Duct	Cost of 2x100mm conduit deployed in open trench	59
180	154	TNS-TNS ring: Duct	Cost of 2x100mm conduit deployed in open trench	59

158 The smallest conduit configuration for a distribution conduit run is 1 duct. Therefore, a conduit configuration designed to accommodate a combined CAN/IEN network would require at a minimum 3 ducts (i.e. 1 distribution duct + 2

⁴⁴ Fixed LRIC model documentation – Version 2, page 56.

IEN ducts). As can be seen in the documentation,⁴⁵ there is no provision for a 3 duct conduit run in the Analysys Model. This is consistent with standard network deployment rules. Therefore a 4 duct system would be the smallest that could hold combined IEN/CAN conduit.

- 159 Similarly, the smallest manhole/pit that could accommodate a 4 duct conduit configuration is a number nine pit (P9).⁴⁶
- 160 Nevertheless, the Analysys Model assumes that the vast majority of sharing is related to 1 and 2 duct configurations and size 5 and 6 pits, facilities that could never accommodate a combined network. Assuming the IEN network can simply be overlaid on the CAN network without incurring additional costs significantly understates the cost of the required trenches, pits and manholes. The underlying cost of the trench, conduit, pits and manholes needs to be increased in those locations where IEN is overlaid on the CAN. The Analysys Model does not do so.
- 161 Figure 29 below identifies the calculations of the composite trench costs for ducts in the Analysys Model.⁴⁷ As can be seen from this figure, the total cost of a single-duct trench is \$60 per metre, but the total cost of a 4-duct trench is \$105 per metre. The Analysys Model, by applying single-duct costs for trenches where multiple ducts are used (because of trench sharing between the CAN and IEN), thus understates total trench costs by more than 40%. Understating the size of a conduit configuration has a significant impact on trenching costs.

Figure 29

	A	B	C	E	F	G	H
1	Detailed unit cost inputs						
2							
3	Capital cost inputs: Duct deployment						
4				Provision of trench	Installation of guard wire	Duct	Total unit cost (AUD/ metre)
5	Urban deployment: trenched duct						
6			Duct: 28	240	1.35	400	641
7			Duct: 24	240	1.35	360	601
8			Duct: 20	240	1.35	300	541
9			Duct: 16	120	1.35	240	361
10			Duct: 12	120	1.35	180	301
11			Duct: 8	60	1.35	120	181
12			Duct: 6	60	1.35	89	150
13			Duct: 4	30	1.35	74	105
14			Duct: 2	30	1.35	58	89
15			Duct: 1	30	1.35	29	60
16			Duct: 1 road-crossing	30	1.35	29	60
17			Duct: 1 (PB >> DP/ Serving pit)	15	1.35	15	31

- 162 Below at Figure 30 is the table from which the total pit costs were derived.

⁴⁵ Fixed LRIC model documentation – Version 2, page 56.

⁴⁶ Fixed LRIC model documentation – Version 2, page 56. Telstra’s engineering guidelines specify the use of a PF4 manhole for conduit configurations consisting of 4 ducts.

⁴⁷ Note that the trench costs in Column E and the total cost in column H increase as the size of the conduit configuration increases.

Figure 30

	A	C	E	F	G	H	I	
115	Network equipment investment cost table						Note: economic I	
116			Note: Adjusting any of the unit cost components will result in a different total unit cost fl					
117		Assets	Basic equipment cost (AUD)	Spares uplift (%)	Installation uplift (%)	Indirect asset cost uplift (%)	Years	
142	25	Pits: PF28	4,000	-%	15%	-%	35	
143	26	Pits: PF20	4,000	-%	15%	-%	35	
144	27	Pits: PF12	4,000	-%	15%	-%	35	
145	28	Pits: P9	4,000	-%	15%	-%	35	
146	29	Pits: P6	1,330	-%	15%	-%	35	
147	30	Pits: P5	620	-%	15%	-%	35	
148	31	Pits: P5 road crossing	620	-%	15%	-%	35	

163 As is evident from the above excerpt from the Analysys Model, as the size of the pit increases so does its cost.⁴⁸ To accommodate 4 ducts, the model documentation (at figure 5.19) says at least a P9 pit is required, costing \$4,000 per pit (line 145); whereas only a P5 pit is needed for a single duct, costing \$620 per pit (line 147). It can be seen, therefore, that by insisting upon pit sharing between the IEN and the CAN without increasing the pit size needed to accommodate both networks, the Analysys Model significantly understates pit costs.

164 While the Analysys Model does include the cost of placing two ducts in a trench in the cost of the Core Network, such approach does not reflect the actual cost incurred, as explained above. If, as the Analysys Model assumes, the CAN and IEN share all trenching within 4 km of every exchange building, those networks would have to be constructed simultaneously. The engineering design of such a construction project would size trench and conduit configurations to accommodate both networks. It is nonsensical to assume a CAN would be designed and built without regard to an IEN, which was constructed simultaneously, but that CAN trenches would be left open for some unspecified timeframe so that IEN duct and cable could be deposited on top of the CAN infrastructure in hopes it would fit.

Proportion of CAN duct and trench costs attributable to sharing with the fibre main network

165 The Analysys Model removes the cost of the main fibre network from the CAN and places those costs in the Core Network. In addition to the main fibre cables, the model also moves the proportion of trench, conduit and pits attributable to those fibre cables from the CAN to the IEN.

166 The Analysys Model also overestimates the amount of sharing between fibre main cable and the rest of the CAN. According to the model documentation, the Analysys Model calculates the quantity of duct and cable needed for every segment of the combined main and distribution cable routes, so that when the main cable network and distribution cable network share a segment of trench, the model provisions sufficient duct to serve both. Consequently, the sharing assumption in the model is premised upon the existence of separate and discrete fibre main cable ducts in the trench that is shared with the distribution network; yet the sharing ratio is applied to CAN trench and conduit configurations that predominately consist of a single distribution duct. If the model truly includes all of the conduit necessary to provision service, all trench which is shared between the main and distribution networks would include a minimum of 2

⁴⁸ Note that neither a number 5 nor a number 6 pit would be able to accommodate conduit configurations consisting of 4 or more ducts.

ducts as is discussed further below. Figure 31 identifies the quantum of CAN duct and pit costs allocated in the Analysys Model to the Core Network by the size of the facilities being shared:

Figure 31

	A	B	C	D	M
7	Asset calculation				
8					
9		Access asset group	Assets	Unit	Duct and trench cost allocated to core (AUD)
22	13	Duct	Duct: 28	metres	(16,531)
23	14	Duct	Duct: 24	metres	(63,497)
24	15	Duct	Duct: 20	metres	(135,653)
25	16	Duct	Duct: 16	metres	(365,592)
26	17	Duct	Duct: 12	metres	(1,537,484)
27	18	Duct	Duct: 8	metres	(1,487,626)
28	19	Duct	Duct: 6	metres	(3,734,160)
29	20	Duct	Duct: 4	metres	(9,986,277)
30	21	Duct	Duct: 2	metres	(28,474,112)
31	22	Duct	Duct: 1	metres	(105,554,259)
32	23	Duct	Duct: 1 road-crossing	metres	-
33	24	Duct	Duct: 1 (PB >> DP/ Serving pit)	metres	-
34	25	Duct	Pits: PF28	#	(23,530)
35	26	Duct	Pits: PF20	#	(176,104)
36	27	Duct	Pits: PF12	#	(4,929,214)
37	28	Duct	Pits: P9	#	(19,688,296)
38	29	Duct	Pits: P6	#	(24,414,943)
39	30	Duct	Pits: P5	#	(30,845,829)
40	31	Duct	Pits: P5 road crossing	#	-

167 The total sharing is calculated using a combined ratio for each geotype that includes both IEN/CAN and intra CAN (i.e. fibre/copper) sharing allocation ratios. Of the \$151 million of duct and trench allocated to the Core for duct sharing between networks (i.e. sum of lines 22 to 31), \$105 million or approximately 70% is for sharing conduit configurations that consist of a single duct. Similarly, of the \$80 million of costs (i.e. sum lines 34 through 39) allocated to the Core network for sharing of pits, \$55 million (i.e. approximately 70%) is related to number 5 and 6 pits that can only accommodate conduit systems consisting of a single duct.

168 Since a single duct conduit structure and the smallest pits will not accommodate combined distribution and main network routes, and yet the Analysys Model assumes these facilities are shared by the distribution and main networks, the model contains an error. The model errs in:

- (a) understating the costs of building the CAN by omitting the additional ducts required to house both the main cable (both fibre and copper) and the distribution cable in the network; or
- (b) overstating the level of sharing between the fibre main network and copper distribution networks; or
- (c) both of the above.

- 169 Assuming the Analysys Model correctly dimensions the size of the CAN, the quantum of trench, conduit, pit and manhole costs that are attributable to the main fibre network (LPGS>>RAU) in the model is overstated. To prove this point we analyse geotype 5. As shown in column H, lines 164 – 179 of Figure 24 above, the sharing allocation ratio for sharing between the CAN fibre and copper networks is 9% (8.5% before rounding). This ratio is applied to the total annual cost of CAN conduit (which includes trench cost), pits and manholes. However, as will be demonstrated, based on the Analysys Model output this factor should be at most 3.3%.
- 170 The Analysys Model does not route main cable directly from the distribution area interface (pillars/LPGS) to the local exchange (LE). Instead, the model snakes main cable through the distribution trenches back to the exchange. The Analysys Model does add some trench and conduit required to connect adjacent distribution areas to enable the main cables to daisy chain their way from one distribution area to the next all the way back to the LE. The model refers to the incremental trench and conduit connecting adjacent distribution trenches together as ‘incremental Pillar/LPGS>>LE trench’. This incremental trench is directly attributable to main cable (i.e. it is not used by the distribution network).
- 171 At Figure 32 an excerpt from the Analysys Model that partially disaggregates the CAN duct network:⁴⁹

Figure 32

A	B	C	D	I	J
This sheet calculates the total number of network assets required in the access network				Geotype 5	Geotype 6
Copper deployment type (1=URBAN, 2=RURAL)				1	1
Trench network		Note: this parameter affects the acceptance). The CAN.xls module needs to			
Distance uplift for slope effect (trench and cable)		0%	Input distance:		
Trench					
Incremental trench distances		meters		42,439,274	12,407,454
PB >> serving pit		meters		7,402,497	1,907,134
Road crossing		meters		6,826,067	1,710,569
FDP >> DP		meters		11,525,657	2,698,743
DP >> next node		meters		15,676,197	5,494,139
Pillar/ LPGS >> LE		meters		1,008,857	596,870
Link on fibre rings (pillar to pillar)		meters		-	-

- 172 Following are some calculations based on the data contained in the above excerpt from the Analysys Model:

Figure 33

Trench Ratios and Analysis				
	Trench		Calculation	Geotype 5
1	PB >> serving pit	meters		7,402,497
2	Road crossing	meters		6,826,067
3	FDP >> DP	meters		11,525,657
4	DP >> next node	meters		15,676,197
5	Pillar/ LPGS >> LE	meters		1,008,857
6	Total Duct	meters	L.1 thru 5	42,439,274
7	Less: seving pit and roads crossings	meters	L.3 thru 5	28,210,711
8	Pillar/ LPGS >> LE % total		L.5 / L.11	3.58%

- 173 As shown in the calculations in Figure 33, the incremental trench length for connecting distribution networks (Pillar/LPGS>> LE) in Geotype 5 is 1.0 million

⁴⁹ Analysys Model, CAN.xls, Access worksheet.

metres (line 5). The total incremental trench length for CAN cables for Geotype 5 (excluding road crossings and PB>>DP/serving pits)⁵⁰ is 28.0 million metres. The ratio of incremental main cable trench length (Pillar/LPGS>>RAU) total trench length for Geotype 5 is 3.58%.

174 Figure 34 is an excerpt from the Analysys Model that identifies the number of clusters that are served by fibre and copper main cables.⁵¹

Figure 34

	A	B	I
2	This sheet calculates the total number of network assets required in the		Geotype 5
3			1
49	Clusters		6,954
50	Pillar/ LE		5,501
51	Pillars at LE		197
52	Other pillars		5,304
53	LPGS		1,453
54	backhauled by fibre		1,453
55	backhauled by wireless		-
56	backhauled by satellite		-

175 As shown above, only 1,453 or 20.9% of the total clusters in Geotype 5 are connected to the central office by a fibre main network (i.e. LPGS systems). Consequently, only 20.9% of the 3.6% of incremental Pillar/LPGS >> LE trench length in Geotype 5 is attributable to the fibre main network (LPGS>>RAU), the remainder being attributable to the copper main network (Pillar>>LE). In total, only 0.7% (i.e. 20.9% x 3.6%) of the total incremental CAN trench length is attributable to the fibre main network (LPGS>>RAU).

176 In addition to the incremental trench length for the fibre main cable network (Pillar/LPGS>>LE), fibre main cables also share the use of distribution trench. Distribution trench in the model is labelled DP>>next node and FDP>>DP. Consequently, some portion of the DP>>next node and FDP>>DP trench length is attributable to fibre main cable. Since fibre main cable, copper main cable and copper distribution cable are each placed in separate duct per the documentation, all distribution trench shared by fibre main cables (LPGS>>RAU) will have a minimum of 2 ducts (i.e. one for distribution cable and one for fibre main cable). In fact, since fibre and copper main cables share the same routes on their path back to the exchange, a minimum of 3 ducts will be required in every combined distribution main conduit run that contains both copper and fibre main cables (i.e. one for distribution cable, one for fibre main cable and one for copper main cable). It follows that fibre main cable can never reside in a CAN distribution trench which only has a single duct. Further, since 79.1% of the total distribution areas are served by copper fed pillars and copper, and fibre main cables follow common routes to the exchange, the preponderance of fibre main cables (LPGS>>RAU) are placed in trenches along side of copper main cables as well as copper distribution cables, requiring a minimum of 3 ducts.

177 Following is a chart that identifies the total duct length in Geotype 5 by size of duct. The amounts were taken from Figure 25 above:

⁵⁰ Road crossings and PB>>DP/serving pits are not allocated to Core network.

⁵¹ Analysys Model, CAN.xls, Access worksheet.

Figure 35

Trench by duct size		Trench Length
28	meters	-
24	meters	1,211
20	meters	7,904
16	meters	24,622
12	meters	151,938
8	meters	194,922
6	meters	615,254
4	meters	2,056,223
2	meters	3,891,060
1	meters	21,267,577
Total All duct length		28,210,711
Total 2 or more ducts		6,943,134
Total 3 or more ducts		3,052,075
Percent available to share		24.6%

- 178 Since only 6.9 million metres of total CAN trench length in Geotype 5 contains two or more ducts, this is the maximum length of CAN trench conduit that main cables can share, assuming the model correctly identifies the amount of duct required at each segment of the network. Further, 1.00 million metres of this trench is incremental main cable trenches (Pillar/LPGS>>LE), which has already been directly attributed to main cable. Consequently, 5.9 M metres is the maximum length of distribution trench in Geotype 5 with duct capacity capable of supporting main cable, including LPGS>RAU fibres, that has not previously been allocated to the main network.⁵²
- 179 At a maximum, only 5.9 million metres of trench in Geotype 5 with 2 or more ducts (i.e. trench with sufficient duct capacity to support main cable) is shared between distribution and main cable. The trench length in Geotype 5 is 28.2 million metres. Therefore only 24.6% of the total CAN duct length is available to share between main and distribution networks. A 50% allocation of this trench and conduit to the main network would amount to 12.3% of total trench/conduit length. Since 20.9% of main cable is fibre, the maximum additional allocation of CAN trench to the core network for sharing between LPGS>>RAU fibre and the distribution network (FDP>>DP and DP>>next node trench/conduit) is 2.6% (12.3% x 20.9%).
- 180 Consequently, the maximum amount of total CAN trench in Geotype 5 (excluding road crossings and BP>>DP/serving pits) which can be allocated to the Core due to LPGS>>RAU fibre trench use is 3.3%, the sum of that portion of total CAN trench attributable to directly assigned incremental Pillar/LPGS>>LE trench (0.7%) and that portion of total CAN trench attributable to sharing between LPGS>>RAU fibre and distribution cable (2.6%). This demonstrates that the Analysys model's allocation of 8.5% is grossly overstated.
- 181 The example given for Geotype 5 is equally applicable to the other Geotypes, some of which mistakenly have allocations of CAN trench/conduit to the Core for LPGS>>RAU fibre as high as 26%.

⁵² Since the preponderance of LPGS>>RAU fibre resides in trench with at least 3 ducts as explained above, a better estimate of the maximum length of trench with sufficient duct capacity to support LPGS>>RAU fibre is only 2.27 M metres. Nevertheless the more conservative estimate of 5.9 M metres is used in this analysis.

How can the model be fixed?

IEN sharing with CAN

- 182 The Analysys Model can be fixed by correcting the sizing of the conduit configurations and pits for the shared CAN and IEN networks in a five step process, as follows:
- (a) Determine the percentage of the CAN trench, duct and pits that are shared with the IEN;
 - (b) Identify the length of each size of CAN conduit configuration that must be resized to accommodate the additional IEN ducts;
 - (c) Identify the quantity of each size of pit or manhole that must be resized to accommodate the additional IEN ducts;
 - (d) Adjust the cost allocation ratio for CAN trench and conduit to recognise the inclusion of IEN duct costs in the design of the combined CAN/IEN facilities; and
 - (e) Remove the cost of the 2 IEN ducts that were incorporated into the Core model to avoid double counting these costs.

183 Each of these steps is discussed in detail below.

Step 1: Determine the percentage of CAN trench and duct length that is shared with the IEN

- 184 The first step in this process is fairly straight forward. The percentage of each size of conduit configuration that is shared between the Core and CAN is derived by dividing the total length of shared trench by the total length of the CAN trench, excluding trenching associated with the Serving Pit Architecture (i.e. road crossings and PB>>DP/Serving Pit). This calculation demonstrates that the Analysys Model assumes 18% of all CAN trenches are shared with the Core network (i.e. IEN). As shown above the Analysys Model assumes that the proportion of CAN trench facilities allocated to the Core network is constant across all sizes of conduit configurations and geotypes.

Step 2: Identify the length of each size of CAN conduit configuration that needs to be resized to accommodate IEN ducts

- 185 The second step in the process is a little more complicated. Even though the Analysys Model assumes that IEN cables and ducts share trenching proportionately with each size of conduit configuration (i.e. 18% of each size CAN conduit configuration is shared with IEN), the impact of sharing must be separately evaluated for each size configuration. The proportion of conduit facilities that must be resized to accommodate the two additional IEN conduits varies by the size of the CAN conduit configuration. Following is the adjustments that have been made to each size of shared CAN conduit configuration:
- (a) All of the CAN 1- and 2-duct conduit configurations that are sharing trenching with the IEN must be converted to four duct configurations. The 1 and 2 duct CAN conduit runs will need 3 (i.e. 1 CAN and 2 IEN) and 4 ducts (i.e. 2 CAN and 2 IEN), respectively, when the IEN facilities are incorporated into the network design. A four duct configuration is the smallest standard conduit size with enough capacity to accommodate 3 or 4 ducts. Consequently, 18% (i.e. the IEN sharing percent) of the total length of 1

and 2 duct CAN conduit runs must be converted to a four duct conduit configuration.

- (b) All of the CAN 4-duct conduit configuration that is sharing trenching with the IEN will similarly need to be converted to 6 duct configuration (i.e. 4 CAN and 2 EIN).⁵³ In total, 18% of the total length of 4 duct CAN conduit runs must be converted to a 6 duct configuration. In addition to converting 18% of the length of 4 duct CAN conduit to 6 duct conduit, and removing it from the total length of 4-duct conduit; the length of 1 and 2 duct conduit that is converted to 4-duct configurations must be added to the length the length of 4-duct conduit configurations.
- (c) Similar to 4 duct conduit configurations, 18% of the total length of 6 and 8 duct CAN conduit runs must be converted to 8 and 12 duct configurations, respectively. Likewise, the length of 4 and 6 duct conduit that is converted to 6 and 8 duct configurations must be added to the length of 6 and 8 duct conduit runs, respectively.
- (d) Unlike size 1 through 8 duct configurations, size 12, 16, 20 and 24 duct configurations will in some instances have enough capacity to accommodate 2 additional IEN conduits. The difference between the sizes of each of these larger conduit configurations is 4 conduits. Therefore, it is possible to have the availability of 1 to 3 spare conduits in the stand alone CAN conduit run. For instance, if the CAN facilities are occupying 9 or 10 conduits in a size 12 conduit configuration, there would be 3 or 2 unoccupied ducts that could be used to house the IEN facilities. However, if 11 or 12 of the conduits are being used, the 2 additional IEN conduits will require resizing to a 16 duct conduit configuration. To account for the potential availability of space to house the added IEN facilities in these larger conduit configurations, it is assumed the addition of IEN facilities will only result in placing larger conduits in 50% of the cases in which IEN ducts are added to the network. Thus 9% of the length of 12, 16, 20 and 24 duct conduit runs must be resized (i.e. 50% of the 18% of the time two ducts are required for IEN facilities). Again, the length of the next smallest conduit configuration that is resized to accommodate the addition of IEN facilities must be added to the length of 12, 16, 20 and 24 duct conduit configurations.
- (e) Since a 28 duct configuration is the largest available configuration in the Anlys Model, the only change to the size 28 duct conduit configuration is to add the length of the size 24 conduit configuration that was resized as a result of sharing with IEN.

Step 3: Identify the quantity of each size of CAN pit and manhole that needs to be resized to accommodate IEN ducts

- 186 As with conduit configurations, CAN pits and manholes must also be resized to accommodate the larger conduit configurations, which result from the addition of IEN facilities in CAN trench. The change in the quantity of each size of pit will vary by the capacity characteristics of the pits being resized. In most instances it will consist of removing the number of pits that are converted to the next largest pit size and adding back those that have been reclassified. The following

⁵³ Note that in a 4 duct configuration it is possible that only 3 of the ducts are in use leaving a spare duct for IEN. However, the IEN has 2 ducts so the smallest combined configuration would require 5 ducts (3 CAN and 2 IEN). The smallest standard configuration that can house five ducts is a 6 duct configuration.

adjustments have been made to the quantities of each size of CAN pit (manhole) due to sharing with IEN:

- (a) Number 5 and 6 pits do not have the capacity to accommodate 4 duct conduit configurations (i.e. the smallest standard configuration that can be used for a combined IEN/CAN cable run). According to the model specifications the smallest pit that can accommodate a 4 duct conduit run is a number 9 pit⁵⁴. Consequently 18% (i.e. IEN sharing percent) of the total quantity of number 5 and 6 pits will need to be converted to number 9 pits.
- (b) The maximum capacity of a number 9 pit is a 4 duct conduit run.⁵⁵ Consequently, all of the CAN stand-alone number 9 pits, which are shared, must be converted to number 12 manholes in order to accommodate the additional IEN ducts. Consequently, 18% of the total quantity of number 9 CAN pits must be converted to number 12 manholes. In addition; the remaining quantity of number 9 pits must be increased to account for the quantity of number 5 and 6 pits that are converted to number 9 pits.
- (c) Size 12 and 20 manholes will frequently have enough capacity to accommodate 2 additional IEN conduits. There is an eight duct difference between the minimum and maximum number of ducts each of the manholes can accommodate under the ACCC's network design⁵⁶. For example, a #12 manhole will be used to house all conduit configurations between 4 (the duct capacity of a #9 pit in the ACCC's network design) and 12 ducts. Therefore, in most instances, there will be enough spare capacity to accommodate the additional IEN facilities (i.e. 2 ducts). The only time larger manholes will be required is when the number of ducts in the network are resized from 12 to 16 or 20 to 24 for number 12 and 20 manholes respectively. Consequently, the proportion of number 12 and 20 manholes that must be resized is equal to the total of length of 12 and 20 conduit configurations that were resized to 16 and 24 conduit configurations, respectively, divided by the total length of all conduit configurations housed by number 12 (i.e. 6, 8 and 12 duct conduits) or number 20 (i.e. 16 and 20 duct conduits) manholes prior to the addition of the IEN facilities. Again, the quantity of the next smallest pit or manhole that was resized to accommodate the addition of IEN must be added to the remaining quantity of size 12 and 20 manholes.
- (d) The only change to the quantity of number 28 manholes is to add the quantity of number 20 manholes that were resized to accommodate IEN facilities.

187 Once the total change in the length of each size of conduit configuration and the quantity of each size of pit and manhole has been identified they are added or deducted from the CAN conduit, pit and manhole quantities prior to the resizing so that the model states the corrected total conduits and pits required for each size and configuration.

⁵⁴ Note that the Telstra access provisioning rules, which are consistent with industry standards, require the use of a PF4 manhole when there are four ducts in a conduit run. Fixed LRIC model documentation – Version 2, page 56.

⁵⁵ Ibid.

⁵⁶ Note that Telstra engineering guidelines also specify the use of PF 8 and 24 manholes, sizes not accounted for in the ACCC's model.

Step 4: Adjusting the allocation ratio to account for changes in the network design

188 The Analysys Model applies a ratio to the volume of shared trench to ensure that only the trench portion of the CAN costs are allocated from the CAN to the Core network. Since the total investment in trenching and conduit is combined in the model, this ratio is intended to segregate the trench portion of this combined investment from the total. The model does not allocate CAN duct cost to the IEN; rather it separately accounts for the cost of IEN duct by simply including the cost of two ducts (without the related trench costs) in the Core model. The corrections made above result in the design of combined IEN/CAN facilities, including ducts for the IEN. Since IEN duct costs are now included in the design of the new network, a portion of these ducts must be allocated to the IEN costs. Consequently, the ratio intended to ensure the cost of CAN ducts is not allocated to IEN is no longer appropriate and has been removed from the model. Further, the trench/conduit cost allocation ratio has been revised to reflect the equal sharing of trench and duct costs between the CAN and Core network.

Step 5: Removing the two stand-alone IEN ducts from the Core network

189 Finally, an adjustment is made to the Core model to remove the cost of the two IEN ducts, which the model assumed to be placed in shared trench. Since, as explained in step 4, the costs of these ducts are accounted for in the development of the combined IEN/CAN facilities costs, there is no longer a need to account for them in the Core model. The allocation of the newly designed CAN network to the Core accounts for trench and duct costs.

Specific corrections to the Analysys Model

IEN sharing with CAN

190 Following is a description of the actual changes that have been made to the Analysys Model to correct the error in determining the cost of the combined CAN and IEN networks. This section will follow the same step by step approach used in the previous section.

Step 1: Determine the percentage of CAN duct length that is shared with the IEN

191 The calculation of the proportion of the CAN trench that Analysys assumes is shared with the interexchange network is derived as follows:

$$\% \text{ CAN Trench Shared} = \text{Total Shared Trench} / \text{CAN Trench (Excluding Road crossings and BP} \gg \text{DP/Serving Pit)}$$

or

$$18\% = 50.2 \text{ million metres shared trench}^{57} / 285.1 \text{ million metres CAN trench}^{58}.$$

192 The total length of shared trench and the ratio of shared trench to total CAN trench has been added to the model. Following is an excerpt of the revised Analysys Model that identifies where these new calculations are located:

⁵⁷ Analysys Model, Cost.xls, I.Ducts.Core worksheet, Col. C, sum lines 15 to 18.

⁵⁸ Analysys Model, CAN.xls, Access worksheet, Sum Col. E to T, lines 161 to 170.

	A	B	C
402		Total CAN Trench shared with IEN	50,229,620
403		Percent CAN trench shared with IEN	18%

Step 2: Identify the length of each size of CAN conduit configuration that must be resized to accommodate IEN ducts

- 193 As explained above a portion of each size CAN conduit configuration (except 28 duct conduit, which is assumed to remain the same size but increase in total length due to the resizing of some 24 duct conduit) must be increased in size in order to accommodate the placement of IEN cable and duct in CAN trench. A new matrix has been added to the CAN module of the Analysys Model to tabulate the impact of this change on the total length of each size of conduit configuration, which is provisioned by the model.⁵⁹ Following is a picture of an excerpt of the CAN model showing a portion of the matrix discussed above:

	A	B	C	D	E	F	G	H
2		Analysys <small>er of network assets required in the access network</small>			Geotype 1	Geotype 2	Geotype 3	Geotype 4
3		Copper deployment type (1=URBAN, 2=RURAL)			1	1	1	1
405		Trench Adjustment for Core Ducts						
406		Trench by duct size						
407		28	meters		-	-	737	538
408		24	meters		10	-	148	485
409		20	meters		(6)	-	1,008	5,217
410		16	meters		97	-	9,690	13,438
411		12	meters		321	-	18,736	25,223
412		8	meters		280	729	41,245	84,164
413		6	meters		4,132	6,871	119,600	264,129
414		4	meters		19,443	23,127	2,856,358	5,413,570
415		2	meters		(5,541)	(11,206)	(404,892)	(909,488)
416		1	meters		(18,737)	(19,521)	(2,642,630)	(4,997,256)

- 194 The following calculations were used to adjust the length for each size of CAN conduit configuration to account for the added IEN facilities.

- (a) The formula for determining the change in the length of 1 and 2 duct CAN conduit configurations due to sharing with the IEN is:

$$\text{Change to length 1 and 2 duct conduit}^{60} = - \text{Length of 1 and 2 duct CAN conduit prior resizing}^{61} \times \text{proportion of duct shared with IEN (18\%)}$$

- (b) The formula for determining the change in the length of 4 duct CAN conduit configurations due to sharing with the IEN is:

$$\text{Change to length 4 duct conduit}^{62} = - \text{Length of 4 duct CAN conduit prior resizing}^{63} \times \text{proportion of duct shared with IEN (18\%)} + \text{Change to length of 1 and 2 duct configurations (see above)}$$

- (c) The formula for determining the change in the length of 6 and 8 duct CAN conduit configurations due to sharing with the IEN is:

$$\text{Change to length 6 and 8 duct conduit}^{64} = - \text{Length of 6 and 8 duct CAN conduit prior resizing}^{65} \times \text{proportion of duct shared with IEN (18\%)} +$$

⁵⁹ Analysys Model, CAN.xls, Access worksheet, Col. A through T, lines 405 through 416.

⁶⁰ Analysys Model, CAN.xls, Access worksheet, Col. A through T, lines 415 and 416.

⁶¹ Analysys Model, CAN.xls, Access worksheet, Col. A through T, lines 170 and 169.

⁶² Analysys Model, CAN.xls, Access worksheet, Col. A through T, line 414.

⁶³ Analysys Model, CAN.xls, Access worksheet, Col. A through T, lines 168.

⁶⁴ Analysys Model, CAN.xls, Access worksheet, Col. A through T, lines 413 and 412.

⁶⁵ Analysys Model, CAN.xls, Access worksheet, Col. A through T, lines 167 and 166.

Change to the length of the next smallest conduit configuration (see above)

- (d) The formula for determining the change in the length of 12, 16, 20 and 24 duct CAN conduit configurations due to sharing with the IEN is:

$$\text{Change to length } y \text{ duct conduit}^{66} = - \text{Length of } y \text{ duct CAN conduit prior resizing}^{67} \times 18\% \text{ of duct shared with IEN} \times 50\% \text{ reclassification factor} + \text{Change to the length of the next smallest conduit configuration}$$

Where:

y = the size of the conduit run being resized (i.e. 12, 16, 20 or 24)

- (e) The only change to the length of size 28 duct conduit configurations⁶⁸ is to add the length of the size 20 conduit configuration that was resized as a result of sharing with IEN (see above).

- 195 The change in the length of each type of conduit configuration, tabulated in the above matrix, has been added to or deducted from the length of each size of conduit configuration, which is provisioned by the model prior to the addition of the IEN ducts,⁶⁹ to derive the revised duct lengths used to calculate CAN investment⁷⁰.

Step 3: Identify the quantity of each size of CAN pit and manhole that must be resized to accommodate IEN ducts

- 196 A new matrix was added to the CAN module of the Analysys Model to calculate the changes in the quantity of each size of pit and manhole that is required⁷¹. Following is a picture of an excerpt of the CAN model showing a portion of this matrix:

	A	B	C	D	E	F	G	H
2	Analysys	er of network assets required in the access network			Geotype 1	Geotype 2	Geotype 3	Geotype 4
3		Copper deployment type (1=URBAN, 2=RURAL)			1	1	1	1
418		Pit Adjustment for Core Ducts						
419	Pits & manholes by size							
420	PF28				1	-	26	28
421	PF20				6	-	319	481
422	PF12				211	218	6,890	11,082
423	P9				673	485	66,111	105,933
424	P6				(227)	(251)	(16,559)	(27,468)
425	P5				(664)	(453)	(56,787)	(90,055)

- 197 The following calculations were used to adjust the quantity of each size of CAN pit and manhole to account for the added IEN facilities.

- (a) The formula for determining the change in the quantity of #5 and #6 pits due to sharing with the IEN is:

$$\text{Change to quantity of \#5 and \#6 pits required}^{72} = - \text{Quantity of \#5 and \#6 pits prior resizing}^{73} \times 18\% \text{ of pits shared with IEN}$$

⁶⁶ Analysys Model, CAN.xls, Access worksheet, Col. A through T, lines 408 to 411.

⁶⁷ Analysys Model, CAN.xls, Access worksheet, Col. A through T, lines 162 to 165.

⁶⁸ Analysys Model, CAN.xls, Access worksheet, Col. A through T, lines 407.

⁶⁹ Analysys Model, CAN.xls, Access worksheet, Col. A through T, lines 161 to 170.

⁷⁰ Analysys Model, CAN.xls, Access worksheet, Col. A through T, lines 327 to 336.

⁷¹ Analysys Model, CAN.xls, Access worksheet, Col. A through T, lines 418 through 425.

⁷² Analysys Model, CAN.xls, Access worksheet, Col. A through T, lines 425 and 424.

⁷³ Analysys Model, CAN.xls, Access worksheet, Col. A through T, lines 188 to 189.

- (b) The formula for determining the change in the quantity of #9 pits due to sharing with the IEN is:

Change to quantity of #9 pits required⁷⁴ = - Quantity of # 9 pits prior to resizing⁷⁵ x 18% of pits shared with IEN + Change to quantity of #5 and #6 pits required (see above)

- (c) The formula for calculating the change in the quantity of number 12 manholes is:

Change to the quantity of #12 manholes⁷⁶ = - Length of 12 duct conduit that was resized as a result of adding IEN facilities⁷⁷ / The sum of the total length of all conduit configurations housed in #12 pits prior to the addition of IEN facilities⁷⁸ x Quantity of # 12 manholes prior to resizing⁷⁹ + the number of the next smallest pit that were resized to accommodate IEN facilities

- (d) The formula for calculating the change in the quantity of number 20 manholes is:

Change to the quantity of #20 manholes⁸⁰ = - Length of 20 duct conduit that was resized as a result of adding IEN facilities⁸¹ / The sum of the total length of all conduit configurations housed in #20 pits prior to the addition of IEN facilities⁸² x Quantity of # 20 manholes prior to resizing⁸³ + the number of the next smallest pit that were resized to accommodate IEN facilities

- (e) The only change to the quantity of number 28 manholes is to add the quantity of number 20 manholes that were resized to accommodate IEN facilities.

198 The changes in the quantity of each size of pit and manhole, identified in the above matrix, is then added to or deducted from the quantities of each size of pit and manhole prior to the addition of the IEN ducts⁸⁴ to derive the revised pit and manhole quantities used to calculate CAN investment.⁸⁵

Step 4: Adjusting the allocation ratio to account for changes in the network design

199 There were two changes to the calculation of the Core allocation ratios:

- (a) The ratio has been revised to include an allocation of duct cost since the duct cost is now included in the calculation of the combined IEN/CAN; and

⁷⁴ Analysys Model, CAN.xls, Access worksheet, Col. A through T, lines 423.

⁷⁵ Analysys Model, CAN.xls, Access worksheet, Col. A through T, lines 187.

⁷⁶ Analysys Model, CAN.xls, Access worksheet, Col. A through T, lines 422 and 421.

⁷⁷ See step 2 for 12 and 20 duct configurations. The amount used in this calculation only includes that portion of the calculation that is used to determine the portion of 12 and 20 duct conduit that is resized to 16 and 24 duct conduits, respectively.

⁷⁸ Analysys Model, CAN.xls, Access worksheet, Col. A through T, Lines 165 to 167 and Lines 162 and 163 for #12 and #20 pits respectively. 6, 8 and 12 duct conduits are housed in a #12 pit and 16 and 20 duct conduits are housed in a #20 pit.

⁷⁹ Analysys Model, CAN.xls, Access worksheet, Col. A through T, Lines 186 and 185.

⁸⁰ Analysys Model, CAN.xls, Access worksheet, Col. A through T, Lines 422 and 421.

⁸¹ See step 2 for 12 and 20 duct configurations. The amount used in this calculation only includes that portion of the calculation that is used to determine the portion of 12 and 20 duct conduit that is resized to 16 and 24 duct conduits, respectively.

⁸² Analysys Model, CAN.xls, Access worksheet, Col. A through T, Lines 165 to 167 and Lines 162 and 163 for #12 and #20 pits respectively. 6, 8 and 12 duct conduits are housed in a #12 pit and 16 and 20 duct conduits are housed in a #20 pit.

⁸³ Analysys Model, CAN.xls, Access worksheet, Col. A through T, Lines 186 and 185.

⁸⁴ Analysys Model, CAN.xls, Access worksheet, Col. A through T, Lines 184 and 189.

⁸⁵ Analysys Model, CAN.xls, Access worksheet, Col. A through T, Lines 339 to 344.

(b) The ratio is revised to reflect the 50/50 sharing of trench costs.

200 The ACCC's original calculation applied a ratio in the calculation of the sharing factor to ensure that only that portion of the combined cost of CAN trench and duct in the model attributable to trench costs was allocated to the Core network. The intention was to allocate a portion of the cost of CAN trenching to the Core network and to include the cost of the IEN duct, which was placed in CAN trenches, in the calculation of Core network costs. This methodology was inappropriate, because it did not reflect the true cost of the larger conduit configurations, which resulted from placing IEN facilities in CAN trench. This error has been corrected by including the cost of placing additional duct to house IEN cable in the calculation of the costs of CAN conduit. Since duct costs are now correctly built into the CAN model, this ratio is no longer required. As a result these ratios have now been set at 100%⁸⁶ so that the cost of both CAN trench and CAN duct is now shared.

201 In addition the sharing calculation was revised to share trench evenly between the IEN and CAN. This was done in a two-step process. First, the total length of shared duct⁸⁷ was set equal to the total shared trench length for the purpose of developing the allocation ratio of shared trenching.⁸⁸ The second adjustment was to set the values in Column C Lines 216 to 225 of the Inputs.Access worksheet equal to 1, also for the purpose of developing the allocation ratio of shared trenching.⁸⁹ The net effect of these changes is to allocate 50% of the cost of trench, which is shared between the CAN and Core networks, to each network.

Step 5: Removing the two stand-alone IEN ducts from the Core network

202 Finally, an adjustment is made to the Core model to remove the cost of the two IEN ducts that are placed in the shared trenches. Since these costs are already accounted for in the development of the combined IEN/CAN facilities, there is no longer a need to account for them in the Core model. The allocation of the newly designed CAN network to the Core will already account for these additional costs.

203 These costs were removed by setting the length of the Core duct for each layer of the interexchange network (Input.Core worksheet, Col D, Lines 83, 109, 145 and 195)⁹⁰ equal to the length of the IEN trench for each layer of the IEN (Input.Access worksheet, Col D, Lines 82, 108, 144 and 194).⁹¹

CAN trench attributable to fibre main cable

204 As explained above, the proportion of CAN trench, which should be allocated to the Core Network, because it is shared with fibre main cable, is comprised of two components:

- (a) the proportion of incremental Pillar/LPGS>>LE trench attributable to fibre main cable; and
- (b) the proportion of distribution trench attributable to fibre main cable.

⁸⁶ Analysys Model, Cost.xls, Inputs.Access worksheet, Col. D through S, line 229.

⁸⁷ Analysys Model, Cost.xls, Inputs.Access worksheet, Col. C, line 227.

⁸⁸ Analysys Model, Cost.xls, I.Ducts.Core worksheet, Col. C, sum(line 15 to 18).

⁸⁹ Analysys Model, Cost.xls, Inputs.Access worksheet.

⁹⁰ Analysys Model, Cost.xls, Inputs.Core worksheet.

⁹¹ Analysys Model, Cost.xls, Inputs.Core worksheet.

205 The length of incremental Pillar/LPGS>>LE trench is found in CAN.xls, Access, line 131. All of this trench is directly attributable to main cable; however it must be allocated between copper main cable and fibre main cable. The proportion attributable to fibre main cable is derived by dividing the number of DAs served by LPGS (CAN.xls, Access, line 53) by the total number of DAs (CAN.xls, Access, line 49). Consequently, the formula for the length of incremental Pillar/LPGS>>LE trench attributable to fibre main cable for Geotype 4 is:

$$131H * (53H / 49H)$$

206 This figure must be divided by the total length of CAN trench (less the property boundary to serving pit and road crossing trench, since these are not shared with main cable) to calculate the Pillar/LPGS>>LE component of the proportion of CAN trench attributable to fibre main cable. This formula is:

$$(131H * (53H / 49H)) / (114H - 115H - 122H)$$

207 Only distribution trench with 2 or more ducts can be shared between distribution and main cable. The length of CAN trench by conduit size (limited to sizes of 2 or more ducts) is found in CAN.xls, Access, Lines 327 through 335. Consequently, the maximum length of CAN trench that can be shared between distribution and main cable in Geotype 4 is the sum of Cells 327H through 335H. Some of this trench, however, has already been directly attributed to main cable (the Pillar/LPGS>>LE trench discussed above), so this length of trench (Cell 131H) must be removed from the total to avoid allocating it to fibre main cable a second time. Assuming that all of the trench that is large enough to accommodate both main and distribution cables is shared, 50% of this length of trench is attributable to main cable. As above, this length of trench must be allocated between copper main cable and fibre main cable. Therefore, the formula for the length of CAN trench attributable to fibre main cable is:

$$(SUM(327H to 335H) - 131H) * .5 * (53H / 49H)$$

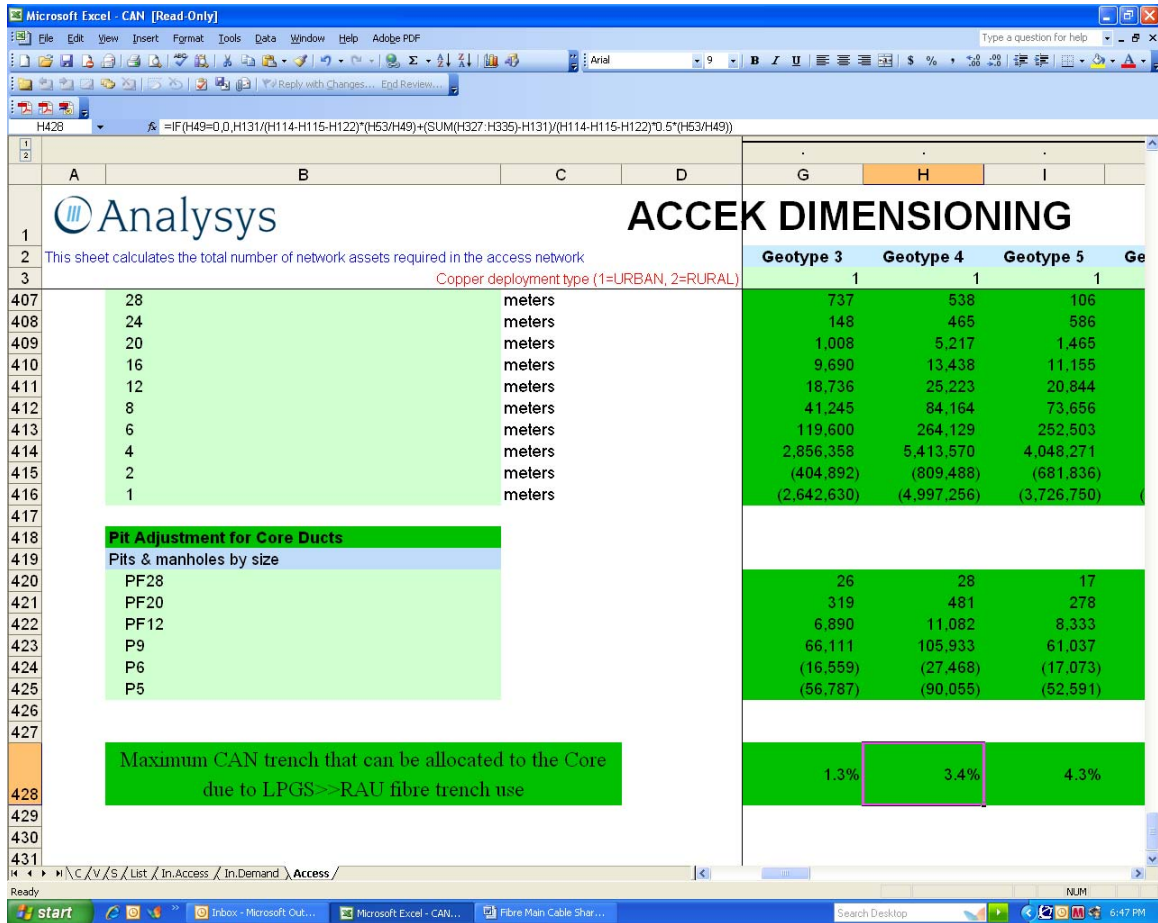
208 This figure must be divided by the total length of CAN trench (less the property boundary to serving pit and road crossing trench, since these are not shared with main cable) to calculate the second component of the proportion of CAN trench attributable to fibre main cable. This formula is:

$$(SUM(327H:335H) - 131H) * .5 * (53H / 49H) / (114H - 115H - 122H)$$

209 The complete formula (the sum of both components) is:

$$=IF(H49=0,0,H131/(H114-H115-H122)*(H53/H49)+(SUM(H327:H335)-H131)/(H114-H115-H122)*0.5*(H53/H49))$$

210 This formula is used to calculate Can.xls, Access, line 428 of the corrected Analysys model.



How material is the error?

211 The exclusion of the additional costs required to fit both IEN and CAN cables has the effect of excluding costs of the following amounts for ULLS, WLR and OTA:

	ULLS (Access cost per line per month)		Wholesale line rental (WLR) Access cost per line per month				PSTN OTA
	Zone A	Zone B	Band 1	Band 2	Band 3/4 (clustered)	Band 3/4 (spread)	All areas
Analysys model	21.62	59.39	8.46	20.26	33.83	56.79	0.69
Fix	23.36	64.57	8.90	21.78	37.04	61.38	0.64
Difference 1.74		5.17	0.45	1.52	3.21	4.59	(0.05)

Error 9: The ACCC has grossly underestimated the costs of building IEN

212 The Analysys model creates a transmission network with a cost of \$145 million but the model and accompanying documentation provides scant detail on the design and equipment and other cost elements for that modelled core network. Essentially, the Analysys model provides an aggregated cost figure and it is impossible for Telstra to break the figure down to consider and verify how it was derived. The lack of detail and transparency in the core network component of the Analysys model contrasts with the greater detail in other parts of the model. The core network represents a significant component of the Analysys Model costs. The lack of detail is a material omission and a matter in relation to which Telstra is entitled to an opportunity and sufficient information to enable it to

make informed submissions in the draft IPP determination process. This is especially so in light of the ACCC's expectations of Telstra detailed below.

- 213 Telstra wrote to the ACCC on 22 September 2009 requesting itemisation of the transmission equipment used in the Analysys Model for this purpose.
- 214 The ACCC responded on 30 September 2009 declining to provide the requested details because “..in the ACCC's view Telstra does not require the specific engineering details requested ..in order to make an assessment about the types and quantities of assets that would be required to meet the demand estimated in the modelled network”. The ACCC went onto to state that:
- “The ACCC understands that traffic generated by the model must be provisioned by sufficient transmission equipment to accommodate the capacity requirements of the core network model and considers this is sufficiently enabled within the design parameters of the model. The ACCC acknowledges that the Analysys cost model, like all models, necessarily simplifies real world systems to provide useful numerical estimates. The purpose of the current consultation is to expose the model assumptions to scrutiny. Telstra would be expected to submit not only what it considers to be in error in the model – but also to submit what preferred values it would like to see in the model for asset prices and quantities. For this task it is sufficient that the Analysys cost model identify a generic class of asset with starting price assumptions and the model calculate the units of that asset class to deploy.”
- 215 Telstra disagrees with the ACCC. Telstra is currently deploying an IP core network and based on our own investment, the \$145 million in the Analysys Model is a substantial underestimate of costs. However, in the absence of the details requested by Telstra but which the ACCC refused to provide, Telstra is not in a position to make a meaningful comparison with the approach in the Analysys model. Moreover, without the requested detail Telstra does not have the necessary knowledge of the core network architecture within the Analysys Model to be able to identify the source(s) of the underestimate e.g. whether this is because the rings have not been correctly dimensioned, or because of the technology used, or because of defects in the engineering design, or because of a computational or modelling error.
- 216 The ACCC will, of course, be in a position to compare the details of the core network in the Analysys Model with any information which Telstra provides, but the ACCC will be doing that in a “black box” without the opportunity for and the benefit of Telstra putting its view. On an issue of such materiality, the ACCC's approach is not consistent with the minimum standards required of a decision maker in the ACCC's position.
- 217 In the absence of the requested details from the ACCC, has been unable to include meaningful submissions on this issue by the due date of the submission. The continued absence of the requested data also may impair Telstra's ability to develop and propose a comprehensive “fix” for the error. While Telstra is continuing to investigate how to resolve this error and intends to provide further details as soon as practicable after 9 October 2009, it repeats its request for the ACCC to provide the information sought in Telstra's letter dated 22 September 2009 as a priority.

Error 10: The Analysys model accepts that a particular pit size is required but then fails to use that size⁹²

- 218 A pit is an underground piece of equipment used to access joints and cables. The size of a pit is determined by the number of ducts in the pit and the number of links coming into the pit (e.g. Two links will enter a pit at a point where two routes merge together).⁹³
- 219 The Analysys Model does not utilise the correct size of pits and manholes; in many cases the chosen pit size is smaller than the Analysys Model states is required for the number of ducts or links coming into the pit.
- 220 Pit size is determined both by the number of ducts in the pit and by the number of links coming into the pit. Each pit must be large enough to both accommodate the number of ducts and to accommodate the number of links. A pit which serves a pillar is an exception to this rule. In that case the pit must be at least a P9 pit; although it must be larger if the number of ducts and/or links dictates a larger size.
- 221 This is explained in the Analysys model’s documentation, as follows:

“Six types of pit are used, as shown below. The type of pit deployed at the cluster nodes is the smallest that can accommodate both the number of ducts entering the node and the number of links entering/leaving the node. The dimensioning rules are summarised below in Figure 5.12:

Pits	Pit capacity in ducts	Pit capacity in links
P5	1	1–2
P6	2–3	3
P9	4–5	4 and above
PF12	6–15	4 and above
PF20	16–23	4 and above
PF28	24 and above	4 and above

Figure 5.12:
Dimensioning of pits
for the cluster nodes
[Source: Analysys]

In addition, every pillar must have at least a P9 pit present. So, for example, a pillar point which is the intersection of 3 links, with 22 ducts entering it in total would require at least:

- a PF20 pit by the number of duct
- a P6 pit by the number of links
- a P9 pit since it is a pillar.

Therefore, in this case, a PF20 pit is deployed.”⁹⁴

- 222 While the documentation correctly requires the pit size to accommodate both the number of ducts and the number of links in the pit, the Analysys Model does not adopt this requirement. As shown below, the final pit size as determined by the model is not large enough to serve the number of ducts that pass through the node. Figure 36 comes from Access – Data-G8.xls, ESA.G8.4.

⁹² Error 3 in the 31 July Letter.

⁹³ An explanation of pits and ducts is set out in the [TC1 c-i-c commences] **CIC** [TC1 c-i-c ends] (Submission Supporting Documents, Document 2.5).

⁹⁴ Fixed LRIC Model Documentation – Version 2.0, Page 57.

Figure 36

	CE	CF	CG	CH	CI	CJ	CK	CL	CM
32	Pit/ manhole calculations								
	Ducts out of node	Max ducts in one link	Count of links into node	Pit - based on most ducts	Pit - based on links	Final pit size			
33									
35	A pillar will be assumed to have at least a P9 pit								
36	first ducts in first max ducts in or first num links into first pit by duct first pit by link first final pit ESA.G8.4								
37	6	3	3	PF12	P6	P9			
38	1	1	1	P5	P5	P5			
39	2	1	2	P6	P5	P5			
40	2	1	2	P6	P5	P5			
41	2	1	2	P6	P5	P5			
42	2	1	2	P6	P5	P5			
43	1	1	1	P5	P5	P5			
44	2	1	2	P6	P5	P5			
45	1	1	1	P5	P5	P5			

223 In the first line of this example there are 6 “Ducts out of node:” consequently, a PF12 pit is required based upon the number of ducts. This is seen in “Pit - based on most ducts.” However, the “Final pit size” erroneously shows a P9 pit. Row 39 for this ESA shows a similar mistake. A P5 pit is chosen as the final pit size even though a P6 pit is required based on the number of ducts present.

How can this error be fixed?

224 In order to fix this error, it is necessary to adjust the Visual Basic code which will ensure that the larger of either number of ducts or number of links becomes the criteria for selecting the final pit size. It is possible to place a formula into the Access-Data-Gx.xls sheets that will accomplish the same result, but that would require manually going into 219 tabs in 27 workbooks and making the change – and that change would be wiped out if Access-Code was ever re-run.

225 Because the logic within the “WriteDuctOutputs” macro is segregated into “Urban” and “Rural”, the code needs to be fixed in 2 places.

What is the effect of fixing the error?

226 The effect of fixing this error on access prices is set out below:

	ULLS (Access cost per line per month)		Wholesale line rental (WLR) Access cost per line per month				PSTN OTA
	Zone A	Zone B	Band 1	Band 2	Band 3/4 (clustered)	Band 3/4 (spread)	All areas
Analysys model	\$21.62	\$59.39	8.46	20.26	33.83	56.79	0.69
Fix	\$21.89	\$69.98	8.51	20.32	37.77	64.33	0.70
Difference 0.27		10.59	0.06	0.06	3.94	7.54	0.01

Error 11: The model errs by excluding the costs of some technologies from the calculation of the unit costs of CAN services, yet including the lines served by those technologies in the calculation⁹⁵

What is the error?

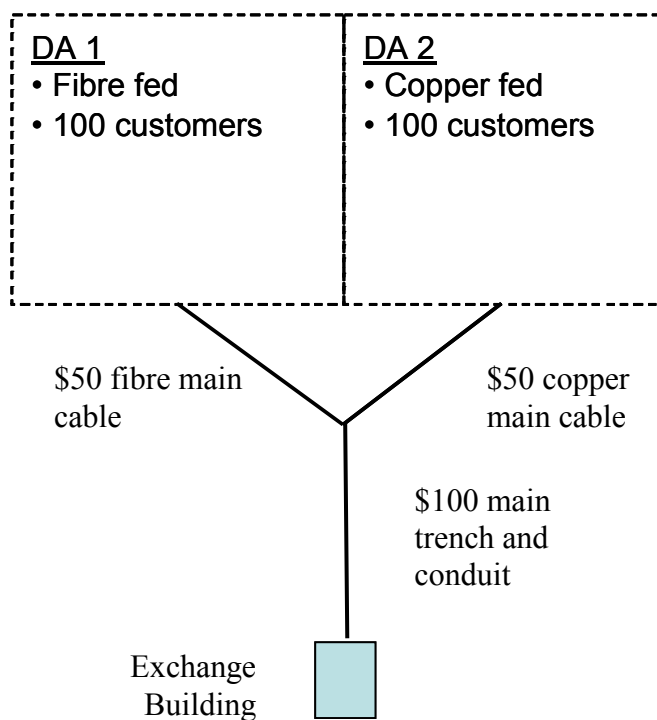
- 227 The Analysys model does not properly determine the unit cost of CAN services because it contains a mismatch between the annual cost and the services in operation used in the calculation. The model builds a network comprised of copper, fibre, wireless, and satellite components, then removes the investment in those components (fibre, wireless, and satellite in the case of ULLS), but does not remove the SIOs not utilised to supply a particular service served by the excluded network components from the unit cost calculation.
- 228 The unit cost of ULLS is the annual capital costs and expenses associated with provisioning the CAN in those areas where ULLS is available divided by the total SIOs of CAN services in those same areas. If the ACCC is correct in using an approach in which the price of ULLS should be based upon the cost of provisioning the CAN irrespective of the technology deployed, the unit cost of ULLS and WLR is annual capital costs and expenses associated with provisioning the CAN in all areas divided by the total SIOs of CAN services in all areas – that is, there should be no excluded cost.
- 229 Whichever approach one takes in the calculation of the cost of ULLS, the Analysys Model is wrong. The Analysys Model does not include all costs associated with provisioning the CAN; it excludes the cost of all fibre, wireless and satellite plant and equipment. Further, the Analysys Model divides the annual cost of the subset of CAN plant and equipment, which it leaves in the calculation of unit cost, by the SIOs of all CAN services, even those served exclusively by the excluded equipment (Some CAN services are served partially by the excluded equipment and partially by copper; and many are served end to end by the excluded equipment). This error results in an understatement of unit cost, because it either understates the annual cost of the CAN (the numerator in the unit cost calculation), or overstates the demand for CAN services (the denominator in the unit cost calculation) depending upon whether one intends to include all types of technology in the cost calculation, or one intends to cost an all copper network.
- 230 The error in the Analysys Model methodology can best be demonstrated by an examination of the treatment of fibre costs in the model. Distribution Areas (DAs) in the CAN are fed by both copper and fibre main cable. ULLS is only available in copper fed distribution areas. Consequently, the Analysys Model excludes the cost of LPGS, main fibre cable and associated trench, conduit and pits from the cost of ULLS. (Since copper and fibre main cables share the same trench and conduit, an allocation of cost of these assets is required.)
- 231 There are two ways in which the main network costs can be allocated between copper fed and fibre fed DAs:
- (a) Divide the total copper and fibre main network costs by the number of customers in fibre fed and copper fed DAs (this is the way the TEA model allocates these costs).

⁹⁵ Error 4 in the 31 July Letter.

- (b) Determine the copper main network costs and divide by the number of customers in copper fed DAs and separately determine the fibre main network costs and divide by the number of customers in fibre fed DAs. This approach requires an apportionment of Main trenching and conduit between fibre and copper cables.

232 The Analysys Model does neither. It only determines the copper main network costs, including an apportionment of main trenching and conduit, but divides those cost by both copper fed and fibre fed customers. The model does determine the fibre main network costs, including an apportionment of main trenching and conduit, but excludes these costs from the CAN altogether.

233 The following example illustrates this.



234 Assume there are two DAs with 100 customers each. DA 1 is fed by a \$50 fibre cable; DA 2 is fed by a \$50 copper cable; and both DAs are fed by a \$100 trench and conduit structure. ULLS is only available in DA 2, since it is the only DA that is fed by copper. In order to calculate the cost of DA 2 alone, the cost of the main network must be allocated between the two DAs.

235 One allocation approach, the approach adopted in the TEA model, is to divide the \$200 total cost of the main network, including all trenching and conduit and both fibre and copper main cables, by the 200 customers in both DAs. This method estimates cost at \$1 per customer.

236 The alternative allocation approach is to first apportion the \$100 cost of main network trenching, conduit and pits between the two DAs and then divide the cost of serving each DA by the customers in that DA. A 50-50 allocation of trenching and conduit results in a \$50 allocation to each DA. Consequently the total main network cost of serving DA 2 is \$100, \$50 for copper main cable plus a \$50 allocation of main trenching, conduit and pits. Dividing the main network

cost of \$100 for DA 2 by the 100 customers in DA 2 also results in a cost of \$1 per customer.

- 237 Either of the above approaches is an acceptable method of calculating the average (unit) cost of the Main network for customers in DA 2. The ACCC, however, takes a third approach. The Analysys Model begins by allocating the cost of trenching and conduit between the two DAs as is done in the second approach and arrives at the same \$100 figure for the cost of the main network for DA 2. The Analysys Model, however, inexplicably divides the \$100 cost of the main network serving DA 2 by the 200 customers in both DAs. So the Analysys Model takes the cost of serving one of the DAs and divides it the customers in both DAs. Their approach results in a cost of \$0.50 per customer.
- 238 The effect of the ACCC's methodology is to understate the cost of ULLS because it excludes the cost of all non-copper technologies from ULLS and yet allocates the some of the costs of the copper main network to customers that are served by the excluded technologies and do not use the copper main network. (The model understates the cost of WLR as well, because the model also excludes fibre and satellite investments from the cost of WLR and yet still divides the total cost of WLR by all CAN lines). The Analysys Model's methodology associated with excluding the cost of the main fibre network from the CAN and placing it in the Core network is explained in Error 8 above.
- 239 It is important to note that the ACCC's methodology is also wrong, if the intention is to estimate the cost of all CAN lines, rather than ULLS lines, because the methodology excludes the cost of significant amounts of plant and equipment used in the provision of CAN service. It excludes all of the cost of fibre, wireless and satellite plant and equipment. The CAN is not capable of serving hundreds of thousands of customers without this plant and equipment.
- 240 The ACCC has responded to this error by stating:⁹⁶

“Telstra’s concern is related to the situation where an access seeker has use of the copper loop from the exchange to a customer in a DA where Telstra serves other customers in that DA direct from the remote equipment.”

- 241 However, this error is not related to that situation specifically, so it appears the ACCC has misunderstood the error. The error occurs for all copper-fed DAs. The Analysys Model only allocates a proportion of that copper main cable to those customers where it should allocate the entire cost of that cable.

Cost Methodology

- 242 The unit cost of a service (i.e. cost per SIO) is the annual capital costs and expenses associated with provisioning the service divided by the total in service demand of that service. In the case of services provided over a common platform, such as the CAN, it is necessary to develop the unit cost, or cost per unit of output, of the network elements, which comprise the common platform that is used in the provision of multiple services; and then, develop the unit cost of network elements, which are used to provision individual services (or a subset of services), if any. The unit cost of each individual service is the unit cost of the network elements, which comprise the common platform, plus the unit cost of

⁹⁶ ACCC letter to Telstra dated 2 April 2009, page 3.

network elements, which are only used to provision the individual service (or a subset of the services provisioned over the common platform).

- 243 A common method of distinguishing the cost associated with the network elements, which comprise a common platform, like the CAN, from the cost associated with network elements, which are used to provision a single or subset of services, is to segregate the total investment and expense associated with network elements into cost pools. For example, all investments and expenses associated with network elements used in the provision of a common CAN platform can identified and assigned to a CAN cost pool; and all investments and expenses associated with network elements associated with provisioning individual services, like satellite links or radio links, can be assigned to satellite or radio cost pools.
- 244 The assignment of investments and expenses to cost pools facilitates the calculation of unit costs for individual services, because the calculation of the cost per unit of output for each cost pool is straightforward. Simply divide the total annual cost in the cost pool by the services in operation, which are provisioned by the network element or elements that comprise the cost pool, to calculate the unit cost.

ULLS

- 245 The determination of the cost per unit of output for ULLS is also a straightforward procedure. First create a cost pool comprised of the network elements used to provide an all copper CAN; and then divide the cost pool by the total number of services in operation provisioned by the network elements in the cost pool. (Note, the ACCC recently embraced an alternative costing methodology for ULLS, which does not limit the technology used in the cost calculation of ULLS to copper. The Analysys Model does not employ this methodology, however; the model limits the technology used in the provision of ULLS to copper.)

Cost Pool

- 246 The model develops cost pools for Access Services by allocating the cost of network elements to individual services in Cost.xls, RF.Acces. As explained above, the error in the model's unit cost calculation for services is caused by a mismatch between the cost pools developed through the assignment of network elements to services in Cost.xls, RF.Access, and the SIOs for services and common network platforms. The SIOs do not match the services provisioned by the assets in the cost pools. This mismatch is readily apparent in the case of ULLS.
- 247 Network elements are assigned to the cost pool for ULLS on column O of Cost.xls, RF.Access. A network element is assigned to the ULLS cost pool on this worksheet, when a 1 is placed in the cell that corresponds to the line for that network element and column O. If the cell corresponding to a line for a network element and column O is left blank, that network element is not assigned to the ULLS cost pool. All CAN network elements in the model are assigned to the ULLS cost pool, except for the following:
- (a) NTP – 2-pair wall socket;
 - (b) Fibre termination point (E1);
 - (c) CPE (radio link) Outdoor unit;
 - (d) CPE (satellite link);

- (e) LPGS equipment;
- (f) LPGS MDF;
- (g) Fibre splicing chamber;
- (h) Fibre: NTP >> next node;
- (i) Fibre: Link on fibre rings (pillar to pillar);
- (j) Fibre: Pillar >> LE (non-ring deployment);
- (k) Fibre: LPGS >>LE (non-ring deployment);
- (l) Wireless BTS site acquisition, prep and construction;
- (m) Wireless BTS equipment:
- (n) Microwave System (including both terminals);
- (o) Microwave hop tower site acquisition, prep and construction;
- (p) Microwave hop equipment; and
- (q) Tie pair cable (LSS).

248 The absence of a 1 in the cells corresponding to these network elements in column O can be seen in the two screen shots in Figure 37 below.

Figure 37

Analysys ACCESS SERVICE ROUTING

This sheet contains the access routing factors used in the workbook
 note: cost from core network is LE costs supporting MDF
 note: business overheads allocated

Access service volumes:

Asset group	Asset	Unconditioned local loop service (ULLS)	Line sharing service (LSS)	Wholesale line rental (WLR)	Service
		611,227	421,063	1,404,856	
1	Other CAN	-	-	-	
2	Other CAN	1	-	1	
3	Other CAN	1	-	1	
4	Other CAN	1	-	1	
5	Other CAN	1	-	1	
6	Other CAN	-	-	1	
7	Radio	-	-	1	
8	Radio	-	-	-	
9	LPGS	-	-	1	
10	LPGS	-	-	1	
11	Cable	1	-	1	
12	Cable	-	-	1	
13	Duct: 28	1	-	1	
14	Duct: 24	1	-	1	
15	Duct: 20	1	-	1	
16	Duct: 16	1	-	1	
17	Duct: 12	1	-	1	

Ready Calculate Sum=611290.4846 NUM

Microsoft Excel - Cost

Analysys ACCESS SERVICE R

This sheet contains the access routing factors used in the workbook
 note: cost from core network is LE costs supporting MDF
 note: business overheads allocat

Access service volumes:

Asset group	Asset	611,227	421,063	1,404,856	
		Unconditioned local loop service (ULLS)	Line sharing service (LSS)	Wholesale line rental (WLR)	Servi
71	66 Cable	1	-	1	
72	67 Cable	-	-	1	
73	68 Cable	-	-	1	
74	69 Cable	-	-	1	
75	70 Cable	-	-	1	
76	71 Radio	-	-	1	
77	72 Radio	-	-	1	
78	73 Radio	-	-	1	
79	74 Radio	-	-	1	
80	75 Radio	-	-	1	
81	76 Other CAN	1	-	1	
82	77 Other CAN	1	-	1	
83	78 Other CAN	1	-	-	
84	79 Other CAN	-	-	-	
85	80 LE	1	-	1	
86	81 Overheads				
87					

RF.S12.Access RF.S13.Access RF.S14.Access RF.S15

Sum=611290.4046 NUM

249 As can be seen the model does not allocate any costs associated with Fibre, Microwave or Satellite network elements into the ULLS cost pool. The model only allocates copper costs to ULLS.

250 Even though the Analysys Model only includes the costs of copper assets in the ULLS cost pool, it spreads those costs over CAN SIOs provisioned by all types of technology, as will be demonstrated below. This is clearly a mismatch between the cost of network elements and the SIOs provisioned by those services leads to a significant understatement of unit costs.

In Service Demand

251 The demand figures used in the unit cost calculation for each network element are calculated in Cost.xls, Dem.In.Access, lines 42:141 (see Figure 38).

Figure 38

Asset	Geotype 5	Geotype 6	Geotype 7	Geotype 8	Geotype 9	Geotype
41	1,797,495	441,664	248,933	153,199	36,767	800
42	1,797,495	441,664	248,933	153,199	36,767	800
43	1,797,495	441,664	248,933	153,199	36,767	800
44	1,797,495	441,664	248,933	153,199	36,767	800
45	1,797,495	441,664	248,933	153,199	36,767	800
46	1,797,495	441,664	248,933	153,199	36,767	800
47	1,797,495	441,664	248,933	153,199	36,767	800
48	1,797,495	441,664	248,933	153,199	36,767	800
49	1,797,495	441,664	248,933	153,199	36,767	800
50	1,797,495	441,664	248,933	153,199	36,767	800
51	1,797,495	441,664	248,933	153,199	36,767	800
52	1,797,495	441,664	248,933	153,199	36,767	800
53	1,797,495	441,664	248,933	153,199	36,767	800
54	1,797,495	441,664	248,933	153,199	36,767	800
55	1,797,495	441,664	248,933	153,199	36,767	800
56	1,797,495	441,664	248,933	153,199	36,767	800
57	1,797,495	441,664	248,933	153,199	36,767	800
58	1,797,495	441,664	248,933	153,199	36,767	800
59	1,797,495	441,664	248,933	153,199	36,767	800
60	1,797,495	441,664	248,933	153,199	36,767	800
61	1,797,495	441,664	248,933	153,199	36,767	800
62	1,797,495	441,664	248,933	153,199	36,767	800
63	1,797,495	441,664	248,933	153,199	36,767	800
64	1,797,495	441,664	248,933	153,199	36,767	800
65	1,797,495	441,664	248,933	153,199	36,767	800

252 The amounts on lines 42 – 141 are derived from the total in service demand for all services that use the CAN, which are found on lines 8 – 37 of the same worksheet (Cost.xls, Dem.In.Access). It must be noted that the in service demand on lines 8-37 is total demand for the services, which use the CAN, irrespective of the technology employed in the provision of service. These services are provisioned by the total mix of technologies used in the CAN (i.e. copper, fibre, wireless and satellite) The in service demand on lines 42 – 141 is a subset of the amounts on lines 8 – 37. With few exceptions, the demand on lines 42 – 141 is the total demand of all services (i.e. the sum of lines 8 – 37) less the demand for Line Sharing Service (LSS) (line 20), since the ACCC has decided to allocate zero CAN cost to LSS.

253 The model uses the same in service demand for all of the network elements included in the ULLS cost pool. It is equal to the total in service demand for all CAN based services, except LSS (i.e. equal to the sum of lines 8-37 minus line 20 in Cost.xls, Dem.In.Access). The in service demand for 400 pair main copper cable is illustrative of all CAN network elements. The in service demand figure of 248,933 used in the calculation of the unit cost of 400 pair Main copper cable in Geotype 7 (Cost.xls, Dem.In.Access, , 97l) is the total in service demand of all services which utilize the CAN in geotype 7, with the exception of LSS (The sum of Lines 8-37 on Cost.xls, Dem.In.Access minus line 20). Many of the SIOs included in this quantum are provisioned with 400 pair Main copper cable, but many are not, because they are served by fibre, wireless or satellite.

Figure 39

Services	Geotype 4	Geotype 5	Geotype 6	Geotype 7	Geotype 8	Geotype 9
1 PSTN End User Access	2,068,722	1,368,806	336,331	189,568	116,676	28,000
2 PSTN local traffic (onnet traffic)	-	-	-	-	-	-
3 PSTN national long distance traffic (onnet calls)	-	-	-	-	-	-
4 PSTN outgoing traffic to international destinations	-	-	-	-	-	-
5 PSTN outgoing to mobile traffic (mobile terminals)	-	-	-	-	-	-
6 PSTN OTA traffic (from international, from mobile)	-	-	-	-	-	-
7 Local carriage service (LCS)	-	-	-	-	-	-
8 ISDN-BRI access	61,482	40,681	9,996	5,634	3,467	-
9 ISDN-PRI access	6,633	4,387	1,076	603	357	-
10 Service 10	-	-	-	-	-	-
11 ISDN - voice traffic	-	-	-	-	-	-
12 Unconditioned local loop service (ULLS)	161,171	106,642	26,203	14,769	9,090	2,000
13 Line sharing service (LSS)	111,028	73,463	18,051	10,174	6,262	1,000
14 Wholesale line rental (WLR)	377,231	249,602	61,330	34,568	21,275	5,000
15 Service 15	-	-	-	-	-	-
16 Dial-up Internet Traffic	-	-	-	-	-	-
17 ADSL retail lines	-	-	-	-	-	-
18 ADSL wholesale lines	-	-	-	-	-	-
19 SDSL retail lines	-	-	-	-	-	-
20 SDSL wholesale lines	-	-	-	-	-	-
21 Service 21	-	-	-	-	-	-
22 Lines in CAN	41,376	27,377	6,727	3,792	2,334	-
23 Service 23	-	-	-	-	-	-
24 Mbit/s in LE-LTH	-	-	-	-	-	-
25 Mbit/s in LTH-MTH	-	-	-	-	-	-
26 Mbit/s in MTH-MTH	-	-	-	-	-	-
27 Service 27	-	-	-	-	-	-
28 Service 28	-	-	-	-	-	-
29 Service 29	-	-	-	-	-	-
30 Service 30	-	-	-	-	-	-

Unit Cost Calculation

254 The unit cost calculation in the model is done in Cost.xls, TA.Access, columns GJ – GY. The unit cost per SIO for 400 pair Main copper cable in geotype 7 is shown in cell 65GP in Figure 40.

Figure 40

Access asset group	Assets	Unit	Geotype 6	Geotype 7	Geotype 8
62	53 Cable Copper main: 50	sheath metres	-	-	-
63	54 Cable Copper main: 100	sheath metres	-	-	-
64	55 Cable Copper main: 200	sheath metres	-	-	-
65	56 Cable Copper main: 400	sheath metres	72.27	93.80	27.99
66	57 Cable Copper main: 800	sheath metres	-	-	-
67	58 Cable Copper main: 1200	sheath metres	-	-	-
68	59 Cable Joints: 2	#	17.65	20.74	22.05
69	60 Cable Joints: 10	#	2.99	1.37	0.49
70	61 Cable Joints: 30	#	0.78	0.32	0.24
71	62 Cable Joints: 50	#	0.44	0.11	-
72	63 Cable Joints: 100	#	-	-	-

255 The formula for this calculation is as follows:

$$(FY65 / Dem.In.Access!I97) * (1+uplift.access.business.overheads)$$

256 FY65 is the total annual cost calculated by the model for 400 pair main cable in geotype 7. This is divided by Dem.In.Access!I97, which is the in service demand used in the model for 400 pair main copper cable in geotype 7. The resulting cost per unit of demand is multiplied by one plus the access business overheads. This calculation results in the unit cost figure of 93.80 found in cell 65GP:

$$(21,256,423 / 248,933) X 1.0985 = 93.80$$

257 So the model calculates the unit cost for 400 pair main copper cable by dividing the total annual cost for this asset by the in service demand of services provided over this asset as calculated by the model and then adding business overheads.

258 The problem is that the model includes all CAN lines in service, including those partially or fully provisioned over fibre, wireless or satellite instead of main copper cable, in its calculation of the in service demand for 400 pair main copper cable. This erroneous in service demand is then used as the denominator in the calculation of the unit cost of 400 pair main copper cable. This methodology is wrong, because it mismatches the cost pool, in this case the total annual cost of 400 pair main copper cable, with the in service demand, in this case the total demand of all CAN services. Consequently the model spreads the cost of 400 pair main copper cable over all lines in the CAN, even though the cost of the technology used in the provision of service for many of those lines is excluded from the cost pool.

259 The use of 400 pair Main copper cable is illustrative. The unit cost calculation of every network element used to provision ULLS contains the same error. The total cost pool for ULLS is only comprised of copper network elements; yet this cost pool is spread over all lines provisioned by the CAN, even those provisioned by fibre, wireless and satellite technology. Further, the error in the model is widespread and affects other CAN services in addition to ULLS.

Other CAN Services

260 The cost pools for PSTN and WLR are inclusive. The PSTN cost pool includes all network elements, except 2-pair wall sockets and tie cables for ULLS and LSS; and the WLR cost pool includes the same network elements as PSTN with the exception of satellite equipment (Cost.xls, RF.Access, columns D and Q respectively). This is seen in Figure 41.

Figure 41

Asset group	Asset	PSTN End User Access	Wholesale line rental (WLR)	Service 15	Dia Inte Tra
Access service volumes:		7,845,759	1,404,856	-	
1	Other CAN	NTP: 2-pair wall socket	-	-	-
2	Other CAN	NTP: 10-pair building termination	1	1	-
3	Other CAN	NTP: 30-pair building termination	1	1	-
4	Other CAN	NTP: 50-pair building termination	1	1	-
5	Other CAN	NTP: 100-pair building termination	1	1	-
6	Other CAN	Fibre termination point (E1)	1	1	-
7	Radio	CPE (radio link) Outdoor unit	1	1	-
8	Radio	CPE (satellite link)	1	-	-
9	LPGS	LPGS equipment	1	1	-
10	LPGS	LPGS MDF	1	1	-
11	Cable	Copper pillars	1	1	-
12	Cable	Fibre splicing chamber	1	1	-
13	Duct	Duct: 28	1	1	-
14	Duct	Duct: 24	1	1	-
15	Duct	Duct: 20	1	1	-
16	Duct	Duct: 16	1	1	-
17	Duct	Duct: 12	1	1	-

261 The in service demand used in the calculation of unit costs is found in Cost.xls, Dem.In.Access, lines 42 - 141. As discussed above, with few exceptions, the demand on lines 42 – 141 is the total demand for all CAN services (i.e. the sum of lines 8 – 37) less the demand for Line Sharing Service (line 20), since the ACCC has decided to allocate zero CAN cost to that service.

262 Since, with the exception of the exclusion of satellite assets from WLR, the cost pools for PSTN and WLR include all CAN assets, the use of total demand for all CAN services in the calculation of unit costs for PSTN and WLR seems, at first glance, to be appropriate, if one corrects for the exclusion of satellite assets from the WLR cost pool. The methodology inherent in the Analysys Model, however, includes two errors. It does not correct for the exclusion of satellite assets from

the WLR cost pool; and, even though fibre main cable and associated trenching, conduit and pits are nominally included in the PSTN and WLR cost pools, the cost of those assets is removed from the cost pools before the unit cost of PSTN and WLR is calculated. Consequently, the unit cost calculations for PSTN and WLR also contain a mismatch between the cost pools used in the calculation of their unit costs and the in service demand used in those calculations. The SIOs include lines provisioned over fibre main cable and the costs of those assets are excluded from the cost pool.

Cost Pool for Other CAN Services

263 As previously explained, the unit cost calculation in the model is done in Cost.xls, TA.Access, columns GJ – GY. The total annual costs used in that calculation is found in columns FS – GH of that same worksheet. Using the cost of single duct conduit (Duct: 1) in geotype 7 as an example, the formula for the total annual cost in cell 31FY (see Figure 42 below) is as follows:

$$BJ31 + CA31 + DZ31 + EQ31 + FH31$$

Figure 42

			FX	FY	FZ	GA
			Geotype 6	Geotype 7	Geotype 8	Geotype 9
27	18 Duct	Duct: 8	748,541	314,718	14,308	-
28	19 Duct	Duct: 6	1,511,926	928,688	10,254	-
29	20 Duct	Duct: 4	4,198,317	3,921,671	251,832	-
30	21 Duct	Duct: 2	8,454,165	6,489,792	1,089,834	167,425
31	22 Duct	Duct: 1	22,951,898	15,795,494	9,891,096	3,895,214
32	23 Duct	Duct: 1 road-crossing	7,508,676	5,483,792	5,754,332	2,004,556
33	24 Duct	Duct: 1 (PB >> DP/ Serving pit)	-	-	-	-
34	25 Duct	Pits: PF28	4,045	-	-	-
35	26 Duct	Pits: PF20	113,263	-	-	-
36	27 Duct	Pits: PF12	1,969,975	1,152,897	97,217	-
37	28 Duct	Pits: P9	4,498,176	4,234,404	3,574,592	430,540
38	29 Duct	Pits: P6	4,330,627	2,975,667	4,538,661	1,065,854

264 BJ31 and CA31 are the total annual capital cost and annual operating expense for single duct conduit respectively. DZ31 is the trench and duct cost for single duct conduit allocated to core expressed as a negative number (see Figure 43). EQ31 is the fibre cost for single duct conduit allocated to core expressed as a negative number. FH31 is the cost savings and costs for single duct conduit allocated from core to CAN.

Figure 43

				DY	DZ	EA	EB
Analysys				Trench and duct cost allocated to core (
Asset calculation				Geotype 6	Geotype 7	Geotype 8	Geotype 9
Access asset group	Assets						
27	18 Duct	Duct: 8		(159,944)	(63,905)	(1,277)	-
28	19 Duct	Duct: 6		(323,059)	(188,575)	(915)	-
29	20 Duct	Duct: 4		(897,071)	(796,316)	(22,473)	-
30	21 Duct	Duct: 2		(1,806,435)	(1,317,786)	(97,255)	-
31	22 Duct	Duct: 1		(4,904,224)	(3,207,357)	(882,662)	-
32	23 Duct	Duct: 1 road-crossing		-	-	-	-
33	24 Duct	Duct: 1 (PB >> DP/ Serving pit)		-	-	-	-
34	25 Duct	Pits: PF28		(864)	-	-	-
35	26 Duct	Pits: PF20		(24,201)	-	-	-
36	27 Duct	Pits: PF12		(420,932)	(234,102)	(8,675)	-
37	28 Duct	Pits: P9		(961,143)	(859,818)	(318,990)	-
38	29 Duct	Pits: P6		(925,347)	(604,225)	(405,071)	-

265 As can be seen from an examination of cell DZ31, the model removes \$3,207,357 which the portion of the cost of single duct conduit attributable to fibre main cable, from the annual cost of single duct conduit prior to the calculation of unit costs. In like manner the model removes the cost of all fibre, conduit and pits associated with fibre main cable from the annual costs of assets used in the calculation of unit costs for all CAN services, including PSTN and WLR.

In Service Demand for Other CAN Services

266 The in service demand for single duct conduit (Duct: 1) in geotype 7 used in the model is 248,933, which is found in Cost.xls, Dem.In.Access, Cell 631 (see Figure 44). This is the total SIOs for all CAN services in geotype 7, except LSS.

Figure 44

Services	Geotype 5	Geotype 6	Geotype 7	Geotype 8	Geotype 9	Geotype
52 11 Copper pillars	1,797,495	441,664	248,933	153,199	36,767	800,
53 12 Fibre splicing chamber	1,663,476	408,733	230,373	141,776	34,024	741,
54 13 Duct: 28	1,797,495	441,664	248,933	153,199	36,767	800,
55 14 Duct: 24	1,797,495	441,664	248,933	153,199	36,767	800,
56 15 Duct: 20	1,797,495	441,664	248,933	153,199	36,767	800,
57 16 Duct: 16	1,797,495	441,664	248,933	153,199	36,767	800,
58 17 Duct: 12	1,797,495	441,664	248,933	153,199	36,767	800,
59 18 Duct: 8	1,797,495	441,664	248,933	153,199	36,767	800,
60 19 Duct: 6	1,797,495	441,664	248,933	153,199	36,767	800,
61 20 Duct: 4	1,797,495	441,664	248,933	153,199	36,767	800,
62 21 Duct: 2	1,797,495	441,664	248,933	153,199	36,767	800,
63 22 Duct: 1	1,797,495	441,664	248,933	153,199	36,767	800,
64 23 Duct: 1 road-crossing	1,797,495	441,664	248,933	153,199	36,767	800,
65 24 Duct: 1 (PB >> DP/ Serving pit)	1,797,495	441,664	248,933	153,199	36,767	800,
66 25 Pits: PF28	1,797,495	441,664	248,933	153,199	36,767	800,
67 26 Pits: PF20	1,797,495	441,664	248,933	153,199	36,767	800,
68 27 Pits: PF12	1,797,495	441,664	248,933	153,199	36,767	800,
69 28 Pits: P9	1,797,495	441,664	248,933	153,199	36,767	800,
70 29 Pits: P6	1,797,495	441,664	248,933	153,199	36,767	800,
71 30 Pits: P5	1,797,495	441,664	248,933	153,199	36,767	800,
72 31 Pits: P5 road crossing	1,797,495	441,664	248,933	153,199	36,767	800,
73 32 Copper lead-in: 2	1,797,495	441,664	248,933	153,199	36,767	800,
74 33 Copper lead-in: 10	1,797,495	441,664	248,933	153,199	36,767	800,
75 34 Copper lead-in: 30	1,797,495	441,664	248,933	153,199	36,767	800,

Unit Cost Mismatch for Other CAN Services

267 The costs of fibre main cable and associated trenching, conduit and pits have been excluded from cost pools used in the unit cost calculations for PSTN and WLR. Additionally the cost of satellite equipment has been excluded from the WLR cost pool. The unit costs of both PSTN and WLR, however, are calculated based upon the total SIOs for all CAN services, except LSS. Many of the lines included in this demand are provisioned with fibre main cable; and some are provisioned with satellite equipment. Consequently there is a mismatch between the cost pools and demand figures used in the calculation of unit costs for PSTN and WLR in the ACCC's cost model. (The same mismatch occurs in the calculation of unit costs for ISDN – BRI access, ISDN – PRI access and lines in CAN, although, for the sake of simplicity, those services have not been included in this discussion.)

How can the error be fixed?

268 The error in the calculation of the unit costs of CAN services per SIO in the Analysys Model is caused by a mismatch between the cost pools and the levels of demand used in the calculation. The error can be rectified by eliminating this mismatch. This can be done either by correcting the cost pool such that it includes the cost all of the assets required to provision service to all of the lines included in the demand; or by correcting the demand so that it only includes lines which are capable of being served by the assets included in the cost pool.

269 If the model created a cost pool for CAN Services and calculated the unit cost of each CAN service directly, it would be a straightforward matter to correct the

unit cost calculation of each service by correcting either the in service demand, or the cost pool, for the service used in the calculation. However, the model does not create cost pools for services; nor does it calculate unit costs for services directly. Rather, the model creates cost pools for network elements and calculates unit costs for network elements. The model then derives the unit costs of all CAN services, including ULLS, from the unit costs of network elements. This two step approach in the structure of the model makes the correction slightly more complex.

- 270 Since the both ULLS and PSTN use primarily the same network elements, and the yet, as explained above, the in service demand for the ULLS cost pool differs from the in service demand of the PSTN cost pool, it is not possible to simply correct the demand used in the calculation of unit costs for network elements in order to correct the mismatches between demand and cost pools inherent in the model.
- 271 Consequently, as will be made clear below, the mismatch between the cost pools for services and the demands used to calculate the unit costs of services must be corrected by adjusting the unit costs of network elements calculated by the model. The unit costs of network elements calculated by the model must be adjusted so they reflect the correct relationship between cost pools and in service demands for each CAN service, before they are input into the derivation of unit costs for individual services.
- 272 Since the error in the calculation of the unit cost of ULLS is different from the error in the calculation of unit costs for other CAN services, the corrective action taken for ULLS will be discussed first, followed by a description of the corrective action for the other CAN services.

ULLS

- 273 For ULLS we have corrected the demand used in the unit cost calculations for CAN services so that it only includes lines provisioned by copper assets, because those are the only assets included in the model's ULLS cost pool; and in some cases we have corrected the cost pool used in unit cost calculations.

Derivation of Unit Cost for Services

- 274 The unit cost for CAN services are derived in Cost.xls, TA.Access, Lines 108 -140 (see Figure 45). The unit cost for ULLS in geotype 4, for example, is derived in cell 122H. The formula is as follows:
- $$\text{SUMPRODUCT}(\text{GM}\$10:\text{GM}\$89*\text{RF.S12.Access})$$
- 275 GM10 – GM89 contains the unit cost for all CAN network elements in geotype 4. RF.S12.Access contains the allocation of network elements to the ULLS cost pool.
- 276 Recall that the cell corresponding to each network element, in the column for ULLS, on the RF.Access worksheet contains a 1, if the network element is allocated to the ULLS cost pool, and a zero (blank space), if the network element is not allocated to the ULLS cost pool. Consequently, the sum of the product of the unit cost of each network element and its corresponding entry for ULLS on the RF.Access worksheet is the sum of the unit cost for all network elements, which have been allocated to ULLS, and zero for all network elements, which have not been allocated to ULLS.
- 277 Simply stated, the unit cost for any CAN service calculated by the model is the sum of the unit costs of the network elements, which have been allocated to that service.

Figure 45

	A	B	C	D	G	H	I
	Analysys			ACENNUITY			
		Services (AUD per unit)	Unit	Geotype 3	Geotype 4	Geotype 5	
110							
111	1	PSTN End User Access	Lines	199	250	263	
112	2	PSTN local traffic (onnet traffic)	Minutes	-	-	-	
113	3	PSTN national long distance traffic (onnet calls)	Minutes	-	-	-	
114	4	PSTN outgoing traffic to international destinations	Minutes	-	-	-	
115	5	PSTN outgoing to mobile traffic (mobile terminating)	Minutes	-	-	-	
116	6	PSTN OTA traffic (from international, from mobile, to/ from)	Minutes	-	-	-	
117	7	Local carriage service (LCS)	Minutes	-	-	-	
118	8	ISDN-BRI access	Lines	199	250	263	
119	9	ISDN-PRI access	Lines	199	250	263	
120	10	Service 10	none	-	-	-	
121	11	ISDN - voice traffic	Minutes	-	-	-	
122	12	Unconditioned local loop service (ULLS)	Lines	197	248	259	
123	13	Line sharing service (LSS)	Lines	-	-	-	
124	14	Wholesale line rental (WLR)	Lines	199	250	263	
125	15	Service 15	none	-	-	-	
126	16	Dial-up Internet Traffic	Minutes	-	-	-	
127	17	ADSL retail lines	Lines	-	-	-	
128	18	ADSL wholesale lines	Lines	-	-	-	
129	19	SDSL retail lines	Lines	-	-	-	
130	20	SDSL wholesale lines	Lines	-	-	-	
131	21	Service 21	none	-	-	-	
132	22	Lines in CAN	Lines	197	249	261	
133	23	Service 23	none	-	-	-	
134	24	Mbit/s in LE-LTH	Mbit/s	-	-	-	

Adjustments to Network Element Unit Costs

- 278 Since the unit cost of all CAN services is equal to the sum of the unit costs of the network elements allocated to those service, the SIOs used in the calculation of unit costs for all network services is identical, because the unit costs of all CAN services are derived from the same set of network element unit costs. Since the cost pool for PSTN includes the cost of all technologies used in the provision of the CAN and the cost pool for ULLS only includes the cost of a single technology, copper, it is wrong to divide both cost pools by the identical demand. The demand used in the unit cost calculation of network elements is higher than what is appropriate for the unit cost calculation of ULLS. That is because the cost of fibre, wireless and satellite technologies are omitted from the ULLS cost pool and yet the demand used in the calculation of unit costs for network elements, the sum of which comprise the unit cost of ULLS, includes lines provisioned by those technologies.
- 279 Consequently, the unit costs of network elements must be adjusted so that they either reflect the correct in service demand for the utilisation of ULLS costs, or they reflect a cost pool which matches the in service demand used in the calculation, before they can be used in the derivation of ULLS unit costs.
- 280 To facilitate these adjustments, the network elements used in the model have been segregated into four categories based upon the characteristics of the demands and cost pools used in their unit cost calculations and the adjustments needed to properly align the demands and cost pools. The four categories of network elements are as follows:

- (a) Copper network elements used to directly serve CAN SIO;
- (b) Trenching, conduit and pits;
- (c) Main copper cable; and
- (d) Fibre, wireless and satellite network elements.

Category 1 - Copper Distribution Adjustment

281 Copper network elements used to directly serve CAN SIOs are those network elements, which comprise the copper distribution network and are not included in one of the other three categories. The calculation of the unit cost of these network elements is based upon the total demand of all CAN services, except LSS. However, these network elements are not used by all SIOs of all CAN services.

282 The model calculates the unit cost of copper network elements used to directly serve CAN SIOs by dividing the cost pool for these network elements by the in service demand of all CAN services, except LSS (i.e. the costs of these network elements is spread across all CAN lines, except LSS). Consequently, these unit costs cannot be used in the derivation of unit costs for ULLS, because they are calculated with an inappropriate in service demand. It is incorrect to use the in service demand for all CAN services, except LSS, in the derivation of unit costs for ULLS, because a portion of those SIOs are directly served by fibre, wireless and satellite network elements and the cost of these non-copper network elements are excluded from the ULLS cost pool. The SIOs served directly by fibre, wireless and satellite network elements must be excluded from the in service demand used in the calculation of the unit cost of ULLS. Therefore, the unit costs of copper network elements used to directly serve CAN SIOs, which are calculated by the model, must be adjusted to correct for the use of an incorrect quantum of SIO in the calculation, before those costs can be used in the derivation of unit costs for ULLS.

283 The adjustment needed to correct for the use of incorrect demand quantum in the unit cost calculation of these network elements is straightforward.

284 The formula, (Unit Cost = Cost Pool / SIO), contains an incorrect input for SIO. This can be corrected as follows:

$$(\text{Cost Pool} / \text{Incorrect SIO}) * (\text{Incorrect SIO} / \text{Correct SIO}) = (\text{Cost Pool} / \text{Correct SIO})$$

285 Since, (Cost Pool / Incorrect SIO) = (Unit Cost result in model). The Unit Cost result in the model can be substituted into the above formula in place of (Cost Pool / Incorrect SIO). The formula becomes:

$$(\text{Unit Cost result in model}) * (\text{Incorrect SIO} / \text{Correct SIO}) = (\text{Cost Pool} / \text{Correct SIO}) = \text{Correct Unit Cost}$$

286 Therefore, to correct the unit costs for copper network elements used to directly serve CAN SIO so the can be used in the derivation of unit costs for ULLS, it is necessary to multiply those costs by (Incorrect SIO / Correct SIO).

287 As explained above, the incorrect SIO used in the calculation of the unit costs of these network elements is all CAN SIO except, LSS; and the correct SIO is the proportion of SIO directly served by copper. Therefore;

$$(\text{Incorrect SIO} / \text{Correct SIO}) = (\text{All CAN SIO, except LSS}) / ((\text{All CAN SIO, except LSS}) * (\text{proportion of SIO directly served by copper})) = 1 / (\text{proportion of SIO directly served by copper})$$

- 288 In order to correct the calculation of ULLS unit costs in the model, it is necessary to multiply the unit costs of copper network elements used to directly serve CAN SIO by $1 / (\text{proportion of SIO directly served by copper})$, before they are input into the calculation of ULLS unit costs.
- 289 The “Average proportion of SIOs addressed directly by copper” is found on CAN.xls, In.Access, line 14 (see Figure 46). This proportion ranges from a low of 11.88% in geotype 2 to a high of 98.57% in geotype 8. The remaining proportion of CAN SIO is served directly with fibre, wireless or satellite assets.

Figure 46

		Geotype 1	Geotype 2	Geotype 3	Geotype 4
Outputs of geotyping					
Demand density					
	Average number of SIOs per location	4.15	24.64	1.55	1.38
	Average number of copper SIOs per location	2.69	3.15	1.35	1.27
	Average number of fibre SIOs per location	104.90	314.11	108.83	109.37
	Average number of wireless SIOs per location	-	-	-	-
	Average number of satellite SIOs per location	-	-	-	-
Access technology					
	Average proportion of SIOs addressed directly by copper	64.05%	11.88%	86.95%	92.18%
	Average proportion of SIOs addressed directly by fibre	35.95%	88.12%	13.05%	7.82%
	Average proportion of SIOs addressed directly by wireless	-%	-%	-%	-%
	Average proportion of SIOs addressed directly by satellite	-%	-%	-%	-%
Wired connections					
Copper parameters					
	Average proportion of copper SIOs directly connected to LE	3.11%	14.02%	2.48%	2.57%
	Average proportion of copper SIOs served by LPGS	-%	-%	5.47%	15.32%
	Average proportion of copper SIOs served by pillars	96.89%	85.98%	92.04%	82.11%
Fibre parameters					
	Average proportion of fibre SIOs directly connected to LE	2.16%	14.98%	6.53%	8.84%
	Average proportion of fibre SIOs served by pillars	97.84%	85.02%	93.47%	91.16%

Category 2 - Conduit Removal Adjustment

- 290 The demand used in the unit cost calculation of trenching, conduit and pits is the total demand of all CAN services, except LSS. However, a portion of the cost of the assets associated with these network elements has been removed from the network element cost pools and allocated to the Core network prior to the calculation of unit costs.
- 291 The allocation of the portion of the cost of Conduit (i.e. trenching, conduit and pits), which is associated with fibre main cable, to the Core network creates a mismatch between the cost pools for these network elements and the SIOs used

in the calculation of unit costs. It is incorrect to divide only a portion of the Conduit cost pools, which are attributable to CAN services, by 100% of the CAN SIOs. Either the cost pools or the quantum of SIOs must be adjusted to rectify this error.

- 292 Since the Conduit in the model is shared by main and distribution cable, it would be difficult to adjust the SIO quantum associated with a subset of these assets. It is, therefore, preferable to adjust the cost pools for these network elements rather than the quantum of SIO to correct the mismatch between the two. The cost pools for Conduit must be adjusted to reflect 100% of the cost of these network elements attributable to CAN services. To make this adjustment, the portion of the cost of these network elements associated with fibre main cable, which was removed from the cost pools must be replaced.
- 293 The percentage of the cost of CAN Conduit allocated to the Core network in the model is found in Cost.xls, TA.Access, Columns CL – DA. That percentage is made up of two components, the percentage Conduit, which is attributable to fibre main cable, and the percentage, which is attributable to sharing between the CAN and IEN. The breakdown between these two components is found in Cost.xls, Inputs.Access. The percentage of CAN Conduit attributable to fibre main cable, which is allocated to the Core network, is found in Cost.xls, Inputs.Access, line 133 (see Figure 47). This is the proportion of Conduit assets, which must be added back into the cost pools for these network elements to correct the mismatch between these cost pools and the SIO used in the unit cost calculation.

Figure 47

CAN Asset		Geotype 3	Geotype 4	Geo
133	LPGS-RAU	3%	7%	
134	Inter-pillar copper	26%	23%	
135	Inter-pillar fibre	4%	3%	
139	13 Duct: 28	7%	10%	
140	14 Duct: 24	7%	10%	
141	15 Duct: 20	7%	10%	
142	16 Duct: 16	7%	10%	
143	17 Duct: 12	7%	10%	
144	18 Duct: 8	7%	10%	
145	19 Duct: 6	7%	10%	
146	20 Duct: 4	7%	10%	
147	21 Duct: 2	7%	10%	
148	22 Duct: 1	7%	10%	
149	25 Pits: PF28	7%	10%	
150	26 Pits: PF20	7%	10%	
151	27 Pits: PF12	7%	10%	
152	28 Pits: P9	7%	10%	

294 The adjustment needed to correct the unit cost of the Conduit network elements is similar to the correction explained above, except the cost pool is adjusted rather than the SIO.

295 The formula, (Unit Cost = Cost Pool / SIO), contains an incorrect input for Cost Pool. This can be corrected as follows:

$$\frac{(\text{Incorrect Cost Pool} / \text{SIO}) * (\text{Correct Cost Pool} / \text{Incorrect Cost Pool})}{(\text{Correct Cost Pool} / \text{SIO})} =$$

296 Since, (Incorrect Cost Pool / SIO) = (Unit Cost result in model). The Unit Cost result in the model can be substituted into the above formula in place of (Incorrect Cost Pool / SIO). The formula becomes:

$$\frac{(\text{Unit Cost result in model}) * (\text{Correct Cost Pool} / \text{Incorrect Cost Pool})}{(\text{Correct Cost Pool} / \text{SIO})} = \text{Correct Unit Cost}$$

297 The Cost Pools for the Conduit network elements used in the model are incorrect because they do not include the portion of costs attributable to fibre main cable. The correct Cost Pools include these amounts. Consequently the above formula, which will correct the error, becomes the following:

$$\text{Correct Unit Cost} = (\text{Unit Cost result in model}) * (\text{Total Cost of Conduit attributable to CAN}) / ((\text{Total Cost of Conduit attributable to CAN}) * (1 - (\text{proportion of Conduit cost attributable to fibre main cable})))$$

298 This simplifies to the following

$$\text{Correct Unit Cost} = (\text{Unit Cost result in model}) * (1 / (1 - \text{proportion of Conduit cost attributable to fibre main cable}))$$

299 In order to correct the calculation of ULLS unit costs in the model, it is necessary to multiply the unit costs of conduit network elements, which are calculated in the model, by (1 / (1 - proportion of Conduit attributable to fibre main cable)), before they are used as an input into the calculation of ULLS unit costs.

Category 3 – Copper Main Cable Adjustment

300 The demand used in the unit cost calculation of main copper cable is the total demand of all CAN services, except LSS. The costs of all main copper cable assets remain in the cost pools of these network elements; however the main fibre cable assets have been removed from the costs calculation of CAN services. (The fibre main cable network elements have been excluded from the cost calculation of CAN services.)

301 Only a portion of the lines in the model are served by main copper cable; the rest are served by fibre, wireless and satellite network elements. Fibre, wireless and satellite network assets are excluded from the ULLS cost pool. Since only a portion of the CAN SIOs are served by the assets included in the ULLS cost pool, those served by copper main cable and copper distribution cable, only that quantum of SIOs should be used in the calculation of unit costs for copper main cable, when that cost is used as an input into the derivation of the unit costs for ULLS. It is an error to spread some of the ULLS cost pool to SIOs served by fibre, wireless and satellite network elements, since the cost of those network elements are excluded from the ULLS cost pool

302 To rectify this error, the unit costs for copper main cable network elements, which has been calculated by the model, must be adjusted to correct the mismatch between the cost pool and the in service demand inherent in the calculation of unit cost for these network elements. The SIOs used in these unit cost calculations must be the SIOs served by copper main cable and copper distribution cable, because those are the only assets which are included in the ULLS cost pool.

303 As explained above the proportion of CAN SIOs served by copper distribution assets is found on CAN.xls, In.Access, line 14 (the "Average proportion of SIOs addressed directly by copper") – see Figure 46. Not all of the copper distribution lines are fed by copper main cable, however; a portion of them are fed by fibre and LPGS. The proportion of copper distribution fed by fibre and LPGS must be removed from the total quantum of copper distribution lines to reflect the proportion of SIOs served by both copper distribution and copper main cable. The average proportion of copper SIOs served by LPGS is found in CAN.xls, In.Access, line 22.

304 The portion of CAN SIO served by copper distribution cable and copper main cable is derived as follows:

$$(\text{Total CAN SIO, except LSS}) * (\text{proportion of CAN SIO served by copper distribution}) * (1 - \text{proportion of copper SIO served by LPGS})$$

305 This is the correct quantum of SIOs that should have been used in the calculation of unit costs for copper main cable network elements.

306 The same methodology that is used above must be employed to adjust the unit cost for copper cable network elements calculated in the model so that it reflects the correct quantum of SIOs, before it is used in the derivation of unit cost for ULLS.

307 The formula, (Unit Cost = Cost Pool / SIO), contains an incorrect input for SIO. This can be corrected as follows:

$$(\text{Cost Pool} / \text{Incorrect SIO}) * (\text{Incorrect SIO} / \text{Correct SIO}) = (\text{Cost Pool} / \text{Correct SIO})$$

308 Since (Cost Pool / Incorrect SIO) = (Unit Cost result in model). The Unit Cost result in the model can be substituted into the above formula in place of (Cost Pool / Incorrect SIO). The formula becomes:

$$(\text{Unit Cost result in model}) * (\text{Incorrect SIO} / \text{Correct SIO}) = (\text{Cost Pool} / \text{Correct SIO}) = \text{Correct Unit Cost.}$$

309 Therefore, to correct the unit costs for copper main cable network elements so the can be used in the derivation of unit costs for ULLS, it is necessary to multiply those costs by (Incorrect SIO / Correct SIO).

310 The incorrect SIO is (Total CAN SIO, except LSS). The correct SIO is (Total CAN SIO, except LSS) * (proportion of CAN SIO served by copper distribution) * (1 - proportion of copper SIO served by LPGS) The incorrect SIO divided by the correct SIO simplifies to:

$$1 / (\text{proportion of CAN SIO served by copper distribution}) * (1 - \text{proportion of copper SIO served by LPGS})$$

- 311 The unit cost of copper main cable network elements calculated in the model must be multiplied by this amount, before they used in the derivation of the unit cost for ULLS.

Category 4 - Fibre Adjustment

- 312 The demand used in the unit cost calculation of fibre, wireless and satellite network elements varies from the demand of all CAN services, except LSS and ULLS, to the demand for PSTN alone. Similarly, the costs of assets associated with these network elements is assigned to various CAN services.
- 313 None of these network elements are included in the cost of ULLS. Therefore, it is not necessary to correct the unit cost calculations of these network elements in order to correct the cost of ULLS.

Other CAN Services

- 314 The model also errs in the calculation of the unit costs of CAN services other than ULLS, because these calculations also contain a mismatch between cost pools and in service demand for services.
- 315 The mismatch between cost pools and in service demand in the calculation of the unit costs for CAN services other than ULLS is caused by one of the following:
- (a) The removal of trenching, conduit and pits associated with fibre main cable from cost pools
 - (b) The removal of fibre main cable from cost pools
 - (c) The removal of satellite assets from cost pools

Conduit Removal Adjustment

- 316 The demand used in the unit cost calculation of trenching, conduit and pits network elements is the total demand of all CAN services, except LSS. However, a portion of the cost of the assets associated with these network elements has been removed from the network element cost pools and allocated to the Core network prior to the calculation of unit costs.
- 317 This error in the calculation of unit costs for CAN services other than ULLS is identical to the error in the unit cost calculation for ULLS. The allocation of the portion of the cost of Conduit (i.e. trenching, conduit and pits), which is associated with fibre main cable, to the Core network creates a mismatch between the cost pools for these network elements and the in service demand used in the calculation of unit costs. It is incorrect to divide only a portion of the Conduit cost pools, which are attributable to CAN services, by 100% of the CAN SIOs.
- 318 The adjustment required to fix this problem is the same as that used to correct ULLS. In order to correct the calculation of the unit costs of other CAN services in the model, it is necessary to multiply the unit costs of conduit network elements, which are calculated in the model, by $(1 / (1 - \text{proportion of Conduit attributable to fibre main cable}))$, before they are used as an input into the calculation of the unit costs of other CAN services.

Fibre Main Cable Removal Adjustment

- 319 Fibre main cable network elements have been assigned to all CAN services except ULLS (Cost.xls, RF.Acces, line 75). The cost of fibre main cable, however, has been, allocated to the Core network and removed from the unit cost of all CAN services (Cost.xls, TA.Access, Cells 79EK – 79EZ). This is identical to the treatment of the conduit associated to fibre main cable, which has been explained in detail elsewhere.
- 320 Consequently, the costs of fibre main cable have been excluded from cost pools used in the unit cost calculations for PSTN and WLR. (Additionally the cost of satellite equipment has been excluded from the WLR cost pool.) The unit costs of both PSTN and WLR, however, are calculated based upon the total in service demand of all CAN services, except LSS. Many of the lines included in this demand are provisioned with fibre main cable (and some are provisioned with satellite equipment). Consequently, there is a mismatch between the cost pools and demand figures used in the calculation of unit costs for PSTN and WLR in the ACCC's cost model. (The same mismatch occurs in the calculation of unit costs for ISDN – BRI access, ISDN – PRI access and lines in CAN, although, for the sake of simplicity, those services have not been included in the discussion.)
- 321 It is not possible to fix this error by adjusting the unit cost calculation of fibre main cable network elements in the model, because the unit cost of the fibre main cable network element used in the model is zero. Consequently, the only way to fix this error is to adjust the cost pools for CAN services so that they include the cost of main fibre cable.

Satellite Removal Adjustment

- 322 This error has been discussed above. The cost of Satellite network elements has not been included in the WLR cost pool; and yet the majority of assets in the WLR cost pool are spread over all CAN SIO, including those served by satellite.
- 323 This error should be fixed by including satellite network elements in the WLR cost pool.

ISDN and Lines in CAN

- 324 For the sake of simplicity, the errors in the calculation of the unit costs of ISDN and Lines in CAN have not been fixed.

Corrections to the Model

- 325 The following modifications have been made to the model in order to implement the corrections to the model's unit cost calculations, which have been explained above. All changes to the model have been highlighted with dark green colouring.
- 326 ULLS
- (a) Adjust unit costs of copper distribution network elements (except conduit)
 - (b) Adjusts unit costs of conduit
 - (c) Adjust unit costs of copper main cable
- 327 Other CAN Services

- (a) Adjust unit costs of conduit
- (b) Include fibre main cable in unit costs of other CAN services
- (c) Include costs of satellite network element in unit cost of WLR

ULLS

Copper Distribution Network Elements (except conduit)

- 328 The following network elements fit into the category of copper network elements used to directly serve CAN SIO (i.e. Copper Distribution):
- (a) Network termination Points (NTP), all sizes;
 - (b) Copper lead-ins, all sizes;
 - (c) Copper pillars;
 - (d) Road crossing duct and pits;
 - (e) Property boundary to Serving pit duct;
 - (f) Copper distribution cable, all sizes;
 - (g) Copper joints, all sizes;
 - (h) MDF connections; and
 - (i) Tie pair cable, all kinds.
- 329 The following correction to unit costs of these network elements was explained above.
- 330 In order to correct the calculation of ULLS unit costs in the model, it is necessary to multiply the unit costs of copper network elements used to directly serve CAN SIOs by $1 / (\text{proportion of SIOs directly served by copper})$, before they are input into the calculation of ULLS unit costs.
- 331 The “Average proportion of SIOs addressed directly by copper” is found on CAN.xls, In.Access, line 14. For convenience this ratio has been replicated on Cost.xls, Dem.In.Access, line 125.
- 332 The factors representing $1 / (\text{proportion of SIOs directly served by copper})$ have also been added to Cost.xls, Dem.In.Access. Since the proportion of SIOs addressed directly by copper varies by geotype, it was necessary to create a table to list the adjustment factors derived from the above formula. Even though these factors are only applicable to the copper distribution network elements listed above, the correction of the other errors associated with the calculation of the unit cost of ULLS has resulted in other factors, which are applicable to other network elements. For convenience, all of the factors needed to correct all of the errors associated with the unit cost calculation of ULLS have been listed in a common table called “Unit Cost Adjustments for ULLS.” This table has been placed on Lines 130 -211 of Cost.xls, Dem.In.Access.
- 333 The factors associated with the copper distribution network elements listed above have been placed on the lines corresponding to those network elements. For example, the factor associated with Copper pillars in geotype 4 is located in

cell 142F. The formula for 142F is 1 / \$F125, which is 1 / (proportion of SIO directly served by copper).

Figure 48

Asset	Geotype 1	Geotype 2	Geotype 3	Geotype 4	Geotype 5	Geotype 6	Geotype 7	Geotype 8
NTP: 2-pair wall socket	156%	84.1%	115%	108%	116%	107%	103%	101%
NTP: 10-pair building termination	156%	84.1%	115%	108%	116%	107%	103%	101%
NTP: 30-pair building termination	156%	84.1%	115%	108%	116%	107%	103%	101%
NTP: 50-pair building termination	156%	84.1%	115%	108%	116%	107%	103%	101%
NTP: 100-pair building termination	156%	84.1%	115%	108%	116%	107%	103%	101%
Fibre termination point (E1)	100%	100%	100%	100%	100%	100%	100%	100%
CPE (radio link) Outdoor unit	100%	100%	100%	100%	100%	100%	100%	100%
CPE (satellite link)	100%	100%	100%	100%	100%	100%	100%	100%
LPGS equipment	100%	100%	100%	100%	100%	100%	100%	100%
LPGS MDF	100%	100%	100%	100%	100%	100%	100%	100%
Copper pillars	156%	84.1%	115%	108%	116%	107%	103%	101%
Fibre splicing chamber	100%	100%	100%	100%	100%	100%	100%	100%
Duct: 28	100%	100%	103%	107%	109%	116%	116%	109%
Duct: 24	100%	100%	103%	107%	109%	116%	116%	109%
Duct: 20	100%	100%	103%	107%	109%	116%	116%	109%
Duct: 16	100%	100%	103%	107%	109%	116%	116%	109%
Duct: 12	100%	100%	103%	107%	109%	116%	116%	109%
Duct: 8	100%	100%	103%	107%	109%	116%	116%	109%
Duct: 6	100%	100%	103%	107%	109%	116%	116%	109%
Duct: 4	100%	100%	103%	107%	109%	116%	116%	109%
Duct: 2	100%	100%	103%	107%	109%	116%	116%	109%
Duct: 1	100%	100%	103%	107%	109%	116%	116%	109%
Duct: 1 road-crossing	100%	100%	100%	100%	100%	100%	100%	100%
Duct: 1 (PB >> DP/ Serving pit)	100%	100%	100%	100%	100%	100%	100%	100%
Pits: PF28	100%	100%	103%	107%	109%	116%	116%	109%
Pits: PF20	100%	100%	103%	107%	109%	116%	116%	109%

334 To complete the correction of the calculation of the unit cost of ULLS, the factors located in the “Unit Cost Adjustments for ULLS” table must be applied to the unit costs of the copper distribution network elements, before those unit costs are input into the derivation of the unit cost of ULLS. This is done in Cost.xls, TA.Access, line 122, where the unit costs of ULLS is derived.

335 The formula for the derivation of the unit cost of ULLS has been modified to incorporate this correction. The original formula for the unit cost of ULLS in geotype 3 was:

$$=SUMPRODUCT(GL\$10:GL\$89*RF.S12.Access)$$

336 As explained previously, this is the sum of the unit costs of network elements, which have been assigned to ULLS in Cost.xls, RF.Access. The corrected formula for the unit cost of ULLS in geotype 3 is:

$$=SUMPRODUCT(GL\$10:GL\$89*RF.S12.Access, Dem.In.Access!E132:E211)$$

337 The new formula multiplies the unit cost of each network element, which has been assigned to ULLS (GL\$10:GL\$89*RF.S12.Access) by the corresponding factor for geotype 3 in the new table, which is located at Cost.xls, Dem.In.Access, lines 132 -211. This modification completes the correction of the error, which is

related to copper distribution network elements, in the calculation of the unit cost of ULLS.

Figure 49

Service calculation		Unit	Geotype 2	Geotype 3	Geotype 4
111	PSTN End User Access	Lines	31.28	239.03	303.6
112	PSTN local traffic (onnet traffic)	Minutes	-	-	-
113	PSTN national long distance traffic (onnet calls)	Minutes	-	-	-
114	PSTN outgoing traffic to international destinations	Minutes	-	-	-
115	PSTN outgoing to mobile traffic (mobile terminating)	Minutes	-	-	-
116	PSTN OTA traffic (from international, from mobile, to/ fro)	Minutes	-	-	-
117	Local carriage service (LCS)	Minutes	-	-	-
118	ISDN-BRI access	Lines	31	239	30
119	ISDN-PRI access	Lines	31	239	30
120	Service 10	none	-	-	-
121	ISDN - voice traffic	Minutes	-	-	-
122	Unconditioned local loop service (ULLS)	Lines	100.18	253.43	320.4
123	Line sharing service (LSS)	Lines	-	-	-
124	Wholesale line rental (WLR)	Lines	31	239	30
125	Service 15	none	-	-	-
126	Dial-up Internet Traffic	Minutes	-	-	-

Conduit Network Elements

- 338 The following correction to unit costs of conduit network elements was explained above.
- 339 In order to correct the calculation of ULLS unit costs in the model, it is necessary to multiply the unit costs of conduit network elements, which are calculated in the model, by $(1 / (1 - \text{proportion of conduit attributable to fibre main cable}))$, before they are used as an input into the calculation of ULLS unit costs.
- 340 The percentage of CAN conduit attributable to fibre main cable, which is allocated to the Core network, is found in Cost.xls, Inputs.Access, line 133. This ratio varies by geotype. Consequently, the factor must be developed for each geotype. The factor for each geotype is equal to $1 / 1 - (\text{The value found in the column corresponding to that geotype on line 133 of Cost.xls, Inputs.Access})$. For example the factor for geotype 4 is equal to $1 / 1 - (\text{Cost.xls, Inputs.Access, Cell 133G})$, which is $1 / (1 - 0.065) = 1.07$.
- 341 For convenience these factors are included in the table called "Unit Cost Adjustments for ULLS" found on Lines 130 -211 of Cost.xls, Dem.In.Access. The factors associated with the conduit network elements described above have been placed on the lines corresponding to those network elements. For example the factor for 16 way conduit (Duct: 16) can be found in cell 147F.

Figure 50

Asset	Geotype 1	Geotype 2	Geotype 3	Geotype 4	Geotype 5	Geotype 6	Geotype 7	Geotype 8
NTP: 2-pair wall socket	156%	84.1%	115%	108%	116%	107%	103%	101%
NTP: 10-pair building termination	156%	84.1%	115%	108%	116%	107%	103%	101%
NTP: 30-pair building termination	156%	84.1%	115%	108%	116%	107%	103%	101%
NTP: 50-pair building termination	156%	84.1%	115%	108%	116%	107%	103%	101%
NTP: 100-pair building termination	156%	84.1%	115%	108%	116%	107%	103%	101%
Fibre termination point (E1)	100%	100%	100%	100%	100%	100%	100%	100%
CPE (radio link) Outdoor unit	100%	100%	100%	100%	100%	100%	100%	100%
CPE (satellite link)	100%	100%	100%	100%	100%	100%	100%	100%
LPGS equipment	100%	100%	100%	100%	100%	100%	100%	100%
LPGS MDF	100%	100%	100%	100%	100%	100%	100%	100%
Copper pillars	156%	84.1%	115%	108%	116%	107%	103%	101%
Fibre splicing chamber	100%	100%	100%	100%	100%	100%	100%	100%
Duct: 28	100%	100%	103%	107%	109%	116%	116%	109%
Duct: 24	100%	100%	103%	107%	109%	116%	116%	109%
Duct: 20	100%	100%	103%	107%	109%	116%	116%	109%
Duct: 16	100%	100%	103%	107%	109%	116%	116%	109%
Duct: 12	100%	100%	103%	107%	109%	116%	116%	109%
Duct: 8	100%	100%	103%	107%	109%	116%	116%	109%
Duct: 6	100%	100%	103%	107%	109%	116%	116%	109%
Duct: 4	100%	100%	103%	107%	109%	116%	116%	109%
Duct: 2	100%	100%	103%	107%	109%	116%	116%	109%
Duct: 1	100%	100%	103%	107%	109%	116%	116%	109%
Duct: 1 road-crossing	100%	100%	100%	100%	100%	100%	100%	100%
Duct: 1 (PB >> DP/ Serving pit)	100%	100%	100%	100%	100%	100%	100%	100%
Pits: PF28	100%	100%	103%	107%	109%	116%	116%	109%
Pits: PF20	100%	100%	103%	107%	109%	116%	116%	109%

342 To complete the correction of the calculation of the unit cost of ULLS, the factors located in the “Unit Cost Adjustments for ULLS” table must be applied to the unit costs of the conduit network elements, before those unit costs are input into the derivation of the unit cost of ULLS. This is done in Cost.xls, TA.Access, line 122, where the unit costs of ULLS is derived. The application is identical to that explained above for copper distribution network elements.

Copper Main Cable Network Elements

343 As was explained above, the unit cost of copper main cable network elements calculated in the model must be multiplied by the following factor, before they used in the derivation of the unit cost for ULLS:

$$1 / (\text{proportion of CAN SIO served by copper distribution}) * (1 - \text{proportion of copper SIO served by LPGS})$$

344 The “Average proportion of SIOs addressed directly by copper” (i.e. proportion of CAN SIO served by copper distribution) is found on CAN.xls, In.Access, line 14. For convenience this ratio has been replicated on Cost.xls, Dem.In.Access, line 125.

345 The average proportion of copper SIOs served by LPGS is found in CAN.xls, In.Access, line 22. For convenience this ratio has been replicated on Cost.xls, Dem.In.Access, line 127.

- 346 For convenience these factors are included in the table called “Unit Cost Adjustments for ULLS” found on Lines 130 -211 of Cost.xls, Dem.In.Access. The factors associated with the copper main cable network elements described above have been placed on the lines corresponding to those network elements. For example the factor for 400 pair copper main cable can be found in cell 187F. The formula for that factor is the following:

$$1 / (125F * (1 - 127F))$$

Figure 51

	A	B	C	D	E	F	G	H	I	J
1		Analysys	ACCESS DEMAND BY SERVICE							
171		Copper lead-in: 1200	156%	84.1%	115%	108%	116%	107%	103%	101%
172		Copper dist: 2	156%	84.1%	115%	108%	116%	107%	103%	101%
173		Copper dist: 10	156%	84.1%	115%	108%	116%	107%	103%	101%
174		Copper dist: 30	156%	84.1%	115%	108%	116%	107%	103%	101%
175		Copper dist: 50	156%	84.1%	115%	108%	116%	107%	103%	101%
176		Copper dist: 100	156%	84.1%	115%	108%	116%	107%	103%	101%
177		Copper dist: 200	156%	84.1%	115%	108%	116%	107%	103%	101%
178		Copper dist: 400	156%	84.1%	115%	108%	116%	107%	103%	101%
179		Copper dist: 800	156%	84.1%	115%	108%	116%	107%	103%	101%
180		Copper dist: 1200	156%	84.1%	115%	108%	116%	107%	103%	101%
181		Copper main: 2	156%	84.1%	122%	128%	134%	131%	111%	128%
182		Copper main: 10	156%	84.1%	122%	128%	134%	131%	111%	128%
183		Copper main: 30	156%	84.1%	122%	128%	134%	131%	111%	128%
184		Copper main: 50	156%	84.1%	122%	128%	134%	131%	111%	128%
185		Copper main: 100	156%	84.1%	122%	128%	134%	131%	111%	128%
186		Copper main: 200	156%	84.1%	122%	128%	134%	131%	111%	128%
187		Copper main: 400	156%	84.1%	122%	128%	134%	131%	111%	128%
188		Copper main: 800	156%	84.1%	122%	128%	134%	131%	111%	128%
189		Copper main: 1200	156%	84.1%	122%	128%	134%	131%	111%	128%
190		Joints: 2	156%	84.1%	115%	108%	116%	107%	103%	101%
191		Joints: 10	156%	84.1%	115%	108%	116%	107%	103%	101%
192		Joints: 30	156%	84.1%	115%	108%	116%	107%	103%	101%
193		Joints: 50	156%	84.1%	115%	108%	116%	107%	103%	101%
194		Joints: 100	156%	84.1%	115%	108%	116%	107%	103%	101%
195		Joints: DP >> pillar (distance)	156%	84.1%	115%	108%	116%	107%	103%	101%
196		Joints: Pillar >> RAU	156%	84.1%	115%	108%	116%	107%	103%	101%
197		Joints: Branching kits	156%	84.1%	115%	108%	116%	107%	103%	101%
198		Fibre: NTP >> next node	100%	100%	100%	100%	100%	100%	100%	100%
199		Fibre: Link on fibre rings (pillar to pillar)	100%	100%	100%	100%	100%	100%	100%	100%
200		Fibre: Pillar >> LE (non-ring deployment)	100%	100%	100%	100%	100%	100%	100%	100%

- 347 To complete the correction of the calculation of the unit cost of ULLS, the factors located in the “Unit Cost Adjustments for ULLS” table must be applied to the unit costs of the copper main cable network elements, before those unit costs are input into the derivation of the unit cost of ULLS. This is done in Cost.xls, TA.Access, line 122, where the unit costs of ULLS is derived. The application is identical to that explained above for copper distribution network elements.

Other CAN Services

- 348 The factors used to correct the unit costs of network elements before they are input into the derivation of the unit costs of other CAN services are also placed in a table in Cost.xls, Dem.In.Access. However, they are placed in a different table than the factors used to correct the unit cost calculation of ULLS. They are placed in a table called “Unit Cost Adjustment for PSTN, WLR, etc.” This table can be found on Lines 214 -295 of Cost.xls, Dem.In.Access.

Conduit Network Elements

- 349 As was explained above, the error associated with conduit network elements in the calculation of unit costs for CAN services other than ULLS is identical to the error in the unit cost calculation for ULLS. The adjustment required to fix this problem is the same as that used to correct ULLS. In order to correct the calculation of the unit costs of other CAN services in the model, it is necessary to multiply the unit costs of conduit network elements, which are calculated in the model, by $(1 / (1 - \text{proportion of Conduit attributable to fibre main cable}))$, before they are used as an input into the calculation of the unit costs of other CAN services.
- 350 The factors are identical to the factors used in the ULLS calculation. They are located on the lines associated with conduit in the “Unit Cost Adjustment for PSTN, WLR, etc.” table.

Figure 52

The screenshot shows an Excel spreadsheet with the following data table:

Asset	Geotype 1	Geotype 2	Geotype 3	Geotype 4	Geotype 5	Geotype 6	Geotype 7	Geotype 8
NTP: 2-pair wall socket	100%	100%	100%	100%	100%	100%	100%	100%
NTP: 10-pair building termination	100%	100%	100%	100%	100%	100%	100%	100%
NTP: 30-pair building termination	100%	100%	100%	100%	100%	100%	100%	100%
NTP: 50-pair building termination	100%	100%	100%	100%	100%	100%	100%	100%
NTP: 100-pair building termination	100%	100%	100%	100%	100%	100%	100%	100%
Fibre termination point (E1)	100%	100%	100%	100%	100%	100%	100%	100%
CPE (radio link) Outdoor unit	100%	100%	100%	100%	100%	100%	100%	100%
CPE (satellite link)	100%	100%	100%	100%	100%	100%	100%	100%
LPGS equipment	100%	100%	100%	100%	100%	100%	100%	100%
LPGS MDF	100%	100%	100%	100%	100%	100%	100%	100%
Copper pillars	100%	100%	100%	100%	100%	100%	100%	100%
Fibre splicing chamber	100%	100%	100%	100%	100%	100%	100%	100%
Duct: 28	100%	100%	103%	107%	109%	116%	116%	109%
Duct: 24	100%	100%	103%	107%	109%	116%	116%	109%
Duct: 20	100%	100%	103%	107%	109%	116%	116%	109%
Duct: 16	100%	100%	103%	107%	109%	116%	116%	109%
Duct: 12	100%	100%	103%	107%	109%	116%	116%	109%
Duct: 8	100%	100%	103%	107%	109%	116%	116%	109%
Duct: 6	100%	100%	103%	107%	109%	116%	116%	109%
Duct: 4	100%	100%	103%	107%	109%	116%	116%	109%
Duct: 2	100%	100%	103%	107%	109%	116%	116%	109%
Duct: 1	100%	100%	103%	107%	109%	116%	116%	109%
Duct: 1 road-crossing	100%	100%	100%	100%	100%	100%	100%	100%
Duct: 1 (PB >> DP/ Serving pit)	100%	100%	100%	100%	100%	100%	100%	100%
Pits: PF28	100%	100%	103%	107%	109%	116%	116%	109%
Pits: PF20	100%	100%	103%	107%	109%	116%	116%	109%

- 351 To complete the correction of the calculation of the unit cost of other CAN services, the factors located in the “Unit Cost Adjustment for PSTN, WLR, etc.” table must be applied to the unit costs of the conduit network elements, before those unit costs are input into the derivation of the unit cost of other CAN services. This is done in Cost.xls, TA.Access, on the lines, where the unit costs of other CAN services are derived (Lines 111, 118, 119, 124 and 132). The application of the factors in the formula is identical to that explained above for ULLS.
- 352 For example the factors necessary to correct the unit costs of conduit network elements, before they are used in the derivation of the unit costs of PSTN are applied in the formula for the cells on line 111 of Cost.xls, TA.Access.

Figure 53

The screenshot shows an Excel spreadsheet with the following structure:

- Header:** "ACCESS - TILTED ANNUIT"
- Text:** "This worksheet performs the annualisation calculation on the access network costs. The calculation is presented differently to the core network annualisation as the access ne..."
- Parameters:**
 - Year modelled: 2009
 - WACC: 10.77%
- Asset calculation:**

Access asset group	Assets	Unit	Annual price change (%)	Tilt adjustment (%)	Useful economic lifetime (Years)
- Service calculation:**

Services (AUD per unit)	Unit	Geotype 1	Geotype 2	Geotype 3
PSTN End User Access	Lines	120.55	31.28	239.03
PSTN local traffic (onnet traffic)	Minutes	-	-	-
PSTN national long distance traffic (onnet calls)	Minutes	-	-	-
PSTN outgoing traffic to international destinations	Minutes	-	-	-
PSTN outgoing to mobile traffic (mobile terminating)	Minutes	-	-	-
PSTN OTA traffic (from international from mobile to/from Minutes)	Minutes	-	-	-

Fibre Network Elements

- 353 The following correction to unit costs of fibre network elements was explained above.
- 354 It is not possible to fix this error by adjusting the unit cost calculation of fibre main cable network elements in the model, because the unit cost of the fibre main cable network element used in the model is zero. Consequently, the only way to fix this error is to adjust the cost pools for CAN services so that they include the cost of main fibre cable.
- 355 The error has been fixed as follows. In the TA.Access tab of Cost.xls the formula for line 79 (Fibre: LPGS >> LE (non-ring deployment)) columns FS through GH have been changed. Using Geotype 4 as an example, the original formula was:

$$=BG79+BX79+DW79+EN79+FE79$$

- 356 The new formula is:

$$=BG79+BX79+DW79+FE79$$

- 357 Cell EN79 has been removed from the calculation.

358 The effect of this change is to include the cost of fibre main cable in the unit cost calculations of PSTN end user access, ISDN, WLR and Lines in CAN.

Satellite Network Elements

359 As was explained above, the cost of Satellite network elements has not been included in the WLR cost pool; and yet the majority of assets in the WLR cost pool are spread over all CAN SIOs, including those served by satellite.

360 This error should be fixed by including satellite network elements in the WLR cost pool.

361 The assignment of network elements to Services is done in Cost.xls, RF.Access. The cell which regulates the assignment of satellite network element to WLR is 13Q. That cell was originally blank, which indicated that the satellite network element was not assigned to the WLR cost pool. Cell 13Q has been changed to 1 in the corrected model; thereby assigning the satellite network element to the WLR cost pool.

362 The effect on access prices of fixing this error is set out below:

	ULLS (Access cost per line per month)		Wholesale line rental (WLR) Access cost per line per month				PSTN OTA
	Zone A	Zone B	Band 1	Band 2	Band 3/4 (clustered)	Band 3/4 (spread)	All areas
Analysys Model	\$21.62	\$59.39	8.46	20.26	33.83	56.79	0.69
Fix	\$24.41	\$70.78	8.46	21.05	35.84	62.56	0.69
Difference 2.78		11.39	0.00	0.79	2.02	5.76	0.00

Error 12: The Analysys Model wrongly allocates between 33 to 55% of costs to the deployment of fibre from which there is no known revenue source⁹⁷

What is the error?

363 The Analysys Model allocates Core Network costs between fibres used for “identified services” and those used for “other services”. In the original version of the Analysys Model, the “other services” category was described as “dark fibres”, but in the final version the title was changed with no explanation of the services which fall within this category and which would use the dark fibres.

364 Telstra has reviewed the list of identified services defined in section 3.1 of the Analysys documentation and confirms that that list includes all services of which Telstra is currently aware. Telstra has also reviewed the list of “other services” and cannot identify any “other services” from which it would derive revenue and therefore for which it would build network (see Statement of [TC1 c-i-c commences] [CIC [redacted] [TC1 c-i-c ends], Submission Supporting Documents, Document 1.12). As a result, what the Analysys Model does is allocate 33% or 50% of the trench costs (depending on the layer of the network modelled) to fibres which are not used for any known service and for which there is no known revenue.

⁹⁷ Error 8 in the 31 July Letter.

- 365 The allocation of costs to unknown services is contrary to both economic and network deployment principles. It is unreasonable to allocate the costs of dark fibres to unknown future services. The network deployment standards used by Telstra are explained in the Statement of [TC1 c-i-c ends]CIC [TC1 c-i-c ends] (Submission Supporting Documents, Document 1.12). In his expert report, Nigel Attenborough (Submission Support Documents, Document 1.2), states that sound cost modelling principles and the practice in other jurisdictions is not to allocate costs to unknown services.
- 366 The amount of investment allocated to non-existent services can be identified in column N of the CostAlloc.Core tab of the Cost.xls module as illustrated in Figure 54 below.

Figure 54

Asset group	Asset	Fibre type index	Core cost type	Calculation Fibre		Cost allocation Fibre	
				SDH	Dark fibre	SDH	Dark fibre
				# or metres	# or metres	metres	metres
41	AT1	AT2-AT1: Fibre	Incremental	1,978,883,021	989,441,510	67%	33%
42	AT1	AT2-AT1: Trench	Incremental	1,978,883,021	989,441,510	67%	33%
43	AT1	AT2-AT1: Duct	Incremental	1,978,883,021	989,441,510	67%	33%
47	LEI/AT1	LE-PoC: Fibre	Incremental	1,978,883,021	989,441,510	67%	33%
48	LEI/AT1	LE-PoC: Trench	Incremental	1,978,883,021	989,441,510	67%	33%
49	LEI/AT1	LE-PoC: Duct	Incremental	1,978,883,021	989,441,510	67%	33%
73	PoC Common	PoC-LAS: Fibre	Incremental	282,682,187	141,341,093	67%	33%
74	PoC Common	PoC-LAS: Trench	Incremental	282,682,187	141,341,093	67%	33%
75	PoC Common	PoC-LAS: Duct	Incremental	282,682,187	141,341,093	67%	33%
79	LAS	Asset 72	Incremental	183,039,426	91,519,713	67%	33%
80	LAS	LAS: UPS (50kVA) and Generator (50kVA)	Incremental	183,039,426	91,519,713	67%	33%
81	LAS	LAS: Air conditioning unit (50kVA)	Incremental	183,039,426	91,519,713	67%	33%
110	LAS/Regional N	LAS-TNS ring: Fibre	Incremental	183,039,426	91,519,713	67%	33%
111	LAS/Regional N	LAS-TNS ring: Trench	Incremental	183,039,426	91,519,713	67%	33%
112	LAS/Regional N	LAS-TNS ring: Duct	Incremental	183,039,426	91,519,713	67%	33%
159	Core node comr	TNS-TNS ring: Fibre	Incremental	116,310,046	116,310,046	50%	50%
160	Core node comr	TNS-TNS ring: Trench	Incremental	116,310,046	116,310,046	50%	50%
161	Core node comr	TNS-TNS ring: Duct	Incremental	116,310,046	116,310,046	50%	50%

- 367 Although column N was labelled “Cost Allocation Dark Fibre” in earlier versions of the model, it is labelled “Cost Allocation Other fibre services” in Version 0.92 of the model. Despite the label change, “other fibre services” are defined in the model’s user guide as fibre services “available for the use of third-parties.” Since no services which provide the use of fibre to third parties exist, the model does

not provide recovery of costs allocated to “other fibre services.” The model documentation states as follows:⁹⁸

“The cost of the fibre is either allocated to SDH (i.e. to be used by the incumbents products) or to other fibre services (i.e. available for the use of third-parties).”

368 As can be seen at Figure 55 below (Cost.xls, TA.Core), the model identifies the total annual cost allocated to “other fibre services” (AJ223) and the proportion of total costs (AJ214). The model does not provide for recovery of \$500m or 22% of the total costs and expenses of the Core network because it allocates those costs to unknown “other fibre services” (sometimes referred to as dark fibre) rather than assigning them to actual services in operation.

Figure 55

Asset calculation		Incremental cost allocation to platforms					
Assets		Cost → platforms (AUD)					
		PSDN	ISDN	xDSL	Other platforms	Transmission	Other fibre services
212	Incremental cost	609,524,261	112,386,166	705,685,567	42,103,395	267,947,485	500,740,218
214		27%	5%	31%	2%	13%	22%
215	Calculations for shared cost EPMU mark-up						
216	Costs marked-up based on core network elements only						
217	Shared cost to be marked-up for core network elements only (AUD)						
218	Total cost of core network elements (AUD)	10,740,096	-	1,986,989	-	-	-
219	Proportion mark-up by platform (%)	84%	-%	16%	-%	-%	-%
220	Amount marked-up for all network elements (AUD)	12,298,300	-	2,275,267	-	-	-
221	Costs marked-up based on all network elements						
222	Shared cost to be marked-up equally for all network elements						
223	Total cost of core network elements	609,524,261	112,386,166	705,685,567	42,103,395	267,947,485	500,740,218
224	Proportion mark-up by platform	27%	5%	31%	2%	13%	22%
225	Amount marked-up for all network elements	9,146,811	1,686,520	10,589,853	631,824	4,321,077	7,514,346
226	Shared cost EPMU mark-up	21,445,110	1,686,520	12,865,120	631,824	4,321,077	7,514,346
227	Incremental + shared costs	630,969,371	114,072,686	718,550,687	42,735,219	292,268,562	508,254,563
228	Business overheads cost EPMU mark-up	747,132,799	135,073,823	850,838,107	50,602,906	346,076,115	601,825,812
229							
230	Service cost calculation						
231							
232	Incremental cost						

369 The \$500 million of annual costs the Analysys Model allocates to “other fibre services” are not assigned to any of the revenue producing services in the Analysys Model.

How can the model be fixed?

370 To assure full recovery of legitimate costs, the Analysys Model needs to be corrected so that all efficiently incurred costs are assigned to services in

98 Fixed LRIC model user guide – Version 2.0, Page 148.

operation. The error can be corrected by ensuring there is no allocation of costs to dark fibre or “other services”. Cells H133 to H136 in the Core.xls, In.Network worksheet should be set to zero. This has the effect of increasing the PSTN OTA from 0.69 to 0.80 (rounding to the nearest cent).

Error 13: The decline rate for dial up internet traffic used in the Analysys Model is inaccurate and does not reflect actual historical trends

371 The Analysys Model calculates a forecast decline rate for dial-up internet traffic that is inconsistent with actual historical decline rates. The rate adopted by the ACCC is not therefore based on any actual evidence of historical decline rates. Telstra demonstrates that the rates used by the ACCC are inaccurate in two ways, as follows:

the ACCC has estimated the total number of dial up internet minutes for the periods from 2007/08 to 2011/12. Those estimates are inconsistent with Telstra’s actual number of total dial up internet minutes for the 2007/08 and 2008/09 years. The forecasts used by the ACCC are not therefore based on actual market trends, which provide the most accurate basis for any forecasts.

The ACCC has no regard to the actual historical decline in the number of SIOs but rather relies on its own estimates of total dial-up internet traffic. Forecasts should be based on actual historical trends which provide the most accurate way to ensure reliable forecasts.

372 The effect of the ACCC’s assumptions is to decrease the costs of PSTN OTA and LCS by between 3 to 10% for the 2007/08 to 2011/2012 years.

The number of dial-up SIOs is declining rapidly

373 The Australian Bureau of Statistics (ABS) has published information on the number of dial-up subscribers in “The Internet Activity Survey– June 2009”, as follows:⁹⁹

Internet Activity Summary, for ISPs with more than 1,000 active subscribers				
Dial-up Subscribers	units	Jun-2008	Dec-08	Jun-09
Business and government	'000	291	230	215
Household	'000	1275	1 060	887
All dial-up subscribers	'000	1566	1 290	1103

374 The above data shows that the total number of dial-up subscribers decreased by 14% within the six month period between December 2008 and June 2009. Between June 2008 and June 2009, the total number of dial-up subscribers dropped by 30%.

⁹⁹ See <http://www.abs.gov.au/ausstats/abs@.nsf/mf/8153.0/>

- 375 Below are Telstra’s actual dial-up Internet Services in Operation (SIOs) between June 2007 and June 2009, as published in Telstra’s annual and half year results. These results comprise all residential, business and government dial up internet services, as follows:

Telstra – Dial-up Internet SIOs					
	Jun-07	Dec-07	Jun-08	Dec-08	Jun-09
SIOs	653,939	595,281	530,092	434,570	362,507
% change		-9.0%	-11.0%	-18.0%	-16.6%
Total % change					-44.6%

- 376 The above actual Telstra figures indicate that between June 2007 and June 2009, the total number of dial up SIOs declined by almost 45%. Both the ABS data and Telstra’s actual figures demonstrate that the number of dial-up subscribers are continuing to decline at significant rates.
- 377 Taking the ABS data as the total number of SIOs, the Telstra data indicates that Telstra had approximately 34% of the total number of SIOs as at June 2008 and 33% of the total number of SIOs as at June 2009.¹⁰⁰ Telstra’s share has therefore remained approximately the same over this 12 month period. This indicates that both the Telstra and ABS data are consistent and show that actual decline rates are significant.

Dial-up internet traffic is declining faster than ACCC’s forecast

- 378 The forecast dial-up internet traffic in the Analysys Model is contained in the “Demand input for modelled services” section in the ‘Inputs.Demand’ worksheet within the ‘Cost’ module (both v1.3 and v2.0) of the Analysys Model. The formula used in the Analysys Model is as follows:

Total dial-up internet traffic =

Total number of dial-up internet calls x Estimated minute of usage per dial-up call

where

Total number of dial-up internet calls =

Total PSTN access lines (Retail + Wholesale excl ULLS) x

Estimated number of successful dial-up calls per retail & wholesale line (excluding ULL)

¹⁰⁰ Telstra notes that while the ABS data for June 2008 only includes ISPs with greater than 10,000 subscribers, the ABS data after that date includes all ISPs with more than 1000 subscribers. The ABS data is therefore likely to capture the vast majority of internet dial up users.

379 The ACCC has assumed that the number of successful dial-up calls per retail & wholesale line (excluding ULL) will drop from 4 per month in 2007-08 to 2 per month by 2011-12, however there is no explanation provided as to how the rate of decline was derived. The Analysys Model then includes the following:¹⁰¹

Analysys Cost Model - Dial-up Internet Traffic						
	2007	2008	2009	2010	2011	2012
Minutes	31,499,375,257	27,600,320,371	23,616,249,171	20,167,531,980	17,020,071,294	13,983,314,700
Calls	505,277,622	442,733,360	378,825,362	323,504,911	273,016,880	224,304,639
% change						
Minutes		-12.4%	-14.4%	-14.6%	-15.6%	-17.8%
Calls		-12.4%	-14.4%	-14.6%	-15.6%	-17.8%

380 The ACCC has assumed that the duration of dial-up calls is 62.3 minutes per call and this assumption remains the same for all years (2006-07 to 2011-12) in the Analysys Model.¹⁰² For 2006-07 and 2007-08, this duration assumption is broadly in line with Telstra's measurements of around 64 minutes a call. Therefore the total dial-up call minutes for these two years in the Analysys Model is relatively close to Telstra's own view.

381 While the ABS and the Telstra data show a significant drop in the number of dial up SIOs of around 30% between June 2008 and June 2009 (see paragraphs 386-387 above), the ACCC's forecast of minutes decline at a rate of between 12.4 to 17.8% or at approximately half the rate of the ABS or Telstra SIO decline rate. Based on the assumption that the duration of dial-up calls has been consistent, the rates adopted by the ACCC are not therefore reasonable as they are not based on actual historical rates. The ACCC has not had any regard to the actual number of SIOs. Rather the ACCC has sought to estimate total dial up internet minutes without explaining the basis for that estimate or providing any reasons as to why those estimates are inconsistent with actual historical trends.

382 Below is the comparison between the ACCC's and Telstra's historical and forecast dial-up internet traffic from 2007-08 to 2011-12.

¹⁰¹ Rows 32 and 66 in 'Inputs.Demand' worksheet within the 'Cost' module.

¹⁰² See row 172 in 'Inputs.Demand' worksheet within the 'Cost' module.

	Telstra					Analysys Cost Model
	Actual / Forecast Local Calls (000s) (a)	Assumed % dial up (b)	Assumed dial-up holding time (min) (c)	Total dial-up calls (d) = (a) x (b)	Total dial-up minutes (d) x (c) (000s)	Total dial-up minutes (000s)
2007-08 (actual)	5,680,147	6.0%	65	340,809	22,152,572	27,600,320
2008-09 (actual)	4,844,000	3.7%	64	179,228	11,470,592	23,616,249
2009-10	4,162,295	3.1%	64	126,950	8,124,799	20,167,532
2010-11	3,621,774	2.5%	64	91,269	5,841,197	17,020,071
2011-12	3,150,061	2.0%	64	64,576	4,132,880	13,983,315

383 In the above forecast for 2009 onwards Telstra has assumed that average dial-up duration will stay at around 64 minutes across the forecast period. This assumption is consistent with the ACCC's assumption that the length of dial up internet calls will remain constant. Telstra believes this assumption of 64 minutes per call is at the upper end of the likely range because dial-up internet users use dial up for short tasks such as email. In Telstra's experience, there has been an increased migration to broadband especially for data intense activities such as downloading, which take more time. Telstra's figures are therefore a generous estimate of future total dial up internet minutes.

384 The ACCC assumes total dial-up minutes will decline to approximately 14 billion by 2011/12. Telstra however, forecasts total dial up minutes of around 4 billion by 2011/12 based on the declining trends for dial-up subscribers and hence total minutes of dial-up internet calls. Telstra expects that the dial-up calls will drop from 6% of total local calls in 2007-08 to around 2.0% by 2011-12. This trend is evidenced by historical data, with the percentage of dial-up calls declining from 6% in 07/08 to 3.7% in 08/09.¹⁰³ Telstra's forecast trend is therefore based on historical trends.

385 Further, the ACCC's forecast total dial-up minutes in 2011-12 of approximately 14 billion is significantly more than Telstra's actual 2008/09 figures of approximately \$11.5 billion. It is unreasonable to assume that the total number of dial up internet minutes for 2011-12 will be greater than Telstra's actual figures for 2008-09, which is three years earlier.

386 Based on the above information, it is clear that the ACCC's forecast total number of dial-up minutes should be much lower to reflect a more realistic current market trend and historical actuals.

¹⁰³ See Telstra's 2008 Annual Report.

What is the effect of fixing the error?

387 The effect on access prices of fixing this error is set out below:

	ULLS (Access cost per line per month)		Wholesale line rental (WLR) Access cost per line per month				PSTN OTA
	Zone A	Zone B	Band 1	Band 2	Band 3/4 (clustered)	Band 3/4 (spread)	All areas
Analysys Model	\$21.62	\$59.39	8.46	20.26	33.83	56.79	0.69
Fix	\$21.62	\$59.39	8.46	20.26	33.83	56.79	0.75
Difference	0.00	0.00	0.00	0.00	0.00	0.00	0.06

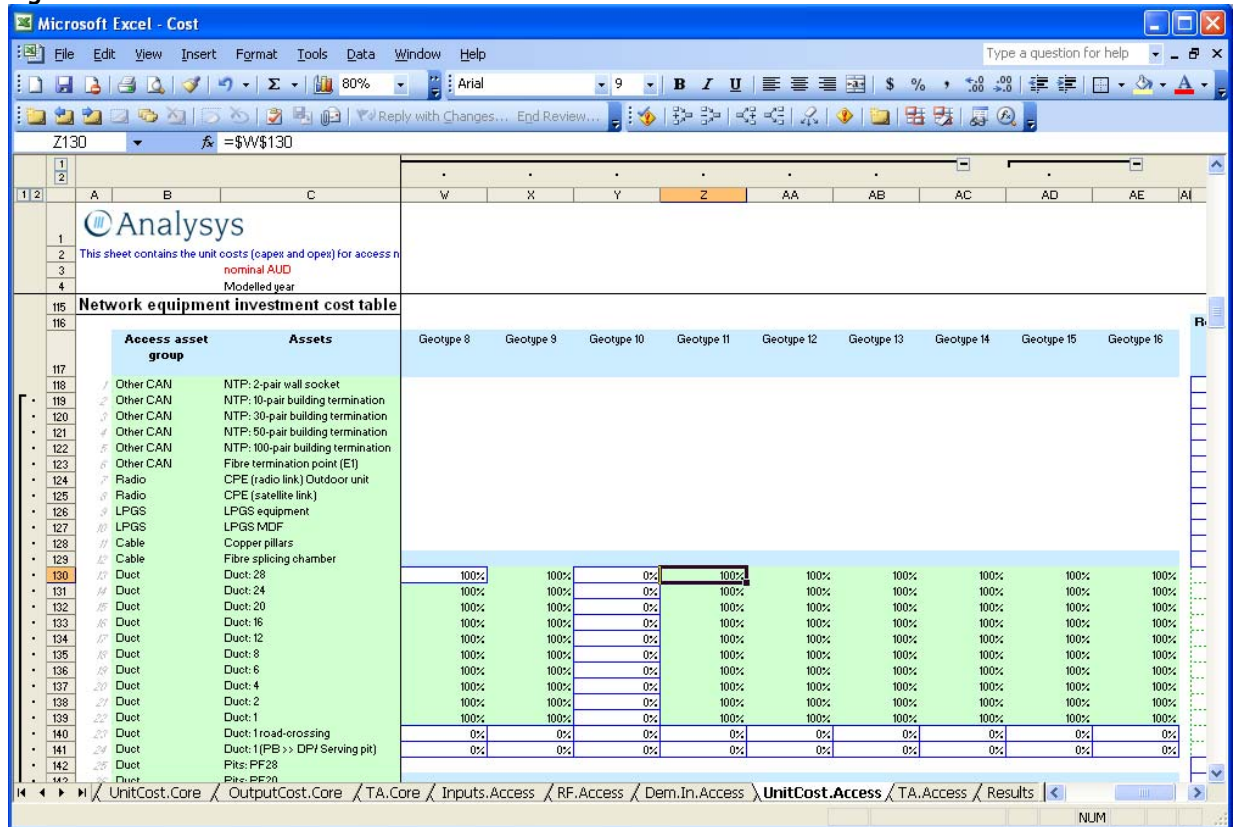
Error 14: The Analysys Model assumes that cables that are greater than 100 pair in size can be ploughed when they cannot¹⁰⁴

What is the error?

- 388 The Analysys Model assumes that cables that are greater than 100 pair in size can be ploughed. They cannot. The reasons for this are set out at section 9 of the Jordan CAN Report.
- 389 Because cables greater than 100 pair cannot be ploughed they need to be put in trenches. The Analysys Model therefore needs to be adjusted so that it no longer assumes ploughing for cables greater than 100 pair in size.
- 390 The illustration of the Analysys Model at Figure 56 below, shows how ploughing enters into the cost calculation. 100% of duct (not cable) is assumed to be ploughed in geotypes 8, 9 and 11 to 16. It is odd that the Analysys Model does not allow the user to enter in ploughing of cable, but rather enters the ploughing of duct. Duct is inflexible 100mm PVC pipe and cannot be ploughed.

¹⁰⁴ Error 11 in the 31 July Letter.

Figure 56



How to fix the error?

- 391 The ploughing error can be fixed by ensuring the correct engineering rules are used in the Analysys Model. An appropriate engineering rule is to allow ploughing for a route that has a maximum of 100 pair cable (see section 9 of Lordan CAN Report).
- 392 However, the Analysys model enters the cost of ploughing for each duct run, and multiple cables can be placed in a single duct. While the model cannot be used to identify single cable runs (as opposed to single duct runs), it is possible to limit ploughing to instances where there is only one duct run. This will mean that the model will still overestimate the extent of ploughing as it will plough multiple cable runs that fit into one duct. The following screenshots (Figures 58, 59) illustrate the change to the model.

Before:

Figure 57

Microsoft Excel - Cost default

File Edit View Insert Format Tools Data Window Help

AA136 = \$W\$130

	O	V	W	X	Y	Z	AA	AB	AC	AD	AE	AF
1												
2												
3												
4												
129	% distance plou	Geotype 7	Geotype 8	Geotype 9	Geotype 10	Geotype 11	Geotype 12	Geotype 13	Geotype 14	Geotype 15	Geotype 16	
130	Duct 28	0%	100%	100%	0%	100%	100%	100%	100%	100%	100%	
131	Duct 24	0%	100%	100%	0%	100%	100%	100%	100%	100%	100%	
132	Duct 20	0%	100%	100%	0%	100%	100%	100%	100%	100%	100%	
133	Duct 16	0%	100%	100%	0%	100%	100%	100%	100%	100%	100%	
134	Duct 12	0%	100%	100%	0%	100%	100%	100%	100%	100%	100%	
135	Duct 8	0%	100%	100%	0%	100%	100%	100%	100%	100%	100%	
136	Duct 6	0%	100%	100%	0%	100%	100%	100%	100%	100%	100%	
137	Duct 4	0%	100%	100%	0%	100%	100%	100%	100%	100%	100%	
138	Duct 2	0%	100%	100%	0%	100%	100%	100%	100%	100%	100%	
139	Duct 1	0%	100%	100%	0%	100%	100%	100%	100%	100%	100%	
140	Duct 1 road-d	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	
141	Duct 1 (PB >	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	
142												
143	% distance open	Geotype 7	Geotype 8	Geotype 9	Geotype 10	Geotype 11	Geotype 12	Geotype 13	Geotype 14	Geotype 15	Geotype 16	
144	Duct 28	17%	17%	17%	17%	17%	17%	17%	17%	17%	17%	
145	Duct 24	17%	17%	17%	17%	17%	17%	17%	17%	17%	17%	
146	Duct 20	17%	17%	17%	17%	17%	17%	17%	17%	17%	17%	
147	Duct 16	17%	17%	17%	17%	17%	17%	17%	17%	17%	17%	
148	Duct 12	17%	17%	17%	17%	17%	17%	17%	17%	17%	17%	
149	Duct 8	17%	17%	17%	17%	17%	17%	17%	17%	17%	17%	
150	Duct 6	17%	17%	17%	17%	17%	17%	17%	17%	17%	17%	
151	Duct 4	17%	17%	17%	17%	17%	17%	17%	17%	17%	17%	
152	Duct 2	17%	17%	17%	17%	17%	17%	17%	17%	17%	17%	
153	Duct 1	17%	17%	17%	17%	17%	17%	17%	17%	17%	17%	
154	Duct 1 road-d	17%	17%	17%	17%	17%	17%	17%	17%	17%	17%	
155	Duct 1 (PB >	17%	17%	17%	17%	17%	17%	17%	17%	17%	17%	
156												
157												

Ready Calculate NUM

After:

Figure 58

		Geotype 7	Geotype 8	Geotype 9	Geotype 10	Geotype 11	Geotype 12	Geotype 13	Geotype 14	Geotype 15	Geotype 16
129	% distance plou										
130	Duct 28	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
131	Duct 24	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
132	Duct 20	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
133	Duct 16	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
134	Duct 12	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
135	Duct 8	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
136	Duct 6	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
137	Duct 4	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
138	Duct 2	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
139	Duct 1	0%	100%	100%	0%	100%	100%	100%	100%	100%	100%
140	Duct 1 road-c	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
141	Duct 1 (PB >	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
142											
143	% distance open										
144	Duct 28	17%	17%	17%	17%	17%	17%	17%	17%	17%	17%
145	Duct 24	17%	17%	17%	17%	17%	17%	17%	17%	17%	17%
146	Duct 20	17%	17%	17%	17%	17%	17%	17%	17%	17%	17%
147	Duct 16	17%	17%	17%	17%	17%	17%	17%	17%	17%	17%
148	Duct 12	17%	17%	17%	17%	17%	17%	17%	17%	17%	17%
149	Duct 8	17%	17%	17%	17%	17%	17%	17%	17%	17%	17%
150	Duct 6	17%	17%	17%	17%	17%	17%	17%	17%	17%	17%
151	Duct 4	17%	17%	17%	17%	17%	17%	17%	17%	17%	17%
152	Duct 2	17%	17%	17%	17%	17%	17%	17%	17%	17%	17%
153	Duct 1	17%	17%	17%	17%	17%	17%	17%	17%	17%	17%
154	Duct 1 road-c	17%	17%	17%	17%	17%	17%	17%	17%	17%	17%
155	Duct 1 (PB >	17%	17%	17%	17%	17%	17%	17%	17%	17%	17%
156											
157											

Error 15: The Analysys Model has too few customer locations because it relies on an inaccurate data base¹⁰⁵

What is the error?

- 393 The Analysys Model identifies customer locations by reference to the G-NAF database. Analysys itself has acknowledged that the G-NAF database has addresses that are invalid. Analysys has then sought to remove erroneous locations and has determined that there are 9.8 million valid locations. The Analysys Model however, only uses 8 million of those locations.
- 394 Telstra says that there are two problems with the Analysys Model as follows:
 - (a) the ACCC should used data of actual locations. These actual locations are identified in Telstra’s TEA model; and

¹⁰⁵ Error 13 in the 31 July Letter.

(b) if the ACCC does not want to use actual locations, it should at the least use the 9.8 million locations identified by Analysys.

395 The reasons why use of actual locations would be better than reliance on the GNAF database are explained at Part B of the “Expert Evaluation of the ACCC Cost Model and its Use in the Pricing of ULLS” submitted to the ACCC in March 2009 by Robert G Harris (**Submission Supporting Documents, Document 2.19**).

396 Analysys describes the location assumptions used to dimension the CAN as follows:¹⁰⁶

“To dimension the CAN, a single projection is made which reflects the number of locations that need to be passed by the CAN. This is greater than the actual number of services in operation (SIOs) and reflects the fact that locations are passed which may not necessarily be connected in the year being modelled. The default value for this input is constant over time and set to be 11.3 million access SIOs This is consistent with the Location and Demand Database that underpins the geoanalysis and access network module, as described in section 4.2.1.”

397 The documentation is not fully explanatory of how the model works. As can be seen in Figure 59 below, the number of SIOs is held constant at 11.3m, but the number of connected locations is 8m (see cell U19).

Figure 59

	Geotype 10	Geotype 11	Geotype 12	Geotype 13	Geotype 14	Geotype 15	Geotype 16	Total
Demand								
Access SIOs	873,732	700,573	849,214	442,560	51,966	515	-	11,300,000
Copper	861,265	678,151	808,283	335,042	18,547	-	-	10,028,429
Fibre	12,467	5,140	9,660	-	-	-	-	1,080,207
Wireless	-	16,627	29,070	101,319	19,257	-	-	166,274
Satellite	-	655	2,201	6,199	14,161	515	-	25,091
SIO distribution								
Copper	99%	97%	95%	76%	36%	-%	-%	
Fibre	1%	1%	1%	-%	-%	-%	-%	
Wireless	-%	2%	3%	23%	37%	-%	-%	
Satellite	-%	0%	0.26%	1%	27%	100%	100%	
Connected locations	757,903	539,513	724,160	405,186	45,742	515	-	8,050,592
Copper	757,762	524,404	697,504	305,189	16,459	-	-	7,869,289
Fibre	141	103	92	-	-	-	-	8,771
Wireless	-	14,385	24,577	93,890	17,670	-	-	150,522
Satellite	-	621	1,987	6,107	11,613	515	-	22,010
SIOs/location								
Copper	1.15	1.30	1.17	1.09	1.14	1.00	1.00	
Fibre	1.14	1.29	1.16	1.10	1.13	-	-	
Wireless	88.36	49.67	105.33	-	-	-	-	
Satellite	-	1.16	1.18	1.08	1.09	-	-	
Satellite	-	1.06	1.11	1.01	1.22	1.00	1.00	

¹⁰⁶ FLRIC Report page 15.

398 However, Analysys state:¹⁰⁷

“The Location and Demand database is a set of nationwide locations that Analysys has derived. They are a proxy of the locations of demand that are used for the sampled ESAs. The database contains a set of 9.76 million co-ordinates with an associated level of demand for each set of co-ordinates.”

399 Analysys explains (FLRIC Report Annex A) that G-NAF, the database used to construct the Location and Demand Database, has 12.6 million entries in all, but not all of these addresses are valid. Consequently Analysys “cleans” the data to arrive at 9.8 million locations:¹⁰⁸

“9.8 million addresses survived these tests, which are explained in detail below.”

400 The Analysys Model dimensions the CAN to pass 8m locations. This is substantially less than the 9.76m locations that Analysys claim is appropriate from the GNAF database.

401 This error can be fixed by increasing the number of connected locations to reflect the value Analysys suggests is appropriate. This will not however fix other errors with the GNAF database.

Error 16: The Analysys Model provisions some customers with wireless without any consideration of topological barriers to wireless signals¹⁰⁹

What is the error?

402 The Analysys Model wrongly assumes that customers can be served by wireless without taking into account the topological barriers to wireless connection. If those topological barriers are taken into account less customers could be serviced by wireless than assumed by the Analysys Model. These issues are considered and explained in the Report Regarding Wireless networks dated 8 October 2009 by Craig Lordan (**Lordan Wireless Report**). Lordan says (at section 6) that the maximum radius for wireless signals to provide voice and data is 15 km.

How can this error be fixed?

403 This error can be fixed in the Access – CODE.xls, Inputs worksheet, by changing cell E218 to 15 km, a value that reflects topological barriers to wireless signals.

¹⁰⁷ FLRIC Report page A-1.

¹⁰⁸ FLRIC Report page A-6.

¹⁰⁹ Error 16 in the 31 July Letter.