

# Extended Tay Estuary Rail Study

## Review of Start Up Services

Report

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# 1 Introduction

- 1.1 Opportunities to improve local rail services in the TACTRAN region were reviewed and the outputs presented in a STAG Type Appraisal in March 2009. The review identified good levels of demand for improved rail services in the Arbroath - Glasgow rail corridor. Two services in particular generated good benefit to cost ratios:
- An hourly Glasgow - Perth service, extending to Arbroath every two hours, i.e. there is a direct service from stations to the north east of Perth to Glasgow; and
  - Separate hourly Glasgow - Perth and Perth - Arbroath services, i.e. an interchange is required at Perth to connect to services to Glasgow.
- 1.2 These services require little in the way of new infrastructure works and utilise rolling stock which will be displaced once new services commence between Glasgow and Edinburgh via Airdrie and Bathgate in December 2010.
- 1.3 However both services required significant levels of subsidy as shown in Table 1-1.

TABLE 1-1 SHORT TERM SERVICE OPTIONS

Service	Estimated annual operating cost	Estimated annual revenue	Subsidy over 60 year appraisal period	Benefit Cost Ratio	Planning objective score	Estimated annual journeys - start up
Hourly Glasgow - Perth with two hourly extension to Arbroath	£2.17m	£1.12m	£21.0m	3.1	9/16	263,000
Separate hourly Glasgow - Perth and Perth - Arbroath services	£2.59m	£1.22m	£28.09m	2.7	12/16	312,000

- 1.4 The March appraisal confirmed enabling works are required at Arbroath to provide a tail light camera and to make Invergowrie Station suitable for handling an hourly train service. The appraisal included just over £1m as capital costs for these enabling works. Opportunities were identified to reduce or even avoid capital works at Invergowrie Station and it was felt further investigation to reduce capital costs is merited at this stage.

- 1.5 This technical report will investigate options as to how initial service start up subsidy could be reduced. The remainder of the report is structured as follows:
- Chapter 2 - Timetables and operating costs
  - Chapter 3 - Capital expenditure works
  - Chapter 4 - Demand and revenue forecasts
  - Chapter 5 - Economic appraisal
  - Chapter 6 - Preferred option.

## 2 Timetables and Operating Costs

### Introduction

- 2.1 For the March appraisal, the service timetables developed were based on the following key points:
- A seven day service was provided from approximately 06:30hrs to 22:00hrs throughout the corridor;
  - The timetables revised stopping patterns of existing services in the early morning and later evening and provided new hourly services for and between the morning and evening peaks; and
  - In order to avoid conflict with improvements to Inverness - Glasgow and Edinburgh services currently under consideration, the developed timetable assumed an Inverness - Perth - Glasgow service every two hours rather than the current three per day in each direction.
- 2.2 In May 2009, Transport Scotland confirmed it would be introducing a new Monday to Saturday off peak hourly service between Glasgow and Perth. This service is expected to commence in May or December 2010. The Glasgow - Perth element is a key component the proposed TERS services.
- 2.3 We have reviewed the timetables developed for the March appraisal with two objectives in mind:
- Reduce annual operating cost through better targeting of resources to services which will generate the most demand;
  - Maximise the synergies with the Transport Scotland funded Glasgow - Perth service proposed for introduction in 2010.
- 2.4 A review of the revenue estimates from the March appraisal identified a reduction of approximately 10% if Sunday services were not provided. Accordingly the new timetables and costs developed in this report are for Monday to Saturday services only.
- 2.5 The start and finish times of services were also reviewed to fit with the enhanced Glasgow - Perth service. This resulted in a 06:45 to 20:30 hrs service rather than 06:30 to 22:00 hrs as originally developed.
- 2.6 In order to keep numbering consistent with the services reviewed in the main appraisal we have designated the new timetables as follows:
- Option 0 - Enhanced Glasgow - Perth service. This formed Phase 1 of the four packages assessed in the March appraisal;
  - Option 1 - Two hourly extension to Arbroath of the enhanced Glasgow - Perth service. This service was referred to as Package 1 - Phase 2 in the March appraisal;
  - Option 2 - Separate Perth - Arbroath shuttle to link with the enhanced Glasgow - Perth service. This was Phase 2 of Packages 2 and 4 in the March appraisal; and
  - Option 5 - This is a hybrid service combining elements of Options 1 and 2.

**Option 0: Enhanced Glasgow - Perth service**

2.7 The revised timetable for services between Glasgow and Perth following introduction of the new services funded by Transport Scotland in 2010 is shown in Figure 2.1.

**FIGURE 2.1 OPTION 0: NEW GLASGOW - PERTH SERVICES TO BE INTRODUCED IN 2010**

Glasgow Queen St	07:06	09:11	10:11	11:11	12:11	13:11	14:11	16:11	17:12	18:11	19:11	
Stirling	07:32	09:42	10:42	11:42	12:42	13:42	14:42	16:42	17:45	18:41	19:42	
Bridge of Allan												
Dunblane	07:39	09:51	10:51	11:51	12:51	13:51	14:51	16:51	17:54	18:50	19:51	
Gleneagles		10:03	11:03	12:03	13:03	14:03	15:03	17:03	18:06	19:02	20:03	
Edinburgh Waverley	06:29											
Perth	07:47	08:03	10:19	11:19	12:19	13:19	14:19	15:19	17:19	18:23	19:19	20:19
Inverness		09:xx	13:xx						19:xx			
Inverness			09:xx					14:51				
Perth	08:41	10:37	11:37	12:37	13:37	14:37	15:37	16:55				
Edinburgh Waverley												
Gleneagles	08:56	10:52	11:52	12:52	13:52	14:52	15:52	17:10				
Dunblane	09:06	11:06	12:06	13:06	14:06	15:06	16:06	17:22				
Bridge of Allan												
Stirling	09:13	11:14	12:14	13:14	14:14	15:14	16:14	17:29				
Glasgow Queen St	09:45	11:45	12:45	13:45	14:45	15:45	16:45	18:09				

<b>KEY</b>	New services to be introduced in 2010 - Transport Scotland funded	693 miles/day
	Existing services in the December 2008 timetable.	

2.8 Operating costs for the new service have been calculated in the same manner as in the March report. Specific costs have been modified to reflect further information provided by First ScotRail:

- Variable costs increase from £1.44 per unit per mile to £1.84 to reflect heavy maintenance not included in the lease cost; and
- Rolling stock lease costs reduced from £242k to £160k per annum to more closely reflect that of a Class 158.

2.9 The economic appraisals undertaken in the March report assumed, with the agreement of the steering group, that rolling stock and traincrew costs for the Glasgow - Perth service element should be assumed as £nil because of the forthcoming commitment to provide this service. The appraisal therefore included the variable cost element only. Revised operating costs based on the adjusted cost rates and new timetable are shown in Table 2-1.

TABLE 2-1 OPERATING COST ESTIMATE: GLASGOW - PERTH SERVICE

Glasgow - Perth rail mileage	Additional daily trips	Annual mileage (Mon - Sat service)	Variable Costs per mile (£1.84) <ul style="list-style-type: none"> <li>Fuel (£0.68)</li> <li>VTA (£0.25)</li> <li>Servicing (£0.51)</li> <li>Maintenance (£0.40)</li> </ul>	Staff Costs 7 Drivers @ £50k 7 Guards @ £36k	Rolling Stock lease costs £160k per unit pa
63	11	217,000	£399,280	£602,000	Nil
<b>TOTAL (including traincrew)</b>					<b>£1,001,280</b>
<b>TOTAL (with variable costs only allocated to TERS)</b>					<b>£399,280</b>

### Option 1: Glasgow - Perth with two hourly extension to Arbroath

2.10 The timetable developed for Package 1 - Phase 2 in the March appraisal was reviewed and modified to reflect the proposed Glasgow - Perth service for introduction in 2010 (refer to Figure 2.1). The revised timetable is shown in figure 2.2 below.

2.11 The key points for the revised timetable are:

- The existing 16:11 Glasgow - Inverness service requires to be retimed to depart at 15:11 to allow the 16:11 Glasgow - Perth service to run through to Arbroath. This provides a good evening peak connection between Perth and stations to Arbroath;
- The existing 14:51 Inverness - Glasgow service requires to be retimed to depart at 13:51. This allows an effective shoulder peak service to run from Arbroath to Glasgow, departing Perth at 16:55;
- The existing 08:18 Dundee - Glasgow service is started at Arbroath. This not only provides a direct early morning service to Glasgow for stations between Arbroath and Dundee and also provides a good connection with Edinburgh services;
- There is good morning peak coverage for all stations between Perth and Arbroath. The evening peak is well served in the northbound direction. Southbound there is a service passing though Dundee either side of the peak, at 16:17 and 18:03. The 18:03 service is shown as running through to Glasgow as it would almost certainly have to run there as empty coaching stock; and
- Is likely to require minor modification once Highland Main Line timetables are agreed because a regular spacing is not provided for enhanced evening peak Glasgow - Inverness services.

FIGURE 2.2 OPTION 1: TWO HOURLY EXTENSION TO ARBROATH

Glasgow Queen St	07:06	09:11	10:11	11:11	12:11	13:11	14:11	15:11	16:11	17:12	18:11	19:11	
Stirling	07:32	09:42	10:42	11:42	12:42	13:42	14:42	15:42	16:42	17:45	18:41	19:42	
Bridge of Allan													
Dunblane	07:39	09:51	10:51	11:51	12:51	13:51	14:51	15:51	16:51	17:54	18:50	19:51	
Gleneagles		10:03	11:03	12:03	13:03	14:03	15:03	16:03	17:03	18:06	19:02	20:03	
Edinburgh Waverley	06:29												
Perth	07:47	08:03	10:19	11:19	12:19	13:19	14:19	15:19	16:19	17:19	18:23	19:19	20:19
Inverness		09:xx	13:xx					18:xx	19:xx	GLQ - PTH extended			
Perth	08:45	08:05	10:20	12:20	14:20				17:20	18:25			
Invergowrie	07:02	08:22	10:37	12:37	14:37				17:37	18:42			
Dundee	07:09	08:29	10:44	12:44	14:44				17:44	18:49			
Dundee	07:10	08:30	10:45	12:45	14:45				17:45	18:54			
Broughty Ferry	07:16	08:36	10:51	12:51	14:51				17:51	19:00			
Monifieth	07:20	08:40	10:55	12:55	14:55				17:55	19:06			
Carnoustie	07:26	08:46	11:01	13:01	15:01				18:01	19:17			
Arbroath	07:33	08:53	11:08	13:08	15:08				18:08	19:24			
Arbroath	07:45	09:43		11:43	13:43			15:54	16:25	17:29	17:39		
Carnoustie	07:52	09:50		11:50	13:50			16:00			17:46		
Monifieth	08:01	09:56		11:56	13:56			16:06			17:52		
Broughty Ferry	08:07	10:00		12:00	14:00			16:10			17:56		
Dundee	08:14	10:07		12:07	14:07			16:17	16:45	17:51	18:03		
Dundee	08:15	10:08		12:08	14:08			16:18			18:08		
Invergowrie	08:22	10:15		12:15	14:15			16:25			18:15		
Perth	08:40	10:33		12:33	14:33			16:43			18:33		
Inverness			09:xx					13:xx Inv	14:54				
Perth	08:41	10:37	11:37	12:37	13:37	14:37	15:37	16:55	17:11	18:12	19:14	20:11	
Edinburgh Waverley													
Gleneagles	08:56	10:52	11:52	12:52	13:52	14:52	15:52	17:10					
Dunblane	09:06	11:06	12:06	13:06	14:06	15:06	16:06	17:22					
Bridge of Allan													
Stirling	09:13	11:14	12:14	13:14	14:14	15:14	16:14	17:29					
Glasgow Queen St	09:45	11:45	12:45	13:45	14:45	15:45	16:45	18:09	18:15	19:14	20:13	21:14	

GLQ - ARB direct	09:11	11:11	13:11	16:11	17:12
ARB - GLQ direct	07:45	09:43	11:43	13:43	15:54

<b>KEY</b>	New services to be introduced in 2010 - Transport Scotlan	693 miles / day	216,216 miles / year
	Proposed new TERS services	504 miles / day	157,248 miles / year
	Existing services in the December 2008 timetable. Most Glasgow - Aberdeen services omitted for clarity		
	New stops inserted into existing services		
▼	Through service		

2.12 This timetable results in a 45% reduction in annual mileage compared with that of the Package 1 - Phase 2 option in the March appraisal. The revised timetable still requires two additional units to operate the service in the peak and an estimated 7 additional drivers and guards, in addition to the traincrew required for the enhanced Glasgow - Perth service funded by Transport Scotland. The operating cost estimate is shown in Table 2-2. At a total of £1.61m this is 26% less than the £2.17m estimated for Package 1 - Phase 2 in the March appraisal.

TABLE 2-2 OPERATING COST ESTIMATE: OPTION 1

Perth - Arbroath rail mileage	Additional daily trips	Annual mileage (Mon - Sat service)	Variable Costs per mile (£1.84) <ul style="list-style-type: none"> <li>Fuel (£0.68)</li> <li>VTA (£0.25)</li> <li>Servicing (£0.51)</li> <li>Maintenance (£0.40)</li> </ul>	Staff Costs 7 Drivers @ £50k 7 Guards @ £36k	Rolling Stock lease costs £160k per unit pa
38	12	158,000	£290,720	£602,000	£320,000
<b>TOTAL increment on 2010 Glasgow - Perth service</b>					<b>£1,212,720</b>
<b>TOTAL (including Perth - Glasgow variable costs of £399,280)</b>					<b>£1,612,000</b>

### Option 2: Glasgow - Perth and Perth - Arbroath shuttles

2.13 The timetable developed for Package 2 - Phase 2 in the March appraisal was reviewed and modified to reflect the proposed Glasgow - Perth service for introduction in 2010 (refer to Figure 2.1). The revised timetable is shown in Figure 2-3.

2.14 The key points for the revised timetable are:

- The existing 16:11 Glasgow - Inverness service requires to be retimed to depart at 15:11 to allow the 16:11 Glasgow - Perth service to run through to Arbroath. This provides a good evening peak connection between Perth and stations to Arbroath. No other Inverness services are affected;
- There is a very good morning and evening peak hour service in both directions;
- In order to make best use of the necessary rolling stock, the 08:37 and 17:39 Arbroath - Perth services run through to Glasgow. The existing 08:18 Dundee - Glasgow service is started at Arbroath, as in Option 1 and the existing 17:12 Glasgow - Perth service is run through to Arbroath; and
- Avoids conflict with the proposed Highland Main Line service improvements at all times of the day.

FIGURE 2.3 OPTION 2: PERTH - ARBROATH SHUTTLE

Glasgow Queen St	07:06	09:11	10:11	11:11	12:11	13:11	14:11	15:11	16:11	17:12	18:11	19:11	
Stirling	07:32	09:42	10:42	11:42	12:42	13:42	14:42	15:42	16:42	17:45	18:41	19:42	
Bridge of Allan													
Dunblane	07:39	09:51	10:51	11:51	12:51	13:51	14:51	15:51	16:51	17:54	18:50	19:51	
Gleneagles		10:03	11:03	12:03	13:03	14:03	15:03	16:03	17:03	18:06	19:02	20:03	
Edinburgh Waverley													
Perth	08:03	10:19	11:19	12:19	13:19	14:19	15:19	16:19	17:19	18:23	19:19	20:19	
Inverness	09:xx		13:xx					18:xx	19:xx	GLQ - PTH extended			
Perth	06:45	07:35	08:25	09:25	10:25	11:25	12:25	13:25	14:25	15:25	16:25	17:25	18:25
Invergowrie	07:02	07:50	08:40	09:40	10:40	11:40	12:40	13:40	14:40	15:40	16:40	17:40	18:42
Dundee	07:09	07:56	08:46	09:46	10:46	11:46	12:46	13:46	14:46	15:46	16:46	17:46	18:49
Dundee	07:10	07:57	08:47	09:47	10:47	11:47	12:47	13:47	14:47	15:47	16:47	17:47	18:54
Broughty Ferry	07:16	08:03	08:58	09:53	10:53	11:53	12:53	13:53	14:53	15:53	16:53	17:53	19:00
Monifieth	07:20	08:07	09:02	09:57	10:57	11:57	12:57	13:57	14:57	15:57	16:57	17:57	19:06
Carnoustie	07:26	08:13	09:08	10:03	11:03	12:03	13:03	14:03	15:03	16:03	17:03	18:03	19:17
Arbroath	07:33	08:20	09:15	10:10	11:10	12:10	13:10	14:10	15:10	16:10	17:10	18:10	19:24
Arbroath	07:45	08:37	09:40	10:37	11:40	12:40	13:40	14:40	15:43	16:33	17:39	18:40	19:40
Carnoustie	07:52	08:44	09:47	10:44	11:47	12:47	13:47	14:47	15:00	16:40	17:46	18:47	19:47
Monifieth	08:01	08:50	09:53	10:50	11:53	12:53	13:53	14:53	16:06	16:46	17:52	18:53	19:53
Broughty Ferry	08:07	08:54	09:57	10:54	11:57	12:57	13:57	14:57	16:10	16:50	17:56	18:57	19:57
Dundee	08:14	09:00	10:03	11:00	12:03	13:03	14:03	14:03	16:17	16:57	18:03	19:03	20:03
Dundee	08:15	09:02	10:05	11:02	12:05	13:05	14:05	15:05	16:18	16:58	18:08	19:05	20:05
Invergowrie	08:22	09:09	10:12	11:09	12:12	13:12	14:12	15:12	16:25	17:05	18:15	19:12	20:12
Perth	08:40	09:27	10:30	11:27	12:30	13:30	14:30	15:30	16:43	17:23	18:33	19:30	20:30
Inverness			09:xx						14:51				
Perth	08:41	09:37	10:37	11:37	12:37	13:37	14:37	15:37	16:55	17:11	18:12	19:14	20:11
Edinburgh Waverley													
Gleneagles	08:56	09:52	10:52	11:52	12:52	13:52	14:52	15:52	17:10				
Dunblane	09:06	10:06	11:06	12:06	13:06	14:06	15:06	16:06	17:22				
Bridge of Allan													
Stirling	09:13	10:14	11:14	12:14	13:14	14:14	15:14	16:14	17:29				
Glasgow Queen St	09:45	10:45	11:45	12:45	13:45	14:45	15:45	16:45	18:09	18:15	19:14	20:13	21:14

GLQ - ARB direct	16:11	17:12
ARB - GLQ direct	07:45	08:37

KEY	New services to be introduced in 2010 - Transport Scotland	693 miles / day	216,216 miles / year
	Proposed new TERS services	1,061 miles / day	331,032 miles / year
	Existing services in the December 2008 timetable. Most Glasgow - Aberdeen services omitted for clarity		
	New stops inserted into existing services		
▼	Through service		

2.15 This timetable results in a 35% reduction in annual mileage compared with that of the Package 2 / 4 - Phase 2 option in the March appraisal. Due to interaction with current Inverness services, the revised timetable requires three additional units to operate the service in the peak. Train crew requirements are estimated as 9 drivers and guards in addition to those required for the Transport - Scotland funded Glasgow - Perth element of the service. The operating cost estimate is shown in Table 2-3. At a total of £2.26m this is only 13% less than the £2.59m estimated for Phase 2 of Packages 2 and 4 in the March appraisal. The small overall reduction, compared with the efficiencies in mileage and traincrew is as a result of the requirement for a third unit - a risk identified in the March appraisal. The requirement for a third unit is driven by the need to fit around the December 2008 timetable and supporting rolling stock diagrams. The Perth - Arbroath shuttle service could be delivered by an efficient two unit operation if timetables were amended for other services between Edinburgh and Glasgow and Perth, Dundee and Aberdeen. The most appropriate time for this review would be once timetable and resource requirements for Highland Main Line services are confirmed. This project will conclude its design development phase in early 2010. A two unit operation would reduce operating costs for Option 2 to £2.1m from the current estimate of £2.26m

TABLE 2-3 OPERATING COST ESTIMATE: OPTION 2

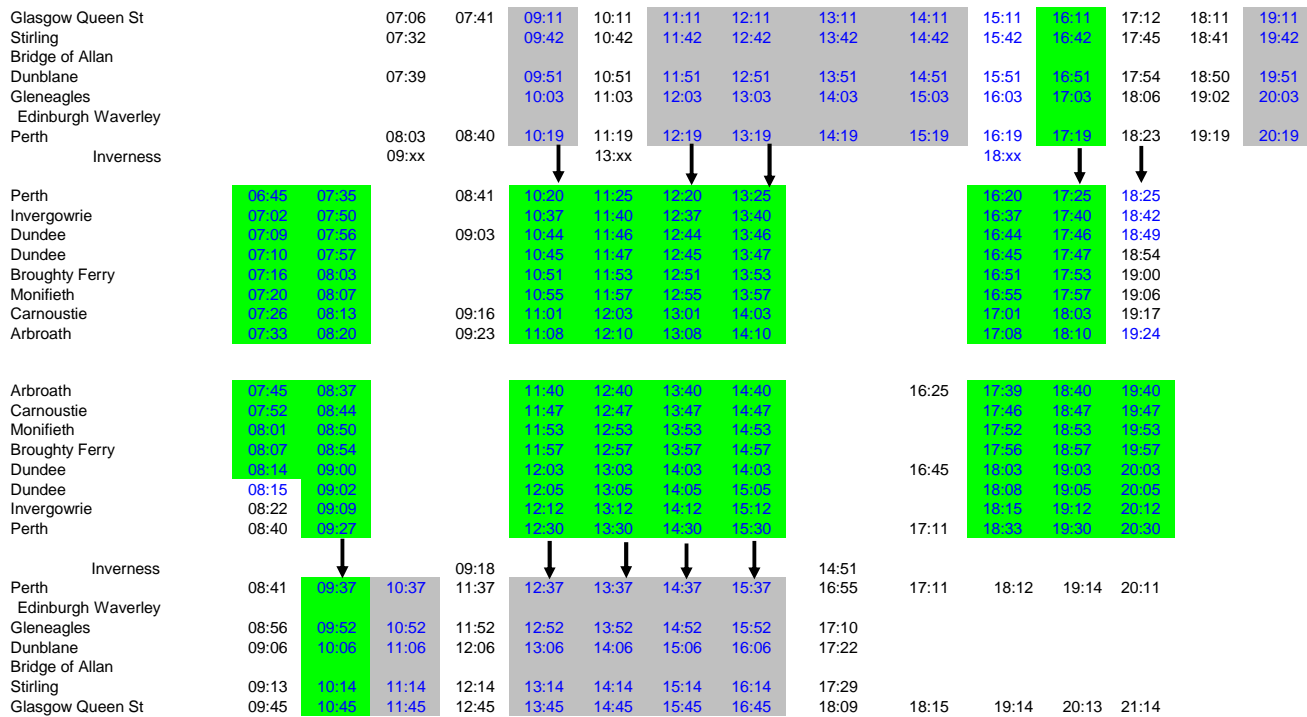
Perth - Arbroath rail mileage	Additional daily trips	Annual mileage (Mon - Sat service)	Variable Costs per mile (£1.84) <ul style="list-style-type: none"> <li>Fuel (£0.68)</li> <li>VTA (£0.25)</li> <li>Servicing (£0.51)</li> <li>Maintenance (£0.40)</li> </ul>	Staff Costs 9 Drivers @ £50k 9 Guards @ £36k	Rolling Stock lease costs £160k per unit pa
38	25	332,000	£610,880	£774,000	£480,000
<b>TOTAL increment on 2010 Glasgow - Perth service</b>					<b>£1,864,880</b>
<b>TOTAL (including Perth - Glasgow variable costs of £399,280)</b>					<b>£2,264,160</b>

### Option 5: Hybrid service combining elements of Options 1 and 2

- 2.16 The timetables developed for Options 1 and 2 have only reduced annual operating costs by 26% and 13% respectively from those costs developed and used in the March appraisal. A preliminary review of the demand forecasting data estimated revenue would reduce by around 20% for the revised timetables compared with that forecast in the March appraisal. The annual subsidy required would therefore lie between £0.9m for Option 1 and £1.3m for Option 2. This is not significantly lower than the £1.0 and £1.4m estimated for the comparable Packages in the March appraisal.
- 2.17 The timetables for Options 1 and 2 were further reviewed in order to identify the services which had the potential to attract the greatest demand. Further consultation was undertaken with First ScotRail to ascertain how much flexibility there was in existing rolling stock and train crew resourcing diagrams. First ScotRail provided a number of excellent suggestions and the Option 5 timetable was developed from these. This is shown in Figure 2.4 and has the following key points:
- Good southbound service for the morning peak and good early morning services from Perth to Arbroath;
  - Evening peak well covered between Perth and Arbroath in both directions;
  - Early peak shoulder between Arbroath and Perth not well covered - first service is 17:39 ex Arbroath;
  - Five through services between Arbroath and Glasgow, in each direction;
  - No service immediately after the morning peak or immediately before the evening peak in either direction; and

- Flexibility to manage impact with Highland Main Line service enhancements as units are available in the off peak to allow any of the 09:11, 11:11 and 12:11 Glasgow - Arbroath services to run through to Inverness instead and allow the Perth - Arbroath element of the service to be accommodated through a “shuttle” as in Option 2. The same applies to the proposed 12:30, 13:30 and 14:30 services from Perth to Glasgow - these can be resourced through available units in the off peak if new Inverness - Glasgow services are required.

FIGURE 2.4 OPTION 5: HYBRID SERVICE



GLQ - ARB direct	09:11	11:11	12:11	16:11	17:12
ARB - GLQ direct	07:45	08:37	11:40	12:40	13:40

<b>KEY</b>	New services to be introduced in 2010 - Transport Scotland funded	693 miles / day	216,216 miles / year
	Proposed new TERS services	787 miles / day	245,544 miles / year
	Existing services in the December 2008 timetable. Most Glasgow - Aberdeen services omitted for clarity		
	New stops inserted into existing services		
	▼ Through service		

2.18 This option attempts to make the best use of rolling stock available in the off peak and therefore the exact service provision and timings will be subject to the current diagrams at the time of service introduction. Appendix A contains a mark up of the timetable showing assumptions as to how each service would be resourced. Key points are:

- The 09:11 Glasgow - Arbroath being a four car, and splitting at Perth with one set working the 10:37 Perth - Glasgow service;
- An additional off peak unit is required at Perth for the 11:35 departure; and
- The 14:11 ex Glasgow does not have a 'back working', and would require to be back in Glasgow or Edinburgh for the evening peak period. We have assumed this returns attached to 15:37 Perth - Glasgow service.

- 2.19 The mileage for the additional rolling stock moves are included in the operating cost calculation.
- 2.20 This timetable results in a 32% reduction in annual mileage compared with that of the Package 1 - Phase 2 option in the March appraisal. However the huge advantage of this option is that it only requires one additional unit to provide the required peak hour services. Train crew requirements are estimated as 7 drivers and guards in addition to those required for the Transport - Scotland funded Glasgow - Perth element of the service. The operating cost estimate is shown in Table 2-4. At a total of £1.61m this is 26% less than the £2.17m estimated for Phase 2 of Package 1 in the March appraisal.

TABLE 2-4 OPERATING COST ESTIMATE: OPTION 5

Perth - Arbroath rail mileage	Additional daily trips	Annual mileage (Mon - Sat service)	Variable Costs per mile (£1.84) <ul style="list-style-type: none"> <li>Fuel (£0.68)</li> <li>VTA (£0.25)</li> <li>Servicing (£0.51)</li> <li>Maintenance (£0.40)</li> </ul>	Staff Costs 7 Drivers @ £50k 7 Guards @ £36k	Rolling Stock lease costs £160k per unit pa
38	17	246,000	£452,640	£602,000	£160,000
<b>TOTAL increment on 2010 Glasgow - Perth service</b>					<b>£1,214,640</b>
<b>TOTAL (including Perth - Glasgow variable costs of £399,280)</b>					<b>£1,613,920</b>

### Conclusion

- 2.21 The timetables developed for Options 1, 2 and 5 have all resulted in reductions of the operating cost estimates used in the March appraisal. All three options will have reduced performance impacts on the rail network than those forecast in the March appraisal due to the lower number of services proposed. Options 1 and 5 have almost identical operating costs which are more than a quarter less than those used in the March appraisal. However for this annual cost, Option 5 provides a much better level of service between Arbroath, Perth and Glasgow. Option 2 still provides the best overall level of service but at a significantly higher cost because of the requirements for three units. This service could be delivered by two units once Highland Main Line timetable and resource requirements are finalised.
- 2.22 With regard to the interface with proposed Highland Main Line service improvements, Option 2 retains most flexibility by having fewest through services between Arbroath and Glasgow. Option 5, however provides flexibility in its use of off-peak resources to work around the future requirements of Inverness - Glasgow services.



## 3 Capital Expenditure Works

### Arbroath Tail Light Camera

- 3.1 Maintenance staff from Network Rail undertook a visual inspection of the Up North siding at Arbroath. This siding will be required to turn services which terminate at Arbroath back to start the return journey to Perth or Glasgow. The advice from the maintenance staff was:
- Minor works are required to re-gauge the sidings, move the buffer stop and make suitable for passenger rolling stock. The estimated cost for this was £20k; and
  - A basic tail light camera installation would be practicable.
- 3.2 Risks identified were:
- A train crew walking route might be required;
  - Cable routes and power supply availability for the tail light camera would require further investigation and design; and
  - The S&C (points) to access the siding from the main lines would require to be checked for life expectancy.
- 3.3 The capital cost estimate was revised in light of this advice and the update is shown in Figure 3.1.
- 3.4 The advice from Network Rail has allowed the cost estimate to be reduced from £240k used in the March appraisal to £204k. The revised estimate still contains optimism bias provision of 44% because further definition of the workscope is still required. We also adjusted the percentage uplifts for design, project management and contractor preliminaries to retain similar values to the original estimate as the effort involved in these will not decrease in proportion to the cost of the implementation works.
- 3.5 The costs estimated apply to reinstating the first 200 yards of the 800 yard long siding. This is sufficient to accommodate a three car DMU and there is no known operational requirement to undertake works to the full length of the siding.

### Invergowrie Station

- 3.6 The March appraisal included a provision of £798k for upgrade of Invergowrie station. The current station is only served a few times per day and does not have appropriate facilities to safely accommodate an hourly rail service. In particular the platforms are only of two car length and First ScotRail has special dispensation to stop three car units here only because of the very low patronage. If the volume of services increase, so will the patronage (it is forecast to rise to 36,000 journeys per annum) and therefore the risk of an incident increases to unacceptable levels.
- 3.7 The key issue at Invergowrie is the short platform lengths of 64m and 70m for the Up and Down lines respectively. This is sufficient to safely accommodate Class 156 and 158 diesel multiple units which consist of two carriages. However due to the need to interwork rolling stock diagrams with Edinburgh and Inverness services, it is likely that some services calling at Invergowrie will be formed of Class 170 diesel

## Review of Start Up Services

multiple units. These have a length of just over 71m with the endmost passenger doors approximately 5m from the front and rear of the set and drivers door 1.5m.

- 3.8 Train stop boards at stations are provided with a minimum of 2m tolerance but with some safety margin on top of this required.
- 3.9 Two options were reviewed in conjunction with First ScotRail:
- Use Selective Door Operation (SDO) to avoid the need to lengthen platforms; and
  - Lengthen the platforms to accommodate three car units in the most cost effective manner.

**FIGURE 3.1 CAPITAL COST ESTIMATE - ARBROATH TAIL LIGHT CAMERA**

<b>Station Construction Costs</b>	<b>Quantity</b>	<b>Unit</b>	<b>Rate</b>	<b>Total</b>	<b>Comments</b>
CCTV camera & monitor	1	No.	60,000	60,000	
Modifications to Signal Box	1	sum	2,500	2,500	
Cable route	200	m	45	9,000	
Upgrading of North Siding	200	m	100	20,000	
<b>Total Base Cost Arbroath SB</b>				<b>91,500</b>	

<b>Non Construction Costs</b>	<b>% of Base</b>	<b>Unit</b>	<b>Rate</b>	<b>Total</b>	<b>Comments</b>
Contractor preliminaries	20.00%			18,300	
GRIP stages 1-4 development	10.00%			9,150	
GRIP stage 5 design	10.00%			9,150	
Project Management	15.00%			13,725	
Possession management	0	shifts	£ 2,000	-	
TOC Compensation	0.00%			-	
<b>Total Non Construction Cost</b>				<b>50,325</b>	

<b>Sub Total</b>				<b>141,825</b>	
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<b>Risk and Optimum Bias</b>	44.00%			<b>62,403</b>	
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<b>TOTAL</b>				<b>£ 204,228</b>	
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### ***Selective Door Operation (SDO)***

- 3.10 Existing rolling stock operated by First ScotRail is not equipped with automatic SDO. With this, the train systems identify the station it has stopped at and only unlock pre-determined doors for operation by the passengers. As the train approaches the station, automatic announcements advise the passengers which doors will not be available for use because of short platforms or other obstructions.

- 3.11 A system is in operation at Beauly on the Far North Line where passengers enter and egress the train through a single door under the local control of the train guard. This system is causing operational problems because of the time taken to embark all passengers through a single set of doors. Patronage at Beauly is comparable with that forecast for Invergowrie. This option has therefore been discounted because of the performance impact on other services if there are extended dwell times at Invergowrie. There is also a safety issue with large numbers of people congregating to board at a single location rather than being spread along the platform.

***Platform Lengthening***

- 3.12 A further site inspection was undertaken at Invergowrie to examine opportunities to lengthen the platforms by the short distance required to safely accommodate a Class 170 unit. The proposal developed is shown in Figure 3.2.
- 3.13 This proposal provides an Up platform of length 75m and a Down of 77m, by infilling three of the four existing end of platform ramps and tying these into the existing platform surfacing.
- 3.14 First ScotRail has confirmed this would allow a drivers stop board to be placed at approximately 72 or 73m along the platform. Finalisation of the stop board positions would require a sighting inspection. Network Rail has also confirmed its acceptance in principle of this proposal subject to safety case verification. Maintenance access to the lineside would be provided by new precast steps from the ends of the extended platforms.
- 3.15 Two additional lamp posts would be required to provide safe lighting levels at the platform ends. A 3m x 1m waiting shelter is proposed for the up platform as no facilities presently exist here.
- 3.16 Both platforms have been resurfaced in the last five years and are in a safe condition. Network Rail has initiated a project to install tactiles and new platform copes as well as improving drainage. Our preliminary design drawing also highlights the works being undertaken by Network Rail as part of their station renewals works programme.
- 3.17 The development work for the Network Rail funded renewals identified the footbridge may require some structural repairs in the medium term. These are not being delivered as part of the current works but may be required sooner than planned as patronage at Invergowrie will increase as a result of the proposed new services.
- 3.18 In order to minimise cost, no other enhancements are proposed to the station. The previous estimate had provision for a modern customer information system, enhanced waiting shelters and enhanced lighting. The revised scheme provides facilities which are safe and gives shelter from the elements. This is an appropriate level of investment when the medium term aim is to relocate the station to a brand new facility 700m away.
- 3.19 A capital cost estimate has been developed for the revised scope of works and is shown in Figure 3.3. The estimated cost reduces from £798k to £246k including 44% optimism bias. As with Arbroath works, the percentage uplifts for the non construction cost elements have been increased to make suitable provision for design, project management and contractor preliminaries.

FIGURE 3.2 INVERGOWRIE STATION - PLATFORM LENGTHENING PROPOSAL

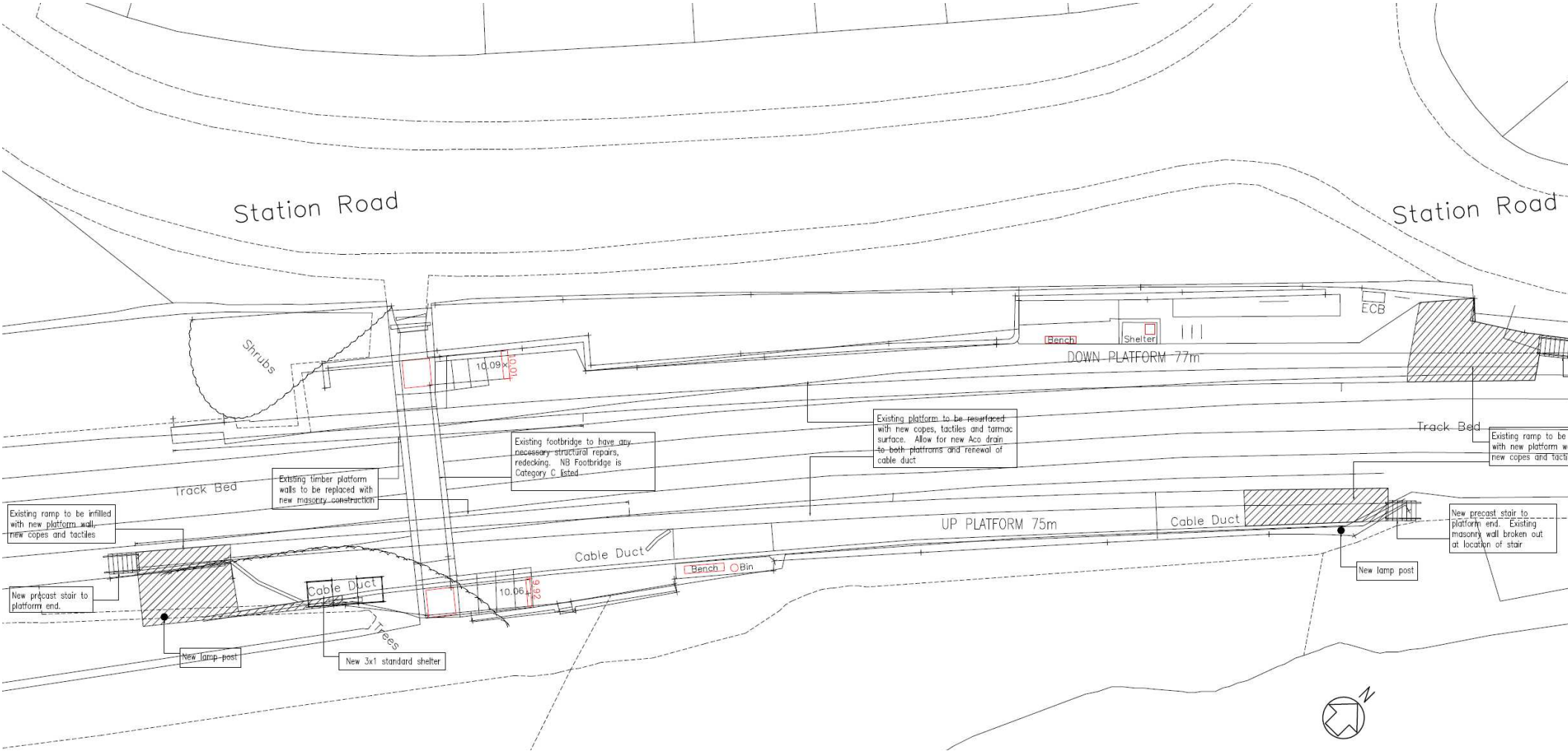


FIGURE 3.3 CAPITAL COST ESTIMATE - INVERGOWRIE STATION

Station Construction Costs	Quantity	Unit	Rate	Total	Comments
Demolition of 3 No ramps	76	m2	70	5,320	
Up Dundee end - New platform extension -crosswall build (8.6m length)	18	m2	660	11,880	
Up Dundee end - New platform extension -crosswall build (5.7m length)	28	m2	660	18,480	
Dn Dundee end - New platform extension -crosswall build (7.7m length)	30	m2	660	19,800	
New lighting column	2	No	1,500	3,000	Improve existing lighting
Precast stairs to platform end	3	No	2,500	7,500	
Car stop signs	4	No	1,000	4,000	
Platform fencing	23	m	100	2,300	
Platform shelter & seating	1	No	25,000	25,000	3m x 1m standard shelter
LLPA / CIS / CCTV / Help Points	0	item	150,000	0	Nil works
Overbridge	0	item	250,000	0	Renewal works through NR
<b>Total Base Cost - Invergowrie Station</b>				<b>97,280</b>	

Non Construction Costs	% of Base	Unit	Rate	Total	Comments
Contractor preliminaries	20.00%			19,456	
GRIP stages 1-4 development	10.00%			9,728	
GRIP stage 5 design	10.00%			9,728	
Project Management	15.00%			14,592	
Possession management	10 shifts		£ 2,000	20,000	
TOC Compensation	0.00%			-	
Land	0.00	Ha	£ 30,000	0	On railway land
<b>Total Non Construction Cost</b>				<b>73,504</b>	

<b>Sub Total</b>				<b>170,784</b>	
<b>Risk and Optimum Bias</b>	44.00%			<b>75,145</b>	
<b>TOTAL</b>				<b>£ 245,929</b>	

### Conclusion

- 3.20 With significant support from First ScotRail and Network Rail, the estimate of capital expenditure required at Arbroath and Invergowrie to commence a TERS service has reduced from £1,038k to £450k including 44% optimism bias. The developed proposals also have the in principle support of both organisations.



## 4 Demand and Revenue Forecasts

### O&D Data Review

- 4.1 We have had access to the report and underlying data from the recently completed TACTRAN Rail Use Survey, which describes the journey characteristics of a sample of those using stations in the TACTRAN area at peak times.
- 4.2 There were three areas in which the availability of data from this survey would give the opportunity to validate our approach:
- Confirmation that the trip rates assumed in the station catchment analysis described in Chapter 7 of the March appraisal report were appropriate;
  - Give further evidence for the likely abstraction rates adopted for forecasts at new stations and stations with limited existing services;
  - Confirm the mix of destinations assumed in the catchment analysis. However, the current use of the mix of destinations from LENNON ticket sales was deemed a more robust source for this information.

### *Station Catchment Base Trip Rates*

- 4.3 The catchment analysis has been based on trip rates ‘calibrated’ at Carnoustie and Gleneagles, which in turn were based on trip rates quoted in the Passenger Demand Forecasting Handbook (PDFH). Two trip rates were assumed: a walk in trip rate for those within 800m of the station and a drive in trip rate, for access from further afield. The origin data does not allow us to validate the split between these two trip rates.
- 4.4 At Carnoustie the assumed trip rates lead to forecasts of about 85% accessing by foot. The observed figure is 60%. This is reasonably close, particularly as some may drive in from close to the station. However, we undertook a sensitivity test to better match the observed figure: adjusting the walk in catchment rate down and hence the drive in catchment rate up. This was then applied to the stations in the Dundee area for which the catchment analysis was used. The effect was a small increase in demand at Broughty Ferry, Monifieth and Invergowrie. Interestingly the forecasts for Golf St, Barry Links and Balmossie reduced.
- 4.5 This sensitivity test appears to validate the catchment analysis for stations in the Dundee area, showing that forecasts for the stations that have been included for train stops are conservative. This supports the case made for not stopping the proposed services at Balmossie, Golf Street and Barry Links.
- 4.6 At Gleneagles the assumed trip rates lead to forecasts of about 2% accessing by foot, because of the very low population close to the station. The survey shows 12.5% walking, but the sample of 8 is very small and the one walker, walked over 2 miles from Auchterarder. In this case, therefore, the survey has been less use to validate our approach.

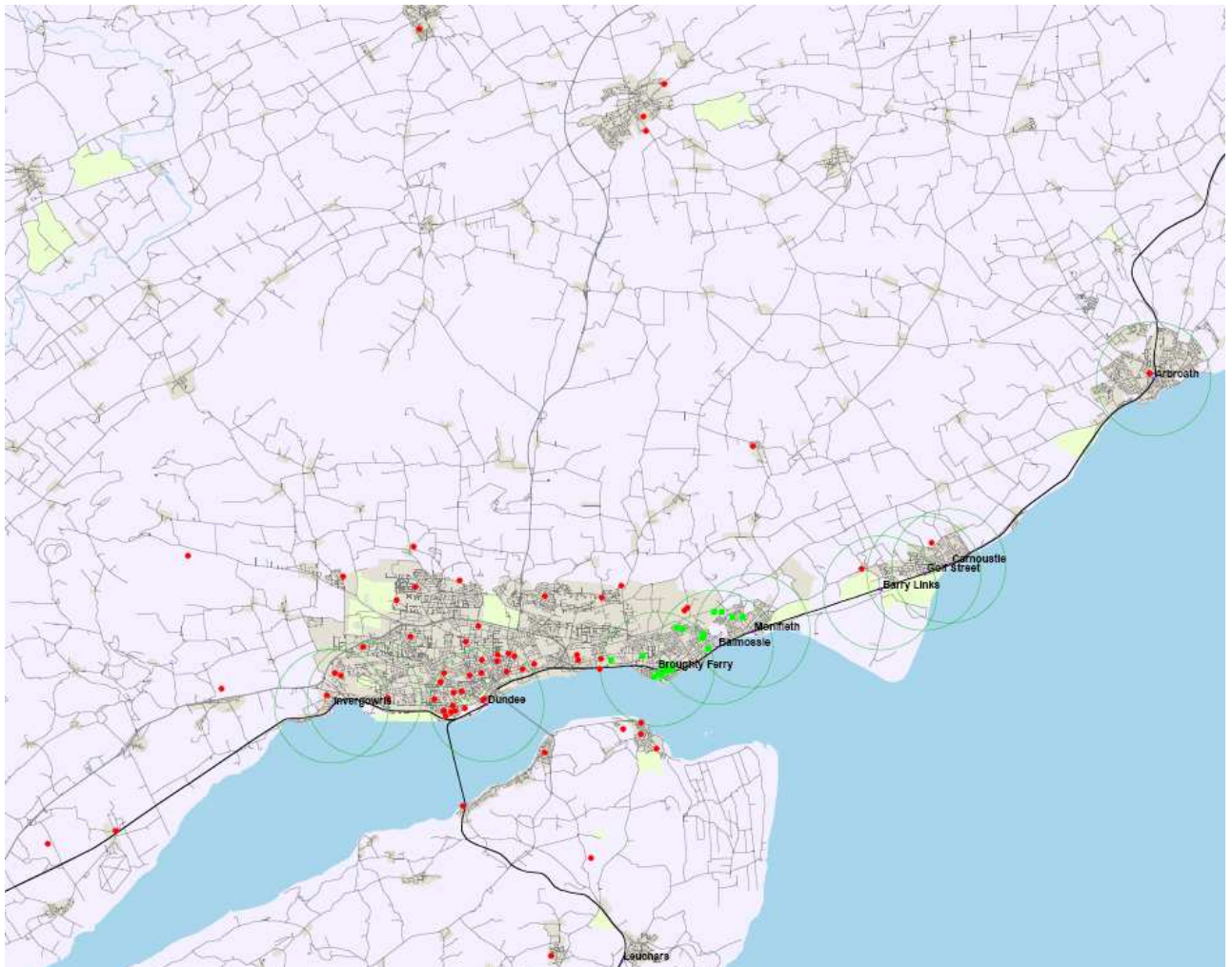
### *Abstraction rates*

- 4.7 In the catchment analysis adopted in the March Appraisal, we have included a factor which recognises that a proportion of the ‘new’ demand for the stations with a poor existing service and new stations will have been abstracted from existing demand at

less convenient stations, in particular Dundee. The rate of abstraction has been based on a combination of assumptions as to the likely mix of destinations from those stations. The O&D survey allows us to examine the origins of trips from the existing stations to help validate the assumption.

- 4.8 For stations in the Dundee area we have assumed that around 35% of newly forecast trips are abstracted from the current Dundee demand. The O&D survey shows that the proportion of trips originating in the Broughty Ferry/Monifieth areas was 20%, which is roughly the same as the proportion of the population in that area. For Dundee West the figure was 15%, around twice the population share. A plot showing the origins of the users surveyed at Dundee Station is shown in Figure 4.1. The green dots represent the 19 out of the 89 postcodes identified which fall within the 2km catchments of Broughty Ferry and Monifieth stations.

FIGURE 4.1 ORIGIN OF PASSENGERS SURVEYED AT DUNDEE RAIL STATION



- 4.9 Unfortunately, this does not really help to estimate the abstraction rates, as 20% of Dundee demand is 50% more than all of the demand forecast for those two stations. However, it does show that there is a propensity for residents of this area to use rail for longer distance trips. With more local access to the rail network we would expect trip rates in this area to increase for longer distance travel, as well as an almost completely new market for local trips, into for instance, Dundee.

- 4.10 The survey also highlighted that a small proportion of the new demand forecast for Gleneagles may be abstracted from current Dunblane demand. This is not part of the current forecast, but we believe is consistent with the level of demand capped by the capacity constraint on the Gleneagles car park.

### Methodology

- 4.11 The demand forecasting methodology employed is consistent with that used in the March appraisal. That is use of:
- MOIRA to estimate changes due to timetable changes on existing markets;
  - a station catchment trip rate model for stations where the current service is limited; and
  - STPR external growth rates to give future year growth.
- 4.12 In this case the timetables submitted in MOIRA were more robust than in the March Appraisal, as they were the fully developed timetables described in Chapter 2 of this document. In particular, the impact of changes to services to Inverness was fully excluded from the March appraisal, as it had not been confirmed which changes were attributable to the scheme. Any such changes have now been incorporated in the timetables used in the MOIRA modelling.
- 4.13 As discussed above, the analysis of the O&D survey has helped to validate the catchment analysis described in the March appraisal report. As such the forecasts for the stations where the current service is limited remain unchanged.

### Summary of Results

- 4.14 Table 4-1 summarises the outcome of the demand forecasting, showing the incremental demand and revenue over the current timetable using 2008 base data. The table also shows the equivalent figures for the March appraisal.
- 4.15 In the work undertaken for this report, new rail demand is generated on both the enhanced Glasgow - Perth service and for the three options to provide service improvements to stations between Perth and Arbroath. As would be expected, for the enhanced Glasgow - Perth service, the greatest increase occurs from Stirling, Dunblane, Perth and Gleneagles travelling to Glasgow. However there are also good flows forecast from Dunblane and Perth to Stirling.
- 4.16 For the new service options between Perth and Arbroath, increases in MOIRA demand are seen over the same three routes for each of the options - Dundee to Perth, Arbroath and Carnoustie. The new services options also generate increased demand at existing stations which is calculated outside MOIRA. This again exhibits a similar pattern across the three options with increases in demand created to and from Broughty Ferry, Monifeith and Invergowrie.

TABLE 4-1 SUMMARY OF 2011/12 FORECAST DEMAND AND REVENUE IN 2007/08 PRICES

Option	Additional Journeys (000s)	Additional Revenue (£000s)
Package 1,2 & 4 Phase 1	79	411
Package 1 Phase 2	263	1,120
Package 2/4 Phase 2	312	1,224
Option 0 (Glasgow - Perth only)	41	203
Option 1	210	838
Option 2	265	1,030
Option 5	248	983

- 4.17 When these results are compared with the work undertaken in March, they are consistent, as would be expected. The differences in magnitude of the numbers can be explained by a combination of removal of the Sunday services and reduction in the hours of operation of the services, i.e. very early morning and late evening services. The impact of removing Sunday services reduces MOIRA demand by approximately 7% when it was undertaken as a sensitivity test.
- 4.18 The most significant impacts can be seen for the Glasgow - Perth element of the service. South-bound services are poorer in the revised timetable with no services between Perth and Glasgow at 09:37, 17:37 and 18:37 and no 08:11 from Glasgow to Perth. This is a significant percentage of services which no longer run during the peak shoulder periods.
- 4.19 In addition, the timetables developed for the March appraisal required numerous changes to Inverness services in order to provide a robust fit with the developing work on Highland Main Line services. In this study, Option 1 requires two changes to Inverness services and Options 2 and 5 only one each. It is therefore much easier to identify the impacts of changes to Inverness services in the MOIRA model giving higher confidence levels in the outputs of this set of demand forecasts. In the March appraisal the outputs of the MOIRA model were adjusted to reflect estimates of change to the Inverness services and it may be that not all benefits attributable to changes in the Inverness services have been removed. The March appraisal outputs remain robust because this was applied to all stages equally therefore all phases of the four packages are affected in the same manner.

## 5 Economic Appraisal

### Introduction

- 5.1 The process used to undertake the economic appraisal for the March report was repeated to produce new data for each of the revised options. The economic benefits are captured through an analysis of the impacts on transport users, both directly of the service and other transport users, for which there is a knock-on effect.
- 5.2 The economic impact of improvements on rail users has been summarised in terms of savings in time, or more specifically generalised journey time. This encompasses journey time, an element representing service frequency and an element representing the need to interchange. Benefits to users basically fall into two sub-groups:
- Existing users, whose travel patterns do not change, but who enjoy a time saving; and
  - Users diverted to rail from other routes, other modes, or from not travelling at all by an improvement in the (generalised) cost - estimated using the standard 'rule of a half'.
- 5.3 In addition to the user benefits, there are economic impacts on other, non-rail, transport users which have been captured. These benefits have been calculated by estimating the reduction in car trips consistent with the increase in rail demand diverted from car. The reduction in car trips results in improvements in accident rates, noise and local emissions. In addition there is a benefit in Greenhouse Gas (GHG) emissions. All of these benefits have been monetised using standard factors, consistent with STAG guidance.
- 5.4 The benefits described above and the financial impacts (both cost and revenue) described elsewhere have been included in a Transport Economic Efficiency (TEE) analysis, which is consistent with STAG. In particular:
- Capital costs for Invergowrie and Arbroath have been estimated in Q1 2009 prices and inflated by 2.5% pa in real terms until the assumed construction in 2011. The capital costs include a 44% optimism bias;
  - Appraisal period of 60 years from 2010;
  - Discounting at 3.5% for first 30 years and 3.0% thereafter;
  - All values discounted to 2002 price base;
  - Revenue and demand forecast until 2029 and then fixed for the rest of the appraisal period;
  - Time savings and car miles removed forecast until 2029 and then fixed for the rest of the appraisal period;
  - Values of time levels and growth consistent with STAG guidance;
  - Factors for calculating non-user benefits consistent with STAG guidance;

- Operating costs assumed to rise by 1% per annum in real terms throughout the appraisal period; and
- An optimism bias of 1% has been applied to the operating costs.

### TEE tables

- 5.5 Table 5-1 outlines the monetised costs and benefits for the three service options developed namely:
- Option 1: Hourly Glasgow - Perth with two hourly extension to Arbroath;
  - Option 2: Hourly Glasgow - Perth and hourly Perth - Arbroath shuttle services; and
  - Option 5: Hourly Glasgow - Perth with mix of through and shuttle services to Arbroath.
- 5.6 To aid clarity the last two columns contain the March appraisal outputs for Phase 2 of Packages 1 and 2/4.

### Analysis

- 5.7 The benefits generated by journey time savings for Options 1 and 2 are less than their equivalent packages in the March appraisal. Both options experience an equal but significant reduction in benefit due to the loss of Glasgow - Perth services in the peak shoulders as described in paragraph 4.18. The Perth - Arbroath services proposed for Option 2 are much the same as in the March appraisal and therefore the benefits are retained for these. However benefit generation for Option 1 compared with the March appraisal are further affected by the loss of through services from Glasgow - Arbroath at 07:06 and 19:11.
- 5.8 The capital and operating costs for both options reduce compared with the March appraisal. Revenue reduces proportionally more than operating cost for Option 2 and in the same proportion for Option 1. Accordingly the Benefit Cost Ratio (BCR) for both options reduces compared with the March appraisal.
- 5.9 Option 5 generates similar levels of revenue to Option 2 but with a similar annual cost to Option 1. Whilst providing overall a lower level of service than Option 2, good levels of user journey time benefits are still achieved for the Perth - Arbroath part of the corridor. This is due to the more numerous through trains to and from Glasgow and the good levels of service across the peak and peak shoulders. This in conjunction with the relatively small gap between annual opex and revenue in the early years of the service offsets the benefit loss in the Glasgow - Perth part of the corridor. The BCR remains comparable with that obtained in the March appraisal.
- 5.10 In the current economic climate, subsidy required from public funds is as important as generation of a positive BCR in making an investment case. Table 5-2 shows the level of subsidy output from the appraisal model as well as the “absolute” value (Revenue subtracted from Opex). It can be seen the new service timetables developed in this study have, in particular for Options 1 and 5, reduced the levels of subsidy required considerably from those forecast in the March appraisal. The table also demonstrates that all three service options still attract good levels of patronage.

TABLE 5-1 ANALYSIS OF MONETISED COSTS AND BENEFITS - INCLUDING GLASGOW - PERTH SERVICES

£'000s 2002 prices and values	Option 1	Option 2	Option 5	Package 1 Phase 2	Package 2/4 Phase 2
Noise	80	101	97	143	153
Local air quality	97	122	118	183	195
Greenhouse gases	134	170	163	245	263
Journey ambience	-	-	-	-	-
Accidents	982	1,243	1,193	1,763	1,889
Consumer users	39,632	58,637	53,393	81,321	90,412
Business users and providers	-	-	-	-	-
Reliability	-	-	-	-	-
Option values	-	-	-	-	-
<b>Present value of benefits (PVB)</b>	<b>40,925</b>	<b>60,274</b>	<b>54,964</b>	<b>83,655</b>	<b>92,912</b>
<b>Present value of costs (PVC)</b>	<b>21,659</b>	<b>31,612</b>	<b>17,827</b>	<b>27,167</b>	<b>34,769</b>
<b>Net present value (NPV)</b>	<b>19,265</b>	<b>28,662</b>	<b>37,137</b>	<b>56,488</b>	<b>58,143</b>
<b>Benefit to Cost Ratio (BCR)</b>	<b>1.9</b>	<b>1.9</b>	<b>3.1</b>	<b>3.1</b>	<b>2.7</b>

TABLE 5-2 SUBSIDY - INCLUDING GLASGOW - PERTH SERVICES

	Option 1	Option 2	Option 5	Package 1 Phase 2	Package 2/4 Phase 2
Forecast Patronage	210,000	265,000	248,000	263,000	312,000
BCR	1.9	1.9	3.1	3.1	2.7
Total Subsidy (appraisal output)	£17.72m	£26.78m	£13.2m	£21.0m	£28.09m
Annual OPEX	£1.61m	£2.26m	£1.61m	£2.17m	£2.59m
Annual Revenue	£0.84m	£1.03m	£0.98m	£1.12m	£1.22m
Annual subsidy	<b>£0.77m</b>	<b>£1.23m</b>	<b>£0.63m</b>	<b>£1.05m</b>	<b>£1.37m</b>

***Stand alone services***

- 5.11 The appraisal outputs described above clearly identify a key element of the positive business case generated in the March appraisal is the benefits accruing from the Glasgow - Perth service element, even in reduced form as proposed for introduction by Transport Scotland in 2010.
- 5.12 Further work was then undertaken to understand how well the proposed TERS enhancements perform when compared with the enhanced Glasgow - Perth service proposed for 2010, i.e. each service element considered independently:
- Option 0 - Enhanced Glasgow - Perth service as shown in Figure 2.1;
  - Option 1 - The additional services between Glasgow and Perth and Perth and Arbroath shown in green in Figure 2.2;
  - Option 2 - The additional services between Glasgow and Perth and Perth and Arbroath shown in green in Figure 2.3; and
  - Option 5 - The additional services between Glasgow and Perth and Perth and Arbroath shown in green in Figure 2.4.
- 5.13 In order to provide a fair comparison, full operating costs for Option 0 were calculated, i.e. the variable costs per mile plus costs for the advised requirement of seven drivers and guards. This increased the annual operating cost from the £399k used to calculate the appraisal outputs shown in Table 5-1 to £1,001k.

- 5.14 It should be noted the £399k value was used initially to maintain consistency with the assumptions underpinning the March appraisal. Use of the increased opex cost will provide a more realistic estimate of the actual cost of provision of the enhanced Glasgow - Perth service. However this means that the following tables are not directly comparable with the data in Tables 5-1 and 5-2, i.e. due to the change in opex cost for Option 0 compared with that used in the full service package appraisals above, the sum of Option 0 and Option 1, 2 or 5 is not comparable with the outputs in Tables 5-1 or 5-2.
- 5.15 Table 5-3 lists the monetised costs and benefits for the incremental enhancements provided by each service option, i.e. For the timetables shown Figures 2.2 to 2.4, Option 0 covers the services shaded in grey and the increment is the services shaded in green.

TABLE 5-3 ANALYSIS OF MONETISED COSTS AND BENEFITS - STAND ALONE SERVICES

£'000s 2002 prices and values	Option 0	Option 1	Option 2	Option 5
Noise	19	61	82	78
Local air quality	24	73	98	93
Greenhouse gases	32	102	138	131
Journey ambience	-	-	-	-
Accidents	232	750	1,012	961
Consumer users	24,806	14,826	33,832	28,588
Business users and providers	-	-	-	-
Reliability	-	-	-	-
Option values	-	-	-	-
<b>Present value of benefits (PVB)</b>	<b>25,113</b>	<b>15,812</b>	<b>35,161</b>	<b>29,851</b>
<b>Present value of costs (PVC)</b>	<b>20,565</b>	<b>14,798</b>	<b>24,751</b>	<b>12,131</b>
<b>Net present value (NPV)</b>	<b>4,547</b>	<b>1,013</b>	<b>10,410</b>	<b>17,720</b>
<b>Benefit to Cost Ratio (BCR)</b>	<b>1.2</b>	<b>1.1</b>	<b>1.4</b>	<b>2.5</b>

- 5.16 Table 5-4 shows the level of subsidy output from the appraisal model as well as the “absolute” value (Revenue subtracted from Opex) for each service appraised on a stand alone basis.

TABLE 5-4 SUBSIDY - STAND ALONE SERVICES

	Option 0	Option 1	Option 2	Option 5
Forecast Patronage	41,000	166,000	222,000	204,000
BCR	1.2	1.1	1.4	2.5
Total Subsidy (appraisal output)	£19.63m	£11.80m	£20.85m	£8.44m
Annual OPEX	£1.0m	£1.21m	£1.87m	£1.22m
Annual Revenue	£0.2m	£0.64m	£0.83m	£0.78m
Annual subsidy	£0.8m	£0.57m	£1.04m	£0.44m

### Analysis

- 5.17 It can be seen that all service elements generate a positive BCR, although Option 5 is significantly higher than the other.
- 5.18 The value of the journey time benefits brought by the enhanced Glasgow - Perth service can now clearly be seen in the data for Option 0. This is an enhancement to an existing service, effectively doubling the off peak frequency from hourly to half hourly. There is a large existing market for this service all of whom achieve good levels of journey time savings. This results in generation of high levels of benefit and a positive BCR despite relatively modest increases to forecast patronage and revenue. Options 1, 2 and 5 are effectively new services therefore the journey time savings generated by the appraisal is substantially formed of new patronage. The proportions of user benefits for each of these service options remain similar to those calculated for the full services and reflect the service levels being provided. A point to note is the two hourly service between Perth and Arbroath generates less than half the user benefits of an hourly shuttle (refer to User Benefits in Table 5.3). In comparing with the March appraisal outputs it can now be seen the good BCR generated for Package 1 - Phase 2 was driven by the Glasgow - Perth service element and not the Perth - Arbroath element. This validates the decision of Package 2 - Phase 2 being the preferred option despite having a lower BCR, because the benefits are more evenly shared across the length of the corridor.
- 5.19 Option 2 has a low BCR due to high operating costs resulting in a significant subsidy requirement. This is, in part, caused by the current requirement for three DMU's to operate the service and the BCR would improve if diagrams were developed to deploy an efficient two unit operation. Option 2 does provide the highest consumer user benefits of all options.

- 5.20 Option 5 performs well because of its low operating cost base whilst also generating reasonable levels of user benefit - twice as much as Option 1 and around 20% less than Option 2.
- 5.21 Option 0 has an average journey fare of £4.95 reflecting the large number of longer distance journeys this route will attract. Options 1, 2 and 5 have a smaller average journey fare in the range £3.74 to £3.86, reflecting the shorter journeys. Options 1 and 5 have a higher average journey fare reflecting the more numerous through services to Glasgow provided by their timetables compared with Option 2. The O&D data supplied by TACTRAN from its March 2009 surveys show there is a willingness from the communities of Broughty Ferry and Monifieth to travel to Dundee by other means in order to make a rail connection. As with the March appraisal, our forecasts are reduced by approximately 35% to account for abstraction, i.e. people already making journeys by rail.
- 5.22 Whilst Options 1 and 5 have similar operating costs, the increased patronage attracted by the Option 5's better level of service across the morning and evening peaks results in a 22% higher revenue. This directly impacts the subsidy requirement in both absolute annual terms and over the 60 year appraisal period. Option 2 attracts the highest patronage and generates most revenue of the three service options. However this is outweighed by high operating costs as a result of the annual mileage and the need to use three units to provide this level of service. Option 2 therefore requires the largest subsidy level.
- 5.23 The final point to note is the fact that Option 0 is a critical component for the success of service enhancements between Perth and Arbroath. Without an enhanced Glasgow - Perth service, the Perth - Arbroath elements of Options 1, 2 and 5 would not be economically viable. Conversely Option 5 in particular provides a very cost effective means of doubling the benefits obtained from an enhanced Glasgow - Perth service - the benefits are doubled and revenue almost quadrupled for an increase in subsidy of around 50%.

## 6 Preferred Option

### Introduction

- 6.1 This report has identified a number of means through which the TERS service could be started up at less cost than forecast in the March appraisal, whilst still delivering good levels of benefits and a high cost benefit ratio.
- 6.2 Through the support of First ScotRail and Network Rail, estimates of capital expenditure for works required at Arbroath and Invergowrie to support a new service have reduced from £1,038k to £450k, including 44% optimism bias.
- 6.3 Three new service timetables have been developed from the two good performing short term options from the March appraisal:
- Option 1: Hourly Glasgow - Perth with two hourly extension to Arbroath (equivalent to Package 1 - Phase 2 of the March appraisal);
  - Option 2: Hourly Glasgow - Perth and Perth - Arbroath shuttles (equivalent to Package 2/4 - Phase 2 of the March appraisal); and
  - Option 5: Combination of options 1 and 2 with a mix of through and shuttle services.

### Analysis

- 6.4 By removing a Sunday service and late evening services, operating costs have been reduced. Compared with the estimates developed in the March appraisal, these have reduced by 26% for Option 1 and 13% for Option 2 compared with Phase 2 of Package 1 and Package 2/3 respectively.
- 6.5 The new timetable (Option 5) developed as a mix of through services between Arbroath and Glasgow and shuttle services between Arbroath and Perth has costs comparable with those developed for Option 1. Moreover Option 5 provides a better level of service across the TACTRAN corridor during the morning and evening peak and peak shoulder periods and retains better flexibility to work around developing Highland Main Line timetable requirements compared with Option 1. Option 2 still provides the best overall level of service and can be independently timetabled from Highland Main Line services.
- 6.6 As would be expected, the high service levels provided by Option 2 attract the highest levels of forecast patronage and revenue. Option 1 still performs well but the two hourly service frequency reduces patronage by around 20% compared with Option 2. Patronage for both options is reduced by compared with the “full” service levels forecast in the March appraisal but with Option 2 slightly less affected - a 16% reduction compared with 20% for Option 1. Due to the good level of service across the morning and evening peaks, Option 5 manages to attract only slightly less patronage than Option 2, and considerably more than Option 1.
- 6.7 The low operating cost and relatively high forecast revenues result in Option 5 requiring the lowest level of subsidy and generating the best BCR from the three options considered.

- 6.8 Option 5 also has the advantage that it requires least resources to start up, i.e. only one unit required, compared with the two for Option 1 and three for Option 2. The preferred option is therefore Option 5 as summarised in Table 6-1 below.

TABLE 6-1 PREFERRED OPTION

	BCR	Subsidy	Revenue	Opex	Subsidy annual
Option 5	3.1	£13.2m	£0.98m	£1.61m	£0.63m

- 6.9 Please note the above outputs are based on the same assumptions as used in the March appraisal. The only costs for the Glasgow- Perth service element are the variable (or mileage) related costs, equating to £399.28k. The working assumption in the March appraisal recognised Transport Scotland would fund traincrew and rolling stock costs. From dialogue with First ScotRail we understand the new Glasgow - Perth service will require to be resourced by seven drivers and guards. A more realistic picture of the performance of the TERS services compared with others is given when the cost and revenue estimates for both service elements are viewed separately. This is shown in Table 6-2 and the Glasgow - Perth element now includes traincrew as well as mileage based costs.

TABLE 6-2 PREFERRED OPTION - DISAGGREGATED INTO SEPERATE SERVICE ELEMENTS

Option 5	BCR	Subsidy (appraisal)	Revenue	Opex	Subsidy (annual)
Glasgow - Perth (Option 0: TS funded services)	1.2	£19.63m	£0.2	£1.0	£0.8
Extending service to Arbroath	2.5	£8.44m	£0.78m	£1.22m	£0.44m

- 6.10 Reviewing each service element separately shows the proposed enhancement to Glasgow - Perth services does generate good benefits and requires a reasonable level of subsidy. By contributing more resource (in the form of a further seven drivers and guards and one DMU in the morning and evening peak) a better performing service element is created, both in terms of BCR and subsidy level. Effectively the Glasgow - Perth service generates very good levels of user benefits through journey time savings, albeit for a relatively small patronage. However the Arbroath to Perth element generates a significantly larger patronage and therefore revenue. Journey time savings for this are good but proportionally not as high as for the Glasgow - Perth service element. However due to the efficient recycling of available resources, opex costs are relatively low and the attracted patronage generates good revenue levels. Therefore the subsidy required for this additional service element is close to half of that required for the Glasgow - Perth service provided through Option 0.

## Conclusion and Next Steps

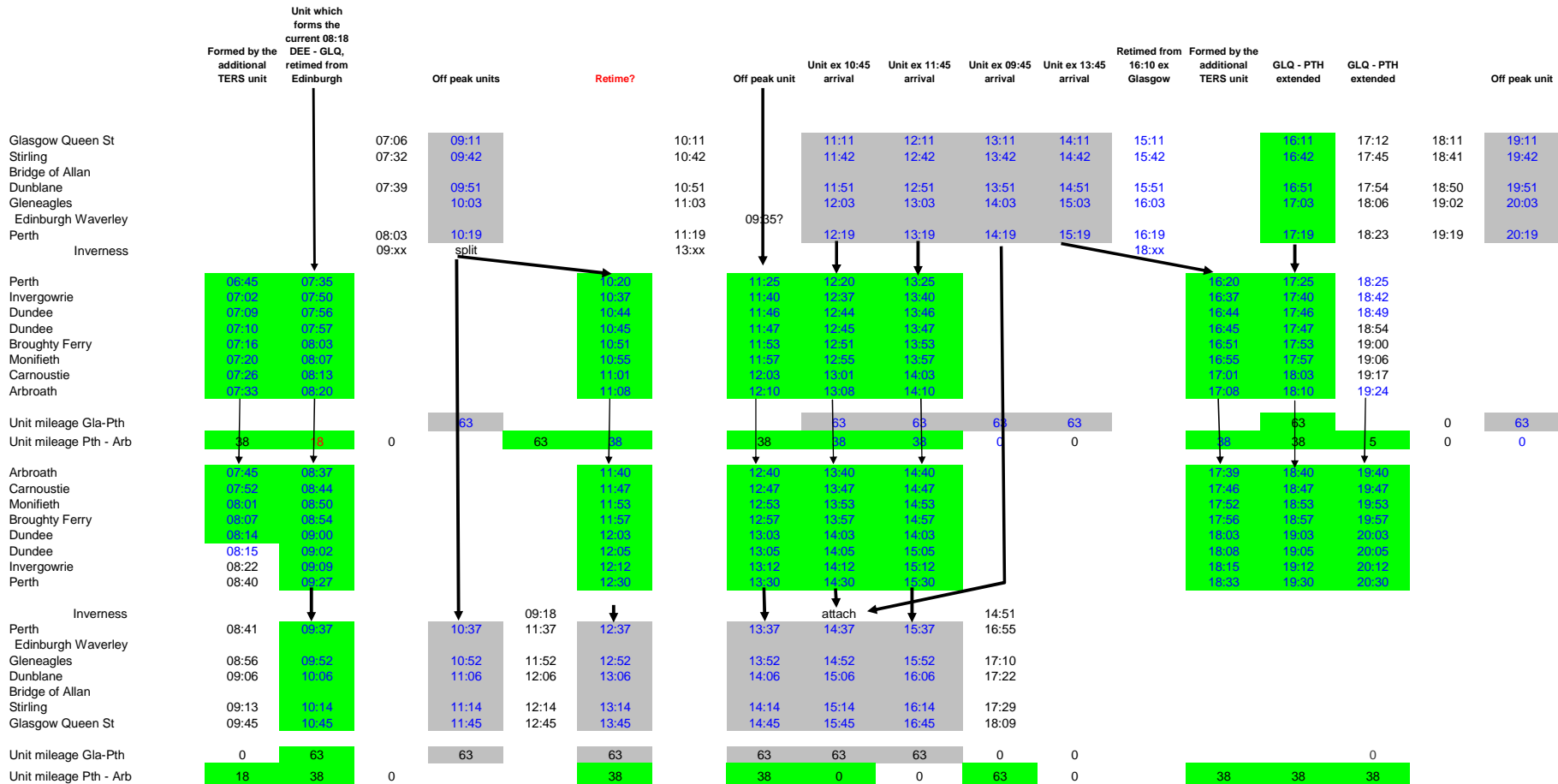
- 6.11 The Transport Scotland funded enhancements to Glasgow - Perth services due to commence in 2010 will deliver good benefits. Adding some more services which improve links between Arbroath and Dundee and Perth and Glasgow results in a trebling of the forecast benefits. The additional service element still requires a subsidy but this is estimated to be less than £500k per annum in the start up phase. The additional service element as shown by Option 5 complements the enhanced Glasgow - Perth service (Option 0) to the benefit of almost five times more people in the TACTRAN area at a relatively low cost - half of that forecast for introducing Option 0 alone.
- 6.12 In order to commence enhanced Glasgow - Perth services in 2010, Transport Scotland will have to instruct First ScotRail to commence preparation and bidding for timetable paths by September 2009. Preliminary decisions will also have to be made around this time on the potential deployment of the five DMU's currently used on the Bathgate - Edinburgh route which will be displaced by the new Airdrie - Bathgate services from December 2010. A key factor in identifying Option 5 as the preferred start up solution is the requirement for only one additional DMU to provide the proposed morning and evening peak hours service linking Arbroath to Glasgow.
- 6.13 It is suggested that when TACTRAN submit the TERS STAG Type appraisal to Transport Scotland for review, they refer to the fact that further work has been undertaken and a more cost effective start up scenario has been identified. A key element to successful implementation of Option 5 during 2011 is for the scheme to be on the "short list" as a candidate to be allocated one of the DMU's to be redeployed. The process to review cascade of these vehicles will take place during Summer 2009 in order to allow preparation time for timetable development, staff recruitment and training, if required.
- 6.14 This suggestion, if adopted by Transport Scotland, would provide a cost effective and resource efficient means of starting up a TERS service. Once further resources became available it is recommended the service levels are increased to that of the Option 2 timetable as an hourly Perth - Arbroath shuttle generates the largest benefits of all short term options studied. This service would further improve the attractiveness of rail as a transport option to the population of the study corridor. The optimum time to introduce the full shuttle timetable would be to coincide with the new Highland Main Line timetable as the resources to provide both services can be interworked. This provides the best opportunity to allow the hourly Perth - Arbroath shuttle to work as an efficient two unit operation.

**APPENDIX**

**A**

**OPTION 5 TIMETABLE - DRAFT RESOURCING**

# Review of Start Up Services



GLQ - ARB direct	09:11	11:11	12:11	16:11	
ARB - GLQ direct	07:45	08:37	11:40	12:40	17:39

KEY	New services to be introduced in 2010 - Transport Scotland funded	693 miles / day	216,216 miles / year
	Proposed new TERS services	767 miles / day	245,544 miles / year
	Existing services in the December 2008 timetable.		
	New stops inserted into existing services		
	Through service		

## CONTROL SHEET

**Project/Proposal Name** Extended Tay Estuary Rail Study

**Document Title** Review of Start Up Services

**Client Contract/Project No.**

**SDG Project/Proposal No.** 22093501

## ISSUE HISTORY

Issue No.	Date	Details
1	17/6/09	First issue
2	24/6/09	Second issue

## REVIEW

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