PRTF: Northern Route Workstream

Devon County Council

Assessment of Scheme Costs and Benefits

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Contents

1. Introduction

1.1.1 Devon County Council (DCC) commissioned Jacobs to undertake an assessment of the Peninsual Rail Task Force (PRTF) Northern Route scheme. This project seeks to identify the conditions required for a sustainable railway serving the South West peninsula and the likely conclusions of an Economic Case, were a bid for funding to Central Government to be made.

1.2 Background

1.2.1 Following a breach of the railway at Dawlish caused by extreme weather in February 2014, the Government commissioned Network Rail to report on options to maintain a resilient rail service to the South West peninsula in the event of extreme weather events occurring again. The study forms a part of Network Rail's Long Term Planning Process.

1.2.2 Several options were identified in addition to strengthening the existing route and appraisal work was commissioned by Network Rail to assess the outline business case for each of the seven potential diversionary routes it identified. Economic appraisal of the alternative route options, consistent with Department for Transport (DfT) WebTAG guidance, demonstrated that each option represents poor value for money.

1.2.3 However, the assessments were undertaken under the assumption that the alternative routes would replace the Dawlish line for travel between Exeter and Plymouth and beyond. The appraisal focussed on the costs and benefits of providing an improved service from Exeter to Plymouth and the resilience benefits brought about by reduced disruption.

1.2.4 This report revisits several of the assumptions underlying the assessment of Option 3 (Alternative Route A) - a reinstated railway via Tavistock and Okehampton along the former London and South West Railway route. The principal change is that the function of the Northern Route is no longer to bypass Dawlish and provide main-line rail connectivity between Exeter and Plymouth via Okehampton. Instead its proposed function is to provide a modest service serving local stations with a diversionary capability should disruption at Dawlish take place.

1.2.5 Detail of the assumptions made, methodology and results are discussed later in this report. The proposed route includes six potential new station locations: Tavistock, Lydford, Sourton Parkway, Okehampton East, North Tawton and Bow as well as the existing station at Okehampton which presently is served by a summer only Sunday service.

2. Costs

2.1 Introduction

2.1.1 This chapter examines the potential cost of reinstating the rail link based on recent rail schemes and previous estimates.

2.2 Network Rail estimated costs

2.2.1 The cost of Alternative Route A with double track throughout and a high operating speed was estimated by National Rail at £875m, including 66% uplift for optimism bias / contingency. The estimated cost per mile of the works, without flood risk alleviation, is broadly comparable to those for the Borders Rail and Airdrie-Bathgate projects in Scotland. However a higher proportion of viaducts and bridges on Alternative Route A, including Meldon viaduct, was assumed to increase costs.

2.2.2 Raising the track level through areas of flood risk was calculated to cost up to £290m in a worst case scenario, in addition to the £875m identified for core works. This estimate was considered high, as it takes into account the greatest volume of additional works that might be required, and assumes relatively high unit rates.

2.3 Borders Railway per km costs

2.3.1 The Borders Railway connects the city of Edinburgh with Galashiels and Tweedbank in the Scottish Borders. Building works began in November 2012. Passenger service on the line began on 6 September 2015. The railway was rebuilt as a non-electrified, largely single-track line. Several surviving Waverley Route structures, including viaducts and tunnels, were rehabilitated and reused for the reopened railway. Passenger services run half-hourly on weekdays and hourly at weekends. The final project cost is quoted at £294m (2012 prices) and included 30 miles (48km) of new track and seven new stations.

2.3.2 Using a simple per km cost from the Borders Railway, the 25km line extension between Okehampton and Tavistock is estimated to cost in the region of £150m (excluding Optimism Bias). A further £157m allowance for structures and £15m for land have been made. With 66% uplift for optimism bias, a total scheme estimate of £535m has been estimated for the section between Okehampton and Tavistock.

2.4 Preliminary Devon County Council cost estimate

2.4.1 Devon County Council is in the process of promoting the reinstatement of the rail route between Tavistock and Bere Alston. The 5.5 mile (8.8km) stretch of railway line was taken out of use in 1968, and the reinstatement would see the return of direct services between Tavistock and Plymouth. Current cost estimates of approximately £60m (including 66% Optimism Bias and an additional allowance for signalling) for the Tavistock to Bere Alston line have been used to estimate the costs of reinstatement between Tavistock and Okehampton. Using a similar cost per km approach and making an allowance for structures and land, a total scheme estimate of £448m has been estimated for the section between Okehampton and Tavistock.

2.5 Conclusion

2.5.1 Using data from two separate rail reopening schemes, it is suggested that the cost estimate used by Network Rail, which assumes a double track high specification line between Exeter and Plymouth, can be reduced significantly if a lower standard of route is constructed.

2.5.2 For the remainder of this report, a full route cost between Exeter and Plymouth of £510m has been assumed as the zero cost has been assigned to the route section between Okehampton and Exeter. The cost of the section between Okehampton and Tavistock is assumed to be £450m.

3. Potential Patronage

3.1 Overview

3.1.1 Two methodologies have been employed to predict future patronage figures. These are as follows:

- Mode choice logit modelling
- Propensity to travel

3.1.2 These methodologies are documented in the following section.

3.2 Methodology 1

3.2.1 The identification of travellers transferring away from car and bus modes to a new rail route between stations from Tavistock (exc.) to Okehampton (inc.) was achieved from the analysis of roadside interview (RSI) data at sites that intercepted car journeys that would potentially be attracted to using the new rail service. The RSI sites used were on the A386 just south of Tavistock that intercepted car journeys to Plymouth and on the A377 Alphington Road, the B3212 Dunsford Hill and the A377 Cowley Bridge Road that intercepted car journeys to/from Exeter.

3.2.2 Potential rail trips were identified from the RSI data, using grid references, as being car trips with both origins and destinations within 2km of the existing and proposed stations (paragraph 1.2.5, excluding Tavistock) on the Northern Route rail service and in Exeter and Plymouth (crow-fly distances).

3.2.3 Car trips transferring to rail from the Tavistock area have not been included in the assessment. This is considered to be appropriate because the costs calculated in section 2 only cover the reinstatement of track between Tavistock and Okehampton. The station at Tavistock and the route between Bere Alston and Tavistock is assumed to form a separate but intrinsic prerequisite to this scheme.

3.2.4 The predicted trip movements that would use rail were estimated using a mode choice logit model. The model proportions journeys between car and rail based on generalised time differences. Generalised time is the sum of walk, wait and rail/car in vehicle time plus rail fare/parking charge converted to equivalent minutes using values of time by trip purpose. Model parameters calibrated for the Gunnislake line, derived from 2001 Census journey to work (JTW) data were used with the A386 Tavistock RSI. Standard mode choice model values from the Tavistock to Bere Alston studies were used with the Exeter RSIs.

3.2.5 Census journey to work data was also analysed to provide a check on the RSI analysis and to provide additional data. 2001 Census journey to work data by residence and employment output area was analysed to identify car work trips with the potential to transfer to rail, defined as having both origins and destinations within 2km of the existing and proposed stations on the Northern Route rail service but not travelling into Exeter and Plymouth. The mode choice logit model with standard parameter values was then used to identify movements that would be likely to transfer to rail. This approach does not take into consideration newly generated trips due to the service being provided rather than just switching existing trips from one mode to another.

3.2.6 The rail passenger demand forecasts for work journeys derived from Census data were then combined with those derived from RSI data. The resulting rail passenger demand forecasts represented typical weekday daily volumes subdivided by journey purpose in the form of station to station matrices. Origin to destination matrices for distance, rail journey time, rail fare and parking charge were also produced for the economic assessment.

3.2.7 Full detail of the methodology has been provided by Devon County Council and is provided in Appendix A.

3.2.8 A total annual patronage in 2021 of 164,000 has been estimated during this analysis, using a standard daily patronage to annual patronage conversion factor of 288 and through application of TEMPro growth factors. This is broken down in Table 3.1 as follows:

Table 3.1: 2021 Forecast Daily Trips (One-Way), Methodology 1

	Source	Year	Estimated Daily Trips	TEMPro Growth Factors	2021 Forecast Daily Trips
To / from Exeter	Alphington Road (Exeter) RSI	2010	104	1.0991	115
	Dunsford Road (Exeter) RSI	2004	19	1.1692	22
	Cowley Bridge Road (Exeter) RSI	2004	70	1.1692	82
To / from Plymouth	A386 (Plymouth) RSI Data	2009	16	1.1079	18
Other stations	Census JTW Data	2011	226	1.0904	246
Bus	Census JTW Data	2011	80	1.0904	87

3.3 Methodology 2

3.3.1 Passenger demand can alternatively be estimated based on a simple propensity to travel assessment. This assessment is based on populations within 1km and 2km distance bandings away from the proposed stations. The assessment includes the likely demand from Tavistock as revenue from this station will be used to support the full service between Plymouth and Exeter.

3.3.2 Forecast population for the year 2021 was generated using GIS mapping, based on the 2011 Census Data, to determine the population of each station catchment within a 1km and a 2km buffer zone. The population for each station location was then converted to 2021 forecast population figures using a growth factor generated by TEMPro, which is DfT's standard tool to forecast population, employment, trip ends and simple traffic growth factors. The catchment population for each station location is shown in Table 3.2. Account has been taken of overlapping catchment areas e.g. at Okehampton and Okehampton East to avoid double counting.

Table 3.2: Population of station locations

Station Locations	Population (2021)		Total Population
	1km Buffer Zone	2km Buffer Zone	
Tavistock	5,800	6,500	12,200
Lydford	300	100	400
Sourton Parkway	100	200	300
Okehampton	4,400	1,700	6,100
Okehampton East	100	1,100	1,200
North Tawton	50	400	400
Bow	100	1,300	1,400

3.3.3 To determine the forecast demand for each station, a proxy value of the propensity to travel was generated from a sample of 22 existing stations located in South West England and 98 stations located in rural Wales. A proxy value for 1km and 2km was calculated from the total usage of the stations, provided by the Office of Rail and Road publication 'Estimates of Station Usage 2014-2015', and the population of each station in the sample within 1km and 2km buffer zones using statistical analysis.

3.3.4 Table 3.3 shows the propensity to travel by rail (expressed as a number of annual trips per person) values used as a proxy to determine the annual demand for each proposed station in the study:

Table 3.3: Propensity to travel by rail – annual trips per head by distance from station

Sample Location	Number of stations in sample	Propensity to travel by rail (1km)	Propensity to travel by rail (2km)
South West England	22	23.30	19.35
Wales	98	19.98	15.04
Average:		**21.64**	**17.19**

3.3.5 The table above shows the propensity to travel by rail for each buffer zone from both samples, and an average was calculated, which was then applied to the stations under consideration in the study.

3.3.6 Applying the average propensity to travel by rail to the stations in the study, results in the following annual demand shown in Table 3.4. It is recognised that Sourton Parkway may have a much larger catchment area, but a conservative approach has been taken and demand has been considered only for its immediate catchment area.

3.3.7 Given the proposed frequency of train service, slow journey times (compared to road) and relatively low cost of parking in Exeter and Plymouth it is not envisaged that a park and ride service would be that attractive except at times of peak travel, eg Christmas and summer tourist period.

3.3.8 The level of demand projected can be handled by the proposed level of service.

Table 3.4: Total demand (annual patronage) of proposed local stations

Station	Estimated demand from the catchment area (2021)		Total demand
	1km	2km	
Tavistock	125,000	111,000	236,000
Lydford	7,000	2,000	9,000
Sourton Parkway	2,000	3,000	5,000
Okehampton	95,000	29,000	125,000
Okehampton East	2,000	19,000	22,000
North Tawton	1,000	7,000	8,000
Bow	2,000	22,000	24,000
Total	235,000	193,000	428,000

3.4 Validation of Approaches

3.4.1 The two approaches, on first inspection, have yielded a wide range of forecasts for patronage of the Northern Rail Route. However, methodology 1 excludes travel from Tavistock, whilst methodology 2 does not. With figures for Tavistock removed from the analysis, methodology 2 yields an annual patronage of 192,000. This is broadly equivalent to the 164,000 annual patronage predicted using methodology 1.

3.4.2 Even with good agreement in the two methodologies, it was felt to be prudent to check the results for realism and give an indication of how optimistic or pessimistic these forecasts might be.

3.4.3 The first exercise has been to validate methodology 2 against the Borders Railway scheme, where in the first four and a half months since opening passenger figures show that 537,000 journeys have been made[1].

3.4.4 Each Borders Railway station has been analysed, and the population within 1km and 2km has been identified. For stations where overlapping of buffers occurred, the station with the shortest distance was assigned the headcount. The results are given in Table 3.5.

[1] http://www.scotsman.com/news/transport/borders-railway-carries-500-000-passengers-in-fewer-than-5-months-1-4014234

Table 3.5: Population of station locations for Borders Railway

Station Code	Station Name	Population within 1km	Population within 2km
1	Shawfair	176	8,604
2	Eskbank	3,792	13,897
3	Newtongrange	4,797	11,556
4	Gorebridge	4,821	6,527
5	Stow	728	791
6	Galashiels	6,087	9,589
7	Tweedbank	2,298	6,139

3.4.5 Populations have further been converted into annual journeys; the results are given in Table 3.6.

Table 3.6: Total Demand of Proposed Borders Railway Stations

Station Name	Estimated demand from the catchment area (2021)		
	Population within 1km	Population within 2km	Total Demand
Shawfair	3,809	152,033	155,841
Eskbank	82,059	245,560	327,619
Newtongrange	103,807	204,195	308,002
Gorebridge	104,326	115,332	219,659
Stow	15,754	13,977	29,731
Galashiels	131,723	169,438	301,160
Tweedbank	49,729	108,476	158,205

3.4.6 The total demand for all stations is predicted to be1,500,000 passengers per annum, which is equivalent to the pro-rated demand (1,432,000 passengers per annum) taken from records from the first four and a half months since opening.

3.4.7 Additional comparisons have also been made on the relative offering of rail over car between the Borders Railway and the Northern Rail Route which are shown in Table 3.7.

Table 3.7: Relative Offerings of Northern Rail Route and Borders Railway

	Parking Costs	Car journey times	Train journey Times	Population
Borders Railway	Edinburgh typically £15-20	1 hour to 1 hour 20 mins Tweedbank to Edinburgh	1 hour to 1 hour 10 mins Tweedbank to Edinburgh	Edinburgh – 500,000 Eskbank – 5,600 Newtongrange – 5,000 Gorebridge – 5,800 Stow – 3,400 Galashiels and Tweedbank – 15,000
Northern Rail Route	Exeter and Plymouth typically £5-£10	30 to 40 minutes - Okehampton to Exeter	1 hour + Okehampton to Exeter	Exeter - 118,000 Bow – 1,100 North Tawton – 1,750 Okehampton – 5,850 Sourton – 420 Lydford – 400 Tavistock – 11,000 Plymouth – 256,000

3.4.8 It is therefore important to note that the relative offerings of the Northern Rail Route and Borders Railway are quite different when compared to car. For this reason, the higher patronage figures predicted using methodology 2, despite the methodology yielding results which are consistent with the Borders Railway, should be considered to be optimistic.

3.4.9 Patronage figures yielded from methodology 2 have nevertheless been used in the remainder of this study in order to understand an upper bound for the relative merits of the PRTF Northern Route.

4. Fare Revenue and Operating Costs

4.1 Overview

4.1.1 If projected demand does not generate sufficient revenue to cover day to day operating costs, then an estimate is made of the additional number of passengers required to reach a break-even point and hence the number of additional households required to generate that additional demand within a 2km catchment area of each station location.

4.2 Benefits

4.2.1 Total revenue for each station is calculated using the total annual demand estimated for each station in section 3 and expected average fares. Most passengers will travel locally and in line with other local services; the main demand is expected to be to Plymouth and Exeter with minimal local demand between stations. To simplify matters passengers are assumed to travel to their nearest major city.

4.2.2 To calculate the fare for each station travelling to/from Plymouth or Exeter, the fare structure provided by Devon County Council has been used. The average fare paid and expected destination is as shown in Table 4.1.

Table 4.1: Fare structure of stations for consideration in the study

Station	Fare price to/from (2016 prices)		Destination
	Plymouth	Exeter	
Tavistock	£2.63	£3.91	Plymouth
Lydford	£3.27	£3.27	Plymouth
Sourton Parkway	£3.59	£2.95	Exeter
Okehampton	£3.91	£2.63	Exeter
Okehampton East	£3.91	£2.63	Exeter
North Tawton	£4.08	£2.46	Exeter
Bow	£4.15	£2.39	Exeter

4.2.3 This then gives base revenue as shown in Table 4.2 for each proposed station.

Table 4.2: Total revenue

Station	Revenue (£)
Tavistock	621,000
Lydford	30,000
Sourton Parkway	17,000
Okehampton	328,000
Okehampton East	57,000
North Tawton	18,000
Bow	57,000
Total	1,128,000

4.2.4 This approach assumes that the only revenue attributable to the service is that which relates to travel on it. However, the service will generate a considerable amount of through traffic via connections at Plymouth and Exeter. The amount of revenue generated by branch lines for journeys that go beyond the branch varies considerably from location to location based on the area's attractiveness and frequency of service. Based on other branch lines in the area it would not be unreasonable to assume that revenue from onward trips could double that shown and this assumption has been used for sensitivity.

4.3 Costs

4.3.1 The operating cost comprises of train and station operating costs, as shown in Table 4.3:

Table 4.3: Operating Costs

Annual Operating Costs (£)	
Train Operating Costs[2]	
Track access	£46,000
Fuel consumption	£468,000
Vehicle leasing	£484,000
Drivers	£1,584,000
Guards	£1,037,000
Station Operating Costs[3]	
Station	£300,000
Total	**£3,918,000**

[2] Source: Rail way industry sources
[3] Source: Devon County Council, assuming operating cost for each station (excluding Okehampton) is £50,000

4.3.2 The vehicle leasing costs and fuel consumption costs are based on a two-car Class 158. A total of six units are required to operate the service with just under 28 train crew (driver and guard/conductor) to operate the total number of annual shifts, plus an additional crew member is budgeted for to cover sickness and training. Salaries for train crew reflect present rates for drivers and guards in the area with a 20% uplift to cover employers' national insurance and pension contribution. Intermediate stations are assumed to be unstaffed and no additional dispatch staff at Plymouth or Exeter or cleaning staff required. Station costs are based on leasing charges and basic operating costs such as lighting, cleaning etc.

5. Break-even analysis

5.1 Comparison of Revenues and Costs

5.1.1 With core revenue of £1.1m and costs of £3.9m there would need to be a substantial increase in demand to reach a break-even position. Revenue would need to increase by £2.8m to break-even; therefore additional demand needs to be generated on the scale shown in Table 5.1. This shows an additional 25,700 households are needed in order to generate the revenue to break-even, so a massive house building programme. Using a very optimistic build out rate of 400 housing units per year in each of Tavistock, Okehampton and across the rural areas this would take some 20 years to deliver.

Table 5.1: Additional demand

Station	Base Population (2021)	Estimated population to break-even (2021)	Required change in population	Required change in household[4]
Tavistock	12,200	42,500	30,300	14,300
Lydford	400	1,600	1,100	500
Sourton Parkway	300	900	600	300
Okehampton	6,100	21,200	15,100	7,100
Okehampton East	1,200	4,300	3,100	1,400
North Tawton	400	1,500	1,100	500
Bow	1,400	4,700	3,400	1,600
Total	22,000	76,700	54,700	25,700

5.1.2 Assuming the railway can capture the additional revenue for off branch trips then revenue increases to £2.2m and revenue per passenger is double that used in the core scenario. This leads to a much smaller increase in population and households that would be required, reducing to just 7,600 additional households. This could, under the above very optimistic build out rates, be achieved within around 6-7 years.

[4] Number of additional households needed calculated from required change in population, divided by the average number of occupants per household, 2.12.

Table 5.2: Additional demand under high revenue scenario

Station	Base Population (2021)	Estimated population to break-even (2021)	Required change in population	Required change in household[5]
Tavistock	12,200	21,200	9,000	4,200
Lydford	400	700	300	100
Sourton Parkway	300	500	200	100
Okehampton	6,100	10,600	4,500	2,100
Okehampton East	1,200	2,100	900	400
North Tawton	400	700	300	100
Bow	1,400	2,400	1,000	500
Total	22,000	38,200	16,200	7,600

[5] Number of additional households needed calculated from required change in population, divided by the average number of occupants per household, 2.12.

6. Cost Benefit Analysis

6.1 Overview

6.1.1 To help in understanding the value of the PRTF Northern Route, a preliminary cost benefit analysis of the new route was completed. This uses the costs as derived in section 2, and benefits accrued from a number of areas as follows:

- Rail User Transport Economic Efficiency
- Marginal External Costs to Road Users
- Resilience Benefits
- Option Values

6.2 Costs

6.2.1 The approximate costs quoted in section 2 (the lower value of £450m) have been converted to 2010 prices and discounted to 2010 as follows:

- Converted to 2010 prices using a GDP deflator of 101.2 for 2015 and 92.80 for 2010.
- Discounted to 2010 prices using a discount rate of 3.5% per annum.

6.2.2 Operating costs of £3.918m per annum have been assumed across the full 60 year appraisal period. These have been converted to 2010 prices and discounted to 2010 as follows:

- Converted to 2010 prices using a GDP deflator of 101.2 for 2015 and 92.80 for 2010.
- Discounted at 3.5% for years 1 to 30 and 3.0% for years 31 to 60.

6.2.3 All costs have been assigned to central government, given that operating costs are effectively paid through franchise negotiations with train operating companies. All costs have also been entered as factor costs; these have been converted to market prices through application of an indirect taxation factor of 1.19.

6.2.4 The above inputs yield a Present Value of Costs of £383m (2010 prices discounted to 2010).

6.3 Rail User Transport Economic Efficiency

6.3.1 TUBA (Transport User Benefit Appraisal) v1.9.6 has been used to quantify the travel time and vehicle operating costs (VOC) benefits accrued by new rail users transferring from car and bus. The TUBA approach also quantifies changes to indirect tax revenues to central government, brought about by changes to expenditure on fuel duty and VAT.

6.3.2 All benefits and costs (capital and operating) costs have been converted and discounted to the DfT's standard economic base year of 2010.

6.3.3 A series of matrices for input to TUBA have been derived as follows:

- travel times: consistent with patronage calculations under methodology 1, with 10 minutes delay added to each Exeter and Plymouth car journey both into and out of the city centres, to reflect possible future congestion in the urban areas brought about by future traffic growth;
- distances: consistent with patronage calculations under methodology 1;
- charges: consistent with patronage calculations under methodology 1;
- trip matrices: OD patterns consistent with patronage calculations under methodology 1 but factored to overall patronage calculated under methodology 2, thereby giving an upper bound estimate of benefits.

6.3.4 A summary of results has been provided in Table 6.1. Note that all values are quoted as benefits in 2010 prices discounted to 2010.

Table 6.1: Summary of Appraisal Benefits

Quantity	Mode	£000s	Commentary
Travel Time	Car	-48,341	Large individual travel time increases brought about by transferring from uncongested A30 to rail which includes interchange times and longer access and egress times.
	Bus	633	Rail trips marginally faster than bus trips.
Vehicle Operating Costs	Car	10,563	Reduced car use leads to reduced fuel and other vehicle expenditure.
	Bus	0	No vehicle expenditure for bus or rail users.
User Charges	Car	-2,724	Savings for some trips as passengers no longer pay parking charges but instead pay a rail fare. Increased expenditures for other passengers as rail fare is more expensive than parking charges. Overall user charge cost for all users.
	Bus	-866	Rail fare assumed to be more expensive than bus fare for most / all users.
Private Sector Revenue	Car	9,475	Sum of all rail fares paid.
	Bus	1031	Sum of all rail fares paid minus loss of bus revenue.
Local Government Revenue	All	-5,387	Loss of parking revenue.

6.4 Marginal External Costs to Road Users

6.4.1 The DfT's Transport Appraisal Guidance (TAG) Unit A5.4 gives details of the marginal external cost approach to quantifying benefits to road users brought about by decreased vehicle kilometres on the road network.

6.4.2 The trip distances of rail users identified using patronage methodology 1, and the overall patronage figures from methodology 2 have been used to calculate the vehicle kilometres removed from the road network, thus providing an optimistic assessment of marginal external costs. This has yielded a total of 79,148 kilometres removed from the road network per day.

6.4.3 Congestion bandings have also been estimated using the characteristics of trips identified in methodology 1. More details on how these congestion bandings have been calculated are provided in Table 6.2. The following assumptions have been made:

- For trips to/from Exeter, all journeys are assumed to experience the last/first 4km of their trip on roads in congestion band 5 (most congested roads);
- For trips to/from Plymouth, all journeys are assumed to experience the last/first 8km of their journey in congestion band 5.
- For all other trip ends, journeys are assumed to experience 1km of their journey in congestion band 3.
- The remainder of all journeys are assumed to be in congestion band 1 (least congested).

Table 6.2: Additional demand under high revenue scenario

Trip End	Number of daily car trips	Total Distance (2-way)	2-way Distance in each Congestion Band				
			1	2	3	4	5
Exeter to Other	182	8,924km	35,725km	0km	812km	0km	3,248km
			90%	0%	2%	0%	8%
Plymouth to Other	19	1,035km	3,862km	0km	83km	0km	668km
			84%	0%	2%	0%	14%
Other to Other	292	7,794km	32,148km	0km	2,602km	0km	0km
			93%	0%	7%	0%	0%
Total	493	17,753km	71,735km	0km	3,498km	0km	3,915km
			90.6%	0.0%	4.4%	0.0%	4.9%

6.4.4 Marginal External Costs (MECs) have been interpolated for years between 2025 and 2030, and 2030 and 2035. Beyond 2035, all MECs have been assumed to be fixed. A discount rate of 3.5% has been used for years between 2025 and 2054, and a discount rate of 3.0% has been used thereafter.

6.4.5 The total MECs calculated, based on an average annual patronage of 192,000 passengers is £12.171m (2010 prices discounted to 2010).

6.5 Resilience Benefits

6.5.1 In March 2015 the PRTF completed a study looking at the cost of disruption brought about by the closure of the line at Dawlish in the winter of 2013 / 2014. The results of the study calculated a cost of £17.5m (2010 values) to the South West economy due to impacts on freight, losses in travel time and overall productivity loss. The study also examined through business surveys the reputational damage that the South West suffered due to the disruption but was unable to quantify these losses.

6.5.2 The reinstated line between Tavistock and Okehampton would offer some diversionary capability and therefore if further disruption was experienced, the same losses would not be experienced. It is difficult to calculate what losses might be, however to give an indication of the possible resilience benefits of the route, it is assumed that losses might be half what they were in 2013 / 2014 for a similar event duration.

6.5.3 It is further difficult to predict the number of events that might occur over a typical 60 year appraisal period. A report, published in the Journal of Transport Geography in 2015, said that 10% of journeys on the line could be affected by 2040[6] due to sea level rises and changes to climate. This would make events such as those in 2013 / 2014 the norm rather than an exception.

6.5.4 Under the following assumptions, resilience benefits over 60 years of £96.316m have been estimated:

- The resilience benefits of the new line under an event such as the one in 2013 / 2014 is £8.75m;
- 2013 / 2014 disruption becomes a 1 in 20 year event by 2021;
- 2013 / 2014 disruption becomes an annual event by 2040;
- A 1 in 20 year event equates to 5% probability the disruption takes place in 1 year;
- Disruption increases linearly between 2021 and 2040; and
- Values discounted at 3.5% for years 1 to 30 and at 3.0% for years 31 to 60.

6.5.5 Given the large uncertainty surrounding the inputs and assumptions as stated above, the calculated resilience benefits must be considered to be the most uncertain of all quantified benefits in this study.

6.6 Option Values

6.6.1 An option value is the willingness-to-pay to preserve the option of using a transport service for trips not yet anticipated or currently undertaken by other modes, over and above the expected value of any such future use. Non-use values are the values that are placed on the continued existence of a service (i.e. transport facility), regardless of any possibility of future use by the individual in question.

6.6.2 The communities served by the proposed rail service already have access to a bus service, though this may not be considered as high quality by all. Okehampton is served by bus services which connect to Plymouth and Exeter, however these services are not coordinated and therefore it is difficult to travel from origins between Plymouth and Okehampton to Exeter and from origins between Okehampton and Exeter to Plymouth.

6.6.3 The Okehampton to Plymouth bus service, run by CityBus, operates with an hourly frequency across the week. The Okehampton to Exeter service, operated by Stagecoach runs more frequently with up to three buses an hour in the AM peak. Whilst not particularly frequent, both services would allow commuting and therefore only the difference in Option Values of £120.00 between bus and rail (as provided in the DfT's TAG Databook) has been used.

[6] http://www.bbc.com/news/uk-england-devon-35146033

Table 6.3: Option Values

Station	Population (2021)	Households	Option Values
Lydford	400	190	£ 411,177
Sourton Parkway	300	143	£ 308,383
Okehampton	6,100	2,905	£ 6,270,451
Okehampton East	1,200	571	£ 1,233,531
North Tawton	400	190	£ 411,177
Bow	1,400	667	£ 1,439,120
Total		4,667	£ 10,073,839

6.7 Wider Benefits

6.7.1 The following wider benefits of the new rail line have not been quantified:

- Agglomeration
- Output change in imperfectly competitive markets
- Tax revenues arising from labour market impacts (from labour supply impacts and from moves to more or less productive jobs)
- Involuntary unemployment
- Thin labour market/search costs

6.7.2 The majority of these elements are closely related to generalised costs. Given the results of the core appraisal in section 6.3 and 6.4, it has been shown that the new rail line is likely to increase average generalised costs by virtue of transport users transferring from relatively uncongested car journeys to a relatively slow rail service. It is therefore considered that wider benefits as outlined above will be negligible.

6.7.3 This preliminary view is based on standard economic theory detailed in the DfT's WebTAG documentation. It does not account for businesses potentially valuing the impact of the re-opened rail line and predicting a larger impact on their economic output. This study does not attempt to calculate specific impacts on businesses, which might normally be captured by detailed business surveys. Given the relative offering of the new rail route compared to car, the scheme is unlikely to extend travel to work areas geographically, thereby increasing the available workforce to businesses. But the rail route will provide a viable alternative to groups without access to car and therefore potentially enlarge the workforce within existing areas by encouraging a higher proportion of people into work.

6.8 Summary

6.8.1 Several economic impacts of the proposed reinstatement of the Northern Rail route between Okehampton and Tavistock have been estimated during this study. These quantities include:

- Rail User Transport Economic Efficiency
- Marginal External Costs
- Resilient Benefits
- Option Values

6.8.2 A summary of the total impacts of the reinstated rail route are summarised in Table 6.4.

Table 6.4: Summary of Northern Route Rail Benefits

Quantity	£m
Rail User TEE	-30.229
Marginal External Costs	12.171
Resilience	96.316
Option Values	10.074
Total	88.332

6.8.3 These benefits are considered low compared to the calculated (discounted) costs of £382.560m.

7. Sensitivity analysis

7.1 Introduction

7.1.1 This section looks at variations from the core case to ascertain what difference changes in the assumptions will make to the overall case.

7.2 Rolling stock assumptions

7.2.1 The cost and operating assumptions are based on a two-coach Class 158 diesel multiple unit. The assumed use of class 158 rolling stock is based on our understanding of the planned cascade of diesel units by First Great Western. It is likely that this will result in withdrawal of class 14x vehicles, with replacement in Devon and Cornwall by classes 150 and 158. Class 158 is understood to be preferred for longer distance services, with class 150 on the branches. Both classes are ex-BR second generation stock of similar age, and our view is that that overall cost profile per vehicle will be similar.

7.2.2 The assumed round trip times are sufficiently long that all unit diagrams are likely to include some morning or evening peak journeys into or out of Exeter or Plymouth at some point during the day. Scope for operation of some diagrams with a single car unit is therefore limited, and it is unlikely that spare stock will be available to strengthen those parts of the diagram which include peak-time journeys.

7.2.3 The only other rolling stock that may be appropriate is the former London Underground District Line stock which is being converted to diesel running. However, until the prototype is built and tested it is uncertain whether it will be suitable for the route and its leasing and operating costs are unknown.

7.2.4 Hence our opinion is that the rolling stock type and costs used are the most appropriate.

7.3 Station Capital Cost

7.3.1 The reduction in capital cost brought about by reducing the number of stations on the route is estimated at £2m per station, with a maximum saving of £10m across the whole scheme removing all stations apart from Okehampton. This saving is small in comparison to the overall scheme costs of £450m. These cost savings will not change the conclusions of the value for money assessment, even assuming the benefits calculated previously remain the same.

7.4 Station assumptions

7.4.1 Some of the proposed stations are projected to be not particularly well used and hence it raises the question as to whether journey time and hence the number of units required could be reduced if they were not included in the scheme.

7.4.2 The main constraint on overall journey times is the fact that this is planned as a single line railway. Between Plymouth and Exeter the outline timetable is based on loops as follows:

- Start of single line section at St Budeaux Jct
- loop at Tavistock
- loop at Okehampton
- Reinstatement of Coleford Jct with double track working as far as Crediton
- End of single line section at Cowley Bridge Jct.

7.4.3 An hourly timetable effectively requires 100% occupation of the line with trains passing every 30 minutes. For stopping services of this type it is generally most efficient if passing loops are at located at stations, as otherwise trains may have to make additional stops between stations to pass.

7.4.4 The removal of stations would speed up running between passing loops, but as trains will still have to wait to pass, overall journey times are unlikely to be reduced enough to free up a train unit. Hence while capital costs would be reduced by a few million pounds by taking out the more lightly used stations, and there would be a small reduction in operating costs, these are not envisaged to be material.

7.5 Taking forward the route in sections

7.5.1 The simple approach taken would suggest that the section between Tavistock and Okehampton generates very little revenue (c£50k a year). In reality one would expect that not all Tavistock passengers would only travel to Plymouth and not all Okehampton passengers would travel to Exeter but that there would be some passengers travelling between Tavistock and Okehampton. If 10% of Tavistock and Okehampton passengers actually travelled to Exeter and Plymouth respectively then the section between Tavistock and Okehampton would actually generate around £150k a year. It would still however remain the weakest part of the route

7.5.2 The cost to operate each section are broadly split a third to each so rounded costs and revenues for each section are as shown in the table which shows all sections fail to cover their direct operating costs.

Section	Revenue £,000	Costs £,000	Net revenue £,000
Plymouth-Tavistock	620	1,300	680
Okehampton-Exeter	460	1,300	840
Whole route	1,130	3,900	2,770

7.6 Likely Benefits under an Optimistic Planning Scenario

7.6.1 This study has also looked at the impacts of alternative planning assumptions, specifically on revenue and the number of additional dwellings required to meet a 'break-even' situation for any new rail service. A total of 25,700 new dwellings are required within the area of study (and within easy access of the proposed rail stations) in order to achieve this break-even situation.

7.6.2 With these alternative planning assumptions, the results of the cost benefit analysis are unlikely to change materially and lead to altering the conclusion that the scheme offers anything other than poor value for money. This can be explained as follows:

- Resilience benefits are unlikely to change under any alternative planning scenario as they are related to patronage on the existing Dawlish route.
- The remaining benefits (rail user TEE, Marginal External Costs and option values) will increase linearly with any increase in housing. Additionally, the total of these benefits under the core scenario sums to a negative value, and its magnitude will increase as the number of dwellings increases.

8. Conclusions

8.1 Summary of results

8.1.1 This study has examined the potential costs and benefits, and the likely rail revenue impacts of a proposed reinstated rail line between Okehampton and Tavistock.

8.1.2 Based on a simple per kilometre cost from the Bere Alston to Tavistock rail scheme and a per kilometre cost from the Borders Railway, a cost in the order of £450m has been estimated. This is lower than calculated by Network Rail but assumes a lower standard of route throughout.

8.1.3 Two methodologies have been used to predict the likely future usage of the proposed rail route. Both methodologies give broadly consistent results and further align with the patronage levels reported for the first months of operation of the Borders Railway. However, the offer of the Northern Rail route compared to car is likely to be poor in comparison to the Borders Railway and therefore the future predicted patronage is still considered to be optimistic. For stations between Lydford and Bow, there could be up to 192,000 annual trips by 2021.

8.1.4 The operating costs and revenue impacts of the new rail service have been compared and it has been shown that with the predicted patronage under current planning assumptions, there would be a significant shortfall between revenue (£1.128m per annum) and costs (£3.918m per annum). In order to overcome this shortfall, a significant change in planning policy would be required, to the extent that 25,700 new dwellings would need to be constructed between the settlements of Bow, Okehampton, Tavistock, Lydford and North Tawton.

8.1.5 Several sources of benefits have been examined and estimated. These include rail user transport economic efficiency, Marginal External Costs, resilience benefits and option values. Overall, these benefits sum to a modest positive figure of £88.332m. It should be noted however that the majority of these benefits are attributed to resilience benefits which are considered particularly uncertain.

8.1.6 The results of the study have shown that the quantified benefits show the scheme representing poor value for money, principally due to the extremely high capital investment costs. The analysis does not include any additional benefits which could only be identified through specific interviews with businesses. Given that the new rail route performs badly in comparison to car it is unlikely that businesses overall will value the advantages of a new rail route highly enough to justify the large expenditure required.

Appendix A. Additional Information

1. INTRODUCTION

1.1 Background & Brief

1.1.1 The case for the Northern Route is one of several work streams which the Peninsula Rail Task Force is progressing as part of its 20 year plan work to set out the overall case for improving rail resilience on the UK south west peninsula. The PRTF consists of Devon, Somerset, Plymouth, Torbay and Cornwall and is due to submit its plans to Government in June 2016.

1.1.2 The specific work is a study to establish the wider benefits of reopening a missing section of railway between Okehampton and Bere Alston (via Tavistock) to enable a complete rail route between Plymouth and Exeter. This could act as a diversionary route during times of disruption on the Dawlish sea wall section of the railway, but in the context of the study could also be used by a regular train service at all other times, connecting Exeter and Plymouth via the main market towns of Tavistock and Okehampton.

1.1.3 This note describes the work carried out to quantify core benefits of travellers transferring away from car modes onto a new rail route between Tavistock and Okehampton. The methodology aligned with that employed on the Tavistock to Bere Alston rail project which is briefly outlined as follows:

'Patronage forecasts for the proposed reopening of the Tavistock rail line to be based on new roadside interview (RSI) data collected on Thursday 21 June 2012 on the A386 just south of Tavistock. The RSI picked up origin-destination and other information for car journeys between the Tavistock area and Plymouth that potentially could be made by the new rail service.

Rail patronage forecasting to be carried out using mode share relationships between rail and car use in the Gunnislake line corridor derived from 2001 Census journey to work (JTW) data combined with National Rail Travel Survey (NRTS) data, and applied to the RSI data. Transfers from bus to rail will be estimated using bus passenger interview data and a mode choice model.'

1.1.4 RSI data has been further analysed to capture trips likely to travel into Plymouth from new stations such as Okehampton, etc.

1.1.5 It was assumed that the majority of remaining benefits will be accrued from trips to / from Exeter. Therefore the above has been supplemented by a similar analysis of roadside interview (RSI) data on Alphington Road, Cowley Bridge Road and on Dunsford Road to capture benefits from trips from new stations into Exeter.

1.1.6 The RSI data has been supplemented with Census journey to work data to validate the RSI data and to provide the basis for estimating rail use between the stations on the Northern Route.

1.1.7 The results of the analysis have been used to provide data for use in the calculation of Transport Economic Efficiency changes for those trips transferring between car to rail only.

1.2 Northern Route, Stations & Timetable

1.2.1 The Northern Route scheme would reinstate the disused rail line between Okehampton and Bere Alston to join with the existing Dartmoor Railway, see Figure 1.

1.2.2 The Dartmoor Railway is a stretch of line which extends 15.5 miles from Coleford Junction in the east through to Meldon Viaduct (just beyond the mothballed ballast quarry) in the west. The line is owned by Aggregate Industries and leased to Dartmoor Railway Community Interest Company (CIC). Okehampton Station is owned by Devon County Council, and the building is leased to Dartmoor Railway CIC. The intermediate stations at Bow and North Tawton are disused and are now privately owned residences. Sampford Courtenay survives as a station, albeit with no buildings.

1.2.3 The line is single-track from Coleford right through to Okehampton, with operation controlled by a staff normally kept at Crediton signal box. The section from Okehampton through to Meldon Viaduct is controlled separately, but the long stretch of single-track line significantly restricts the services that can be run. However, unlike some preserved railways which are restricted to 25mph, the Dartmoor line is certified for running at up to 55mph.

1.2.4 New stations would be provided at Okehampton East, North Tawton and Bow on the existing Dartmoor Railway and at Sourton Parkway (A30), Lydford and Tavistock on the reinstated section.

1.2.5 An indicative timetable pattern has been developed for the purpose of indicating journey times and points on the route for a local rail service, see Figure 2. The broad assumption is that local train services along this route would be an extension of services to/from either Honiton (Devon Metro aspiration to serve local stations east of Exeter) or Waterloo (existing service) and these trains would then form a local train service north of Dartmoor incorporating the existing Tamar Valley line with a broadly hourly frequency.

1.2.6 The timetable pattern has not been tested by the rail industry for robustness but the assumptions relating to existing/forthcoming train service patterns are detailed below. The journey time is long but is based upon existing timetable studies for the Tavistock – Plymouth project and the current timetable for Sunday Rover train services between Okehampton and Exeter, albeit with some reasonable assumptions that line speeds can be increased between Crediton and Okehampton subject to investment. It is assumed that a new line between Tavistock and Okehampton is built to a higher line speed standard.

1.2.7 It should be noted that the draft Tavistock – Plymouth timetable does not have a clock face timetable; therefore patterns may have to change each hour, or the Tavistock timetable amended accordingly to achieve a clock face timetable which enables integration with existing service patterns at both Exeter and Plymouth ends of the route.

Figure 1: Northern Route & Stations

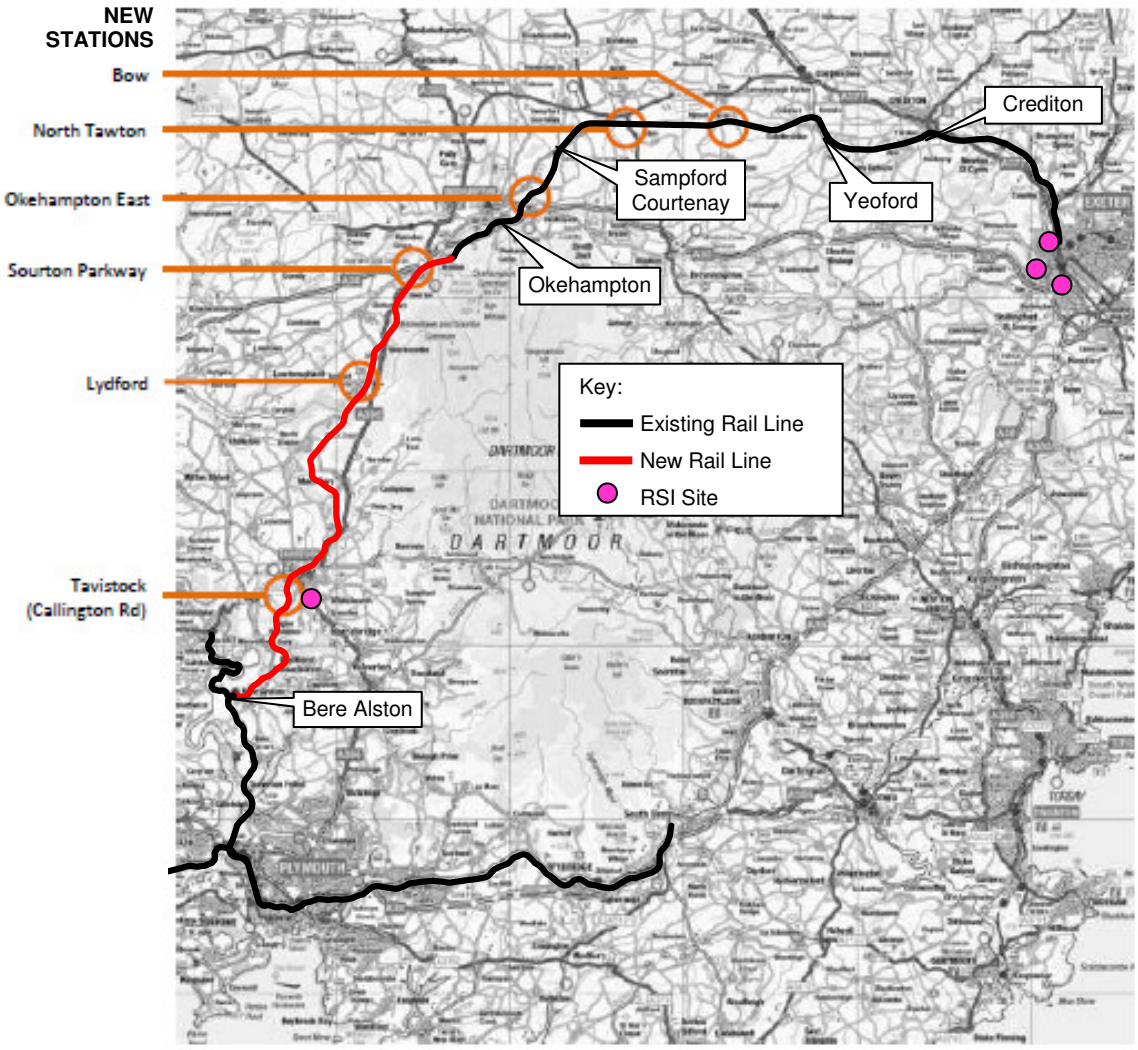

Figure 2: Indicative Timetable

Indicative sample of local train service pattern for purpose of assisting wider impacts study only (Mon-Fri, Dec 15 to May 16)	Down	Up
Station (entirely new stations in *yellow italics*)	Dep.	Dep.
Exeter Central	1037[1]	1200
Exeter St Davids	1045	1156[5]
Crediton	1056	1145[4]
Bow	1109	1123
North Tawton	1115	1117
Sampford Courtenay	1121	1111
Okehampton East	1127	1105
Okehampton	1131	1101
Sourton Cross	1141	1051
Lydford	1147	1045
Tavistock	1158[2]	1034
Bere Alston	1208	1024
Bere Ferrers	1213	1017
St Budeaux Victoria Road	1222	1010
Keyham	1224	1006
Dockyard	1226	1004
Devonport	1228	1003
Plymouth	1233	1000[3]

Key to assumptions:
[1] Ex Waterloo service continues to Plymouth via Okehampton
[2]train picks up indicative timetable as already prepared for draft Tavistock timetable study
[3]train leaves Plymouth on a path already identified in draft Tavistock timetable study
[4]train departs after preceding Ex Barnstaple train has reached Cowley Bridge Junction
[5]train continues on a new path towards Honiton as a supplementary Devon Metro service mid-way between Waterloo services.

1.3 Overview of Rail Patronage Forecasting

1.3.1 The identification of travellers transferring away from car modes onto a new rail route between Tavistock and Okehampton was achieved from the analysis of roadside interview (RSI) data at sites that intercepted car journeys that would potentially be attracted to using the new rail service. The RSI sites used, see Figure 1, were on the A386 just south of Tavistock that intercepted car journeys to Plymouth and on the A377 Alphington Road, the B3212 Dunsford Hill and the A377 Cowley Bridge Road that intercepted car journeys to/from Exeter.

1.3.2 Potential rail trips were identified from the RSI data, using grid references, as being car trips with both origins and destinations within 2km of the existing and proposed stations on the Northern Route rail service and in Exeter and Plymouth (crow-fly distances)

1.3.3 The potential trip movements that would use rail were estimated using a mode choice logit model. The model proportions journeys between car and rail were based on generalised time differences. Generalised time is the sum of walk, wait and rail/car in vehicle time plus rail fare/parking charge converted to equivalent minutes using the value of time. Model parameters calibrated for the Gunnislake line, derived from 2001 Census journey to work (JTW) data were used with the A386 Tavistock RSI. Standard mode choice model values were used with the Exeter RSIs.

1.3.4 Census journey to work data was also analysed to provide a check on the RSI analysis and to provide additional data. 2001 Census journey to work data by residence and employment output area was analysed to identify car work trips with the potential to transfer to rail, defined as having both origins and destinations within 2km of the existing and proposed stations on the Northern Route rail service and in Exeter and Plymouth. The mode choice logit model with standard parameter values was then used to identify movements that would be likely to transfer to rail.

1.3.5 An estimate of the transfer of existing bus trips to rail was also made using Census data to identify bus commuting trips, the mode choice logit model to estimate the proportion that would transfer to rail and then factored to all purposes using the proportion for Tavistock to Plymouth trips from the A386 RSI.

1.3.6 The rail passenger demand forecasts for work journeys derived from Census data were then combined with those derived from RSI data. The resulting rail passenger demand forecasts represented typical weekday daily volumes subdivided by journey purpose in the form of station to station matrices. Origin to destination matrices for distance, rail journey time, rail fare and parking charge were also produced for the economic assessment.

2. ROADSIDE INTERVIEW SURVEYS

2.1 Description of Surveys

2.1.1 The roadside interviews (RSI) that intercepted car movements with the potential to transfer to the Northern Rail Route were:

- A386 Tavistock – southbound, between 07:30 and 18:30 hrs on Thursday 21 June 2012. A total of 1,225 valid responses were obtained from 1,297 interviews. There were 1,052 valid interviews for cars with an overall sample rate of 23%;
- A377 Alphington Road, Exeter (at Sydney Street) – outbound, between 07:00 and 19:00 hrs on Tuesday 6 July 2010. A total of 1,870 valid responses were obtained from 1,964 interviews. There were 1,482 valid interviews for cars with an overall sample rate of 13%;
- B3212 Dunsford Hill, Exeter – inbound, between 07:00 and 19:00 hrs on .... 2004. A total of 668 valid responses were obtained from 826 interviews. There were 572 valid interviews for cars with an overall sample rate of 23%;
- A377 Cowley Bridge Road, Exeter – inbound, between 07:00 and 19:00 hrs on ... 2004. A total of 1125 valid responses were obtained from 1249 interviews. There were 964 valid interviews for cars with an overall sample rate of 17%

Table 1: Roadside Interview Sample Rates

Half Hour Beginning	No. of Interviews				Car Sample Rate			
	A386	A377 Alph.	B3212 Duns.	A377 Cowley	A386	A377 Alph.	B3212 Duns.	A377 Cowley
7:00:00	0	43	4	38		13%	7%	18%
7:30:00	35	64	27	58	14%	13%	17%	16%
8:00:00	52	78	44	70	21%	16%	29%	15%
8:30:00	43	61	37	68	20%	13%	42%	12%
9:00:00	50	53	54	10	23%	11%	31%	3%
9:30:00	48	51	29	40	24%	12%	17%	15%
10:00:00	45	60	14	50	22%	15%	11%	20%
10:30:00	46	66	29	52	23%	13%	32%	24%
11:00:00	37	71	17	37	19%	14%	19%	17%
11:30:00	36	54	22	30	17%	11%	61%	15%
12:00:00	53	52	25	19	30%	9%	40%	10%
12:30:00	55	61	15	40	30%	13%	25%	23%
13:00:00	43	69	5	52	20%	14%	5%	28%
13:30:00	45	59	31	32	22%	12%	34%	18%
14:00:00	48	69	23	23	28%	15%	23%	14%
14:30:00	61	65	30	39	34%	12%	36%	21%
15:00:00	45	69	23	38	24%	15%	33%	20%
15:30:00	51	63	9	42	25%	12%	12%	22%
16:00:00	54	71	20	52	23%	14%	20%	27%
16:30:00	57	78	30	44	31%	12%	31%	29%
17:00:00	55	82	24	38	27%	16%	12%	22%
17:30:00	49	71	33	48	23%	15%	20%	27%
18:00:00	44	72	27	44	23%	12%	28%	30%
18:30:00	0	68	18	38	0%	13%	69%	26%
	1052	1482	572	964	23%	13%	23%	17%

2.2 Potential Rail Trips

2.2.1 Potential rail trips were identified from the RSI data as those interviews where the stated car trip origins and destinations were within 2km of stations on the Northern Route or stations within Exeter and Plymouth.

2.2.2 The results of the analysis, Table 2 shows by far the highest number of potential rail trips would from cars using the A386 just south of Tavistock. Alphington Road would contribute the next highest number of potential rail trips, followed by Dunsford Hill and Cowley Bridge Road. Total potential daily rail trips to Exeter would be 829, very similar to the 818 trips to Plymouth.

2.2.3 Potential park & ride trips from Sourton Parkway station into Exeter were identified from the Alphington Road RSI car trips that had origins within 2km of stations in the centre of Exeter and destinations in North Cornwall and are likely to use the A30. A total of 269 potential park & ride rail trips were identified.

Table 2: Potential Rail Trips From RSI Data

RSI Site	No. of Interviews	Expanded No. of Trips				
		Work	Employers Business	Education	Other	All Purposes
A386 Tavistock	158	236	77	43	462	818
A377 Alphington Road	36	92	66	26	256	441
A377 Alphington Road Park & Ride	30	105	7	0	157	269
B3212 Dunsford Hill	30	36	14	-	90	140
A377 Cowley Bridge Rd	33	90	11	39	108	248

2.2.4 Analysis of the distribution of potential rail trips excluding park & ride, Table 3, shows 65% of trips to Exeter originating from Okehampton, 21% from Bow and 7% from North Tawton. The Exeter city centre stations of St Davids, Central and St James shows 48% of all destination trips and Marsh Barton has 22% of destinations.

2.2.5 86% of Plymouth potential rail trips came from Tavistock whereas Okehampton only contributed 4% and there were lower proportions from other stations.

2.2.6 The largest potential rail movement from the Exeter RSIs is between Okehampton and Marsh Barton and for the A386 RSI is between Tavistock and Plymouth, see Table 4.

Table 3: Potential Rail Trips From RSIs – O & D Totals

Exeter RSIs Data				A386 Tavistock RSI			
Origin	Trips	Destination	Trips	Origin	Trips	Destination	Trips
Okehampton	457	Marsh Barton	179	Tavistock	705	Plymouth	607
Bow	178	Exeter Central	163	Gunnislake	47	Devonport	90
Okehampton East	79	Exeter St Davids	133	Okehampton	32	St Budeaux	69
North Tawton	55	Exeter St Thomas	122	Lydford	13	Keyham	36
Sampford Courtenay	26	Polsloe Bridge	119	Bere Alston	13	Dockyard	11
Tavistock	18	St James Park	106	Bow	4	Bere Alston	6
Lydford	15	Digby & Sowton	5	North Tawton	4		
All	829	All	829	All	818	All	818

Table 4: Potential Rail Trips From RSIs – OD Movements

Exeter RSIs Data			A386 Tavistock RSI		
Origin	Destination	Trips	Origin	Destination	Trips
Okehampton	Marsh Barton	109	Tavistock	Plymouth	511
Okehampton	Exeter St Davids	90	Tavistock	Devonport	79
Okehampton	Polsloe Bridge	72	Tavistock	St Budeaux	65
Okehampton	Exeter St Thomas	65	Gunnislake	Plymouth	44
Okehampton	Exeter Central	65	Tavistock	Keyham	32
Bow	Marsh Barton	56	Okehampton	Plymouth	28
Okehampton	St James Park	51	Tavistock	Dockyard	11
Bow	Exeter Central	37	Lydford	Plymouth	13
Okehampton East	Exeter Central	33	Bere Alston	Devonport	7
Bow	St James Park	29	Bere Alston	Plymouth	6
Okehampton East	Exeter St Thomas	26	Tavistock	Bere Alston	6
Bow	Exeter St Davids	23	Bow	Plymouth	4
Bow	Polsloe Bridge	22	Okehampton	Devonport	4
Okehampton East	Polsloe Bridge	20	Gunnislake	St Budeaux	3
North Tawton	Exeter St Davids	17	North Tawton	Keyham	4
Lydford	Exeter Central	15			
North Tawton	Marsh Barton	14			
Sampford Courtenay	Exeter St Thomas	13			
Sampford Courtenay	St James Park	13			
North Tawton	Exeter Central	10			
Bow	Exeter St Thomas	9			
North Tawton	Exeter St Thomas	8			
North Tawton	St James Park	7			
Tavistock	Polsloe Bridge	6			
Tavistock	St James Park	6			
Okehampton	Digby & Sowton	5			
Tavistock	Exeter Central	3			
Tavistock	Exeter St Davids	3			
All	All	829	All	All	818

3. CENSUS JOURNEY TO WORK DATA

3.1 2001 & 2011 Census Data

3.1.1 The 2001 Census provided the number of journeys to work by mode for all origin and destination combinations at the output area level. 2011 Census journey to work origin-destination data was not available at the output area level but the numbers of car work journeys by method of travel was available by output area. The 2001 distribution of work journeys was applied to 2011 mode data enabling updated origin-destination movements of car work trips to be calculated. This data was used later in validating and supplementing the estimates of potential rail trips obtained from the RSI data.

3.2 Potential Rail Trips

3.2.1 Potential rail trips were identified from the origin-destination pairs of Census output areas with population centroids within 2km of stations on the Northern Route or stations within Exeter and Plymouth. This yielded 1177 car driver work trips from 300 origin-destination pairs.

3.2.2 Analysis of the distribution of potential rail trips, Table 5, shows 29% of trips originating from Okehampton, 15% from Bow and 20% from North Tawton. 28% of potential rail trips were destined for Okehampton and 13% for North Tawton. Work trips with both origins and destinations within Exeter and Plymouth were included in the data although the numbers travelling out to work in Okehampton and other locations on the Northern Route were low. There were a high number of potential trips between stations on the Northern Route, notably between Okehampton and Bow, North Tawton, Sampford Courtenay and Tavistock.

Table 5: Potential Rail Trips From Census – Car Driver O & D Totals

2011 Census Journey to Work Data – Car Driver Trips			
Origin	Trips	Destination	Trips
Okehampton	314	Okehampton	305
North Tawton	211	North Tawton	139
Bow	160	Digby & Sowton	98
Okehampton East	101	Marsh Barton	91
Tavistock	54	Tavistock	84
Sourton Parkway	38	Exeter Central	79
Sampford Courtenay	38	Exeter St Thomas	44
Exeter St Thomas	33	Sourton Parkway	42
Lydford	33	St James Park	41
Polsloe Bridge	24	Exeter St Davids	30
Exeter St Davids	18	Sampford Courtenay	29
St James Park	18	Meldon Quarry	20
Meldon Quarry	6	Plymouth	14
Calstock	6	Polsloe Bridge	14
Plymouth	6	Bow	13
Bere Alston	3	Devonport	12
Devonport	3	Lydford	11
Exeter Central	3	Okehampton East	4
Newton St Cyres	3	St Budeaux	3

All	1072	All	1072

3.3 Potential Transfer from Bus to Rail

3.3.1 Potential bus to rail transfer trips were identified from the origin-destination pairs of Census output areas with population centroids within 2km of stations on the Northern Route or stations within Exeter and Plymouth. This yielded 105 bus work trips from 24 origin-destination pairs.

3.3.2 Analysis of the distribution of potential rail trips transferring from bus, Table 5, shows 43% of trips originating from Okehampton, 28% from Bow, 15% from North Tawton and 11% from Okehampton East. 45% of potential rail trips were destined for Exeter Central, 24% to St James Park and 10% to Okehampton. Work trips with both origins and destinations within Exeter and Plymouth were included in the data although the numbers travelling out to work in Okehampton and other locations on the Northern Route were low. The overall number of bus trips with the potential to transfer to rail was low, and most of these would be trips between stations on the Northern Route and the centre of Exeter.

Table 6: Potential Rail Trips From Census – Bus O & D Totals

2011 Census Journey to Work Data – Bus Trips			
Origin	Trips	Destination	Trips
Okehampton	45	Exeter Central	47
Bow	29	St James Park	25
North Tawton	16	Okehampton	11
Okehampton East	12	Marsh Barton	8
Lydford	3	Sourton Parkway	4
		Plymouth	4
		Tavistock	3
		Devonport	3
All	105	All	105

4. RAIL PASSENGER FORECASTS

4.1 Synthesis of Potential Rail Trips From RSI & Census Data

4.1.1 The comparison of the potential journey to work rail trips from RSI and Census data, Table 7, shows the more comprehensive coverage of the Census data. Journeys between Northern Route stations and from Exeter and Plymouth to the Northern Route stations are included in the Census data but not in the RSI data.

4.1.2 The Census data shows slightly higher numbers of journeys than the RSI sites for movements from the Northern Route stations to Exeter and Plymouth which are fully observed in both the RSI and Census data. This would be expected because the RSI data relates to journeys at single locations on the three main road routes linking the Northern Route stations and Exeter whereas the Census data covers all trips on all routes. Also as the Census provides work locations, it was necessary to estimate the number of work trips on a typical workday to be consistent with the RSI data. A factor of 0.8 imported from other studies was used to take account of work trips not made due to holidays, sickness, home working etc..

4.1.3 The numbers of work journeys from the Northern Route stations to Exeter and Plymouth from the RSI and Census data were similar and this was considered an acceptable validation of the use of the RSI data in estimating rail passenger demand.

4.1.4 It was considered acceptable to use the car driver Census data to estimate rail work journeys between Northern Route stations and the bus Census data to estimate the transfer from bus to rail. This was achieved by using Census work journeys and factoring by the ratio of all purposes to work journeys from the number of potential rail trips obtained from the RSI data as described later.

Table 7: Potential Journey to Work Rail Trips

RSI – Car to Rail	N Route	Plymouth	Exeter Centre
N Route Stations	0	17	147
Plymouth	0	0	0
Exeter	0	0	0
Census – Car to Rail	N Route	Plymouth	Exeter Centre
N Route	429	26	166
Plymouth	10	0	0
Exeter	96	0	0
Census – Bus to Rail	N Route	Plymouth	Exeter Centre
N Route	15	5	64
Plymouth	0	0	0
Exeter	0	0	0

4.2 Car / Rail Mode Share Model

4.2.1 The 2001 Census provided the number of journeys to work by mode for all origin and destination combinations at the output area level thus providing data for rail and car work trips that was used in forecasting patronage for the Tavistock rail line. 2011 Census origin-destination at a sufficiently detailed level was not available. Data derived for the Gunnislake line was used to derive a mode choice relationship between rail and car trips which was then applied to the potential rail trips obtained from the RSI.

4.2.2 A standard binary logit model was calibrated for car / rail mode share:

$$Pcar = 1 / (1 + \exp(-\lambda(Crail + \delta - Ccar)))$$

where: Pcar = proportion of car trips to car plus rail trips

Crail and Ccar = generalised costs of rail and car

λ = dispersion parameter

δ = mode constant

4.2.3 The dispersion parameter and mode constant can then be estimated by linear regression or maximum likelihood using the rearranged logit model formula:

$$\text{Log}(Pcar / (1-Pcar)) = \lambda(Cbus - Ccar) + \lambda \delta$$

4.2.4 The numbers of rail and car trips were extracted for those origin-destination pairs of Census output areas with rail work journeys from homes and to jobs within 10km of rail stations on the Gunnislake line and within 1km of stations in Plymouth. Rail generalised costs in minutes were built up as follows for each of these output area pairs:

- Access time calculated from distance of origin to stations on the Gunnislake line at a walking speed of 5 kph for distances less than 2km and a motorised/cycle average speed of 20 kph for longer distances;
- Wait time of 10 minutes;
- Travel times according to the Gunnislake line timetable;
- Average fares for rail journeys from stations on the Gunnislake line based on monthly season tickets converted to generalised minutes using values of time according to journey purpose calculated using WebTAG guidance;
- Egress time from calculated from distance to destination from Plymouth stations at a walking speed of 5 kph for distances less than 2km and a motorised/cycle average speed of 20 kph for longer distances.

4.2.5 Car generalised costs were built up from:

- Access time calculated from distance of origin output area to the main road network;
- Travel time, distance and speed obtained from 2012 Plymouth traffic model link data from main roads to Plymouth rail stations;
- Parking charge of £8 for commuting trips and £3.60 for all other purposes, with half the charge being applied in the city bound direction and converted to generalised minutes using values of time according to journey purpose calculated using WebTAG guidance;

- Vehicle operating cost calculated from vehicle speed and distance according to WebTAG guidance and converted to generalised minutes using values of time according to journey purpose.

4.2.6 The demand data was grouped into broad generalised cost bands for the estimation of the logit parameters, see Table 8 and Figure 3. The calculated dispersion parameter value of 0.0654 is consistent with the illustrative dispersion value of 0.04 for modal split given in WebTAG 3.10.3. The calculated mode constant is -22, the negative value indicating that rail is slightly more favoured than car for the same travel cost. This is unusual but can be explained by the long and congested journeys by road in comparison to the more direct and quicker rail journey on the Gunnislake line. These conditions will be similar for the Tavistock rail service and the same logit parameters are considered suitable. As a check the calibrated model was applied to stations on the Gunnislake line and the rail journey to work data was closely reproduced, see Table 9.

4.2.7 It was considered that the calibrated logit parameters described above were appropriate for forecasting rail demand from the Northern Route stations to Plymouth. But rail would not be so attractive for trips to Exeter because the A30 provides a fast, high quality highway route. Consequently it was decided to use a standard dispersion parameter of 0.04 and zero mode constant for forecasting rail demand from the Northern Route stations to Exeter.

Table 8: Work Journeys – Rail / Car Logit Calibration

Cost Range (min)		Pcar	log(Pcar/1-Pcar)	Weighted Rail-Car Cost
From	To			
-10	0	0.1429	-1.79176	-5.36522
0	10	0.2326	-1.19392	4.690798
10	20	0.3333	-0.69315	11.30386

Figure 3: Work Journeys – Rail / Car Calibration

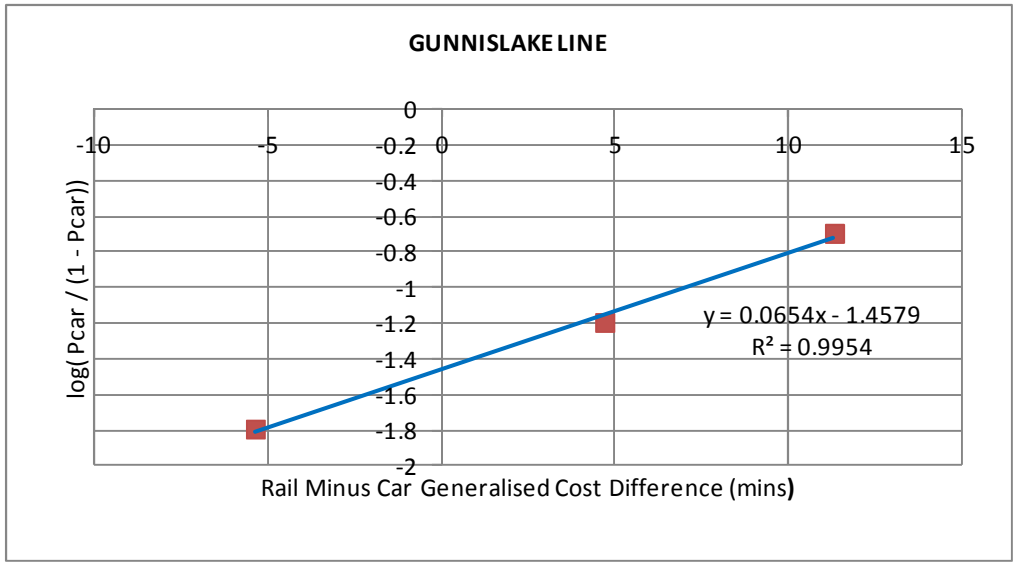

Table 9: Logit Model Validation

Station	Census Journey to Work			Logit Model	
	Car Trips	Rail Trips	Car + Rail Trips	Car Proportion	Rail Trips
Gunnislake	6	18	24	0.349253	16
Calstock	1	9	10	0.217571	8
Bere Alston	13	33	46	0.244366	35
Bere Ferrers	3	9	12	0.141951	10

4.3 Generalised Costs

4.3.1 The car / rail mode choice model was applied to origin-destination pairs of RSI data with car journeys from and to locations within 2km of rail stations on the Northern Route and in Exeter and Plymouth. Rail generalised costs in minutes were built up as follows for each of these interview records representing potential rail trips:

- Access times to/from stations calculated from distance to stations at a walking speed of 5 kph for distances less than 2km;
- Wait time of 10 minutes assuming knowledge of timetable;
- Travel times according to the illustrative timetable, Table 10;
- Average fares for rail journeys between stations as given in Table 10 converted to generalised minutes using values of time according to journey purpose calculated using WebTAG guidance.

Table 10: Rail Travel Times & Fares

Station	Down Dep.	Up Dep.	One-Way Fare(£)
Newcourt	10:07	12:30	6.93
Marsh Barton	10:17	12:20	6.75
Digby & Sowton	10:07	12:30	6.81
Exmouth	09:47	12:50	7.62
Lympstone Village	09:52	12:45	7.48
Topsham	10:02	12:35	6.93
Pinhoe	10:17	12:20	6.55
Exeter St Thomas	10:20	12:17	6.65
Polsloe Bridge	10:20	12:17	6.65
St James Park	10:22	12:15	6.55
Exeter Central	10:37	12:00	6.54
Exeter St Davids	10:45	11:56	6.54
Newton St Cyres	10:53	11:48	4.48
Crediton	10:56	11:45	4.37
Bow	11:09	11:23	4.15
North Tawton	11:15	11:17	4.08
Sampford Courtenay	11:21	11:11	4.00
Okehampton East	11:27	11:05	3.91
Okehampton	11:31	11:01	3.91

Meldon Quarry	11:36	10:56	3.59
Sourton Parkway	11:41	10:51	3.59
Lydford	11:47	10:45	3.27
Tavistock	11:58	10:34	2.63
Gunnislake	11:53	10:39	2.30
Calstock	11:58	10:34	2.20
Bere Alston	12:08	10:24	1.81
Bere Ferrers	12:13	10:17	1.61
St Budeaux	12:22	10:10	0.65
Keyham	12:24	10:06	0.65
Dockyard	12:26	10:04	0.65
Devonport	12:28	10:03	0.13
Plymouth	12:33	10:00	0.00

Notes:
1. £2.63 single fare Tavistock-Plymouth as in Tavistock rail study.
2. £2.63 single fare Okehampton-Exeter
3. £2.17 single fare (current full monthly season/40 journeys) Crediton-Exeter Central.
4. Other stations pro-rata according to distance.
5. Station to station times & fares obtained from table by the absolute differences.

4.3.2 Car generalised costs were built up from:

- Access time to/from origins/destination calculated from distance to the main road network;
- Travel time from ANPR and Trafficmaster data and distance from GIS;
- Parking charge of £8 for commuting trips and £3.60 for all other purposes in the centres of Exeter and Plymouth, with half the charge being applied in the city bound direction and converted to generalised minutes using values of time according to journey purpose calculated using WebTAG guidance;
- Vehicle operating cost calculated from vehicle speed and distance according to WebTAG guidance and converted to generalised minutes using values of time according to journey purpose.

4.4 Rail Mode Share Forecasts

4.4.1 The logit mode share models were applied to the potential rail trips identified from the A386 and Exeter RSI data and the Census journey to work data using generalised costs built up for each interview record at described previously. The resulting numbers of forecast rail trips by data source is given in Table 11.

Table 11: Forecast Rail Trips

Source RSI / Census	No. of Interviews / Movements	Rail Trips / Day					% Rail
		Work	Employers Business	Education	Other	All Purposes	
A386 Tavistock	158	207	59	30	321	617	75%
A377 Alphington Road	36	19	15	1	29	63	14%
A377 Alphington Road Park & Ride	30	25	2	0	15	41	15%
B3212 Dunsford Hill	30	8	2	-	10	21	15%
A377 Cowley Bridge Rd	33	39	2	9	20	248	28%
Census JTW	300	75	-	-	-	-	19%

4.4.2 The logit model was also applied to the potential rail trips identified from the Census journey to work bus trips. Generalised costs for bus were built up using timetable journey times and current fares with access and wait times similar to rail journeys. Overall, 37% of potential trips were estimated to travel by rail, a low proportion resulting from the long bus journey time from the Okehampton area into Exeter.

4.4.3 The RSI and Census data sources were then combined as shown in Table 12 using the assumptions that were described in Section 4.1.

Table 12: Summary of Forecast Rail Trips

RSI – Car to Rail	N Route	Plymouth	Exeter Centre	Exeter Other
N Route Stations	0	31	185	8
Plymouth	0	0	0	0
Exeter	0	0	0	0
Census JTW – Car to Rail	**N Route**	**Plymouth**	**Exeter Centre**	**Exeter Other**
N Route	227 [1]	0	0	9
Plymouth	0	0	0	0
Exeter	0	0	0	0
Census JTW – Bus to Rail	**N Route**	**Plymouth**	**Exeter Centre**	**Exeter Other**
N Route	19 [2]	6	55	0
Plymouth	0	0	0	0
Exeter	0	0	0	0
Forecast Rail Trips	**N Route**	**Plymouth**	**Exeter Centre**	**Exeter Other**
N Route	492 [3]	37	240	8
Plymouth	37 [4]	0	0	0
Exeter	248 [5]	0	0	0

Note: 1. Census JTW x RSI all purposes / RSI JTW = 103x224/102
2. Census JTW x bus all purposes / RSI JTW = 9/0.49
3. Census work to home = home to work = (227+19)x2
4. Plymouth to N Route = RSI N Route to Plymouth = 31+6
5. Exeter to N Route = RSI N Route to Exeter = 193+55

4.4.4 The overall station to station rail passenger forecasts as shown in Table 13. The total forecast numbers of daily rail trips between the Northern Route stations and Exeter and Plymouth was estimated at 224 and there would be the same number of daily trips in the reverse direction. Rail trips between Northern Route stations was estimated at 227 and rail trips transferred from bus at 80 and there would be the same number of daily trips in the reverse direction. So the total number of daily rail trips was estimated at 940.

Table 13: Forecast Rail Trips

Northern Route – Exeter & Plymouth (Rail Trips/Day – One Direction)			Northern Route - Northern Route (Rail Trips/Day – Both Directions)		
From	To	Trips	From	To	Trips
Okehampton	Exeter St Davids	20.2	North Tawton	Okehampton	36.3
Bow	Exeter St Davids	14.5	Okehampton	North Tawton	24.7
Okehampton	Plymouth	14.4	Okehampton	Sampford Courtenay	17.6
Bow	Exeter Central	13.4	Okehampton	Tavistock	15.8
Okehampton	Exeter Central	12.1	Tavistock	Okehampton	15.6
North Tawton	Exeter St Davids	10.7	Bow	Okehampton	13.8
Okehampton	Polsloe Bridge	9.7	Sampford Courtenay	Okehampton	12.4
Okehampton	Exeter St Thomas	9.5	Okehampton	Sourton Parkway	12.0
Okehampton East	Exeter Central	9.4	Okehampton East	North Tawton	11.6
Bow	St James Park	8.1	Bow	North Tawton	9.8
Lydford	Plymouth	7.3	Lydford	Tavistock	9.4
North Tawton	Exeter Central	6.2	Sourton Parkway	Okehampton	8.5
Okehampton	St James Park	6.2	Okehampton	Lydford	5.9
Bow	Polsloe Bridge	5.5	Sampford Courtenay	North Tawton	4.3
Okehampton East	Exeter St Thomas	5.3	Okehampton East	Tavistock	4.0
Bow	Marsh Barton	4.1	Tavistock	Lydford	3.4
Bow	Plymouth	4.0	Lydford	Okehampton	3.1
Okehampton	Devonport	3.4	Sourton Parkway	Meldon Quarry	2.6
North Tawton	Exeter St Thomas	3.3	North Tawton	Sourton Parkway	2.4
Sampford Courtenay	St James Park	2.7	North Tawton	Okehampton East	2.1
Okehampton	Marsh Barton	2.4	Lydford	Meldon Quarry	1.8
Sampford Courtenay	Exeter St Thomas	1.9	North Tawton	Meldon Quarry	1.6
North Tawton	Keyham	1.9	North Tawton	Bow	1.6
Bow	Exeter St Thomas	1.7	Sampford Courtenay	Meldon Quarry	1.5
Okehampton East	Polsloe Bridge	1.6	Tavistock	Meldon Quarry	1.4
North Tawton	St James Park	1.4	Meldon Quarry	Tavistock	1.3
Lydford	Exeter Central	1.1	Sourton Parkway	Tavistock	1.2
North Tawton	Marsh Barton	0.7	Sourton Parkway	North Tawton	1.1
Tavistock	Exeter St Davids	0.5	Tavistock	North Tawton	0.7
Okehampton	Digby & Sowton	0.4			
All	All	183	All	All	227

Table 14: Forecast Park & Ride Rail Trips

Northern Route – Exeter & Plymouth (Rail Trips/Day – One Direction)		
From	To	Trips
Exeter St Davids	Sourton Parkway	16.6
Exeter St Thomas	Sourton Parkway	10.1
Exeter Central	Sourton Parkway	8.4
Polsloe Bridge	Sourton Parkway	3.0
St James Park	Sourton Parkway	2.7
Digby & Sowton	Sourton Parkway	0.4
Pinhoe	Sourton Parkway	0.1
Exeter St Thomas	Sourton Parkway	10.1
All	All	41

Table 15: Forecast Rail Trips Transferred From Bus

Northern Route – Exeter & Plymouth (Rail Trips/Day – One Direction)		
From	To	Trips
Bow	Exeter Central	18.2
Okehampton	Exeter Central	11.7
North Tawton	Okehampton	11.0
Okehampton East	Exeter Central	5.1
North Tawton	St James Park	5.1
Okehampton	Sourton Parkway	4.6
Okehampton	Devonport	4.0
Bow	St James Park	3.9
Okehampton	St James Park	3.9
Bow	Plymouth	3.1
Okehampton East	St James Park	2.8
Bow	Marsh Barton	2.8
Lydford	Tavistock	1.8
Okehampton	Marsh Barton	1.4
All	All	80

4.5 Sensitivity Tests

4.5.1 The rail industry's Passenger Demand Forecasting Handbook (PDFH) method was used to compare and validate the rail passenger forecasts for the Northern Route. The PDFH trip rate of 25 one way rail trips per 1000 population for village areas surrounding urban centres was used to estimate rail trips from homes. All of the 2011 Census population within 800m and 25% of the population between 800m and 5km of stations was used as recommended in PDFH.

4.5.2 It was also necessary to make a demand adjustment for service frequency. The PDFH elasticity method was used to estimate the trips rates for higher demand with headways of 60 minutes and 30 minutes assuming a 60 minute journey time (Okehampton to Exeter) and -0.9 elasticity:

Trip rate for 60 min headway = [(60+60x0.4)/(60+120x0.4)]^-0.9 x 25 = 31

Trip rate for 30 min headway = [(60+30x0.4)/(60+120x0.4)]^-0.9 x 25 = 36

4.5.3 The resulting rail passenger forecasts using the PDFH method, Table 16, are similar in total to the logit model forecasts for the rail trips estimated from the RSI data. The PDFH method also shows that the reduction in service headway from 60 minutes to 30 minutes would increase rail passenger demand by around 16%. The logit model shows higher rail numbers for Bow and North Tawton stations where rail provides a convenient alternative to road and lower numbers for Okehampton where the A30 provides a high speed and capacity road and rail would not be so attractive.

4.5.4 However, there are also 227 rail trips per day estimated for journeys between the Northern Route stations. These have been estimated using the logit model that was calibrated to longer distance trips and these forecasts need to be used with caution especially for short distance trips of only one or a few stations.

4.5.5 There are also 80 rail trips per day estimated to transfer from bus. Again caution is needed in using these forecasts as the same logit model was used as for car and transfers from bus to rail for short distance trips may be unrealistic.

4.5.6 The logit model is considered to provide the more realistic forecasts but the PDFH method is shown to validate the logit model forecasts using the RSI data. Hence the additional rail demand forecast for journeys between Northern Route stations and transfers from bus need to be used with caution.

Table 16: PDFH Passenger Forecasts

Station	Daily Rail Passengers by Service Headway (one way)		
	PDFH		Logit Model
	60min	30min	60min
Lydford	13	15	8
Sourton Parkway	5	6	41
Okehampton	108	126	78
Okehampton East	49	57	16
Samford Courtenay	10	12	5
Meldon Quarry	3	3	0
North Tawton	15	17	24
Bow	12	14	51
All	215	250	224

4.5.7 The logit model parameters calibrated to the existing Gunnislake service were applied only to potential rail trips to Plymouth as identified from the A386 RSI for the logit model passenger forecasts. Standard logit parameters were applied to trips to Exeter because the A30 road provides a high speed and standard route and rail would not be so attractive to Exeter as to Plymouth from Northern Route stations.

4.5.8 As a sensitivity test the calibrated logit parameters were applied to the Exeter RSIs with the premise that parking difficulties and costs in Exeter centre would make rail as an attractive option as from Gunnislake and Tavistock into Plymouth. Parking would not be an issue at Northern Route stations and so it was not considered appropriate to apply the Gunnislake logit parameters to the Census data for trips between the Northern Route stations.

4.5.9 The result of the test of the increased attractiveness of rail to Exeter was that rail trips from the Northern Route stations into Exeter would increase by 89 per day and total daily rail trips would increase from 675 to 853, an increase of 26%.

5. DATA FOR ECONOMIC ASSESSMENT

5.1 Rail Matrices for TUBA

5.1.1 The data required to construct the rail demand, time and fare matrices for TUBA economic assessment was presented in the form of the individual RSI and Census journey to work records that had been identified as potential rail trips together with derived data required for TUBA.

5.1.2 The data was included in 'EconomicsDataV1.xlsx' and included the following data fields:

- Origin and destination grid reference (co-ordinates of address for RSI data and population centroid of output area for Census journey to work data) and nearest station (within 2km of origin and destination);
- Forecast daily number of rail trips;
- Trip purpose;
- Car occupancy (for RSI data);
- Rail wait time (10 minutes as knowledge of timetable assumed);
- Rail station to station time (minutes);
- Walk access time to/from origin/destination station (minutes);
- Rail fare (£).

5.2 Data for Marginal External Congestion Costs

5.2.1 The data required to estimate marginal external congestion costs according to the WebTAG Databook method was appended to the individual RSI and Census journey to work records that were included in 'EconomicsDataV1.xlsx' as follows:

- Highway main road journey time (minutes) and distance (km);
- Highway access time and distance;
- Parking charge (£).