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Penarth Headland Economic Impact Study

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Penarth Headland – Business Case

The following document provides an assessment of the economic benefits of developing a new walking and cycling route along the Penarth Headland in the Vale of Glamorgan, Wales.

The proposed route would run along the base of the cliffs at Penarth. The cliffs are crumbling, posing a considerable engineering challenge in stabilising them so that the route can be constructed on the shore below.
This document will inform the business case alongside a feasibility study of the proposed development that has been undertaken by the Vale of Glamorgan County Council.

1 Executive Summary

1.1 Economic benefits of the Penarth Headland Route

The economic benefits of the Penarth headland route have been appraised based on expected annual cyclist and pedestrian usage on the proposed shared use path after construction is completed. The economic benefits of this annual usage have been appraised as if observed for the next 20 years (i.e. a 20-year appraisal period has been used).

This analysis calculates baseline annual cycling and walking usage by local users before estimating usage on the constructed route based on uplift seen in previous infrastructure projects. The post-construction usage estimates have been developed using evidence from the Infrastructure Impact Tool (IIT), local data from past schemes in the surrounding area and other comparable sites. The post-construction usage scenarios include an estimated annual number of trips and are presented as low, middle and high scenarios.

Under the middle scenario, where the shared use route sees a 122% increase in cycling and 65% increase in walking trips above baseline:

- It is estimated that 759,156 cycling trips and 1,025,848 pedestrian trips could be occurring annually on the route.
- The economic benefits of the route development over a 20 year period are valued at £25,730,335, inclusive of £23,091,498 health-related economic benefits.
- The estimated tourism-related economic benefits of developing the route from pedestrian usage are valued at £8,063,365 per year with 178 FTE jobs directly and indirectly supported through this tourism.
- The Benefit-Cost Ratio (BCR) was calculated for the three usage scenarios. With total costs of the route estimated at £12,114,074 (including maintenance), all showed the route to have a positive economic impact: The Benefit-Cost Ratio (BCR) for the middle usage scenario was 2.12[1], where the economic benefits of constructing the route estimated to outweigh the costs. For comparison, the low usage scenario has an estimated BCR of 0.89 (where economic costs outweigh the benefits) and the high usage scenario BCR of 3.36.

[1] The average BCR of all schemes in the Connect2 active travel infrastructure programme is 6.3:1 The BCRs of individual schemes range greatly from 3:1 to 32.8:1.

Respondents of the Route User Intercept Surveys show overwhelming support for new route. When shown the proposed route on a map, 64% of respondents said they would always use the new route and 35% responded they would use it sometimes.

2 Background

Sustrans' Research and Monitoring Unit (RMU) have undertaken cost benefit analysis of the proposed development of a shared-use path along the headland at Penarth, from the Cardiff Bay barrage to Penarth pier. This analysis has been carried out on three estimated post-construction usage scenarios.

This document outlines the economic benefits of the proposed route for three usage increase scenarios, including the health and tourism-related economic benefits.

2.1 Study Area

Figure 1 Map overview of proposed route

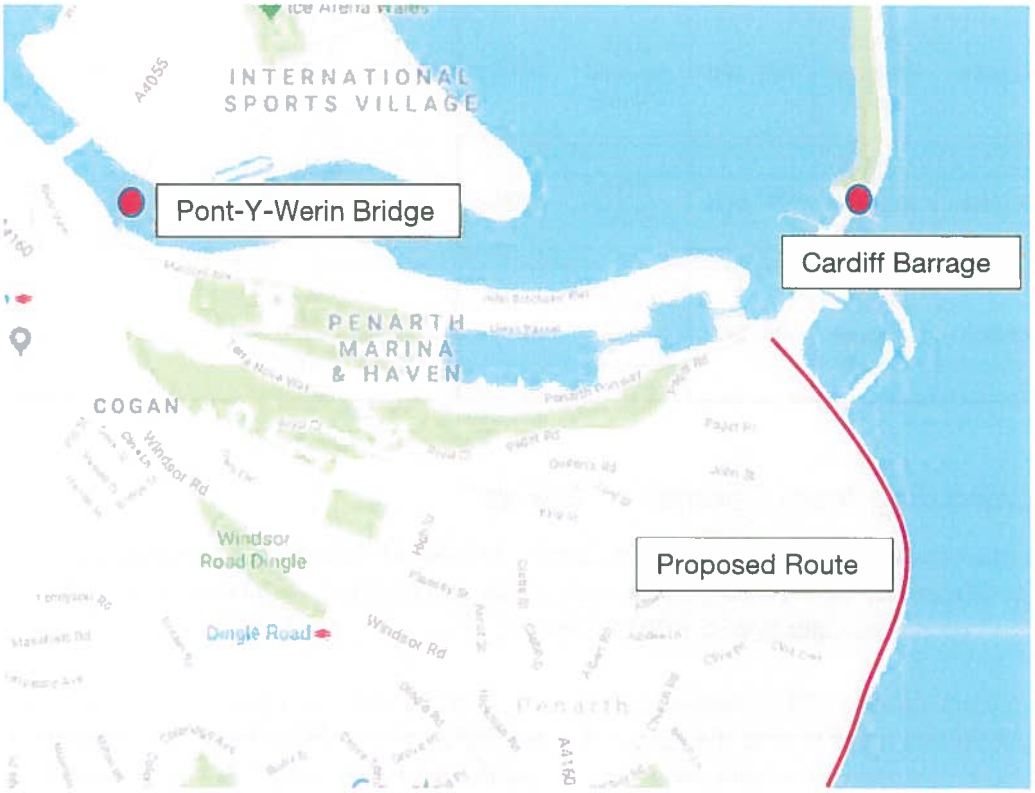
The proposed new route will run from the Cardiff Bay Barrage, South East towards Penarth Pier. The new shared-use path would be 1.1km and run along the shoreline, avoiding the steep incline of current routes into Penarth. The route would also enhance access to the pier and promenade, potentially providing a new alignment for route 88 of the National Cycling Network (NCN) in the area. The cliffs in

the area are friable and therefore the path will be separated from the cliff base at a sufficient distance to ensure risk of falling rock is minimised. It is also intended to construct the path at a level which minimised the need for closure due to high tides. These engineering challenges contribute significantly to the cost of route construction.

2.2 Current active travel in Penarth – supporting evidence

The usage change observed in past infrastructure schemes of a similar nature or in the vicinity of the proposed Penarth Headland route was reviewed as an indication of what the impact of the proposed route might be. The Cardiff Bay barrage joins Cardiff to Penarth, avoiding the need to circumnavigate Cardiff Bay. There is a cycle route and separated pedestrian path along the top of the barrage. Car access is limited, not going beyond a car park on the south side of the barrage. The proposed shared use route would join onto the path coming off the south side of the barrage to continue around the headland onto Penarth seafront, providing a continuous traffic-free route as well as enhanced car parking facilities at the Barrage end. Pont-Y-Werin is a pedestrian and cycle bridge crossing the Ely River from Cardiff to Penarth, located upriver from the barrage (**Figure 2**).

Figure 2 Location of Pont-Y-Werin Bridge and the Cardiff Barrage in relation to the proposed location of the new shared use path



The usage and usage change observed varies according to type of infrastructure (bridge, junction improvement, off-road route, etc.). The Pont-Y Werin Bridge and the Cardiff Bay barrage are likely to see higher usage uplift than the shared use path proposed along the Penarth Headland due to both schemes representing the provision of infrastructure to link to points where there previously was none.

The Penarth Headland proposed route provides an alternative, improved route where there is an existing possibility. There is also a degree of displacement likely due to the reduced gradient of the headland route over existing routes, particularly for cyclists travelling westwards into Penarth from either the Barrage or Pont Y Werin.

As a result, a case study coastal route between Hastings and Bexhill, in East Sussex, was also reviewed. This route was constructed along the shore line and avoids the busy A-road which links Hastings and Bexhill.

Table 1 shows the uplifts seen from these local infrastructure schemes and the coastal path in Hastings (a comparable scheme). The pre-usage figures for the Penarth route are intended to show the likely usage of the route when built, given observed usage on comparable and local routes that would feed into this headland route. The uplift observed from pre to post is intended to capture increased usage as a result of the improved infrastructure provision encouraging mode shift and enabling new journeys.

Table 1 Uplift in Cycling and Pedestrians usage at Pont-Y-Werin, Cardiff barrage and Hastings to Bexhill

Site	Cyclist					Pedestrians				
	Pre-Usage AUE	Pre-Usage Source	Post-Usage AUE	Pre-Usage Source	Uplift (%)	Pre-Usage AUE	Pre-Usage Source	Post-Usage AUE	Pre-Usage Source	Uplift (%)
Pont-Y-Werin	41,324	2010 Manual Count	163,495	2012 Manual Count	296%	43,406	2010 Manual Count	288,190	2012 Manual Count	564%
Cardiff Barrage	66,563	2009 Manual Count	341,963	2018 RUIS	413%	168,307	2009 Manual Count	621,726	2018 RUIS	269%
Hastings to Bexhill	23,360	2010 Manual Count	85,699	2012 Manual Count	267%	80,273	2010 Manual Count	132,194	2012 Manual Count	65%

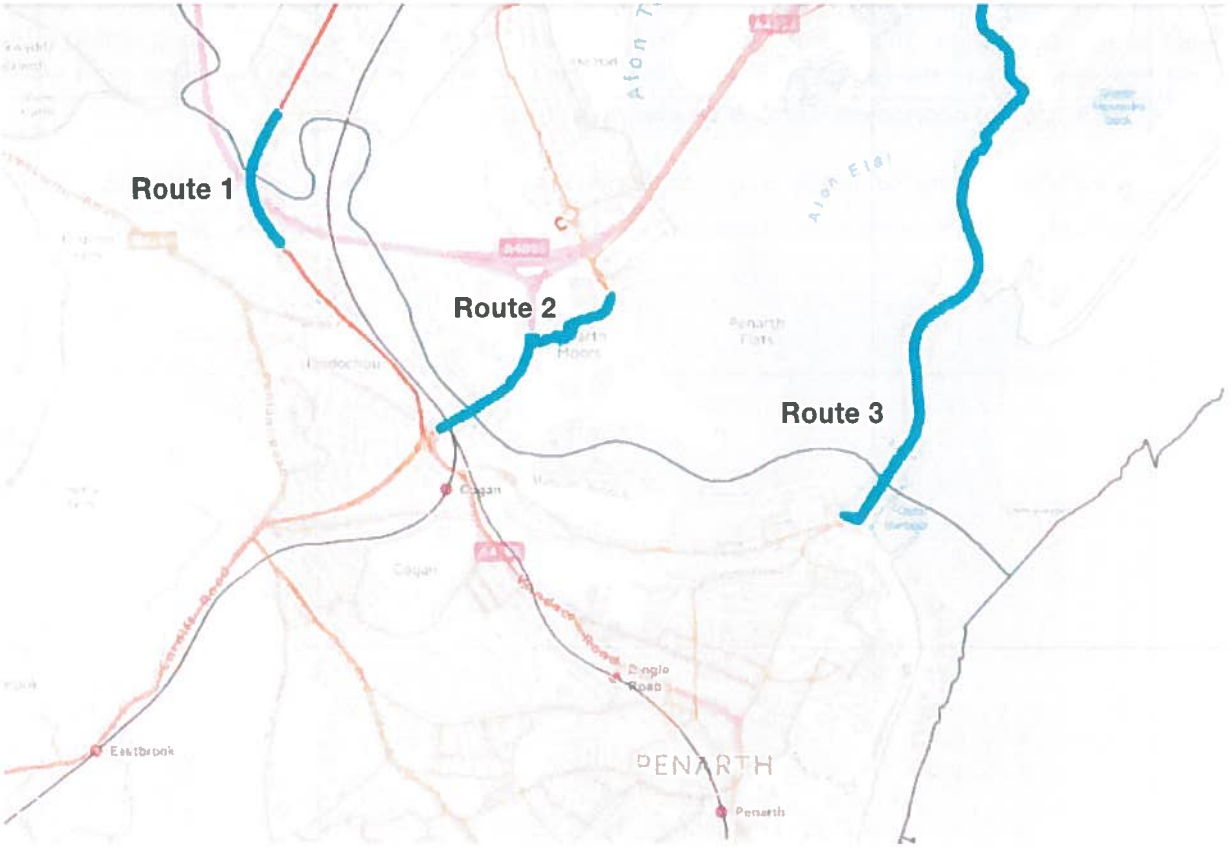
2.3 Commuting from Penarth to Cardiff

The three main commuting routes between Cardiff and Penarth are shown in **Figure 3** below. This GIS output was created by downloading Propensity to Cycle Tool data from GitHub.com. The Propensity to Cycle Tool data uses data from the 2011 Census.

The data shows Census 2011 origin-destination commutes that have been routed using the 'fastest route' CycleStreets algorithm at the Lower Super Output Area (LSOA) level. This algorithm predicts the likely route that any user would take from the centre of a given origin LSOA to the centre of a given destination LSOA if they were to cycle, and as such it is used as a predictive tool for mapping commuter travel behaviour. The PCT plots LSOA level commuter trips on a cycle route network generated using the CycleStreets routing engine, giving an indication of potential use of a route for cycling if all commuters were to use them.

Using the Future Manipulation Engine (FME) the data was aggregated across intersection points (i.e. junctions) to give a breakdown of the sum of all commuting modes for all trips along that intersection. The routes highlighted in **Figure 3** show the most common routes from Penarth to Cardiff, crossing the district border.

Figure 3 Map showing the 3 most popular commuting routes from Penarth to Cardiff



The routes and associated commuters are shown in **Table 2**, along with the proportion of cyclist and pedestrians using the routes.

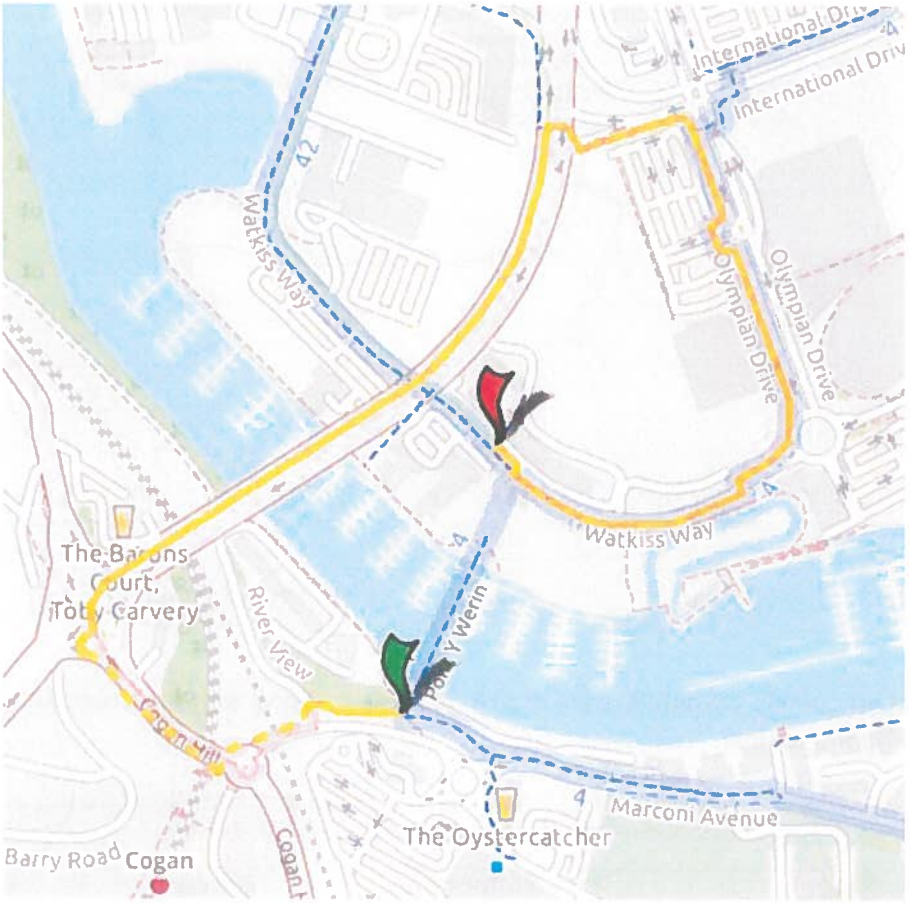
Table 2 PCT commuter numbers on the 3 fastest routes from Penarth to Cardiff and the proportion of cyclist and pedestrian users according Census 2011 data

Route	Number of commuters From Census 2011	Current Proportion of Cyclist	Current Proportion of Pedestrians
Route 1: Penarth Road	7,335	2.5%	1.4%
Route 2: A4055	2,408	2.5%	2.2%
Route 3: Cardiff Barrage	654	8.4%	4.0%

The data differs from the known counts presented in Table 1 of this document. This is due to the type of routing under the 'fastest route' setting used by the CycleStreets algorithm. The fastest option in and out of Penarth may not always be the barrage, but if looked at in terms of quietest route the Barrage sees the most use. The fastest route takes into account the centroid of the origin and destination LSOA of each commuter, which has an effect on the way the routes are calculated. This does not consider routing from the periphery of any LSOA, which may differ and is a limitation. In this

case, the large number of individuals travelling to destination LSOAs in the West of Cardiff city means that the routing algorithm is sending more people via the A-roads to the West of the city.
The routing algorithm directs individuals over Route 2, rather than over the Pont-Y-Werin bridge (a dedicated walking and cycling bridge). This is due to an issue with the OpenStreetMap (an open-source map[2]) used as the base for the routing. The connection from the Pont-Y-Werin Bridge on the Cardiff side has been removed from OpenStreetMap, preventing the routing engine from mapping routes across the bridge. This is illustrated in **Figure 4**, which shows a CycleStreets suggested route to get from one side of the bridge to another (shown in orange). Note the dashed cycle path line is missing, although the connection can still be seen in purple.

Figure 4 Map showing the routing in CycleStreets due to missing infrastructure in OpenStreetMaps



There are further limitations with the PCT data when the data from Route 3 across the Cardiff Barrage is reviewed. The estimations of commuter numbers include drivers, despite it being a traffic free route that is only accessible to pedestrians and cyclists. As you can see, pedestrians and cyclists are estimated to make up only 12.4% of total commuter travel on Route 3. In reality, this is likely to be much higher given that it is dedicated walking and cycling infrastructure.
Unfortunately, given the limitations in the PCT data and the CycleStreets routing algorithm identified in this analysis, it is not possible to conclusively estimate what the commuting usage of any new route on the Penarth Headland might be as a result of these figures.

[2] OpenStreetMap is open-source and therefore, can be edited

However, this does indicate that Route 3 is attributed the highest relative mode share to active travel (walking and cycling), according to the Cycle Streets algorithm and Census 2011 data. This indicates it is the preferred route between Penarth and Cardiff of the three options.

3 Methodology

3.1 Route User Intercept Survey (RUIS)

The Sustrans Route User Intercept Survey method has been widely applied around the UK, making this exercise directly comparable with surveys conducted on many other routes.

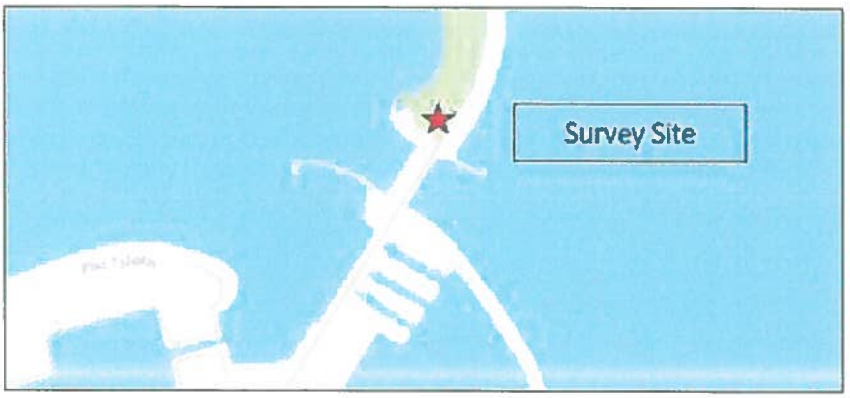
The survey form used was adapted for the Penarth Headland economic appraisal to include the following bespoke question:

A new cycling and walking route is proposed to run along the coast of the Penarth headland, south-east from this point and at sea level (see red line on map). Would you use this over your current route?

A map showing where the route could go was provided to respondents for reference and responses were given on a scale of 'Always', 'Sometimes', 'Rarely', 'Never' and 'Don't know'.

The survey took place on the Cardiff Bay barrage, where the current route across the Bay would connect to one end of the proposed route (**Figure 5**). Surveys were conducted on one term-time weekday, and one term-time weekend day, one holiday weekday and one holiday weekend day in February 2018. The survey dates were: 10th, 13th, 17th and 20th February 2018.In each case, the surveys were conducted between the hours of 0700h and 1900h. A total of 48-hours of survey coverage was achieved at the site. Due to weather on some of the survey days, especially on the 10th of February, data collection from surveys was affected. There was severe gale force winds and heavy rain on the 10th, meaning fewer users on the barrage and reduced willingness to stop for the surveyor. The weather meant that surveys were stopped at 17:30 on this day.

Figure 5 Survey site location



3.2 Annual Usage Estimates

An Annual Usage Estimate (AUE) is an estimate of the total number of individual trips made over a year (i.e. not the total number of users). If a complete annual count dataset from an automatic cycle counter is not available, then an AUE can be derived from a partial automatic cycle counter dataset or a manual count. This requires an extrapolation of the observed count data across the year, with a consideration of the impact of seasonality on usage.

Sustrans' methodology for estimating AUEs uses 'typical' seasonality and average annual daily totals (AADT) from a pool of over 200 reference counters (all of which have a full years' worth of data). Seasonality is calculated using average monthly daily totals (AMDT). A proportional relationship between the average monthly totals and annual usage of each of the reference counters is derived. This proportional relationship is applied to any partial count or observed manual count data to extrapolate to an AUE that is adjusted for seasonal variation in usage. In this case the manual counts from the conducted RUIS has been used to calculate the AUE.

3.3 Economic Appraisal Tools

Infrastructure Investment Tools (IIT)

The cycling IIT (CIIT) and the pedestrian IIT (PIIT) are based on a database of past infrastructure scheme interventions delivered across the UK. This approach adopts a forecasting approach based on comparable schemes, as recommended by the Department for Transport (DfT) in their WebTAG Unit A5.1 for Active Mode Appraisal[3]. This approach is also consistent with the Welsh government Transport Appraisal Guidance (WelTAG). In adopting a case study approach, assumptions have been made that infrastructure developments are likely to perform similar to what was observed in the past. This approach is not specific to the local context evaluated here and may not fully integrate all of the unique aspects of the proposed development. It is a generalised approach based on evidence from past schemes and as such should not be considered a definitive calculation of the expected outcomes of a scheme.

The IIT's are used to estimate a potential increase in usage from any currently observed usage (i.e. a baseline estimate) to any change that results after a scheme has been constructed. This post-construction estimate is based on evidence of observed cyclist and pedestrian usage pre- and post-infrastructure delivery in the past. The PIIT is a new tool, which was created based on the CIIT model. The data that the PIIT draws on for reference is not as extensive as the number of schemes which feed into the CIIT. The tools do not give estimates in reference to a specific time period over which this usage change is observed or occurs. All outputs from the IIT's are in the form of an annual number of cyclist or walking trips.

Benefit-cost ratio (BCR) Tool

Sustrans RMU have developed an economic appraisal tool which is used to estimate the economic benefits of capital investments in walking and cycling based on information provided about the location and usage of the investment .The tool was initially developed to comply with the Department for Transport (DfT)'s guidance, WebTAG (Web-based Transport Appraisal Guidance). In Wales, the Welsh government's Transport Appraisal Guidance (WelTAG) is used, as this is adapted to Welsh-specific objectives and the outcomes and strategic priorities of the Wales Transport Strategy. There are no specific adaptations to the Sustrans RMU BCR tool mandated in the latest version of WelTAG, therefore the BCR tool developed in accordance with WebTAG is compatible for the Welsh context.

The BCR tool requires the following inputs:

- Trip frequency
- Journey purpose

[3] WebTAG Unit A5.1 for Active Mode Appraisal. Available at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/427098/webtag-tag-unit-a5-1-active-mode-appraisal.pdf

- Trip distance
- Proportion not using a car for any part of their journey
- Proportion who could have used a car for their journey but have chosen not to

The BCR tool provides an estimate of the monetised economic benefits for the following impact areas related to cycling and walking:

- Health (using the WHO HEAT tool)
- Absenteeism
- Amenity
- Greenhouse Gas Emissions Reduction
- Accidents Savings
- Decongestion
- Air Quality Improvement
- Noise Pollution Reduction
- Infrastructure Development
- Indirect Taxation (disbenefit)

All economic benefits appraised through the BCR tool are based on a 20 year appraisal time period. This provides an estimate of the economic benefits of a specific level of scheme usage being observed over the next 20 years. All benefits are discounted over the 20-year time period to provide a present-day value.

Health Economic Assessment Tool (HEAT)

The (WHO) Health Economic Assessment Tool (HEAT) is used to evaluate the health-related economic benefits of walking and cycling. The benefits calculated through HEAT relate to the reduced mortality generated through a specific number of walking and cycling trips. All health-related economic benefits are calculated over a 20 year appraisal time period, to maintain compatibility with the WebTAG-generated economic outputs.

The version used in this appraisal is not the most current as the BCR tool currently still uses the previous version of the tool. The Further information on the HEAT tool used can be found on the HEAT website[4].

Leisure Expenditure Model Tools: Cycling and Walking

Sustrans RMU has developed two models which calculate the economic benefit to an area from recreational cycling and walking in terms of 'spend per head' and the job roles these activities create.

[4] The WHO HEAT tool and associated guidance are available at: http://www.heatwalkingcycling.org

The **Leisure Cycling Expenditure Model**[5] was originally developed in 2007 in association with the University of Central Lancashire (UCLAN) to estimate the impact of cycle tourism. It has been iteratively updated, most recently in 2017.

The model was developed based on an extensive data collection exercise undertaken between 2001 and 2006 on long-distance routes in the North of England, using user surveys, automatic counter data and travel diaries. The model can be used to estimate the economic impact of cycle tourism based on an estimate of annual 'spend per head' for all recreational cyclist users on the route. This estimate of cycle tourism-related expenditure is differentiated according to home-based and recreational tourist users. The outputs are indicative, rather than precise, estimates of the potential direct economic impact of investing in recreational cycling and give an estimate of the annual tourism-related economic benefits of recreational cycling usage on a proposed route. This is in terms of tourism expenditure and the social value of tourism per year.

The **Leisure Walking Expenditure Model** (LWEM) is a tool for estimating the economic benefit of leisure walking in terms of the expenditure it contributes to the local economy. This model originated from the Recreation Expenditure Model (now the LCEM) and builds on expenditure data collected from route users over a number of years.

It is based on data collected from Route User Intercept Surveys (RUIS) across the UK (though mainly in Wales and Scotland). The model estimates the total annual spend for all home- and holiday-based based leisure walkers. It also calculates the number of full time equivalent (FTE) roles this spend would support. In order to further understand the effect of the expenditure, spend and FTE roles are split by sector.

[5] Previously titled the Recreational Expenditure Model (REM)

4 Penarth Headland RUIS data

Baseline AUE

An Annual Usage Estimate (AUE) is required to calculate the expected economic benefits from the proposed route construction. This shows the potential number of trips that could be made on the proposed route if it were approved and constructed. Due to a low survey response rate among cyclists, only the manual count data was used to calculate an estimate of annual usage, as this was assumed to more accurately represent usage on the route.

From the manual count data, the breakdown of the baseline AUE for the proposed new route is shown in the **Table 3** below:

Table 3 Breakdown of Manual Count generated Baseline AUE

User Type	%	Annual Usage
Cyclists	32	341,963
Pedestrians	58	621,726
Other	10	103,011
Gender		
Female (inc. Under 16)	41	432,892
Male (inc. Under 16)	59	633,808
Age		
Child	11	118,464
16-64 years	76	811,847
65+ years	13	136,389

Manual count data

Over the four days manual counts were done to monitor route usages in terms of age, gender, mode and variance between school term time and holiday. The results are displayed in **Table 4** below. This data was used to calculate the AUE shown in **Table 3.**

Table 4 Manual count data from RUIS site

	Cyclists	Cyclist %	Pedestrians	Pedestrians %	Other	Other %	Total
Children	329	27	1,041	71	36	2	1,406
Adult Male	1,548	33	2,609	56	521	11	4,678
Adult Female	666	19	2,430	70	364	11	3,460
Older	269	19	1,108	77	53	4	1,430
School Holiday	2,112	23	6,311	70	616	7	9,039
School term time	700	36	877	45	358	19	1,935

RUIS Demographics

All survey results presented have not had weighting applied in the analysis. As such, the results presented are based on the number of respondents alone and are not weighted according to any proportions observed in the manual count. This is due to the sample of survey respondents not capturing the full range of users observed in the manual count to a sufficient level.

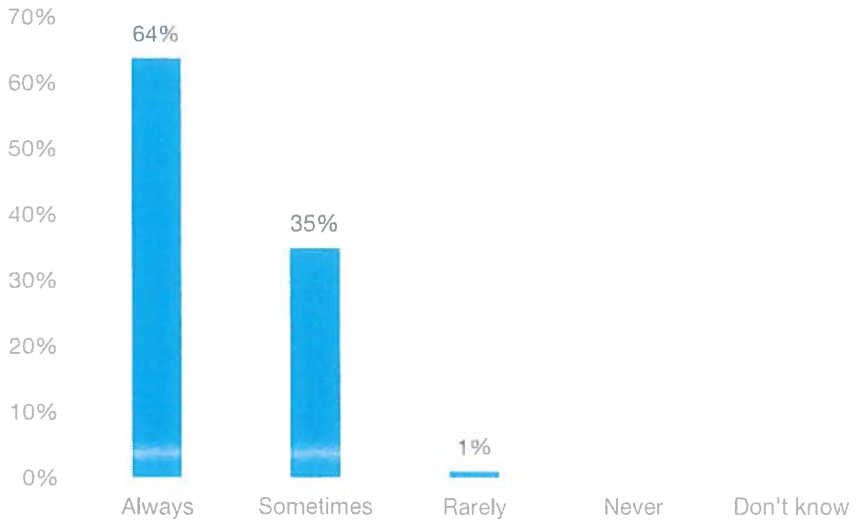
Of the respondents of the RUIS:

- 56% (54) were female and 44% (43) male
- 21% were aged 16-34, 28% were 35-54, 23.7% were 55-64 and 27.8% were aged 65 or older.
- 37% 36) were employed full time and 16% (15) part time, 41% (40) were retired, 4% (4) were students and 1% (1) were homemakers
- 91% (88) of respondents were using the route for recreation. Of these, 92% (81) of respondents originated from a home-base, 8% (7) were holiday/tourist trips
- The average spend by those on holiday/tourist trips was £26.86 (average of 7 responses)[6]

Perceptions of the Proposed Shoreline Route and the existing Cardiff Barrage Route

The Penarth Headland RUIS showed a map of the proposed shared use path and asked respondents if they would use the route. Results indicate the route would be well used with 64% of respondents saying they would always use the route and 35% saying they would use the new route sometimes (**Figure 6**).

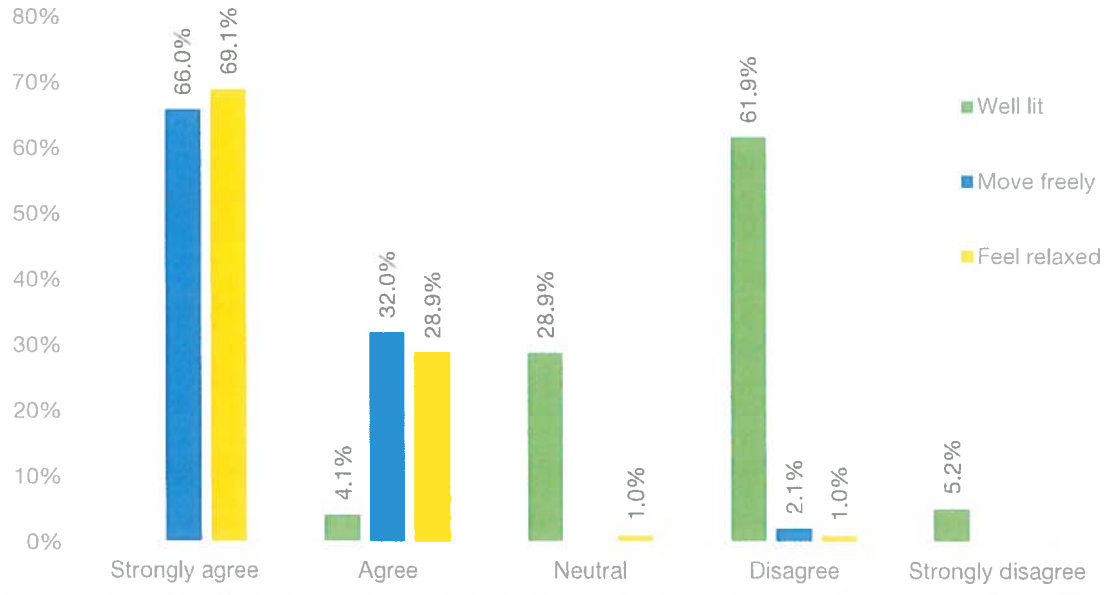
Figure 6: Responses to "Would you use the proposed new route along Penarth Headland?"



[6] Note: this expenditure figure displays expenditure amounts provided by respondents to the RUIS, and has not been derived using the LWEM or LCEM. Results from the LWEM and LCEM tools are displayed separately. This value has not been incorporated into the analysis of the LWEM or LCEM and is the reporting of the data collection result only.

The perceptions of the current Cardiff barrage route indicate people feel it is a place in which they feel relaxed and can move freely, indicating good perceptions of safety on the route; though the majority of respondents think the lighting is insufficient. This is illustrated in **Figure 7** below.

Figure 7: Levels of agreement with safety aspects if the Cardiff Barrage



5 Assessment of Economic Benefits

This section outlines the economic benefits of the proposed **Penarth Headland shared-use route,** including:

- Health-related benefits of increased walking and cycling on the proposed routes
- Direct and indirect job creation from infrastructure works and increased recreational walking on the routes
- Overall positive return on investment

5.1 Annual Usage Estimate

An Annual Usage Estimate (AUE)[7] is required to calculate the expected economic benefits from a proposed route development as it looks at benefits from an increase in current usage. As this is a new route the AUE was calculated from the RUIS manual count data commissioned on the South side of the Cardiff Barrage, where the proposed route would connect to. (**Table 5**). The AUE calculation draws on past projects and takes into account seasonal variability in order to provide an estimate.

Table 5 RUIS Manual Count Annual Usage Estimate (AUE)

Site	Cycling AUE	Walking AUE	Total AUE
Penarth Headland RUIS	341,963	621,726	1,066,700

The baseline is an estimation of 'current usage' in proximity to the proposed route.

5.2 AUE increase scenarios – Penarth Headland Shared Use path

To forecast the expected economic benefits of the route, a range of post-intervention scenarios where usage has increased above the baseline are set.

These scenarios are based on outputs from the **Infrastructure Investment Tools (IIT)** for cyclists and pedestrians which provides an estimate of the expected cycling and pedestrian usage increases based on a database of past schemes where infrastructure of a similar type has been delivered. The IIT models were run using the baseline AUE and the infrastructure category 'Cycle and pedestrian track' for the urban rural classification of 'Urban town and city'.

The IIT provides an indication of usage increase that is likely to be expected from construction of the route. This is the estimate of annual usage once the scheme has been constructed, accounting for mode shift and growth in cycling usage that is encouraged through the route development. To account for potential uncertainty and the possibility that usage change may be higher or lower than what was observed in the past, a range of three post-usage scenarios are used.

[7] An Annual Usage Estimate (AUE) refers to the number of individual cycling trips made annually on a route

The three scenarios for cycling uplift are shown in **Table 6**. The lower scenario uses the predicted 72% uplift from the CIIT. Given the supporting evidence from the Cardiff Barrage and Pont-y-Werin uplift it reasonable that this would be seen as a low increase in usage. As the CIIT is based on aggregated data from a wide range of schemes and locations, it may not fully capture local conditions. Based on evidence of higher uplift than the CIIT in the two local schemes (see **Table 1** for full detail), the middle and higher scenarios have been set at intervals of 50% higher than the 72% scenario, up to 122% and 172% respectively. The scenarios represented have been chosen based on the CIIT and what has been observed in the surrounding area and similar past schemes. These are ambitious scenarios that seek to capture the demand for active travel infrastructure seen in the area from past local schemes, yet are still in line with the CIIT predictions.

Table 6 Post-scenario cycling AUE scenarios

Scenario	Baseline AUE	Percentage increase in cyclist usage	Post-scenario AUE
1: Low	341,963	72%[8]	586,840
2: Middle	341,963	122%	759,156
3: High	341,963	172%	930,137

The three scenarios for pedestrian uplift are shown in Table 7 below. Again the low scenario is taken for the PIIT estimate (26%). Given the uplift seen from past projects in Penarth, in the comparable scheme in East Sussex and the RUIS survey results which show that 64% of respondents would use the new route all the time, the mid and high scenarios were set at 65% and 104%.

Table 7 Post-scenario pedestrian AUEs

Scenario	Baseline AUE	Percentage increase in pedestrian usage	Post-scenario AUE
1: Low	621,726	26%	783,375
2: Middle	621,726	65%	1,025,848
3: High	621,726	104%	1,268,321

Together, post-scenario cycling and pedestrian usage estimations represent the three scenarios that are appraised in WebTAG.

5.3 Monetised economic benefits

The BCR tool provides an appraisal of the economic benefits of an infrastructure development and requires specific inputs in order to provide a monetised value for the expected benefits under the three post-construction usage scenarios.

For this route, the BCR appraisal tool has been used to calculate the expected economic benefits based on the post-scenarios for both pedestrians and cyclists. All economic benefits presented have been calculated using the WelTAG appraisal tool over a 20-year time period.

[8] The value of 72% is a percentage value that is an output of the cyclist IIT that has been rounded up. Therefore, the post-scenario AUE displayed here will not match with a manual calculation of a 72% increase, but it is the correct representation of the cyclist IIT output. In this case, the rounding up is from a value of 71.6%.

In addition to the baseline and post-scenario AUEs, all necessary BCR tool inputs were taken from the commissioned RUIS data.

No variation in these additional inputs has been made between the baseline and post-scenario cases as it is not possible to predict how these might change as a result of the development.

Depending on what occurs in practice and how these variables change in reality, the valuations obtained through WelTAG using these fixed inputs may reflect an economic value that is either higher or lower than the reality.

5.4 Health-related economic benefits

The health-related economic benefits of the Penarth Headland shared use path have been estimated using the World Health Organisation's (WHO's) Health Economic Appraisal Tool (HEAT)[9]. All health-related economic benefits are calculated over a 20 year appraisal period.

The BCR tool includes health-related economic benefits that have been generated using HEAT. The HEAT outputs that have been calculated are outlined in **Table 8.**

Table 8 HEAT outputs

Scenario	Post-scenario cycling AUE	Post-scenario pedestrian AUE	HEAT output (cyclists)	HEAT output (pedestrians)	HEAT output (combined)
1: Low	586,840	783,375	£8,733,586	£1,023,083	£9,756,669
2: Middle	759,156	1,025,848	£17,156,006	£5,935,492	£23,091,498
3: High	930,137	1,268,321	£25,500,863	£11,010,169	£36,511,031

The combined HEAT output for both pedestrian and cyclist usage is used as the health economic benefit input in the WelTAG tool.

5.5 Overall economic benefits

The overall economic benefits of the proposed route include both the BCR tool and HEAT outputs.

Table 9 displays the range of economic benefits that could be expected under all possible combinations of the three cycling and pedestrian usage scenarios that have been examined. All of these economic benefits include the HEAT outputs displayed in **Table 8.**

[9] The WHO HEAT tool is available at: http://old.heatwalkingcycling.org/

Table 9 BCR and HEAT - Economic benefit

		Walking AUE increase		
		26%	65%	104%
Cycling AUE increase	72%	£10,825,645	£16,464,367	£22,285,170
	122%	£20,091,613	£25,730,335	£31,551,138
	172%	£29,269,896	£34,908,618	£40,729,421

As well as viewing the estimated economic benefits as an array of possible scenarios, these economic benefits can be displayed as three scenarios: a low usage change scenario, a middle usage change scenario and a high usage change scenario. This corresponds with how the economic benefit outputs for the Penarth Headland route are presented.

These three scenarios will be input into the LCEM and LWEM. The three scenarios are outlined in **Table 10** below.

Table 10 BCR and HEAT - Multi-scenario economic benefits

Scenario	Cycling AUE increase	Pedestrian AUE increase	Post-scenario AUE (cycling)	Post-scenario AUE (pedestrian)	Economic benefits
1: Low	72%	26%	586,840	783,375	£10,825,645
2: Middle	122%	65%	759,156	1,025,848	£25,730,335
3: High	172%	104%	930,137	1,268,321	£40,729,421

5.6 Benefit-cost ratios

The total construction cost of the proposed Penarth Headland route is estimated at £10,000,000. Annual (routine) maintenance costs for the route length of 1.1km are estimated to be £938 per year, not including any costs of repairing significant, unexpected damage. This has been derived by finding the midpoint between costs for maintenance of a low-intensity and high-intensity route. Over the 20 year appraisal time period, the total scheme costs (construction and maintenance) are estimated at £12,114,074.

Table 11 below show the estimated economic impact, including health benefits from HEAT, for each of the different increase scenarios over a 20 year appraisal period. The benefit to cost ratio for each scenario is included under the 'BCR' column.

Table 11: Estimated economic benefits

	Cycling	Walking	Total Benefits	Cost (inc. maintenance over 20 years)	BCR
1: Low (72% cycling, 26% walking)	£9,630,722	£1,194,923	£10,825,645	£12,114,074	0.89:1
2: Middle (122% cycling, 65% walking)	£18,896,690	£6,833,645	£25,730,335	£12,114,074	2.12:1
3: High (172% cycling, 104% walking)	£28,074,973	£12,654,448	£40,729,421	£12,114,074	3.36:1

Any BCR above 1 signifies that the economic benefits of constructing the route are equal or greater than the provided cost. Both the middle and upper increase scenarios have positive BCRs, signifying strongly that under these levels of estimated post-construction usage, the economic benefits are such that they outweigh the costs. This is not the case for the low increase scenario. It is not possible to select any one scenario as the most likely to materialise. The range of scenarios is intended to provide an indication of potential outcomes.

5.7 Tourism-related economic benefits

The Leisure Cycling Expenditure Model (LCEM) and Leisure Walking Expenditure Model (LWEM) tools have been used to generate an estimate of the combined tourism-related economic benefits of the proposed Penarth Headland route. This approach has used a combined recreational AUE to provide an overall estimate of the tourism-related economic benefits.

The LWEM tool has been run using the recreational usage inputs from the Penarth RUIS conducted in February 2018. The economic benefits captured are excluded from economic appraisals following both the WebTAG and WelTAG frameworks and therefore, can be considered to be additional to those benefits outlined in **Table 10.** These tourism-related economic benefits are derived from a different approach to the economic benefits generated through the RMU BCR tool and therefore, **should not** be combined. Outputs from the LWEM and LCEM represent a cashable benefit i.e. expenditure in the local economy, whereas benefits generated via the BCR tool are expected benefits that have been attributed a monetary value but do not represent expenditure.

The LWEM tool provides an estimate of the annual recreational spend by both home-based and tourist leisure walkers on accommodation, food and drink, retail, car costs, walking costs and public transport. This provides an estimate of the direct contribution that leisure walking generated through the proposed route developments will make on the local economy on a yearly basis.

Table 12 Combined Leisure Walking Expenditure Model (LWEM) outputs

Scenario	Annual recreational spend - HOME	Annual recreational spend - HOLIDAY	Overall tourism economic benefits
1: Low	£2,914,044	£3,243,435	£6,157,480
2: Medium	£3,816,010	£4,247,355	£8,063,365
3: High	£4,717,975	£5,251,274	£9,969,250

The LWEM also provides an estimate of the direct and indirect full-time equivalent (FTE) jobs supported in the local economy through recreational walking. Details of this are provided in **Table 13.**

Table 13 Leisure walking usage and employment support

Scenario	Direct employment (FTEs)	Indirect employment (FTEs)	Total employment (FTEs)
1: Low	85.4	50.6	136.0
2: Medium	111.8	66.3	178.1
3: High	138.2	81.9	220.2

Unfortunately, due to the low number of cyclist respondents in the Penarth RUIS data set, the inputs required for the LCEM could not be generated, as no leisure cyclists on holiday were surveyed in our sample. No suitable comparison sites that fit the correct input requirements could be found.

National data on outdoor tourism in Wales indicates that the overall economic contribution of all visits over 3 hours long was £966.4 million in 2016[10]. This national-level evidence indicates that there would likely be an economic impact from leisure cycling generated by the Penarth Headland route, especially in light of the economic impact of leisure walking that has been estimated. However, it has not been possible to estimate any locally specific impact using the data obtained on this occasion.

6 Considerations

There are a number of considerations relevant to the assessment of economic benefits that has been carried out for Penarth Headland Route. These considerations relate to the GIS analysis of the area, the baseline AUE calculation and the analysis and use of the tools outlined.

GIS

- The PCT tool should be used as indicative of the cycling structure of an area and the levels of cycling along routes if all commuters were to cycle. It is dependent on workplace LSOA's which influence which routes are mapped. In this case, many of the workplaces in the area are in the North West, and so using the Cardiff Barrage would not be seen as logical to the routing algorithm.
- The routes commuter numbers shown represent the fastest routes from Penarth LSOA's to Cardiff LSOA's. When looking at the quietest routes significant change is seen in the usage across the 3 routes highlighted.
- OpenStreetMaps is an open source community built map. This means it can be edited by many users. At some point the connection of the Pont-Y-Werin Bridge to routes on the North side of the river has been removed, which prevents the CycleStreets algorithm routing across it.

Baseline AUE Data Selection

- The RUIS data shows an uneven spread of cyclist usage across the four survey days on the Cardiff Barrage, with almost half of those counted on one day, 49.8% on 20th February. This was a school holiday weekday during the half term break, which may account for the higher usage.
- Of the 97 surveys conducted over the 4 days of the RUIS, only 8 were from cyclists. This is incongruous with the proportion of pedestrians (65.5%) and cyclist (25.6%) counted, and so is not a representative sample.
- There was a high rate of nonresponses among users, with 541 individuals refusing over the 4 days. 174 of these were cyclists. 42% of those asked either refused or did not stop, while 20% cited the poor weather as their reason. Due to this the survey information may not fully represent all route users. This can be attributed to the weather seen due to the time of year the survey was conducted.
- Due to the low sample of cyclist surveys from the RUIS the baseline annual usage estimate was taken from the manual counts. This means that the sample has not been weighted and the AUE output has not accounted for data shown in the RUIS as it was not a representative sample.

Post-scenario AUEs and analysis

- The Pedestrian IIT is a newly developed tool by Sustrans RMU. The database of examples it has to draw on is not as large as that used for the Cyclist IIT (98 compared to the 174 in the CIIT). In this instance, the comparison base for 'cycle and pedestrian tracks' in an 'urban town and city' was 27.

BCR Tool

- Maintenance costs have been calculated for the BCR tool input at £938 per year. Analysis work is currently underway by ARUP to fully estimate the maintenance costs of the new Penarth Headland route. As no specific figures are currently available to include in this analysis an estimate has been derived from maintenance costs data from other routes. This value of £938 comes from taking the midpoint between known costs of maintaining a demanding route and an undemanding route, taking into account the route distance and typical maintenance activities. It also includes a 20% increase on the costs to account for the complexity of the route at Penarth being at a cliff base. This figure does not include any one off costs for significant damage or replacement. This estimate is indicative only, and not exact to the Penarth Headland route. In reality the maintenance costs of the route could be higher or lower than the estimate used in this appraisal.

- The cycling uplift scenarios were chosen based on data from the surrounding area, which suggests there is high demand for active travel infrastructure. Looking at uplift from past RUIS comparisons for the barrage and the Pont Y Werin Bridge, uplift is seen to be 3-5 times than original AUE (514% and 267% respectively). At a comparable site, of Hastings to Bexhill, where the route also ran along the coast line and was a new construction, there was an AUE increase of 267%. Given this, the estimates used for Penarth are in keeping with the broad evidence base that is represented by the CIIT but seek to capture the high usage increases that have been observed both in the local area and at past similar schemes.

- Given the limitations of the PIIT, the PIIT output was used as the low scenario for pedestrians in the BCR. The mid scenario of 65% would give an equivalent uplift to that seen from the coastal route between Bexhill and Hastings. Combine with the RUIS responses to the 'new route' question this would be viable, as 63% said that would use the route always, and 36% said they would use the route sometimes. The higher estimate increases by the same difference between the lower and mid scenarios, although a large jump, when compared to the uplift seen after the Pont Y Werin Bridge (756%), is a realistic possibility.

LCEM

- Due to the lack of cyclist respondents the required inputs for the LCEM were not obtained and the tool could not be used in this analysis. There were only 8 recreational cyclists observed in the RUIS and all were based from their homes. These home-based recreational trips are not valued in the LCEM, therefore – there were no observed trips to enter into the model to generate an associated expenditure value for leisure cycling. This may have been in part down to the weather and the time of year in which the survey was done. Therefore, this should not be taken as an assumption that there is no economic value of recreational cycling associated with the proposed route, merely that one could not be estimated on the basis of the RUIS data received in this case.

- Data from comparable site and the past projects in the area were looked at to use as an indication of the leisure cycling expenditure that could be expected. Unfortunately the specific RUIS questions regarding tourism needed to run the expenditure model were not asked in these cases, most likely because they were not relevant to those projects. A RUIS carried out in the summer months may have been more likely to capture leisure cyclists, due to the seasonality of cycling tourism. However, there is no guarantee this would occur. The AUEs in

this document have had seasonality calculations applied, and therefore, are not limited by the month in which the usage data was captured.

Transport Links

- In order to maximise the potential benefit of the Headland Link, particularly for cyclists, consideration must be given to providing a continuous shared-use route from the Penarth end of the route utilising Penarth Promenade and the wider highway network. Currently cyclists wishing to access the area around Penarth Pier would be required to travel on carriageway descending either Beach Road or Bridgeman Road, both of which terminate at the promenade which has no shared use access currently.
- It is recommended that the development of the Headland link also considers connectivity for cyclists from Route 88 entering Penarth along the former railway alignment from Lavernock (Railway Walk), utilising the esplanade to access the southern end of Penarth promenade and providing a contraflow along this frontage to access the headland link. This could also consider connections to and from Penarth Railway station. Wider local network connections within Penarth would also benefit options for accessing the Headland route and this should be subject to further consideration in due course.