



Tourism Industry Council of Tasmania

**Three Capes Track
Economic Impact of Additional
Day Walk Visitors**

February 2010

This report contains 10 pages plus Appendices
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1 Executive summary

1.1 Background

KPMG has been engaged by the Tourism Industry Council of Tasmania (TICT) to determine the economic benefits of the proposed Three Capes Track (3CT). The focus of this research and modelling was on the additional benefits that could accrue to Tasmania (and specifically in the Tasman Peninsula region) as a result of the additional visitors that will be drawn to the region to experience some parts of the new track (day or part-day walks).

This analysis was not required to take into account, the projected 10,000 visitors that will undertake the proposed entire five-day walk, which has already been the subject of a separate economic impact assessment by Syneca Consulting (2008).

1.2 Approach

In order to undertake this engagement, we worked with TICT and other stakeholders from Tourism Tasmania and Parks and Wildlife to source and develop the assumptions to underpin the economic impact modelling. We then dispatched the data to Professor John Mangan at the University of Queensland to undertake the economic impact modelling using the Tasmanian Non-Linear Model (TNLM). In this analysis, both the TNLM and a specifically created Tasman Peninsula model are used. The properties of the TNLM are described in detail in Appendix 1. This report presents the outcomes of this process.

1.3 Assumptions

We have estimated the economic impact of increased visitation (from international and interstate visitors¹) to Tasmania and the Tasman Peninsula, because of the presence of the 3CT. Increased visitation will take a number of forms:

- 1 New visitors to both Tasmania and the Tasman Peninsula
- 2 Some visitors will substitute part or all of their time in other parts of Tasmania to visit the Tasman Peninsula, and
- 3 Some visitors will extend the duration of their visits to Tasmania because of the 3CT²

In the case of impact (1), the benefits are unambiguous and flow to both the Tasmania economy as a whole and to the Tasman Peninsula regional economy. For impact (2) displacement takes place and the gains to the Tasman Peninsula regional economy will be fully or partially offset by reduced visitor impact in other regions, which are assumed to amount to a zero sum outcome.³ Impact (3) is similar to impact (1), benefitting both the Tasmanian economy as a

¹ There is no reliable data on intrastate visitation

² It is highly unlikely that visitors would spend less time in Tasmania because of the 3 Capes walking track

³ Partial offset would occur where visitors spend more (less) in the Tasman Peninsula than they were spending in the area from which they substituted.

whole and the Tasman Peninsula, but with major proportional additional benefits flowing to the Tasman Peninsula. However, for the purposes of this modelling, this impact has not been included.

In respect to these impacts, two scenarios have been modelled:

- a conservative scenario which is based on 17.11% growth in visitation to the Tasman Peninsula to 2017 with a 30:70 split between new and substitute visits
- an optimistic scenario, which is based on 26.47% growth in visitation to the Tasman Peninsula to 2017 with a 40:60 split between new and substitute visitors

Data relating to the duration of stay and nightly spend has been provided by the TICT, drawn from the Tasmanian Visitor Survey. The modelling results set out below present a summary the whole of State and Tasman Peninsula impacts for both scenarios, hence presenting a conceivable range of impacts.

1.4 Modelling results

Impacts on the Tasmanian economy

The range of impacts on the entire Tasmanian economy based on the conservative and optimistic assumptions are as follows.

Table 1: Economic significance of total additional visitors to the Tasmanian economy due to additional walkers as a result of the 3CT (\$M) – Conservative and optimistic estimates

Impact	Conservative	Optimistic
Gross output/turnover	\$90.43	\$188.01
Additional GSP	\$44.07	\$92.73
Additional Factor Income	\$36.52	\$76.84
Jobs supported in economy	741	1,563

One feature of these results is that they are not fully proportional. The results show slightly intensified impacts for the more optimistic scenario, indicating increasing returns to higher-level visitation. These are unequivocal benefits to the Tasmanian economy and are net of displacement, on the assumption that no other crowding out occurs or supply constraints prevent full benefits from occurring.

Impacts on the Tasman Peninsula economy

The range of impacts on the Tasman Peninsula economy based on the conservative and optimistic assumptions are as follows.

Table 2: Economic significance of total additional visitors to the Tasman Peninsula economy due to additional walkers as a result of the 3CT (\$M) – Conservative and optimistic estimates

Impact	Conservative	Optimistic
Gross output/turnover	\$27.58	\$43.75
Additional GSP	\$9.93	\$15.86
Additional Factor Income	\$7.86	\$12.55
Jobs supported in economy	203	323

The 3CT would therefore make a significant and material difference to economic prosperity on the Tasman Peninsula. This benefit will be further enhanced by the impact of intrastate visitors, which we have not modelled due to the absence of this data.

2 Assumptions

2.1 Visitor impacts

This project sets out to estimate the economic impact of increased visitation (from international and interstate visitors) to Tasmania and the Tasman Peninsula, because of the presence of the 3CT. Increased visitation will take a number of forms:

- 1 First there will be new visitors to both Tasmania and the Tasman Peninsula
- 2 Second there will be some tourists that substitute part or all of their time in other parts of Tasmania to substitute a visit to the Tasman Peninsula, and
- 3 Third, there will be some visitors who will extend the duration of their visits to Tasmania because of the 3CT⁴

In the case of impact (1), the benefits are unambiguous and flow to both the Tasmanian economy as a whole and to the Tasman Peninsula regional economy. That is, we assume there is no displacement of existing visitors. (There is sufficient accommodation and other tourism services available)

In respect to impact (2) displacement takes place and the gains to the Tasman Peninsula regional economy will be fully or partially offset by reduce visitor impact in other regions⁵. For clarity of analysis, we have assumed that the net effect on the Tasmanian economy as a whole is zero and that the gains and losses associated with the shift in visitor destination are a zero sum outcome.

Impact (3) is similar to impact (1), benefitting both the Tasmanian economy as a whole and the Tasman Peninsula, but with major proportional additional benefits flowing to the Tasman Peninsula. However, for the purposes of this analysis, we have not included this impact on the basis of conservatism.

2.2 Estimated visitor numbers

In order to estimate the additional visitor numbers that would be attracted to Tasmania and the Tasman Peninsula by the presence of 3CT, the new leisure visitors⁶ were divided into the following categories:

- 1 new leisure visitors attracted to Tasmania by 3CT that will do day walks on the Tasman Peninsula

⁴ It is highly unlikely that visitors would spend less time in Tasmania because of the 3 Capes walking track

⁵ Partial offset would occur where visitors spend more (less) in the Tasman Peninsula then they were spending in the area from which they substituted.

⁶ All data is for leisure visitors only (holiday and visiting friends and relatives (VFR). Visitors to Tasmania for conventions, events, business and any other purpose are not included)

- 2 the “substitution effect” of people that would have visited Tasmania anyway but will now visit the Tasman Peninsula to do day walks as a result of 3CT, and
- 3 the total number of additional leisure visitors to the Tasman Peninsula attracted by the 3CT and will do day walks.

Estimates for these categories were derived as follows.

New visitors to the state versus substitution

To then calculate what proportion of visitors will be new visitors to Tasmania (a) and what proportion will be a substitution of people already in the state who decide to visit the Tasman Peninsula (b), we have estimated the ratio.

This has been based on the impact that could be expected as a result of having a new and iconic product in the market that is consistent with the Tasmanian brand and promoted appropriately. To do this the estimate has been based on TICT experience with other new developments and has been divided into two scenarios:

- the conservative estimate would be a 30:70 split between new visitors versus substitution, and
- the more optimistic estimate is a 40:60 split between new visitors versus substitution.

Both of the scenarios still assume a greater proportion of the new visitors to the Tasman Peninsula will be substitutes as opposed to new visitors, which we consider is a conservative outcome.

Additional leisure visitors to the Tasman Peninsula⁷

To calculate this we have started with the current (2009) number of leisure visitors to the Tasman Peninsula from the Tasmanian Visitor Survey to June 2009 (this was the source of the original data supplied) which is 55,292 international visitors and 167,780 interstate visitors, totalling 223,072 visitors per annum.

Then we have applied the likely gains in visitor numbers to 2017 if we assume a consistent rate of growth based on historical levels (without any 3CT impact) as per the Tourism Tasmania modelled impacts.⁸ This equates to 55.4% growth in international visitors and 44.0% growth in interstate visitors by 2017 resulting in 85,924 international visitors and 241,603 interstate visitors, totalling 327,527 visitors per annum by 2017 without the impact of 3CT factored in.

⁷ Day walk data on the Tasman Peninsula is not available. Data for day walks in any part of Tasmania from the Tasmanian Visitor Survey has been applied.

⁸ Derived by assessing recent share gains made by Tasmania in the interstate and inbound markets and projecting these forward (from BDA Marketing Planning), as advised by Tourism Tasmania

We have then estimated the impact of the 3CT on growth in visitors to the Tasman Peninsula above this natural growth. In the seven years to 2017 we have estimated the following compounding additional visitor impacts by year as a result of 3CT, again using two scenarios:

- the conservative scenario assumes growth in visitor numbers of 1%, 1%, 2%, 3%, 3%, 3%, and 3%, where growth is scaled up as the first two years represent the period of construction with a full impact of about 3% per year for the final four years when the walk is open and operational. This means that by 2017, the annual lift in visitor numbers to the Tasman Peninsula as a result of the compounding impact of 3CT will be 17.11%.
- the optimistic scenario assumes growth in visitor numbers of 1%, 1%, 2%, 5%, 5%, 5%, and 5%, with a similar scaling up but with a full impact of about 5% per year for the final four years when the walk is open and operational. This means that by 2017, the annual lift in visitor numbers to the Tasman Peninsula as a result of the compounding impact of 3CT will be 26.47%.

As a result of this, the additional annual leisure visitors to the Tasman Peninsula in 2017 as a result of the 3CT is estimated by multiplying the anticipated Tasman Peninsula visitors in 2017 by 17.11% and 26.47% to get the estimated impact of 3CT, so that:

- The conservative scenario shows an additional 14,702 international visitors and 41,338 interstate visitors, totalling 56,040 additional visitors per annum
- The optimistic scenario shows an additional 22,744 international visitors and 63,952 interstate visitors, totalling 86,696 additional visitors per annum.

These projected additional visitors were then multiplied by duration of stay and spending data outlined below, to derive an estimate of the value of additional direct expenditure at 2017.

2.3 Estimated duration of stay and spending

Assumptions in respect to duration of stay and visitor spending have been provided by the TICT based on data drawn from the Tasmanian Visitor Survey.

Duration of stay

The duration of stay for visitors to the Tasman Peninsula is assumed to be 1.4 nights for international visitors and 1.8 nights for interstate visitors.

In terms of new visitors to Tasmania attracted by 3CT, the model assumes the duration of stay for these visitors is 13.6 nights for international visitors and 16.7 nights for interstate visitors.

Spending

The average nightly spending for visitors to the Tasman Peninsula is assumed to be \$144 in Tasmania by international visitors and \$185 for interstate visitors.⁹

In terms of new visitors to Tasmania attracted by 3CT day walks, the model assumes the average nightly spend is \$166 for international visitors and \$216 for interstate visitors.

These spending assumptions are based on 2009 dollars and these have not been inflated over the period of growth covered by the model.

2.4 Other comments

The modelling has been based on conservative assumptions. Firstly, the modelling has not factored in the substitution of visitors from other parts of Tasmania. Any extension of length of stay by visitors also cannot be estimated.

Secondly, the number of additional intrastate visitors to the Tasman Peninsula as a result of the impact of 3CT has not been estimated due to the less reliable nature of the data that is held on this group.

One difficulty in estimating total economic impacts in this case is that the increases in visitation are cumulative and take place over time, culminating in 2017. Most economic models have difficulties with dynamic modelling and normally use a comparative static approach. Here the impacts have been modelled as at 2017. Therefore the modelling is projecting whole period impacts that may need apportionment over time¹⁰.

⁹ Spending data is not available on the Tasman Peninsula. Spending by visitors to the Tasman Peninsula within Tasmania from the Tasmanian Visitor Survey has been applied

¹⁰ This is a particularly difficult task for employment as modeling is imprecise as to when jobs will begin and end
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3 Economic impact projections

3.1 Whole of Tasmania economic impacts

This section sets out the economic impacts of the 3CT based on the assumptions outlined in the previous section. The data and some of the commentary is attributed to Professor Mangan.

The impact of new visitors to Tasmania as a whole is the **headline result** of the analysis. Only new visitors (both interstate and international) are countered in the analysis for Tasmania and they are unambiguously exogenous.

Tables 3 and 4 sets out the whole of period benefits for the Tasmanian economy for combined interstate and international visitors, under the conservative and optimistic scenarios. The disaggregated results by source of visitor (interstate and international) have been calculated and are provided in Appendix 2.

Table 3: Economic significance of total additional visitors to the Tasmanian economy due to additional walkers as a result of the 3CT (\$M) – Conservative estimates

	Final Demand	Industry Effects	Consumption Effects	Total	Flow-on
Gross Output/turnover	54.69	16.44	19.30	90.43	35.74
Value added	26.92	8.03	9.12	44.07	17.15
Factor Income	22.16	6.61	7.75	36.52	14.36
Employment supported	455	136	150	741	286

Source TNLM (2009) using supplied direct spending data

The results from non-linear modelling tend to be on the conservative side. However the results are still quite significant. For comparison the results from running the optimistic scenario are shown in Table 4.

Table 4: Economic significance of total additional visitors to the Tasmanian economy due to additional walkers as a result of the 3CT (\$M) – Optimistic estimates

	Final Demand	Industry Effects	Consumption Effects	Total	Flow-on
Gross Output/turnover	112.82	34.59	40.60	188.01	75.19
Value added	56.64	16.90	19.19	92.73	36.09

	Final Demand	Industry Effects	Consumption Effects	Total	Flow-on
Factor income	46.62	13.90	16.32	76.84	30.22
Employment supported	956	285	322	1563	607

Source TNLM (2009) using supplied direct spending data

One feature of the results is that they are not fully proportional. The results show slightly intensified impacts for the higher case, indicating increasing returns to higher level visitation.

As a result, and because of the large gap between the conservative and the optimistic forecast the range of results is wide. Specifically the range of whole period benefits are as follows¹¹:

- Gross output/turnover effects range from \$90.43 million to \$188.01 million
- Additional GSP range from \$44.07 million to \$92.73 million
- Additional factor Income range from \$36.52 million to \$76.84 million
- Support for between 741 and 1563 jobs throughout the economy

These are unequivocal benefits to the Tasmanian economy and are net of displacement, on the assumption that no other crowding out occurs or supply constraints prevent full benefits from occurring.

3.2 Economic impact on the Tasman Peninsula

The combined results under the conservative and optimistic scenarios are shown in Table 5 and 6. Most of this regional benefit is displacement from other parts of the economy and, while beneficial to the Tasman Peninsula economy, it is not counted in the above benefits to Tasmania as a whole.

Table 5: Economic significance of total additional visitors to the Tasman Peninsula economy due to additional walkers as a result of the 3CT –Conservative estimates (\$M)

	Final Demand	Industry Effects	Consumption Effects	Total	Flow-on
Gross Output/turnover	16.73	4.99	5.86	27.58	10.85
GSP additions	6.36	1.48	2.09	9.93	3.57

¹¹ For a discussion of the economic impact measures see KPMG (2009)

	Final Demand	Industry Effects	Consumption Effects	Total	Flow-on
Factor Income	4.88	1.36	1.62	7.86	2.98
Employment supported	100	51	52	203	103

Source: Estimates from use of Tasman Peninsula table

Once again, slightly increasing returns are shown between the conservative and the optimistic scenarios.

Table 6: Economic significance of total additional visitors to Tasman Peninsula economy due to additional walkers as a result of the 3CT - Optimistic estimates (\$M)

	Final Demand	Industry Effects	Consumption Effects	Total	Flow-on
Gross Output/turnover	26.44	7.96	9.35	43.75	17.31
GSP additions	10.15	2.37	3.34	15.86	5.71
Factor Income	7.79	2.17	2.59	12.55	4.76
Employment supported	159	81	83	323	164

Source: Estimates from use of Tasman Peninsula table

In summary the ranges of impacts between the conservative and optimistic assumptions are:

- Gross output/turnover effects range from \$27.58 million to \$43.75 million
- Additional GSP range from \$9.93 million to \$15.86 million
- Additional factor Income range from \$7.86 million to \$12.55 million
- Support for between 203 and 323 jobs throughout the economy

The 3CT would therefore make a significant and material difference to economic development on the Tasman Peninsula.

A Technical Appendix¹²

A.1 Economic modelling

Economic modelling may proceed from a number of perspectives, with the principal difference being the decision to model industry specific activities (partial equilibrium) or to take a simultaneous approach (general equilibrium), whereby the outcomes are calibrated on net welfare gain across the economy. However, in most cases the two approaches should be seen as complementary rather than alternatives. For example, the general approach allows consideration of the net benefit of a range of alternative activities and may be seen as the best means of ex-ante resource allocation planning. Conversely, consideration of specific activities such as a set of walking tracks, is often more suited to partial economic modelling. This is because the issue under consideration is not whether the original decision to build the walking tracks was the most efficient use of resources but rather, having made the decision to construct walking tracks, what economic benefit do they bring to the host economy?

Another factor to consider in economic modelling is that, in the short run, virtually all economic activity is displacing and involves shifting investments between projects. Persons spend money on one activity by reducing expenditure on other activities or by borrowing or dis-saving. Modellers and policy makers recognise this fact and attempt to isolate exogenous spending (net new spending within a spatial area), by discounting expenditure from local residents, which they assume to be complete displacement and estimating only that spending brought into that specific economy by non-residents¹³.

In the case of this study, it follows that spending on walking track related activities by international visitors and inter-state visitors may be considered exogenous, while spending by locals and intra-state visitors is assumed to be displacement.

These types of issue are reflected in methodological differences in the construction and interpretation of economic models, ranging from traditional input-output (IO), through econometric IO to Computable General Equilibrium models (CGE). Taken to extremes, a general equilibrium approach would only estimate a positive economic value from the operations of the walking track if it represented the most efficient use of these scarce resources in comparison to other potential uses, because such methods seek to allocate resources efficiently across an economy. For this reason CGE is often the preferred method for making investment decisions designed to maximise economic welfare across the economy as a whole.

At the other extreme, traditional IO analysis is primarily interested in the impact of each specific project taken separately and after recognising that the initial investment decision is taken as given.

While this may seem a more direct way of attempting to provide economic measurement, the traditional IO method has a number of weaknesses. The principal of these is that, once a decision is made to consider a project in isolation, those factors that operate in the real world

¹² All content in this section is provided by Professor John Mangan

¹³ This need not be the case. For some major events, locals dis-save or borrow and this expenditure should be seen as exogenous because it originated solely because of the occurrence of the event in question.

such as the competition among other economic agents for scarce materials are not considered. For example, constraints on economic activity such as supply imbalances, lack of demand for the product or non-linearities in economic production are assumed not to exist. In this sense the output from a traditional IO analysis gives the best (or maximum) result from an economic activity on the assumption that there are no barriers in the rest of the economy that may constrain this maximum result from occurring. For small, localised projects that have no great impact on the economy this may be a reasonable assumption. For larger projects or projects that take place in a booming economy, these assumptions can be highly misleading.

However, modifying traditional IO by the introduction of non-linear assumptions goes a long way to reducing a number of these constraints and for events the size of the Tasmanian walking track industry, probably offers the best way of obtaining an accurate economic evaluation¹⁴. The other advantage of this method is that it employs the use of marginal coefficients rather than average coefficients. In this sense, it approximates the results of CGE modelling where it is used in an impact context¹⁵. A well known example of the suitability of non-linear IO modelling to modelling the economics of tourist related activity, is the study by Gamage and West of the macro economic effects of tourism in the Victorian Economy.¹⁶

A.2 Economic impact measures

Gross Output (regional turnover) - refers to the gross value of increased production from an additional economic activity. Within this gross value is included the value of raw materials that, in most cases, have already been counted as part of gross output from earlier production. Therefore there is a tendency for Gross output figures to include some double counting. As a result, more concentration is placed upon incremental (additional output created) *or value added*. Nevertheless, the concept of Gross output should not be abandoned because it is a good indicator of the level of turnover in the economy and hence a good measure of the total level of economic activity.

Value Added - refers to added or net output. Value Added is **equivalent to the Gross State / Regional Product** as used by the Australian Bureau of Statistics. It is the measure usually preferred when measuring economic impact. It measures the added value placed on intermediate products (raw materials) from the productive process. It is made up of margins, wages, profits and transfers.

Factor Income - relates to the share of value added (and gross output) which is directly paid to individuals or firms in the form of wages and or profits. By definition it is a percentage of value added and cannot exceed value added.

¹⁴The properties of Non-Linear models are shown in appendix 1, see also, Murphy, T. (2003) "The Economic Significance of the Charles Stuart University", WRT for a supporting view on the merits of marginal coefficients IO models. He argues that

The application of marginal coefficients to IO tables provides a more accurate representation of the flow-on effects of tourist related stimuli than would be possible using a linear model. The use of marginal coefficients largely overcomes the overestimation of impacts that can result from using the linear approach"

¹⁶ Gamage, A and West, G (2001) "Macro Effects of Tourism in Victoria" *Journal of Travel Research* 40, 101-109

Jobs - relates (usually) to the amount of labour required for the level of production. Depending upon the type of activity, job numbers measure either the use of existing labour (continuing jobs) or hiring new staff. Full Time Equivalent (FTE's) employment refers to the number of full time person-years of employment generated by a particular project or event. This alleviates the overstating of the level of job growth due to the stimulus.

A.3 Economic valuation estimates

The data shown in Tables 2-6 were applied to the marginal coefficients table for both interstate and international visitors. By way of interpretation, the initial spending shock is shown in the top left hand corner (for example, \$54.69 million in Table 1). The other data in column 1 are *model estimates* of the direct impact, in those categories, from the initial spending injections. The other columns are indirect or flow-on impacts, comprised of industry effects and consumption effects, their sum and the total extent of flow-on.

Industry effects are those resulting from production links in the tourist industry production chain. *Consumption effects* relate to spending on final demand usage and private consumption from income earned in the production process.

In some modelling, consumption effects are not reported. Production only effects are represented by results only citing type 1 multiplier analysis. However, it is now recognised that, often, consumption effects are the major impact in some service related investment and should be included in the modelling process.

A.4 The Tasmanian Non-Linear Model

An Input-Output table originally supplied by KPMG¹⁷ was modified to have non-linear properties by the use of the IO-8 software developed by Guy West from the Centre of Economic Policy Modelling at the University of Queensland¹⁸. The table was updated in 2006 to reflect latest Australian Bureau of Statistics Census employment data and more recently supplemented by labour force data supplied by the Australian Bureau of Statistics.

It was modified by the addition of new sectors including separate sectors for Accommodation/ Cafes and Restaurants and a splitting out of the Trade sector into separate Retail and Wholesale Trade sectors. Finally, it has been revamped in 2009 to take account of new estimates of output, income and employment elasticities recently made available at the University of Queensland¹⁹. In an essentially static model, the way in which non-linearities can be included is by the interaction of estimated elasticity coefficients upon the multipliers, particularly the employment and factor income multipliers.

¹⁷ The original IO table has been updated a number of times to reflect growth and structural change in the Tasmanian Economy and new estimates of elasticities in the Australian Economy, most recently in 2009

¹⁸ Some assumptions had to be made concerning elasticity coefficients for some industries. Where exact data was not known, the Rest of Australia (minus NSW) estimates were used.

¹⁹ For this reason there are now some differences between sectoral results obtained within the current version and those obtained in earlier studies.

A.5 Non-Linear Input Output Models²⁰

The Non-Linear Input-Output Model (NLIO) seeks to remove one of the major limitations of standard input-output analysis by removing the assumption of linear coefficients for the household sector and allowing marginal income coefficients adjustment. This is because, as is widely known, the household sector is the dominant component of multiplier effects in an input-output table. As a result using marginal income coefficients for the household sector will provide a more accurate and empirically more valid estimate of the multiplier effects, which in turn, provides results closer to those of a computable general equilibrium (CGE) model. The transactions flows in the input-output table can be expressed in matrix equation form as:

$$\mathbf{T}(\hat{\mathbf{X}}^{-1})\mathbf{X} + \mathbf{Y} = \mathbf{X}$$

That is, for each industry, total industry sales equals intermediate sales to other industries for further processing plus sales to final users, where \mathbf{T} is the matrix of intermediate transactions, \mathbf{X} is the column vector of sector total outputs and \mathbf{Y} is the column vector of aggregate final demands. This can be rewritten as:

$$\mathbf{A}\mathbf{X} + \mathbf{Y} = \mathbf{X}$$

Where \mathbf{A} is the matrix of direct coefficients which represents the amounts of inputs requires from sector i per unit of output of sector j . Thus, for a given direct coefficient matrix, it is possible to solve the set of simultaneous equations to find the new sector production levels \mathbf{X} which will be required to satisfy a potential or actual change in the levels of sector final demands \mathbf{Y} . By rearranging and converting to differences, this equation can be rewritten as:

$$\Delta\mathbf{X} = (\mathbf{I} - \mathbf{A})^{-1}\Delta\mathbf{Y}$$

where $(\mathbf{I} - \mathbf{A})^{-1}$ is termed the total requirements table, Leontief inverse matrix or general solution, and represent the direct and indirect change in the output of each sector in response to a change in the final demand of each sector. $\Delta\mathbf{Y}$ can incorporate any element of final demand expenditure, including household expenditure, government expenditure and capital expenditure.

This model is a linear model in which the \mathbf{A} matrix represents a (constant) matrix of average input propensities. Normally, the \mathbf{A} matrix endogenises the household sector²¹ so that household consumption induced effects can be measured. This is referred to as the type II model; the alternative type I model is where households are treated as exogenous to local economic activity. Generally speaking, the consumption-induced effects are the largest component of the total multipliers. This is because consumer driven consumption (and income) to a large extent dominates local economic activity.

Total inputs are equal to intermediate inputs plus primary inputs (labour and capital). In the conventional input-output model, the inputs purchased by each sector are a function only of the level of output of that sector. The input function is assumed linear and homogeneous of degree one, which implies constant, returns to scale and no substitution between inputs. A more

²⁰ The description of the Non-linear model properties is taken from CEPM model descriptions (West 2003)

²¹ That is, household income varies with the level of intersectoral activity.

reasonable assumption is to allow substitution between primary factors. If there is an expansion in economic activity, say due to a development project, employers will attempt to increase output without corresponding proportional increases in employment numbers, particularly in the short term, e.g. construction projects, where there are economies of scale in getting the existing workforce to work longer hours rather than employ additional persons. This occurs for two reasons.

First, there is evidence in Australia that labour productivity (output per employee) is increasing over time. Secondly, as companies strive to reduce costs and satisfy the micro-economic reform processes imposed on all states by the National Competition Policy, there is evidence of a shift in primary factor use from labour to capital. This implies that the conventional input-output model has a tendency to over-estimate impacts, in particular the income and employment impacts. Therefore, a more realistic approach to modelling impacts is to replace the average expenditure propensities for labour income by employers with marginal input propensities. In other words, the household income row in the A matrix, which are average input coefficients, should be replaced by income elasticities of demand. Note that, as in the CGE model, the linear coefficients assumption between intermediate inputs, and also total primary inputs and total inputs is retained.

One problem associated with this approach is that the solution procedure is now more complex. Now the income impacts will be a function of ΔX but the income coefficients are included in the A matrix which determines ΔX . Therefore the equation set becomes recursive; ΔX depends on A and A depends on ΔX . Solving the input-output equation therefore requires an iterative procedure, a common method being the Gauss-Seidel method.

The income and employment flow-ons from the initial impact also need to be modified. In the conventional input-output model, income and employment flow-ons are calculated as linear functions of the output flow-ons, but in the revised model the parameters relating income to output are no longer constant. The impact on household income needs to be calculated as the difference between the base (i.e. before impact) income levels and the post impact income levels. It can be shown that this is equivalent to using the matrix equation:

$$\Delta \text{Inc} = \hat{X}_0^{-1}(\Delta \hat{X})\hat{L}U_0$$

where U is a vector of household income flows and L is a vector of sectoral household income elasticities of demand. The zero subscript denotes the base level values and the hat denotes a diagonal matrix formed from the elements of the corresponding vector. This equation simply states that, for each sector, the change in household income payments equals the proportional change in output times the base level income payments multiplied by the income elasticity of demand. These income elasticities of demand can be shown to be equal to:

$$I_j = \eta_{WX} + \eta_{EX}$$

where η_{WX} is the elasticity of wage rate with respect to output, and η_{EX} is the elasticity of labour demand with respect to output; that is, they are made up of two components, the wage price component and the labour productivity component.

Similarly, the change in sectoral employment can be calculated as the change in the sectoral wage bill times the wage rate:

$$\Delta \text{Emp} = \hat{H}_0^{-1} \hat{P}_0^{-1} \Delta \text{Inc}$$

where H is a vector of average household income coefficients and P is a vector of coefficients representing average output per employee.

There are several implications arising from the use of this model, compared to the conventional input-output model. Firstly, while the output multipliers and impacts should not be significantly different between the two models, we would expect the income and employment impacts to be smaller in the marginal coefficient model. This is because many industries, especially those which are more capital intensive and can implement further productivity gains, can increase output, particularly in the short run²², without corresponding proportional increases in employment and hence income payments.

Secondly, unlike the conventional input-output model in which the multiplier value is the same for all multiples of the initial shock, the multiplier values from the marginal coefficient model vary with the size of the initial impact. Thus larger changes in final demand will tend to be associated with smaller multipliers than small changes in final demand. Therefore, the differential impacts of the marginal coefficient model are not additive, unlike the conventional (linear) Leontief model and CGE model.

Overall, within the confines of a static model, the major improvements brought by the non-linear model are to improve the overall accuracy of the factor income and employment impact projections.

²² The term 'short run' here does not refer to any specific time period; rather it will vary from industry to industry. It is used here in the conventional economic sense to mean that the full adjustment from any shock has not had time to occur, i.e. the system has not yet returned to full, long run, equilibrium.

B Disaggregated impacts by source of visitor

B.1 Impacts to the Tasmanian economy – Conservative

Table B1.1: Economic significance of additional Interstate visitors to the Tasmanian economy due to additional day walkers as a result of the 3CT (\$M) – Conservative estimates

	Final Demand	Industry Effects	Consumption Effects	Total	Flow-on
Gross Output/turnover	44.73	13.55	15.81	74.09	29.36
GSP additions	22.14	6.64	7.45	36.23	14.09
Factor Income	18.07	5.42	6.32	29.81	11.74
Employment supported	370	111	124	605	235

Source: TNLM (2009) using supplied data

Table B1.2: Economic significance of additional International visitors to the Tasmanian economy due to additional day walkers as a result of the 3CT (\$M) – Conservative estimates

	Final Demand	Industry Effects	Consumption Effects	Total	Flow-on
Gross Output/turnover	9.96	2.89	3.48	16.33	6.37
GSP additions	4.78	1.39	1.67	7.84	3.06
Factor Income	4.09	1.19	1.43	6.71	2.62
Employment supported	85	25	26	136	51

Source: TNLM (2009) using supplied data

B.2 Impacts to the Tasman Peninsula economy – Conservative

Table B2.1: Economic significance of additional Interstate visitors to the Tasman Peninsula economy due to additional day walkers as a result of the 3CT (\$M) – Conservative estimates

	Final Demand	Industry Effects	Consumption Effects	Total	Flow-on
Gross Output/turnover	13.77	4.13	4.82	22.72	8.95

	Final Demand	Industry Effects	Consumption Effects	Total	Flow-on
GSP additions	5.23	1.24	1.75	8.22	2.99
Factor Income	3.99	1.16	1.36	6.51	2.52
Employment supported	75	43	43	161	86

Source: Tasman Peninsula table

Table B2.2: Economic significance of additional International visitors to the Tasman Peninsula economy due to additional day walkers as a result of the 3CT (\$M) – Conservative estimates

	Final Demand	Industry Effects	Consumption Effects	Total	Flow-on
Gross Output/turnover	2.96	0.86	1.04	4.85	1.9
GSP additions	1.13	0.25	0.34	1.71	0.6
Factor Income	0.89	0.20	0.26	1.35	0.5
Employment supported	25	7	9	41	16

Source: Tasman Peninsula table

B.3 Impacts to the Tasmanian economy – Optimistic

Table B3.1: Economic Significance of additional Interstate visitors to the Tasmanian economy due to additional day walkers as a result of the 3CT (\$M) – Optimistic estimates

	Final Demand	Industry Effects	Consumption Effects	Total	Flow-on
Gross Output/turnover	92.28	28.52	33.27	154.07	61.79
GSP additions	46.58	13.98	15.68	76.86	30.28
Factor Income	38.03	11.41	13.31	62.75	24.72
Employment supported	780	234	260	1274	494

Source: TNLM (2009) using supplied data

Table B3.2: Economic Significance of additional International visitors to the Tasmanian economy due to additional day walkers as a result of the 3CT (\$M) – Optimistic estimates

	Final Demand	Industry Effects	Consumption Effects	Total	Flow-on
Gross Output/turnover	20.54	6.07	7.33	34.35	13.40
GSP additions	10.06	2.92	3.52	16.50	6.44
Factor Income	8.59	2.50	3.01	14.08	5.50
Employment supported	176	51	62	289	113

Source: TNLM (2009) using supplied data

B.4 Impacts to the Tasman Peninsula economy – Optimistic

Table B4.1: Economic Significance of additional Interstate visitors to the Tasman Peninsula economy due to additional day walkers as a result of the 3CT (\$M) – Optimistic estimates

	Final Demand	Industry Effects	Consumption Effects	Total	Flow-on
Gross Output/turnover	21.88	6.63	7.73	36.24	14.36
GSP additions	8.39	1.99	2.81	13.19	4.80
Factor Income	6.41	1.86	2.18	10.45	4.04
Employment supported	120	70	69	259	139

Source: Tasman Peninsula table

Table B4.2: Economic significance of additional International visitors to the Tasman Peninsula economy due to additional day walkers as a result of the 3CT (\$M) – Optimistic estimates

	Final Demand	Industry Effects	Consumption Effects	Total	Flow-on
Gross Output/turnover	4.56	1.33	1.62	7.51	2.95
GSP additions	1.75	0.38	0.53	2.66	0.91
Factor Income	1.38	0.30	0.41	2.09	0.71

	Final Demand	Industry Effects	Consumption Effects	Total	Flow-on
Employment supported	39	11	14	64	25

Source: Tasman Peninsula table