Capturing the value of an electric linear ferry service

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Abstract

The Noosa River Glider is a public transport solution to enable a modal shift from car based transport between Noosa riverside business centres. By making riverside business centres more accessible there will be a measurable increase in visitation, trade and economic worth. Through innovative taxation strategies these increases may support the ongoing operation of an electric linear ferry service.

The problem relates to how the value of the proposed ferry service is captured and applied to offset capital and operating expenses. A new system of taxation, or levy, may be acceptable to riverside traders, in expectation of increased in trade. The same cannot be said for the broader community, many of who may not see increases in visitation, trade and economic worth as positive outcomes for their region.

This research commences with a review of value capture approaches to fund infrastructure projects in Australia. The investigation extends to consider the Land Value Tax technique and its applicability to the current taxation and rating schemes in the Noosa shire. Subsequent modelling demonstrates how land value increases are passively recaptured through existing Queensland Land Tax mechanisms. The impact and recovery of initial infrastructure expenditure related to the NRG service is then evaluated with the aid of cash flow analysis.

Emerging findings support the Henry Tax Review assertion that well-structured taxes on land and natural resources are a highly efficient means of raising revenue.

[Property and the environment, Property valuation, and Future directions in property]

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Keywords: Value capture, transport infrastructure, electric linear ferry, land tax.

Introduction

The Noosa River Glider (NRG) is a transport solution designed to enable a modal shift from car based transport between riverside business centres in the Noosa shire in Queensland, Australia. On average the NRG is set to replace 1,200 daily vehicle journeys (Boyd Retail 2017).

By making the riverside business centres more accessible as a walkable urban environment there should be a measurable increase in visitation, trade and economic worth (Leinberger and Rodriquez 2016). Businesses expected to benefit from the service include the traders in Tewantin, Noosaville and Noosa Heads.

The problem relates to how the value of the proposed ferry service is captured and applied to offset capital and operating expenses. A new system of taxation, or levy, may be acceptable to riverside traders, in expectation of increased in trade. The same cannot be said for the broader community, many of who may not see increases in visitation, trade and economic worth as positive outcomes for their region.

The proposed funding model focusses on the capture of site value uplift but not in a manner that privatises a public good or diverts taxation revenue to private infrastructure providers.

Literature review

This research commences with a review of value capture approaches to fund infrastructure projects in Australia. The investigation extends to consider the Land Value Tax technique and its applicability to the current taxation and rating schemes in the Noosa shire.

Value capture

Agencies charged with improving and maintaining transportation networks have had to employ creative approaches to fund new infrastructure projects (Vadali 2014; Regional Development Australia Sunshine Coast 2016). According to Vadali (2014) value capture is one mechanism helping agencies to do more with less, obtain efficiencies

through new management approaches and discover alternative funding methods to cover any funding shortfalls.

Value capture has a history in local government finance, and its origins are rooted in the benefit principle of taxation (Vadali 2014). The term ‘value’ refers to the benefit accrued by the landowner or developer because of the infrastructure investment (Vadali 2014). Capture, relates to the entity or agency capturing a portion of the gains as a way of recouping the costs of investment (Vadali 2014).

In practice value capture is an innovative public finance method in which the increases in property or land value owing to public infrastructure improvements are captured through land-related taxes or other means to pay for such improvements (Batt 2001; Dalvi 1998; Vadali 2014). Vadali (2014) identifies ten value capture techniques. The techniques range from impact fees, or one-time charges, through to joint ventures and the granting of air rights. The techniques this research will focus on relate to land tax with:

- Land value tax (LVT) - a tax imposed on the value of land benefiting from transportation infrastructure.

- Tax increment financing (TIF) - a mechanism allocating any increase in total property tax revenues toward public investment within a designated district. (Vadali 2014)

According to Chapman (2017) and Tsai et al. (2017) there is increasing interest in value capture methods that leverage land tax to financing infrastructure. Chapman (2017) supports this assertion through noting a series of international studies including the 2013 study by Barbu that ‘...assesses the implications of moving from a property tax to a land tax to finance public transit in Ontario and Toronto regions in Canada’ (Chapman 2017, p.35). The natural advantage of land tax as a focus for value capture is discussed in the Henry Tax Review (Henry et al. 2010), Clark-Jones et al. (2016) and Chapman (2017). In the Henry Tax Review, land tax is identified as one of the most efficient means of raising review. The efficiency is said to arise from ‘the immobility of the tax base and, unlike most other taxes, levying different rates of land tax in different States

has very low efficiency costs' (Henry et al. 2010, np). Chapman (2017) speaks of the inherent social benefits of land taxation as a mechanism for funding infrastructure with:

… *many economists now regard the land portion of the property tax as progressive, because wealthy people tend to own more land than poor people. In addition, it is also argued that the land tax is efficient because there is no economic [behaviour] that can be changed to avoid the tax.* (Chapman 2017, p.32)

The application of LVT and TIF approaches to funding infrastructure is not without substantial challenges. Clark-Jones et al. (2016) discuss the challenge in using evidence-based policy-making for value capture in isolating and estimating the effect that infrastructure has had on land values. Hedonic Pricing models may assist with predicting value uplift however, they do not observe the timing of value accrual (Clark-Jones et al. 2016).

There are further complications in applying value uplift projections to geographic areas. In general, the further one lives from a station or port, the less they benefit from accessibility. That said the relationship between distance to station (or port) and value uplift does apply to all parcels of land. For some forms transport infrastructure there are negative attributes, such as noise and air pollution, as well as an increase in crime, at concentrated at access points (Clark-Jones et al. 2016).

Estimating the value uplift

According to the Department of Infrastructure and Regional Development (DIRD) (2015) there are more than a hundred papers addressing value uplift with the usable observations for commercial and residential properties from these meta studies are summarised in Table 1.

Table 1: Average value uplift per transit mode

Mode	**Average value uplift (%)**	**Range (%)**	**Number of observations**
Heavy rail	6.9	-42 to 40	18
Light rail	9.5	-19 to 30	32
Bus rapid transit	9.7	-5 to 32	17

DIRD (2015)

In a detailed study by Murray (2017) the impact of the Gold Coast Light Rail (GCLR) on statutory land value increases was estimated at $300 million. The gains were primarily accrued by landowners within 400 metres of the stations who saw their statutory land values increase around 7 per cent more than otherwise (Murray 2017). The estimated value gains were equivalent to one quarter of the capital cost of the Stage One of the GCLR (Murray 2017).

Tsai et al. (2017) acknowledge that limited research has been undertaken to determine the effect of ferry systems on land values. In their study, they applied a geographically weighted regression to determine the property value effects of the Brisbane linear ferry system. The research considered transaction prices from sales records, as opposed to statutory land assessments as used in the study by Murray (2017).

The Tsai et al. (2017) research findings confirm that 'property values in the study area do benefit from accessibility to ferries, especially in areas where residential redevelopment has taken place around the ferry terminals' (Tsai et al. 2017, p.134). In keeping everything else constant, 'a one [kilometre] decrease in the distance to the CBD is expected to increase the price by 2.2 percent on average, whereas a one [kilometre] decrease in the distance to the ferry terminal is expected to increase the price by 4 percent' (Tsai et al. 2017, p.127).

Tanko and Burke (2015) and Tsai et al. (2017) confirm, property values rise when accessible to ferries. Unlike train stations the value uplift does not appear to drop as you get close to the station or terminal. With respect to the CityCat operation in Brisbane there is support to suggest an 8 percent increase in property values as one travels to the terminals from 2 kilometres away (Tanko and Burke 2015).

Capturing the uplift

According to Clark-Jones et al. (2016) land tax has the potential to recover a significant percentage of a project's cost while leaving a benefit for landowners. In a worked example, they found a '3-7 [percent land value uplift] around the Cross-River Rail project, … could generate $33.5-$45.1 million annually' (Clark-Jones et al. 2016, p.7). By implementing their levy strategy over a thirty-year timeframe, Clark-Jones et al. (2016) demonstrate 14.5-19.5 percent of the total project cost could be recovered.

Murray (2017) discusses gains a recapture in his analysis of the Gold Coast Light Rail project. The analysis includes consideration of recovery through land tax and local council rates. That said he primarily advocates for 'further transit funding mechanisms through direct charges of local beneficiaries' (Murray 2017 p.8). In supporting the argument, he estimates a relatively modest $2.5 million increase in land tax revenue for the Queensland Government.

Summary

From previous research, it is found that value capture presents a theoretically sound approach to fund infrastructure projects in Australia. A new system of taxation, or levy, may be acceptable to stakeholders who see a direct benefit from a project such as the proposed linear ferry service in Noosa. The same cannot be said for the broader community, with some likely to raise concerns regarding equity (DIRD 2015) and others who may not see increases in visitation, trade and economic worth as positive outcomes for their region.

Methodology

This research extends to consider the Land Value Tax technique and its applicability to the current taxation and rating schemes in the Noosa shire. Subsequent modelling demonstrates how land value increases are passively recaptured through existing land tax mechanisms. The impact and recovery of initial infrastructure expenditure related to the electric linear passenger ferry service, Noosa River Glider, is then evaluated with the aid of Discounted Cash Flow analysis.

Background

Electric Linear Passenger ferry

According to Siemens (2017), electric ferry and taxi services have been developed and trialled since 1886. During the 20th century marine electric drives have been principally used for submarines, warships, cruise ships and ice-breakers (Molland 2008, cited in Symington and Binns 2015).

In more recent times Australia has been a leader in prototyping efficient marine electric drives and high-energy-density batteries with the Oshunpro prototype tested in the Noosa river in 2011 and the Solar Pacific Cruiser prototype built in Hervey Bay (Symington and Binns 2015). An Australian company, Solar Sailor, was established in the late 1990s to commercialise a patented solar wing and develop a hybrid catamaran, the SolarSailor. The SolarSailor vessel was operated as a commercial cruise vessel from 2000 to 2010. In 2008, Solar Sailor was subsequently commissioned to provide hybrid commuter ferries to service the Hong Kong Jockey club (OCIUS 2017).

In early 2015, the first all-electric battery-powered car and passenger ferry was commissioned (Siemens 2017, Corvus 2016). The emission free MF Ampere is an aluminium catamaran carrying 120 cars and 360 passengers (Corvus 2016). The Ampere is said to save 1 million litres diesel/year and 2,680 metric tonnes of CO2.

The BB Green was launched in June 2015. The vessel takes up to 99 passengers and operates at a speed of 30 knots with batteries and electric propulsion (Green City Ferries 2015). According to Green City Ferries (2015) The 25-tonne ship can achieve a speed of 30 knots propelled by two 280kw electric motors. The ship is designed to have 400 kWh (Lithium Ion Titanate) of batteries which enable the BB Green to operate at high speed for over 30 minutes with a 26-kilometre range before ‘super-charging’ for 15-20 minutes (Green City Ferries 2015).

Noosa River Glider

The project scope extends to the design of an electric linear passenger service for the Noosa river. The design and development of an electric linear passenger service for the Noosa river. The service is proposed to run the 9.4-kilometre circuit between Tewantin, Noosaville and Noosa Heads. The deliverables as detailed in Table 2.

Table 2: Project deliverables

Three Noosa River Gliders	Electric catamarans with an 80-passenger capacity. The deck will be single level with 'at grade' access and egress to allow for wheel chair and bicycle access. The gliders deck configuration will incorporate external areas to the front and rear with a covered internal seating area. The space will need to accommodate the temporary storage of bicycles (potentially an electric bicycle recharge hub) and surfboards. The 'bridge' will be raised to allow for a single skipper to have a clear view for driving. The remainder of the roof surface will include solar panels, thin layer membranes or even scales.
three terminals	The terminals will comprise floating pontoons. The Tewantin terminal, or port, will have an appropriate connection to allow for high voltage recharging of the glider batteries. This will most likely include a battery storage and connection (potentially underwater) to a land based solar array.

Financials

Due to the innovative nature of the ferry service the upfront capital expenditure is difficult to determine without further planning and financial outlay. That said the three primary items are likely to comprise the NRG vessels, terminals and professional fees. Capital expenditure for the project is detailed in Table 3.

Table 3: Capital expenditure summary

Capital expenditure	**No.**	**Cost/no. ($)**	**Cost ($)**
Tewantin port (incl. Charger)	1	2,000,000	2,000,000
Passenger terminals	2	800,000	1,600,000
NRG (80 passenger)	3	2,300,000	6,900,000
Professional fees	1	1,050,000	1,050,000
Contingency allowance	1	577,500	577,500
Total capital expenditure			**12,127,500**

According to IBIS (2017) profit margins for ferry operations have increased over the past five years, partly due to the privatisation of certain commuter services. Private operators need to generate enough operating profit to cover the substantial operating costs. Consequently, many private operators of inner-city ferries are subsidised by the government, which helps to boost their profit margins. In addition, purchase costs have fallen over of the past 5 years due to declines in the price of fuel, which has supported industry profit growth (IBIS 2017).

Operating profit

The operating revenue and cost projections provide for a minor profit. That said the operating figures exclude depreciation and ongoing costs, such as interest, relating to

the capital expenditure. As a standalone venture the NRG service would need to be supported through some form of government assistance or ownership.

Governments assist in reimbursing concessional travel and community service obligations. The privatisation of Sydney Ferries in 2012 changed the mechanism for the largest form of assistance in the industry, from a direct operating subsidy to a concession (IBIS 2017). According to IBIS (2017) other government players such as Brisbane Transport still directly provide transport services to residents.

The NRG presents a simple and more targeted stakeholder approach to the funding model. In a sense, it is the beneficiaries that pay through a traditional, unaltered taxation approach. The approach focusses on the capture of value uplift but not in a manner that privatises a public good or diverts taxation revenue to private infrastructure providers.

Tanko and Burke (2015) and Tsai et al. (2017) confirm, property values rise when accessible to ferries. Unlike train stations the value uplift does not appear to drop as you get close to the station/terminal. With respect to the CityCat operation in Brisbane there is support to suggest an 8 percent increase in property values as one travels to the terminals from 2 km away (Tanko and Burke 2015).

Noosa River Glider Value Capture

With respect to the NRG it is conceivable that property within two kilometres of the terminals is likely to see an uplift. This uplift may negatively impact housing affordability as detailed in Table 3. However, land owners and entities that receive revenue for land and property valuations will benefit from the capital gain.

Table 3: NRG service catchment

Area	Properties (no.)	Ave. Site Value	SV>$600k (no.)	SV>$600k ($)
Tewantin	2,984	185,526	69	75,970,000
Noosa Heads	4,238	343,670	524	1,169,350,000
Noosaville	5,424	258,069	756	867,486,639
Catchment	**12,646**	**269,639**	**1,349**	**2,112,806,639**

Site values refer to the statutory assessments sourced from RP Data 2017

The respective site value uplift will provide the Queensland Government with an increase in revenue from land tax. Land tax is calculated on the freehold land owned in

Queensland on 30 June each year (Queensland Government 2017). The rating scales and thresholds for land tax vary depending on the type of owner and total taxable value of their property holdings. As an individual, a property owner is liable for land tax if the total taxable value of your freehold land at 30 June is $600,000 or more (Queensland Government 2017). As demonstrated in Table 4 previously untaxed properties are pushed into taxable thresholds when an 8.0 percent increase is applied to the statutory site value.

Table 4: NRG service catchment subject to 8.0% increase in site value

Area	**Properties (no.)**	**Average Site Value**	**SV>$600k (no.)**	**SV>$600k ($)**
Tewantin	2,984	200,368	78	87,706,800
Noosa Heads	4,238	371,164	535	1,269,777,600
Noosaville	5,424	278,714	795	961,174,770
Catchment	**12,646**	**291,210**	**1,408**	**2,318,659,170**

Static value capture

With the individual thresholds applied, the land tax take may increase by $2,688,570 (Table 5). While the additional revenue may take a period to realise through the land valuation lag it is important to note that the tax take will generally increase annually.

Table 5: Land tax capture

Queensland Land Tax	**Current**	**Assume 8% SV increase**
SV >$600k no.	1,349	1,408
SV >$600k av.	1,566,202	1,646,775
Land tax @ 4500+1.65c>$1M	18,673,307	21,361,877

Individual threshold range $1-2.99M (Queensland Government 2017)

The financial benefit of the site value uplift is less pronounced for Noosa Council. Depending on rate categories the increase is likely to fall between $800,905 and $1,993,262 (Table 6) (Noosa Council 2017).

Table 6: Rates capture

Noosa rates	**Current**	**Assume 8% SV increase**
Taxable no.	12,646	12,646
Taxable SV	3,409,849,300	3,682,637,244
Rates @0.2936c	10,011,318	10,812,223
Rates @0.7307c	24,915,769	26,909,030

General rate categories 15 – 2 (Noosa 2017)

Through site value modelling it is evident that the benefit of the land value uplift will be shared. Property owners will have a stronger asset base for which they will taxed by both the Queensland Government and Noosa Council. The Queensland Government will receive between 57 and 77 percent of the additional tax revenue.

Dynamic value capture

Cash flow analysis

In an aim to better forecast profitability and in turn make more informed decisions regarding the likely financial success of a project, there have been detailed feasibility models developed and employed. Broadly the models used to value development properties and forecast returns from proposed projects in Australia may be classed as either static or dynamic analysis (Australian Property Institute 2012).

Dynamic analysis allows for potential movements in prices and costs over the period of the development (Australian Property Institute 2012). This, more complex, form of financial analysis is most accurately applied through the Discounted Cash Flow (DCF) method, or cash flow modelling. Cash flow models more accurately represent the actual timing of revenue and expenditure over the development period (Coleman et al., 2013; Wilkinson & Reed, 2008).

With advances in technology and education, DCFs have arguably become the preeminent industry tool for valuing complex development projects of a staged or longer-term nature (Coleman et al., 2013; Havard, 2014).

Cash flow analysis and Value Capture

The impact and recovery of initial infrastructure expenditure related to the electric linear passenger ferry service, Noosa River Glider, has been evaluated with the aid of cash flow analysis. The cash flow has been structured for a 20-year duration and has monthly intervals. The structure is proposed to mirror the actual timing or cash inflows and outflows.

The initial 33 months include the proposed initial capital expenditure with an escalation of 2.0 percent per annual applied monthly. As such the Summary in Table 7 presents

negative net cash flows in the first three years. No further capital expenditure or operating charges have been applied as the cash flow models the interest of the Queensland Government recovering land tax as a return for initial investment.

The revenue relates to the land tax premium attributable to the 8.0 percent statutory site value increase. According to the DIRD (2015) much of the value uplift is gained at the project announcement. That said that value does not flow immediately through to land tax recovery. Due to the three-year averaging mechanism and the timing of revaluations, the 8.0 percent uplift is anticipated to accrue proportionately in June 2019, 2020 and 2021 (Queensland Government 2017).

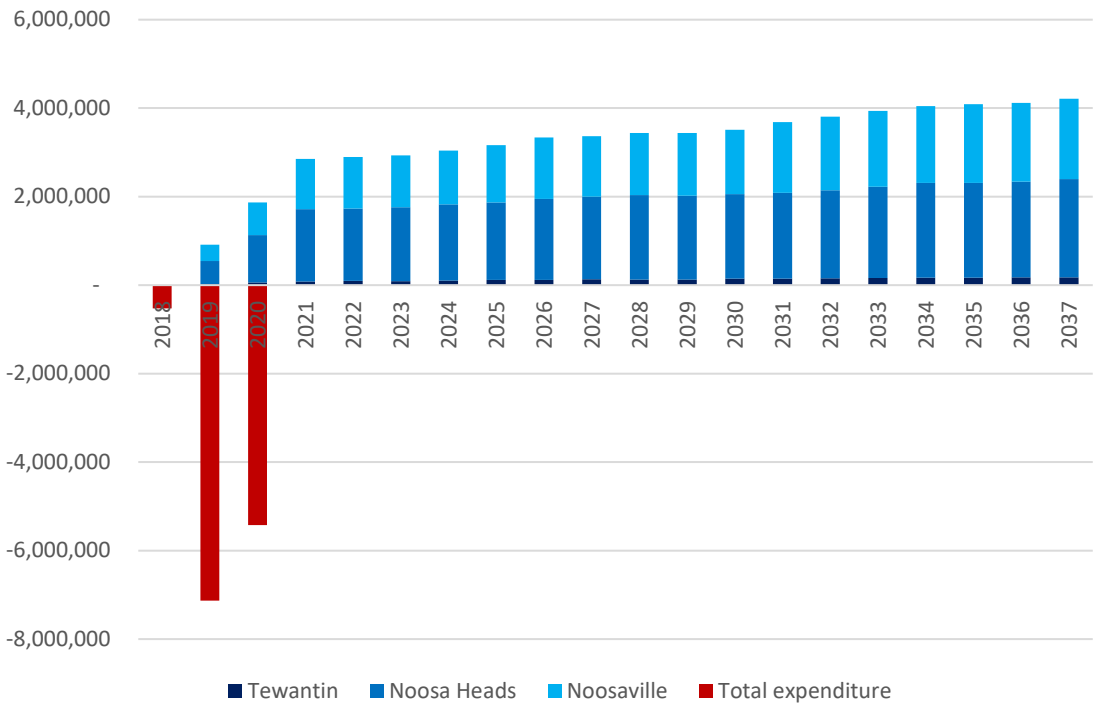
In a consistent manner, a natural increase in site values has been forecast at 2.0 percent annually. The escalation rate is modestly lower than the historical 10-year trend, to September 2017, in Brisbane house prices of 2.8 percent (Australian Bureau of Statistics (ABS 2018b). The rate does reflect the longer term lower escalation environment with the Australian All Groups Consumer Price Index sitting below the 2.0 to 3.0 percent target at 1.8 percent (ABS 2018a). The adopted escalation is equivalent to the increase in expenses.

The cash flow profile with expenditure in red and revenue from respective suburbs in the Noosa River Gliders catchment are illustrated in Chart 1.

Table 7: Cash flow summary

Noosa River Glider																				
Discounted Cash Flow																				
Queensland Government Land Tax Recapture																				
Monthly DCF Presented Annually	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**	**2037**
Year																				
Capital expenditure																				
Initiation	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Planning	- 525,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Execution	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Tewantin port (incl. Charger)	-	- 1,176,362	- 297,748	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Passenger terminals	-	- 941,089	- 238,199	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
NRG (80 passenger)	-	- 4,058,448	- 1,027,232	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Professional fees	-	- 617,590	- 156,318	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Contingency allowance	-	- 339,674	- 85,975	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Close	-	-	- 3,616,904	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total expenditure	**- 525,000**	**- 7,133,164**	**- 5,422,375**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Revenue	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Tewantin	-	23,463	62,810	85,537	95,307	92,249	104,710	120,718	119,648	133,850	128,880	124,748	143,881	143,862	154,397	164,787	170,958	169,764	175,036	178,820
Noosa Heads	-	524,462	1,068,245	1,630,766	1,635,551	1,671,540	1,717,548	1,751,039	1,829,693	1,863,322	1,906,087	1,892,656	1,913,402	1,939,180	1,988,621	2,062,103	2,136,391	2,143,122	2,164,840	2,217,926
Noosaville	-	367,717	734,750	1,135,422	1,168,034	1,165,852	1,218,858	1,289,981	1,388,519	1,367,227	1,404,023	1,419,863	1,451,460	1,602,339	1,663,107	1,711,440	1,737,961	1,776,010	1,779,189	1,815,786
Net Cash Flow	**- 525,000**	**- 6,217,521**	**- 3,556,570**	**2,851,725**	**2,898,892**	**2,929,641**	**3,041,116**	**3,161,737**	**3,337,859**	**3,364,398**	**3,438,990**	**3,437,268**	**3,508,743**	**3,685,382**	**3,806,125**	**3,938,331**	**4,045,311**	**4,088,896**	**4,119,065**	**4,212,532**
IRR	25%																			

Chart 1: Cash flow profile



Findings

As demonstrated in the Noosa River Glider case study, a sizable portion of the initial project funds may be recaptured through the existing land tax system. The recapture is not immediate and it may take some years to recover the expenditure.

By modelling the cash flows it is evident that a relatively modest increase in statutory site values can provide a substantial increase in tax liability. This is in part due to properties moving up through set thresholds. Specifically, a property that may not have been subject to land tax may become liable as the site value increase combines with natural inflation pressures. In the dynamic modelling an 8.0 percent increase in statutory site values for the Noosa River Glider catchment is expected to provide the Queensland Government with a 25 percent Internal Rate of Return (IRR). The reflected IRR presents an attractive return, being above the typical 12 to 14 percent target rate for infrastructure investors (Deloitte 2014). As demonstrated through sensitivity analysis the return to the Queensland Government remains above the prevailing ten-year government bond yield of around 2.8 percent (Fusion Media 2017) with statutory site value increases of 2.18 percent (Table 7).

Table 7: Sensitivity analysis

Site Value Increase	**2%**	**4%**	**6%**	**8%**	**10%**	**12%**	**14%**
Internal Rate of Return %	1.84	10.88	18.19	25.09	31.98	39.16	46.46

Conclusions

This research commenced with a review of value capture approaches to fund infrastructure projects in Australia. The investigation extended to consider the Land Value Tax technique and its applicability to the current taxation and rating schemes in the Noosa shire. Subsequent modelling demonstrated how land value increases are passively recaptured through existing Queensland Land Tax mechanisms. The impact and recovery of initial infrastructure expenditure related to the Noosa River Glider (NRG) service was then evaluated with the aid of cash flow analysis.

This research and the respective static and dynamic modelling are subject to limitations. Specifically, the cost or expenditure of the NRG has not been confirmed. A change in the initial project expenditure will impact the returns reflected in the analysis. Similarly, there are limitations related to the modelling of the land tax revenue. As the ownership entity and statutory value of portfolio holdings will impact the thresholds and rating levels.

That said, the emerging findings support the Henry Tax Review (Henry et al. 2010) assertion that well-structured taxes on land and natural resources are a highly efficient means of raising revenue.

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