TRANSPORT MODELLING

in the COVID-19 age

In this discussion paper:

by Tom Longworth

Producing useful transport models generally requires a forecasting process that is steeped in fact-based explanatory variables, and works from a solid representative base of activity. Since the onset of the COVID pandemic, and associated public health actions, the role of transport modelling is a vexed question.

In many ways, the pandemic has a polarising effect on society, so why should its impact on opinions about transport modelling be any different? Views range from 'no point modelling until it's over' through to 'why would the pandemic impact modelling?

Apart from polarising views, the pandemic is all about uncertainty. Even as more information about the basic biology and health impacts of the virus are discovered, there still remain some very large open questions, which go to the heart of what a post-COVID pandemic world might look like.

Early in the pandemic an epidemiologist was asked by a journalist *when was the best time to model the pandemic?* As a modeller, I could relate to the answer, which was, a not very helpful, *'when it's over'*.

This is one way to manage the uncertainty – but that is exactly why we do models, to manage uncertainty; even without COVID, the future is uncertain. It follows that this increase in uncertainty is actually a good reason to do more transport modelling, not less.

BUT HOW TO MODEL?

In some cases, waiting till 'it's over' is probably a prudent approach. Although, as discussed below, you might be waiting a long time for it 'to be over' and for post-pandemic trends to be discernible. In other settings, a 2020 base model might be ok, but then the question is how to forecast?
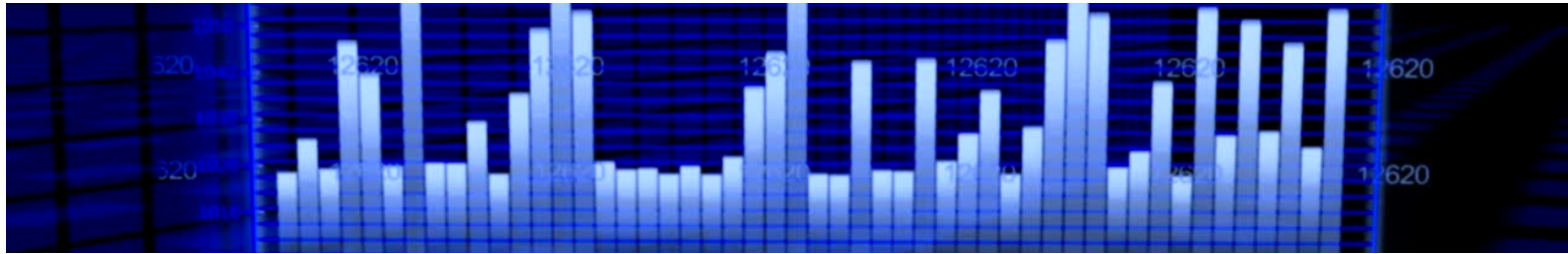
WHAT TO DO ABOUT A BASE MODEL?

Clearly, now is not the time to model an airport's land side access. Recent work has indicated that for a small area, with few land uses that are directly COVID-impacted, a 2020 model can be useful. This has relied on comparison of key traffic locations to establish that 2020 and 2019 volumes, whilst different, are not so vastly different as to preclude it. The small scale of the model also suggests relatively minor consequences of the forecasts and reality diverging?

For a larger area, there are options to build base models using 2019 data from existing datasets.We recently specified a 'field data collection programme' for a medium sized model using a combination of:

- limited 2017-2019 counts
- VS Data from 2019 and 2020
- 2019 and 2020 counts, travel times and travel patterns (ODs) from a large dataset prepared by Compass IOT (or similar)

Data Collection during COVID can still be valid depending on size and location of model required

This opens up the possibility of building 2019 base models in 2020, without having conducted a 2019 field programme – 'a survey time machine'. It does, however, rely on access to large amounts of historic data, through SCATS and systems, such as Compass IOT's. This suggests that under some circumstances a base model looks possible.

FORECASTING

As always, the forecasting is where the real uncertainty lies and it is the underlying rationale for building models. Even though it might be possible to establish a 2019 or 2020 Base Model the first question is whether this base is at all representative for forecasting? Frankly, this is an open question, but on a case by case basis, this is arguably possible. The second question is what scenarios should be used in forecasting?

There are lots of potential answers to this question, with a range of hypotheticals:
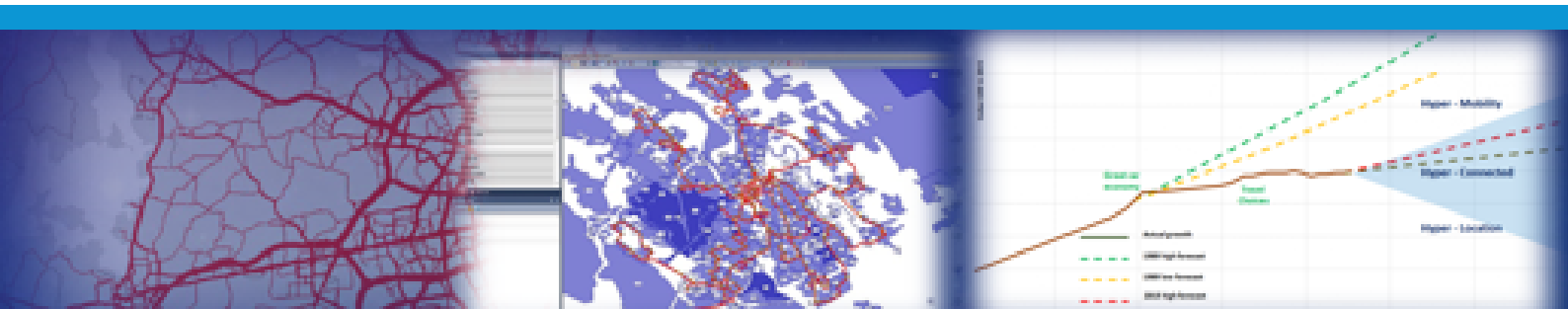
- COVID is likely to be a transient effect, project X is a long-term strategic requirement for Sydney, therefore, we should use the 2016 v1.51 land use scenarios from TPA, but perhaps assume a lag of five years
- COVID is an issue, but the long-term development of Sydney's urban fabric has so much momentum, that there is no reason to assume underlying trends will change due to a single disease
- COVID is not the issue, the latest land use projections are the issue and are leading to problems in developing an efficient and effective land use and transport system.
- Technical issues with the grand model are the main issue – COVID is a red herring – the networks ought to reflect reality, specifically capacity constraints

How would these hypotheses be tested? When will data be available to support one or more of these positions? The disappointing answer is that clear data to test these hypotheses across a large geographic area will not be available for several years, at best, and possibly a decade, at worst.

Population Levels

In terms of population levels in Australia, two key components of population forecasting are:

Birth Rates Over Time

As with most forecasting variables, birth rates are derived from trend information. So far, almost no babies have been born who were conceived in a COVID world. We have heard lots of speculation, ranging from:

- the lock downs will boost the birth rate' or
- the recession will significantly reduce the birth rate'.

But that is all it is, speculation.

We won't have any idea of the initial impact of COVID on birth rates, probably until December 2021, when ABS publish its births data (3301.0) for 2020. This, of course, relies on the registration process in each state working properly, which is a big assumption, especially if fear of catching COVID in hospital is driving women to free-birth and, hence, materially delay the registration process.

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The following discussion canvasses the potential impact of COVID on traditional forecasting variables and looks more broadly to see if there are some rule-of-thumb indicators that might guide the extent of COVID's economic and transport dislocation.

It could then be another four or five years before there is sufficient data to discern a meaningful trend in the birth rate. Orthodoxy is that this is a variable that follows slow, long term trends; the reality is that it can change rapidly, as per the 'baby bonus' years in the 2000s.

Net overseas migration

Another important driver of the Australian economy since the late 1700s (yes, more than 200 years) has been net overseas migration. This has largely stopped. ABS will release net overseas migration information for the year to June 2020 in April 2021. Again, there is lots of speculation about what might happen with migration. Possibly, no meaningful levels of immigration or emigration will occur until July 2021, when Australia's international border is slated to open. Of course, border openings could be pushed back till later in 2021 or even into 2022, or based on current debate, it might be brought forward.


Once the borders open, how will people behave? Will people still want to their life here? Will Australians have the same propensity, as previously, to travel overseas to live for extended periods? On what basis will the Commonwealth set immigration quotas?

Of note is that the first set of population forecasts for Australia, produced by Prof WD Borrie for the NHMRC in 1944, struggled to find an authoritative answer to how the Commonwealth would manage immigration after the war; he settled on ignoring immigration in his forecasts – we would suggest this assumption is unlikely to be applicable now.

This does not even touch on the vexed questions of:
- inter-state migration. State border closures have certainly slowed/stopped this component of population forecasting. Whilst these closures look to be unconstitutional, they are likely to stay for some time, as it looks like they are probably in the public interest; nor,
- household formation rates, one of the main drivers of dwelling demand.
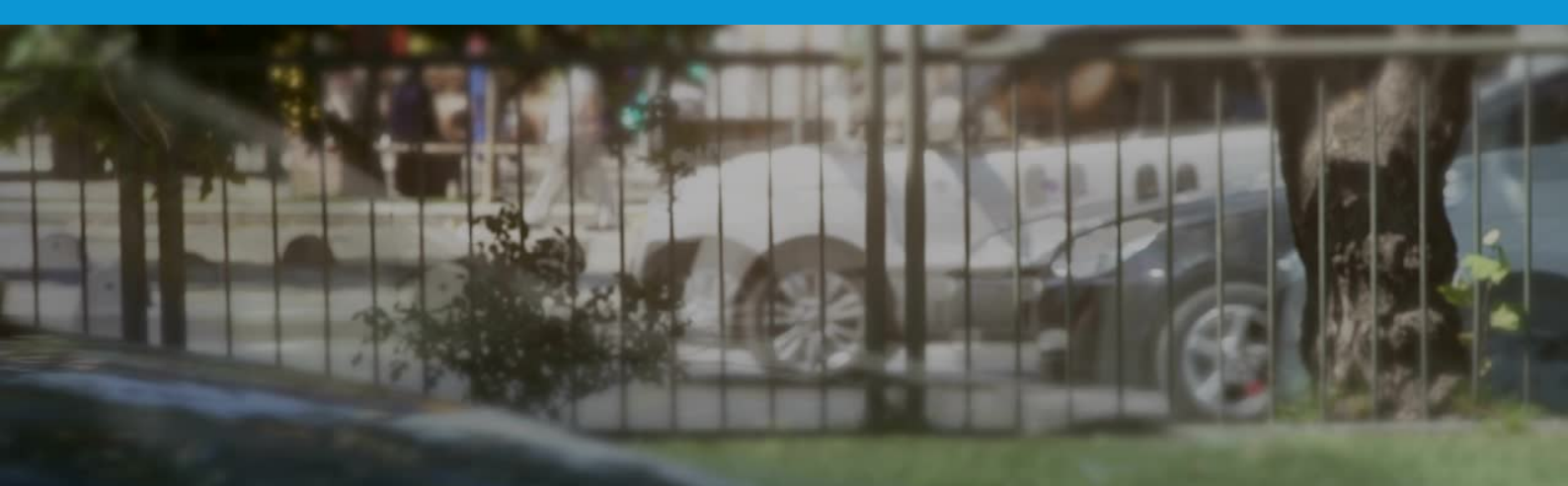
Economy & Employment Levels

Forecasting employment growth out of the last recession (early 1990s) was problematic; even though it was a fairly 'standard recession'. Indeed, for the first 3 or 4 years of recovery, despite forecasts of a jobs pick-up and actual solid GDP growth, there was very little employment growth, hence it was dubbed a 'jobless recovery'. This time around there is no recent trend data available for economic recovery, so the ability to forecast employment is even more difficult.

Also, some big strategic questions hang over key parts of Australia's external sector, some COVID-related, some with loose COVID associations:
1. Our key trading partner is embarking on a much more assertive relationship with the rest of the world, and it appears to see Australia as a soft target
2. Overseas student may recover somewhat from where they are now, but it's very unlikely to be at the same scale as previously (see number 1)
3. Tourism will take time to re-build, partly dependent on economic recovery in key inbound markets (also, see number 1)
4. Damage to the global air transport sector is far reaching, with consolidation due to airline failure accompanied by severe dislocation to their specialised, high-skill employee base, and potentially impairment of logistic systems that keep planes flying safely (e.g., what if Boeing goes broke and pharma bro buys their spare parts inventory?). This situation will take time to reverse, during which air fares may be way above pre-COVID levels.

How serious are these external head winds? An initial drop in the value of the AUD vs USD suggested that markets thought it would be a big deal, with the dollar falling to a low around 58 US cents in mid-March 2020. However, the local currency has been in the low 70 US cents for the last month, marginally above where it was in the six months prior to COVID, if weakness in the USD is acknowledged, this suggests a thumping collapse of our external sector is less likely.

Other people have indicated that urban transport volumes have dropped materially and will stay down; in fact, one narrative is that demand may keep going down. They point to ongoing data collection and seek to read the tea leaves, linking each fluctuation in demand with each change in public health policy, and then trying to extrapolating that into the future. A quick scan of possible indicator variables of longer-term economic impacts on transport activity is at odds with this overly negative position.

If you look at urban road transport – the response of a toll road operator's stock price to COVID might be instructive. Conventional wisdom is that congestion in the broader road network is good for toll road operators, as their tolled facilities become relatively more attractive to use (i.e., better value from the toll). This effect is probably most notable for light vehicles. If urban traffic volumes were to fall and stay substantially lower than pre-COVID, then this would be expected to free-up general road capacity and reduce urban congestion – potentially this could reduce expected toll road use by a greater amount than the general demand drop (give or take). If this were to occur over a protracted period, it would be reasonable to assume that a toll road operator could be less profitable, and this might be reflected in its stock price.
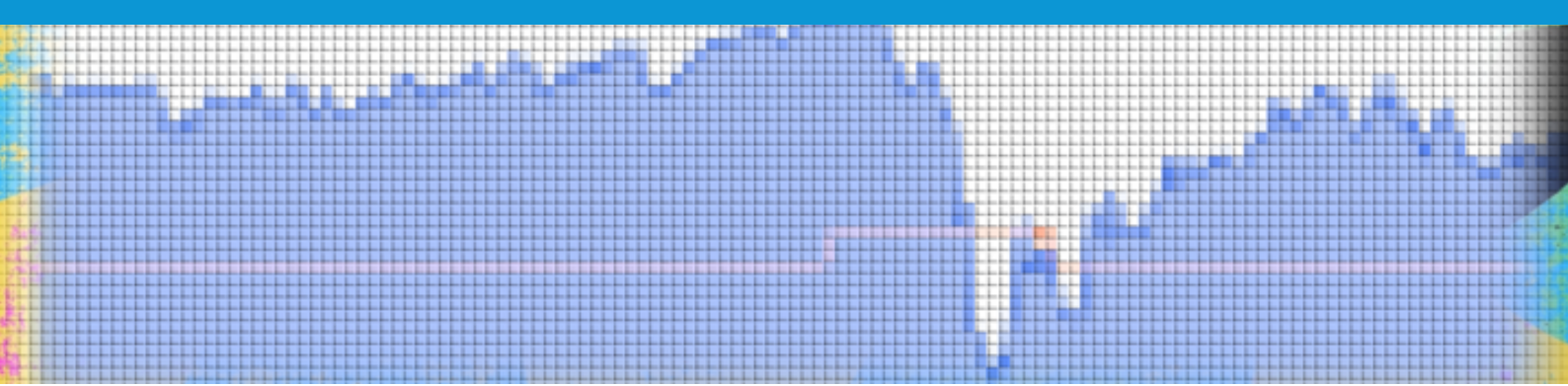
Using an ASX listed toll road operator's stock price as an indicator of expectations (perhaps eighteen months to three years out), the market charted the following course:

- A large fall in stock price of around 35% from 17 Feb to a low on 16 March
- Followed by a steady increase in stock price to around 90% of the value of the pre-COVID stock price by 1 June
- For the past month, the stock price has hovered around 83% to 87% of the pre-COVID price, putting it roughly back where it was in June 2019.

This looks like the market currently does not expect a collapse in the value for toll road assets. Whilst the stock market trends are not definitive (there are other factors at play), they indicate expectations that there will remain a solid amount of urban transport movement, over the medium term. So total collapse in urban transport demand looks highly unlikely.

Distribution of Population & Employment

Leaving aside the difficulties of explaining the level of population and employment, their distribution within an urban area is a key driver of urban travel demand, especially in the peaks. Answering this distribution question is important, but very difficult. In the post-war years Australian cities experienced an outward drift of population to new suburbs (the doughnut effect); by the late 1980s this trend had run its course, with inner city populations growing again, as part of urban consolidation, and exceeding their previous highs in the 1990s.

The doughnut effect, was driven (so to speak) by the new-found mobility of the car, allowing outward movement to the suburbs. But the marketing material of the day suggests there were other attractive attributes of the suburbs: cleanliness,their open spaces, in contrast to the disease-ridden inner city. This picks up on a theme canvassed by Banjo Paterson:

> "*I am sitting in my dingy little office, where a stingy*
> *Ray of sunlight struggles feebly down between the houses tall,*
> *And the foetid air and gritty of the dusty, dirty city*
> *Through the open window floating, spreads its foulness over all.*"
>
> An extract from *"Clancy of the Overflow"*, by AB Paterson

He goes on, opining about the poor health of the townsfolk fair to say, the Banjo was not a big fan of urban consolidation.

Will COVID unravel this long-term population consolidation trend towards the centre in Sydney, in Melbourne, in Brisbane? Will there be a neo-doughnut effect? Anecdotal evidence, based on relative changes in rental vacancy rates, is that there has been an unquantified drift to outer parts of Sydney, primarily from inner areas (similar trends are likely in other capitals).

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How big this initial impact on population distribution is won't be known until the ABS publishes its Regional Population Growth collection: in March 2021 for the year to June 2020 (containing three months of pandemic impact – about the time it takes to sell a house or break a lease, and move); and March 2022 for year to June 2021.

Longer term trends won't be discernible in detail until 2028 when the 2026 Census data will be published and compared with 2021 and 2016. This relies on the census programme continuing. Big question, no solid data, at least for several years!

Working From Home (WFH)

COVID has pushed this along to new heights, and after a generation of hearing about remote working, the technology available to the average punter, in the main, now works.
Will this leave us as a nation of telecommuters?

We hear that some big employers are really impressed with how well working from home has functioned, and have stated they won't return to an all onsite, all-the-time approach; one figure we heard was that a large commercial user could reduce their floorspace by 30%. Others have expressed severe frustration at their teams working from home.

It won't be until the Census is released in late 2022 or early 2023 that we'll have a detailed view of the spatial distribution of how working from home might be affecting transport patterns.

OTHER DATA SOURCES

There are numerous other data sources available, other than Census and Regional Population Growth. These have their strengths and weaknesses, including:

Household Travel Survey (HTS)

This is taken by TfNSW and is the world's longest running continuous travel survey. Its sample is designed to aggregate three years (or waves) of data to meet the sampling errors in the survey specification. If COVID has transient effects, say resolving in a year, it is possible that the HTS won't detect this within its confidence limits. If COVID's effects linger longer, then it might take two full survey waves to be detected with statistical rigour: so it would need 20/21 and 21/22 to be aggregated.
These might not be available until late 2022; even then, the COVID effects would be attenuated by the largely non COVID 19/20 wave.

On going System Data

OPAL, sensor data, Compass IOT data, etc; This information is high frequency and available within government, providing an indication of how system demand may have changed with COVID. Unfortunately, this potential time series of demand does not explain how demand changed. Relating change in demand to changes in public health conditions and major events defining the pandemic is really interesting, but not really useful for forecasting. Just because there was an X% drop in demand when the first set of restrictions emerged in late March, doesn't mean that society will respond the same when a subsequent set of restrictions are introduced.

Anecdotal Information

Land use changes appear in the media from time to time and as a group who follows this information closely, we find it really interesting. We have noted some rental effects above, that look to underly a 'neo-doughnut' effect. This is an area of controversy and uncertainty, this does provide a basis to start to develop some broadly themed scenarios, which we are working through to prepare unofficial scenarios of small area population projections.

Data Collection during COVID can still be valid depending on size and location of model required

IS MODELLING TO BLAME FOR TRANSPORT PROBLEMS?

Even where modelling is undertaken in a reasonably stable environment, with more certainty around demographic drivers than at present, major metropolitan-compromising problems can arise. Possibly Sydney's biggest failure of urban transport policy in the last 50 years was the rolling meltdown of the Sydney rail system due to overcrowding, which was especially acute during the early to mid-2000s.

What were the factors that brought about this meltdown? Various incarnations of a sophisticated strategic model had been in place, since the Sydney Area Transportation Study (SATS) in the early 1970s. Surely this would have alerted decision makers to the risks of an overloaded rail system?

Our work suggests there was a confluence of many factors underlying this problem, but three factors that standout for us are:

- **An unwillingness of policy makers to heed warnings** about loss of system capacity due to double deck trains replacing single decker rolling stock. This was raised in detail as an issue in a State Planning Authority public discussion paper in 1967[1], when 10% of Sydney's rolling stock was double decker – the policy response to this significant erosion of capacity of Australia's largest single capital asset? Move the fleet to 100% double decker over the next 30 years and reduce rail system capacity further. In other words, let's compound the problem. You don't need an accurate future land use scenario to know that the wrong option was selected.

- **Not making the most of available data.** The number of jobs in the Sydney CBD, a key determinant of rail patronage, had been falling consistently during the post-war period; a similar trend was evident in many large western cities. Financial deregulation, commencing in earnest in 1983, reversed this trend, with the Sydney CBD cementing its position as Australia's financial capital, and the financial sector expanding rapidly. The first detailed read on this inflection in the CBD jobs trend should have been the 1986 Census. Unfortunately, for some reason the work trip-end from that Census, was not processed by the state transport agency, leaving a big gap in data. The next opportunity for a detailed read on CBD employment was the 1991 Census; unfortunately, this was heavily impacted by the recession of the early 90s (the HIS was also taken in 1991). Consequently, the first solid, trend-aligned Census-based data on CBD employment and commuting did not emerge till the 1996 Census was released in 1998, 15-years after the start of the increase in CBD jobs. This may have led to the strategic model under-estimating rail patronage to the CBD. By 1998 it was probably too late to do anything, so not much was done

- Keenness to derive the benefits of urban consolidation, without willingness to pay for its impacts. Since the late 1980s there has been bipartisan support – although sections of the community were not necessarily wildly enthusiastic about it - for significant urban consolidation in Sydney, following a near-ban on apartment construction in large parts of Sydney since the 1960s. A motivation for urban consolidation was to make use of brownfield and underutilised land in the inner parts of Sydney, as deindustrialisation continued, whilst supporting this increased activity with under-used urban infrastructure, including water supply, sewerage and transport[1]. Thereby, the policy would reduce environmental impacts and costs to government of servicing greenfield development – these are really sound policy goals. But there was very little additional investment in urban rail capacity until this trend had been going for some 15 or so years, and the rail system was clearly creaking under stress[2]. It was almost as though the governments of both stripes weren't prepared to back themselves that the policy of urban consolidation was actually going to work, even though a causal look at Sydney's skyline was showing it was working big time.

A lesson from this is that analysts need to make the most of the tools and information available, and somehow, if major problems are to be avoided, elected officials need to heed simple technical advice and to have faith that some of their own policies will actually have an impact.

Where Does This Leave Us?

We don't know with certainty how COVID will affect:

- Population levels and distribution
- Employment levels and distribution, including key economic drivers, such as our external sector
- Underlying drivers of commuter patterns- e.g. the persistence of large-scale working from home; willingness to use transit
- Initial demographic effects after 2019 will not be discernible for a year or two, and then detailed distributional trends won't emerge for another four to eight years.

What the above indicates is:

- Establishing 2019 base models, under some
- circumstances, is reasonable
- Large collapses of urban transport demand don't appear to be expected by financial markets, at least not for passenger car (lower transit ridership might be a persistent issue)
- As time goes on there will be more certainty around forecasting, unless a second pandemic emerges.

In order to manage uncertainty for large projects, modelling their demands and economic performance under a broad range of scenarios can give policy makers some insights into the robustness and, hence, viability of specific projects under various outcomes.This multi-scenario modelling was a common feature of forecasting in Sydney during the 1980s and 1990s. The strategic modelling for the Western Sydney Orbital's EIS – today's M7 – (among others) started in the mid-1990s using two different population distribution scenarios prepared by different experts.
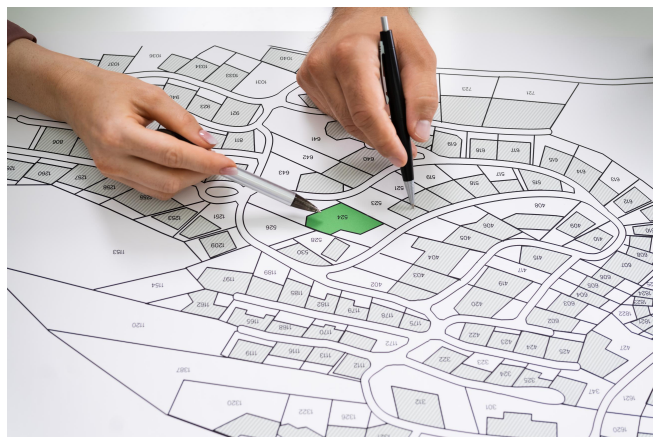
One expert had assumed a more distributed development form and the other was more bullish on urban consolidation. This provided a range of demand forecasts for infrastructure sizing and network wide road user costs for the economics, representing two similar but slightly different scenarios. Unfortunately, by the time the project was approved in 2003, the strategic modelling had been pared back to a single land use scenario.

We are currently developing a range of land use scenarios, largely based around anecdotal information about specific behaviours since the onset of the pandemic. These should provide a range of forecasts which are likely to capture the 'outcome envelope' in the years ahead. If analysis of large projects under these broad circumstances indicate economic merit, then the projects could be considered to be robust.

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