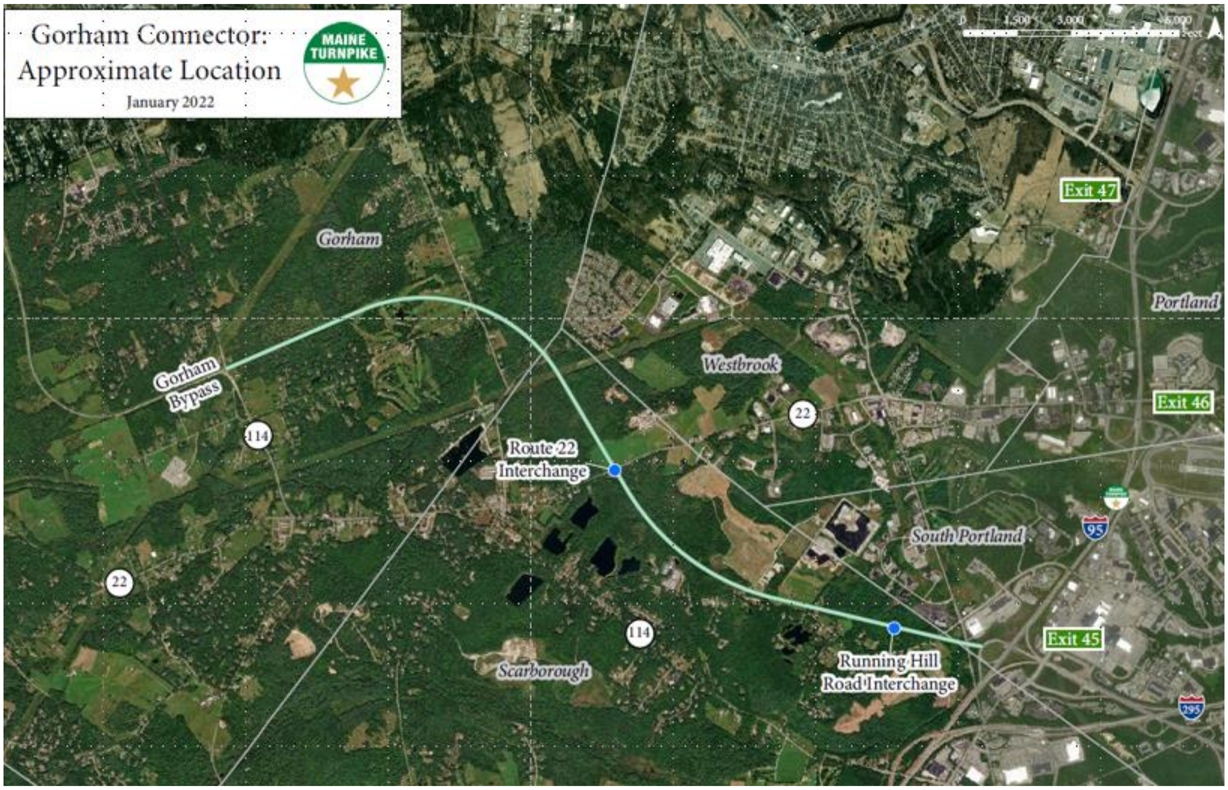
Will the Gorham Connector Cause Sprawl?



A Report on the Indirect Land Use Effects of the Gorham Connector

by

Uri Avin FAICP, Dr. Rolf Moeckel, Dr. Daniel Engelberg

Affiliates, National Center for Smart Growth, University of Maryland

March 2024

Table of Contents

List of Figures

List of Tables

Executive Summary

Our title - Will the Gorham Connector Cause Sprawl? – seeks to capture the essence of the debate around the Indirect Land Use Effects (ILE) of increasing mobility and capacity via expanded roadway infrastructure. The proposed Gorham Connector is a new, 4.8-mile, 4-lane, controlled-access highway connecting the roundabout at Routes 112 and 114 in Gorham, Maine, to Exit 45 on the Maine Turnpike in South Portland, Maine. Sprawl, defined as scattered, low-density development, is already prevalent throughout our study area's suburban/rural municipalities, and is the kind of semi-rural character that the municipalities' adopted zoning yields. The primary question posed by this study is whether the Gorham Connector is likely to overwhelm this semi-rural landscape with wall-to-wall development. A secondary question we consider is whether any induced growth spurred by the Gorham Connector will generate trips (induced demand) that will clog up the Gorham Connector and absorb much of its new capacity.

By way of definition, ILE are land use and population changes that would not have occurred but for the increased accessibility from a specific transportation project. The Gorham Connector's potential ILE are not only important to many stakeholders. They also provide a quantitative forecast of future potential indirect impacts that can be attributed to the project pursuant to regulatory reviews under the National Environmental Policy Act, Clean Water Act, or Maine's Natural Resources Protection Act. Without applying a quantitative tool as in this study, ILE are difficult to estimate because they are inherently qualitative, occur later in time than the facility itself, are further away in distance, and are uncertain in extent. Hence the active public debates around the topic in such projects. Our analysis seeks to answer the question of what extent of ILE can be reasonably expected by applying a best practices approach.

To do so, we have collected and analyzed extensive background information and have chosen the most rigorous approach to conducting the ILE analysis – constructing and running an integrated land use-transportation model. This approach involves running the results of the travel demand model through SILO, a well-established land use simulation model. SILO iteratively forecasts the effects of added accessibility and other related factors on land use change. This quantitative approach removes much of the subjective judgment typically associated with sprawl debates and planning judgment, replacing it with a more objective, testable tool in which assumptions and inputs are transparent.

While a computer simulation model can suggest an opaque, super-technical process, the fundamentals of the analysis are straightforward in concept and follow a common-sense agenda. We look at the following key factors that might suggest either greater or lesser land use change and analyze the information we collect against those factors:

- Change in Accessibility (e.g., travel time between destinations)
- Change in Property Value (e.g., housing price changes over a recent time horizon)
- Forecasted growth (e.g., future population in study area in 2045)
- Relationship between supply and demand (e.g., development capacity vs. market demand)
- Availability of non-transportation services (e.g., availability of utilities)
- Other factors that can impact the market (e.g., town amenities and characteristics)
- Public Policy (e.g., adopted comprehensive land use plans, zoning)

SILO's analysis of these factors shows that the indirect land use effects of the Gorham Connector are marginal. When we reduce our findings to annual growth in the number of households that can be attributed to the Gorham Connector, we find that it results in between a 0% and 10% increase in the total number of households in the seven municipalities in the study area compared to a no-build scenario. This translates into 14 units being added annually to the projected annual increase of 690 study area households without the Gorham Connector. In raw numbers, by municipality, over the 17 years between 2028 (when the Gorham Connector is assumed to open) and 2045 (the 20-year modeling horizon), this breaks down into the following annual household changes:

- Zero household changes in Portland, Westbrook, and Hollis
- Two additional households per year each in South Portland and Buxton
- Three additional households per year in Standish
- Four additional households per year each in Gorham and Scarborough

In terms of forecasted residential growth, these are very small numbers. Nevertheless, they do follow a certain logic: the towns with the most direct access and directional travel time benefits realize the most additional growth. The land use shifts identified here, between a 0% to 10% increase over no-build, are consistent with relevant research findings and other comparable studies.

Regarding the Gorham Connector's impact analysis, the travel time advantages of the Gorham Connector, while real, are not large enough for many households to actually change their home locations, thereby resulting in only small increases in residential growth in the study area. On the question of induced demand, conventional rhetoric is that communities can't build their way out of congestion because, as noted, ILE will absorb newly available capacity; this is an unfortunate over-simplification of a more complex reality. Numerous factors act together to fill up new roadway capacity well before land use change even enters the picture. These factors and the percentage of road capacity absorbed by them, based on the best and most relevant research available, suggests the following typical dynamics.

About 40% of new road capacity will be absorbed by ***External Factors*** to ILE, such as:

- increased population and jobs throughout the entire region that increase traffic volumes.
- rising incomes, which cause more driving in the region.
- people retiring later, consistent with ongoing trends and resulting in more driving.
- more people working (e.g., more women in the labor force), producing more trips.

Beyond these external factors that are quite apart from any induced land use changes, important changes in ***travel behavior*** absorb an additional 31% of new road capacity resulting from a new highway like the Gorham Connector. Changes in travel behavior include:

- new trips because of opportunities for more efficient travel due to reduced travel times.
- changes in commute timing because the roads are now less congested and/or intersections no longer pose delays.
- Fewer people carpooling because they now save time on less congested roads.
- Use of new routes.

Incorporating these considerations leaves an average of only 9% of roadway capacity that is absorbed by land use shifts. This typically preserves about 20% of the facility as new capacity.

In the above research results, the range in traffic attributable to land use effects, as a percentage of project facility traffic, was from 0% to 18%. In our case, we estimate that the percentage of roadway capacity on the Gorham Connector absorbed by the land use shifts noted earlier amounts to less than 2%, on the low end of the land use shift traffic impacts spectrum. To confirm the validity of these results, we conducted sensitivity testing that showed our models are working correctly and are properly sensitive to the all-important impacts of increased accessibility.

Current residential growth caps in several of the study area municipalities do not yet constrain future growth or modify ILE allocations. Town policies focused on increasing densities in designated growth areas may indeed shift *where* induced growth occurs internally but is not likely to change *how much* occurs. Likewise, the State's pressure on municipalities (LD 2003) to increase the production of denser housing types may change the mix of housing and its location but will not change the amount of induced growth projected. Our findings do not undermine the efforts and plans by individual towns to exercise further growth management.

1. Introduction and Study Process

This Report summarizes the ILE analysis findings for the Gorham Connector, a new, tolled, 4-lane controlled access roadway proposed to resolve decades of documented safety and mobility deficiencies in the region west of Portland, Maine.

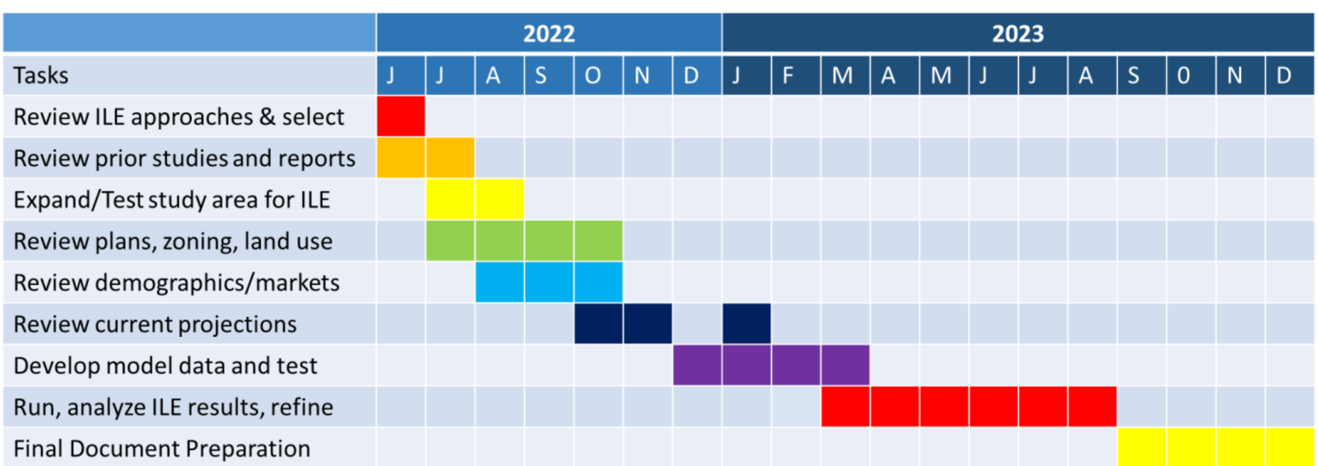
We begin by describing various approaches to conducting ILE, noting how this study follows the most rigorous methodology to ensure defensible findings (Fehr and Peers, 2022). Factors to consider for ILE analysis are then discussed and background data for the ILE analysis and the models is presented. The actual model used – SILO - is then described. The bottom-line ILE findings are next presented and their reasonableness discussed.

This report is written in a narrative, non-technical style, for straightforward understanding. Discussion of the technical aspects of population projections is addressed in Appendix 1. Appendix 2 relates the analysis conducted for this Report to FHWA Guidance and standards for ILE studies from a NEPA and best practices perspective. Seven Technical Appendices that document the background work for this report will be available as part of the alternatives analysis document and permit submission by mid-2024.

In terms of outreach and communications between the consultant team and various stakeholders during the study, the team worked with all seven study area municipalities in assembling and mapping data, verifying assumptions and sharing analysis and findings. Onsite visits to the municipalities were made to interview key officials, learn more about local conditions and perspectives, and present initial data findings. Formal presentations were made to the municipalities and various state and federal agencies to discuss results and receive feedback. Discussions yielded further clarifications by the consultants of their methods and assumptions. PowerPoint presentations of the ILE findings were made at agency, municipal, and public meetings in late 2023 and early 2024 and the Report was posted online concurrent with formal public meetings on the project.

The entire study process spanned 19 months from initiation through documentation. Figure 1 presents the ILE consultant team tasks over this timeframe.

Figure 1: ILE Process Steps and Timeline



2. How to Address Indirect Land Use Effects

Because ILE is a way of quantifying the indirect land use impacts, or induced growth, caused by new transportation capacity, often construed as “urban sprawl”, it is appropriate to briefly define sprawl before defining ILE.

Figure 2: Aerial view of a portion of Buxton

Sprawl Definition

A common definition of sprawl would include scattered, uncontrolled, low-density development (e.g. Knaap et al 2007). Despite language in the study area communities’ comprehensive land use plans about protecting rural character, the actual zoning districts in place do not fully facilitate this goal. Examples of such sprawling development abound in the study area because rural zoning generally allows large-lot single family homes by right, at densities ranging from 1 unit per 2/3 acre in Westbrook to 1 unit per 5 acres in Buxton (Figure 2).

ILE Definition

ILE are land use and population changes that would not have occurred without the increased accessibility from a specific transportation project (FHWA, 2010). Compared to direct effects, like right-of-way (ROW) acquisition, ILE are:

- *later in time*

  Depending on the scale of the facility in its regional context, this can range from five to ten or more years before its indirect effects dissipate.

- *farther removed in distance*

  Again, depending on the facility’s scale in context, this can range from less than a mile to five or more miles.

- *more uncertain*

  Because ILE are not always obvious or intuitive, careful analysis is required to parse out these effects.

Indirect Land Use Effects that might result from a new roadway are of interest not only to communities that might be impacted by them because of a concern over urban sprawl, for example. The analysis also provides a quantitative forecast of future potential indirect and cumulative impacts that can be attributed to the project pursuant to regulatory reviews under the National Environmental Policy Act, Clean Water Act, or Maine’s

Natural Resources Protection Act. Consequently, how to address ILE has been a topic of ongoing Federal, and sometimes, State guidance.

Ways of assessing ILE

There is a wide range of approaches to ILE analysis. Over the past 20 years, several Federal and national-level publications have addressed the options for analyzing ILE (Pasesky 2002, Avin 2007, FHWA 2010, NEPA 2018). The approaches vary widely in complexity and rigor, usually in relation to the scale of the improvement and its contextual complexity. Most State guidance on ILE, where it exists, has tended towards the easier, simpler, and less rigorous approaches (Avin 2007); Maine, specifically, does not have any consistent policy or regulatory guidance on ILE analyses. In practice, the level of rigor applied has often been driven by the level of controversy or perceived opposition to the project.

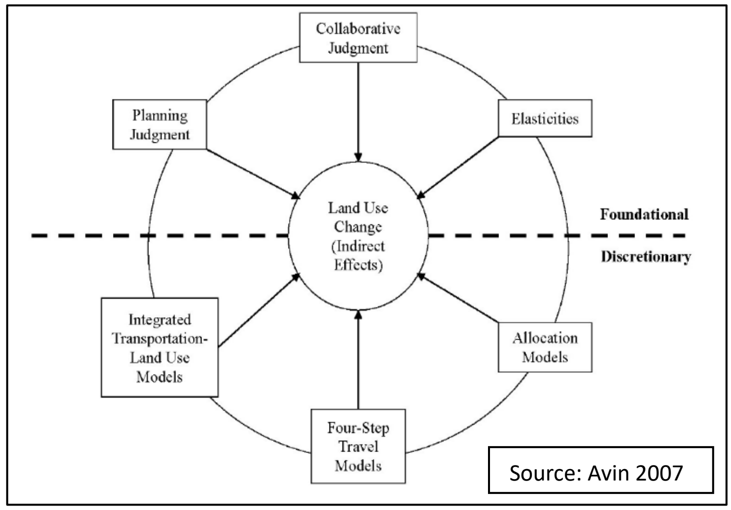
A useful summary of various ILE approaches is contained in a key reference document *Forecasting Indirect Land Use Effects of Transportation Projects, NCHRP project 25-25, Task 22* (Avin 2007), summarized below:

- **Planning Judgment** is a structured process for analyzing and forecasting land use change that relies on an understanding of the basics of transportation/land use interactions, basic data sources, asking the right questions and using rules of thumb from research to make informed judgments.
- **Collaborative Judgment** extends the solo planner's understanding through soliciting advice from others knowledgeable about the study area. In such cases, it is particularly important to structure this input so that the weight of given individuals, personalities and agendas are evened out. Delphi panels, a specific form of Expert Land Use panels (ELUs), address this need.
- **Elasticities** bridge the gap between practice and research by providing a synthesis of the best theoretical and empirical research that allows analysts to better sort out the complexities of induced demand, indirect land use effects, and induced investment effects. The elasticities relate change in highway capacity (e.g., assessed through Vehicle Miles Traveled [VMT]) to change in travel behavior and in land use effects.
- **Allocation Models** can allow the analyst to distribute a defined amount of indirect land use change at a disaggregate level (e.g., to TAZs) by making areas more or less attractive for development based on a number of factors that include accessibility. Planner and collaborative judgment are necessary in the creation of the rules and the evaluation and tweaking of the results.
- **Travel Demand Models** refer to the standard travel demand models that simulate travel behavior by generating, mode-splitting, distributing, and assigning trips (the four steps) to a travel network in a four-step model. These models can provide very useful information for inferring land use change by accounting for changes in accessibility and can even be used to allocate land use change by modifying interim model outputs and rerunning the model to explore the impacts of indirect land use effects on transportation facility performance.
- **Integrated Transportation-Land Use Models** combine the interaction of land use and transportation in one modeling process to address indirect land use effects. Unless structured to do so, however, they will not necessarily provide this information adequately. They vary in

data needs and complexity and are attractive where the necessary resources exist and where the project warrants an intensive effort.

The above approaches are not mutually exclusive and, as noted, some can be used in a complementary way. All ILE work should begin with some pre-screening to determine the likelihood of ILE. This exercise is essentially a form of Planning Judgment in that it examines the key factors driving ILE. The diagram in Figure 2 organizes the six bulleted approaches in clockwise fashion according to increasing rigor, beginning with Planning Judgment in the northwest corner. The top three approaches are called "Foundational" in that they should inform all approaches to ILE. Given the high priority assigned by the MTA to the Gorham Connector and the debate surrounding its potential impacts, particularly concerns over induced sprawl, this study of ILE uses Integrated Transportation-Land Use Models - the most rigorous and demanding of the approaches described – and structures the analysis appropriately to deliver defensible ILE results.

Figure 3: Framework for Forecasting Indirect Land Use



As stated, the analysis should cycle through the main factors driving ILE in prescreening mode, so as to get a grasp on the nature and likely extent of the impact. A further guide to prescreening is in Oregon DOT's highly regarded ILE guidance document (EcoNorthwest 2001) via a table that not only lists the key factors to consider but also suggests the likely magnitude of ILE shifts depending on the strength of these factors.

We reproduce this table as Table 1, using it to structure our presentation in the next section on background analysis and prescreening. We also preview the next section's findings in Table 1 by highlighting (light yellow) our judgement on the relative strength of each factor in the prescreening analysis. Table 1suggests a combination of both weak and strong drivers for ILE change. However, on key drivers like accessibility, forecast growth and land supply, our preview judgment suggests that limited land use change will occur. Our land use model, called SILO (Simple Integrated Land-Use Orchestrator), incorporates the seven factors identified in Section 4 of this report, Table 5.

The next section walks through each of these factors in turn, supporting our judgments shown in Table 1.

Table 1: Assessing Indirect Land Use Impact (Source: EcoNorthwest 2001)

Change variable	Data sources	If value is…	use change in the study area is probably…	
Change in accessibility Measured as change in travel time or delay, if available. Otherwise, assessment of v/c or change in access	For large projects or jurisdictions: Travel demand models Otherwise: expert opinion from ODOT or consultant transportation planners or engineers working on the project	Less than 2 minutes of time savings for an average trip, or no change in v/c	None to very weak	Low
		2-5 minutes	Weak to moderate	
		5-10 minutes	Strong	
		More than 10 minutes	Very strong	High
Change in property value Measured in dollars	Assessment data Expert opinion	No change	None to very weak	Low
		0% to 20% increase	Weak to moderate	
		20% to 50% increase	Strong	
		More than 50% increase	Very strong	High
Forecasted growth Measured as population, employment, land development; for region, city, or sub-area	Official population & employment forecasts (a "coordinated" forecast per ORS, if possible). Travel demand forecasting should be driven by same population and employment forecasts	Average annual growth rate (population/employment) of less than 1%	None to very weak	Low
		1%-2%	Weak to moderate	
		2-% - 3%	Strong	
		Over 3%	Very strong	High
Relationship between supply and demand Measured as land supply	Planning documents, especially related to Goals 9, 10, 14 (see Step 4 re development capacity, history, trends, and forecasts) Interviews with realtors, brokers, developers, planners	More than 20-year supply of all land types, all sub-areas	None to very weak	Low
		10 to 20-year supply	Weak to moderate	
		Less than 10-year supply	Strong	
		Less than 10-year supply and specific identified problems in the study area	Very strong	High
Availability of non-transportation services (e.g. sewer/water) Measured number of people or employees that can be served; or barriers to service provision	Local planning documents, especially Goal 11, 12; & CIPs Interviews with local planners and engineers Other reports generated as part of the highway project evaluation	Key services not available and difficult to provide	None to very weak	Low
		Not available and can be provided	Weak to moderate	
		Not available, easily provided and programmed	Strong	
		Available now	Very strong	High
Other factors that impact the market for development	Local planning documents Socioeconomic and ROW reports generated as part of the highway project evaluation Assessment data, MLS, local real estate reports Interviews with brokers, developers	Weak market for development	None to very weak	Low
		Weak to moderate market	Weak to moderate	
		Strong market	Strong	
		Very strong market	Very strong	High
Public policy	Local planning documents Interviews with local officials, local planners, reps of neighborhood or interest groups, state agency planners	Strong policy, strong record of policy enforcement and implementation	None to very weak	Low
		Weak policy, weak enforcement	Moderate to strong	
		No policy, weak enforcement	Very strong	High

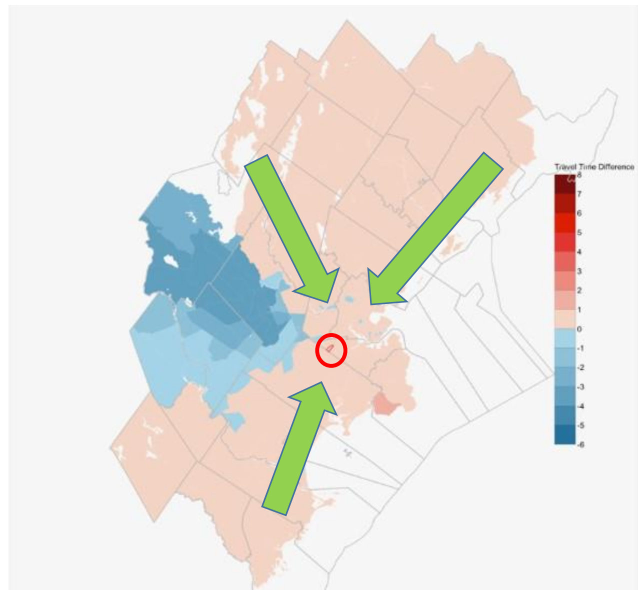
Note: Table assumes that the proposed transportation improvement improves accessibility. If not, then the potential for land use change is either insignificant, or could be in the opposite direction (e.g., decreases in land values from the no-build alternative could cause land use changes). If all other measures are "strong" and the access measure "weak", the indirect land use impacts are likely to be less.

3. Background Analysis and Prescreening

The sequence of information in this section follows the order of the seven key factors in Table 1 and provides a preliminary sense of the likely extent of ILE related to the Gorham Connector.

Change in Accessibility
We explore this, the primary driver of ILE, by demonstrating the change in peak hour commute time resulting from the Gorham Connector. Figure 4 shows changes in travel time from travel zones in the entire travel model study area to a specific employment node in the Maine Mall area (circled in red).

Figure 4: Difference in Average Travel Time to South Portland with the Gorham Connector (Note: The Gorham Connector will save more travel time during the peak of the peak than the peak averages in the map suggest) [source: Rolf Moeckel]

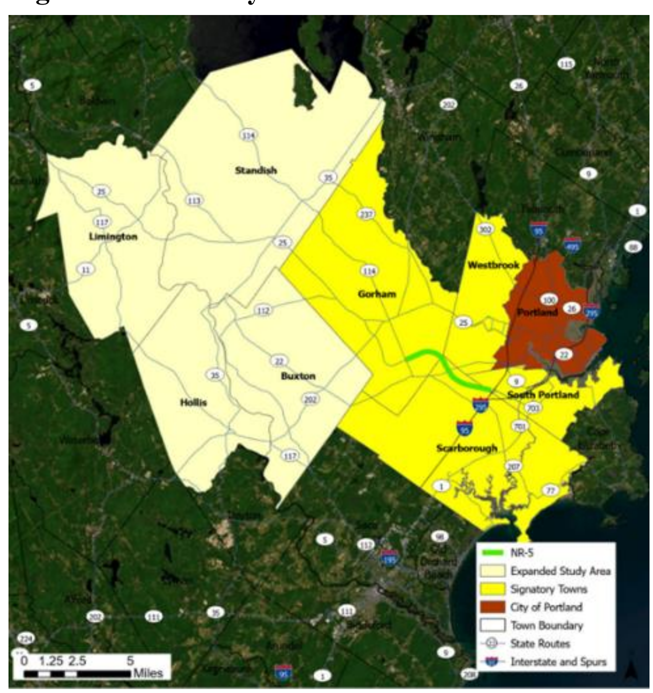


The average savings in peak hour travel time (of up to 4 minutes) for all trips are shown fanning out westward from the employment node through Scarborough, Gorham and Standish. We would accordingly expect these municipalities to exhibit the greatest ILE impacts, all else being equal. In relation to Table 1, this degree of time savings falls into the category of Weak to Moderate land use change.

While 4 minutes might not be a large change for an individual traveler, many travelers will experience this travel time saving, adding up to many hours of saved travel time overall. Individual travelers may experience even larger travel time savings, as the savings of up to 4 minutes only refers to the *average* of the afternoon peak (defined as 3 p.m. to 6 p.m.).

Note also that this accessibility impact test shows that our ILE study area needed to be expanded beyond the four core study area communities of Gorham, Scarborough, South Portland, and Westbrook, shown in dark yellow in Figure 5. In light yellow, are the jurisdictions added to the study area to properly capture ILE. Because Limington is outside the travel model area, SILO does not capture ILE effects there, but they can be inferred from the other, adjacent jurisdictions' impacts. Portland, shown in dark orange, is not included in the study area as a core community, but is captured by effects of the Gorham Connector on regional travel and growth patterns.

Figure 5: ILE Study Area



Change in Property Value
Over the 20-year period shown in Figure 6, median home prices have increased between 51% (Gorham) and 74% Portland), putting the region into the Very Strong potential ILE change category for this factor in Table 1.

Forecasted Growth

All sets of population projections used for this study - by GPCOG-PACTS, our team's Trends projections and SILO - show around 0.6% average annual growth in the study area between 2020 and 2045 (Table 2). While relatively high for Maine, this rate of growth is consistent with recent regional trends and well below the 1% considered to be in the None to Very Weak range in Table 1.

Relationship between Supply and Demand

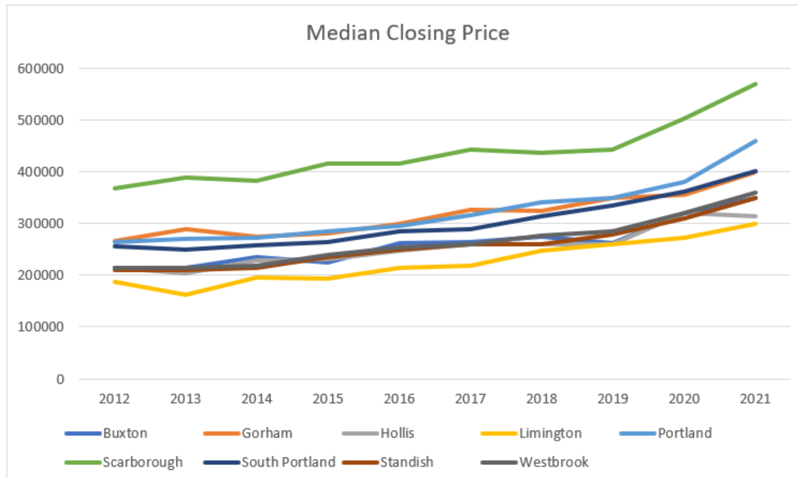
Our development capacity analysis conducted for this study shows that, regardless of draft GPCOG-PACTS or Trends projections, none of the jurisdictions are likely to approach their development capacity (Figure 7 and Technical Appendix E for more detail). This removes land scarcity as a serious constraint on development potential. Accordingly, this factor is rated as a Very Weak inducement for development change in Table 1. Irrespective, demand remains high because of housing supply constraints and even higher costs in proximate markets like greater Boston.

Availability of non-transportation services

Non-transportation services are generally available in the study area, even if not within a given, smaller jurisdiction. From a development viewpoint, key non-transportation services potentially affecting growth consist of the presence/absence of public utilities.

While the comprehensive plans of all the jurisdictions address the need for increased access to public utilities, only Scarborough (2021) actively discusses this in their land use plans. We found it very difficult to ascertain the expansion plans of the Portland Water District. Table 3 is our summary of current utility capacity and volume conditions. None of the urban jurisdictions served by wastewater treatment plants is near capacity.

Figure 6: Change in median home prices 2012 - 2021 (Source: Multiple Listing Services)

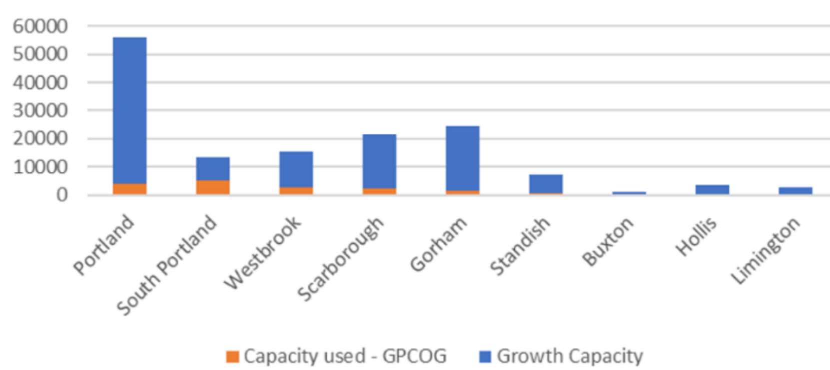


*Adjusted to 2021 dollars

Table 2: 2020 - 2045 Growth Projections (Source: Average of PACTS, Trends and SILO projections by Dan Engelberg)

Jurisdiction	2020 Pop.	Average 2045 Pop.	Average % Growth	Units Per Year	Annual Average %
Buxton	8,376	8,607	3%	9	0.11%
Gorham	18,336	20,751	13%	97	0.53%
Hollis	4,745	5,147	8%	16	0.34%
Portland	68,408	75,147	10%	270	0.39%
Scarborough	22,135	26,119	18%	159	0.72%
South Portland	26,498	31,673	20%	207	0.78%
Standish	10,244	10,457	2%	9	0.08%
Westbrook	20,400	25,869	27%	219	1.07%
Total	**179,142**	**203,769**	**14%**	**985**	**0.55%**

Figure 7: Study Area Growth Capacity Available vs. Used by 2045 (Source: Dan Engelberg and HNTB)



We conclude that existing treatment capacity is not an issue but we do not have any information on the challenges facing rural jurisdictions that may want to provide some sewer capacity to encourage more compact development and limit low density development. Accordingly, we give this factor a Weak to Moderate rating in Table 1.

Table 3: Current Utility Capacity in Study Area (Source: Compiled by HNTB, 2023)

Town	Public Water Available in Growth Areas	Wastewater Treatment Facility	Facility Type	Design Capacity/Peak Flow in Millions of Gallons per Day (MGD)	Current Volume vs. Capacity
Portland	Y	Portland Water District	Secondary	80 MGD	~25%
South Portland	Y	South Portland Wastewater Treatment Plant	Secondary	9.3 MGD/22.9 MGD	~41%
Westbrook, Gorham	Y	Westbrook-Gorham Regional Wastewater Treatment Facility; Portland Water District	G-W Primary; PWD Secondary	4.54 MGD/15.7 MGD	~29%
Scarborough	Y	Scarborough Sanitary District	Secondary	1.38 MGD/2.5 MGD	~55%
Standish	Y	N/A	Septic[2]	N/A	N/A
StandishBuxton	N	N/A	Septic	N/A	N/A
Hollis	N	N/A	Septic	N/A	N/A
Limington	N	N/A	Septic	N/A	N/A

Other factors that impact the market for development

Socio-economic Trends

Takeaways from an extensive comparison of 2009 – 2019 Socio-Economic Trends (Appendix 1) yield the following insights:

- **Urban/suburban** areas are seeing more changes overall than **rural** areas
- **Westbrook** is seeing the most change in terms of increasing population, especially younger people, housing costs, commute time and inflow/outflow
- **Portland** is undergoing similar changes with steeper rising costs for housing but growing incomes and less poverty
- **South Portland** is getting wealthier, with fewer residents driving to work and more using transit but population and jobs have remained largely stagnant
- **Scarborough** is getting older, but more people work from home and we see reduced commute times
- **Gorham** is growing fastest but with a younger population, longer commutes and more out-commuting
- **Standish** and **Buxton** are the least changed although Standish employment seems to fluctuate widely with disposable spending because of the lake tourism industry.
- **Hollis** is growing the fastest of the rural towns and with an older, wealthier population
- **Limington**'s housing is getting more expensive, with more people working from home, especially outside the area, and with fewer driving to work

Overall, this analysis suggests that the market for development in the area should be rated as Strong in Table 1, with rising housing costs pushing development further out.

Assessment data, local real estate reports, broker interviews

Appendix 1 presents the results of a housing cost analysis for the study area. Data there shows the difference between listed and closing prices, giving a snapshot of the very recent explosion in housing prices since 2019, especially in the urban towns but throughout the study area. This underlines the strong market for housing in the area and the potential for more growth in the rural jurisdictions given their greater affordability. The Gorham Connector will increase accessibility to these outlying jurisdictions. The integrated land use-transportation model will account for how much additional growth in these jurisdictions can be attributed to the Gorham Connector, given the current forces driving decentralization and "sprawl" irrespective of the Gorham Connector.

In addition to our statistical analysis, interviews with real estate agents were conducted (Appendix C). Their input can be summarized as follows:

- Demand has been building since 2009; COVID merely accelerated it and it will not abate
- Many out-of-state buyers with money are inflating costs; many of them are retirees or remote workers
- There are three buyer types:
    - **urbanites** looking at Portland as the hot spot, but next best are places with a village/community feel and restaurants and grocery stores nearby.
    - **families with kids** are looking for highly rated school systems (e.g., Scarborough).
    - **first time, younger buyers** are also looking primarily to Standish, Hollis, Limington, and Buxton for lower housing costs.
- "Aging in place" is a strong, growing trend that includes shared/multi-generational living.
- Companies renting apartments for workers is an emerging trend.
- With remote work, commute time is less important as a factor in location; transit seems irrelevant.
- Town officials are not proactively anticipating a residential influx, rather relying on the status quo in terms of land use regulation and growth ordinances.

The above takeaways from realtors indicate that development pressures and outward growth pressures are strong irrespective of the Gorham Connector's advent. The degree to which these pressures will be shaped by public policy is the next and final part of this section's analysis.

Public Policy

<u>Local Planning documents – Comprehensive Land Use Plans</u>
A complete analysis of the jurisdictions' Comprehensive Plans is provided in Technical Appendix D. The primary growth and Gorham Connector-related questions for Comprehensive Plans and zoning that will

influence the potential for land use change are compiled in the Table 4. The date under each town in the columns is when their current Comprehensive Plan was adopted.

Some of the "bottom line" findings from this comparative review (conducted in mid-2022) are:

- Four of the more recent plans (Westbrook, Scarborough, Gorham, Standish) explicitly relate to, support and consider the GC and its potential impacts
- Their acknowledgement is typically expressed in policies around transportation and land use, typically promoting denser development in targeted nodes and overall increases in commercial and residential capacity
- All identify the need for more utilities to support their growth areas but explicit plans or phasing to extend utilities are not evident
- None of these plans explicitly quantify the expected impact of the GC on land use changes
- The older, more rural towns do not much consider the GC and its possible impacts, Buxton (2003) most of all, though they all propose stricter rural zoning to preserve their rural character
- Buxton (2003), Hollis (2005) and Limington (1997) do not want more growth
- The urban/suburban towns do not propose stricter rural zoning
- The plans are not necessarily implemented via zoning

Table 4: Summary of Plans, Policies and Regulations in Relation to the Gorham Connector

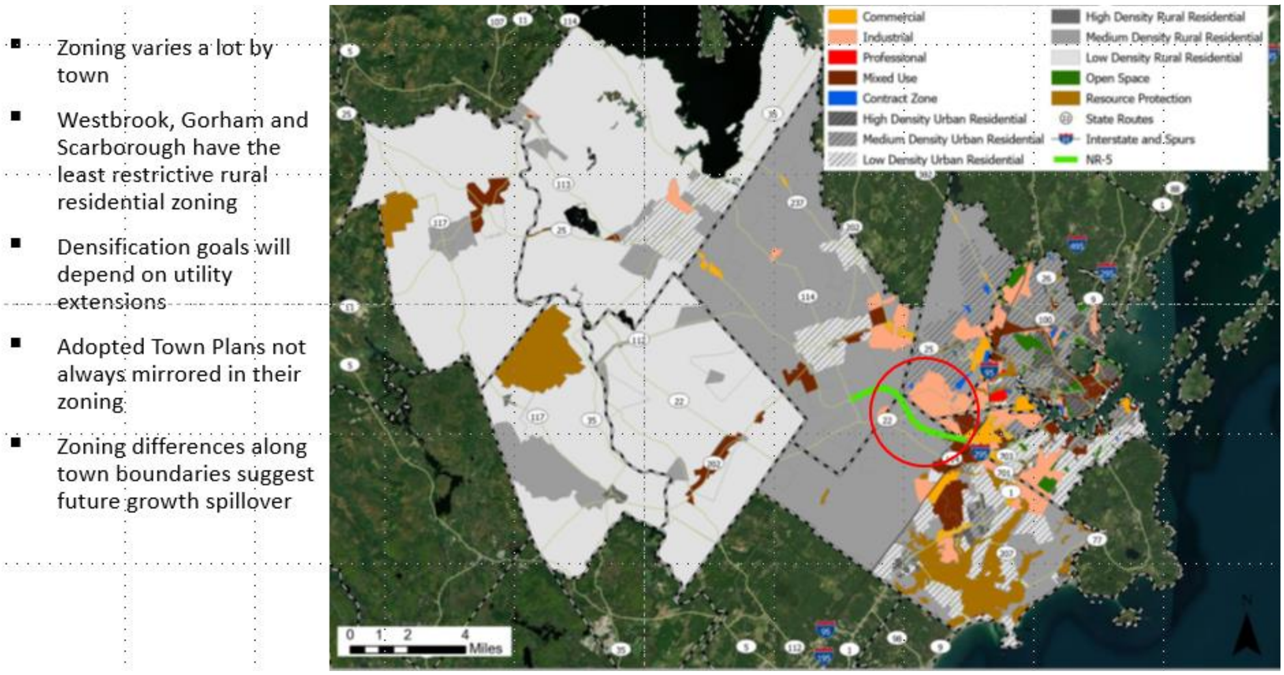
	Portland 2017	South Portland 2012	Westbrook 2012	Scarborough 2021	Gorham 2016/2021	Standish 2016	Buxton 2003	Hollis 2005	Limington 1997
GC acknowledged	no	no	yes	yes	yes	yes	yes	no	maybe
Quantified growth projections	yes	yes	yes	yes	yes	yes	yes	yes	yes
Projections account for the GC	no	no	yes	yes	yes	yes	no	no	maybe
Growth encouraged	yes	yes	yes	yes	yes	yes	no	no	no
Land Uses policies respond to GC	no	yes	yes	yes	yes	yes	no	yes	no
Land use patterns respond to GC	no	no	yes	yes	yes	no	no	no	no
Proposed changes quantified	yes	yes	yes	yes	yes	yes	no	yes	yes
Follow up zoning implements plan	yes	yes	unclear	partially	partially	partially	no	no	unclear
Residential capacity increases	yes	yes	yes	yes	yes	yes	unclear	no	no
Commercial capacity increases	yes	yes	yes	yes	yes	yes	yes	no	no
Stricter rural zoning proposed	no	no	no	no	maybe	yes	maybe	yes	yes
Need for more utilities	yes	yes	yes	yes	yes	yes	yes	yes	yes
Utility plans change	no	no	no	yes	no	no	unclear	no	no

While the comprehensive plans suggest that there is some preparation for the Gorham Connector by the more urban municipalities, the less urban communities are generally resistant to more growth. Whether, in fact, this opposition will affect development patterns will be determined by the actual zoning choices made by local governments.

Local planning documents - Zoning and development capacity

Figure 8 shows the composite zoning pattern for the study area as a whole and notes some features of the pattern and its relationship to the Comprehensive Plans.

Figure 8: Study Area Composite Zoning (Source: HNTB compilation)



Relative to expected growth, there is abundant zoned development capacity. Broadly, the study area has capacity for over 140,000 units while the expected new households within the study area are less than 10% of that. Given existing trends and projections, none of the jurisdictions are likely to approach their development capacity. In fact, none of the jurisdictions are likely to utilize more than 19% of their development capacity.

The capacity to absorb growth is particularly pertinent for core jurisdictions and inner suburban jurisdictions. Even if our capacity estimates were halved in these jurisdictions, Portland alone would still be able to absorb the entire study area growth with much room left over. While there might be locally popular areas within jurisdictions that reach build out, families will not need to look very far for available space. However, high average housing pricing in the City of Portland, as compared to other suburban and rural locations, limit the current opportunities for more growth in the urban core.

4. The Land Use Model

SILO is a simple yet powerful land-use model that can be fully integrated with a travel demand model. This allows representing the full land-use/transportation feedback cycle. (See Figure 9)

SILO is a microscopic model, enabling integration with both aggregate (or four-step) and disaggregate (or activity-based) travel demand models. SILO is written in Java and provided open-source (https://github.com/msmobility/silo).

Initially developed as a research project by Parsons Brinckerhoff, Inc. (now WSP) for Minneapolis/St. Paul in 2010, SILO was also implemented for the state of Maryland by the National Center for Smart Growth at the University of Maryland. Over the last ten years, the model has been implemented in Austin, TX, Munich (Germany), Manchester (England), Bangkok (Thailand), Perth (Australia) and the Kagawa Region in Japan. A more detailed description of the model can be found in Moeckel (2017)[1].

SILO is designed as a microscopic discrete choice model (Figure 10). Microscopic, because each household, person or dwelling is treated as an individual object in a synthetic population. There is a module to adjust non-spatial demographic changes and another module to adjust real estate development. A separate module simulates household relocation. The updated distribution of the population can be used in a transport model to model travel demand. Revised travel times, distances and costs can be fed back into SILO to readjust household relocation and where developers invest for new housing.

All decisions that are spatial (household relocation and development of new dwellings) are modeled with Logit models. Initially developed by Domencich & McFadden (1975), such models are particularly powerful at representing the psychology behind decision-making. Other decisions (such as getting married, giving birth to a child, leaving the parental household, upgrading an existing dwelling, etc.) are modeled by Markov models that apply transition probabilities. An important innovation in SILO is

Figure 9: Relationship of SILO to Other Analytical Inputs (Source: Rolf Moeckel)

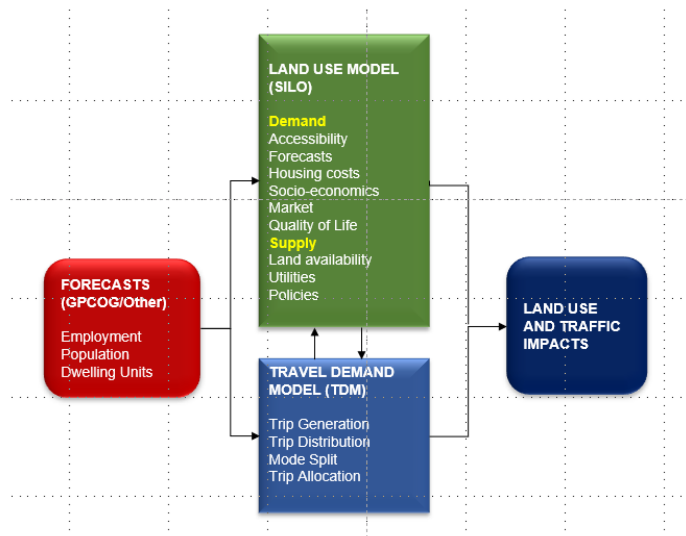
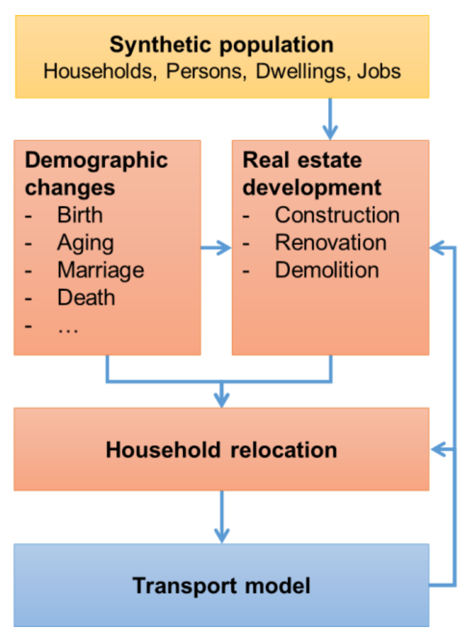


Figure 10: Summary of Diagram of SILO Operations (Source: Rolf Moeckel)



[1] Published in the Journal of Transport and Land Use, publicly available at https://doi.org/10.5198/jtlu.2015.810.

to explicitly represent constraints in location choice. Constraints include travel time to work and housing costs.

Being a microsimulation model, every household and person is simulated individually. SILO models household relocation, non-spatial demographic changes (such as birth, aging, marriage or having children), developers' decisions to build new residential buildings and change of dwellings over time (including renovation, deterioration, and demolition). These are briefly described in more detail below.

Synthetic Population

As SILO operates at the level of individual households and persons, a synthetic population is created for the base year. This module creates lists of households, person, dwellings, and jobs (an example for synthetic households is shown on the right). Publicly available PUMS data are expanded to generate the synthetic population. These lists of households, person, dwellings, and jobs are updated year by year through events that SILO simulates.

id	dwelling	zone	hhSize	autos
1	4814	864	5	2
2	32582	858	1	1
3	481	870	2	1
4	511562	913	2	0
5	52	934	3	1
6	92683	916	2	1
7	[illegible]	[illegible]	[illegible]	1

Demography

The demography module simulates all events that change households but are not spatial in nature. These include the birth of a child, aging, two people marrying (or cohabitating) or getting divorced (or separating), children leaving the parental household, workers changing their job and death. Some demographic changes, such as a child leaving the parental household, trigger a location search that is handled in the household relocation module.

Household Relocation

This household relocation module simulates households searching for a new dwelling. Benefits at the current dwelling are compared with potential living benefits of alternative dwellings to decide whether a household is moving or not. This module also handles households that in-migrate into the study area or that out-migrate.

Real Estate Development

The list of dwellings changes over time. New dwellings are built, others are renovated, some deteriorate, and a few dwellings are demolished. The real-estate module updates dwellings based on current demand and supply of housing. Every simulation period, developers assess current demand by dwelling type and region. If demand is high (expressed by a low vacancy rate), developers will search for available land that is zoned for residential development and build the dwelling type in demand. To find the best locations for new dwellings, developers mimic the location choice behavior of households, and thereby, developers are likely to build the most marketable new dwellings.

Price adjustments

A price model updates costs for dwellings based on current demand, expressed as a vacancy rate. For each dwelling type, vacancy rates in every neighborhood are calculated. If vacancy rates are above the structural vacancy rate, defined as the regionwide vacancy rate for a given dwelling type, prices decline. If vacancy rates are below the structural vacancy rate, landlords assume they have a market for increasing rents (or land prices) and quickly adjust prices upwards. Price increases are assumed to happen faster, while price reductions are slow. This reflects observed behavior that landlords attempt to keep prices high, even if demand is rather low.

Note that the seven factors listed in Table 1 are each incorporated in the SILO model in various ways (Table 5).

Table 5: Incorporation of Key ILE Factors in SILO (Source: Rolf Moeckel)

Change in Factor	Description for Analysis and Sources	How used in SILO
Change in Accessibility	Impact of access to jobs, shops, leisure, etc. on household relocation	Accessibility by auto and by transit are household relocation factors segmented by income and houshold size
	Impact of travel times on household relocation	Travel time to work for all workers in a household by auto and –if fewer cars than workers in household– by transit are household relocation factors
Change in Property Value	Impact of housing costs on household relocation Changes in costs over time and realtor interviews	Housing costs are household relocation factors segmented by income and household size
Forecasted growth	Official growth Forecasts or other sources	Treated as an external control total on study area growth in the model
Relationship between supply and demand	Research on market demand (historical/interviews) vs. development supply (zoned land)	Plans for urban development reflected in implementation of zoning plans that specify for each TAZ which housing development (e.g. single-family homes, multi-family homes) is permitted. Additionally, known future development (such as a public housing project) can be added in a specific future year.
Availability of non-transportation services	Utility plans	Incorporated into zoning capacity calculations
Other factors that can impact the market	Impact of income on household relocation	Housing location factors are distinguished by 4 income groups
	Town attractiveness in terms of Education, Crime, Cost of Living, amenities etc.	Use of NICHE ratings built into SILO location factors
Public Policy	Smart growth strategies, urban growth boundary, Comp Plans, Zoning, Restriction of certain developments in selected areas	See entry under relationship between supply and demand

5. Results

ILE Impacts

Our analysis shows that the Indirect Land Use Effects of the Gorham Connector are marginal, at best (Table 6). The last column has the *annual* number of households that develop in the various municipalities as a result of the Gorham Connector, and these range between 0 and 4. These numbers, as a percentage of the growth occurring *without* the Gorham Connector, are a maximum of almost 10% (Standish) and a minimum of 0%. The overall study area increases annually by 14 households (+2 over the baseline) as a result of the Gorham Connector.

Table 6: The Results of the ILE Analysis for the Gorham Connector

	2020 HH (Households)	2045 HH (base)	2028 – 2045 annual HH growth (base)	2028 - 2045 annual HH growth (w/GC)	Difference in annual HH growth (w/GC – base)
Portland	32,300	35,843	269	269	0
South Portland	12,575	15,238	111	113	2
Westbrook	9,613	11,758	85	85	0
Scarborough	8,965	11,040	86	90	4
Gorham	7,428	8,837	69	73	4
Standish	4,360	4,264	30	33	3
Hollis	2,010	2,199	17	17	0
Buxton	3,561	3,720	23	24	2
TOTALS	80,812	92,898	690	704	14

Note in Table 6 that the municipalities are listed from most to least urban. The four municipal MOA signatories are shown in red font and the three added rural towns are shown in purple font. Census data are given in the first data column and then a 2045 projection. The third column shows projected annual households between 2028 and 2045 because the Gorham Connector is assumed to open in 2028 and its impacts are thus measured from this point on. The resulting 17 years of growth serve as a baseline without the Gorham Connector impacts and the next column shows the annual numbers with the Gorham Connector impact. The last column simply shows the difference between them.

Given these very small impacts, the Indirect Land Use Effects from the Gorham Connector do not warrant any special land use mitigation efforts. This is not to say, of course, that the local municipalities, if they wish to preserve their rural character, should not take further land use steps in that regard.

Effects of changing land uses and of growth management measures

Given the study area's very large excess of housing supply over demand, just adding more capacity (for example, by densifying areas) will not increase a jurisdiction's share of growth. Scarborough, if its growth exceeds projections, could be the exception given its growth caps. That said, jurisdictions might be able to relocate growth internally. For instance, parts of central Gorham have limited new capacity. More households may choose to locate there if its growth capacity is increased in village centers instead of outside designated growth centers.

What will the effect of the Maine Legislature's housing mandate (LD 2003) be on ILE? This mandate significantly increases housing capacity statewide, including in the study area. However, capacity (housing supply) is already far in excess of demand (projections) and so we do not see any significant effect on housing allocations as our model is controlled by demand projections. It is plausible that housing types and locations within jurisdictions may shift in response to the State mandates but this would not change the number of units allocated to municipalities because of the Gorham Connector.

Are some towns growth caps of 35 units/year incorporated? Growth caps in the three relevant towns are not incorporated in our analysis. Based on our information, the projected growth in household numbers does not yet begin to be limited by these capacities , except in Scarborough, especially its rural area, which may be close to the caps (Technical Appendix E). Where caps are placed on particular areas (e.g., rural areas in Scarborough), and they are eventually approached, then new ILE dwelling units would be redirected by SILO to other unconstrained areas within the jurisdiction.

6. Are the Results Plausible?

We address plausibility in three ways: by comparing our findings to available research, to other comparable studies and by sensitivity testing of the model.

Putting the findings in a research context

Clearly, these impacts are very small, both in absolute numbers and percentages. They are at odds with the widely held notion that you cannot build your way out of congestion because roads just fill up with the growth that they induce. These perceptions might be true in some cases, but broadly speaking, they are not accurate. To understand why induced land use impacts are typically a very small component of the traffic volume on new roads we need to view the totality of growth impacts on traffic.

Quite apart from any Land Use shifts, the Gorham Connector's added road capacity will be absorbed by what are ***External Factors***:

- Increased population and jobs in the region that increase traffic volumes
- Rising incomes, which cause more driving in the region
- People retiring later, consistent with ongoing trends, producing more driving
- More people working (e.g., more women in the labor force), producing more trips

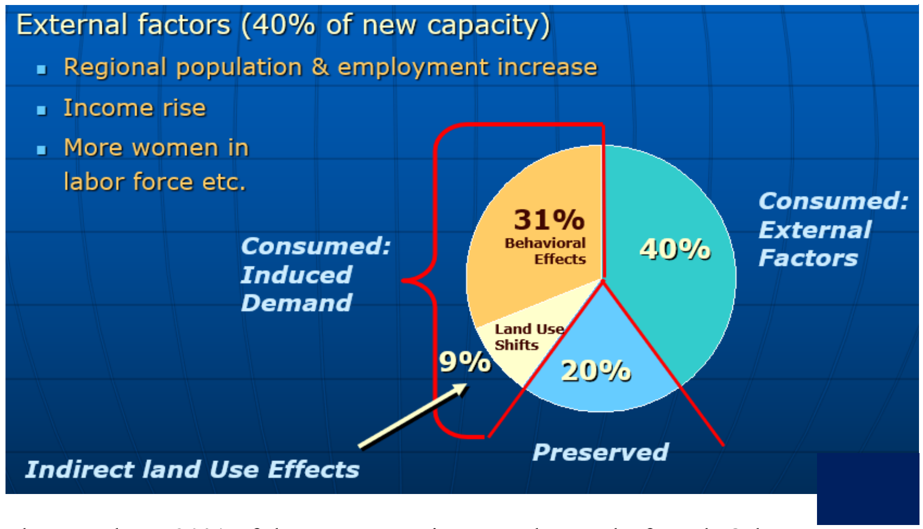
But beyond these external factors, that are quite apart from any induced land use changes, there are important changes in ***travel behavior*** that result from a new highway like the Gorham Connector:

- Some people now make new trips because of the new opportunities opened up by the Gorham Connector.
- Some people change commuting schedules because the roads are now less congested
- Reduced carpooling because of more efficient travel on less congested roads
- Redirection to a new route based on reduced travel times

Research shows that the External Factors and travel changes are much more important than land use shifts in absorbing added capacity (Cervero 2003). Careful analysis is needed to account for these various factors.

Figure 11 summarizes the most respected research conducted in this contested arena (Fehr and Peers 2022), based on 24 case studies of highway expansions in California (Cervero 2003).

Figure 11: Components of Induced Growth (Source: Robert Cervero, 2004)



We see that External factors account for 40% of capacity absorption on the roadway. Behavioral effects account for another 31% of absorbed capacity, and land use shifts account, on average, for only 9% of the capacity absorbed on the road. The range around this 9% in the case studies was a low of 0% and a high of 18%. All this leaves about 20% of the new capacity as truly newly found. Other studies, and there only a few comparable ones, tend to confirm our general findings for the Gorham Connector, as shown in VMT changes in the studies documented in Table 7.

We estimate that the comparable capacity absorption for the traffic volumes on the Gorham Connector of the induced land use shifts is less than 2%. This is on the low side of the typical results and certainly consistent with the relatively modest scale and growth rates in the region.

A strong, local example that supports these findings is the widening of the Maine Turnpike from Mile 12 to 42 in the late 1900's and early 2000's. Decades of congestion and safety impacts resulted in the decision to widen the Maine Turnpike in the mid 1990's. Once widened, this section of interstate highway did not immediately fill with traffic, instead this section of highway operates at an acceptable level of service even today and is projected to do so for many years to come. The level of traffic growth on this section has mirrored economic growth in the state, increasing at a slow but steady pace rather than at an accelerated pace when additional capacity was available. The Maine Turnpike Safety and Capacity Study, available at www.maineturnpike.com, supports these findings of remaining capacity.

Comparable Case Studies

Table 7 presents ILE findings for eight comparable highway studies conducted in the US and Europe over the past two decades. The first 5, in particular, employ a similar approach to ILE as does this report. Despite large differences in the scale of the various projects and their settings, the indirect land use impacts (typically measured in terms of population and household change) range between 0% and 5% of the overall region studied. Our result for the Gorham Connector of 2% first right within this range. In terms of changes within specific jurisdictions or subareas in the regions studied, there are very few data points available. Those that are shown present, as one would expect, a wider range of findings: from +1.6% to +22%. Our maximum impact of 10% change fits within this range also.

Table 7: Summary of Selected Studies on Indirect Land Use Effects

Name, place, date, source	Nature of project/context	Methods/Tools used	% change from no-build
1. Gorham Connector, Portland, Maine, 2024[2]	Added 6-mile radial link in mature suburban network; mature metro growing 0.7% p.a.	Travel demand model integrated with SILO land use model	+0% to 9% (households) 2% VMT increase
2. Traffic Relief Plan, Washinton DC region, MD, 2017[3]	Added 2 toll lanes to part of Washington Beltway and to radial interstate; mature region growing 1% p.a.	Travel demand model integrated with SILO land use model	+4.7% region o/a +22% for periphery -3.6% for inner areas (population); 0.1% VMT increase
3. Sacramento region. CA, 2001/2004[4]	Two new beltway links, additional HOV lanes, vastly expanded light rail network, increased road pricing, and tighter land use policies.	Travel demand model integrated with MEPLAN land use model	+1.5% (hh and emp. floorspace) in outer ring from beltway, + 1.4% from HOV lanes; other areas, esp. older suburbs, grow slower than baseline; VMT + 8.9% from Beltway, +4.7% from HOV
4. Stockholm Bypass, Sweden, 2014[5]	A 13-mile (21km) bypass, mostly tunneled, around the city; mature region growing 1% p.a.	Travel demand model integrated with land use model	Change of 5% in pop and workplace growth in County; 1.5% of region; 3.4% VMT increase
5. Norway - new highways, 2024[6]	Seven highway projects (three are ferry replacements w/very large travel time savings) in urban and rural settings of 10 to 60km length in (small towns with rapid growth potential)	Travel demand model integrated with land use model	For municipalities with largest increases 0.0% - 1.6% (w/o ferry municipalities)
6. Intercounty Connector (ICC), Montgomery County, MD, 2009 (two competing analyses)[7]	New 18-mile, 6 lane toll highway connecting two major radial corridors in mature metro growing 1% p.a.	Iterative Delphi process Travel demand model linked to a simple land use model	+1.2% of 6-county region Households +4.6% of 6- county region households
7. Monroe Bypass, NC, 2010[8]	14-mile, new 4 lane limited access highway bypasses 3 towns; exurban metro region growing over 20% p.a.	Planner judgement	Under +1% in County subarea (households)

[2] Avin et al, 2024
[3] National Center for Smart Growth, 2020
[4] Rodier et al., 2001
[5] Börjesson et al., 2014
[6] Stigen et al., 2024
[7] Ewing & Bartholomew, 2009
[8] Michael Baker Engineering Inc., 2010

While all the research referenced above is one check on the reasonablenss of our findings, we have conducted another, more specific, test on the sensitivity of our model to establish its validity. Here we imagine a hypothetical "SuperConnector" that radicaclly reduces travel time in the corridor to see if it has the expected effects on land use shifts.

Testing a SuperConnector

Imagine if travel times were reduced by the Gorham Connector ten times as much as projected in the travel demand model. In other words, what if a trip from Standish to the Maine Mall, for example, took 3 minutes instead of 30 minutes? What would this substantial change in accessiblity mean for ILE?

Table 8 replicates the previous results from Table 6, except that two final columns are added showing the results with and without a SuperConnector and the difference in annual household growth. The impacts on land use are now very significant and are all in the expected direction.

Table 8: Results of ILE Analysis for a SuperConnector

	2020 HH (Households)	2045 HH (base)	2028 – 2045 annual HH growth (base)	2028 - 2045 annual HH growth (w/GC)	Difference in annual HH growth (w/GC – base)	2028 - 2045 annual HH growth w/ Super Connector	Difference in annual HH growth (w/SuperConnector – base)
Portland	32,300	35,843	269	269	0	185	-85
South Portland	12,575	15,238	111	113	2	94	-17
Westbrook	9,613	11,758	85	85	0	74	-11
Scarborough	8,965	11,040	86	90	4	75	-11
Gorham	7,428	8,837	69	73	4	115	46
Standish	4,360	4,264	30	33	3	63	32
Hollis	2,010	2,199	17	17	0	23	6
Buxton	3,561	3,720	23	24	2	71	48
TOTALS	80812	92,898	690	704	14	700	10

We see that the effect of the SuperConnector is to grow the periphery at the expense of the inner areas. Portland loses 85 units per year, for example, while Buxton grows by 48 units per year. The combination of commute time, housing costs and other factors favors the outlying municipalites for future grwoth in this imaginary scenario, even though the region overall only grows by 10 units annually.

This result indicates that our models are indeed sensitive to travel time changes and are reflecting these in land use shifts in a plausible way.

7. References

1. Avin, U., Moeckel, R., & Engelberg, D. (2024). Will the Gorham Connector Cause Sprawl? A Report on the Indirect Land Use Effects of the Gorham Connector.Uri Avin, Robert Cervero, Terry Moore, ECONorthwest and Christopher Dorney, NCHRP Report 25-25 (22), Forecasting Indirect Land Use Effects of Transportation Projects, December 2007
2. Michael Baker Engineering, Inc., Indirect and Cumulative Effects Quantitative Analysis, April 2010
3. Börjesson, M., Jonsson, R. D., Berglund, S., & Almström, P. (2014). Land-use impacts in transport appraisal. Research in Transportation Economics, 47, 82–91. https://doi.org/10.1016/j.retrec.2014.09.021
4. Robert Cervero "Road Expansion, Urban Growth, and Induced Travel: A Path Analysis," *Journal of the American Planning Association*, Vol. 69, No. 2 (www.planning.org), pp. 145-163. 2003
5. Robert Cervero, "Are Induced Travel Studies Inducing Bad Investments?" *Access*, Vol. 22, pp. 22-27. 2004
6. Tom Domencich and Daniel L. McFadden, Urban Travel Demand: A Behavioral Analysis. North-Holland Publishing 1975
7. ECONorthwest and Portland State University (for Oregon DOT). A Guidebook for Evaluating the Indirect Land Use and Growth Impacts of Highway Improvements (SPR 327), National Technical Information Service, Springfield, Virginia 2001.
8. Ewing, R., & Bartholomew, K. (2009). Comparing Land Use Forecasting Methods: Expert Panel Versus Spatial Interaction Model. Journal of the American Planning Association, 75(3), 343–357. https://doi.org/10.1080/01944360902956296
9. Fehr and Peers, Induced Vehicle Travel Impact Analysis, Technical Guidance, January, 2022
10. Federal Highway Administration, Interim Guidance on The Application Of Travel And Land Use Forecasting In NEPA, March 2010
11. HNTB, Gorham East-West Corridor Feasibility Study, Final Report for the Maine Turnpike Authority MaineDOT, September 2012
12. Knaap, Gerrit-Jan, Song, Yan, and Nedovic-Budic, Zorica. Measuring Patterns of Urban Development: New Intelligence for the War on Sprawl, *Local Environment*, vol. 12, issue 3, pp. 239-257, June 2007
13. NEPA, Instructions for Reviewing Travel and Land Use Forecasting Analysis in NEPA Documents February 21, 2018
14. National Center for Smart Growth (NCSG), University of Maryland, Smarter Roads, Smarter Cars, Smarter Growth? November, 2020
15. Larry Pasesky, NCHRP Report 466, "Desk Reference for Estimating the Indirect Effects of Proposed Transportation Projects" 2002
    Caroline Rodier, et al. Anatomy of Induced Travel; Using an Integrated Land Use and Transportation Model in the Sacramento Region, Transportation Research Board Annual Meeting (www.trb.org). 2001
16. Stigen, T. A., Nilsen, Ø. L., & Stevik, T. K. (2024). Impacts of highway induced land use changes on transport demand. Transportation Research Procedia, 78, 578–585. https://doi.org/10.1016/j.trpro.2024.02.072

Appendix 1: A Note on Projections

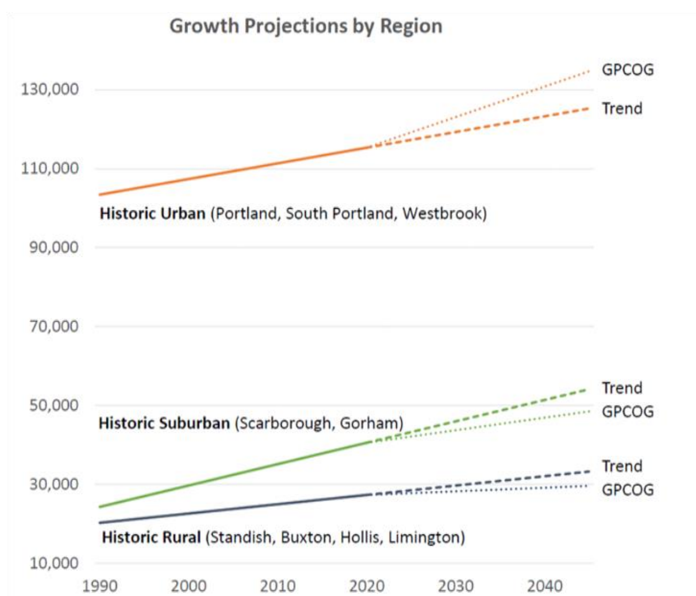
Our findings have been presented by comparing projected growth with and without the Gorham Connector. In Appendix 1, we discuss the official Metropolitan Planning Organization (MPO) projections and note the need for developing other projections as well, including those made by SILO itself, as part of its modeling process. SILO respects the regional control totals set by the MPO.

It is important to note in advance that the differences we observe in the various projections are not large enough to suggest that the ILE findings would be any different. They may, however, influence travel volumes on the Gorham Connector. We conducted a closer examination of Greater Portland Council of Governments (GPCOG's projections by comparing them with a trend growth pattern. The differences are instructive and noteworthy.

The "official" projections for the Portland region are provided by the duly appointed Metropolitan MPO called PACTS, under the umbrella of GPCOG. These projections for population, households and employment are typically used for various purposes, including as inputs into transportation models. In the models, the projections are broken into smaller geographies called Transportation Analysis Zones or TAZs. Because household-generated trips must be balanced with the trips attracted by jobs, all these numbers are important in deciding on future infrastructure needs and priorities. The GPCOG projections were, accordingly, carefully scrutinized as part of the Gorham Connector study and the ILE process.

Because no current explanation of the basis for MPO projections was available, one way to evaluate projections is to compare them with prior trends to see how they might diverge and then to try account for such divergences. A lot depends on how far back one takes the Trends before projecting them forward. They ought to cover a period of ups and downs that represent recent history in a plausible way. We defined Trends as the decade between 2010 and 2019 and projected these forward and compared them with GPCOG numbers. Figure 1.1 shows the results, broken out by type of jurisdiction.

Figure 1.1: Comparison of GPCOG and Trend Projections

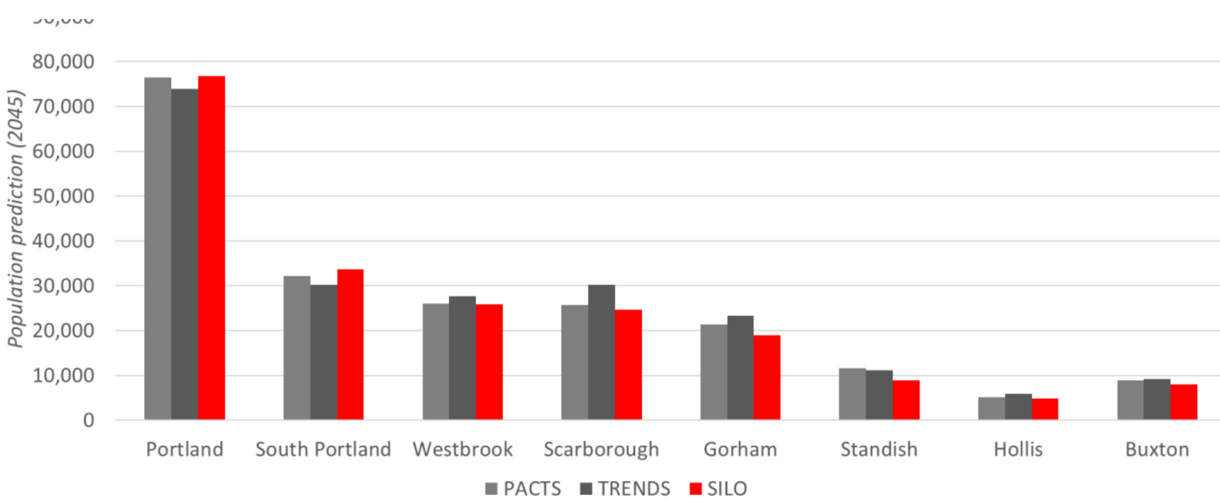


A pattern becomes apparent: compared to Trends, GPCOG over-projects urban growth and under-projects suburban and rural growth. The logic behind GPCOG projections is not self-evident and does not appear to be formally documented. It is possible that they represent a policy desire on the part of the regional agency, one that is found among many regional agencies in the US, in which policies to maintain compact urban areas are preferred over more dispersed patterns (sprawl). Such aspirational projections, however, should be balanced by Trend projections since ambitious Smart Growth projections for the region, including those developed for the scenarios of the 2012 Gorham Connector study (HNTB 2012), have not panned out. Indeed, the opposite happened in that case[9].

Accordingly, we arrayed Trend projections against GPCOG numbers in Figure 1.2 and the PACTS travel demand mode[10]l was run using both sets of projections to provide "bookends". Employment projections by GPCOG were not modified although they display as similar bias. Travel volumes on the Gorham Connector proved to be about 5% higher with Trends vs GPCOG numbers. This is to be expected given the larger numbers in the suburban and rural municipalities using the Gorham Connector for commutes in the Trend pattern.

To further complicate matters, as was evident in our earlier discussion of SILO, the land use model develops population projections independent of the other two sets of projections. Running multiple iterations of SILO, however, yielded a good approximation of the other two sets of projections (Figure 1.2).

Figure 1.2: Comparison of PACTS, Trends and SILO Projections



As a pattern, SILO is more like the PACTS model in the urban towns while the Trends model results in higher projections in the suburban and rural towns (especially Scarborough and Gorham) than both PACTS and SILO. In part, this is because the PACTS model also is very optimistic about employment growth in Portland and South Portland compared to the Trends employment scenario. Because we use PACTS employment numbers to drive the SILO residential location model, this likely overstatement of future core employment helps account for SILO's relative "over-allocation" of population to the urban towns.

[9] The 2012 study compared a 2035 very low-density population scenario with a very compact urban scenario with reality in 2019 being midway between them; for employment projections, however, reality showed a much more decentralized pattern.

[10] The PACTS Travel Demand Model is the regions travel demand model and a tool for traffic forecasting. Data from the model were calculated from a predictive travel demand model that was specifically developed for Connect 2045, the long-range transportation plan for the PACTS urbanized area. Any use of the model and its data does not suggest that GPCOG/PACTS has reviewed the data or assumptions therein nor does it indicate GPCOG/PACTS involvement in and/or support for a particular project.

Nevertheless, for a modeled set of projections, we believe the SILO numbers are quite adequate for ILE purposes. Again, given the small ILE shifts shown by our analysis, we do not believe that land use impacts would be meaningfully different were the PACTS or Trends numbers to have driven the ILE analysis.

Appendix 2: Compliance with ILE Best Practices Guidance

As noted earlier, this Report is written in a narrative form with limited references to formal regulatory guidance. The purpose of this section is to make the connection between such official guidance and the ILE work done on the Gorham Connector.

The format for this section uses the various sequential process and chapter headings of the 2018 Federal Guidance document "Instructions for Reviewing Travel and Land Use Forecasting Analysis in NEPA Documents"[11]. The second column of Table 2.1 notes the key concerns for ILE in each process step and then, in the third column, the analysis and actions of the study team in response. Some points made elsewhere in this Report and in the Appendices are repeated here but some new material is also introduced.

In summary, the Table shows that we have observed and followed NEPA's technical standards and the best practices they recommend.

Table 2.1: This Study's Compliance with ILE Best Practices

Stage in the NEPA process	Main analytical concerns	Study team's responses and actions
Scoping of project	Did process determine the potential for land use change early in the analysis?	Yes. Extensive screening of potential change was conducted through an analysis of the key factors that typically drive ILE (see Table 1). Despite this analysis suggesting only modest change, a rigorous modeling approach to change was adopted, given community debate. The study area was significantly expanded from four to seven municipalities to account for an early analysis of the project's accessibility impacts. The MPO's travel model covers a much larger area than the expanded area so that the larger regional travel patterns are well accounted for.
Traffic and Land Use forecasts	Were the source and methodology of the traffic and land use forecasts vetted critically?	Yes. Land use forecasts by the MPO did not have full documentation but use a cohort survival model to drive demographics and internal discussion on allocation heuristics; a Delphi panel is not used. A comparison of the MPO projections against a simple 10-year trends forecasts revealed significant differences suggesting the official forecasts were consistent with more aspirational Smart Growth-driven outcomes. Accordingly, both MPO and Trend forecasts were used in different runs of the travel model. The land use model, SILO, was calibrated to approximate these other forecasts. Extensive interaction occurred throughout the project between the traffic forecasting and land use forecasting teams.
	Were the land use forecasts reviewed for whether they explicitly account for the project or not?	Yes. Neither the MPO nor any of the municipalities explicitly quantified any land use changes resulting from the project in their plans or documents; this allowed for a "clean" Build and No Build land use scenario; similarly, the traffic forecasts were only for a Build and No Build condition and travel model inputs did not assume any Indirect land use changes.

[11] This guidance references and elaborates on the earlier 2010 FHWA guidance document.

Purpose and Need	Do these account for any land use aspects and are they carried through in the subsequent analysis?	Yes. The 2020 project purpose developed in consultation with the lead federal agency and other federal and state agency partners does reference land use impacts, in "catch – all" language often used in such statements, as noted at the end of the quote: "..to address demonstrated safety and mobility deficiencies within the Gorham-Portland corridor by implementing improvements that maximize public safety, the sustainable movement of people and goods, and minimize adverse community and environmental impacts". The ILE analysis rigorously assesses potential adverse community impact, emphasizing locally undesired residential low density sprawl impacts. Importantly, some of the employment growth/commercial benefits of the project as well as its potential growth-concentrating impacts near interchanges are explicitly included in land use plans of Gorham or denied in others (e.g., Scarborough).
Range of Alternatives	Were appropriate alternatives developed in the course of the project?	For transportation purposes, several appropriate Build and No Build alternatives were developed and assessed in terms of the Purpose and Need Statement and evaluated. The alternatives using existing widened urban/suburban roads were not judged to involve any significant indirect land use changes. The applicant's preferred Build option, however, was the object of the ILE analysis conducted.
Effects Analysis	Were alternative land use forecasts needed, developed and assessed?	Only as in the Build and No Build contexts but, as noted above, several alternative projections were developed which the SILO land use model approximated. The small differences between these various forecasts were judged to have no impact on land use outcomes. Sensitivity analysis was applied to the land use model (e.g. varying accessibility benefits dramatically) to confirm the model was working plausibly. Sufficient iterations of the interacting transportation and land use models were run as well as of the land use model itself until stable results were yielded. Results were also checked against relevant research findings.
Preferred Alternative	Do the land use effects influence the preferred alternative?	No. Our finding was based on marginal land use impacts that did not materially affect traffic volumes or patterns on the preferred alternative.
Changes during the study process	Were any important changes over the study timeframe accounted for?	Yes. COVID – related impacts on travel behavior were explicitly considered in the travel modeling; the residential market impacts of COVID were also investigated and accounted for. The land use model explicitly accounts for household budget tradeoffs between housing and transportation costs for all study area households.

About the Authors

All three authors are Affiliates of the National Center for Smart Growth at the University of Maryland where they have collaborated on numerous transportation-land use scenario modeling projects at various scales. These studies have included the quantitative testing of multiple policy options combining highway, transit, pricing and land use interventions to achieve more sustainable outcomes.

Uri Avin FAICP, the team leader, was the primary author of the 2007 Federal Guidebook on Forecasting the Indirect Land Use Effects of Transportation Projects. He has conducted ILE analysis, using various approaches, in Maryland, Virginia, North Carolina, Texas and California. Aside from ILE work, his 50 years of experience include serving as a county Planning Director, a national Consultant and a Research Professor at the University of Maryland. For the National Transit Institute, he developed and taught a course on the Transportation-Land Use Connection to DOTs and MPOs around the country for five years. His publications are widely cited and his plans have been recognized through 34 national or state awards for excellence, including projects in Maine.

Dr. Rolf Moeckel is a Professor at the Technical University of Munich. He is the developer of SILO, the land use model applied in this project, which he has applied around the US, Europe and Asia to test various policies for more sustainable multi-modal transportation. His consultant work focuses on the travel behavior/land use interface, with an emphasis on spatial modeling. His research, publications and practice include innovations in transit and pedestrian planning as well as automobile and freight. He authored a recent synthesis of the state of the art in transportation/land use modeling. Prior to his academic career, he was a consultant in the Systems Analysis Group at Parsons Brinckerhoff (now WSP).

Dr. Daniel Engelberg has focused his research and practice on transportation/land use problems where significant uncertainty complicates the planning effort and approach. He has, for example, developed and managed long range planning scenarios in the DC region, deploying tools like SILO, travel demand models, GHG emissions models, and water quality models so as to arrive at robust policies for implementation. Quantitative analysis of population and employment projections and land use/zoning patterns are a standard part of his repertoire. Currently he is the postdoctoral researcher on the Common SENSES project at Northeastern University.