Pathways to the Future
TRANSPORTATION

Technical Report H:
Assumptions for Travel Demand Modeling

Long Range Transportation Plan 2050



Richmond Regional Transportation Planning Organization
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Assumptions for Travel Demand Modeling

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ABSTRACT
The Richmond Regional Transportation Planning Organization (RRTPO) is in the process of updating the regional Long-Range Transportation Plan (LRTP) to the horizon year 2050. This LRTP has been branded Pathways to the Future: Transportation 2050. As part of this process and in keeping with federal regulations, the RRTPO used a Regional Travel Demand Model - the Richmond/Tri-Cities Model (RTC Model) for analysis during several stages. This report summarizes the travel demand modeling framework and key assumptions.

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Contents

Introduction 2
Modeling Context 4
Data Inputs for Pathways to the Future: Transportation 2050 4
Performance-Based Project Prioritization 10
System Performance Analysis 10
Future Commitments and Actions 11

Introduction

This section summarizes the travel demand modeling framework and key assumptions used in development of the Pathways to the Future: Transportation 2050 Long-Range Transportation Plan (LRTP).

- **Regional Modeling Framework:** The Richmond/Tri-Cities (RTC) Model is a regional travel demand model developed by VDOT and maintained by RRTPO using the CUBE 6.4 modeling platform. The model employs a standard four-step process—trip generation, trip distribution, mode choice, and route assignment—to estimate future automobile, transit, and truck travel patterns for planning-level analysis. As the region is designated as an orphan maintenance area for the 1997 8-Hour Ozone standard, regional emissions conformity modeling is not required.
- **Socioeconomic Data Assumptions:** The Richmond Regional Transportation Planning Organization (RRTPO) utilized the adopted and validated 2050 Socioeconomic Data Report for the RRTPO planning area. For the Tri-Cities Area MPO (TCAMPO) portion of the model region, an interim proxy set of socioeconomic data based on the validated 2045 socioeconomic dataset was used due to unresolved inconsistencies between TCAMPO's adopted 2050 forecast and the RTC model structure.
- **Model Compatibility Considerations:** Review of the adopted TCAMPO forecast identified several data issues requiring resolution prior to implementation within the RTC Model, including discrepancies in reported TAZ geography, anomalous household values in selected zones, and the absence of employment forecasts disaggregated by industry sector. Industry-level employment forecasts are required to develop model land-use inputs and support truck travel forecasting. In the absence of a complete, model-compatible dataset, an interim proxy derived from the validated 2045 forecast was determined to be the most appropriate input for regional analysis.
- **Scenario Planning Integration:** Consistent with the Pathways to the Future scenario planning process adopted in September 2024, the LRTP evaluates five alternative future growth and land-use scenarios representing a range of demographic, economic, and development outcomes. The interim TCAMPO proxy data was applied consistently across all scenarios. Relative to the adopted 2050 control totals for population and employment, using the interim proxy data results in a regional difference of approximately 0.7 percent in population and 0.9 percent in employment in the baseline future. By comparison, the adopted scenario

planning process evaluates futures with regional population and employment outcomes that vary by approximately 30 percent, indicating that the variance introduced by the interim proxy assumptions is small relative to the range of uncertainty explicitly examined through the scenario planning process in assessing the performance of the proposed projects.

- **Project Prioritization Methodology:** Following consultation with VDOT and TCAMPO and confirmation of the lack of model-compatible data for the Tri-Cities portion of the region, RRTPO elected to proceed with project prioritization using a consistent set of baseline assumptions across all model runs. Because the same socioeconomic assumptions were applied to both No-Build and Build alternatives, comparative project performance and relative rankings remain appropriate for planning-level screening and evaluation. Project selection ultimately incorporated model performance measures alongside public input, stakeholder feedback, fiscal considerations, and project readiness.
- **Future Actions and Commitments:** RRTPO has committed to rerunning the system performance analysis and amending the LRTP within six months of receiving a complete, model-compatible 2050 socioeconomic dataset, including the industry-level employment information required by the RTC Model. In addition, RRTPO has assumed responsibility for development of a unified 2025/2055 Socioeconomic Data & Forecast Report for the entire RTC model region to support the next regional model update currently planned for 2027.

Modeling Context

The Richmond Regional Transportation Planning Organization (RRTPO) and Tri-Cities Area MPO (TCAMPO) serve a single urbanized area and have a single Regional Travel Demand Model - the Richmond/Tri-Cities Model (RTC Model or simply 'the model'). The RTC Model was developed by VDOT and is maintained by RRTPO. The RTC model simulates automobile, transit and truck flows on the regional network and forecasts future demand using a four-step process that addresses trip generation, trip distribution, mode choice and route assignment. The RTC Model uses the CUBE modeling platform consisting of a library of scriptable programs that facilitate construction of travel demand forecasting models. The current version of the RTC model was built in CUBE Version 6.4. The RTC Model is an essential analytical tool for both regional and corridor transportation planning.

For this LRTP, the model is used to support planning-level evaluation, not project-level design or forecasting. As an orphan maintenance area, regional emissions modeling derived from the travel demand model is also not required. This LRTP update also introduces scenario planning which explicitly adopts variations on future growth and land use patterns within the RRTPO planning area to explore robustness of investments.

Data Inputs for Pathways to the Future: Transportation 2050

For the 2050 LRTP, validated 2050 socioeconomic inputs were used as adopted in the RRTPO 2050 Socioeconomic Data Report for the RRTPO subarea. For the TCAMPO subarea, the most recent fully validated dataset (2045) was used to create an interim proxy for 2050 due to unresolved inconsistencies in preliminary 2050 inputs for that portion of the region.

While TCAMPO adopted a 2050 Socioeconomic Forecast report in July 2023, the report was not developed fully consistently with the adopted TAZ boundaries in the Richmond Tri-Cities Model. The TCAMPO report uses 331 TAZs (excluding the Chesterfield portion which was developed by RRTPO staff as part of the 2050 forecast) and the RTC model has 328 TAZs. In total, there were 4 TAZs in the TCAMPO report which are not in the model and 2 model TAZs that were not included in the report at all. Although both datasets represent the same geographic area, differences in TAZ definitions prevent direct implementation of the adopted forecast within the RTC Model without a spatial crosswalk and GIS data, or a methodology for reconciling these spatial disconnects.

In addition to the spatial mismatch, the adopted data includes significant quality control issues which prevent inclusion in the RTC model as adopted. Review identified several anomalous records, including a reported TAZ that could not be reconciled to the RTC Model geography or report map and revisions to base year data including household population totals below zero in several zones.

Table 4.2: Primary Land Use File Attributes

Name	Description
N	Index Number
ZONE	Zone Number
OLD_TAZ	TAZ Number before renumbering zone system
PDC	Planning District Commission
JUR	Jurisdiction Name
JURNUM	Jurisdiction Number
TOT_POP	Total Population
POP_HH	Total HH Population
POP_GQ	Total Group Quarter Population
HH	Households
K12_ENROLL	Total K12 Enrollment
U_ENROLL	Total University Enrollment
AUTO	Automobiles registered in this zone
TOT_EMP	Total employment in this zone
RET_EMP	Retail employment in this zone
Name	**Description**
NON_EMP	Non-Retail employment in this zone
AVGAUTO	Average Autos per Household
ACRES	Zone area in acres
CBD	Flag for the CBD zones
EXTERNAL	Flag for External zones
NAICS_XX	NAICS Employment Group with NAICS code 'XX' described in Table 4.3

Figure 1: Land Use Input Required Fields

Most critically to the model function, the adopted 2050 socioeconomic (SE) data does not include the corresponding employment classification by NAICS code needed to develop employment breakdowns and two-dimensional balancing for the truck component of the model. The RTC Model requires employment by industry sector because truck trip generation and attraction rates vary significantly by economic activity. Without NAICS-based employment forecasts, truck demand cannot be developed using the adopted model structure. Development of these inputs requires allocation of forecast employment to industry sectors so that truck trip generation and attraction can be represented consistent with the RTC Model structure. As shown in Figure 1, these are required attributes for the land use files.

These issues were identified during initial review of the adopted dataset and remained unresolved as of January 2026. Consequently, the interim proxy dataset was retained for LRTP analysis. In the absence of data cleaning and complete NAICS level forecasts, the RRTPO determined that the 2045 data represented the best available future year forecast that is fully disaggregated and model compatible and have used this as an interim proxy for the 2050 scenario modeling undertaken in the Pathways to the Future: Scenario Planning Pilot (adopted in September 2024). As modeled, this represents a **0.7% difference in population** and **0.9% difference in employment** assumptions across the model region in the baseline future relative to the locality level control totals in the 2050 SE data reports.

Across the scenarios developed, the RRTPO is exploring a wide range of growth rates with approximately **29.6% difference in population** and **34.3% difference in employment** assumptions between the lowest and highest growth scenarios. Based on the 2050 socioeconomic forecast reports, the subarea covered in the RRTPO Data Report and scenarios accounts for 90% of population and 92% of employment expected across the model area in 2050 and the alternative scenarios have much greater significance and impact on the analysis of plan outcomes. Accordingly, RRTPO determined that the interim assumptions were sufficient to support planning-level evaluation, scenario testing, and comparative project prioritization for the 2050 LRTP pending receipt of a complete model-compatible forecast.

Scenario Planning Process

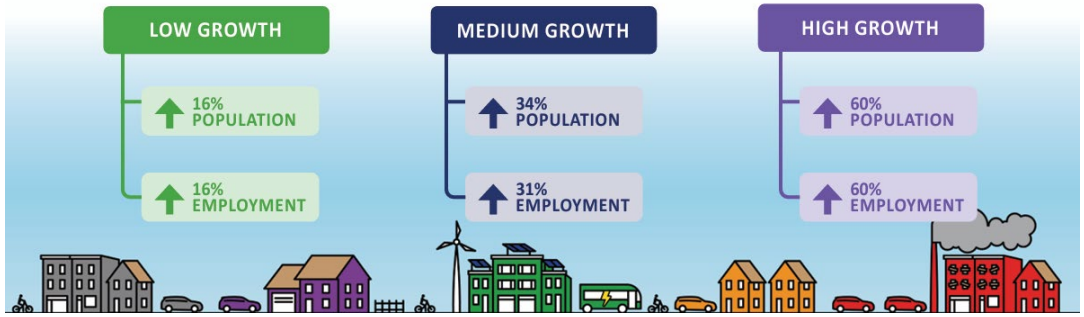


Figure 2: Growth Rates Explored in Scenarios

PlanRVA has embarked on a scenario planning process (Pathways to the Future) in recognition that point-in-time forecasts cannot adequately capture the uncertainty of the future and robust planning requires accounting for the uncertainty around growth and land use change over time. The five (5) scenarios create a range of distributions with one (1) low growth, two (2) medium growth, and two (2) high growth scenarios. The modeled growth within the entirety of the nine (9) localities served by RRTPO under each scenario is shown in the infographic. The 2050 interim proxy data was used consistently across all five (5) scenarios for the remainder of the model region.

The scenarios and tools used for the scenario planning pilot were developed over approximately 24 months culminating in final adoption by the RRTPO Policy Board at the September 5, 2024 meeting. This approval included approval of the five (5) scenarios for use in the LRTP and future planning work. Summary tables of the scenarios are shown on the following page. Beyond growth rates, these scenarios represent diverging patterns of land use across the nine (9) jurisdictions.

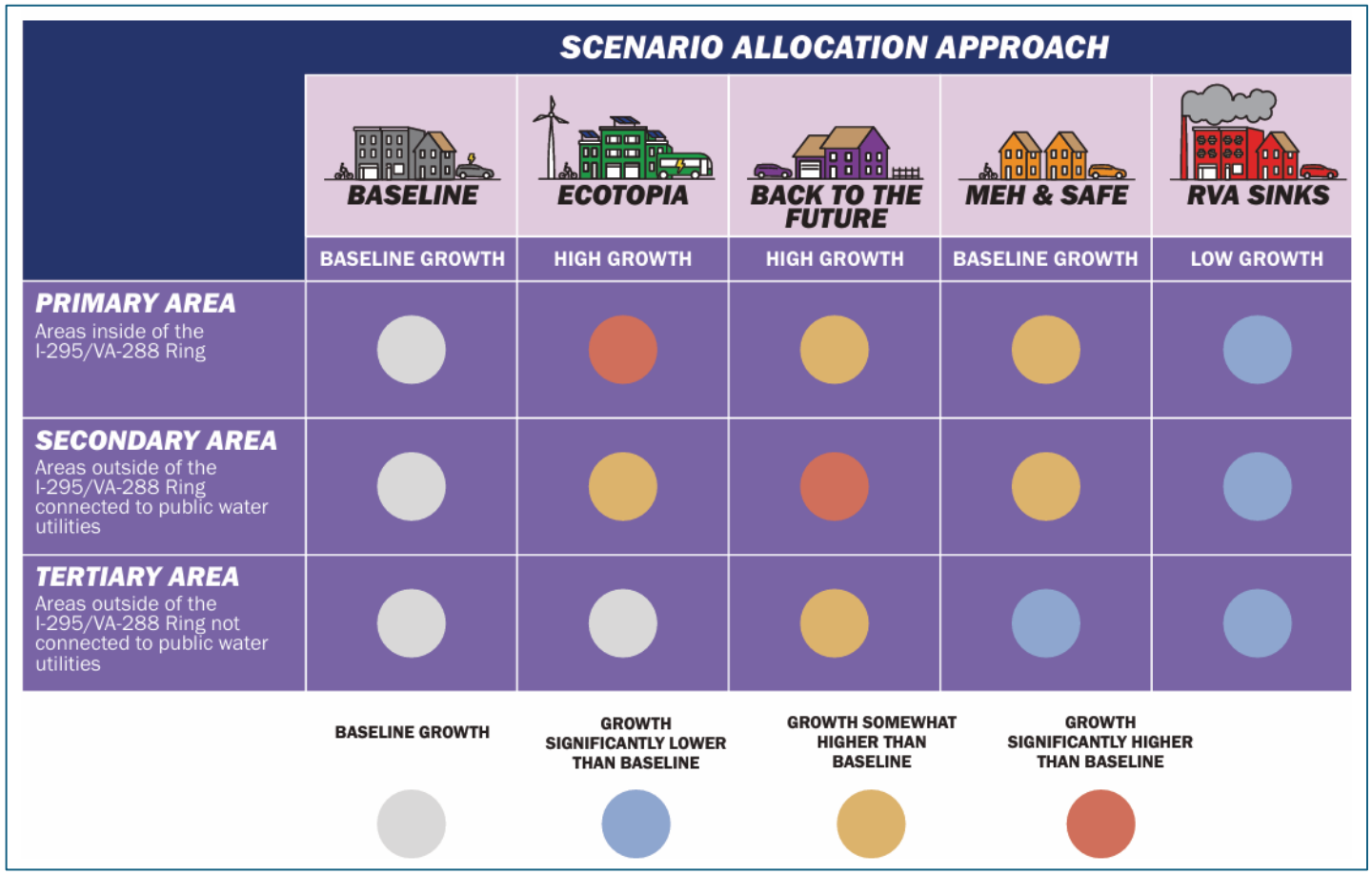


Figure 3: Growth Distribution by Scenario

	P2F Baseline	P2F RS	P2F MNS	P2F B2F	P2F Eco	2050 SE Reports
Ashland	8,306	9,963	8,483	10,863	9,514	8,306
Charles City	6,552	6,395	6,725	7,936	6,866	6,552
Chesterfield	504,814	430,720	505,939	636,917	612,217	504,814
Colonial Heights	16,794	16,794	16,794	16,794	16,794	19,646
Dinwiddie	34,725	34,725	34,725	34,725	34,725	30,477
Goochland	34,742	28,710	34,931	43,440	43,726	34,742
Hanover	133,850	121,093	132,828	159,936	146,268	133,850
Henrico	422,954	409,694	420,177	477,151	501,397	422,954
Hopewell	23,676	23,676	23,676	23,676	23,676	23,471
New Kent	36,081	32,124	36,046	51,388	41,591	36,081
Petersburg	28,646	28,646	28,646	28,646	28,646	33,280
Powhatan	39,576	35,493	38,653	50,092	43,121	39,576
Prince George	42,253	42,253	42,253	42,253	42,253	50,888
Richmond	278,538	237,352	275,872	305,073	336,580	278,538
TOTAL	**1,611,507**	**1,457,638**	**1,605,748**	**1,888,890**	**1,887,374**	**1,623,175**

Figure 4: Summary of Population by Scenario and as shown in the RRTPO and TCAMPO 2050 SE Forecast Reports

	P2F Baseline	P2F RS	P2F MNS	P2F B2F	P2F Eco	2050 SE Reports
Ashland	13,408	12,313	11,105	20,636	15,835	13,408
Charles City	1,850	1,805	1,851	2,238	1,939	1,850
Chesterfield	186,051	165,650	186,059	251,454	229,025	186,051
Colonial Heights	9,009	9,009	9,009	9,009	9,009	9,344
Dinwiddie	10,224	10,224	10,224	10,224	10,224	10,438
Goochland	21,704	19,585	21,703	33,335	26,167	21,704
Hanover	54,953	51,094	57,251	73,090	62,989	54,953
Henrico	246,718	214,059	246,718	285,666	315,344	246,718
Hopewell	7,345	7,345	7,345	7,345	7,345	7,366
New Kent	6,299	5,751	6,299	10,998	7,458	6,299
Petersburg	10,212	10,212	10,212	10,212	10,212	13,540
Powhatan	7,704	7,253	7,706	10,435	8,647	7,704
Prince George	30,355	30,355	30,355	30,355	30,355	19,422
Richmond	178,256	161,344	178,257	193,352	213,789	178,256
TOTAL	**784,088**	**705,999**	**784,094**	**948,349**	**948,338**	**777,053**

Figure 5: Summary of Employment by Scenario and as shown in the RRTPO and TCAMPO 2050 SE Forecast Reports

Performance-Based Project Prioritization

After discussions of the divergence and outstanding issues with the data with VDOT's modeling team and the Tri-Cities MPO in December 2025 and confirmation by the Tri-Cities MPO of the lack of 2050 model-compatible data for the TCAMPO planning area, RRTPO elected to continue with project prioritization for the 2050 LRTP based on relative performance comparisons across projects using the baseline future scenario, including the interim proxy Tri-Cities data. The Tri-Cities MPO agreed that the preliminary analysis would be updated upon receipt of a complete, model-compatible 2050 dataset if the Tri-Cities MPO was unable to provide updated data by early January and committed to providing a corrected, model-compatible data set as soon as possible. While absolute travel forecasts may vary modestly as socioeconomic assumptions are refined, the consistent application of the interim proxy data across all model runs supports the use of comparative performance measures for planning-level project evaluation and screening. Because the same assumptions were applied to both No-Build and Build alternatives, relative project rankings are expected to remain stable even as future socioeconomic inputs are updated. RRTPO has developed performance measure reporting that was largely confined to the MPA level, allowing initial screening to focus on results within the RRTPO planning area to the extent possible.

As with all planning processes, the project-level performance measures were not the only factor considered in project evaluation and selection. RRTPO developed four (4) alternative investment scenarios using mode, cost, and project performance. The final selection was developed based on public input, a consensus starting point from the preferred scenarios, and negotiation among project sponsors to focus on the projects most ready to advance.

System Performance Analysis

In addition to the baseline assumptions, the consensus project set was also evaluated against the future land use scenarios. These scenarios apply varying development patterns to the same transportation network and behavioral structure, allowing assessment of how the selected project set performs under different growth and land use conditions. Consistent performance across multiple scenarios demonstrates the robustness of the selected investments and strengthens confidence in the plan's long-range outcomes. This modeling process explicitly assumed uncertainty and does not report a singular future but compares each growth pattern with the no build baseline to explore how the investment performance will vary if the future develops in different ways from the baseline trajectory. The scenario analysis therefore serves as a sensitivity test of the preferred investment package,

allowing evaluation of project performance under a range of future demographic and land use conditions that exceed the variance introduced by the interim proxy assumptions.

Future Commitments and Actions

In recognition of the interim proxy nature of the Tri-Cities area inputs, the RRTPO commits to the following items within six months of receiving a complete, model-compatible 2050 socioeconomic dataset, including the required NAICS employment disaggregation:

1. Rerunning the system performance analysis and formally amending the LRTP with the updated findings.
2. Formally updating each of the five (5) future land use scenarios to incorporate the validated 2050 distributions by TAZ in Colonial Heights, Dinwiddie, Hopewell, Petersburg, and Prince George for future planning use.

Furthermore, RRTPO has taken lead responsibility for developing the 2025/2055 Socioeconomic Data & Forecast report for the entire model region in preparation of a new model development in 2027. The intent of this shift is a single forecast using a consistent process which ensures all model needs are met across the entire model area. This process is already underway with substantial completion expected by the end of this calendar year.