***-- 2/10/2020 --***

*Technical Memorandum*

# Wasatch Front Area Micromobility Toolset: Bike Demand Tools Work Plan

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The purpose of this memo is to describe the draft work plan for the selected micromobility analysis toolset based on the previously completed needs assessment and technical solution.

## Purpose, Needs, and Foundational Tools

As described in more detail in the needs assessment and technical solution memo, the purpose of the micromobility analysis toolset is to:

- Make use of growing data to improve understanding of current micromobility landscape and opportunities
- Support prioritization and decision-making for micromobility infrastructure:
    - Demand estimates/forecasts
    - First mile/last mile transit analysis
    - Understanding network and land-use related impacts
- Better accounting for micromobility travel modes in regional travel modeling
- Enhance interagency coordination of micromobility data collection and applications

The agreed upon functional needs and capabilities of the toolset are:

- Estimate and forecast demand for existing and planned micromobility facilities using demand to and from traffic analysis zones (microzones)
- Extrapolate observed user counts to overall usage statistics for existing users
- Ability to generate road/pathway network-based shortest paths
- Ability to generate travelsheds for different user types and to query socioeconomic data and amenities data layers
- Quantify relative level of network enhancement from the addition of proposed facilities
- User friendly, intuitive user interface
- Built on platform that the partners already possess

- Componentized so that additional functionality can be added from existing building blocks
- Tools have 'open' characteristics wherein tool logic, process, and codebase can be shared as much as possible so analysis can be transparent, repeatable, and is capable of being enhanced and expanded in the future
- Capabilities for automated and batch analysis
- Efficient toolset algorithms and overall runtimes

It was also decided during the needs assessment and technical solutions exercise to use the following foundational tools in the development of the toolset:

- User interface built on the ArcGIS/ArcMap platform that the partners already possess
- May make use of popular and mature open source Python packages as pandanas, networkx, scipy.sparse.csgraph
- Use the Utah Multimodal Network database developed by UDOT and the Utah Automated Geographic Reference Center (AGRC)
- Use the WFRC travel demand model data and outputs as needed
- Use microzones as the spatial fidelity for modeling micromobility travel
- Use an incremental logit model to estimate demand between zones based on changes in network accessibility improvements and/or land use

# Micromobility Toolset Work Program

The key design aspects of the micromobility toolset, as outlined in the needs assessment and technical solutions memo, prescribe a holistic approach to building the toolset's analysis functions and supporting datasets. This micromobility toolset 'work program' approach allows for specific capabilities and information resources to be built first, provided consideration is made in the design process for how the components that deliver the initial capabilities can be later adapted and releveraged, to meet additional future needs.

With this in mind, the initial tools in the micromobility toolset will be a set of general bike demand tools that focus on estimating bike demand and current and future usage. As the initial bike tools are designed and built, allowances will be incorporated that allow these tools to be adapted as much as possible, to support similar analysis for other rmicromobility modes and submodes including pedestrian trips and recreation, scooters, ebikes, and bikeshare.

The draft work program is illustrated in the table below.

| **Phase** | **Phase 1** | **Phase 2** | **Phase 3** |
|---|---|---|---|
| Focus | Needs and Solutions | Initial Bike Demand Estimation Tools | Usability Improvements, New Modes, Improved Estimates |
| Timeline | Fall 2019 | 2020 | 2021+ |

# Initial Bike Demand Tools Plan, Key Features

The initial toolset will be built to address the following features. Some of these features, particularly features associated with the behavioral engine, may be modified based on the model estimation for the incremental logit model:

- Markets and segmentation – will estimate bike trips and user segmentation by user type (casual, commuter) and period (daily, monthly, seasonal, annual, to be determined)
- Network – will use the multimodal network
- Socioeconomic data – will use microzones, Census data, and WFRC land use data allocated to microzones
- Platform – will use ArcGIS together with popular and mature open source Python packages and will use a basic approach to scenario management (for example each scenario will be self-contained and maintained in a folder on the user's hard drive)
- Integration with Travel Model – will consider model inputs and outputs such as zonal land use, existing OD trip matrices, transit network and onboard survey data, etc. It will have capability to translate output results (OD trip matrices, bike network volumes) into formats easily read by the travel model. The Travel Model does not estimate recreation-related trips so this trip type will need to be addressed separately.
- Timeframe – will be the year the input data represents
- Scale – will be the entire WFRC/MAG region by default with the ability to select a subset of microzones that represent the study area (or area of impact). While we see this as critical functionality, there are different ways to accomplish it. We acknowledge risks related to different views on how the toolset will accommodate user-specified scale needs. The benefit of subarea selection is runtime performance of the toolset.
- Behavioral engine – will be an incremental logit that estimates bike demand between microzone OD pairs based on characteristics of demographics, land use and transportation facilities.
    - Access to regional recreation pathways and trailhead connections to non-paved recreation opportunities if in the network
    - Presence of bike and scooter share services if data is provided
    - Proximity to transit stations and stops and the comparative opportunities they present to pair bike travel with medium to long length transit service
    - Proximity of key amenities such as schools, parks, grocery stores, community centers, urban and neighborhood centers if in the land use data
    - For each microzone, a network-based travelshed will be generated for different level-of-stress users
    - Elevation change and other grade-level issues

# Initial Bike Demand Tools Work Tasks

The suggested work tasks are broken into two phases and seek to engage WFRC/MAG in developing the initial bike demand tool data set.

**Phase 2 Work Effort**

| Task | RSG Hours | RSG Cost | WFRC/MAG Hours |
|---|---|---|---|
| Task 1: Project management | 26 | $6,000 | |
| Task 2: Model Design and Configuration (RSG lead) | 110 | $20,000 | |
| Task 3: Data Design Consultation and Data Development (WFRC/MAG lead) | 16 | $3,200 | 180 |
| Task 4: Initial Platform Implementation (RSG lead) | 200 | $28,000 | 160 |
| Task 5: Model Validation (RSG lead) | 50 | $10,000 | |
| Task 6: Documentation & Training (WFRC/MAG lead) | 16 | $2,800 | 80 |
| Total | 418 | $70,000 | 420 |

Task 1: Project Management - This task consists of bi-weekly check ins to monitor project progress. Ongoing PM duties including project invoicing and coordination.

*Task 1 Deliverables: Monthly progress reports and invoices. Task 1 Completion: 5 months from NTP.*

Task 2: Model Design and Configuration - This task involves the creation of the behavioral model and its connection to the Multimodal Network and ArcMap software. Model development will be conducted in conjunction with Task 3, where relevant input data are developed. RSG will prepare an initial model design that incorporates our understanding of existing data sources for WFRC comment. RSG will collaborate with WFRC to finalize the design incorporating WFRC comments. RSG will review existing bike route choice / behavioral models such as AMBAG, SFCTA, and Oregon Metro, and propose a starting point for the bike demand model. The bike demand model will be revised and finalized based on available data and WFRC needs.

*Task 2 Deliverables: Technical memo on model design and bike demand model development. Task 2 Completion: 1 month from NTP.*

Task 3: Data Design, Consultation and Data Development - RSG will assist WFRC with the development of the data as specified in the model design. This will be pursued iteratively with Task 2 as varied model inputs are evaluated toward a final model. The data design will address the data update process as well.

*Task 3 Deliverables: Final micromobility toolset data set. Task 3 Completion: 2 months from NTP.*

Task 4: Initial Platform Implementation - RSG will lead development of the software tool, integrating the behavioral model and routing engine with the multimodal network in ArcMap. The tool will include the following components:

- ArcGIS Toolbox UI / Geoprocessing Environment (WFRC/MAG lead)
- Data Management (WFRC/MAG assist)
- Calculation of Model Inputs, Variables (RSG lead)
- Behavioral Model (RSG lead)
- Network Routing (RSG lead)
- Reporting (WFRC/MAG lead)

RSG will set up the software development environment including arcpy, python and WFRC's GitHub presence. RSG will work with WFRC to develop a test example for illustrating toolset functionality to be used in training (Task 6). WFRC/MAG will focus on the front-end and data management and RSG will focus on the behavioral engine and network routing. Open data formats will be used for component data exchange to ensure efficient collaboration. RSG will develop each component in an Agile fashion. Upon initial version of the toolset, RSG will make improvements as the task budget allows.

*Task 4 Deliverables: Toolkit functionality, Github repository, working example. Task 4 Completion: 4 months from NTP.*

Task 5: Validation - RSG will validate and adjust the preliminary model by comparing available bike demand data (regional bicycle counters (SLC, MAG, UDOT) and STRAVA) to model estimates. RSG will make improvements as the task budget allows.

*Task 5 Deliverable: Tech memo on model validation. Task 5 Completion: 5 months from NTP.*

Task 6: Documentation and Training - RSG will assist WFRC/MAG with the development of training materials for a training session for regional stakeholders.

*Task 6 Completion: 5 months from NTP.*

# Suggested Next Phase Work Items

Phase 3 is focused on improvements to the initial tools, development of new features, and the addition of new modes. Suggested work items for phase 3 include:

- Project management
- Small revisions based on feedback
- On-call application support
- Additional market segmentation by mode, user type

- Updated calibration and validation to new data sets
- User experience enhancements such as improved scenario management, error handling / input checking, reporting / visualization, etc.