Technical Memo

To: SHRP2 - C10 Tri-Agency Project Implementation Files

From: Elizabeth Sall, Technical Lead

Diana Dorinson, Project Manager

Date: April 7, 2015

Subject: Proposed Workplan

---

0. Summary

The following technical memo documents the updated workplan for the SHRP2 - C10 Project. This memo has three main sections:

1. The Management Workplan section describes the approach for providing on-going direction and oversight of the project. It includes a description of the project's management team structure, the tools and techniques that the project team will use, and a summary of policies that the management team has agreed to use to resolve issues that may arise over the course of the project.
2. The Technical Workplan is a detailed summary of all activities required to complete the scope of work. This section includes a description of each of the formal tasks and their planned sub-tasks together with a listing of the associated staff resources, interim milestones, and final deliverables. Key dependencies between tasks have also been highlighted.
3. The revised budget and updated schedule are attached as a separate Excel file.

1. Management Workplan

This section describes the approach for providing on-going direction and oversight of the project. The project management activities for this project are formalized within the overall workplan as Task 1, which is summarized at the end of this Management Workplan section.

Management Team

This multi-agency project has a management structure composed of five individuals performing six different roles: a Project Manager, a Technical Lead, an Administrative Lead, and three Agency Leads.

Project Manager:

Diana Dorinson of Transportation Analytics

The Project Manager is responsible for monitoring and reporting on the progress of the project as a whole. Specific activities will include:

- Preparing for and running Management Team meetings
- Tracking of the overall scope, schedule, and budget
- Monitoring and reporting on project performance measures
- Preparing quarterly reports to be submitted to FHWA
- Tracking status of deliverables and monitoring QA/QC efforts
- Formal role as leader of Task 1, Project Management

Technical Lead:

Elizabeth Sall of UrbanLabs LLC

The Technical Lead will monitor and synchronize the efforts of technical staff on the project. Specific activities will include:

- Providing input on technical approaches, standards, and methods
- Coordinating the schedule & dependencies of work across tasks
- Regularly meeting with technical task leaders to ensure appropriate progress
- Managing progress towards interim milestones and final deliverables
- Leading development of all communications & outreach materials
- Coordinating involvement of academic community and other
- Formal role as leader of Task 9, Communications & Outreach

Administrative Lead:

David Ory of MTC

The Administrative Lead handles grantee activities that cannot be executed by the independent contractors who are acting in the Project Manager and Technical Lead roles. Specific responsibilities will include:

- All grantee paperwork with FHWA & Caltrans
- Administration of funding agreements with partner agencies
- Procurement & administration of directly sub-contracted resources
- Preparation & submission of invoices
- Formal submission of quarterly reports and deliverables to FHWA

Agency Leads:

David Ory of MTC, Joe Castiglione of SFCTA, and Billy Charlton of PSRC

Each of the three partner agencies has designated a Project Management Lead who has authority over their agency's participation in the project. Jointly, these three Agency Leads will also act as the final arbiters of key technical decisions that must be made during the project, as described below under "Decision-making Framework". Individual administrative responsibilities will include:

- Contracting & procurement
- Financial management and monthly reporting/invoicing

- Internal resource allocation and staffing levels
- Providing access to computational resources, needed data
- Providing input on—and ultimately final approval of—all technical approaches, standards, and methods

Decision-making framework

Purpose and Need

Over the course of the joint SHRP2 - C10 implementation project between MTC, SFCTA, and PSRC, there are a number of issues that should be subjected to joint agreement. These issues span from data standards and software approaches to data choices and estimation results and specifications. This document discusses both how these joint decisions will take place as well as what will be subjected to joint agreement.

Process for joint decision-making

The process for joint decision-making involves the following steps:

1. **Identify Agreement Points:** The Technical Lead, in consultation with the management team, identifies issues requiring joint agreement in Asana
2. **Propose Approach to Technical Team:** For each agreement point outside of Project Management, the responsible Task Leader will circulate a proposed approach to the Technical Team with enough documentation to evaluate it and understand the benefits and drawbacks.
3. **Update Proposed Approach based on Technical Feedback:** If necessary, the responsible Task Leader will work with the Technical Lead to resolve the issues and update the proposed approach.
4. **Propose Approach to Management Team:** The responsible Task Leader will submit an updated proposed approach to the Management Team with enough documentation to evaluate it and understand the benefits and drawbacks
5. **Conduct Management Team Decision Process:** Management Team will respond to the Task Leader and Technical Lead with any concerns or proposed changes to the proposed approach within a week (or sooner if needed and agreed to). Agreement should be made by consensus. If the majority of the Management Team reaches agreement at the end of the week time-frame, the proposal and any changes will be considered "accepted," or "accepted, with adjustments." If sufficient response has not been received, or there are areas of disagreement among the Management Team, the Technical Lead or Project Manager will convene a discussion in order to try and reach an agreement. If the Management Team fails to reach consensus at the end of this discussion, there will be a vote whereby majority of the Management Team (comprised of David Ory, Joe Castiglione, and Billy Charlton or their proxies) will rule.
6. **Document Finalized Agreement:** The responsible Task Leader amends the approach based on the comments in consultation with the Technical Lead and finalizes the documentation.

Information to be provided for each agreement point

While each agreement point will be slightly different, generally speaking responsible Task Leaders should document the following areas so that the Technical and Management Teams have the information they need:

- Objectives and considerations
  - what are you trying to achieve?
  - what do we need to consider in this decision?
  - what other tasks are affected?
- Existing solutions / Background (may not be applicable to all issues)
  - what is already out there?
  - what are strengths/weaknesses w.r.t. our objectives?
- Methodology/Process used (may not be applicable to all issues)
  - i.e. if it is a model estimation, then this might include a description of the alternative specifications tried out and the estimation method
- Proposed approach/standard/specification
  - what details need to be approved?

What requires joint agreement

The Technical Lead will attempt to identify all the tasks that will require joint agreement in the beginning of the project and highlight these via the "Joint Agreement" tag in Asana. The Technical Lead will run this list by the Management Team and ask for feedback.

Generally speaking, the following issues require joint agreement:

- Data standards
- Data selection
- Market segmentations
- Estimation results
- Communication materials

However, it is likely that over the course of the project other issues will arise that should be subjected to joint agreement. The Technical Lead and Project Manager will monitor the tasks on Asana and discussions in order to flag such issues.

Management Tools

The project team is using a variety of web-based tools to facilitate collaboration and efficient coordination of work activities across the partner agencies:

- Asana - Common project management platform used to assign and track small-scale tasks, document on-going staff-level discussions and issues, and keep project team informed.
- Google Docs - Collaborative document editing for work-in-progress content.
- Box - Document repository for data storage and archive of completed and/or approved project materials.
- Github - Public code repository and software development platform, including bug/issue-tracking.

QA/QC Plan

Purpose and Need

Over the course of the joint SHRP2 - C10 implementation project between MTC, SFCTA, and PSRC, multiple types of work products will be generated. Some work products will document internal work-flows and intermediate decisions, while others will be formal deliverables that will be written for an external audience and submitted to FHWA. All work products are expected to be of a professional quality and appropriate to their purpose and audience, and they will be reviewed by relevant technical staff and the Technical Lead as they are developed to ensure consistency and coordination across tasks. Formal project-level QA/QC review is reserved for those work products intended for external audiences, including Code, Communications & Outreach Materials, and FHWA Deliverables. This document describes the process by which each of these three types of work products will be reviewed and approved.

Work Products Subject to QA/QC

While all work products will be reviewed for quality and consistency, certain types of work products will be subject to structured QA/QC review, as summarized in Table 1, and described in more detail below.

Table 1 - QA/QC Steps by Work Product Type

Type of Work Product	Technical Team Review?	Project Manager Review?	Management Team Review?
Code	YES - with testing framework and code review	No	No
Communications/ Outreach	YES - If Technical Lead is not primary author	YES - Conducts review of Technical Lead work products	YES - After Technical Lead and/or Project Manager Reviews
FHWA Deliverable	YES - Outline and Draft version	YES - Outline and Draft version	YES - Draft version only

Code and Software Tools

Multiple pieces of code will be generated over the course of this project, both processing tools to manipulate data inputs and outputs and also implementation of the revised code-base within the regional models. Code must be tested and reviewed to ensure adequate functionality and appropriate interactions between software components. Each Task Leader responsible for code will develop and execute an appropriate testing framework. All code authors will use Github "pull requests" to initiate external review of their contributions before the code is incorporated.

Communications and Outreach Materials

Many project activities will be documented for the academic community and practitioners through communications and outreach materials such as a public-facing website, fact-sheets, research papers, and conference presentations. Each of these items will be reviewed prior to publication. For materials produced by the technical staff (e.g., research paper), the Technical Lead will conduct QA/QC review. For materials where the Technical Lead is the primary author (e.g., website content), the Project Manager will conduct the QA/QC review, involving other technical experts in the review, as appropriate. Following this initial review, the Management Team will have an opportunity to review & comment on the draft before it is finalized. The Project Manager will coordinate the review cycle between the Technical Team and the Management Team.

FHWA Deliverables

These work products are specifically designated in our work-plan and within Asana task listings. All FHWA deliverables will be subject to QA/QC review prior to submission, and will pass through three distinct phases. At each stage, the Project Manager will monitor comments and concerns raised, and ensure that all items are appropriately resolved before the document proceeds to the next stage:

1. **Outline** -- Prior to commencing work on producing any formal deliverable, the Task Leader will use a defined deliverable template to develop an outline of the proposed document content for review by the Technical Lead and Project Manager. After consultation with the Technical Lead and Project Manager, the Task Leader solicits written material from one or more authors and compiles the materials into a Draft.
2. **Draft** -- The draft version of the document will be reviewed by the Technical Lead and other members of the Technical Team, including the project's technical advisors, as well as the Management Team. The Project Manager will coordinate disposition of reviewer comments within the project team. Once this review is complete, the document will be transmitted to FHWA.
3. **Final** -- After receiving comments from FHWA, the Project Manager will coordinate a final round of edits to incorporate any requested changes. The deliverable then becomes final, and is made part of the project archive.

QA/QC Principles

When conducting a QA/QC review, readers will assess the following considerations:

- The technical information presented must be clear, concise, and complete.
- The approach, methods, and findings should be sufficiently explained that a reader who is uninvolved with the project can understand the majority of the details.
- The document should clearly refer the reader to any references or external sources where more information is available.

Contingency Plan and Risk Mitigation

Purpose and Need

Over the course of the joint SHRP2 - C10 implementation project between MTC, SFCTA, and PSRC, there may be a need to adjust the staffing and/or budget from the originally approved workplan. This document describes the steps that have already been taken to prepare for this possibility and the actions that should be pursued in the event of a need to deviate from the plan.

Key Risks

The risks associated with this project fall into two main areas: staffing availability and resource consumption. In the first case, staff resources allocated to this project may be diverted away from the project due to higher near-term priorities that arise at one or more of the local agencies. In the second case, there is a risk that certain unknowns about the project inputs or assumptions will lead to an excessive amount of testing & re-working.

Either of these issues could delay progress and make it difficult to complete the scope of work within the grant timeline and/or budget. The management team has made a commitment to monitoring project task status with these concerns in mind. Agency leads are aware of the potential need to make adjustments to the original plan to keep the work moving along, and they are prepared to activate the Decision-Making Framework to resolve any concerns or issues that are raised.

Staffing Contingency

Several steps have been employed to maintain sufficient staff resources on the project. First, the use of independent contractors for the Project Manager and Technical Lead roles will facilitate cross-agency coordination throughout the project and reduce the chance that work is delayed by the individual ups and downs of any one agency. Second, an alternate task leader has been identified for each technical task, so that if the task leader is pulled away, someone else is up to speed on the details and can help maintain continuity. Third, if junior staff become unavailable for a short time, the Agency Lead will make a decision about replacing them other another member of their agency team. Finally, MTC is currently procuring on-call resources who could be tasked with backfilling any staffing gaps that are expected to be significant.

Depending on the magnitude of a staffing change and the particular individuals involved, a budget re-allocation between agency partners may be necessary to make any of the above options work. This would be discussed using the standard Decision-Making Framework.

Budget Contingency

There are multiple reasons why the total budget needed to complete this project may not map exactly to the original approved workplan. In some cases, there may be a need to spend more time and effort on a particular sub-task than anticipated in the budget. In other cases, staff resources at different billing rates may need to be swapped in to complete tasks on time.

At this time, the Revised budget estimate is lower than the Baseline budget submitted with the grant application. The difference between the $700,000 Federal grant and the current estimate of FHWA-reimbursable costs is $21,249. This represents just over 3% of the current estimate of the total FHWA-cost. Though not large, the Management Team recognizes that designating this amount as a contingency budget would enable the team to fund the FHWA-reimbursable portion for minor amounts of additional labor that may become necessary. In addition, all three partner agencies have expressed their willingness to contribute some additional in-kind support if it would help bring the project to a more successful conclusion.

The Project Manager and Technical Lead will regularly monitor progress and flag any tasks which are approaching their approved budget. If the task cannot be fully completed using the remaining budget, they will make a proposal to bridge the gap in one of three ways: (1) access the contingency, (2) request in-kind labor, or (3) adjust task scope & work products. The Management Team will act on the proposal using the standard Decision-Making Framework.

Task 1: Project Management & Technical Oversight

This task includes the day-to-day activities that facilitate the execution of the technical work plan. The Management Team will provide administrative support, monitor and report on progress, and ensure the work is documented in quality deliverables. This task also includes project-wide technical guidance provided by the Technical Lead and the three Agency Leads, namely the coordination of work across tasks & agencies and the review & approval of key technical decisions at designated Agreement Points.

This task is being managed by: Diana Dorinson of Transportation Analytics
With help from:

- Elizabeth Sall of UrbanLabs LLC
- David Ory of MTC
- Joe Castiglione of SFCTA
- Billy Charlton of PSRC

The overall Budget is:

- $446,715

Interim milestones include:

- Technical memo describing workplan (this document)
- Executed contracts, MOUs, and partner funding agreements
- Monthly Management Team Updates (status of labor, budget, schedule)
- Monthly Invoices (partner agencies submit to MTC; MTC submits to FHWA)
- Performance Measures Updates (part of Quarterly Progress Reports)
- Quarterly Progress Reports FHWA Deliverable
- Future Directions document FHWA Deliverable Agreement Point

2. Technical Workplan

Overall Task Organization

Task 2: Transit Network Supply

This task encompasses the development of schedule-based transit networks in both regions, access and transfer links, and any setup or maintenance tools to facilitate the continued use of the tool. The task includes the following subtasks:

A. Transit network creation and synthesis
B. Transit network conflation
C. Additional transit variables
D. Transit networks for various scenarios
E. Final documentation

This task is being managed by: Stefan Coe of PSRC
With help from:

- Drew Cooper of SFCTA
- Additional contractors or agency staff

And advisory support from:

- Lisa Zorn of MTC
- Alireza Khani of CTR

The overall Budget is:

- $64,817

A - Transit network design and synthesis

This subtask's overall goal is to decide on a standard for Fast-Trips transit network input and produce an approach for synthesizing and combining GTFS feeds into this standard input format. Items that will need to be ironed out in the network design include:

- Fast-Trips needs
- Fares
- Network mode attributes
- Mode choice modes
- Demand resolution and access/egress link generation
- Transfer link generation
- Drive access links and park and ride lot representations

Each of these will need to be discussed with Task 4, Task 6, and Task 8.

Interim milestones include:

- Network design Agreement Point
- Standard for transit network input into Fast-Trips Agreement Point Standard

- Approach for synthesizing and combining transit network feeds Agreement Point
- Completed and tested transit network creation process Code

B - Transit / highway network conflation

This subtask's overall goal is to develop a methodology and process by which the variables developed on the roadway network (i.e. travel time) can be translated to the transit networks and vice versa. This includes the access link and demand-geometry relationships (i.e. MAZs or TAZs).

Interim milestones include:

- Approach for transit and highway network conflation Agreement Point
- Working and tested highway and transit network conflation and interaction process Code

C - Additional Transit Variables

This subtask's overall goal is to create additional transit variables that can be used in the transit route choice utility equation (i.e. dwell time, reliability, and crowding), and a working and tested process for getting them into Fast-Trips input. All new variables should be able to be created endogenously within the model process for both base and future year scenarios, unless being used to control for covariance or if reasonable assumptions about the future can be made.

Interim milestones include:

- Estimated dwell time model from APC data Agreement Point
- Methodology and data standards for reliability Agreement Point Standard
- Methodology and data standards for crowding Agreement Point Standard
- Working and tested process for getting additional transit variables into Fast-Trips and route-choice estimation Code

D - Transit network inputs for various scenarios

This subtask's overall goal is to develop the inputs for the various needed scenarios for the project.

Interim milestones include:

- Small test case network
- Base year networks
- Sensitivity test networks

E - Final Documentation

This subtask's overall goal is to finalize the documentation and make sure other members of the project team understand the final results of this task.

Interim milestones include:

- Final Tech Memo on Transit Networks FHWA Deliverable Agreement Point

Task 3: Transit Demand for Calibration

This task will validate, test, and adjust disaggregate transit demand data from the two regions using available observed data in order to ensure the demand inputs for Fast-Trips calibration are consistent with observed behavior. This will allow us in the calibration phase to ascertain the **network model deficiencies**, and not confound them with demand issues.

The task includes the following subtasks:

A. Define input standard for demand into Fast-Trips
B. Demand adjustment methodology development
C. Demand adjustment tool development
D. Transit demand input for various scenarios
E. Transit demand for test cases
F. Finalize documentation

This task is being managed by: Dan Tischler of SFCTA
With help from:

- Brice Nichols of PSRC
- Alireza Khani of CTR
- Additional contractors or agency staff

And advisory support from:

- Lisa Zorn of MTC
- Mark Hickman of University of Queensland

The overall Budget is:

- $75,389

A - Define input standard for demand into Fast-Trips

This subtask's overall goal is to decide on a standard for Fast-Trips demand input including considerations surrounding time of day and market segmentation. Decisions regarding both demand market segments and time of day should take into account the ability to aggregate them and feed the existing log-sums back up through the model chain.

Interim milestones include:

- Approach for transit demand market segments Agreement Point
- Approach for time of day Agreement Point
- Data standard for Fast-Trips input Agreement Point Standard

B - Demand adjustment methodology and validation targets

This subtask's overall goal is to develop a methodology to adjust demand to more accurately reflect observed transit demand data, and to develop a set of demand validation targets.

Interim milestones include:

- Demand validation Targets Agreement Point
- Demand adjustment approach Agreement Point

C - Demand adjustment tools

This subtask's overall goal is to develop a set of tools that will implement the demand adjustment methodology approved in task 3-B.

Interim milestones include:

- Working and tested process for scaling ABM output to observed transit demand Code
- Working and tested process for adding variables that may not exist in ABM Code

D - Validated regional base year transit demand

This subtask's overall goal to develop validated base year demand inputs for Fast-Trips for use in the overall calibration of the overall network (Task 8).

Interim milestones include:

- Raw base year demand
- Validated base year demand Agreement Point

E - Transit demand for unit tests and subarea sensitivity tests

This subtask's overall goal to develop the Fast-Trips demand inputs for the unit-testing network, which will be used to test the software (Task 6), and the sub-area sensitivity test that will be used to evaluate the reasonableness of the transit route choice model (Task 4). It is anticipated that the base year version of the subarea sensitivity tests can be taken from Task 3-D.

Interim milestones include:

- Fast-Trips input for Unit-Test network
- Fast-Trips input for base subarea sensitivity test network
- Fast-Trips input for scenario subarea sensitivity test network

F - Final Documentation

This subtask's overall goal is to finalize the documentation and make sure other members of the project team understand the final results of this task.

Interim milestones include:

- Final Tech Memo on Transit Demand FHWA Deliverable Agreement Point

Task 4: Transit Rider Behavior

This task includes the data development from the observed transit route choice and the estimation and calibration of route choice models capable of capturing appropriate heterogeneity and sensitivity of transit rider behavior. This task will be informed by SFCTA's past experience estimating a bicycle route choice model and CTR's past experience estimating a transit route choice model in Austin.

The task includes the following subtasks:

A. Background research and model estimation approach
B. Estimation dataset creation
C. Estimate route choice model
D. Calibrate route choice model
E. Finalize documentation

This task is being managed by: Suzanne Childress of PSRC
With help from:

- Lisa Zorn of MTC
- Stefan Coe of PSRC
- Alireza Khani of CTR
- A PSRC Intern
- Additional contractors or agency staff

The overall Budget is:

- $63,108

A - Background Research and Model Estimation Approach

This subtask will conduct background research and review available datasets in order to develop a proposed transit route choice model estimation approach. In addition to summarizing the policies and factors that the model should reflect (the explanatory and forecasting objectives), the estimation approach should include: estimation datasets, choice set generation methodology, level of service variables, time of day categories, market segments, and estimation software. Market segments and time of day variables should be developed in conjunction with Task 3 and 6. Level of service variables should be developed in conjunction with Task 2 and 6 to make sure they can be appropriately calculated by Fast-Trips. Choice set generation should be developed in conjunction with Task 6.

Interim milestones include:

- Literature review and background research on applied route choice modeling.
- Approach for transit route choice estimation Agreement Point

B - Estimation Dataset Development

This subtask will clean, summarize, document, and format an estimation dataset for the route choice model. It will involve two components: revealed transit route choice data by market segment, and level of service data for the choice set. The development of the choice set data will happen within Fast-Trips and depends on the substantial completion of several milestones in Task 6 and Task 2.

Potential fall-back: If the new version of Fast-Trips is not yet ready, it may be possible to execute the first round of this task using the existing version of the model. However, this would likely preclude the use of new level of service variables.

Interim milestones include:

- Cleaned and formatted revealed choice dataset Code
- Fast-Trips-generated route choice set
- Finalized estimation dataset

C - Estimate Transit Route Choice Model

This subtask estimates transit route choice models using the methodology in Task 4-A and dataset developed in Task 4-B. While it is anticipated that many rounds of model specifications will be tested, the Task Leader should summarize an initial set of estimations for Management Team review and feedback and then another, final set of proposed estimations. The final step for this task is to update the Fast-Trips input parameters with the agreed-upon estimation results.

Interim milestones include:

- Summarized and documented first set of route choice estimation result Agreement Point
- Summarized and documented proposed final route choice estimation results Agreement Point
- Fast-Trips inputs that reflect the segmentations, variables, and parameters

D - Calibrate route choice model sensitivity

This subtask will use the estimation results developed in Task 4-C, and test the appropriateness of the sensitivity relative to observed data. There will be two sensitivity tests of two subareas - one each in the Puget Sound and Bay Area with enough observed data from each (from Task 5) to validate the model. These tests will be developed and organized by the Task 7 leader. This task can use validation parameters developed by Task 5 and 8 to assess if an updated estimation is necessary.

Interim milestones include:

- Complete initial sensitivity tests and evaluate model performance Agreement Point
- Conduct additional estimation, if necessary Agreement Point
- Update estimation documentation

F - Final Documentation

This subtask's overall goal is to finalize the documentation and make sure other members of the project team understand the final results of this task.

Interim milestones include:

- Final Tech Memo on transit route choice FHWA Deliverable Agreement Point

Task 5: Transit Performance Data

This task includes the collation, evaluation, and packaging of transit performance data that will be used to evaluate the performance of the modeling system.

The task includes the following subtasks:

A. Collate, evaluate, and describe available transit performance data
B. Develop transit performance data standards and tools
C. Process and package transit performance data
D. Finalize documentation

This task is being managed by: Drew Cooper of SFCTA
With help from:

- Brice Nichols of PSRC

The overall Budget is:

- $42,303

A - Collate, evaluate and describe available transit performance data

This subtask will reach out to various transit operators and obtain transit performance data based on the identification of the base year and sensitivity scenario determined by Task 7. It is anticipated that at a minimum, we will need information on travel times (dwell, stopped, moving), boardings, alightings, reliability, and crowding/vehicle types. Many of these data will require coordination with the transit network creation standards in Task 2 (i.e. reliability, dwell times, vehicle capacities, crowding). A subset of this data needed by Task 3 will be prioritized for earlier delivery. Finally, this subtask will evaluate and describe the data they have obtained.

Interim milestones include:

- Identify rush order needs for Task 3
- Obtain data from both Puget Sound and Bay Area
- Written evaluation of data from both Puget Sound and Bay area

B - Develop transit performance data standards and tools

This subtask will develop a data standard that will balance the desire to evaluate the numerous degrees of freedom in the model system with the robustness of the available observed data, legibility of the implied validation report, and manageability of the dataset. The subtask will then develop a set of tools to process the raw data and create data that adheres to this standard.

Interim milestones include:

- Develop transit performance data standard Standard Agreement Point
- Working and tested code to clean and process raw transit performance data Code
- Working and tested code to create standard transit performance dataset Code

C - Process and package transit performance data

This subtask uses the tools developed in task 5-B and the data obtained in task 5-A to process the raw datasets into the standard performance data to be used in validation of both the base and sensitivity cases. These will be used by task 4-D to evaluate the sensitivity of the estimated route choice model.

Interim milestones include:

- Standardized performance data for Bay Area and Puget sound base case scenarios
- Standardized performance data for Bay Area and Puget sound sensitivity case scenarios

D - Final Documentation

This subtask's overall goal is to finalize the documentation and make sure other members of the project team understand the final results of this task.

Interim milestones include:

- Final Tech Memo describing transit performance data development FHWA Deliverable Agreement Point

Task 6: Software Implementation

This task includes the implementation of code, including the development of new features required for dynamic transit assignment.

The task includes the following subtasks:

A. Refactor one version of Fast-Trips to Python: Pfast-Trips
B. Combine and add other feature branches to Pfast-Trips
C. Implement multi-class assignment feature
D. Implement skimming and choice set generation capabilities
E. Indicator Library
F. Finalize documentation

This task is being managed by: Billy Charlton of PSRC
With help from:

- Lisa Zorn of MTC
- Stefan Coe of PSRC
- Brice Nichols of PSRC
- Joe Castiglione of SFCTA
- Alireza Khani of CTR
- Mark Hickman of University of Queensland

The overall Budget is:

- $86,602

A - Refactor one version of Fast-Trips to Python: Pfast-Trips

This task will take the existing c++ code base and port it to Python. Conversion to Python will widen the Fast-Trips user base and make collaborative development easier. The existing code base is 4,000 lines and translation to Python will be advised by the original Fast-Trips developer. After an initial port, some performance and usability upgrades will be implemented including an update to use the input standards developed in Task 2 and Task 3. Performance is not paramount at this stage, but it should not be deal-breakingly slow.

Interim milestones include:

- Working and tested Pfast-Trips for existing Fast-Trips inputs Code
- Working and tested Pfast-Trips for proposed Fast-Trips inputs Code

B - Combine and add other feature branches to Pfast-Trips

This subtask will scan other versions of Fast-Trips for features that should be implemented in Pfast-Trips and implement those that warrant further use. It is thought that park and ride trips will be one of these features. This task will also develop some control methodology to allow users to exercise certain features.

Interim milestones include:

- Proposed list of features to implement from other Fast-Trips versions Agreement Point
- Working and tested additional features in Pfast-Trips Code

C - Implement multi-class assignment feature

This subtask will research and implement the ability to perform multi-class assignments in Fast-Trips.

Interim milestones include:

- Working and tested multi-class assignment feature in Pfast-Trips Code

D - Implement skimming and choice set generation capabilities

This subtask will research and implement skimming and choice set generation capabilities in Fast-Trips. Skimming is necessary in order to obtain network-level features such as crowding, fares, travel times, and reliability. Methods for calculating these variables across the network will be developed in Task 2, but this task will implement them into Pfast-Trips. This task needs to be complete in order for the estimation to begin for Task 4. Choice set generation capabilities may already exist in Fast-Trips.

Interim milestones include:

- Propose approach for skimming and choice set generation Agreement Point
- Working and tested skimming and choice set generation feature in Pfast-Trips Code

E - Indicator Library

This subtask will develop an indicator library including off-the-shelf data summary scripts including, but not limited to the needs of the Task 8 validation strategy.

Interim milestones include:

- Proposed indicators Agreement Point
- Working and tested indicator library code Code

F - Final Documentation

This subtask will finalize the quick start guide and clean up any in-line documentation needs.

Interim milestones include:

- In-line documentation setup (i.e. Sphinx)
- Quick start users guide for Fast-Trips FHWA Deliverable Agreement Point

Task 7: Test Case Development

This task includes the specifying and management of various scenarios used for testing software validity and model performance.

The task includes the following subtasks:

G. Establish test case objectives
H. Scenario selection
I. Scenario development
J. Finalize documentation

This task is being managed by: Dan Tischler of SFCTA
With help from:

- Stefan Coe of PSRC

The overall Budget is:

- $13,414

A - Establish test case objectives

This subtask will determine the needs of several categories of test case in consultation with other task leaders:

- **small unit-test scenario** that will be small enough to run software unit tests on and understanding the algorithms used
- **subarea base scenarios** for both the Puget Sound region and Bay Area region, which will be used to evaluate the performance of the network creation tools of Task 2 and the static validation of the route choice model developed in Task 4 (when compared with the transit performance data collected in Task 5).
- **subarea sensitivity test scenarios** which will be used to determine the appropriateness of the Task 4 route choice models when compared with the Task 5 validation data.

Interim milestones include:

- Test case objectives and needs documentation Agreement Point

B - Scenario Selection

This subtask will compare the objectives and needs developed in Task 7-A with the available data (in consultation with Task 2, 3, 4, and 5) to define each of the test case scenarios. This will

determine the data that gets refined from each of the other tasks as well as the validation scenario.

Interim milestones include:

- Defined unit-test scenario Agreement Point
- Defined validation year in Bay Area and Puget Sound Agreement Point
- Defined base/sensitivity subarea scenarios in Bay Area Agreement Point
- Defined base/sensitivity subarea scenarios in Puget Sound Agreement Point

C - Test Scenario Development

This subtask organizes and manages the development of the test scenarios defined in Task 7-B. While the small unit-test scenario will be developed in this task, other scenarios will be created in Tasks 2, 3, and 5 and simply managed via this task. This task may need to be performed iteratively as other tasks are in motion. The leader of this task will monitor and make updates as necessary.

Interim milestones include:

- Unit-test scenario for use in Task 6
- Base case subarea scenarios for validating Task 2 scripts and validating initial route choice modelling in Task 4
- Sensitivity test subarea scenarios for validating the sensitivity of the models developed in Task 4.
- Documentation of performance of subarea sensitivity tests.

D - Final Documentation

This subtask will finalize the documentation and make sure other members of the project team understand the final results of this task.

Interim milestones include:

- Final Tech Memo describing test cases and sensitivity test results FHWA Deliverable Agreement Point

Task 8A: SFCTA Implementation and Testing

This task includes the implementation, testing, and calibration Fast-Trips into the SF-CHAMP model system.

The task includes the following subtasks:

A. Identify I/O requirements to/from SF-CHAMP and Fast-Trips
B. Develop code implement Fast-Trips into SF-CHAMP
C. Test SF-CHAMP and Fast-Trips Integration Mechanics
D. Calibrate and Validate Transit Assignment Module

This task is being managed by: Drew Cooper of SFCTA
With help from:

- Lisa Zorn of MTC

The overall Budget is:

- $33,508 (SFCTA portion of Task 8 only)

A - Identify I/O requirements to/from SF-CHAMP and Fast-Trips

This subtask will determine the needs of Fast-Trips from SF-CHAMP and the needs of SF-CHAMP from Fast-Trips and propose any necessary reconciliation. Areas anticipated to require reconciliation include time of day/departure time (i.e. how do you summarize level of service across a time period), modal choices (i.e. do you keep the submodes in trip mode choice or let Fast-TrIPs do this), and skim data types (i.e. logsums or best-path). Additionally, since SF-CHAMP will be relying on skims calculated at an aggregate level, it is possible that a random assignment of demand based on a distribution will result in infeasible transit trips (i.e. trips assigned to start at 11:30 pm when the last bus leaves at 11:00 pm). Thus, the implementation strategy must address this discrepancy.

Interim milestones include:

- Documentation of an implementation strategy including all i/o requirements Agreement Point

B - Develop code to implement Fast-Trips into SF-CHAMP

This subtask will develop pieces of code that will bridge the gaps between SF-CHAMP and Fast-Trips identified in Task 8A-A.

Interim milestones include:

- Working and tested code that creates Fast-Trips input from SF-CHAMP demand Code
- Working and tested code that converts SF-CHAMP networks to Fast-Trips inputs, in conjunction with Task 2 Code
- Working and tested code that reads skims developed in Fast-Trips for use in SF-CHAMP Code
- Working and tested code that reads Fast-Trips outputs and develops reports and summaries Code

C - Test SF-CHAMP and Fast-Trips integration mechanics

This subtask puts all the pieces developed in Task 8A-B into the SF-CHAMP model system and tests them to make sure the model runs correctly from top to bottom.

Interim milestones include:

- Working SF-CHAMP model system with Fast-Trips

D - Calibration and Validation of Transit Assignment Module

This subtask will undertake the calibration of the Transit Assignment Module such that it validates to a reasonable level for use in planning studies. This subtask will first create a validation plan for SF-CHAMP with Fast-Trips based on an understanding of the variance spread of the Transit Performance data from Task 5. Using the data developed in Task 5, a working testing environment will be created. An initial validation will likely lead to a feedback loop to other tasks that require refinement and small tweaks to the inputs and parameters. Sensitivity tests for both demand and the networks will be incorporated into the calibration task as needed.

Interim milestones include:

- Validation Plan for SF-CHAMP/Fast-Trips Agreement Point
- Working validation testing environment
- Initial Bay Area Validation Agreement Point
- Final Validated Model System Agreement Point

E - Final Documentation

This subtask will finalize the documentation.

Interim milestones include:

- Final Tech Memo describing SF-CHAMP implementation, calibration procedure, and final validation results FHWA Deliverable Agreement Point

Task 8B: PSRC Implementation and Testing

This task includes the implementation, testing, and calibration Fast-Trips into the PSRC model system.

The task includes the following subtasks:

A. Get demand from SoundCast to Fast-Trips
B. Get network supply from SoundCast to Fast-Trips
C. Get Fast-Trips' skims to SoundCast
D. Create validation capabilities for model system
E. Full working model system
F. Final Documentation

This task is being managed by: Stefan Coe of PSRC
With help from:

- Suzanne Childress of PSRC
- Brice Nichols of PSRC

The overall Budget is:

- $11,344 (PSRC portion of Task 8 only)

A - Get demand from SoundCast to Fast-Trips

This subtask will determine the demand needs of Fast-Trips from SoundCast, propose any necessary reconciliation, and develop code to implement any necessary data translations. Areas anticipated to require reconciliation include time of day/departure time and modal choices.

Interim milestones include:

- Proposed method for SoundCast to Fast-Trips demand translation, in conjunction with Task 3 Agreement Point
- Working and tested code that converts SoundCast Demand to Fast-Trips inputs Code

B - Get network supply from SoundCast to Fast-Trips

This subtask will determine the network supply needs of Fast-Trips from SoundCast, propose any necessary reconciliation, and develop code to implement any necessary data translations. Areas anticipated to require reconciliation include modal choices and additional variables.

Interim milestones include:

- Proposed method for SoundCast to Fast-Trips network translation, in conjunction with Task 2 Agreement Point
- Working and tested code that converts SoundCast networks to Fast-Trips inputs Code

C - Get Fast-Trips' skims to SoundCast

This subtask will determine and execute any necessary reconciliation between the skims that Fast-Trips will create and what SoundCast expects. Areas anticipated to require reconciliation include modal choices and market segmentation.

Interim milestones include:

- Proposed method for Skim reconciliation between SoundCast and Fast-Trips Agreement Point
- Working and tested code in SoundCast that uses Fast-Trips skims Code

D - Create model validation capabilities for the system

This subtask will develop code to summarize the SoundCast / Fast-Trips model performance.

Interim milestones include:

- Proposed validation reporting for SoundCast and Fast-Trips Agreement Point
- Working and tested validation reporting code Code

E - Full working SoundCast Model system with Fast-Trips

This subtask will piece together and test a full top-to-bottom SoundCast/Fast-Trips system.

Interim milestones include:

- Fully working and tested PSRC model environment with Fast-Trips Agreement Point

F - Final Documentation

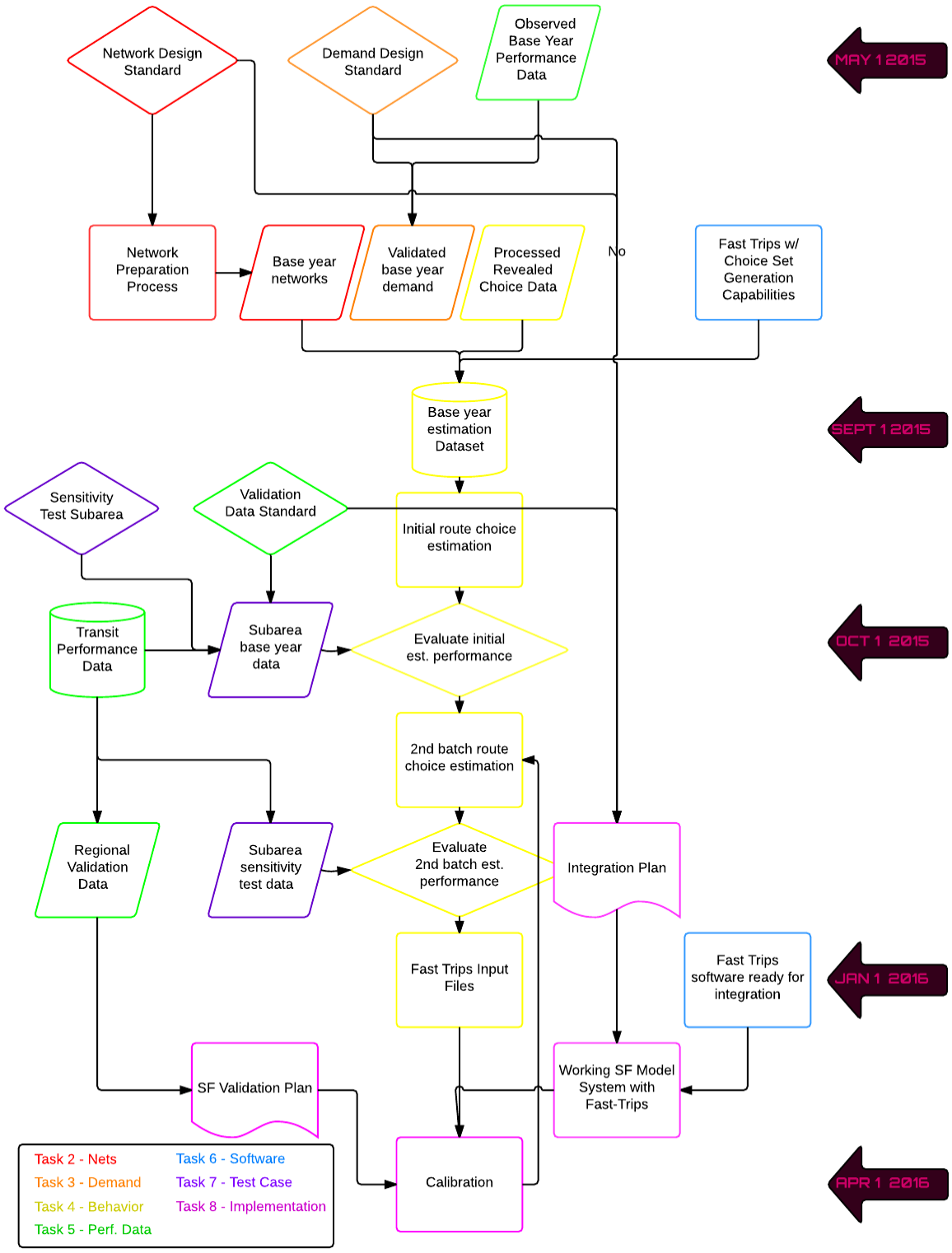
This subtask will finalize the documentation.

Interim milestones include:

- Final Tech Memo describing PSRC implementation initial validation results FHWA Deliverable Agreement Point

Schedule Drivers

The following diagram shows some of major milestones that will be driving the schedule and how they relate with previous and subsequent tasks. Tasks shown are the ones that relate to other tasks. Note that any major milestone listed on here or tasks that these interim milestones depend on could become a part of the critical path at any time. Failure to meet any of the major milestones could result in a schedule setback for the entire project. **Any potential to not meet any major milestone should be raised immediately to the Project Manager**. Milestones are shown based on the latest date that they need to be complete by; however it is anticipated that many of these will be completed earlier in order to minimize potential schedule overages.


Network Design Standard
Demand Design Standard
Observed Base Year Performance Data
MAY 1 2015
Network Preparation Process
Base year networks
Validated base year demand
Processed Revealed Choice Data
No
Fast Trips w/ Choice Set Generation Capabilities
Base year estimation Dataset
SEPT 1 2015
Sensitivity Test Subarea
Validation Data Standard
Initial route choice estimation
Transit Performance Data
Subarea base year data
Evaluate initial est. performance
OCT 1 2015
2nd batch route choice estimation
Regional Validation Data
Subarea sensitivity test data
Evaluate 2nd batch est. performance
Integration Plan
Fast Trips Input Files
Fast Trips software ready for integration
JAN 1 2016
SF Validation Plan
Working SF Model System with Fast-Trips
Task 2 - Nets
Task 3 - Demand
Task 4 - Behavior
Task 5 - Perf. Data
Task 6 - Software
Task 7 - Test Case
Task 8 - Implementation
Calibration
APR 1 2016

Technical Design Decisions

What is the "validation date"?
This decision will be made as part of Task 7-B after considering the available observed data for both performance, demand, and route choices as well as transit network data. This decision needs to get made before proceeding with validation data processing.

What market segments will we carry from the ABM through Fast-Trips and back to the ABM?
An initial decision about what market segments to explore will be made in Task 3 as part of the standard demand specification task after considering the available data from the ABM and the likelihood that these segments make different route choices or affect the system differently. After the Task 4 estimation is complete, it is likely that several of these market segments will not have significantly different route choices and can be considered for consolidation. Similarly, the analysis in Task 2 of transit dwell times and other items affecting transit travel time may demonstrate a need to explore fewer market segments or could highlight a market segment that had not yet been considered.

What resolution will time of day be considered for both networks (Task 2) and demand (Task 3)?
We will not be changing the intelligence behind any time of day model within either ABM to get greater time of day resolution. However, a distribution may be applied to the final ABM output based on observed data in order to get greater resolution in Fast-Trips. Fast-Trips will employ a schedule-based assignment algorithm, so its time resolution for this will be in seconds. In order to translate individual trajectories back to multi-class skims, some assumptions will need to be made in Task 8 about how to combine and summarize.

What geographic resolution will the network creation task (Task 2) assume the demand is in?
We do not assume any demand resolution different than the current geographic resolution of each respective travel model. That said, the system should be able to be updated easily to a new resolution.

What resolution will the network creation task (Task 2) assume the networks are in?
We do not assume any network resolution different than the current resolution of each respective travel model. That said, the system should be able to be updated easily to a new resolution.

What are the validation targets?
The validation targets for the Bay Area will be determined in Task 8.A and be based on an analysis of the variance in transit performance data from Task 5.

External Communication Workplan

Task 9: Communications and Outreach

This task includes the specifying and management of various scenarios used for testing software validity and model performance.

The task includes the following subtasks:

A. Website development and maintenance
B. Fact sheet development and updates
C. C10 Coordination
D. Technical Papers
E. Teaching Material development
F. In-person meetings and travel
G. Hosting of other agencies

This task is being managed by: Elizabeth Sall (as an SFCTA contractor)
With help from:

- Diana Dorinson of Transportation Analytics
- Graphic Designers
- Technical staff

The overall Budget is:

- $94,056

A - Website development and maintenance

Develop and maintain a front-facing project website.

Interim milestones include:

- Develop front-facing project website Agreement Point
- Update website content monthly

B - Fact sheet creation and updates

Develop and update a project fact sheet.

Interim milestones include:

- Initial Fact Sheet Agreement Point
- Fall 2015 Fact Sheet update Agreement Point
- Spring 2016 Fact Sheet update Agreement Point
- Fall 2016 Fact Sheet update Agreement Point

C - C10 Coordination

Participate in C10 coordination meetings.

Interim milestones include:

- Participation in quarterly C10 calls

D - Technical Papers

Monitor relevant conference deadlines, brainstorm and collectively decide with the Technical and Management Team on papers to write, and write the papers.

Interim milestones include:

- Decide on 2016 TRB paper submittals Agreement Point
- Submit any 2016 TRB papers Agreement Point
- Decide on 2016 ITM paper submittals Agreement Point
- Submit any 2016 ITM papers Agreement Point
- Decide on 2017 TRB paper submittals Agreement Point
- Submit any 2017 TRB papers Agreement Point
- Decide on 2017 Planning Applications abstract submittals Agreement Point
- Submit any 2017 Planning Applications abstracts Agreement Point

E - Teaching Material Development

This subtask will develop a partnership with a university to develop one class worth of teaching materials and an assignment to teach the concepts developed in this project.

Interim milestones include:

- University partnership FHWA Deliverable
- Final teaching materials FHWA Deliverable Agreement Point

F - In person meetings and travel

This subtask is a holding ground for any travel that needs to take place as a part of any other task.

Interim milestones include:

- Discussion of travel requests on an ad-hoc basis Agreement Point

G - Host other Agencies

This subtask will send out an RFI for visiting agencies, decide on an award for visiting agency, notify agency of travel funds, and facilitate the visit from the other agency.

Interim milestones include:

- Release RFI for visiting agencies Agreement Point
- Decide on award for visiting agency Agreement Point
- Complete visiting agency visit Agreement Point FHWA Deliverable

Rollup Budget

Revised Staffing

By Task	Cost - FHWA	Cost - In Kind	Cost - Total	Hours
Task 1 - Project Mgmt / Tech Oversight	$322,847.04	$123,867.84	$446,714.88	2,980
Task 2 - Network Supply	$39,793.30	$25,023.30	$64,816.60	711
Task 3 - Transit Demand	$55,813.63	$19,575.63	$75,389.25	763
Task 4 - Transit Rider Behavior	$51,504.00	$11,604.00	$63,108.00	598
Task 5 - Transit System Performance	$21,151.48	$21,151.48	$42,302.95	494
Task 6 - Software Implementation	$71,766.85	$14,834.85	$86,601.70	822
Task 7 - Test Case Development	$6,706.82	$6,706.82	$13,413.64	127
Task 8 - Agency Implementation and Testing	$29,321.03	$15,521.03	$44,842.05	453
Task 9 - Communications and Outreach	$79,846.40	$14,209.60	$94,056.00	506
Total	**$678,750.54**	**$252,494.54**	**$931,245.07**	**7,454**
Contingency: $700k less Revised	***$21,249.47***			

By Funding	Cost - FHWA
Total - FHWA	**$678,750.54**
MTC In-Kind	$85,276.16
SFCTA In-Kind	$79,468.88
PSRC In-Kind	$77,249.50
Mark Hickman In-Kind	$10,500.00
Total In-Kind	**$252,494.54**
Total - All Funding Sources	**$931,245.07**

By Recipient	Cost - FHWA	Cost - In Kind	Cost - Total
MTC	$213,052	$85,276	$298,328
SFCTA	$388,449	$79,469	$467,918
PSRC	$77,250	$77,250	$154,499
Hickman	$0	$10,500	$10,500
Total	**$ 678,750.54**	**$ 252,494.54**	**$ 931,245.07**

By Task, By Recipient (FHWA only)	MTC	SFCTA	PSRC	Sum
Task 1 - Project Mgmt / Tech Oversight	$2,600.00	$294,975.04	$25,272.00	$322,847.04
Task 2 - Network Supply	$14,770.00	$12,354.30	$12,669.00	$39,793.30
Task 3 - Transit Demand	$38,998.00	$13,539.63	$3,276.00	$55,813.63
Task 4 - Transit Rider Behavior	$27,600.00	$12,300.00	$11,604.00	$51,504.00
Task 5 - Transit System Performance	$0.00	$15,638.98	$5,512.50	$21,151.48
Task 6 - Software Implementation	$59,192.00	$5,104.85	$7,470.00	$71,766.85
Task 7 - Test Case Development	$0.00	$4,943.82	$1,763.00	$6,706.82
Task 8 - Agency Implementation and Testing	$13,800.00	$9,854.03	$5,667.00	$29,321.03
Task 9 - Communications and Outreach	$56,092.16	$19,738.24	$4,016.00	$79,846.40
Total	**$213,052.16**	**$388,448.88**	**$77,249.50**	**$678,750.54**

Rollup Budget

Application (2014-08-29) *(w/ formula corrections)*

By Task	Cost - FHWA	Cost - In Kind	Cost - Total	Hours
Task 1 - Project Mgmt / Tech Oversight	$323,215.04	$123,555.84	$446,770.88	3,000
Task 2 - Network Supply	$43,444.80	$25,244.80	$68,689.60	713
Task 3 - Transit Demand	$46,144.59	$18,744.59	$64,889.17	737
Task 4 - Transit Rider Behavior	$50,105.50	$17,705.50	$67,811.00	638
Task 5 - Transit System Performance	$29,000.10	$13,000.10	$42,000.20	484
Task 6 - Software Implementation	$93,121.00	$27,261.00	$120,382.00	670
Task 7 - Test Case Development	$14,637.56	$6,637.56	$21,275.12	132
Task 8 - Agency Implementation and Testing	$32,363.03	$16,763.03	$49,126.05	462
Task 9 - Communications and Outreach	$70,692.24	$7,120.08	$77,812.32	400
Total	**$702,723.85**	**$256,032.49**	**$958,756.34**	**7,236**

Contingency: $700k less Revised

By Funding	Cost - FHWA
Total - FHWA	**$702,723.85**
MTC In-Kind	$80,260.80
SFCTA In-Kind	$76,298.69
PSRC In-Kind	$88,973.00
Mark Hickman In-Kind	$10,500.00
Total In-Kind	**$256,032.49**
Total - All Funding Sources	**$958,756.34**

By Recipient	Cost - FHWA	Cost - In Kind	Cost - Total
MTC	$355,292	$80,261	$435,553
SFCTA	$247,899	$76,299	$324,197
PSRC	$99,533	$88,973	$188,506
Hickman	$0	$10,500	$10,500
Total	**$ 702,723.85**	**$ 256,032.49**	**$ 958,756.34**

By Task, By Recipient (FHWA only)	MTC	SFCTA	PSRC	Sum
Task 1 - Project Mgmt / Tech Oversight	$134,320.00	$163,935.04	$24,960.00	$323,215.04
Task 2 - Network Supply	$18,200.00	$12,412.80	$12,832.00	$43,444.80
Task 3 - Transit Demand	$23,400.00	$17,474.59	$5,270.00	$46,144.59
Task 4 - Transit Rider Behavior	$32,400.00	$6,863.50	$10,842.00	$50,105.50
Task 5 - Transit System Performance	$0.00	$24,040.10	$4,960.00	$29,000.10
Task 6 - Software Implementation	$70,360.00	$1,961.00	$20,800.00	$93,121.00
Task 7 - Test Case Development	$8,000.00	$4,237.56	$2,400.00	$14,637.56
Task 8 - Agency Implementation and Testing	$15,600.00	$9,854.03	$6,909.00	$32,363.03
Task 9 - Communications and Outreach	$53,012.16	$7,120.08	$10,560.00	$70,692.24
Total	**$355,292.16**	**$247,898.69**	**$99,533.00**	**$702,723.85**

Rollup Budget

Difference (New less Old)

By Task	Cost - FHWA	Cost - In Kind	Cost - Total	Hours
Task 1 - Project Mgmt / Tech Oversight	-$368.00	$312.00	-$56.00	-20
Task 2 - Network Supply	-$3,651.50	-$221.50	-$3,873.00	-2
Task 3 - Transit Demand	$9,669.04	$831.04	$10,500.08	26
Task 4 - Transit Rider Behavior	$1,398.50	-$6,101.50	-$4,703.00	-40
Task 5 - Transit System Performance	-$7,848.63	$8,151.38	$302.75	10
Task 6 - Software Implementation	-$21,354.15	-$12,426.15	-$33,780.30	152
Task 7 - Test Case Development	-$7,930.74	$69.26	-$7,861.48	-5
Task 8 - Agency Implementation and Testing	-$3,042.00	-$1,242.00	-$4,284.00	-9
Task 9 - Communications and Outreach	$9,154.16	$7,089.52	$16,243.68	106
Total	**-$23,973.32**	**-$3,537.95**	**-$27,511.27**	**218**

Contingency: $700k less Revised

By Funding	Cost - FHWA
Total - FHWA	**-$23,973.32**
MTC In-Kind	$5,015.36
SFCTA In-Kind	$3,170.18
PSRC In-Kind	-$11,723.50
Mark Hickman In-Kind	$0.00
Total In-Kind	**-$3,537.96**
Total - All Funding Sources	**-$27,511.27**

By Recipient	Cost - FHWA	Cost - In Kind	Cost - Total
MTC	-$142,240	$5,015	-$137,225
SFCTA	$140,550	$3,170	$143,720
PSRC	-$22,284	-$11,724	-$34,007
Hickman	$0	$0	$0
Total	**$ (23,973.32)**	**$ (3,537.96)**	**$ (27,511.27)**

By Task, By Recipient (FHWA only)	MTC	SFCTA	PSRC	Sum
Task 1 - Project Mgmt / Tech Oversight	-$131,720.00	$131,040.00	$312.00	-$368.00
Task 2 - Network Supply	-$3,430.00	-$58.50	-$163.00	-$3,651.50
Task 3 - Transit Demand	$15,598.00	-$3,934.96	-$1,994.00	$9,669.04
Task 4 - Transit Rider Behavior	-$4,800.00	$5,436.50	$762.00	$1,398.50
Task 5 - Transit System Performance	$0.00	-$8,401.13	$552.50	-$7,848.63
Task 6 - Software Implementation	-$11,168.00	$3,143.85	-$13,330.00	-$21,354.15
Task 7 - Test Case Development	-$8,000.00	$706.26	-$637.00	-$7,930.74
Task 8 - Agency Implementation and Testing	-$1,800.00	$0.00	-$1,242.00	-$3,042.00
Task 9 - Communications and Outreach	$3,080.00	$12,618.16	-$6,544.00	$9,154.16
Total	**-$142,240.00**	**$140,550.19**	**-$22,283.50**	**-$23,973.32**

Budget by Task

	Responsible Agency	Hours	Cost - FHWA	Cost - In Kind
1. Project Management and Technical Oversight		**2,980**	**$322,847**	**$123,868**
Diana Dorinson	SFCTA	1,040	$145,600	
a - Technical Advice				
Elizabeth Sall	SFCTA	936	$131,040	
Dave Ory	MTC	192		$32,104
Billy Charlton	PSRC	192	$15,552	$15,552
Joe Castiglione	SFCTA	100	$9,550	$9,550
b - Administration				
Dave Ory	MTC	288		$48,156
Billy Charlton	PSRC	120	$9,720	$9,720
Joe Castiglione	SFCTA	92	$8,786	$8,786
Jen Duthie	MTC	20	$2,600	
2. Network Supply		**711**	**$39,793**	**$25,023**
Stefan Coe	PSRC	53	$2,173	$2,173
Sub-Tasks				
a - transit network design and synthesis				
Drew Cooper	SFCTA	60	$2,942	$2,942
Lisa Zorn	MTC	10	$1,150	
Stefan Coe	PSRC	100	$4,100	$4,100
StaffTBD-1	MTC	60	$6,000	
b - transit / highway network conflation				
Drew Cooper	SFCTA	60	$2,942	$2,942
Stefan Coe	PSRC	60	$2,460	$2,460
StaffTBD-1	MTC	60	$6,000	
c - Additional Transit Variables				
Drew Cooper	SFCTA	72	$3,530	$3,530
Stefan Coe	PSRC	36	$1,476	$1,476
c - transit networks for various scenarios				
Drew Cooper	SFCTA	60	$2,942	$2,942
Stefan Coe	PSRC	60	$2,460	$2,460
Alireza Khani	MTC	20	$1,620	
e - final documentation				
Stefan Coe	PSRC	0	$0	$0
3. Transit Demand		**763**	**$55,814**	**$19,576**
Dan Tischler	SFCTA	50	$2,943	$2,943
Sub-Tasks				
a - Define input standard for demand to Fast-Trips				
Lisa Zorn	MTC	6	$690	
Brice Nichols	PSRC	16	$504	$504
Alireza Khani	MTC	28	$2,268	
b - Demand adjustment methodology and validation targets				
Alireza Khani	MTC	60	$4,860	
StaffTBD-1	MTC	30	$3,000	
Dan Tischler	SFCTA	30	$1,766	$1,766
Mark Hickman	Hickman	40		$6,000

Budget by Task

	Responsible Agency	Hours	Cost - FHWA	Cost - In Kind
c - Tools - demand transform, user detail, and demand scaling				
Lisa Zorn	MTC	6	$690	
Brice Nichols	PSRC	22	$693	$693
StaffTBD-1	MTC	200	$20,000	
Dan Tischler	SFCTA	8	$471	$471
d - Validated regional base year transit demand:				
Brice Nichols	PSRC	10	$315	$315
Lisa Zorn	MTC	6	$690	
Alireza Khani	SFCTA	40	$3,240	
StaffTBD-1	MTC	64	$6,400	
e - Demand for unit tests and subarea sensitivity tests				
Dan Tischler	SFCTA	48	$2,825	$2,825
Brice Nichols	PSRC	48	$1,512	$1,512
f - Documentation:				
Dan Tischler	SFCTA	39	$2,295	$2,295
Brice Nichols	PSRC	8	$252	$252
StaffTBD-1	MTC	4	$400	
4. Transit Rider Behavior		**598**	**$51,504**	**$11,604**
Suzanne Childress	PSRC	58	$3,074	$3,074
Sub-Tasks				
a – Research and Design Model Estimation Approach				
Suzanne Childress	PSRC	30	$1,590	$1,590
Lisa Zorn	MTC	30	$3,450	
Alireza Khani	SFCTA	20	$1,620	
Elizabeth Sall	SFCTA	20	$2,800	
b- Data Cleaning, Summarization, and Formatting for estimation				
Suzanne Childress	PSRC	30	$1,590	$1,590
Lisa Zorn	MTC	40	$4,600	
Alireza Khani	SFCTA	20	$1,620	
Stefan Coe	PSRC	40	$1,640	$1,640
c - estimate a route choice model for transit				
Suzanne Childress	PSRC	20	$1,060	$1,060
Lisa Zorn	MTC	120	$13,800	
Alireza Khani	SFCTA	40	$3,240	
d - re-estimate and adjust route choice models after application				
Suzanne Childress	PSRC	20	$1,060	$1,060
Lisa Zorn	MTC	30	$3,450	
e - documentation of model estimation process/paper writing				
Suzanne Childress	PSRC	30	$1,590	$1,590
Lisa Zorn	MTC	20	$2,300	
Alireza Khani	SFCTA	20	$1,620	
Elizabeth Sall	SFCTA	10	$1,400	

Budget by Task

	Responsible Agency	Hours	Cost - FHWA	Cost - In Kind
5. Transit Performance Data		**494**	**$21,151**	**$21,151**
Drew Cooper	SFCTA	0	$0	$0
Sub-Tasks				
0. Rush Order Needs				
Drew Cooper	SFCTA	84	$4,118	$4,118
Brice Nichols	PSRC	40	$1,260	$1,260
1. Identify agencies with AVL/APC data				
Drew Cooper	SFCTA	15	$735	$735
Brice Nichols	PSRC	15	$473	$473
2. Collect and evaluate available data				
Drew Cooper	SFCTA	30	$1,471	$1,471
Brice Nichols	PSRC	30	$945	$945
3. Develop data storage format				
Drew Cooper	SFCTA	100	$4,903	$4,903
4. Develop tools for processing raw data to stored data				
Drew Cooper	SFCTA	20	$981	$981
Brice Nichols	PSRC	20	$630	$630
5. Documentation				
Drew Cooper	SFCTA	70	$3,432	$3,432
Brice Nichols	PSRC	70	$2,205	$2,205
6. Software Implementation		**822**	**$71,767**	**$14,835**
Billy Charlton	PSRC	0	$0	$0
Sub-Tasks				
a - Refactor existing open-source Fast-trips code to Python				
Lisa Zorn	MTC	160	$18,400	
Alireza Khani	MTC	40	$3,240	
Mark Hickman	Hickman	30		$4,500
b - Merge other feature branches from SACOG, Portland Fast-trips implementations				
Lisa Zorn	MTC	64	$7,360	
Alireza Khani	MTC	32	$2,592	
Brice Nichols	PSRC	20	$630	$630
c - Implement multi-class assignment				
Lisa Zorn	MTC	80	$9,200	
Stefan Coe	PSRC	60	$2,460	$2,460
d - Implement route skimming methodology				
Joe Castiglione	SFCTA	30	$2,865	$2,865
Brice Nichols	PSRC	60	$1,890	$1,890
Elizabeth Sall	SFCTA	16	$2,240	
Lisa Zorn	MTC	120	$13,800	
Stefan Coe	PSRC	30	$1,230	$1,230
e - Visualization software -- 5.a. Develop "indicator library" - off-the-shelf data summary scripts				
Brice Nichols	PSRC	40	$1,260	$1,260
Lisa Zorn	MTC	40	$4,600	

Budget by Task

	Responsible Agency	Hours	Cost - FHWA	Cost - In Kind
7. Test Case Development		**127**	**$6,707**	**$6,707**
Dan Tischler	SFCTA	16	$942	$942
Sub-Tasks				
B - Methodology				
Dan Tischler	SFCTA	20	$1,177	$1,177
Stefan Coe	PSRC	12	$492	$492
C - Network Choices				
Dan Tischler	SFCTA	7	$412	$412
Stefan Coe	PSRC	5	$205	$205
D - Network Development				
Dan Tischler	SFCTA	25	$1,471	$1,471
Stefan Coe	PSRC	20	$820	$820
E - Documentation				
Dan Tischler	SFCTA	16	$942	$942
Stefan Coe	PSRC	6	$246	$246
8. Agency Implementation and testing		**453**	**$29,321**	**$15,521**
Stefan Coe	PSRC	12	$492	$492
Drew Cooper	SFCTA	21	$1,030	$1,030
Sub-Tasks				
a - Gluing and troubleshooting w/ SoundCast				
Suzanne Childress	PSRC	45	$2,385	$2,385
Stefan Coe	PSRC	45	$1,845	$1,845
Brice Nichols	PSRC	30	$945	$945
b - Gluing and troubleshooting w/ Bay Area model				
Drew Cooper	SFCTA	20	$981	$981
Lisa Zorn	MTC	60	$6,900	
c - Calibration of Bay Area model				
Drew Cooper	SFCTA	160	$7,844	$7,844
Lisa Zorn	MTC	60	$6,900	
9. Communications and Outreach		**506**	**$ 79,846**	**$ 14,210**
Elizabeth Sall	SFCTA	104	$14,560	
Sub-Tasks				
a - Website, updated monthly				
--i initial website				
Elizabeth Sall	MTC	20	$2,800	
--ii Monthly updates				
Elizabeth Sall	MTC	48	$6,720	
Generic Staff - PSRC	PSRC	24	$1,004	$1,004
Generic Staff - SFCTA	SFCTA	24	$1,295	$1,295
b - Factsheet, updated semi-annually				
---i Initial Factsheet				
Elizabeth Sall	MTC	10	$1,400	
MTC Graphic Designer	MTC	20		$1,300
---ii Factsheet Updates				
Elizabeth Sall	MTC	32	$4,480	
MTC Graphic Designer	MTC	16		$1,040

Budget by Task

	Responsible Agency	Hours	Cost - FHWA	Cost - In Kind
c - Inter SHRP Coordination				
Elizabeth Sall	MTC	16	$2,240	
Dave Ory	MTC	16		$2,675
d - Technical Papers				
Generic Staff - PSRC	PSRC	60	$2,510	$2,510
Generic Staff - SFCTA	SFCTA	60	$3,236	$3,236
Direct Cost	MTC	32	$5,452	
e - Teaching material development				
University Partner	MTC		$10,000	
f - In person meetings travel budget				
Direct Cost	MTC		$18,000	
g - Host other agencies				
Direct Cost	MTC		$5,000	
Generic Staff - PSRC	PSRC	12	$502	$502
Generic Staff - SFCTA	SFCTA	12	$647	$647

Deliverables by Task

1. Project Management & Technical Oversight
Technical memo describing workplan
Quarterly progress reports
Bi-weekly management meetings

2. Network Supply
Methodology for developing and maintaining transit network data
Data standards for transit network data
Tools for developing and maintaining transit network data
Transit networks for Puget Sound, Bay Area, and test case
Technical memo describing transit network data development (each subtask responsible for writing their section)

3. Transit Demand
Observed Transit Demand Matrix for Puget Sound and Bay Area
Model Transit Demand Matrix, informed by observed transit demand matrix
Tools for manipulating transit demand data
Data standards for transit demand data
Transit demand for Puget Sound, Bay Area, and test case
Technical memo describing transit demand data development (each subtask responsible for writing their section)

4. Transit Rider Behavior
Processed route choice data
Choice set generation
Data standards for routes
Tools standards
Route choice estimation
Route choice validation
Technical memo describing methodology and results from trnaist route choice analysis

5. Transit Performance Data
Data standards for transit validation
Tools to summarize APC data into data for validation
Validation data for before/after scenarios in Puget Sound and Bay Area
Technical memo describing transit system performance data development

6. Software Implementation
osplanning community
Refactored FAST-TrIPs code
Usability improvements for modeling
User interface for service planning/transit planning
Quick start users guide

7. Test Case Development
Small test network that can be delivered with code
Test networks in Bay Area and Puget Sound with before/after data
Technical memo describing test case application and results

8. Agency Implementation and testing
Functional Bay Area model with FAST-TrIPs
Functional SoundCast with FAST-TrIPs
Calibrated Bay Area model with FAST-TrIPs
Technical memo describing implementation, calibration, and validation

9. Communications and Outreach
Fact sheets, updated semi-annually
Website, updated monthly
Host other agencies
Develop presentations and papers

Schedule

	Test Case Development and Startup	s proceed in parallelwith some back and forth using test cases to make s				Gluing and revising		Zipping it all up
	2015	2015	2015	2015	2016	2016	2016	2016
Project Management	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2
- Kickoff meeting in SF-->final work scope	x							
- BiWeekly management meetings	x	x	x	x	x	x	x	x
- Weekly task management standing meetings	x	x	x	x	x	x	x	x
- Contracting and Invoicing	x	x	x	x	x	x	x	x
Network Supply								
- road network/travel times	x	x	x					
- bus travel time behavior	x	x	x					
- transit schedules	x	x	x					
- network manipulation tools	x	x	x	x	x	x	x	
Transit Demand								
- AB model output mechanics		x	x	x	x	x	x	x
- validate AB model demand with On-Boards + APC		x	x	x				
- create validated demand matrix with which to calibrate network model		x	x	x				
Transit Rider Behavior								
- develop tools for and process the GPS route data		x	x					
- develop supply-side variables such as reliability		x	x	x	x			
- estimate a route choice model for transit				x	x	x		
- calibrate and adjust route choice model					x	x	x	x
Validation Data								
- develop tools for processing APC data	x	x						
- process APC and ridership data in all regions		x	x					
- develop tools to generate automatic validation reports			x	x				
Software Implementation								
- Refactor FAST-TrIPs to be on open source platform and controllable by	x	x	x	x	x	x		
- Create user-interface for report generation and validation		x	x					
- Create user interfact for using FAST-TrIPs for service planning						x	x	x
Test Case Development								
- Small test network	x							
- SF test network w/ before/after data		x	x					
- PS test network w/ before/after data		x	x					
Agency Implementation and testing								
- Gluing and troubleshooting w/ SoundCast					x	x	x	
- Gluing and troubleshooting w/ SF-CHAMP					x	x	x	
- Gluing and troubleshooting w/ Travel Model Two					x	x	x	
- Calibration once it goes together at varying levels					x	x	x	
Communications and Outreach								
- Host other agencies								x
- Fact sheets								x
- Technical Papers							x	
- Web updates		x	x	x	x	x	x	x
- Teaching material development						x	x	x
- Collaboration on software development via osplanning								