Transportation Research Institute
100 Merryfield Hall
Corvallis, OR 97331-4304
Phone 541.737.4273
Fax 541.737.3462

Center for Transportation Research
2625 N. Loop, Suite 2100
Ames, IA 50010-8615
Phone 515.294.8103
Fax 515.294.0607

WHM Transportation Engineering
2717 Rio Grande St
Austin, TX 78705
Phone 512.473.8343
Fax 512.473.8273

Oregon Green Light CVO Evaluation

Detailed Test Plan # 8

Measure 2.3.3 Observe overall preclearance system availability to weighmasters and motor carriers

Measure 2.3.4 Observe preclearance system availability for long combination vehicles at Farewell Bend Port of Entry

TABLE OF CONTENTS

TABLE OF EXHIBITS

1 DETAILED TEST INTRODUCTION

1.1 BACKGROUND

This Detailed Test Report is the eighth of 14 test reports that will be submitted as part of the independent technical evaluation of the Oregon Green Light CVO project. The Oregon Department of Transportation (ODOT) is in the process of implementing their Intelligent Vehicle Highway System Strategic Plan for Commercial Vehicle Operations (now referred to as ITS/CVO). Through Green Light, Oregon is installing twenty-two mainline preclearance systems featuring weigh-in-motion (WIM) devices and automatic vehicle identification (AVI) at the major weigh stations and ports-of-entry throughout the state. In addition, certain sites will be equipped with data collection systems for use in regulatory enforcement (ITEN sites) while other sites will be equipped with safety enhancements that regulate road conditions and speed.

The purpose of these documents is to provide detail to procedures taken when testing the various measures proposed in the Green Light Evaluation. The Detailed Test Plans will cover all of the test measures described in Exhibit 2-1 of The Oregon “Green Light” CVO Project - Evaluation Plan [1].

Each of the tests conducted by the research team for the evaluation of Green Light will address one of five goals of the evaluation as documented in the Evaluation Plan. These are:

- Assessment of Safety
- Assessment of Productivity
- Assessment of User Acceptance
- Assessment of Mainstreaming Issues
- Assessment of Non-Technical Interoperability Issues

The objectives associated with each goal are given in detail in *The Oregon "Green Light" CVO Project - Individual Test Plans* (ITP) [2]. In addition, condensed one-page tables are contained in the appendices of the ITP, outlining the measures to be conducted for each of the stated objectives. The detailed test plan documents will expand on the information provided in the ITP and provide in detail the activities carried out for each *evaluation measure* during the course of the evaluation in regards to the stated objectives.

1.2 PURPOSE AND SCOPE

This particular detailed test plan outlines the three evaluation measures employed to determine the objective *determine changes in vehicles processed at each site,* one of six objectives in support of the goal of assessing productivity. Like the accompanying Detailed Test Plans, this document is not meant to be exclusive of the ITP, but rather an extension of that document to provide scope and direction for the research team.

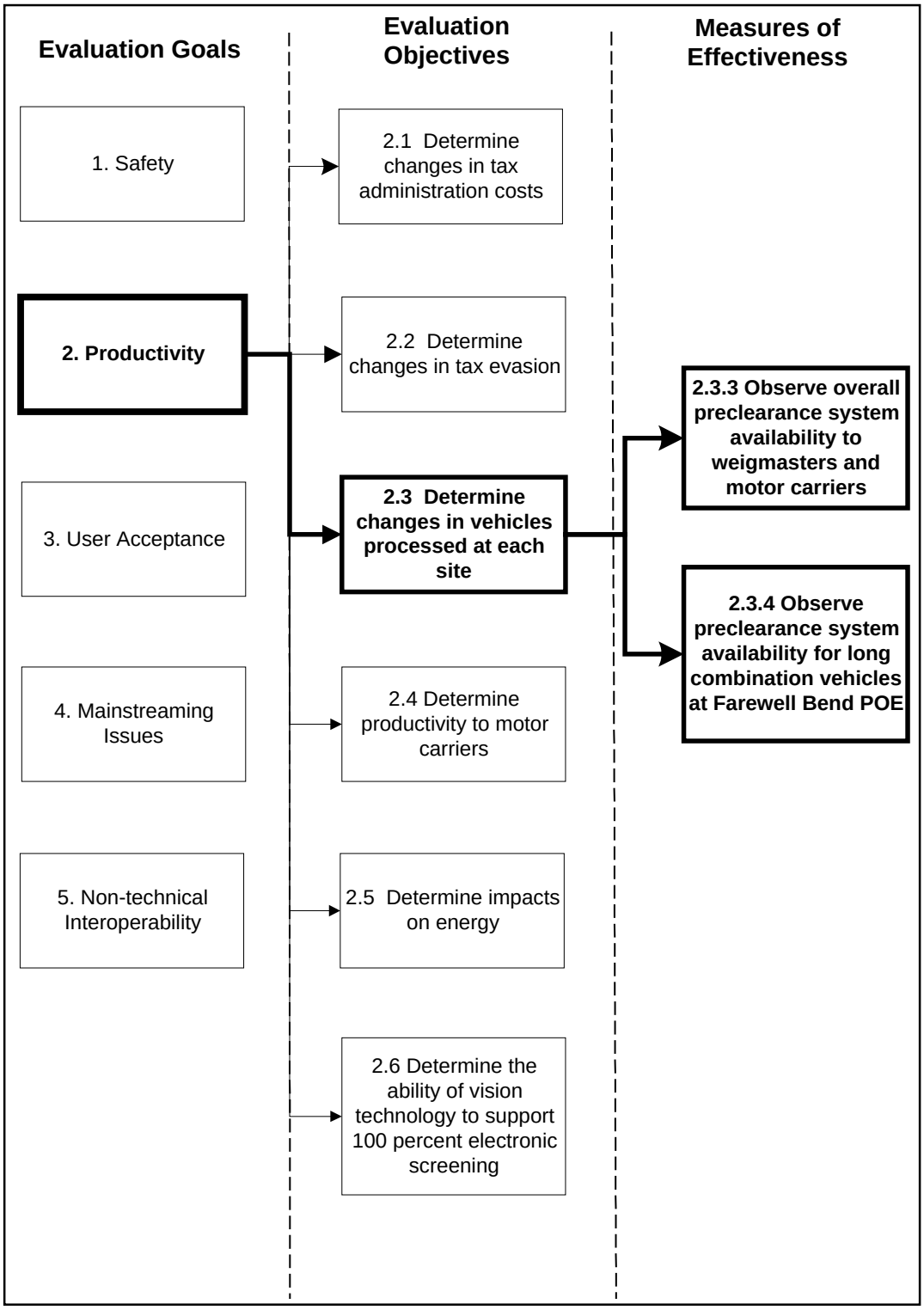
The three evaluation measures are

- **2.3.3 Observe overall preclearance system availability to weighmasters and motor carriers**
- **2.3.4 Observe preclearance system availability for long combination vehicles at Farewell Bend Port of Entry**

Because of the similarities of these measures in regards to pre-test, test, and post-test activities, they are addressed together in this Detailed Test Plan. A description of the hypotheses to be tested as well as the test methodology and deliverables is described in detail in Chapter 2. Chapter 3 provides a detailed test schedule and budget for the test measure.

The scope of this detailed test plan within the context of the overall Green Light Evaluation is shown in Exhibit 1-1. The test measures outlined in this document are highlighted for reference.

Exhibit 1-1 Evaluation Goals, Objectives, and Measures



1.3 DISCUSSION

The success of Green Light will greatly depend on the reliability of the preclearance system as judged by both the State of Oregon and motor carriers. This Detailed Test Plan outlines an assessment of the system's availability to both the motor carrier and the weighmasters for an established time period. The Green Light System is very complex and extensive. Exhibit 1-1, Functional Architecture for Oregon Green Light, illustrates the architecture of mainline electronic screening with national interoperability. The availability of the system to motor carriers and weighmasters is dependent on each of the databases and connecting links functioning correctly. System availability to motor carriers and weighmasters begins with the roadside subsystem. Exhibit 1-2, Roadside Subsystem Architecture, illustrates this subsystem. System availability to motor carriers and weighmasters depends on each of the elements within the subsystem and connecting links functioning correctly.

The scope of this evaluation will include the observation and quantification of "trouble" reports submitted to the Transponder Administrator and International Road Dynamics (IRD). The Transponder Administrator is responsible for maintaining the Radio Frequency Identification (RFID) tags and IRD is responsible for maintenance of the roadside subsystem for the duration of the operational test.

Exhibit 1-2, Functional Architecture for Oregon Green Light

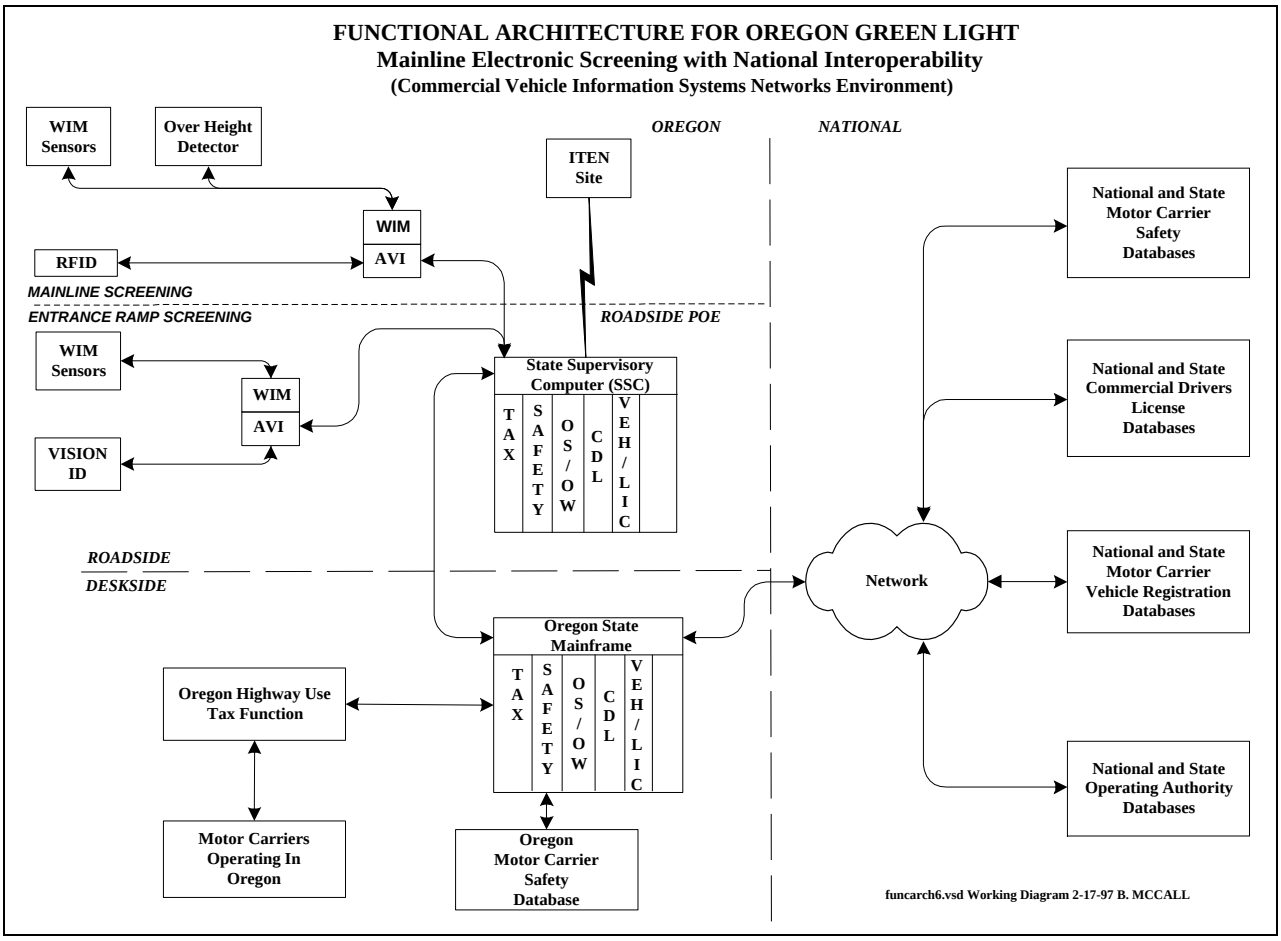
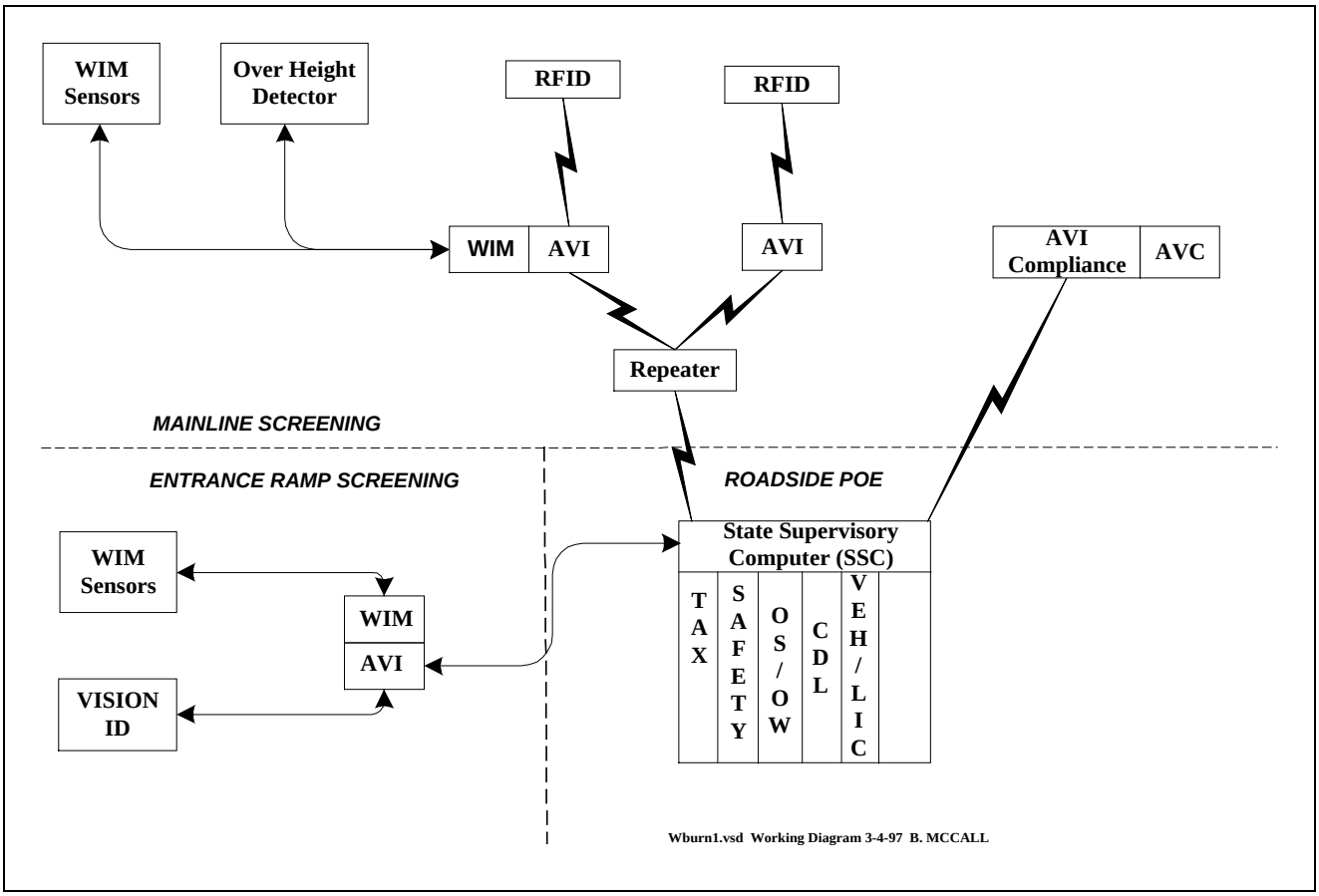


Exhibit 1-3, Roadside Architecture



2 TEST METHODOLOGY

2.1 PHYSICAL DESCRIPTION

2.1.1 Purpose and Scope

This study will document statewide electronic screening system availability in terms of the percent of time that the roadside system (Automated Vehicle Identification, Weigh in Motion Scale, Automated Vehicle Classification, the connection to state supervisory computer system, and radio transmitters) is available to the weighmasters, and; the percent of distributed transponders functioning for motor carriers as intended. Therefore, the availability of electronic screening to motor carriers and weighmasters is the sum of the time that the transponder is functional and the time that roadside system is functional. In addition to the quantitative analysis, CTRE will also attempt to document the causes for electronic screening system failure and the corrective action taken.

For the second part of this evaluation, the research team will focus on system availability for a specific subgroup of carriers at a single weigh station. Idaho, Oregon, Utah, and Washington have joined in a cooperative effort to implement electronic screening for long combination vehicles (LCV). Electronic screening is based on placing the permit number on the transponder to be read by the mainline electronic screening readers. The LCV permit program is called Multi-jurisdictional Automated Preclearance System (MAPS). CTRE will track the experience of these long combination vehicles at the Farewell Bend POE located on Interstate 84 near the Idaho border. (See Exhibit 2-1 Location of Farewell Bend)

The long combination vehicle operators that participate in the MAPs program are of interest for two primary reasons. First, long combination vehicles are exceptional in that they do not fit

within the State's size restrictions. Their automated exception status will provide a test of the flexibility of the preclearance system. Second, the MAPs agreement is the result of an effort to streamline interstate motor vehicle regulation. This systems evaluation will allow participants to begin to measure effectiveness of this program.

Exhibit 2-1 Location of Farewell Bend

2.1.2 Hypotheses

The following hypothesis is given in support of the two measures and will be tested according to accepted statistical techniques:

- **2.3.3 The overall system availability will be approximately 95%.**
- **2.3.4 The system availability for long combination vehicles at Farewell Bend will be approximately 95%.**

2.2 PRE-TEST ACTIVITIES

Pre-test activities for this measure will focus on the sources, quality, and availability of data. It is expected that the transponder administrator, the roadside system administrator, and the Oregon State Department of Transportation's Motor Carrier Transportation Branch will be the primary sources of data.

1) Data Sources and Availability

The following documents will assist the research team in identifying and obtaining the necessary data.

- System Maintenance Agreement

  The system maintenance agreement between Oregon Department of Transportation outlines documentation protocol for system maintenance activities. This document will be obtained from the Oregon Department of Transportation's Motor Carrier Transportation Branch.

- Transponder Administrator Request for Proposals

  The transponder administrator request for proposal outlines expectations of the transponder administrator. This document will be obtained from the Oregon Department of Transportation's Motor Carrier Transportation Branch.

- Multi-jurisdictional Automated Preclearance System (MAPS) Memorandum of Agreement

  The MAPs Memorandum of Agreement will include a comprehensive list of participating

long combination vehicle (LCV) operators.

2) Determination of Benchmark Timeframe

The list of transponder recipients will be obtained from the transponder administrator. The list of transponders that have been identified by an AVI will be obtained from the State Supervisory Computer administrator. Scheduled hours of operation for the roadside system will be gathered from the weighmasters as the weigh stations come on line.

2.3 TEST CONDUCT ACTIVITIES

2.3.1 Descriptions/Participants

- Center for Transportation Research and Education (Bill McCall, Mark Nelson, staff) will conduct the research, including collection and analysis of data.
- Transportation Research Institute (Dr. Chris Bell, Paul Montagne and staff) will be the lead contractor for the evaluation. They will coordinate the development and execution of the Detailed Test Plans.

2.3.2 Procedures

1) Assess transponder availability

The basic data collection sources are the “trouble” reports and corrective action reports prepared as a deliverable by the Transponder Administrator and the system maintenance contractor, International Road Dynamics. The following is a step-by-step description of the anticipated evaluation procedure as illustrated in Exhibit 2-1.

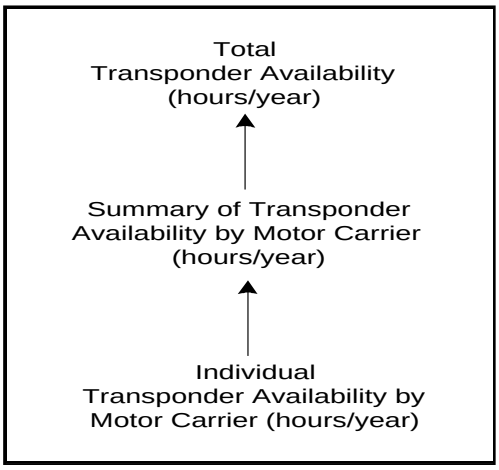
1a) Acquire “Trouble” Reports From Transponder Administrator

The researchers will establish a process that provides CTRE with “trouble” reports and associated corrective action reports sent to the Oregon DOT by the transponder administrator.

1b) Obtain Copies of System Wide "Trouble" Reports and Associated Corrective Action Reports From the Transponder Administrator.

The reports will include transponder identification number, transponder issue date, the date and time the transponder is first read, vehicle identification number, date and time the "trouble" was reported to the transponder administrator, reader location at which the "trouble" was detected, the date and time the trouble was corrected, and the length of time taken to correct the problem.

Exhibit 2-2 Transponder Availability Evaluation Process Description



1c) Develop a matrix of the "trouble" reports and associated corrective actions

The reports and corrective actions will be organized by POE/weigh station location. Record the "trouble" reports that take place over a two year period beginning as the facilities come on line and the transponders are issued to motor carriers and installed on trucks.

1d) Calculate transponder availability

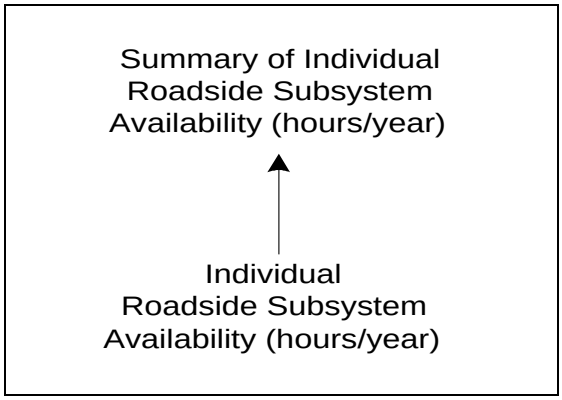
The researchers will calculate the percent of time that individual transponders are available to support electronic screening. The availability will be determined by subtracting downtime from total hours in the two year period (17520 hours) and then dividing by total hours.

1e) Summarize overall transponder availability by aggregating individual transponder availability.

2) Assess roadside subsystem availability

The following steps are illustrated in Exhibit 2-3, Roadside Subsystem Availability Evaluation Process Description. The basic data collection sources are the "trouble" and corrective action reports that are to be prepared as deliverables to the Oregon Department of Transportation by International Road Dynamics, the subsystem administrator.

Exhibit 2-3 Roadside Subsystem Availability Evaluation Process Description



2a) Acquire Roadside Subsystem "Trouble" Reports

The researchers will establish a process that provides CTRE with the roadside subsystem trouble reports and associated corrective action reports sent to the Oregon Department of Transportation by International Road Dynamics, the roadside subsystem maintenance contractor.

2b) Obtain copies of trouble reports and associated corrective action from the International Road Dynamics.

The roadside subsystem reports will include data elements such as site location, the date and time the trouble is reported, description of trouble, and description of the corrective action taken.

2c) Develop a matrix of the data elements in the trouble reports and associated corrective actions.

Record the trouble and correction reports that take place over a two year period beginning as the facilities come on line.

2d) Calculate the percent of time that subsystems are available to support electronic screening at individual weigh stations.

The availability will be determined by subtracting downtime from total weigh station service hours within the two year period and then dividing by total weigh station service hours.

2e) Summarize the individual roadside subsystem availability by aggregating individual roadside subsystem availability.

3) Assess Total System Availability for Long Combination Vehicles at Farewell Bend.

Transponder and roadside subsystem availability will be tracked for long combination vehicles at the Farewell Bend Port of Entry for a two year period. System availability data will be extracted from the overall system availability data, using Multi-jurisdictional Automated Preclearance System (MAPS) permits as unit identifiers.

2.4 POST-TEST ACTIVITIES

2.4.1 Reporting Procedures for Individual Test

Individual test reports will be prepared for each of the test measures outlined in the Evaluation Plan and will proceed as follows:

1. Preparation of a draft report for each test to be submitted to the steering committee (SC) for their approval.
2. Approval of the SC at a scheduled meeting.
3. Preparation of a final test report for each test, incorporating SC recommendations.
4. Submittal of 1 hardcopy original, 1 electronic original, and ten bound copies of each test report to Oregon Department of Transportation's project management team.
5. Transmittal of the test reports by ODOT to FHWA.

2.4.2 Reporting Schedule for Individual Test Reports

The reporting schedule for the individual test reports is shown below:

Exhibit 2-4 Reporting Schedule - Individual Test Reports

Deliverables	Schedule	Scheduled Due Date*
Drafts of Individual Test Reports	July 1-August 30, 1999 (60 days)	September 1, 1999
Review of Individual Test Reports by Steering Committee	September 1-30, 1999 (30 days)	October 1, 1999
Individual Test Reports (Final)	October 1-November 30, 1999 (60 days)	December 1, 1999

2.4.3 Data Retention/Archival Procedures

Data collected and documents produced over the course of the evaluation will be archived and

submitted to ODOT project management. In addition, a document summarizing the data and reports will be produced as follows:

1. Preparation of a summary document describing data analyzed and reports prepared

over the course of the evaluation.

2. Submittal of a data archive containing raw data files and all reports in compressed format.

2.4.4 Reporting Schedule for Data Retention/Archival Procedures

The reporting schedule for the archiving of data and the preparation of a summary document is given below:

Exhibit 2-5 Reporting Schedule - Data Archiving

Deliverables	Schedule	Scheduled Due Date*
Drafts of a Data Summary Report	Dec 1, 1999 - Jan 30, 2000 (60 days)	February 1, 2000
Review of Data Summary Report by Steering Committee	Feb 1 - Feb 28, 2000(28 days)	March 1, 2000
Data Summary Report(Final) and Data Archive	Mar 1 - Mar 30, 2000 (30 days)	April 1, 2000

2.4.5 Test Summary Report Procedures

A test summary report will be prepared highlighting findings from the individual test reports. The document will be produced as follows:

1. Preparation of a draft report summarizing the results of all the individual test reports for submittal to the SC.
2. Approval of the SC at a scheduled meeting.
3. Preparation of a final test summary report, incorporating SC recommendations.
4. Submittal of 1 hardcopy original, 1 electronic original, and ten bound copies of the summary report to Oregon Department of Transportation's project management team.
5. Transmittal of the test reports by ODOT to FHWA.

2.4.6 Reporting Schedule for Test Summary

A reporting schedule is shown below for the test summary report:

Exhibit 2-6 Reporting Schedule - Test Summary Reports

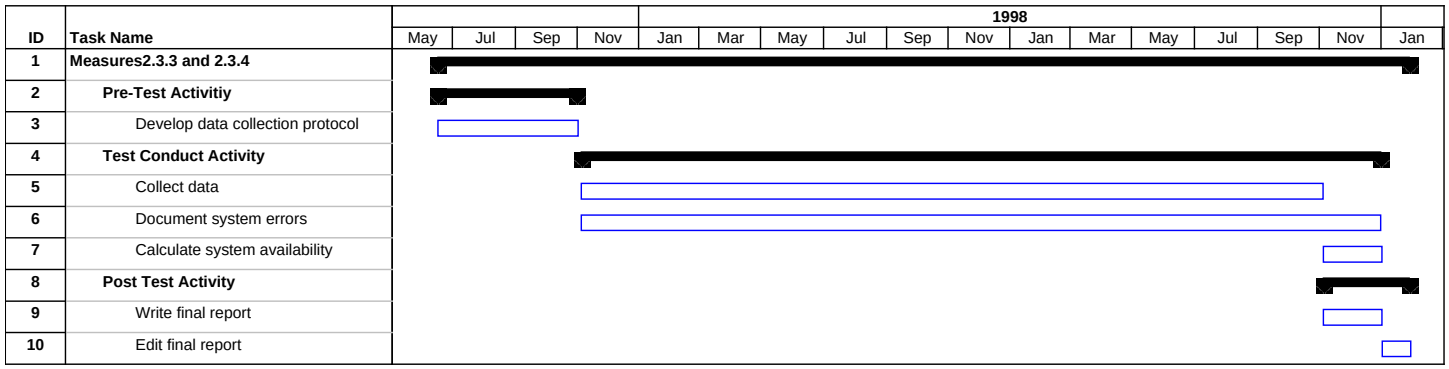
Deliverables	Schedule	Scheduled Due Date*
Drafts of Test Summary Report	Dec 1, 1999 - Jan 30, 2000 (60 days)	February 1, 2000
Review of Test Summary Report by Steering Committee	Feb 1 - Feb 28, 2000(28 days)	March 1, 2000
Test Summary Report (Final)	Mar 1 - Mar 30, 2000 (30 days)	April 1, 2000

3 TEST MANAGEMENT PLAN

3.1 DETAILED TEST SCHEDULE

A detailed test schedule is shown in Exhibit 3-1.

Exhibit 3-1 Project Timeline for Test Measures 2.3.3 and 2.3.4



3.2 COST BREAKDOWN BY MEASURE

A cost breakdown for these test measures is shown below. These amounts are estimates only and are subject to change as the evaluation evolves.

Exhibit 3-2 Detailed Budget for Test Measures 2.3.3 and 2.3.4

Organization:Iowa State University (CTRE)						
DTP	**Measure**	**Researcher/Personnel**	**Hours**	**Cost**	**Fringe Benefits**	**Totals**
8	2.3.3	T Maze	10	$634	$156	$790
		B McCall	40	$1,792	$552	$2,344
		M Nelson	60	$1,235	$381	$1,616
		Student	104	$1,679	$254	$1,933
		Subtotals	214	$5,340	$1,342	$6,682
		Support Personnel	52	$888	$318	$1,206
	Equipment:			$0		
	Supplies:			$515		
	Travel:			$2,850		
	Subtotal:					$3,365
	Overhead					$4,951
	Total:					**$16,204**

Organization:Iowa State University (CTRE)						
DTP	**Measure**	**Researcher/Personnel**	**Hours**	**Cost**	**Fringe Benefits**	**Totals**
8	2.3.4	T Maze	10	$634	$156	$790
		B McCall	40	$1,792	$552	$2,344
		M Nelson	60	$1,235	$381	$1,616
		Student	104	$1,679	$254	$1,933
		Subtotals	214	$5,340	$1,342	$6,682
		Support Personnel	52	$888	$318	$1,206
	Equipment:			$0		
	Supplies:			$515		
	Travel:			$2,850		
	Subtotal:					$3,365
	Overhead					$4,951
	Total:					**$16,204**

4 REFERENCES

1. Bell, C.A., B. McCall, and, C.M. Walton, A “The Oregon ‘Green Light’ CVO Project, Evaluation Plan” GLEV9601, Oregon State University, Transportation Research Institute, September 1996.

2. Bell, C.A., B. McCall, and, C.M. Walton, AThe Oregon >Green Light= CVO Project, Individual Test Plan AGLEV9602, Oregon State University, Transportation Research Institute, October 1996.

Transportation Research Institute
100 Merryfield Hall
Corvallis, OR 97331-4304
Phone 541.737.4273
Fax 541.737.3462

Center for Transportation Research
2625 N. Loop, Suite 2100
Ames, IA 50010-8615
Phone 515.294.8103
Fax 515.294.0607

WHM Transportation Engineering
2717 Rio Grande St
Austin, TX 78705
Phone 512.473.8343
Fax 512.473.8273

Oregon Green Light CVO Evaluation

Detailed Test Plan # 9

Measure 2.5.1 Estimate Changes in Fuel Use

TABLE OF CONTENTS

TABLE OF EXHIBITS

1 DETAILED TEST INTRODUCTION

1.1 BACKGROUND

This Detailed Test Report is the ninth of 14 test reports that will be submitted as part of the independent technical evaluation of the Oregon Green Light CVO project. The Oregon Department of Transportation (ODOT) is in the process of implementing their Intelligent Vehicle Highway System Strategic Plan for Commercial Vehicle Operations (now referred to as ITS/CVO). Through Green Light, Oregon is installing twenty-two mainline preclearance systems featuring weigh-in-motion (WIM) devices and automatic vehicle identification (AVI) at the major weigh stations and ports-of-entry throughout the state. In addition, certain sites will be equipped with data collection systems for use in regulatory enforcement (ITEN sites) while other sites will be equipped with safety enhancements that regulate road conditions and speed.

The purpose of these documents is to provide detail to procedures taken when testing the various measures proposed in the Green Light Evaluation. The Detailed Test Reports will cover all of the test measures described in Exhibit 2-1 of The Oregon “Green Light” CVO Project - Evaluation Plan [1].

Each of the tests conducted by the research team for the evaluation of Green Light will address one of five goals of the evaluation as documented in the Evaluation Plan. These are:

- Assessment of Safety
- Assessment of Productivity
- Assessment of User Acceptance
- Assessment of Mainstreaming Issues
- Assessment of Non-Technical Interoperability Issues

The objectives associated with each goal are given in detail in The Oregon “Green Light” CVO Project - *Individual Test Plans* (ITP) [2]. In addition, condensed one-page tables are contained in the appendices of the ITP, outlining the measures to be conducted for each of the stated objectives. The detailed test plan documents will expand on the information provided in the ITP and provide in detail the activities carried out for each *evaluation measure* during the course of the evaluation in regards to the stated objectives.

1.2 PURPOSE AND SCOPE

This particular detailed test plan outlines the three evaluation measures employed to determine the objective *determine impacts on energy*, one of six objectives in support of the goal of assessing productivity. Like the accompanying Detailed Test Plans, this document is not meant to be exclusive of the ITP, but rather an extension of that document to provide scope and direction for the research team.

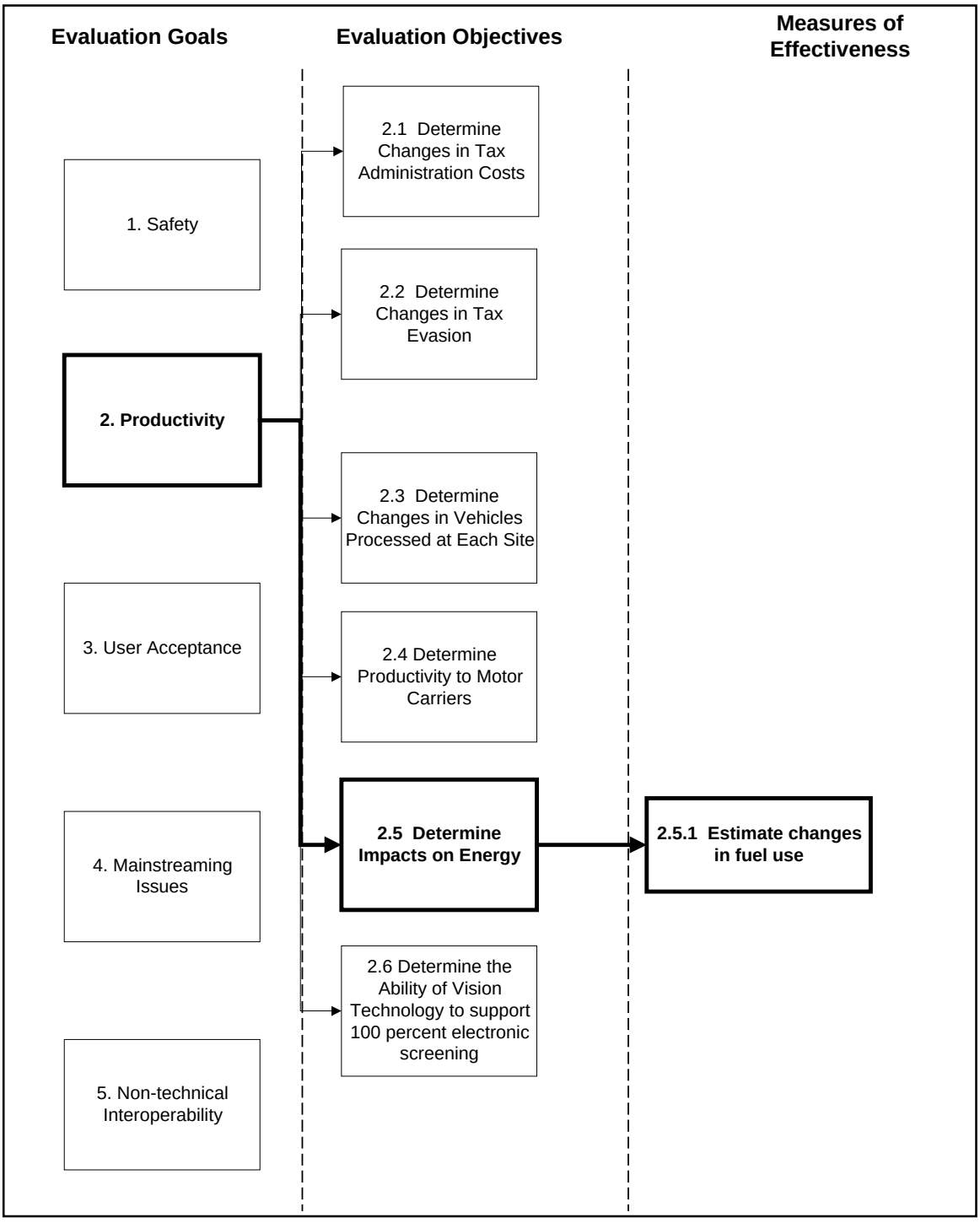
The evaluation measure is

- **2.5.1 Estimate changes in fuel use attributable to preclearance**

A detailed description of the hypothesis to be tested as well as the test methodology and deliverables is provided in Chapter 2. Chapter 3 provides a detailed test schedule and budget for the test measure.

The scope of this detailed test plan within the context of the overall Green Light Evaluation is shown in Exhibit 1-1. The test measures outlined in this document are highlighted for reference.

Exhibit 1-1 Evaluation Goals, Objectives, and Measures



1.3 DISCUSSION

The fuel consumption of commercial vehicles is affected by many factors. For example, studies have shown that the fuel consumption of a fully loaded, class eight commercial vehicle increases by one-tenth of a mile per gallon for every one mile per hour increase in speed from 55 miles-per-hour to 65 miles-per-hour. The operations of weigh stations can also affect the fuel consumption of commercial vehicles. For example, it is likely that a truck waiting in long queues to be processed through a weigh station equipped with a static scale will consume more fuel than a truck that is weighed on a ramp Weigh-In-Motion (WIM) scale and cleared to return to the mainline. A primary objective of the Oregon Green Light CVO evaluation is to measure any fuel savings that may be attributable to electronic screening.

One of the basic premises of this detailed test plan is that results gained in previous research projects can be transferred to the Oregon Green Light environment. Oregon Weigh station designs are similar to other weigh station designs in other parts of the country. Of course, the unique speed, weather, road, and topographical characteristics of a particular site, each affect fuel consumption. It is believed, however, that the results from previous research projects will provide reasonable and reliable estimates of fuel savings and will be applicable to the Oregon Green Light environment.

For the simulation portion of this test plan, the research team will focus on the Woodburn Port of Entry (POE). Located on Interstate 5 South of Portland, Woodburn is Oregon's busiest weigh station and is scheduled to be the first to be equipped with preclearance technology.

1.4 OTHER STUDIES

The purpose of the Green Light CVO Project is to develop and deploy advanced technology to improve the safety and efficiency of commercial vehicle operations, to increase the performance of the highway system, and to protect the investment in our infrastructure. Several pre-clearance operational tests have been deployed since the advent of the Intermodal Surface Transportation Efficiency Act of 1991(ISTEA). Tests such as the HELP/CRESCENT Project, were an early indicator of the feasibility of electronic clearance of commercial motor vehicles.

The Advantage I-75 CVO Mainline Automated Clearance System (MACS) is in its operational phase. The project corridor, which runs from Ontario through Michigan, Ohio, Kentucky, Tennessee, Georgia, and Florida, is a prototype demonstration of pre-clearance technology.

Part of the evaluation task of the Advantage I-75 MACS Project was to establish an estimate of fuel savings attributable to bypassing weigh stations. There are a variety of weigh station designs along the I-75, so a representative sample of the weigh station designs was used in the testing to determine a fuel savings estimate. Preliminary results from this operational test will be released shortly.

2 TEST METHODOLOGY

2.1 PHYSICAL DESCRIPTION

This section provides a detailed account of the activities that make up this evaluation. This evaluation will be partially based on transferring the results of the field data collection and analysis conducted for the Advantage I-75 Mainline Automated Clearance System. The Advantage I-75 Mainline Automated Clearance System, Detailed Evaluation Plan Part Two: Motor Carrier Fuel Consumption Individual Evaluation Test Plan, May 10, 1996 provides a detailed discussion to the methods used to collect and analyze the data.

2.1.1 Purpose and Scope

To identify changes in fuel use, the research team will employ a two-pronged approach. It will first focus on transferring the knowledge gained in the evaluation of the Advantage I-75 Field Operational Test . CTRE is currently conducting fuel consumption tests as part of the evaluation of the Advantage I-75 CVO electronic screening initiative. The I-75 fuel consumption test is based on accepted fuel consumption test procedures. CTRE will present the findings of the I-75 test and discuss the implication of the findings for mainline weigh in motion systems in general.

For the second part of the evaluation, the research team will develop and present a simulation model of the Woodburn POE and the adjacent mainline. Woodburn POE has been selected because the Woodburn design is typical and representative of many sites in Oregon. Using both Arena and Corsim Software, Dr. Ali Kamyab will develop models that will allow the Oregon Department of Transportation to predict and illustrate fuel consumption savings attributable to Oregon Green Light.

The simulation model can be manipulated to predict fuel consumption for an infinite number of scenarios. It is expected that the two primary input variables would be; *1) the proportion of trucks equipped with transponders. 2) overall truck traffic on the mainline.* Other variables that might be considered include*: classification or profile of truck types, changes in speed as a result of changes in speed limit, and/or changes in service time at the weigh station.* So, for example, if ODOT projects that by the year 2007 there will be an eight percent increase in truck traffic with a doubling in the population of long combination vehicles and with sixty five percent of all trucks being equipped with transponders, the simulation can predict the fuel consumption savings attributable to Oregon Green Light.

2.1.2 Hypothesis

The following hypothesis is given in support of the measure.

2.5.1 Reduction or elimination of stops at weigh stations commercial motor vehicles will result in measurable fuel savings for transponder equipped commercial vehicles.

2.2 PRE-TEST ACTIVITIES

Pre-test activities for this measure will focus on the sources, quality, and availability of data.

1) Data Sources and Availability

The primary data sources used for this test measure are:

- The Advantage I-75 Mainline Automated Clearance System, Detailed Evaluation Plan Part One, dated October 18, 1995.
- The Advantage I-75 Mainline Automated Clearance System, Detailed Evaluation Plan Part Two, Motor Carrier Fuel Consumption Individual Evaluation Test Plan, dated May

10, 1996.

- The report of the analysis of the field data collected according to the Motor Carrier Fuel Consumption Test Plan.
- Oregon Department of Transportation's Traffic Volume Tables (published annually). This document provides historical traffic data, including a breakdown by classification of vehicles, for Interstate 5 in the vicinity of Woodburn POE.

2.3 TEST CONDUCT ACTIVITIES

2.3.1 Descriptions/Participants

- The Center for Transportation Research & Education (Bill McCall, Mark Nelson, and staff) will conduct the research.
- Transportation Research Institute (Chris Bell, Paul Montagne, and staff) will be the lead contractor for the evaluation and will coordinate development and execution of the individual test plan.

2.3.2 Procedures

1) *CTRE will present the findings of the Advantage I-75 fuel consumption tests and discuss the implications of the findings for mainline weigh-in-motion applications beyond Interstate 75.*

1a) Describe the objectives, procedures, and findings of the I-75 fuel consumption tests.

The I-75 fuel consumption tests were based on SAE Type II Fuel Consumption Test recommended practice (October 1986). The objective of the tests was to determine the differences in fuel consumption between two nearly identical trucks operating under defined scenarios. The scenarios were designed such that one truck simulated

electronic clearance by driving past the weigh station at mainline speeds while the other truck simulated weigh station processing by driving through and stopping or slowing (depending on the dictates of the weigh station) at the weigh station. The two trucks were installed with special 15-gallon fuel tanks and given specific instructions regarding speed and route. The drivers followed the same loop of interstate highway pulling into (or passing) one weigh station in each direction. The trucks hauled identical loads and the same drivers were used for each round of tests. The test runs began within one-minute of each other to control as much variability in fuel consumption as possible. The fuel consumption was then measured according to the procedures defined in the SAE Type II Fuel Consumption Test recommended practice (October 1986).

At the end of each run, the difference in fuel use is measured. The findings are tested using two-sample t-testing procedures to determine whether the savings are significantly different than zero. Results are then reported as fuel savings in gallons per weigh station bypassed with a standard error.

1b) Discuss the relevance and transferability of the Advantage I-75 fuel test findings.

The value of Advantage I-75 fuel test are dependent upon the transferability of the findings. The final report on fuel consumption will discuss the transferability of findings.

2) *Simulate the impact of electronic screening on fuel consumption patterns at and in the vicinity of the Woodburn POE.*

The Federal Highway Administration's newly developed CORSIM software enables the research team to simulate the traffic conditions of Interstate 5 in the vicinity of the Woodburn POE over time and, in doing so, to predict fuel consumption trends.

2a) Weigh Station Module.

CTRE will first develop a weigh station module using customized traffic simulation software. The module will be based on the unique design characteristics, topography, and traffic patterns of the Woodburn POE. The data collection and model development procedures for this module are described in greater depth in Detailed Test Plan #7.

2b) Mainline Module Data Collection.

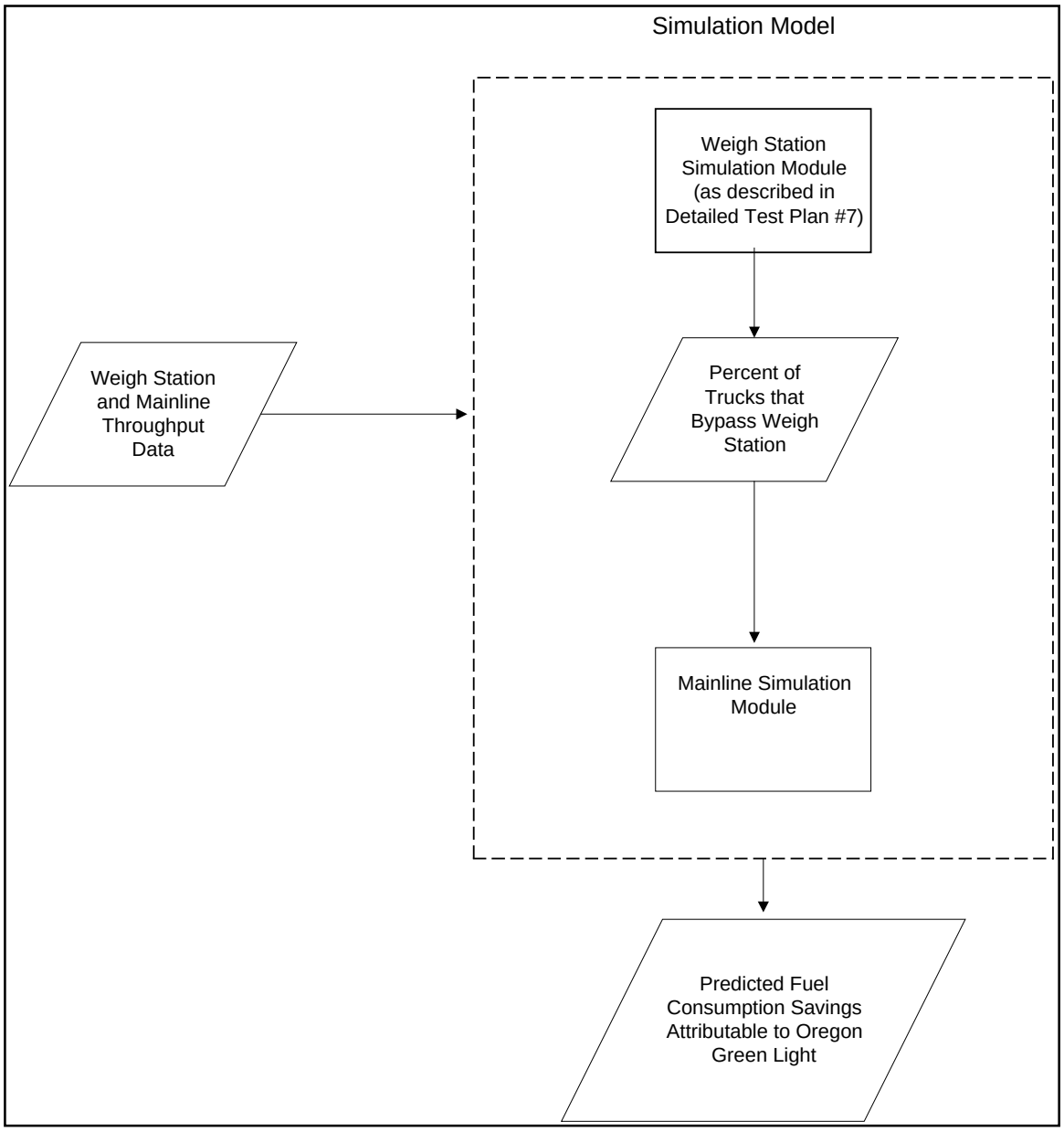
The throughput data collected as part of the weigh station module (reference Detailed Test Plan #7) will also serve as input for the mainline module. One of the outputs of the weigh station simulation, "ratio of bypasses to pull-ins under various assumptions," will be input data for the mainline module.

2c) Mainline Module Development.

CTRE will develop and present a computer simulation to illustrate the effect of electronic screening on mainline traffic activity and the resulting changes in fuel consumption. Fuel consumption estimates will be broken out by vehicle classification. FHWA's Corsim traffic modeling software will be used to develop the mainline module. Corsim contains internal data tables that define fuel consumption by vehicle class. The table expresses these rates as a function of acceleration, given the vehicle performance index and vehicle speed.

The Oregon Department of Transportation publishes Traffic Volume Tables annually. The tables include traffic data for Interstate 5 in the vicinity of Woodburn Port of Entry. The tables provide not only traffic volume data but also classification of vehicles. This data will be used to verify the mainline traffic data collected on site. It can also serve as baseline input for the simulation model.

Exhibit 2-1 Fuel Consumption Simulation Data Flow Chart



2.4 POST-TEST ACTIVITIES

2.4.1 Reporting Procedures for Individual Test

A report will be prepared for these test measures according to the guidelines given in the Evaluation Plan and will proceed as follows:

1. Preparation of a draft report for each test to be submitted to the steering committee (SC) for their approval.
2. Approval of the SC at a scheduled meeting.
3. Preparation of a final test report for each test, incorporating SC recommendations.
4. Submittal of 1 hard copy original, 1 electronic original, and ten bound copies of each test report to Oregon DOT's project management team.
5. Transmittal of the test reports by ODOT to FHWA.

2.4.2 Reporting Schedule for Individual Test Reports

The reporting schedule for the individual test reports is shown below:

Exhibit 2-2 Reporting Schedule - Individual Test Reports

Deliverables	Schedule	Scheduled Due Date*
Drafts of Individual Test Reports	July 1-August 30, 1999 (60 days)	September 1, 1999
Review of Individual Test Reports by Steering Committee	September 1-30, 1999 (30 days)	October 1, 1999
Individual Test Reports (Final)	October 1-November 30, 1999 (60 days)	December 1, 1999

2.4.3 Data Retention/Archival Procedures

Data collected and documents produced over the course of the evaluation will be archived and submitted to ODOT project management. In addition, a document summarizing the data and reports will be produced as follows:

1. Preparation of a summary document describing data analyzed and reports prepared over the course of the evaluation.
2. Submittal of a data archive containing raw data files and all reports in compressed format.

2.4.4 Reporting Schedule for Data Retention/Archival Procedures

The reporting schedule for the archiving of data and the preparation of a summary document is given below:

Exhibit 2-3 Reporting Schedule - Data Archiving

Deliverables	Schedule	Scheduled Due Date*
Drafts of a Data Summary Report	Dec. 1, 1999 - Jan 30, 2000 (60 days)	February 1, 2000
Review of Data Summary Report by Steering Committee	Feb. 1 - Feb. 28, 2000(28 days)	March 1, 2000
Data Summary Report(Final) and Data Archive	Mar 1 - Mar 30, 2000 (30 days)	April 1, 2000

2.4.5 Test Summary Report Procedures

A test summary report will be prepared highlighting findings from the individual test reports. The document will be produced as follows:

1. Preparation of a draft report summarizing the results of all the individual test reports for submittal to the SC.
2. Approval of the SC at a scheduled meeting.
3. Preparation of a final test summary report, incorporating SC recommendations.
4. Submittal of 1 hard copy original, 1 electronic original, and ten bound copies of the summary report to Oregon DOT's project management team.
5. Transmittal of the test reports by ODOT to FHWA.

2.4.6 Reporting Schedule for Test Summary

A reporting schedule is shown below for the test summary report:

Exhibit 2-4 Reporting Schedule - Test Summary Reports

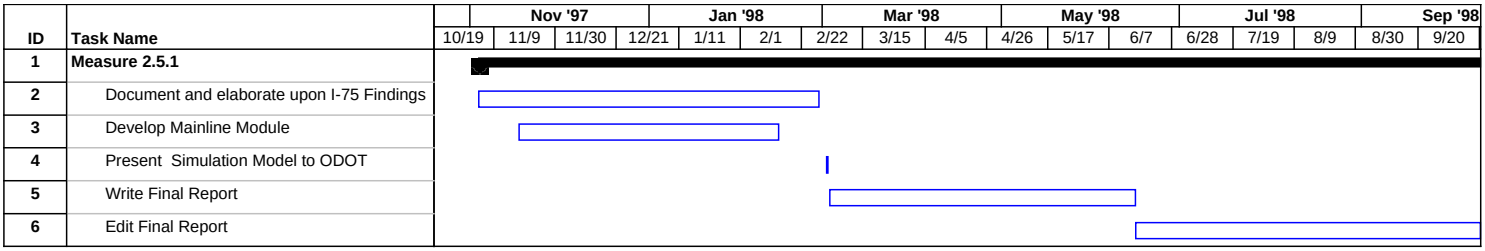
Deliverables	Schedule	Scheduled Due Date*
Drafts of Test Summary Report	Dec. 1, 1999 - Jan 30, 2000 (60 days)	February 1, 2000
Review of Test Summary Report by Steering Committee	Feb. 1 - Feb. 28, 2000(28 days)	March 1, 2000
Test Summary Report (Final)	Mar 1 - Mar 30, 2000 (30 days)	April 1, 2000

3 TEST MANAGEMENT PLAN

3.1 DETAILED TEST SCHEDULE

A detailed test schedule is shown in Exhibit 3-1.

Exhibit 3-1 Detailed Test Schedule for Measure 2.5.1



3.2 COST BREAKDOWN BY MEASURE

A cost breakdown for these test measures is shown below. These figures are estimates only and are subject to revision as the evaluation progresses.

Exhibit 3-2 Cost Breakdown for Measure 2.5.1

Organization:Iowa State University (CTRE)						
DTP	**Measure**	**Researcher/Personnel**	**Hours**	**Cost**	**Fringe Benefits**	**Totals**
9	2.5.1	T Maze	30	$1,902	$467	$2,369
		B McCall	80	$3,584	$1,104	$4,688
		M Nelson	160	$3,294	$1,015	$4,309
		A Kamyab	210	$5,727	$1,764	$7,491
		Student	312	$5,036	$762	$5,798
		Subtotals	792	$19,543	$5,112	$24,655
		Other Personnel	192	$3,248	$1,175	$4,423
	Equipment:			$875		
	Supplies:			$1,000		
	Travel:			$0		
	Subtotal:					$1,875
	Overhead					$13,234
	Total:					**$44,187**

4 REFERENCES

1. “Joint TMC/SAE Fuel Consumption Test Procedure-Type II- SAE J1321 OCT 86” pp. 36.11-36.14. SAE Recommended Practice, Report of the SAE/DOT Advisory Committee, approved 1981, and reaffirmed by the Truck and Bus Fuel Economy Committee, October 1986.

2. Bell, C.A., B. McCall, and, C.M. Walton, A “The Oregon ‘Green Light’ CVO Project, Evaluation Plan” GLEV9601, Oregon State University, Transportation Research Institute, September 1996.

3. Bell, C.A., B. McCall, and, C.M. Walton, AThe Oregon >Green Light= CVO Project, Individual Test Plan AGLEV9602, Oregon State University, Transportation Research Institute, October 1996.

Transportation Research Institute
100 Merryfield Hall
Corvallis, OR 97331-4304
Phone 541.737.4273
Fax 541.737.3462

Center for Transportation Research
2625 N. Loop, Suite 2100
Ames, IA 50010-8615
Phone 515.294.8103
Fax 515.294.0607

WHM Transportation Engineering
2717 Rio Grande St
Austin, TX 78705
Phone 512.473.8343
Fax 512.473.8273

Oregon Green Light CVO Evaluation

Detailed Test Plan # 10

Measure 2.6.1 Evaluate the accuracy of the vision technology by comparison of vision readout with actual plate numbers

TABLE OF CONTENTS

TABLE OF EXHIBITS

1. DETAILED TEST INTRODUCTION

1.1 BACKGROUND

This Detailed Test Report is the tenth of 14 test reports that will be submitted as part of the independent technical evaluation of the Oregon Green Light CVO project. The Oregon Department of Transportation (ODOT) is in the process of implementing their Intelligent Vehicle Highway System Strategic Plan for Commercial Vehicle Operations (now referred to as ITS/CVO). Through Green Light, Oregon is installing twenty-two mainline preclearance systems featuring weigh-in-motion (WIM) devices and automatic vehicle identification (AVI) at the major weigh stations and ports-of-entry around the state. In addition, certain sites will be equipped with data collection systems for use in regulatory enforcement (ITEN sites) while other sites will be equipped with safety enhancements that regulate road conditions and speed.

The purpose of these documents are to provide detail to procedures taken when testing the various measures proposed in the Green Light Evaluation. There will be a Detailed Test Report generated for each of the test measures described in Exhibit 2-1 of The Oregon “Green Light” CVO Project - Evaluation Plan [1].

Each of the tests conducted by the research team for the evaluation of Green Light will address one of five goals of the evaluation as documented in the Evaluation Plan. These are:

- Assessment of Safety
- Assessment of Productivity
- Assessment of User Acceptance
- Assessment of Mainstreaming Issues
- Assessment of Non-Technical Interoperability Issues

The objectives associated with each goal are given in detail in The Oregon "Green Light" CVO Project - *Individual Test Plans* (ITP) [2]. In addition, condensed one-page tables are contained in the appendices of the ITP, outlining the measures to be conducted for each of the stated objectives. The detailed test plan documents will expand on the information provided in the ITP and provide in detail the activities carried out for each *evaluation measure* during the course of the evaluation in regards to the stated objectives.

1.2 PURPOSE AND SCOPE

This particular detailed test plan outlines one of two test measures employed to obtain the objective *determining the ability of vision technology to support 100 percent electronic service*, one of six objectives in support of the goal of assessing productivity. Like the accompanying Detailed Test Plans, this document is not meant to be exclusive of the ITP, but rather an extension of that document to provide scope and direction for the research team.

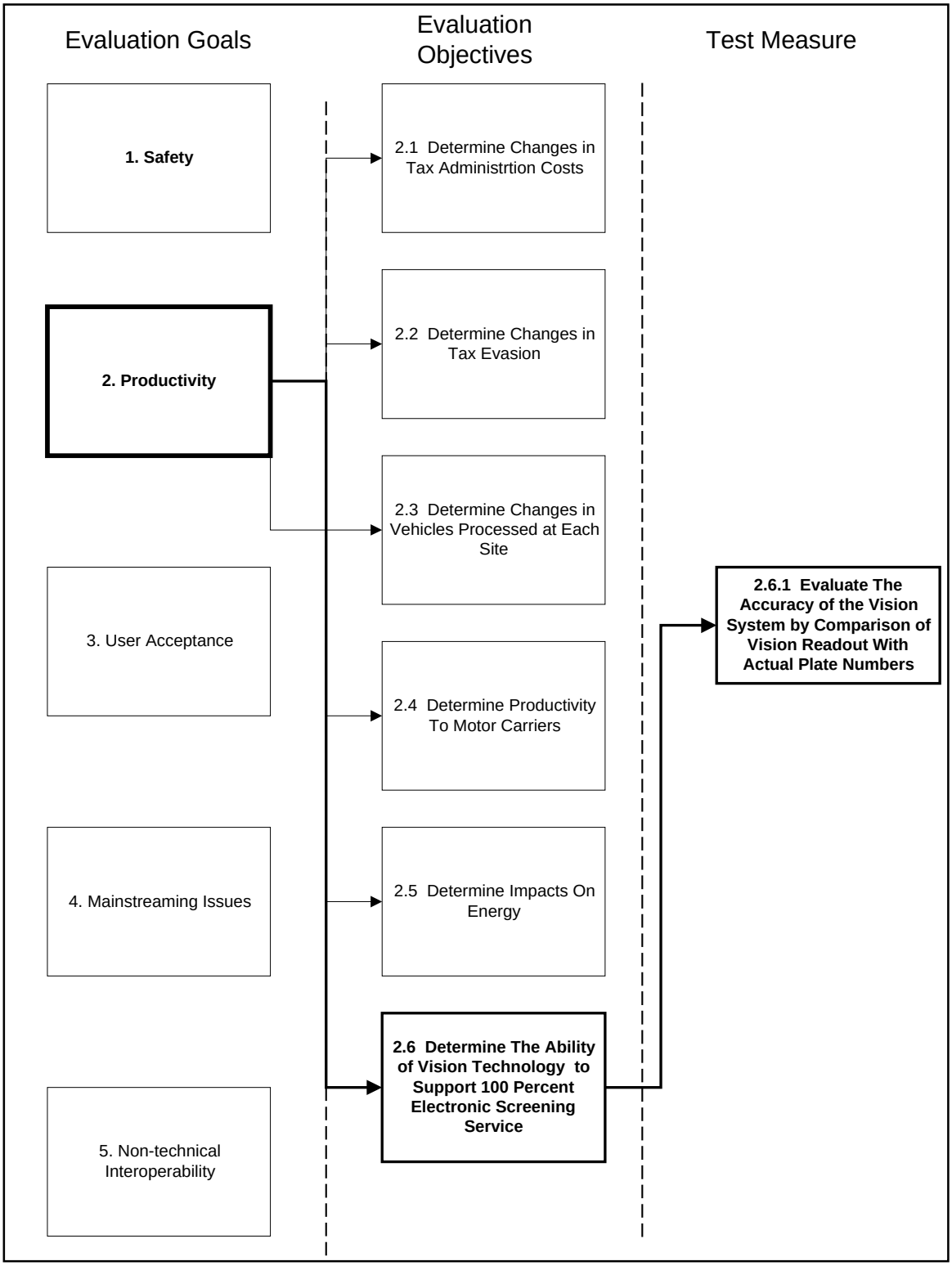
The evaluation measure used to determine change in truck behavior due to the DSIS is stated below:

- **2.6.1 Evaluation of the accuracy of the vision system by comparison of vision readout with actual plate numbers**

A detailed description of the hypothesis to be tested as well as the test methodology and deliverables is described in detail in Chapter 2. Chapter 3 provides a detailed test schedule and budget for the test measure.

The scope of this detailed test plans within the context of the overall Green Light Evaluation shown in Exhibit 1-1. The test measure outlined in this document is highlighted for reference.

Exhibit 1-1 Evaluation Goals, Objectives, and Measures



1.3 DISCUSSION

The license plate readers under evaluation were acquired with Commercial Vehicle Information System (CVISN) pilot project funds. The equipment is used and was previously installed in Iowa. The readers have been installed since mid 1996 but have never been fully functional. Most of the problems have not been with the readers themselves but with the inability to transmit data from the remote computer up to the system advisory computer. This has been largely due to the type of data (6 bit vs. 8 bit) being transmitted. The system is currently undergoing some system restructuring.

Currently, the installed plate readers have trouble reading Oregon PUC plates due to the low contrast of colors (white letters on a red background). The vendor, Perceptics Inc., is currently working with ODOT on how to remedy this situation. This test will be conducted once these issues have been resolved, which may not be until mid 1998.

Exhibit 1-3 License Plate Reader Locations

2. TEST METHODOLOGY

2.1 PHYSICAL DESCRIPTION

This section discusses the activities carried out in the evaluation of the license plate readers deployed under Green Light. At this time there are many uncertainties about exactly how the LPR equipment will be configured, and this test description is tentative. Subsequent revisions will provide the level of detail found in the other Detailed Test Plans.

2.1.1 Purpose

The purpose of this test is to determine the accuracy of the license plate readers, both in terms of the capture rate and the ability to convert a read plate to the correct corresponding characters.

2.1.2 Hypothesis

The following hypothesis is given in support of the two measures and will be tested according to accepted statistical techniques:

2.6.1 Evaluation of the accuracy of the vision system by comparison of vision readout with actual plate numbers

2.2 PRE-TEST ACTIVITIES

Pre-test activities for this measure will focus on the data sources, and determining site locations. These steps are discussed below.

1) Data Sources and Availability

Data will consist of readouts from the LPR remote computer and records of actual license plates passing through the system. A camera may be used to record actual plate numbers which will allow for greater amounts of data to be efficiently collected.

2) Determine Site Locations

At the time of this revision, ODOT is primarily concerned with making the two Woodburn sites fully functional. This test measure will be conducted at the Woodburn site initially and at the remaining sites if time and resources allow.

2.3 TEST CONDUCT ACTIVITIES

Below are the steps to be taken out in the evaluation of the vision technology at Woodburn POE.

2.3.1 Descriptions/Participants

- Transportation Research Institute (Chris Bell, Paul Montagne, staff) - will conduct the research, including collection and analysis of data.

2.3.2 Procedures

Over the course of the study, the following steps will be conducted:

1) Record actual plate numbers as they pass through system

Plate numbers will be recorded one of two ways; using a standing video camera that captures truck plates as they pass through the system or, recording by hand. Video is preferable as it allows for greater amounts of data to be collected, but also presents other problems, such as keeping the camera safe, and capturing plates in less-than-optimal conditions.

2) Record VISION readouts

3) Analyze Data

2.4 POST-TEST ACTIVITIES

2.4.1 Reporting Procedures for Individual Test

A report will be prepared for this test measure according to the guidelines given in the Evaluation Plan and will proceed as follows:

1. Preparation of a draft report for each test to be submitted to the steering committee (SC) for their approval.
2. Approval of the SC at a scheduled meeting.
3. Preparation of a final test report, incorporating SC recommendations.
4. Submittal of 1 hardcopy original, 1 electronic original, and ten bound copies of the report to ODOT's project management team.
5. Transmittal of the report by ODOT to FHWA.

2.4.2 Reporting Schedule

The reporting schedule for the individual test reports is shown below:

Exhibit 2-1 Reporting Schedule - Individual Test Reports

Deliverables	Schedule	Scheduled Due Date*
Drafts of Individual Test Reports	July 1-August 30, 1999 (60 days)	September 1, 1999
Review of Individual Test Reports by Steering Committee	September 1-30, 1999 (30 days)	October 1, 1999
Final Test Reports	October 1-November 30, 1999 (60 days)	December 1, 1999

2.4.3 Data Retention/Archival Procedures

Data collected and documents produced over the course of the evaluation will be archived and submitted to ODOT project management. In addition, a document summarizing the data and reports will be produced as follows:

1. Preparation of a summary document describing data analyzed and reports prepared over the course of the evaluation.
2. Submittal of a data archive containing raw data files and all reports in compressed format.

2.4.4 Reporting Schedule for Data Retention/Archival Procedures

The reporting schedule for the archiving of data and the preparation of a summary document is given below:

Exhibit 2-2 Reporting Schedule - Data Archiving

Deliverables	Schedule	Scheduled Due Date*
Drafts of a Data Summary Report	Dec 1, 1999 - Jan 30, 2000 (60 days)	February 1, 2000
Review of Data Summary Report by Steering Committee	Feb 1 - Feb 28, 2000(28 days)	March 1, 2000
Data Summary Report (Final) and Data Archive	Mar 1 - Mar 30, 2000 (30 days)	April 1, 2000

2.4.5 Test Summary Report Procedures

A test summary report will be prepared highlighting findings from all of the test measures. The document will be produced as follows:

1. Preparation of a draft report summarizing the results of all the individual test reports for submittal to the SC.
2. Approval of the SC at a scheduled meeting.
3. Preparation of a final test summary report, incorporating SC recommendations.
4. Submittal of 1 hardcopy original, 1 electronic original, and ten bound copies of the summary report to ODOT's project management team.
5. Transmittal of the test reports by ODOT to FHWA.
6. Reporting Schedule for Test Summary

A reporting schedule is shown below for the test summary report:

Exhibit 2-3 Reporting Schedule - Test Summary Reports

Deliverables	Schedule	Scheduled Due Date*
Drafts of Test Summary Report	Dec 1, 1999 - Jan 30, 2000 (60 days)	February 1, 2000
Review of Test Summary Report by Steering Committee	Feb 1 - Feb 28, 2000 (28 days)	March 1, 2000
Test Summary Report (Final)	Mar 1 - Mar 30, 2000 (30 days)	April 1, 2000

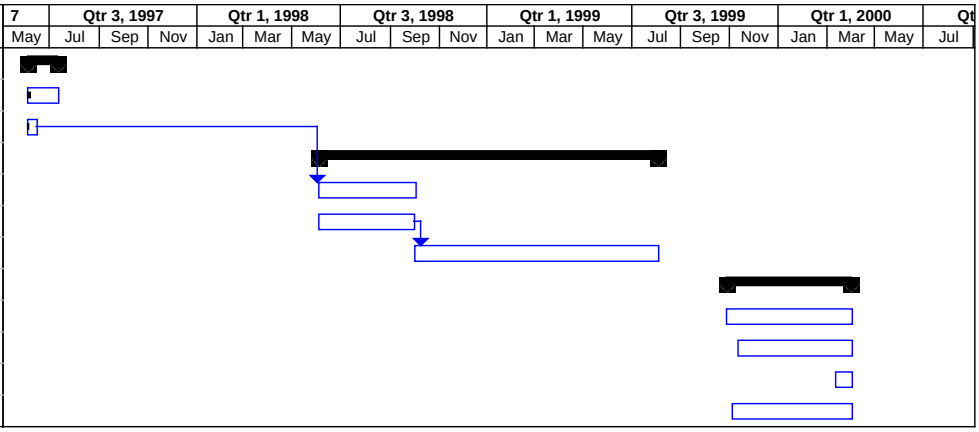
3. TEST MANAGEMENT PLAN

3.1 DETAILED TEST SCHEDULE

A detailed test schedule is shown in Exhibit 3-1.

Exhibit 3-1 Project Timeline for Test Measure 2.6.1

ID	Task Name
2	**Pre-test**
3	Data Sources and Availability
4	Determine Site Locations
5	**Test conduct**
6	Record actual plate numbers
7	Record VISION readouts
8	Analyze Data
9	**Post-test**
10	Analysis of data
11	Summarize findings
12	Archive records
13	Completion of test report



3.2 COST BREAKDOWN BY MEASURE

A cost breakdown for these measures are shown below in Exhibit 3-2. These figures are only estimates and are subject to revision as the evaluation progresses.

Exhibit 3-2 Cost Breakdown for Test Measure 2.6.1

Organization: Oregon State University (TRI)					
DTP	**Measure**	**Researcher**	**Hours**	**Cost**	**Totals**
10	2.6.1	C A Bell	88	$3,740	
		P E Montagne	458	$7,328	
					$11,068
	Payroll Exp:	C A Bell	32%	$1,197	
		P E Montagne	37%	$2,711	
	Subtotal:				$3,908
	Supplies:			$600	
	Travel:			$600	
	Subtotal:				$1,200
	Overhead		42%		$6,794
	Total:				**$22,970**

4. REFERENCES

1. Bell, C.A., B. McCall, and, C.M. Walton, A "The Oregon 'Green Light' CVO Project, Evaluation Plan" GLEV9601, Oregon State University, Transportation Research Institute, September 1996.

2. Bell, C.A., B. McCall, and, C.M. Walton, AThe Oregon >Green Light CVO Project, Individual Test Plan AGLEV9602, Oregon State University, Transportation Research Institute, October 1996.

3. Oregon Department of Transportation, "Oregon Green Light CVO Project Overview and Phase III Funding Work Plan" January 1997.

Transportation Research Institute
311 Apperson Hall
Corvallis, OR 97331-2302
Phone 541.737.4273
Fax 541.737.3462

Center for Transportation Research
2625 N. Loop, Suite 2100
Ames, IA 50010-8615
Phone 515.294.8103
Fax 515.294.0607

WHM Transportation Engineering
2717 Rio Grande St
Austin, TX 78705
Phone 512.473.8343
Fax 512.473.8273

Oregon Green Light CVO Evaluation

Detailed Test Plan # 11

Measure 3.1.1 Determine motor carrier attitudes toward electronic screening, including perceived impacts and attitudes towards new services such as the Road Weather Information System and the Downhill Speed Information System

Measure 3.1.2 Monitor Green Light transponder utilization by the motor carrier industry

TABLE OF CONTENTS

TABLE OF EXHIBITS

1 DETAILED TEST INTRODUCTION

1.1 BACKGROUND

This Detailed Test Report is the tenth of 12 test reports that will be submitted as part of the independent technical evaluation of the Oregon Green Light CVO project. The Oregon Department of Transportation (ODOT) is in the process of implementing their Intelligent Vehicle Highway System Strategic Plan for Commercial Vehicle Operations (now referred to as ITS/CVO). Through Green Light, Oregon is installing twenty-two mainline preclearance systems featuring weigh-in-motion (WIM) devices and automatic vehicle identification (AVI) at the major weigh stations and ports-of-entry throughout the state. In addition, certain sites will be equipped with data collection systems for use in regulatory enforcement (ITEN sites) while other sites will be equipped with safety enhancements that regulate road conditions and speed.

The purpose of these documents is to provide detail to procedures taken when testing the various measures proposed in the Green Light Evaluation. Detailed Test Reports will be generated for each of the test measures described in Exhibit 2-1 of The Oregon “Green Light” CVO Project - Evaluation Plan [1]. All of these reports are designed to be works-in-progress and are to be updated regularly as needed to reflect changes in the evaluation and deployment of Green Light. This is the second revision of this particular detailed test plan.

Each of the tests conducted by the research team for the evaluation of Green Light will address one of five goals of the evaluation as documented in the Evaluation Plan. These are:

- Assessment of Safety
- Assessment of Productivity
- Assessment of User Acceptance
- Assessment of Mainstreaming Issues
- Assessment of Non-Technical Interoperability Issues

The objectives associated with each goal are given in detail in The Oregon "Green Light" CVO Project - *Individual Test Plans* (ITP) [2]. In addition, condensed one-page tables are contained in the appendices of the ITP, outlining the measures to be conducted for each of the stated objectives. The detailed test plan documents will expand on the information provided in the ITP and provide in detail the activities carried out for each *evaluation measure* during the course of the evaluation in regards to the stated objectives.

1.2 PURPOSE AND SCOPE

This particular detailed test plan outlines the test measures employed to obtain the objective *assessing motor carrier acceptance of Green Light,* one of two objectives in support of the goal of assessing user acceptance. Like the accompanying Detailed Test Plans, this document is not meant to be exclusive of the ITP, but rather an extension of that document to provide scope and direction for the research team.

The evaluation measures used to assess motor carrier acceptance are stated below:

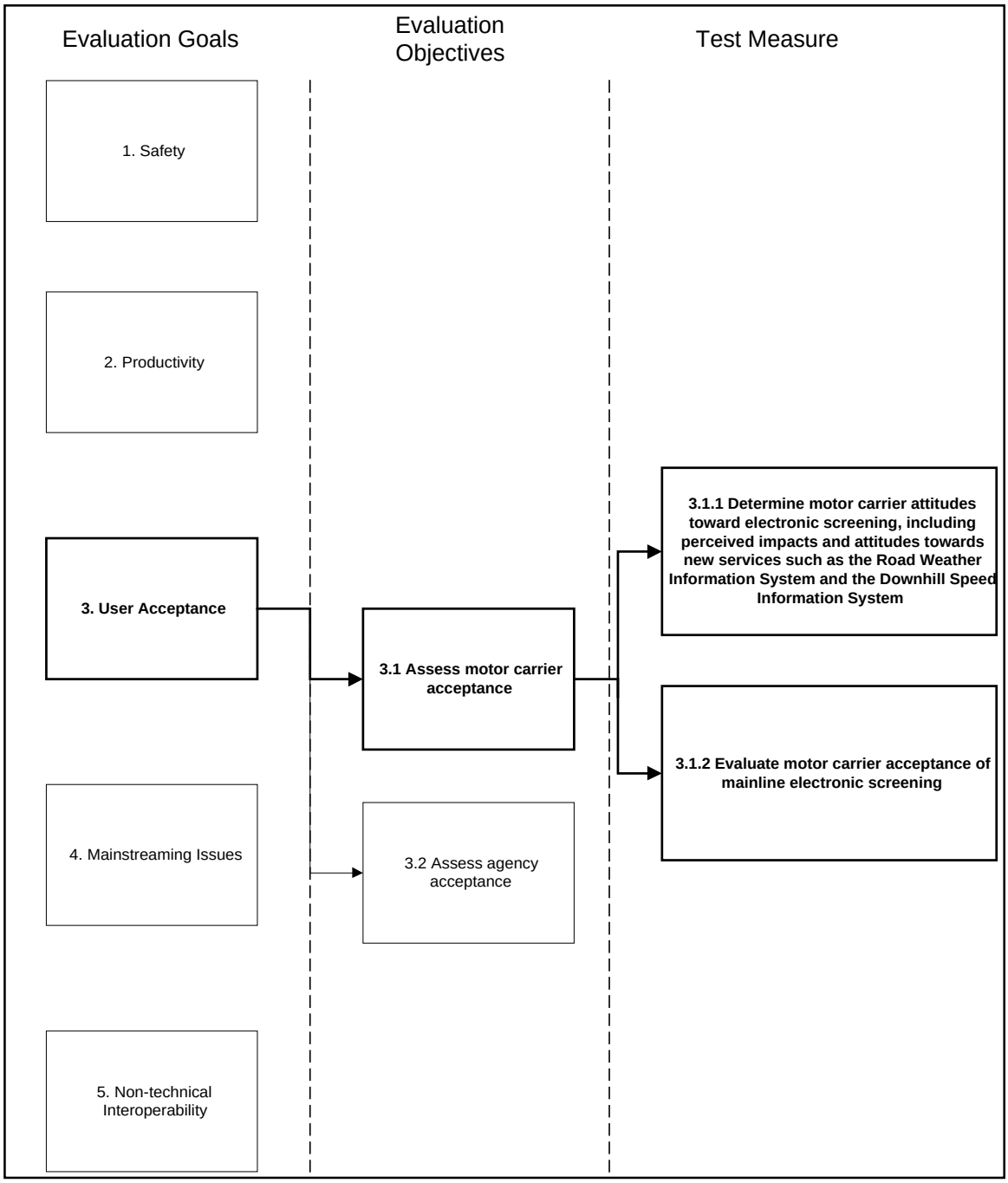
- **3.1.1 Determine motor carrier attitudes toward electronic screening, including perceived impacts and attitudes towards new services such as the Road Weather Information System and the Downhill Speed Information System**
- **3.1.2 Monitor Green Light transponder utilization by the motor carrier industry**

Measure 3.1.1 will utilize a mail survey in order to determine user attitudes as outlined in Chapter 3. The design of the survey will be based on *The Total Design Method* as presented in "Mail and Telephone Surveys-Total Design Method" by Dillman [3]. Measure 3.1.2 will track the issuance of transponders to the motor carrier population over the course of the evaluation period

A detailed description of the hypotheses to be tested as well as the test methodology and deliverables is described in detail in Chapter 2. Chapter 3 provides a detailed test schedule and budget for the test measure.

The scope of this detailed test plans within the context of the overall Green Light Evaluation is shown in Exhibit 1-1. The test measure outlined in this document is highlighted for reference.

Exhibit 1-1 Evaluation Goals, Objectives, and Measures



1.3 DISCUSSION

Each of the following elements of the Green Light project has the potential to affect motor carrier operations within Oregon. Using the survey, each of these elements will be assessed in terms of their acceptance by the motor carrier industry.

Mainline Preclearance

Mainline preclearance is the term used to describe the screening of commercial motor vehicles while still on the freeway or highway using advanced equipment located on the mainline. This screening process allows a significant amount of truck traffic to remain on the mainline and avoid exiting and reentering at fixed scales and ports-of entry. Equipment used for mainline preclearance are transponders located in the cab of participating vehicles, transponder readers fixed to overhead poles on the mainline, scales embedded in the roadway that weigh each axle as the truck passes, and overheight detectors. As a commercial vehicle approaches ports of entry and weigh stations with these elements installed, it is identified, weighed, checked for height violations, and classified. The identification process will include checking the carrier's safety status, credentials and permits. This information is sent to supervisory system computer (SSC). If the vehicle meets the basic bypass criteria, it continues on the mainline and is not required to stop.

Integrated Tactical Enforcement Network

Green Light will incorporate developing enforcement sites that are to be used in the Integrated Tactical Enforcement Network (ITEN). ITEN is a collection of remote sensing devices located on the state highway system along alternate routes to major weigh stations and port of entry. It will serve as a management tool to more effectively utilize enforcement personnel.

Safety Enhancements

Two Downhill Speed Information Systems (DSIS) will be installed over the course of the Green Light Project. The purpose of these systems is to reduce the frequency and severity of downgrade truck accidents along steep grades. In the case of Oregon's DSIS, a weigh-in-motion device, and variable message sign will combine to weigh a vehicle, and relay a suggested descent speed to the driver. Trucks carrying transponders will have specific information about their truck included in the displayed message.

The DSIS will be installed at Siskiyou Summit on Interstate 5 for northbound traffic descending into Ashland and atop Cabbage Hill on I-84 for traffic descending into Pendleton. Both of these sections have a history of high incident rates involving commercial motor vehicles.

Three Road Weather Information Systems (RWIS) will be installed to measure road surface conditions, wind speed and direction, dew point, air temperature and visibility. The information will then be relayed to motorists via variable message signs, information kiosks, and the Internet. The RWIS utilizes a tower at the roadside that collects weather data. In addition, a sensor ids embedded in the roadway that monitors surface temperature. This installation, known as an remote processing unit, collects data and relays it to a central computer via phone or radio.

2 TEST METHODOLOGY

2.1 PHYSICAL DESCRIPTION

This section discusses in detail the activities carried out in the assessment of motor carrier acceptance of Green Light. Essentially there will be two tests described in this detailed test plan. The first test will incorporate two questionnaire surveys, one administered early in Green Light's deployment another towards the end of the evaluation period.

The second test will involve the tracking of transponder usage by the motor carriers. This will be done in coordination with the transponder administrator. Data about the carriers such as fleet size and location will be examined along with transponder issuance for Green Light participants.

2.1.1 Purpose

The questionnaire survey will be used to determine user attitudes in two distinct areas:

1. User attitudes toward electronic screening and its perceived impacts on the motor carrier
2. User attitudes towards new services such as the RWIS and DSIS technologies, and selecting vehicles for inspection based on inspection and compliance status

The target population will include both drivers and owners. The questionnaire will be filled out by a representative portion of the total motor carrier population in attempts to limit any sampling error. Findings will be analyzed and compared to show how the motor carrier industry is adapting to the new services over time.

The tracking of transponder usage over the course of the evaluation period will be used to supplement the questionnaire in regards to how well the motor carrier industry. This analysis will serve to provide an understanding of the types of carriers who are participating in the program and using the services provided.

2.1.2 Hypotheses

The following hypotheses are given in support of the three measures and will be tested according to accepted statistical techniques:

- **3.1.1 The majority of carriers will have a positive attitude towards electronic screening and new services**
- **3.1.2 Carriers will demonstrate acceptance by installing transponders**

2.2 PRE-TEST ACTIVITIES

Pre-test activities for these measures will focus on designing the questionnaire survey, administering a small test mailing of the questionnaire, refining the questionnaire and defining the target population.

1. Design the questionnaire

The questionnaire will be designed to address issues that are indicative of the attitudes of the motor carrier to the technology introduced by Green Light. In particular, the questionnaire will attempt to assess the attitude of motor carriers towards mainline pre-screening, downhill speed and road weather information systems, as well as the use of integrated tactical enforcement networks.

The survey will be designed as a “before and after” survey and will be administered twice, once before the deployment of Green Light, and again towards the end of the evaluation period. Realizing that a similarly-worded “After” survey will eventually be administered, it is important that the survey include all the questions needed to make a fair judgment on the impacts of Green Light.

Given that there will be a strong “self-selection” bias in who responds to the questionnaire, it is important that an approach be devised to **weight** the sample of completed surveys to reflect the characteristics of the parent universe, so far as they are known. That is, to the extent that there exists reliable information about the universe of trucking firms that one is interested in, one should try to collect data that conform (in question wording, pre-coded responses, etc.) to those available statistics. Such survey responses may then be used to weight the surveys returned to reflect the characteristics of the universe. Possible options are the location of the firm, the size of the firm, or the types of commodities carried.

Accompanying the survey will be a cover letter and a brief description of each of the Green Light components to aid recipients in understanding the various Green Light technologies. In addition, a single sheet outlining benefits of Green Light to industry and government will be included.

Feedback from members of ODOT’s Motor Carrier Safety Branch as well as specialists in the field of survey design, will be solicited throughout the design phase in order to garnish their expertise.

2. Conduct a test survey

In order to prevent ambiguities in the wording of the questionnaire, a test questionnaire will be

mailed to 50 motor carriers in Oregon. This will also help to determine response rates expected in the survey. The list of fifty carriers will be provided by ODOT and will preferably include carriers familiar with similar transponder based technologies. This will provide the researchers with valuable feedback about the survey design. Response rates will be exaggerated in this respect because the carriers will not be indicative of the motor carrier population as a whole, and will be adjusted accordingly.

3. Refine the questionnaire

The test questionnaire should serve to clarify any ambiguities that may exist in the wording of the questions. Any comments or obvious confusion on the part of participants will be carefully looked at and incorporated into the final survey.

4. Obtain carrier mailing list from ODOT

The Motor Carrier Safety Branch keeps a database of motor carriers conducting business with ODOT. The database contains roughly 60,000 motor carriers. It includes the name, address, phone number, fleet size, and unique identifier for each carrier, as well as permit and tax data. A query of this database using certain constraints will provide the research team with an initial set of the addresses of potential participants. This list of addresses will then be sampled randomly so that all of will have an equal chance of being selected to receive the survey

Many of the carriers in ODOT's database are not suitable for selection in the study due to the nature of their operations. Examples are small delivery carriers who only operate within urban areas such as Portland, busses, pick-ups and passenger cars registered as commercial vehicles, or small parcel carriers. In effect, what the sample population should contain are those carriers which have are most likely to be affected by Green Light (which can best be described as heavy trucks). Current regulations require that all vehicles with a gross vehicle

weight greater than 26,000 lbs. exit the roadway at open weigh stations for processing. These carriers are most likely to be affected by the mainline preclearance, ITEN, and DSIS technologies. RWIS provides warnings to all vehicles and is not limited to commercial motor vehicles.

The computer request form used by ODOT's Information Services allows for data requests to limit carriers by type of carrier (active vs. inactive), fuel type, weight, operation classification, and vehicle body type. An example of the form is shown in the appendix.

For the purposes of this study, the query of addresses will be limited to all carriers operating diesel trucks, 26,000 lbs. or greater. Operation classifications will include all types of carriers except Interstate Common Carrier Passengers, Interstate Common Carrier Local Cartage, and Interstate Common Carrier Small Parcel. These changes reflect the advice of ODOT MCTB personnel familiar with the types of carriers who would utilize Green Light and its components. All vehicle body types will be selected except passenger cars, busses, and pickups.

A cursory examination of ODOT's motor carrier database estimates the total population to be in the area of 20,000 carriers when limited to carriers as described above.

5. Develop a sampling procedure

It is useful in minimizing variance and increasing confidence levels to develop strata which naturally break the population into groups that are inherent to differences in the population. Examples might be looking at Oregon carriers vs. carriers from adjoining states, vs. all other carriers. Another breakdown might be examining long haul vs. short haul carriers. By dividing the population into strata such as these, one can analyze how groups' opinions differ from those from another group or strata. The population can also be examined as a whole.

This study will use location of the motor carrier as the criteria for establishing strata. The basis for this decision was that local carriers are likely the ones to be most affected by Green Light, followed by carriers in nearby states. Table 2-1 below illustrates the breakdown of motor carriers by strata used in this test plan.

Table 2-1 Strata Used In Sampling Design

	Carriers	Power Units
Oregon	7602	30522
Washington	2247	13577
California	1626	9269
Nevada	116	489
Idaho	857	5613
	4846	28948
All Others	7238	157533
Total Population	**19686**	**217003**

6. Calculate sample size

Sample size is largely driven by the constraints of the survey design which are discussed in the following section. Given the fact that the response rate for such a survey using Dillman's method, which requires multiple mailings of the survey along with a pre-letter and follow up postcard, the sample size will largely be driven by what is affordable. The initial survey must be planned so that it is not prohibitive to conduct a similarly rigorous mailing towards the end of the evaluation period.

Assuming a 30% response rate, the necessary sample size to afford a 95% confidence level with a 10% error, sample size is determined to be 400 completed questionnaires from each

strata. This amounts to roughly 3000 carriers to be targeted in the sample or 1000 from each of the three strata. To encourage responses from Oregon carriers, 1200 surveys will be mailed to carriers who reside in the state. This information is summarized in the table below:

Table 2-2 Sample Size for Survey

Strata	Sample Frame	Sample Size
Oregon Carriers	7602 carriers	1200
Neighboring States	4846 carriers	1000
All Others	7238 carriers	1000

7. Sampling

Using a spreadsheet program, the initial mailing list will be sorted into strata based on address to break the initial population of 20,000 carriers into there respective groups i.e. Oregon, Pacific Northwest (Idaho, Nevada, Washington, and California), and all others. The research team will then select every n^{th} carrier to arrive at the selected sample size. This will result in 3200 carriers, randomly selected from the carrier population.

2.3 TEST CONDUCT ACTIVITIES

2.3.1 Descriptions/Participants

- Transportation Research Institute (Chris Bell, Paul Montagne, staff) – will conduct the research, including collection data.
- Survey Research Center, Oregon State University – will consult TRI on the layout of the questionnaire and the survey design.
- ODOT Motor Carrier Transportation Branch (Gregg Dal Ponte, Jim Brock) – will provide TRI with a list of addresses from which to draw the sample, as well as the mailing of a pre-letter to the motor carriers.

2.3.2 Procedures

Over the course of the study, the following steps will be conducted. These steps are taken from Dillman's *Mail and Telephone Surveys, The Total Design Method.* The method involves a multiple mailing process which can achieve as high as 50% in response rate. It involves subsequent mailings of a pre-letter, first questionnaire, follow-up postcard, and second questionnaire to all recipients. Each of these components is discussed below.

1) Pre-letter mailing

A pre-letter will be drafted to be sent out from ODOT's Motor Carrier Transportation Branch, preferably endorsed and signed by the director. The content of the letter will focus on the announcement that a survey is forthcoming from Oregon State regarding Green Light. The pre-letter serves to give credence to the study and emphasizes the importance of such a survey. It is mailed out two weeks prior to the initial mailing using ODOT's mailing services using the mailing list provided by OSU

2) First questionnaire mailing

The first questionnaire is printed and mailed one week after the pre-letter is mailed by ODOT. The survey will include a cover letter that reiterates the pre-letter, emphasizing the importance of the study to the participants. In addition to the survey, some basic information about The Green Light components will be included as described in the pre-test activities. The cover letter will direct all questions regarding the survey to OSU, and will be printed on OSU letterhead.

3) Follow-up postcard

A follow-up postcard will be mailed one week later to all recipients. It is written as a thank you to those who have responded and a reminder to those that haven't of the importance of their response. It will be mailed out from OSU, printed on a 3 X 5 card with the study director's signature.

4) Second questionnaire mailing

A second survey will be mailed out to the non respondents, three weeks after the mailing of the first questionnaire.

5) Record and report results

The Survey Research Center at OSU will conduct analysis of the results for the questionnaire using SAS or some other dedicated statistical package. The Center uses graduate students to summarize the findings and ensures a rigorous statistical analysis of the data. TRI will then write up the results n the form of a final report. Preliminary findings of the "before" survey will be submitted to ODOT as soon as the results are tabulated.

6) Repeat the survey design later in the evaluation period

The entire survey design will be revisited and re-conducted later in the evaluation period. Though an exact date cannot be known at this time, it is likely to occur in mid-1999, after

Green Light has been operational for some time. The original mailing list will be retained and, based on actual response rates from the first mailing, may be used again. It may be necessary that due to the transient nature of the industry, a new sample will be generated from ODOT's database.

7) Track transponder usage

In order to fulfill the second test measure of monitoring motor carrier acceptance by the documenting the use of transponders, the research team will maintain a database that records the number of transponders in use over the course of the evaluation.

The data requested would be a weekly or biweekly report of transponders being issued or returned by carriers. In addition, certain characteristics of the carrier's operations will be required to track differences that might occur due to fleet size and location of the fleet. Data elements would preferably include:

Carrier Name or some other identifier

Location of motor carrier by state

Fleet size

# of transponders in service

Carrier name would be useful for recording purposes, but is not necessary if some surrogate is used to identify the company. **We realize the information requested is sensitive and needs to be kept confidential**. Our reports would not refer to individual carriers, and the information would be held in confidence here at OSU

2.4 POST-TEST ACTIVITIES

2.4.1 Reporting Procedures for Individual Test

A report will be prepared for these test measures according to the guidelines given in the Evaluation Plan and will proceed as follows:

1. Preparation of a draft report for each test to be submitted to the steering committee (SC) for their approval.
2. Approval of the SC at a scheduled meeting.
3. Preparation of a final test report, incorporating SC recommendations.
4. Submittal of 1 hardcopy original, 1 electronic original and ten bound copies of the report to ODOT's project management team.
5. Transmittal of the report by ODOT to FHWA.

2.4.2 Reporting Schedule

The reporting schedule for the individual test reports is shown below:

Exhibit 2-2 Reporting Schedule - Individual Test Reports

Deliverables	Schedule	Scheduled Due Date*
Drafts of Individual Test Reports	July 1-August 30, 1999 (60 days)	September 1, 1999
Review of Individual Test Reports by Steering Committee	September 1-30, 1999 (30 days)	October 1, 1999
Final Test Reports	October 1-November 30, 1999 (60 days)	December 1, 1999

2.4.3 Data Retention/Archival Procedures

Data collected and documents produced over the course of the evaluation will be archived and submitted to ODOT project management. In addition, a document summarizing the data and reports will be produced as follows:

1. Preparation of a summary document describing data analyzed and reports prepared over the course of the evaluation.
2. Submittal of a data archive containing raw data files and all reports in compressed format.

2.4.4 Reporting Schedule for Data Retention/Archival Procedures

The reporting schedule for the archiving of data and the preparation of a summary document is given below:

Exhibit 2-3 Reporting Schedule - Data Archiving

Deliverables	Schedule	Scheduled Due Date*
Drafts of a Data Summary Report	Dec 1, 1999 - Jan 30, 2000 (60 days)	February 1, 2000
Review of Data Summary Report by Steering Committee	Feb 1 - Feb 28, 2000(28 days)	March 1, 2000
Data Summary Report (Final) and Data Archive	Mar 1 - Mar 30, 2000 (30 days)	April 1, 2000

2.4.5 Test Summary Report Procedures

A test summary report will be prepared highlighting findings from all of the test measures. The document will be produced as follows:

1. Preparation of a draft report summarizing the results of all the individual test reports for submittal to the SC.
2. Approval of the SC at a scheduled meeting.
3. Preparation of a final test summary report, incorporating SC recommendations.
4. Submittal of 1 hardcopy original, 1 electronic original, and ten bound copies of the summary report to ODOT's project management team.
5. Transmittal of the test reports by ODOT to FHWA.
6. Reporting Schedule for Test Summary

A reporting schedule is shown below for the test summary report:

Exhibit 2-4 Reporting Schedule - Test Summary Reports

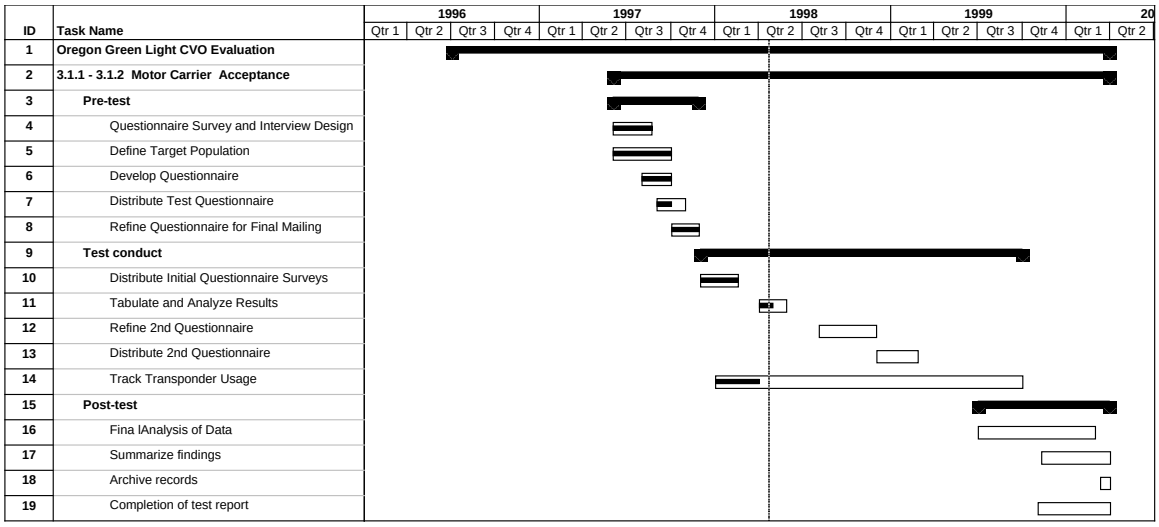
Deliverables	Schedule	Scheduled Due Date*
Drafts of Test Summary Report	Dec 1, 1999 - Jan 30, 2000 (60 days)	February 1, 2000
Review of Test Summary Report by Steering Committee	Feb 1 - Feb 28, 2000 (28 days)	March 1, 2000
Test Summary Report (Final)	Mar 1 - Mar 30, 2000 (30 days)	April 1, 2000

3 TEST MANAGEMENT PLAN

3.1 DETAILED TEST SCHEDULE

A detailed test schedule is shown in Exhibit 3-1.

Exhibit 3-1 Project Timeline for Test Measures 3.1.1 – 3.1.2



3.2 COST BREAKDOWN BY MEASURE

A cost breakdown for these measures is shown below in Exhibit 3-2. These figures are only estimates and are subject to revision as the evaluation progresses.

Exhibit 3-2 Cost Breakdown for Test Measures 3.1.1 and 3.2.2

Organization: Oregon State University (TRI)					
DTP	**Measure**	**Researcher**	**Hours**	**Cost**	**Totals**
11	3.1.1	C A Bell	128	$5,440	
		P E Montagne	666	$10,656	
					$16,096
	Payroll Exp:	C A Bell	32%	$1,741	
		P E Montagne	37%	$3,943	
	Subtotal:				$5,684
	Supplies:			$4,400	
	Travel:			$2,400	
	Subtotal:				$6,800
	Overhead		42%		$12,003
	Total:				**$40,583**

Organization: Oregon State University (TRI)					
DTP	**Measure**	**Researcher**	**Hours**	**Cost**	**Totals**
11	3.1.2	C A Bell	64	$2,720	
		P E Montagne	332	$5,312	
					$8,032
	Payroll Exp:	C A Bell	32%	$870	
		P E Montagne	37%	$1,965	
	Subtotal:				$2,836
	Supplies:			$200	
	Travel:			$200	
	Subtotal:				$400
	Overhead		42%		$4,732
	Total:				**$16,000**

4 REFERENCES

1. Bell, C.A., B. McCall, and, C.M. Walton, A “The Oregon ‘Green Light’ CVO Project, Evaluation Plan” GLEV9601, Oregon State University, Transportation Research Institute, September 1996.

2. Bell, C.A., B. McCall, and, C.M. Walton, “The Oregon Green Light’ CVO Project, Individual Test Plan” GLEV9602, Oregon State University, Transportation Research Institute, October 1996.

3. Dillman, Don A., “Mail and Telephone Surveys-The Total Design Method” John Wiley & Sons, New York. 1978