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Oregon Green Light CVO Evaluation

Detailed Test Plan # 4

Measure 1.3.1 Comparison of the mean truck speeds when the Emigrant Hill Downhill Speed Information System is operating with when it is not.

Measure 1.3.2 Comparison of the mean speed of trucks that receive specific messages to that of trucks that do not.

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TABLE OF EXHIBITS

1 DETAILED TEST INTRODUCTION

1.1 BACKGROUND

This Detailed Test Report is the fourth 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 test measure employed to obtain the objective *determining change in truck behavior due to the Downhill Speed Information System (DSIS)*, one of three objective in support of the goal of assessing safety. 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.

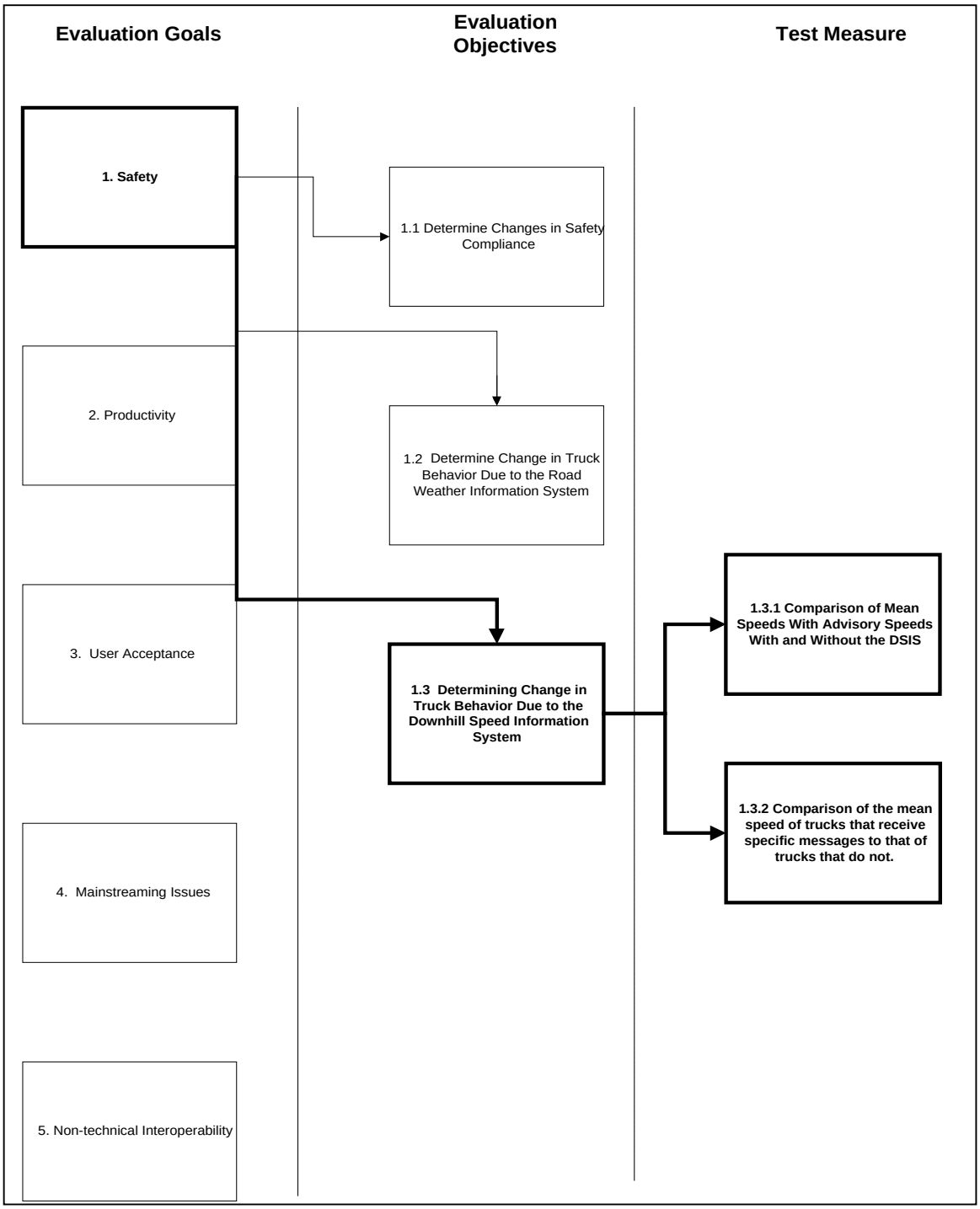
The evaluation measures used to determine changes in truck behavior due to the DSIS are stated below:

- **1.3.1 Comparison of the mean speed of ODOT-transponder-equiped vehicles when the DSIS is operating with when it is not.**
- **1.3.2 Comparison of the mean speed of ODOT-transponder-equiped vehicles with that of trucks with no transponders when the DSIS is operating.**

A 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 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

Downhill Speed Information Systems seek to affect commercial vehicle driver behavior by providing a safe downhill speed message for their specific vehicle via a variable message sign. The purpose is to reduce the frequency and severity of downgrade truck accidents. Two of the systems are being installed in Oregon, one at Emigrant Hill on I-84 and a second atop Siskiyou Summit on I-5 (see Exhibit 1-2). The Emigrant Hill system is up and running, while the Siskiyou Summit location is not yet under construction.

Exhibit 1-2 DSIS Locations in Oregon

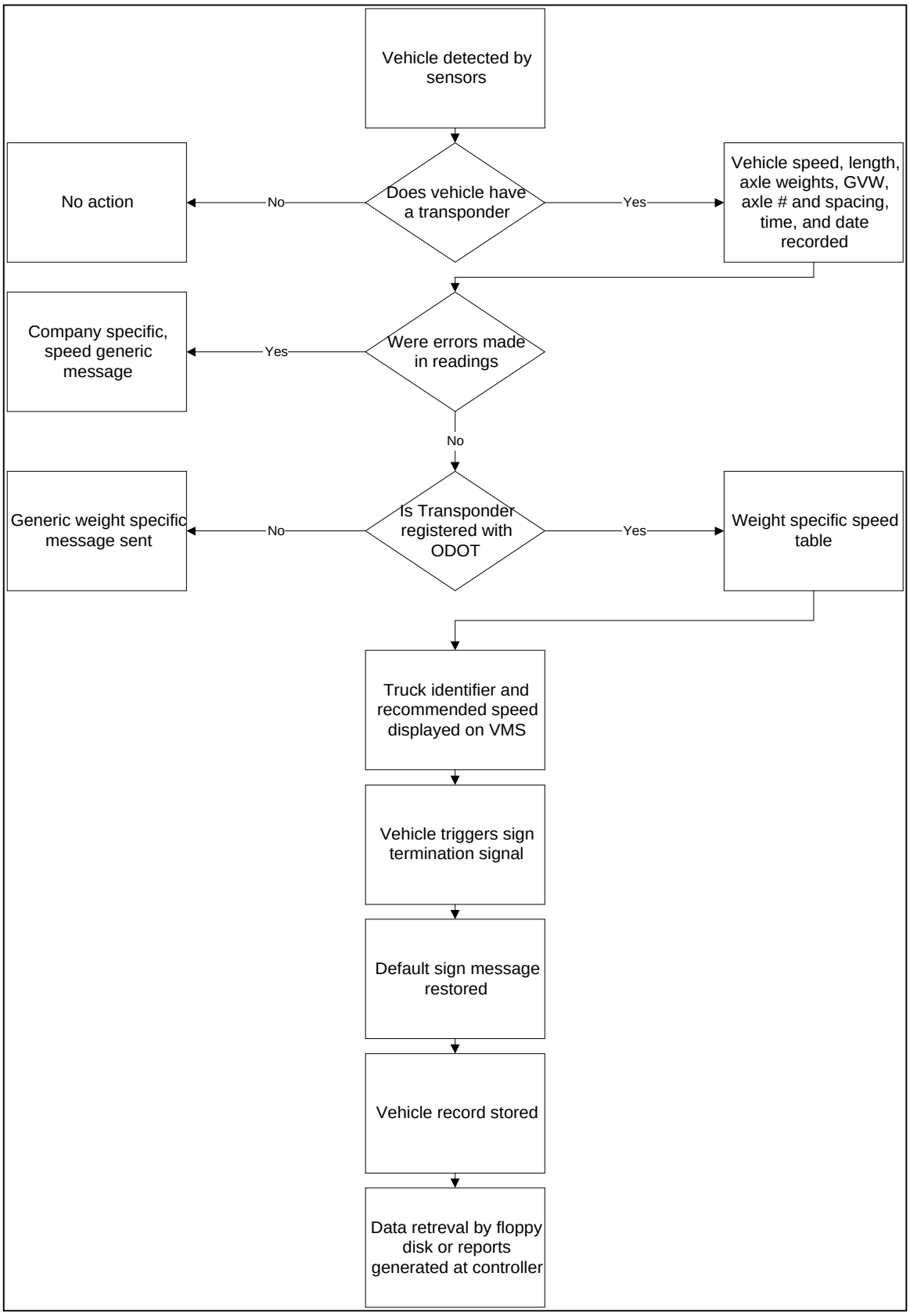
In the case of Oregon's downhill system, a weigh-in-motion device, electronic transponder, and an overhead variable message sign all combine to effectively weigh a vehicle, retrieve its OPUC information, and relay a message to the driver. [3]

The DSIS will calculate and display a safe descent speed for each truck passing through the system at greater than 40,000 lb. gross vehicle weight, based on three factors:

1. truck configuration
2. gross vehicle weight
3. steepness of grade

A flow chart of the system operation for the DSIS is shown in exhibit 1-3.

Exhibit 1-3 DSIS Operation Flowchart



An overhead variable message sign down stream of the loop detectors and weight-in-motions strips will display the advised speed. In the case of Emigrant Hill, as shown in exhibit 1-4, a weigh station is conveniently located at the top of the pass and a variable message sign is in place after it.

Exhibit 1-4 VMS From Emigrant Hill Weigh Station

WIM strips and transponder scanners have been installed one mile upstream of the weigh station directly on the freeway as part of Green Light's integration of mainline preclearence. Based on the weight measured by the WIM and the information gathered from the transponder signal, a decision whether to pull the truck into the weigh station is made. Trucks that are within the legal limit and have the proper registration and safety credentials bypass the weigh station and continue on the freeway. Once past the weigh station, the bypassed trucks receive

an advisory message from the VMS such as “Mayflower truck #XXX, based on your weight of 70,000lbs, your recommended speed is 20 mph.” (See Exhibit 1-3)

Trucks that are not bypassed receive a similar message when they exit the weigh station.

2 TEST METHODOLOGY

2.1 PHYSICAL DESCRIPTION

This section discusses in detail the activities carried out in the evaluation of the DSIS system at Emigrant Hill on I-84 east of Pendleton. The Siskiyou Summit site will not be included in the DSIS evaluation due to its late deployment date.

2.1.1 Purpose

These tests will focus on the collection and analysis of commercial motor vehicle (CMV) speed data on the descent WB from Emigrant Hill on Interstate 84. For the purposes of this study, a commercial motor vehicle is any vehicle with a gross vehicle weight greater than 60,000 lb. Specifically, the tests will measure:

1. How truck speeds change when the DSIS is operating compared with when it is not
2. How the truck speeds differ from the recommended speed.

The descent from the summit is approximately nine miles, with a 6% grade and some sharp curves. It is an area that has seen a number of truck accidents due to excessive speed and brake failure. The DSIS system is being installed at this site to encourage drivers to descend at a recommended speed based on weight.

2.1.2 Hypothesis

The following hypotheses were given in support of the two measures and will be tested according to accepted statistical techniques.

1.3.1 Mean speeds in the vicinity of the operating DSIS system will converge towards advisory speeds.

1.3.2 Mean speeds of trucks that receive a specific message will converge toward advisory speeds more quickly than those that do not receive a specific message.

2.2 PRETEST ACTIVITIES

Pretest activities for this measure will focus on the sources, quality, and availability of data, and determining the appropriate sample size. These steps are discussed in detail below.

2.2.1 Data Sources and Availability

The primary data source for this test measure is speed data collected by radar gun at Emigrant Hill (spot speed surveys). As the DSIS system is operational but many CMV carriers have not yet installed transponders, the following four "focus groups" of trucks will be simultaneously sampled for comparison.

1. Trucks that have transponders that are registered in the ODOT database
2. Trucks with transponders that are not registered with ODOT
3. Trucks with transponders, but received some error in reading them or in measuring the truck's weight. This group includes trucks outside the weight range of 60 to 80klb.
4. Trucks that have no transponders

As shown in the DSIS flow chart, exhibit 1-2, these four groups will be treated differently by the DSIS. Trucks with ODOT transponders will receive a message specific to their truck, e.g. “Bi-Mart Truck #XXX, your speed….” Trucks with non-ODOT transponders will also receive a message, but it will not be specific to them, e.g. “Truck Advisory – Recommended Downhill Speed for your weight….” Trucks that were erroneously read will receive a generic caution or a

truck specific message depending on the error that occurred. Trucks with no transponders will not trigger the system and so will not receive a variable message. There is still the painted sign at the top of Emigrant Hill giving suggested speeds for weight ranges, and these trucks will read their advised speed from that sign.

The collection of new speed data will measure changes in driver behavior and how much those changes can be attributed to the recommended speed displayed to them. The speed data will be collected using a calibrated radar gun at several points of the descent. Speeds will be logged by hand into data collection sheets that ODOT will provide. Data can then be keyed directly into EXCEL. The data will be analyzed using accepted statistical techniques.

2.2.2 Calculation of Sample Size

A basic premise of statistical analysis is that any “natural phenomenon” occurring a large number of times will approximate the normal distribution or “bell curve.” Depending on the degree of accuracy desired from the normal approximation, “a large number” could be anywhere from thirty to several hundred. The composition and volume of traffic is measured by ODOT each year at various points around the state and is reported in the transportation volume tables [5]. From those measurements, an estimate of the population size, or the number of trucks descending Emigrant Hill each day, can be calculated. In both 1997 and 1998 At ODOT recorder 30-004, which is on I-84 near Pendleton, approximately 27% of traffic volume would be considered truck traffic. This included single-unit, 3-axle vehicles and larger. The volume of traffic, per day, at milepost 233.45 near Emigrant Park was 8,700 vehicles in 1997 and 8,300 vehicles in 1998. Projecting these measurements, we can expect somewhere in the vicinity of 2300 trucks to descend Emigrant Hill on any particular day in 1999, which is a sufficiently large number to assume a normal distribution of truck behavior.

When estimating the mean of a normal population, such as the mean speed of trucks descending Emigrant Hill, it is possible to calculate the sample size necessary to ensure a certain degree of confidence. Standard estimation theory states that the sample size *n* necessary to ensure that the error in estimating the population mean μ will be less than a specified amount e according to the following theorem [4]:

$$n = \left(\frac{z_{\alpha/2}\,\sigma}{e}\right)^2$$

Where n is the sample size
Z is the value of the standard normal distribution
σ is the variance, α the uncertainty, and e the acceptable error

Therefore, if the sample mean *x* is to be used as an estimate of μ, one can be (1-σ)100% confident that the error will be less than a specified amount *e*.

Strictly speaking, the formula above is applicable only if the population variance for the sample is known. Lacking this information, a preliminary sample size of n>30 can be used to calculate a standard deviation which will suffice as an estimate of σ, and then an estimate of the necessary number of additional measurements can be made. However, previous studies have given the approximate variance of traffic speeds, and so with a 95% confidence interval (z=1.96) and a degree of uncertainty of α at .05, approximately 150 trucks for each group will be surveyed. A revised estimate will be made on site after 30 or more samples.

2.3 TEST CONDUCT ACTIVITIES

2.3.1 Participants

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

ODOT Motor Carrier Enforcement Officer - will operate the weigh scale during the test.

2.3.2 Equipment

- Calibrated speed gun provided by ODOT
- WIM Mainframe computer and variable message sign provided by ODOT
- Two sets of two-way radios provided by TRI
- Clipboards, data collection sheets, paper provided by ODOT
- Van provided by OSU

2.3.3 Procedure

1) Predetermine collection period

The data will be collected during daylight hours and on days when weather is not a factor. High visibility days are preferred to eliminate any unnecessary bias. Two different locations will be selected on the descent for data collection. The spot surveys will be recorded for each focus group simultaneously, so there will be a minimum of complicating factors such as weather, road construction, etc. The weigh station must also be closed.

2) Acquire equipment

The vehicle used for the speed study will be an inconspicuous, white mini-van, provided by the state motor pool at Oregon State University. There are no distinct markings on the van other than a “state motor pool” bumper sticker and state issued license plates.

The radar gun will be provided by ODOT. The same gun will be used throughout the study. It is regularly serviced and calibrated and is reasonably accurate. The research team will keep a calibration history of the gun. Oregon State University will provide the two-way radios, clipboards, and any other minor equipment.

3) Conduct the spot speed survey

Each spot survey will require two researchers, one at the top of Emigrant hill to record vehicle types, weights, and recommended speeds, and a second researcher downstream manning the radar gun. Data will be collected when the weigh station is not officially operating, but the system will be on so the researcher at the top of the hill can record weights, truck id's and recommended speeds. Two-way radios will be used to communicate between the researchers.

The data will be collected from inside the vehicle. The van will be parked on the right hand shoulder in a conspicuous location away from any overpasses or exits. The gun will be mounted on the dashboard and covered with a newspaper or other inconspicuous camouflage. This will hopefully prevent drivers from knowing that their speeds are being measured and encourage them to drive normally.

1d) Analysis of data

Speeds will be keyed into an EXCEL spreadsheet for analysis. The data, time, location, recommended speed and weather and road conditions will be recorded. Mean speeds will be calculated from the data and then compared to the advisory speeds. Data sets for each focus group will be compared to the others so as to reveal changes in mean speeds.

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 report for each test, 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 a Data Summary Report	Dec 1, 1999 – Jan 30, 1999 (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

2.4.3 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

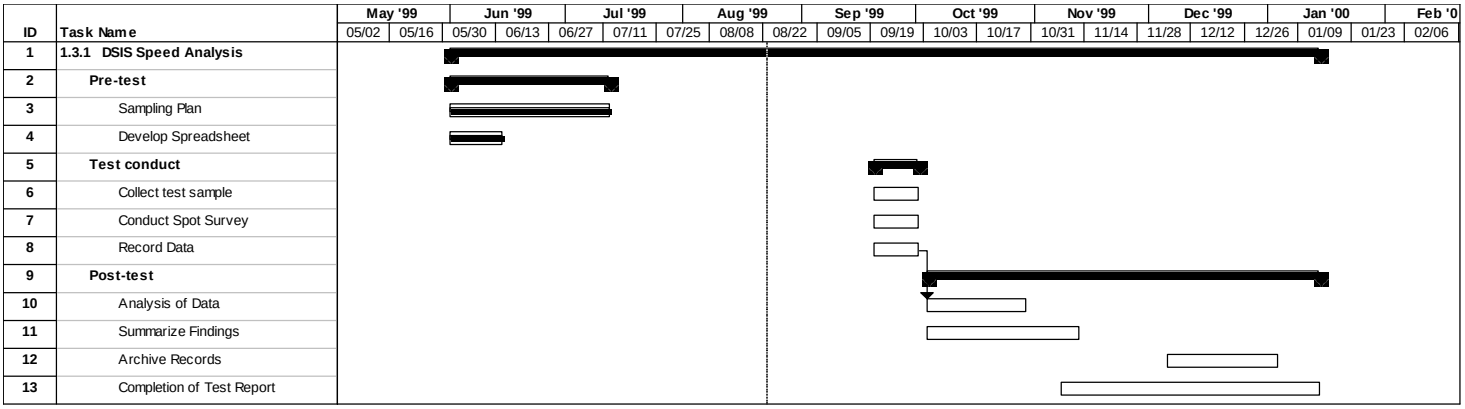
Deliverables	Schedule	Scheduled Due Date*
Drafts of Test Summary Report	Dec 1, 1999 - Jan 30, 2000 (60 days)	February 1, 2000
Review of Test Summary Report by Steering Committee	Feb 1 - Feb 28, 2000 (28 days)	March 1, 2000
Test Summary Report (Final)	Mar 1 - Mar 30, 2000 (30 days)	April 1, 2000

3 TEST MANAGEMENT PLAN

3.1 DETAILED TEST SCHEDULE

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

Exhibit 3-1 Project Timeline for Test Measures 1.1.1



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 1.3.1 and 1.3.3

Organization: Oregon State University (TRI)					
DTP	**Measur**	**Research**	**Hour**	**Cost**	**Total**
4	1.3.	C A	40	$1,700	
		P E	208	$3,328	
					$5,028
	Payroll	C A	32%	$544	
		P E	37%	$1,231	
	Subtota				$1775
	Supplie			$600	
	Travel			$600	
	Subtota				$1200
	Overhea		42%		$3,361
	Total				**$11,365**

Organization: Oregon State University (TRI)					
DTP	**Measur**	**Research**	**Hour**	**Cost**	**Total**
4	1.3.	C A	40	$1,70	
		P E	208	$3,32	
					$5,028
	Payroll	C A	32%	$544	
		P E	37%	$1,231	
	Subtota				$1.775
	Supplie			$600	
	Travel			$600	
	Subtota				$1200
	Overhea		42%		$3,361
	Total				**$11,365**

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. ODOT Research and New Technology, Transportation Development Branch, “Oregon Green Light CVO Project - Overview and Phase III Workplan” Oregon Department of Transportation, Salem OR, January 1997.

4. Bell, C.A., S.U. Randhawa, P. Ryus, and, Z. Xu, “Development of an Integrated System For Evaluation of Oregon’s Truck Data - Phase I: Database Development and Preliminary Evaluation of Data” TNW93-05 Transportation Northwest Final Report, August 1993.

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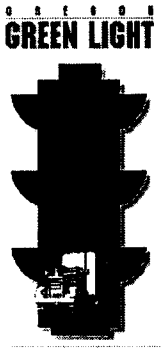
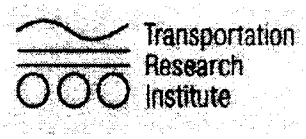
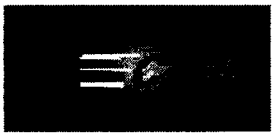


Oregon Green Light CVO Evaluation

Detailed Test Plan #5

Measure 1.3.2 Ratio of accidents before and after installation of Downhill Speed Information System





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1.1 BACKGROUND

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The purpose of these documents are 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 one of two test measures employed to obtain the objective *determining change in truck behavior due to the Downhill Speed Information System (DSIS)*, one of three objectives in support of the goal of assessing safety. 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.

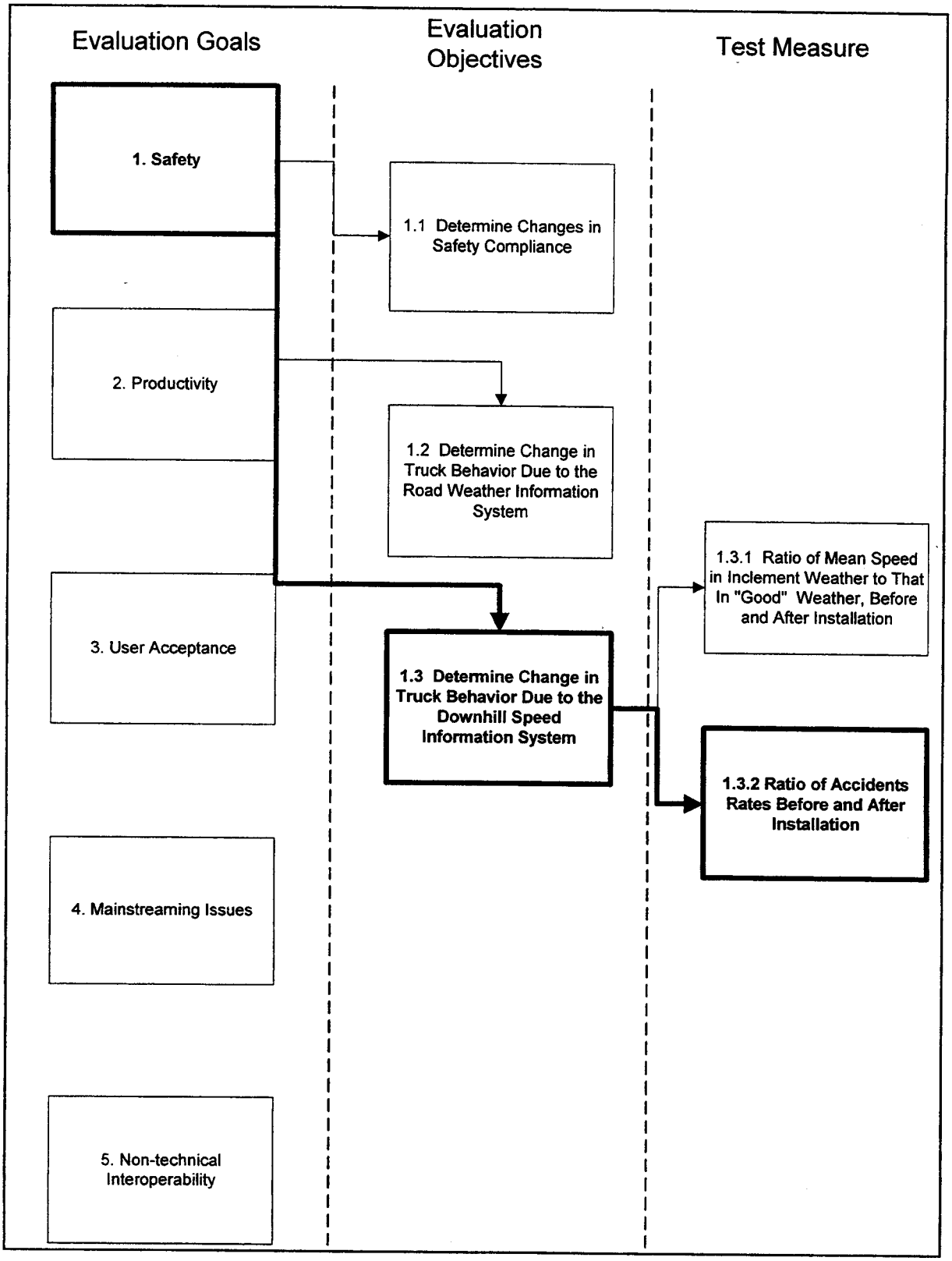
The evaluation measure used to determine change in truck behavior due to the DSIS is stated below:

- **1.3.2 Comparison of accident rates before and after installation of the Downhill Speed Information System.**

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 plan 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.

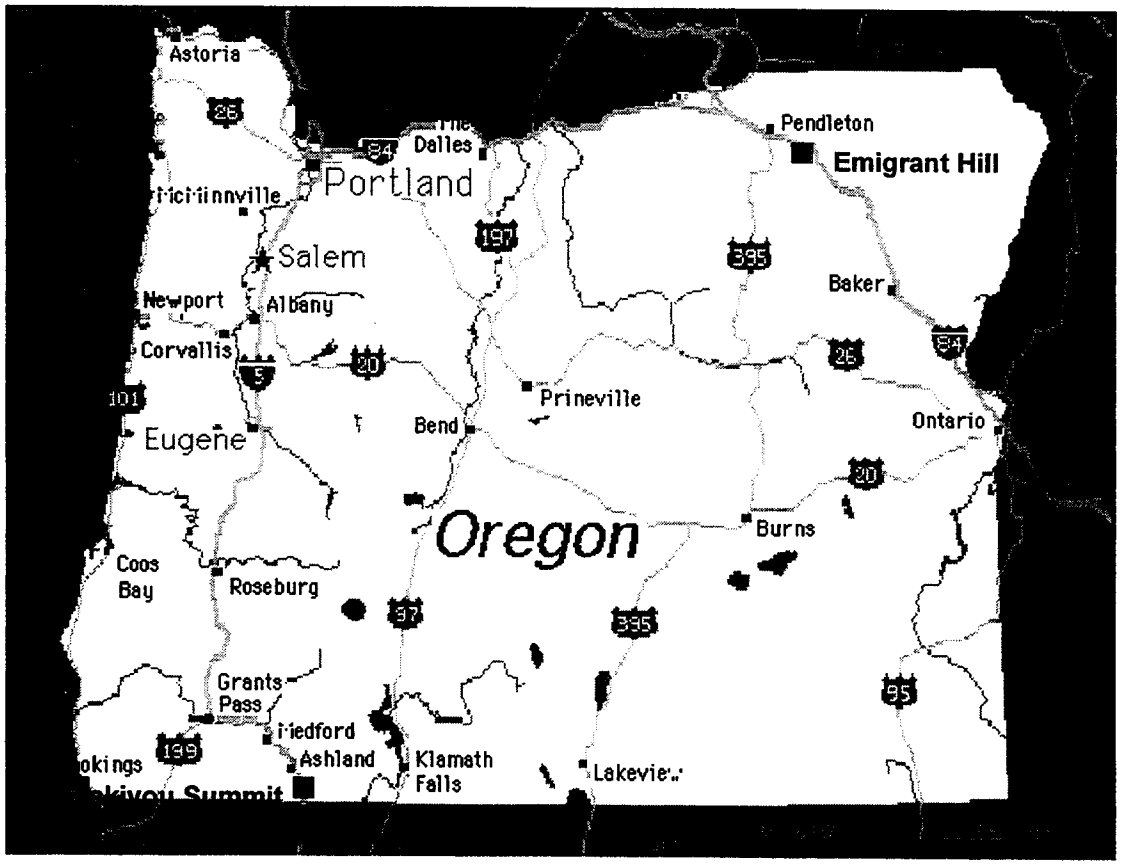
Exhibit 1-1 Evaluation Goals, Objectives, and Measures



1.3 DISCUSSION

Downhill Speed Information Systems seek to affect commercial vehicle driver behavior by providing a safe downhill speed message for their specific vehicle via a variable message. The purpose is to reduce the frequency and severity of downgrade truck accidents. Two of the systems are being installed in Oregon, one at Emigrant Hill on I-84 and a second atop of Siskiyou Summit on I-5. The Emigrant Hill system is slated for deployment in late summer 1997, while the Siskiyou Summit location will not be finished until June of 1999.

Exhibit 1-2 Green Light DSIS Locations



Green Light DSIS Locations

In the case of Oregon's DSIS, a weigh-in-motion device, a license plate reader (LPR), and an overhead variable message sign, all combine to effectively weigh a vehicle, read its OPUC

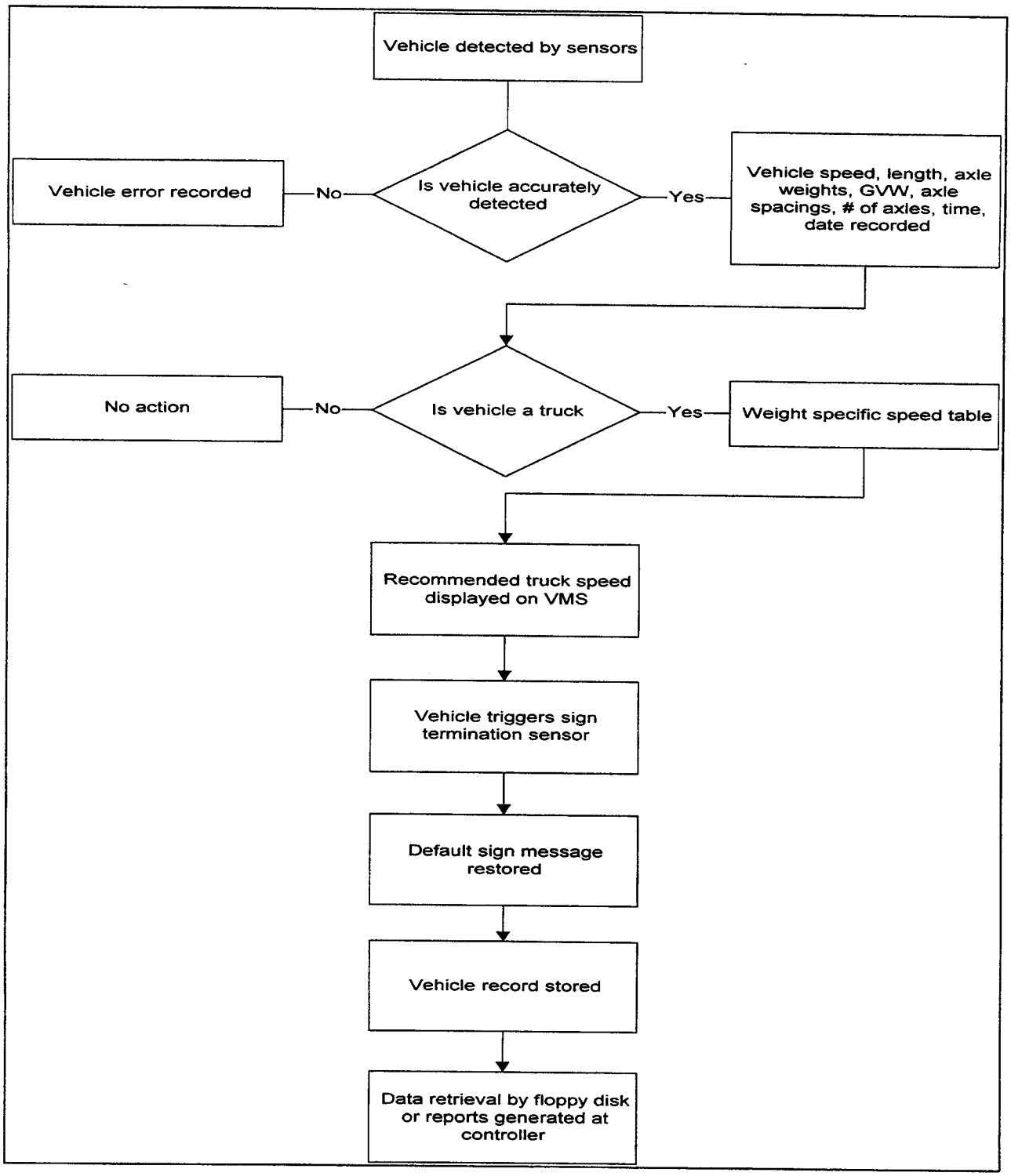
license plate, and relay a message to the driver. [3]

The DSIS system will calculate and display a safe decent speed for each truck passing through the system at greater than 40,000 lbs. gross vehicle weight based on four factors:

1. truck configuration
2. gross vehicle weight
3. steepness of grade
4. weather condition

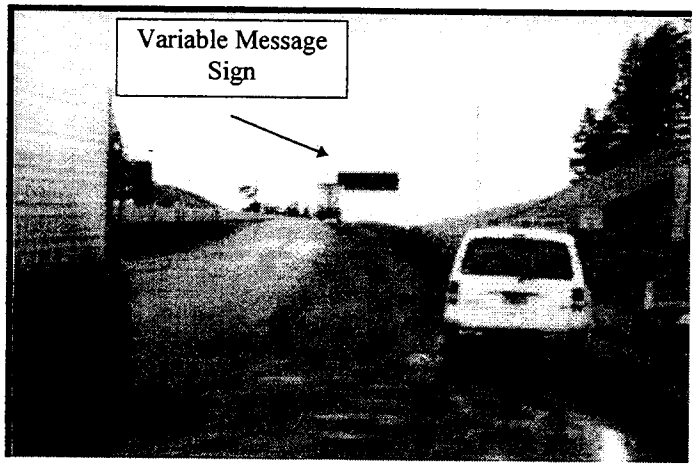
A flow chart of the system operation for the DSIS is shown in Exhibit 1-3 (IRD 1996):

Exhibit 1-3 DSIS Operation Flowchart



An overhead variable message sign downstream of the loop detectors and weigh-in-motion strips will display the advised speed. In the case of Emigrant Hill, a weigh station is conveniently located at the top of the pass along with a variable message sign as shown below.

Exhibit 1-4 Emigrant Hill Weigh Station



WIM strips and AVI equipment (license plate readers) are being installed one mile upstream of the weigh station directly on the freeway as part of Green Light's integration of mainline preclearance. Based on the weight recorded at the WIM and the PUC plate number recorded through the AVI equipment, a decision to pull the truck into the weigh station is made. Trucks that are within the legal limit and have the proper registration and safety credentials bypass the weigh station and continue on the freeway. Once past the weigh station, each truck will receive an advisory message such as "ODOT plate #XXX, based on your weight of 70,000lbs., your recommended speed is 20 mph" (See Exhibit 1-4).

Trucks that are not bypassed are displayed a speed through a different sign located on the ramp prior to reaching the static scale. It is simpler in design and does not address the truck by company name or plate number. The sign is a static "scoreboard" type. Painted text will read: "Your recommended speed is XX mph", where the XX will change much like a scoreboard.

2 TEST METHODOLOGY

2.1 PHYSICAL DESCRIPTION

This section discusses in detail the activities carried out in the evaluation of the Emigrant Hill DSIS system on I-84 east of Pendleton. The Siskiyou Summit site will not be included in the DSIS evaluation due to its late deployment date.

2.1.1 Purpose

This test will focus on the collection and analysis of commercial motor vehicle (CMV)) accident data occurring in the vicinity of Emigrant Hill. The National Governors Association (NGA) definition of a commercial vehicle is used in the query of accidents from the ODOT database. Vehicles include any truck with a GVW greater than 10,000 lbs., any commercial vehicle carrying hazardous materials requiring placarding, or busses designed for 16 passengers or more. The test will be done by comparing the accident rate for commercial vehicles descending Emigrant Hill WB before the DSIS installation to the rate of accidents after installation. Use of escape ramp records will also be used to examine the effects of the downhill system on runaway trucks.

The decent from the summit is about nine miles, with a 6% grade and some sharp curves. It has been an area that has seen a number of heavy truck accidents due to excessive speeds and brake failure. The DSIS system is being installed at this site to encourage drivers to descend at a recommended speed based on weight.

2.1.2 Hypothesis

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

1.3.2 Accidents in the vicinity of the DSIS system will decrease as information on suggested speed is provided to commercial vehicle operators.

2.2 PRE-TEST ACTIVITIES

Pre-test activities for this measure will focus on the sources, quality and availability of accident data, developing a time frame for establishing benchmarks, and determining site locations. These steps are discussed in detail below.

1) Data Sources and Availability

The four primary data sources used for this test measure are:

1. Oregon DOT's accident records database
2. Activity logs of construction activities during the study period
3. Daily records of pavement conditions
4. Records of escape ramp usage

Data is compiled from ODOT's CRASH data system. The database can provide accident statistics with a wide array of data fields containing physical descriptions of the accidents. Accidents can be sorted by any one of these data fields in order to target accidents meeting a given criteria. Some of the data elements pertinent to examining changes in accidents as a result of the DSIS installation are:

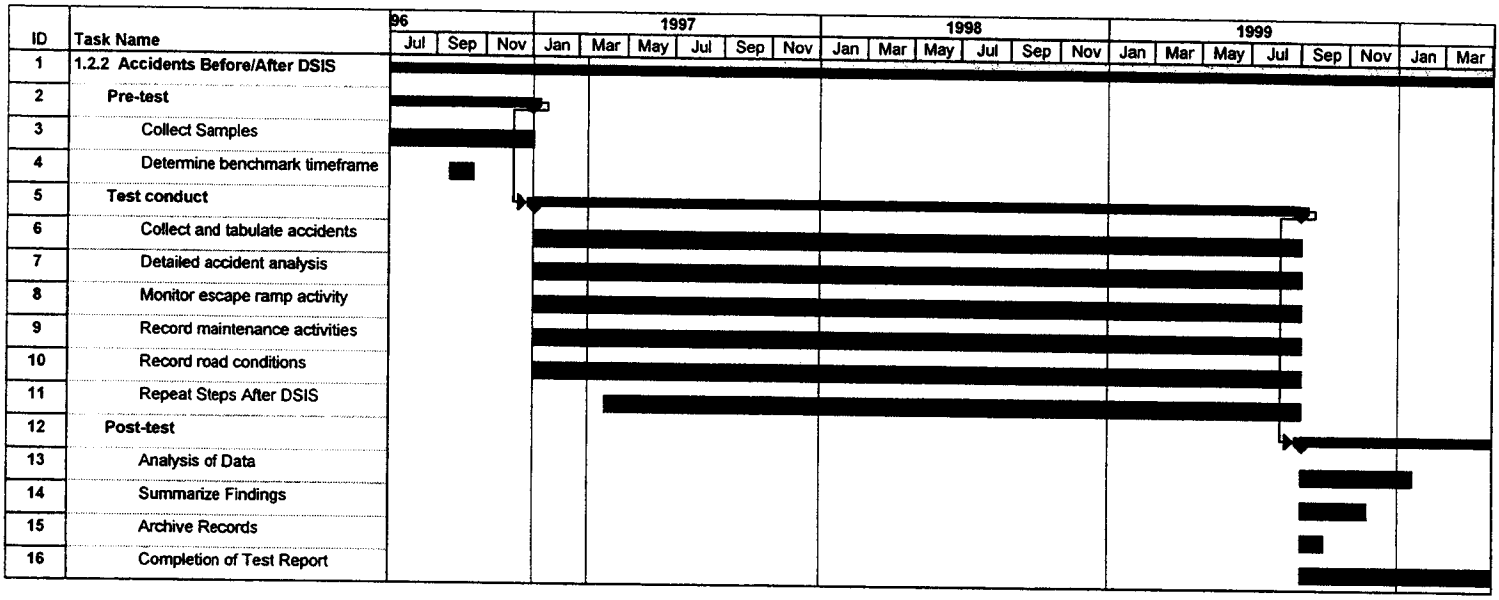
- Location (dictated by milepost marker)

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 1.3.2



3.2 COST BREAKDOWN BY MEASURE

A cost breakdown for this measure 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 Measure 1.3.2

Organization: Oregon State University (TRI)					
DTP	**Measure**	**Researcher**	**Hours**	**Cost**	**Totals**
5	1.3.2	C A Bell	40	$1,700	
		P E Montagne	208	$3,328	
					$5,028
	Payroll Exp:	C A Bell	32%	$544	
		P E Montagne	37%	$1,231	
	Subtotal:				$1,775
	Supplies:			$600	
	Travel:			$600	
	Subtotal:				$1,200
	Overhead		42%		$3,361
	Total:				**$11,365**

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

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Oregon Green Light CVO

Evaluation

Detailed Test Plan # 6

Measure 2.1.1 Determine the changes in resources required in the auditing process

Measure 2.2.1 Determine changes in highway use tax revenues collected and why

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TABLE OF EXHIBITS

1 DETAILED TEST INTRODUCTION

1.1 BACKGROUND

This Detailed Test Report is the sixth 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 two evaluation measures employed to support the objectives *determining changes in tax administration costs and determine changes in tax evasion,* two 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.

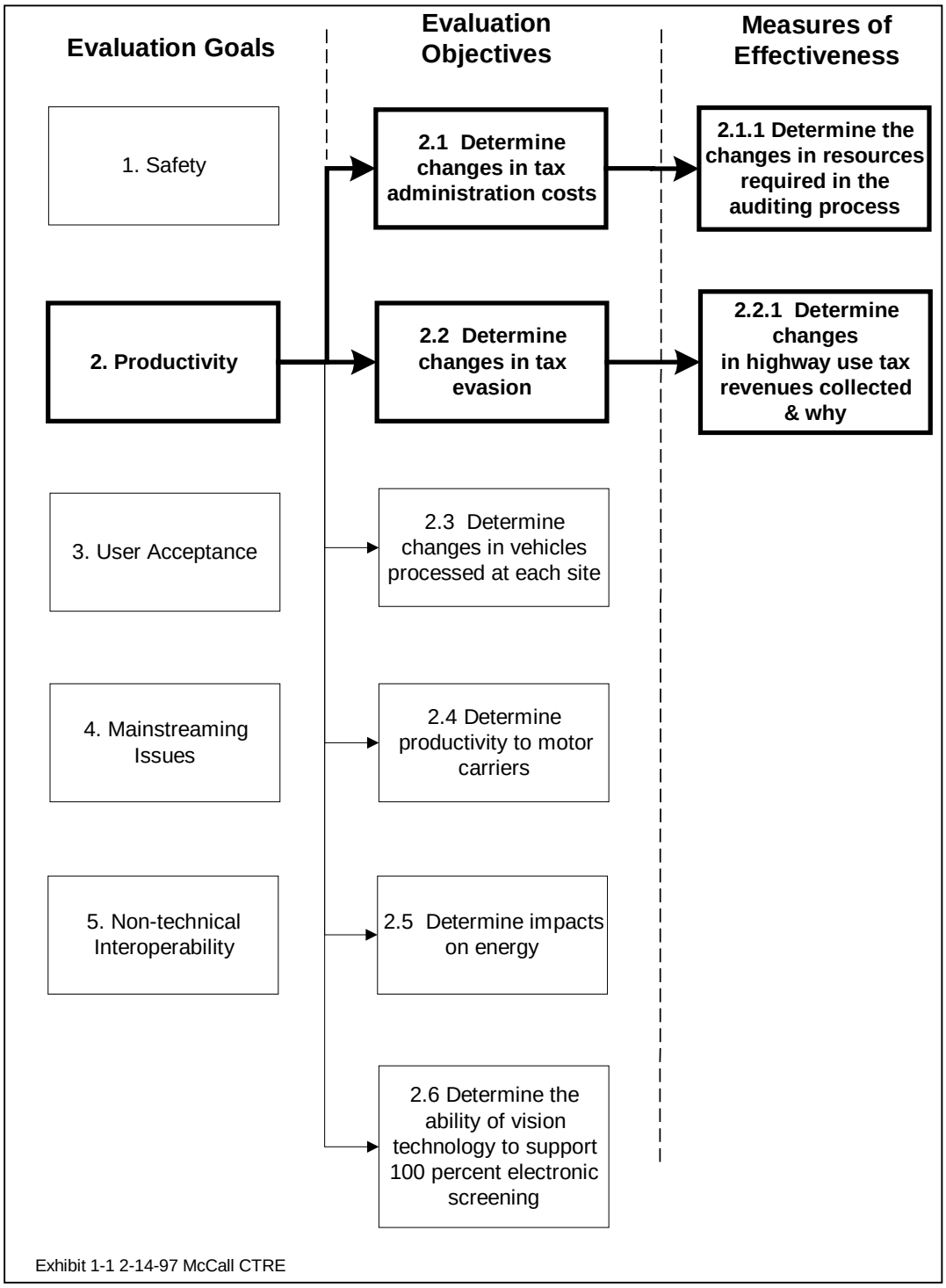
The two evaluation measures are:

- **2.1.1 Determine the change in resources required in the auditing process.**
- **2.2.1 Determine expected changes in highway use tax revenue collections.**

Because of the similarities of these measures in regard to pre-test, test, and post-test activities, they are addressed together in this Detailed Test Plan. A detailed description of the hypotheses 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

For the 1993-1995 biennium, the cost of administering (including all costs of collection, auditing and enforcement activities) Oregon's highway use tax collections was estimated to be $21.1 million, or 4.8 percent of revenues collected. The evasion rate was estimated to be 5 percent of total receipts, equating to roughly 22 million dollars in lost revenue for the same biennium.

In 1993, the Oregon Department of Transportation, along with the Oregon Public Utility Commission, drafted a strategic plan for IVHS/CVO in Oregon. Included in this plan were a list of specific goals, the second of which was to benefit government through increased efficiency and effectiveness. The resulting Oregon Green Light initiative is expected to improve the efficiency of the tax auditing process, as well as the effectiveness of the process in terms of the collection rate This test plan outlines the evaluation of the impact of Green Light on both the efficiency and effectiveness of Oregon's highway use tax collection.

Update March 1998

As originally written, this Detailed Test Plan included Test Measure 2.1.1, Determine the changes in the resources required in the collection process. CTRE has conducted a summary review of Oregon Department of Transportation procedures. A process map of the collection process was developed based on a review of ODOT procedural manuals and interviews with Motor Carrier Branch staff. CTRE concluded that Oregon Green Light will have little direct effect on the collection *process.* The positive impact of Oregon Green Light will much more likely be realized in terms overall effectiveness rather than procedural efficiency. That is, the benefits of Oregon Green Light will more likely be measurable in terms of the accuracy of tax reports, the ability of auditors to recognize inconsistencies and the resulting decrease in the tax evasion rate.

To make best use of evaluation resources, CTRE proposes shifting the emphasis of this portion of the evaluation away from the tax collection process and towards the relationship between Oregon Green Light technology, auditing and tax reporting behavior. The modifications in this Detailed Test Plan reflect this shift. All findings, including those from our preliminary evaluation of the collection process, will be documented in detail in the final report.

Each of the following elements of the Green Light project has the potential to affect the highway use tax collection process, the auditing process, and/or the highway use tax revenue collection rates. Exhibit 1-2, Functional Architecture for Oregon Green Light, provides a diagram of the relationships among the elements of Green Light.

Mainline Preclearance

Green Light will provide mainline preclearance for commercial vehicles. As a commercial vehicle approaches ports of entry and weigh stations, 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).

System Development and Upgrades

The implementation of the Green Light project will require numerous hardware and software upgrades to the existing system. All software will be upgraded to the most current versions. In addition to the enhancements, several database management and developmental improvements will take place. A central database, containing all pertinent CVO data, will be refined and deployed.

Integrated Tactical Enforcement Network

Enforcement sites are to be used in the Integrated Tactical Enforcement Network (ITEN). ITEN

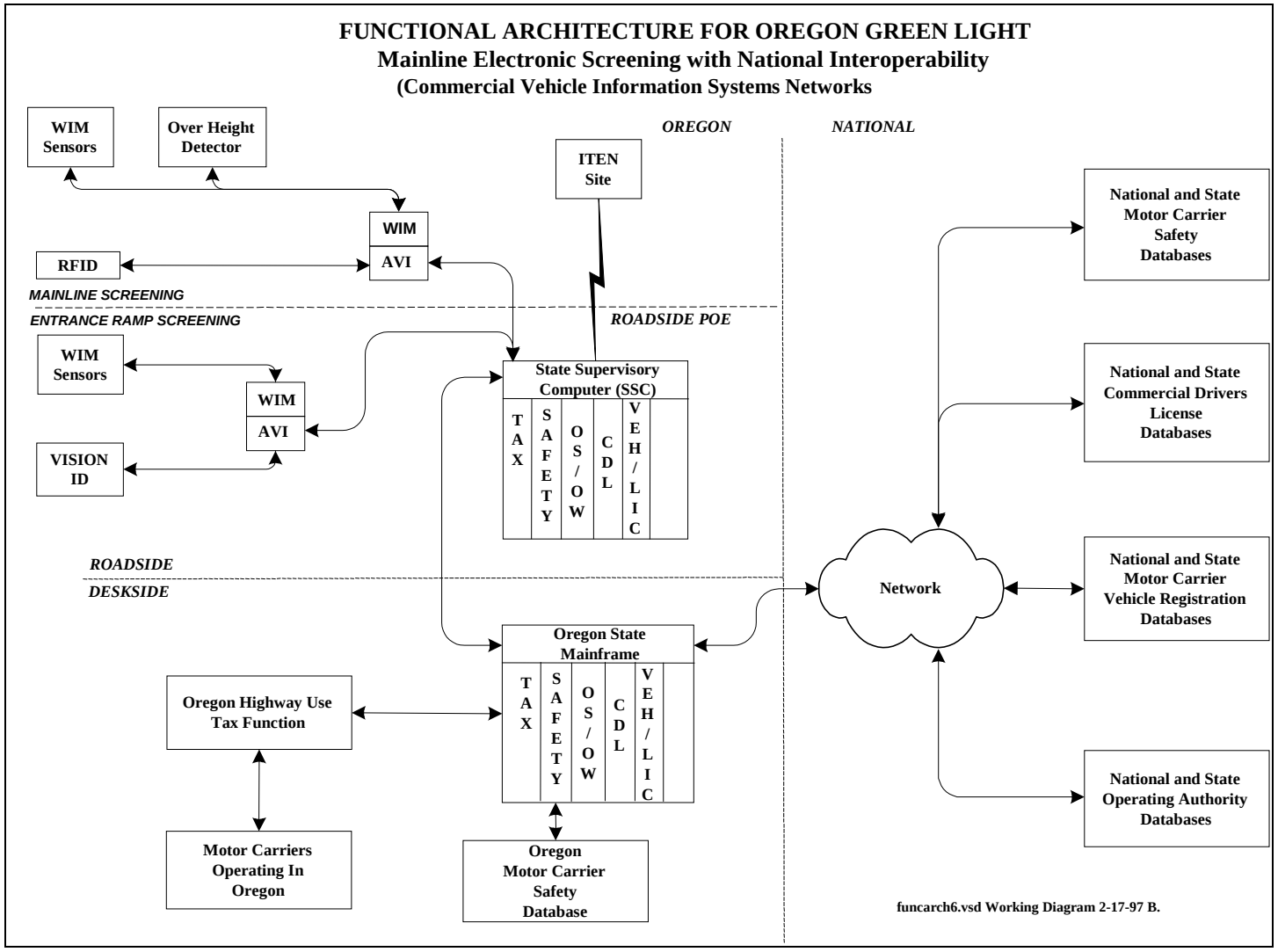
is a collection of remote sensing devices located on the state highway system. It will serve as a management tool to more effectively utilize enforcement personnel.

1.4 OTHER STUDIES

The Oregon Weight-Mile Tax Study (Cambridge Systematics, Inc. and SYDEC , Inc. February, 1996) was prepared for the Oregon Legislative Revenue Office, the Oregon Public Utilities Commission, and the Oregon Department of Transportation. The objective of the report was to estimate the evasion rate and identify methods of evasion. Recently completed, this report provides an outline of current practices and identifies the issues that define road use revenue collection in Oregon.

Oregon Department of Transportation Financial Services Branch's *"Cost Accounting and Cost Allocation Need"* study. The consultant firm of Coopers and Lybrand are under contract with the Oregon Department of Transportation to conduct a true cost study for the agency. The first task is to define Oregon Department of Transportation products and services, its organizational/departmental responsibilities and its major customers. The second task is to define the baseline costing capabilities. CTRE will incorporate process and cost findings of this study in the development of baseline process mapping and activity cost identification to the extent that documentation is available.

Exhibit 1-2 Functional Architecture for Oregon Green Light



2 TEST METHODOLOGY

2.1 PHYSICAL DESCRIPTION

This section describes the activities to be carried out to meet the evaluation objectives.

2.1.1 Purpose

The first step in determining the changes in the resources required to support the tax auditing process is to establish a baseline. That is, identify the individual transactions and activities that make up the processes and determine the resources required to execute these activities. A process map will be developed to clearly identify individual transactions and activities for both tax collection and auditing. The resources required to support each activity will be identified through interviews with Oregon Department of Transportation staff and review of budget reports.

The second step is to develop a process map of the planned modifications to the tax collection and auditing processes that will result from the introduction of Oregon Green Light. The resources required to support each planned activity will be identified through interviews with Oregon Department of Transportation staff, review of budget reports and estimates of future activity costs.

Finally, it is expected that Oregon Green Light will change the auditing processes in ways that are yet unforeseen. For this reason, the research team will revisit the process map with members of the advisory team one year after the beginning of Green Light deployment. It is expected that, at this point, the process map will be fine tuned to reflect these changes. The resources required to support each activity of the fine tuned process will be identified through

interviews with Oregon Department of Transportation staff and estimates of future activity costs.

Changes in the highway use tax collection rate will be determined by comparing the estimated rate for the first three fiscal years following Green Light implementation with the baseline estimates. *The Oregon Weight-Mile Tax Study* (Cambridge Systematics, Inc. and SYDEC , Inc. February, 1996) provides current tax evasion rate estimates and will serve as the baseline. It is expected that the tax collection and enforcement process will be fine tuned in response to Oregon Department of Transportation's experience with Oregon Green Light technology. Estimates of future collection rates will take these collection process modifications into account.

2.1.2 Hypotheses

The following hypothesis will be tested:

2.1.1 The audit process will become more automatic.

2.2.1 Oregon Green Light will support changes *(in road use revenue collections*).

2.2 PRE-TEST ACTIVITIES

For Measure 2.1.1, CTRE will obtain copies of all available procedural manuals, organizational charts, budget documents, and reports relevant to road use revenue collection, auditing, and enforcement activities.

For Measure 2.2.1, CTRE will first obtain daily logs from both the Woodburn Port of Entry and the Wilbur weigh station to determine the proportion of trucks observed at Woodburn that are also observed at Wilbur. The proportion will allow us to estimate the effort that will be needed to collect data.

Once it has been determined that the needed data will be collected in a reasonable amount of

time, CTRE will work with Oregon State University's Transportation Research Institute to recruit and train a data collection crew. CTRE anticipates a data collection crew of four people.

CTRE will work the Oregon Department of Transportation to schedule data collection.

2.2.1 Data Sources and Availability

The reports referenced in section 1.3 of this test plan, *The Oregon Weight-Mile Tax Study* (Cambridge Systematics, Inc. and SYDEC , Inc. February, 1996) and *Motor Carrier Services Transaction Processing Project Phase II*, Final Report (PRODATA Inc. March, 1993), have been obtained.

CTRE will review policy and procedure manuals, organizational charts and budget documents relevant to the business processes of the Oregon Department of Transportation's Motor Carrier Transportation Branch. Once identified, these items will be obtained from the Oregon Department of Transportation.

Gayle Green, Motor Carrier Audit Technical Coordinator and Robert Ottelle, Motor Carrier Audit Manager with Oregon Department of Transportation's Financial Services Branch will serve as the initial points of contact in the mapping and activity cost assessment of the auditing branch. *The Oregon Weight-Mile Tax Study* will be the source of baseline data for estimated tax evasion rates.

As part of the evaluation, CTRE will collect original data from roadside observations (see section 2.3.2 of this test plan) and compare observations with motor carriers quarterly mileage tax reports. The tax reports will be properly masked to preserve the confidentiality of the data. Term of access to the motor carrier tax reports will be set by the Oregon Department of

Transportation. To collect roadside data, CTRE will require physical access to at least two weigh stations. Terms of access to the weigh stations will be set by Oregon Department of Transportation's Motor Carrier Transportation Branch.

2.2.2 Determination of Benchmark Timeframe

Fiscal data will be collected for the current and preceding two bienniums. Activity cost estimates will be based on current practices and outlays.

The Oregon Weight-Mile Tax Study will be the source of baseline data for estimated tax evasion rates.

2.3 TEST CONDUCT ACTIVITIES

2.3.1 Descriptions/Participants

- Transportation Research Institute (Chris Bell, Paul Montagne, staff) will be the lead contractor for the evaluation. Coordinate development and execution of the individual test plan.
- Iowa State University-CTRE (Bill McCall, Dennis Kroeger, Mark Nelson and staff); will conduct the research, including the development of process maps, interviews, documentation of preliminary findings and facilitation of Oregon Department of Transportation review.
- Oregon Department of Transportation-Motor Carrier Transportation Branch will provide information on current practices and costs of the revenue collection and auditing process as well as enforcement activities and estimated impact of Oregon Green Light technology.

2.3.2 Procedures

1) Determine the change in the auditing process

1a) *Develop a business process map*

CTRE will develop a business process map to depict the interrelationships, functions and activities that make up Oregon Department of Transportation's highway use tax auditing process. The process map will reflect information gathered in the review of the literature and interviews with Gayle Green, Motor Carrier Audit Technical Coordinator with the Oregon DOT's Financial Services Branch and Robert Ottelle, Audit Manager with the Oregon DOT's Motor Carrier Branch.

Auditing can be divided into supporting activities. Auditing activities include, for

example, annual review of motor carrier records and individual field audits.

1b) *Identify the costs of all activities within each process*

Using the process map as a blueprint, CTRE will work with Oregon Department of Transportation personnel to identify all activities that make up the auditing process. Having established the activities to the satisfaction of Oregon Department of Transportation personnel, costs for each will be identified. Activity costs include the costs of all significant resources needed to perform the activity. Resources will include people, (salary and benefits), training, computer systems, travel, facilities, supplies, insurance etc. In cooperation with Gayle Green and Robert Ottelle, cost data will be developed based on Oregon Department of Transportation's budget/cost reports and program documents.

1c) *Identify activities that require fine tuning*

After observing the performance of the new auditing process for one year, a revised process map will be developed to incorporate changes. The resources required to support each activity of the fine tuned process will be identified through interviews with Oregon Department of Transportation staff and estimates of future activity costs.

2) Determine changes in highway use tax collected and why

The Oregon Weight-Mile Tax Study of 1996 concluded that Oregon's highway use tax evasion rate for the 1993-1995 biennium was roughly five percent or nominally, five million dollars per year in unpaid tax burden. The finding of this study will serve as the baseline in the evaluation of the expected changes in road use revenue as a result of Oregon Green

Light deployment.

If successful, Oregon Green Light technology will serve as a deterrent to the primary methods of evasion; under or non reporting of mileage and traveling over registered weight. Mainline preclearance could both decrease the number of unauthorized bypasses that result from full queues and increase the ability of auditor's to gather and track motor carrier travel.

CTRE will interview enforcement personnel and auditors beginning in June of 1998, after the Department has had one year of experience with Oregon Green Light technology. Because the ITEN Operational Test is not scheduled to begin until 1998, evaluation of its impact will not begin until June of 1999. Oregon Department of Transportation Weight Enforcement Officers and Motor Carrier Transportation Branch Auditors will be asked to draw upon their professional experience and their exposure to Green Light technology to assess the potential impact on collection rates. Impact will be assessed based on various assumed levels of participation in the preclearance program on the part of the motor carriers.

Hypothesis: Motor carriers that are observed more likely to submit accurate quarterly mileage tax reports.

CTRE will compare the accuracy of mileage tax reports for a sample group of carriers that observed at weigh stations with a sample group of carriers that are not knowingly observed. Data will be collected for observed and unobserved trucks. The objective of data collection is to assign a distance traveled to a sample of each group. The steps include:

1. Observe and record plate numbers of trucks as they leave the Woodburn Port of Entry. Delineate between trucks that cross the static scales (observed) and trucks that get directed to the bypass lane (unobserved).
2. Observe all trucks that enter the Wilbur weigh station. The Wilbur weigh station is located 144 miles downstream from the Woodburn Port of Entry. It is expected that a significant portion of trucks observed leaving the Woodburn Port of Entry will pass through Wilbur between two and four hours later. A data collection crew will be posted at the Wilbur weigh station to once again observe and record the plate numbers of all trucks passing through both stations. The needed sample size will be calculated as part of the pre test activities. CTRE expects that a sample size of approximately 1200 trucks will be needed.
3. Review tax reports for the quarter that includes the data collection period. Determine the proportion of observed trucks that reported at least 144 miles, the distance between the two observations.
4. Conduct statistical analysis of data. CTRE will provide a conclusion and interpretation of findings in the final report.

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 for their approval.
2. Approval of the steering committee at a scheduled meeting.
3. Preparation of a final test report for each test, incorporating the steering committee's recommendations.
4. Submittal of one hard copy original, one electronic original, and ten bound copies of each test report to Oregon Department of Transportation's project management team.
5. Transmittal of test reports by Oregon Department of Transportation to FHWA.

2.4.2 Reporting Schedule for Individual Test Reports

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 Final Report	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 Report	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 Oregon Department of Transportation 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

Exhibit 2-2 Reporting Schedule - Data Archiving

Deliverables	Schedule	Scheduled Due Date*
Drafts of a Data Summary Report	December 1, 1999-Jan 30, 2000 (60 days)	February 1, 2000
Review of Data Summary Report by Steering Committee	February 1-February 28, 2000 (28 days)	March 1, 2000
Data Summary Report (Final) and Data Archive	March 1-March 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 Department of Transportation's project management team.
5. Transmittal of the test reports by Oregon Department of Transportation to FHWA.

2.4.6 Reporting Schedule for Test Summary

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

Exhibit 2-3 Reporting Schedule - Test Summary Reports

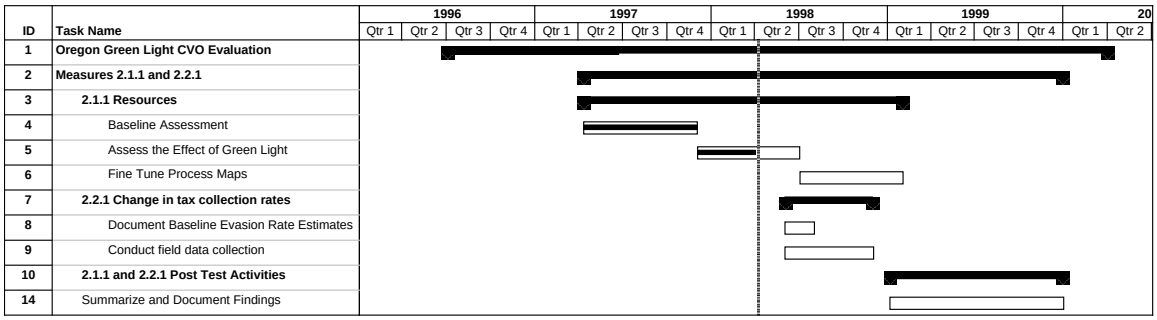
Deliverables	Schedule	Scheduled Due Date*
Drafts of Test Summary Report	Dec. 1, 1999 - Jan 30, 2000 (60 days)	February 1, 2000
Review of Test Summary Report by Steering Committee	Feb. 1 - Feb. 28, 2000(28 days)	March 1, 2000
Final Summary Report	Mar 1 - Mar 30, 2000 (30 days)	April 1, 2000

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 2.1.1, 2.2.1



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 Test Measures 2.1.1, 2.2.1

Organization:Iowa State University (CTRE)						
DTP	**Measure**	**Researcher/Personnel**	**Hours**	**Cost**	**Fringe Benefits**	**Totals**
6	2.1.1	T Maze	7	$423	$104	$527
		B McCall	100	$4,480	$1,380	$5,860
		M Nelson	150	$3,095	$953	$4,049
		Student	52	$839	$127	$966
		Subtotals	309	$8,837	$2,564	**$11,401**
		Support Personnel	104	$1,761	$638	**$2,399**
	Equipment:			$0		
	Supplies:			$333		
	Travel:			$3,167		
	Subtotal:					**$3,500**
	Overhead					$7,612
	Total:					**$24,913**

Organization:Iowa State University (CTRE)						
DTP	**Measure**	**Researcher/Personnel**	**Hours**	**Cost**	**Fringe Benefits**	**Totals**
6	2.2.1	T Maze	13	$845	$208	$1,066
		B McCall	200	$8,960	$2,760	$11,920
		M Nelson	301	$6,191	$1,907	$8,398
		Student	104	$1,679	$254	$2,037
		Subtotals		$17,675	$5,128	**$22,803**
		Support Personnel	208	$3,522	$1,276	**$4,798**
	Equipment:			$0		
	Supplies:			$667		
	Travel:			$6,333		
	Subtotal:					**$7,000**
	Overhead					$15,224
	Total:					**$49,825**

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. Oregon Weight-Mile Tax Study, Cambridge Systematics, Inc. with SYDEC, Inc. and Pacific Rim Resources, Inc. Prepared for Oregon Legislative Revenue Office, Oregon Public Utilities Commission and the Oregon Department of Transportation. January 4, 1996 p. ES-4

3. Strategic Plan for IVHS/CVO in Oregon” (Oregon Department of Transportation and the Oregon Public Utility Commission, Salem Oregon, July 1993)

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Oregon Green Light CVO Evaluation

Detailed Test Plan # 7

Measure 2.3.1 Predict total vehicles processed

Measure 2.3.2 Predict number and length of service interruptions per shift

Measure 2.4.1 Predict average travel time savings for each vehicle

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TABLE OF EXHIBITS

1 DETAILED TEST INTRODUCTION

1.1 BACKGROUND

This Detailed Test Report is the seventh 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 test measures employed to obtain the objectives: *2.1 Simulate changes in vehicles processed at the Woodburn Port of Entry* and *2.2 Simulate productivity to motor carriers* two 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 used in the simulation are:

- **2.3.1 Predict total vehicles processed.**
- **2.3.2 Predict number and length of service interruptions per shift.**
- **2.4.1 Predict average travel time savings for each vehicle.**

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

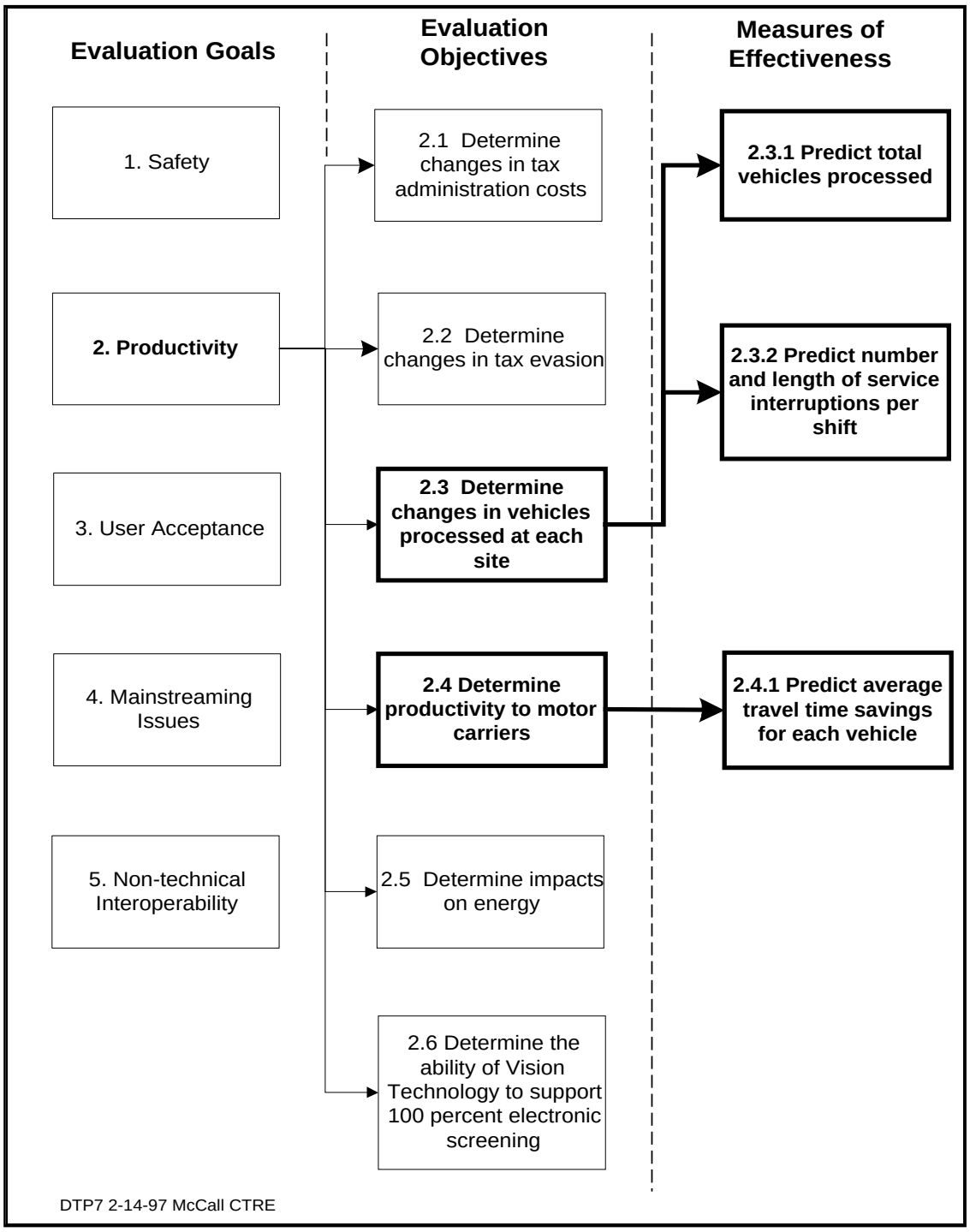
CTRE will provide a simulation model of the Woodburn Port of Entry to estimate expected

changes in weigh station performance and commercial vehicle travel time savings under various assumptions about the proportion of transponder equipped vehicles and overall traffic levels. Specifically, the simulation model will be used to predict changes in the following;

- Total number of vehicles processed (cleared and not cleared).
- Total number of interruptions (open/closed) per shift and total time of interruptions.
- Average travel time savings per vehicle.

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 vision of the Green Light Project includes improving the efficiency of commercial vehicle operations and the performance of weigh stations without compromising safety or the public's investment in the infrastructure. This particular evaluation will provide benchmark data from which to assess changes in weigh station performance and provide a predictive model for assessing future changes in commercial vehicle traffic levels. The evaluation is complicated by the fact that traffic conditions at each station are affected by a number of unique factors such as topography and traffic volume. CTRE will evaluate the Woodburn Port of Entry at both peak and non-peak travel times. The objective is to provide information that is representative of the range of behavior observed at Oregon weigh stations with similar designs.

The Woodburn Port of Entry will be the focus of this study. Woodburn is the busiest weigh station in the state and is scheduled to be one of the first weigh stations to be equipped with a mainline automated preclearance system.

Exhibit 1-1 Location Woodburn Port of Entry

1.4 OTHER STUDIES

Heavy Vehicle Electronic License Plate Program (HELP)-Program Summary -1991. HELP was a multi-state, multi-national research effort to design and test an integrated heavy vehicle monitoring system that uses Automatic Vehicle Identification (AVI), Automatic Vehicle Classification (AVC), and Weigh-In-Motion (WIM) technology. CTRE will review the methodologies employed to assess productivity in the HELP operational tests.

CTRE is currently involved in the evaluation component of the Advantage I-75 project. Advantage I-75 represents a multi-state partnership of public and private sector interests along the I-75 corridor. The project will promote the efficiency of motor-carrier operations by allowing transponder equipped and properly documented trucks to bypass weigh stations along the I-75

corridor.

2 TEST METHODOLOGY

2.1 PHYSICAL DESCRIPTION

This section discusses in detail the activities carried out in the simulation of the Woodburn Port of Entry to predict weigh station performance and motor carrier productivity.

2.1.1 Purpose and Scope

The purpose of this evaluation is to develop a benchmark of weigh station performance and motor carrier productivity and to estimate the impact of Green Light technology, using the benchmark data as input into a customized computer simulation of the Woodburn Port of Entry.

The simulation modeling will build upon CTRE's experience with weigh station simulation as part of the ongoing Advantage I-75 evaluation. The software is quite sophisticated and can provide continuous animated displays of a number of parameters such as traffic flow, queue behavior, and processing time at the weigh station. The flexibility of the model, combined with the rich data source provided by the throughput data collection, will allow the evaluation team to illustrate the expected effect of many clearance scenarios (e. g., varying the population of transponder equipped vehicles and varying the level of mainline truck traffic) on the primary variables of interest (total number of vehicles processed-cleared and not cleared, total number of interruptions (open/closed) per shift and total time of interruptions, and, average travel time savings per vehicle).

2.1.2 Hypotheses

The following hypotheses are given in support of the four measures and will be tested according to accepted statistical techniques should it be necessary to utilize them:

2.3.1 The number of trucks processed will eventually increase

2.3.2 The number of interruptions will decrease

2.4.1 Average travel time per vehicle will decrease

2.2 PRE-TEST ACTIVITIES

Pre-test activities for this measure will focus on the quality and availability of data and the development of a time frame for establishing benchmarks. These steps are discussed in detail below.

1) Data Sources and Availability

The primary data sources used for this test measure are:

- Throughput data will be collected on site. The data collection process is described in Sections 2.2.2 and 2.3.2 of this document.
- Woodburn Port of Entry Site Plans. Site plans have been obtained from the Oregon Department of Transportation. These plans will serve as the basis of the preliminary model development.

2) Determination of Benchmark Timeframe

On -site data will be collected at the Woodburn Port of Entry for a continuous one to three day period. Data collection is tentatively scheduled for May 6th through May 8th 1997. Each day, the data collection crew will collect six hours of throughput timing data along with other data concerning approach and departure speed and service time. A schedule will be developed to include a.m. peak, p.m. peak and non-peak periods. This data will provide a benchmark for

number of trucks processed, number and length of service interruptions and average truck travel time.

2.3 TEST CONDUCT ACTIVITIES

2.3.1 Descriptions/Participants

- Iowa State University's Center for Transportation Research and Education (Bill McCall, Mark Nelson, Dr. Ali Kamyab, and staff) will conduct the research, supervise data collection, analyze data and develop the simulation model.
- Oregon State University's Transportation Research Institute (Chris Bell, Paul Montagne, and staff) is the lead contractor for the evaluation. The Transportation Research Institute (TRI) will coordinate the development and execution of the Detailed Test Plans. TRI will assist in the recruitment of research assistants to staff the data collection crew.

2.3.2 Procedures

1) Collection of profile data and preparation for throughput data collection at the Woodburn Port of Entry.

1a) Develop a preliminary model.

Dr. Ali Kamyab will create a rough simulation model of the Woodburn Port of Entry based on available site plans and known functionality. The preliminary model will allow Dr. Kamyab to better understand specific data requirements prior to the data collection trip.

1b) Recruit Data Collection Crew.

CTRE, in cooperation with Oregon State University's Transportation Research Institute

staff, will recruit a data collection crew for the on-site throughput data collection. The size of the crew will depend on the layout of the weigh station and the level of traffic.

1c) Measure physical layout of Woodburn and train data collection crew.

The day prior to throughput data collection, the physical layout of Woodburn Port of Entry will be more precisely measured. There will also be a two hour training session for the data collection crew.

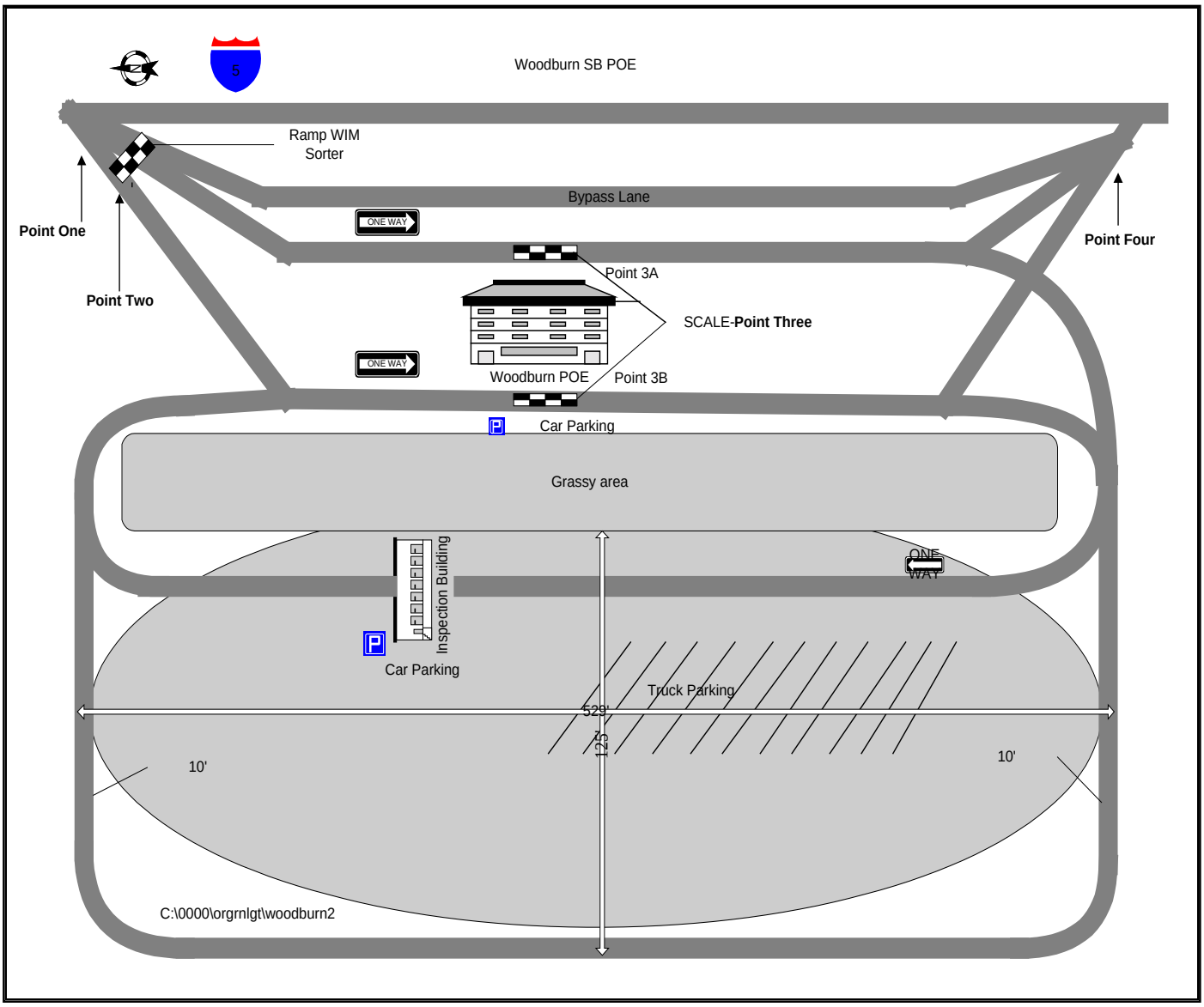
2) Collection of throughput data

The information needed includes:

- Travel time between Points One, Two, Three and Four. (shown in Exhibit 2-1 Woodburn Scale Layout).
- Average static scale service time.
- Number of mainline bypass trucks
- Number of weigh station bypass trucks
- Weigh Station Geometry

The following outline describe the procedures for recording vehicle arrival time and unique vehicle identification information for each of the data collection points. Instead of chronological order, the outline is organized by location.

Exhibit 2-1. Woodburn Scale Layout



2a) Point One Data Collection

Point one will be staffed by three individuals: one arrival observer, one arrival recorder, and one bypass observer/recorder. Point one is the average end of the queue. That is, the estimated point at which trucks must come to a stop. Once marked, the distance

from Point One to Point Two is measured using a surveyor's wheel and recorded on the site plan.

Prior to the beginning of the session, the arrival recorder documents weather conditions. As the session begins, the arrival observer calls out the unique truck identification (first four digits of prorate plates) and arrival time to the recorder. The recorder writes this information on the Vehicle Arrival/Departure Identification Form (see EXHIBIT 2-5). Using this system, the team can record the identification and arrival time of up to ten trucks in any one minute period.

At times, it is expected that the vehicles' prorate plates will not be immediately conspicuous. To ensure uniform identification of these vehicles at all data collection points, cab color and vehicle make will be recorded when prorate plates are not observed.

The bypass observer/recorder records each commercial vehicle bypass event that is attributable to a queue overflow condition. The observer tallies each bypass on the Truck Bypass Form (See EXHIBIT 2-5)

2b) Point Two Data Collection

Point two is located at the ramp weigh in motion sorter. It will be staffed by two individuals, an observer and a recorder. As with point one, the observer calls out the unique truck identification (first four digits of prorate plates) and arrival time to the recorder. The recorder writes this information on the Vehicle Arrival/Departure Identification Forms (see EXHIBIT 2-5). Using this system, the team can record the identification and arrival time of up to ten trucks in any one minute period.

2c) Point Three Data Collection

Point Three will be staffed by two individuals, one at each of the static scales. Generally the arrival speed at these sites is slow and one individual can both identify and record the needed information.

The distance from Point Two to Point Three is measured using a surveyor's wheel and recorded on the site plan. As each truck arrives, the research assistant assigned to Point Three notes and records the unique identification number, arrival time and processing scenario. The difference between the arrival and departure time at the scale defines the static scale service time. There are three possible processing scenarios: 1. Stop at scale: static weigh and exit. 2. Level One: static weigh, credential check (while stopped on scale platform), and exit and 3. Level Two: Static weigh, inspection, credential check, and exit.

It should be noted that not all vehicles arriving at Point One will be observed at Point Three. It is expected that the majority of vehicles will be directed back to the mainline via the static scale bypass lane after weighing on the ramp weigh-in-motion scale. The observer(s) at Point Three will only note the vehicle arrival, identification and processing scenario data for those vehicles that are directed to the static scale.

2d) *Point Four Data Collection*

Point Four corresponds to the point where vehicles exit the weigh station and return to the mainline. This point will be staffed by two individuals, one arrival observer and one arrival recorder. The process at Point Three is identical to the process at Point One.

3) Development of the Simulation Model

Dr. Ali Kamyab, a research scientist at CTRE, will develop the simulation model.

The simulation model will be used to evaluate total number of vehicles processed (cleared and not cleared), total number of interruptions (open/closed) per shift and total time of interruptions, and vehicle travel time savings attributable to the preclearance system. The simulation model will be developed using the application program Arena. Arena provides an integrating environment for graphically building a model using SIMAN simulation language. The animation capability of Arena enables audiences to view the changes in performance of the weigh stations resulting from Green Light deployment.

The output of the simulation model includes data that describes weigh station performance. Data includes the proportion of trucks bypassing the weigh station without authorization, queue length, and processing time at the weigh station. These summaries also provide a measure of the precision of the estimates.

The data collected at the weigh station will also be used in the validation and customization of the simulation model. The data will be produced in statistical summary form and will include mean, standard deviation, and distribution of a number of variables. It will be used as input data for the simulation model and to check that the simulation model can reproduce real conditions.

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 ODOT'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 2-1 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 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 ODOT'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 2-3 Reporting Schedule - Test Summary Reports

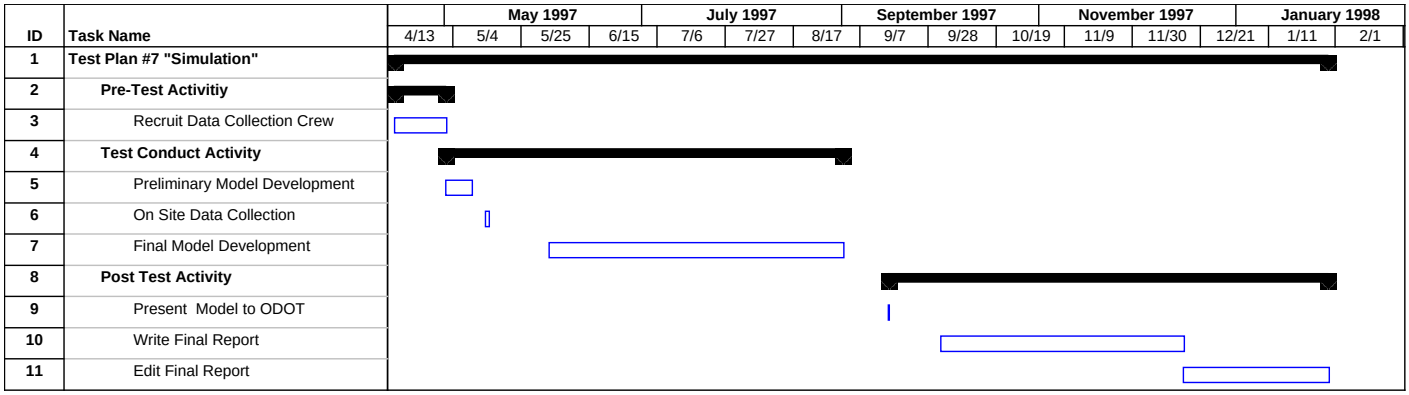
Deliverables	Schedule	Scheduled Due Date*
Drafts of Test Summary Report	Dec 1, 1999 - Jan 30, 2000 (60 days)	February 1, 2000
Review of Test Summary Report by Steering Committee	Feb 1 - Feb 28, 2000 (28 days)	March 1, 2000
Test Summary Report (Final)	Mar 1 - Mar 30, 2000 (30 days)	April 1, 2000

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 Measures 2.3.1, 2.3.2 and 2.4.1



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 Cost Breakdown for Test Measures 2.3.1, 2.3.2 and 2.4.1

Organization:Iowa State University (CTRE)						
DTP	**Measure**	**Researcher/Personnel**	**Hours**	**Cost**	**Fringe Benefits**	**Totals**
7	2.3.1	T Maze	13	$845	$208	$1,053
		B McCall	57	$2,554	$787	$3,340
		M Nelson	53	$1,098	$338	$1,436
		A Kamyab	213	$5,818	$1,792	$7,609
		Student	104	$1,679	$254	$1,933
		Subtotals	441	$11,993	$3,378	**$15,372**
		Other Personnel	131	$2,206	$802	**$3,008**
	Equipment:			$875		
	Supplies:			$751		
	Travel:			$1,850		
	Subtotal:					**$3,476**
	Overhead					$9,231
	Total:					**$31,086**

Organization:Iowa State University (CTRE)						
DTP	**Measure**	**Researcher/Personnel**	**Hours**	**Cost**	**Fringe Benefits**	**Totals**
7	2.3.2	T Maze	13	$845	$208	$1,053
		B McCall	57	$2,554	$787	$3,340
		M Nelson	53	$1,098	$338	$1,436
		A Kamyab	213	$5,818	$1,792	$7,609
		Student	104	$1,679	$254	$1,933
		Subtotals	441	$11,993	$3,378	$15,372
		Other Personnel	131	$2,206	$802	$3,008
	Equipment:			$875		
	Supplies:			$751		
	Travel:			$1,850		
	Subtotal:					$3,476
	Overhead					$9,231
	Total:					**$31,086**

Organization:Iowa State University (CTRE)						
DTP	**Measure**	**Researcher/Personnel**	**Hours**	**Cost**	**Fringe Benefits**	**Totals**
7	2.4.1	T Maze	13	$845	$208	$1,053
		B McCall	57	$2,554	$787	$3,340
		M Nelson	53	$1,098	$338	$1,436
		A Kamyab	213	$5,818	$1,792	$7,609
		Student	104	$1,679	$254	$1,933
		Subtotals	441	$11,993	$3,378	$15,372
		Other Personnel	131	$2,206	$802	$3,008
	Equipment:			$875		
	Supplies:			$751		
	Travel:			$1,850		
	Subtotal:					$3,476
	Overhead					$9,231
	Total:					**$31,086**

Exhibit 3-2 Cost Breakdown for Test Measures 2.3.1, 2.3.2 and 2.4.1 (Cont.)

Organization: Oregon State University (TRI)					
DTP	**Measure**	**Researcher**	**Hours**	**Cost**	**Totals**
7	2.3.1	Students	60	$450	
					$450
	Payroll Exp:	Students	5%	$22.50	
					$23
	Subtotal:				
	Supplies:			n/a	
	Travel:			$40	
	Subtotal:				$40
	Overhead		42%		$213
	Total:				**$725**

Organization: Oregon State University (TRI)					
DTP	**Measure**	**Researcher**	**Hours**	**Cost**	**Totals**
7	2.3.2	Students	60	$450	
					$450
	Payroll Exp:	Students	5%	$23	
					$23
	Subtotal:				
	Supplies:			n/a	
	Travel:			$39	
	Subtotal:				$39
	Overhead		42%		$195
	Total:				**$725**

Organization: Oregon State University (TRI)					
DTP	**Measure**	**Researcher**	**Hours**	**Cost**	**Totals**
7	2.4.1	Students	60	$450	
					$450
	Payroll Exp:	Students	5%	$22.50	
	Subtotal:				
	Supplies:			n/a	
	Travel:			$40	
	Subtotal:				$513
	Overhead		42%		$213
	Total:				**$726**

4 REFERENCES

1. Bell, C.A., B. McCall, and, C.M. Walton, "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.

Exhibit 3-3 Data Collection Forms

Weigh Station Name:	Traffic Direction:
Observation Point: (circle one) 1 2 3 4	Session Start Time:
Observer Name:	Recorder Name:
Weather Conditions:	Point __-Point__ Distance: ____
	Date:

Minutes **Vehicle Identification and Arrival Time (Seconds)**

0 ID. Secs.										
1 ID. Secs.										
2 ID. Secs.										
3 ID. Secs.										
4 ID. Secs.										
5 ID. Secs.										
6 ID. Secs.										
7 ID. Secs.										
8 ID. Secs.										
9 ID. Secs.										

Service Time Form

Weigh Station Name:	Traffic Direction: (circle one) North South
Observer Name:	Date:

Current Time:	**Current Time**:	**Current Time**:	**Current Time**:
Service Time (sec)	**Service Time (sec)**	**Service Time (sec)**	**Service Time (sec)**
1-	1-	1-	1-
2-	2-	2-	2-
3-	3-	3-	3-
4-	4-	4-	4-
5-	5-	5-	5-
6-	6-	6-	6-
7-	7-	7-	7-
8-	8-	8-	8-
9-	9-	9-	9-
10-	10-	10-	10-
11-	11-	11-	11-
12-	12-	12-	12-
13-	13-	13-	13-
14-	14-	14-	14-
15-	15-	15-	15-
16-	16-	16-	16-
17-	17-	17-	17-
18-	18-	18-	18-
19-	19-	19-	19-
20-	20-	20-	20-
21-	21-	21-	21-
22-	22-	22-	22-
23-	23-	23-	23-
24-	24-	24-	24-
25-	25-	25-	25-
Current Time:	**Current Time:**	**Current Time:**	**Current Time:**

Vehicle Counts Form

Weigh Station Name:	Traffic Direction: (circle one) North South
Observer Name:	Traffic Lane: (circle one) Inner Outer Middle
Date:	Time: (circle one) AM PM

Time Begins	Cars	Trucks
:		
:		
:		
:		
:		
:		
:		
:		