

Task 19

Comprehensive and Detailed Final Project Report (Phases I & II)

Commercial Vehicle Information Exchange Window (CVIEW) Roadside Enforcement/Compliance Project

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**New York State Energy Research and Development Authority
And
New York State Department of Transportation**

Submitted by:

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DISCLAIMER

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PREFACE

The New York State Energy Research and Development Authority (NYSERDA) is a public benefit corporation created in 1975 by the New York State Legislature. For more than a quarter century, NYSEDA has been working on finding innovative solutions to the energy and environmental issues that face residents of the Empire State. As part of that mission, the Authority has sought answers that would benefit not only New York's energy and environmental future, but the economy as well. To do so, NYSEDA has traditionally partnered with other state agencies, as well as industrial, commercial, environmental and economic development groups all across New York State.

In 1999, the New York State Department of Transportation (NYSDOT) had just completed a three-year contractual research relationship with a consortium of seven New York State universities, colleges and research institutions. Based on the success of that experience, the Department sought to establish additional partnering arrangements with research consortia to carry out basic and applied research, technology transfer, and short-term consultation services in the fields of engineering, operations, public transportation, management and finance, public policy, and human resources.

As a complement to a university-based constituency, NYSEDA organized a Transportation Infrastructure Research Consortium comprised of seventeen private-sector research entities. The membership is characterized as businesses, not-for-profits, and professionals that have a track record of performing transportation-related research, development, and demonstration as a normal part of their service-related or internal operations. Many of the organizations also have strong relationships with universities, state agencies and authorities, and federal funding agencies, and are already performing collaborative research through those relationships.

In June of 2001, New York State Comptroller's Contract C012668 was executed and governs the activities of the NYSEDA-administered Transportation Infrastructure Research Consortium. The term of the agreement is for five years, extending from March 1, 2001 through February 28, 2006. The direct and dynamic linkages between transportation, energy, and the environment have continually reinforced the cooperative relationship formed between NYSDOT and NYSEDA. Since its inception, numerous collaborative efforts have been undertaken and the report that follows is a product of that relationship.

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16. Abstract An extensive effort was undertaken by Clough Harbour & Associates on behalf of, and with assistance from, the New York State Department of Transportation (NYSDOT) in order to research and design a prototype roadside commercial vehicle electronic screening system including design guidelines, standards and specifications, to be utilized in New York State for data collection and roadside enforcement purposes, and to be potentially replicated at additional commercial vehicle inspection locations throughout the State. The culmination of this project is a comprehensive research, development and testing effort that resulted in the final design of a system and components for a deployable roadside electronic screening system that meets the existing and future needs of New York State's commercial vehicle safety and security inspection operations. The resulting prototype electronic screening system is operational and deployed along Interstate 90 westbound in the Town of Schodack, Rensselaer County, located approximately 1 ½ miles downstream of an existing commercial vehicle inspection location. Deployed at the testing location of the original mobile electronic screening system developed and based on recommendations as part of Phase One of this effort, the I-90W/Schodack prototype electronic screening site now includes permanent inroad and roadside installations of three different Weigh-In-Motion (WIM) technologies, Automatic Vehicle Identification (AVI) sensors and a License Plate Recognition (LPR) camera system. The system also includes a local wireless network configuration for on-site equipment communications as well as Internet access allowing enforcement to obtain access to the system remotely, and the functionality of monitoring and collecting bi-directional data on a 24/7 basis and providing a direct data feed to the regional transportation management center (TMC). In addition to serving as the model/prototype system for all future electronic screening deployments Statewide, NYSDOT is also utilizing this site to test additional commercial vehicle enforcement technologies such as rear (trailer) License Plate Reader cameras, US DOT Number reader cameras, overheight vehicle detection systems, and 5.9 GHz Dedicated Short Range Communication (DSRC) vehicle/roadside technology.			
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**Commercial Vehicle Information Exchange Window (CVIEW) Roadside
Enforcement/Compliance Project**

Comprehensive and Detailed Final Project Report, Task #19 (Phases I & II)

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Executive Summary

This Final Report for the Commercial Vehicle Information Exchange Window (CVIEW) Roadside Enforcement/Compliance Project is the culmination of many years of research, development and implementation of various electronic screening (e-screening) technologies for commercial vehicles. The result of these efforts is the technology test site now deployed at the Schodack commercial vehicle inspection location on US Interstate 90 westbound.



Figure 1 Advance Location - Schodack E-Screening Site

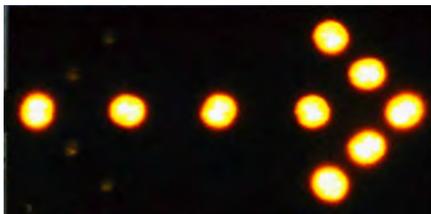
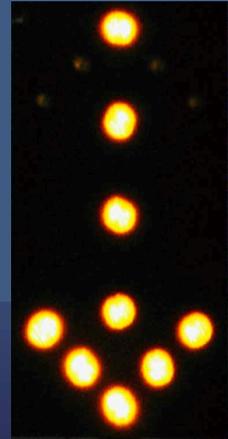
Home to the original mobile screening system developed in Phase One of this project, the Schodack e-screening site now includes permanent installations of three unique Weigh-In-Motion (WIM) technologies, Automatic Vehicle Identification (AVI) sensors, and a License Plate Recognition (LPR) system based on recommendations developed as part of Phase One. It includes a local wireless network configuration for site communication and Internet access for remote operation by enforcement personnel, as well as 24/7 data monitoring and collection. NYSDOT has used this site to test additional technologies such as a direct and automated data feed to the regional transportation management center (TMC), side-fire cameras for USDOT number recognition and 5.9 Dedicated Short Range Communications (DSRC) GHz vehicle/roadside communications.

This report chronologically compiles the entire content of written deliverables for both phases of the project. These individual reports contain key findings, system specifications, and plans of the current site. At the discretion of the NYSDOT Project Manager, a four week live pilot demonstration period

originally planned was not performed. As such, findings, feedback and recommendations that would have been a result of the pilot are not included in this report.

Research Report

TASK 1: Research and Analysis to Provide a Mobile CVIEW Screening System



Submitted to:

NYSERDA

**NEW YORK STATE ENERGY RESEARCH
AND DEVELOPMENT AUTHORITY**



**NEW YORK STATE
DEPARTMENT OF TRANSPORTATION**

Submitted by:



**CLOUGH, HARBOUR
& ASSOCIATES LLP**
ENGINEERS, SURVEYORS, PLANNERS
& LANDSCAPE ARCHITECTS



July 9, 2003

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Executive Summary

Overview

Clough Harbour & Associates LLP (CHA) was awarded New York State Energy Research and Development Authority (NYSERDA) contract C-01-66C: Commercial Vehicle Information Exchange Window (CVIEW) Roadside Enforcement / Compliance. This research report represents the findings CHA made during the course of the project's first Task; Research and Analysis to Provide a Mobile CVIEW Screening System.

Early Decisions

Several key early decisions were made prior to the start of the project. The screening system would be based on the NORPASS (North American Preclearance and Safety System) screening systems developed and implemented by the Kentucky Transportation Cabinet and the Kentucky Transportation Center.

The screening software used on the project will be Model MACS, Developed by TRW, and now part of Northrop Grumman, for the State of Kentucky. The choice of this software has had a large impact on the range of options for the design of this system.

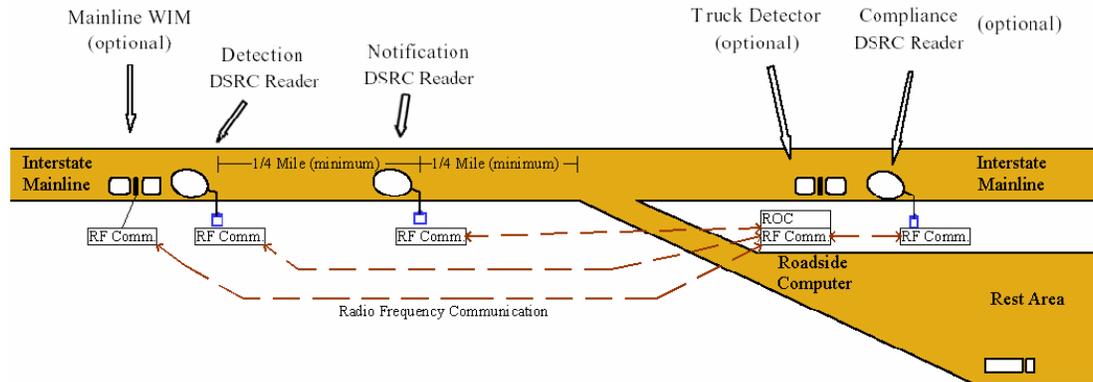
The most significant choice was to make this the first mobile electronic screening system in the nation. All other current screening implementations are at fixed inspection stations throughout the country. New York State does not have these fixed, dedicated facilities, so a mobile system can offer a greater degree of flexibility and can be placed at various locations, with some limitations.

General Site Design

During screening commercial vehicle traffic is directed into the right hand lane of the interstate mainline. It first crosses an optional Weight-in-Motion device (WIM), while the Detection or Advance Reader reads the transponder ID in the vehicle. This reader sends the ID via radio frequency(RF) communications to the Roadside Operational Computer (ROC) running Model MACS. Model Macs compares the transponder ID to the records in its database that have been generated from OSCAR (E-Credentialing). Model MACS then sends a pass or fail message via radio frequency communications to the next reader, the Notification Reader. When the Notification Reader detects the vehicle it sends out the pass or fail signal, which is displayed to the driver by a red or green light on the transponder. A vehicle getting a green light may bypass the inspection site, while anyone with a red light must pull in. Optionally, a

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Compliance Reader may be employed to monitor commercial vehicles bypassing the site and notify inspection personnel at the ROC of any violators.



Transponder Readers & Communications

Two potential suppliers of transponder readers were identified and contacted about supplying technology for this project. Ultimately, only one was able to meet the specification of being compatible with the screening software, Model MACS. This supplier, Information Systems Laboratories (ISL), is also able to supply a compatible radio frequency communications system.

If Model MACS can be re-written in the future to support other readers, or reader manufacturers such as Mark IV develop systems that support Model MACS, there will be greater choice, and more competitive pricing. But for now, only ISL is able to meet the technical specifications and schedule requirements of this project.

Screening Data

Model MACS has a defined data format and file structure that it requires to populate its database. OSCAR will export the screening data in that format to a specified network location. Prior to beginning a screening session, the inspector will connect the ROC to the network and a batch file will automatically copy the screening data to the ROC. Screening logs can also be uploaded to the network in a similar fashion.

Mobile Equipment & Power Supply

Current fixed screening systems employ mast arms to position the reader antennas directly over the lane for optimum accuracy. This system will be required to be located well off the highway. To maintain accuracy in this position, the antenna must be located well off the ground so an oblique angle to the transponders can be maintained. In addition, the radio frequency communications system requires a relatively clear line of sight, which is best achieved well above ground level. Antennas located low to the ground will be

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subject to major interference from vehicles, signs, etc.

We've specified trailers with 30' extendable masts to support both the reader and communications antennas. The trailers will contain a solar power supply with a gas generator backup. Since these have been determined to be time critical purchases, we've identified and asked for bids from pre-qualified system vendors. Two vendors responded with similar bids. We recommend splitting the equipment purchase between the vendors, allowing us to compare them for suitability on future deployments.

Signage

The effectiveness of the electronic screening system is directly related to the ability to safely notify, advise and direct commercial vehicles into the appropriate travel lanes for detection and notification by the readers. To maintain the portability of the system we recommend that all signs be constructed of high-visibility fabric panels on folding crashworthy, light weight bases.

Site Selection

Based on an analysis of several possible sites, the rest area at Schodack on I-90 westbound has been chosen for the operational test of this system. The original choice was the Clifton Park rest area on I-87 Northbound, but problems with its proximity to Exit 9 ruled it out.

In the course of analyzing various sites it became clear that not every site will be suitable for mobile electronic screening. Others may require some site work to provide access points for the mobile equipment, or additional technology to augment the radio frequency communications systems. Our recommendation is that each potential site is reviewed for suitability, or a site inventory to determine a list of potential sites be conducted.

I. TRANSPONDER READERS & COMMUNICATIONS

Our initial research showed that in the past several years there has been considerable change in ownership, consolidation and business closings among suppliers of transponder reader equipment. We were only able to find 2 viable vendors of transponder readers, Mark IV and Information Systems Laboratories (ISL). Mark IV supplies readers for E-Z Pass and other related electronic toll collection systems throughout the region. ISL provides readers specifically for commercial vehicle electronic screening as well as other transportation management systems.

Initial contact with both vendors resulted in a table comparing compatibility, durability availability, pricing and other features. (Appendix A) After delivering a detailed Statement of Work document to the vendors (Appendix B), Mark IV contacted the Model MACS programmer at Northrop Grumman and determined that their readers would not function with Model MACS, and that a significant hardware upgrade to Mark IV's readers or change to Model MACS would be required (Appendix C). They would need to be convinced of sufficient demand for a new product prior to investing in development.

Since Model MACS was written specifically for the ISL readers, they were able to respond to our system specifications. In addition to being able to provide the reader hardware, they are also able to integrate the radio frequency communications equipment. The advantage to using ISL is that they can provide a system that will not cause interference between the reader-transponder communications and the reader-roadside computer communications. ISL has specified a system that should operate in most roadside environments, and can provide site analysis support for the communications equipment if the system is deployed at a site with less than optimal line of site conditions.

Recommendations:

Since there is currently only one vendor capable of supplying readers that are compatible with Model MACS, there is little choice but to use that vendor to meet the goal of CVISN Level 1 compliance by the end of September 2003. We recommend proceeding with ISL for this project, but alternative options should be explored for future deployments. A true cost analysis for the modification of Model MACS to work with Mark IV's fusion reader, if possible, should be obtained. Most likely, however, additional functionality would have to be added to the Mark IV readers to function properly for commercial vehicle screening. They have indicated they would look at that option if sufficient market opportunity can be demonstrated.

For radio frequency modem communications we recommend using ISL as a vendor since they can best offer integration with their reader equipment. The ability to operate reader antennas and RF antennas in close proximity and at similar wavelengths is a key requirement of this project.

We see potential cost savings for future mobile deployments of a Model MACS screening system if certain modifications to the software are made. Model MACS currently requires a dedicated COM port for each device attached (e.g. readers, WIM) to the system. That works well for a hard-wired system, but causes inefficiencies in a wireless environment. Each incoming signal at the ROC requires a separate Radio frequency modem and antenna so that the signal can be channeled through its assigned COM port. A more efficient wireless environment would use wireless networking, where each device would be identified by a unique IP address. This would require using only one master wireless device at the ROC, and allow greater line of site flexibility since the RF device at the notification reader could also serve as a repeater for the detection reader and WIM. Under the current system, individual repeaters would be required for both the WIM and detection reader.

II. Screening Data

The New York State Department of Transportation (NYSDOT) has made the decision to use Model MACS, created by TRW, Inc., now part of Northrop Grumman, for their electronic screening application. Based on this decision, the format for the input data required has already been determined. New York State will need to create an ASCII file with the name EVLSCREEN.TXT. The data for this file will come from the OSCAR system in the format provided as shown in Appendix D.

The Data Working Group has determined that the fields used in Model MACS do not completely reflect the data NYS wants to use for screening. In particular, the HUT (Highway Usage Tax) flag is very important. Since the Model MACS database contains fields that are currently unused, the HUT flag can be assigned to one of those fields for the purpose of the operational test. The inspection team using the software will not see the violation as a HUT violation, but the screening will be accurate. The goal for the future is to commission a new version of Model MACS which will directly support all NYS specific data fields. A current open item is determining the cost and timeframe to make these modifications.

Recommendations:

It will be the responsibility of the NYS Inspection Team to load a current copy of EVLSCREEN.TXT file onto the laptop. It was agreed upon that connectivity to the network that contained the file, was up to the NYS Inspection Team. It was determined that connectivity was not an issue due to the fact that inspections are planned well in advance. The person responsible for loading the file to the laptop will connect to a New York State network and run a batch program provided by CHA. The batch program will move the EVLSCREEN.TXT file from the network to the location on the laptop where Model MACS will look for incoming data files.

When the Model MACS application is started up, it will automatically load the EVLSCREEN.TXT data into the database. At the inspection site, the Model MACS application will work with the weigh station computer and collect real time data from the in-vehicle transponders and WIM. This information is used to determine if the vehicle will be permitted to bypass the inspection station. Bypass decisions are based upon a number of factors, all of which are set in the Model MACS screening software. All vehicles that do not have transponders will be required to pull into the inspection station.

During the screening process, Model MACS creates a log file. CHA can provide a batch file to upload the Model MACS log files from previous screening sessions to a New York State network. This can be accomplished either during the upload of the new screening data, or as a separate process to be performed after a screening session. The exact procedure will be outlined as part of Task 4, Detailed Design of Process.

III. Mobile Equipment & Power Supply

CVIEW Mobile System Platform Selection Process

An essential part of the mobile system is the platform to which the reader and signal processor is attached.

The general specifications for which the mobile platform was designed is as follows:

- Must be mobile
- Must be able to operate in all seasons
- Must have a back up power supply
- Must be flexible enough to work up to 30 feet off the shoulder of a road and have a high enough mast or tower to be able to read the transponders as well as communicate to ROC via RF signals.
- Tower or mast must be able to support the two required RF antennas and operate in a variety of weather conditions.
- In order to reduce costs a manual crank up type mast or tower was specified instead of a powered system.
- In order to increase the reliability of the electronics package it was designed to be transported separately from the actual platform and would be installed once the platform is set up.

In order to keep costs at a minimum a self propelled, enclosed system was not specified. An analysis of typical platforms resulted in a trailer type arrangement as being specified.

From these general guidelines a specific set of specifications were established:

Base Platform:

- Single axel steel welded trailer
- 2" adjustable ball hitch
- single drop torsion suspension or approved equivalent
- DOT approved lighting package to include electrical brake lights
- Self lubricating wheel spindles
- Telescopic manual outriggers with adjustable jacks sized to counter full mast extension (See Mast Specifications).
- Heavy duty safety chains
- 1 Spare tire and wheel, tire tool, operation manual
- A minimum of two locking tool boxes
- Equipment installation platform (unistrut or other approved) to allow attachment of up to a 3' wide by 3' tall by 16" deep electronics box.
- Maximum trailer size including tongue-12 ft long by 7 feet wide by 6 feet high.

This trailer is intended to be pulled off road shoulders and down small gentle grassy embankments common to most federal and state highways.

Tower or Mast:

- 28- 32 foot maximum height of extension with capability to mount antennas at 20', 25' or top (ie. 28 -32')
- Hand crank operation with safety lock
- Cable storage reel
- Cable guide rings
- T arm mount at top of tower capable of holding up to two 20 lb antennas each antenna with a sail area of 3 square feet (Total of 6 sq. feet)
- Tower or mast must be able to be deployed by one person with minimum amount of time and effort.
- Tower should be telescoping type with one hinge for nesting parallel to trailer bed.
- Maximum nested length of tower or mast is 10 ft.
- Tower or mast must be mounted on trailer to provide stability when deployed as well as when broken down and towed on road ways.
- Tower or mast should have the ability to be easily rotated (for antenna alignment) even when fully deployed and have a locking mechanism once desired azimuth is obtained.
- Tower or mast and all associated cables, accessories should be constructed of non corrosive heavy duty metal.
- No guide wires will be permitted for stabilization of tower or mast and must be capable of operating at 45 mph wind speed when fully deployed. A Survival wind speed of 100 mph is required.

Power Supply:

- The primary power supply will be battery operated.
- A 12 volt Battery system will have the capability of delivering 1200 watts or 100 amps of total power over a 20 hour period (C20) without requiring a charge while maintaining 60% of its total rated capacity. A minimum 2500cycle life is required assuming the maximum discharge in a cycle is 60% of total rated capacity.
- The primary charging method will be via solar panel(s) with a minimum of 50 watts charging power.
- A 3.5 to 6 hp gasoline powered backup generator will also be required to charge batteries and provide auxiliary power for lighting or hand tools used for short durations. The generator should have at least 5 gallon fuel tank.
- All critical cabling should be run in "Artic Flex" or equivalent cable with an operational temperature of -70° to +130°F.
- Battery charging must be automatic with automatic switchover from solar to generator before batteries reach manufactures recommended drawdown level. Automatic high voltage cut off during charging must be included to ensure batteries are not overcharged above the manufacturers recommended level.
- A minimum of 3 convenience outlets are required to provide AC power for hand tools etc. run off the generator. All outlets should be GFI type rated for outdoor wet location use.

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These specifications were sent to seven equipment vendors that were located via an internet search. Each vendor was contacted via phone and prequalified and then e-mailed the specifications. Since this is a pilot study, some of the specifications sent may be altered if the original specs were determined to be cost prohibitive or if they would require a prolonged design and build lead time that would not fit in the project schedule.

Recommendations:

*We recommend that due to the closeness of two of the bidders and compliance with the specifications that one system be purchased from **Floatgraph Technologies** of Napa California and the other one or two systems be purchased from **Mobile Equipment International LLC** of Tulsa Oklahoma for this pilot study. Using two vendors for this pilot study will allow us to compare the actual products head to head and may allow for a better refinement of specifications for any follow up systems.*

Mobile Platform Delivery and Modifications

CHA Tech Services LLC, CHA's Construction Services Affiliate, will take delivery of the mobile platforms systems at their 26 Aviation Road facility in Albany, New York. This facility includes a locked and fenced storage yard.

Upon receipt of delivery, CHATS will perform a systems check of all equipment platforms and troubleshoot any problems that are found. In addition, the mobile platforms will be modified to ensure compatibility to the latest DOT standards to include paint scheme.

CHATS will also modify the platforms to ensure that a proper grounding system is attached to each platform to include a copper grounding rod that will need to be manually driven into the ground upon setup to protect the on board equipment.

For photos of similar type systems, please see Appendix E.

IV. Signage

The effectiveness of the system is directly related to the ability to safely notify, advise and direct commercial vehicles into the appropriate travel lanes for detection and notification by the readers. The signage layout, colors and text messages will be consistent with the NYSDOT and FHWA requirements for the individual site locations. To maintain the portability of the system, we recommend that all signs be constructed of high-visibility fabric panels on folding crashworthy, light weight bases. The signage layout will typically consist of an advance posting arrangement to notify commercial vehicles of the upcoming CVIEW screening system followed by advisory and directive signage for proper lane positioning to ensure transponder recordation, notification and compliance.

The NYSDOT and FHWA have provided directive that the use of proprietary signage along the Interstate system is prohibited. As such, the use of the Norpass tradename or logo will not be allowed on any signage to be placed within the Interstate right of way. The use of a more generic text to identify the site as a “test area” or “demonstration area” type of signing will be an acceptable text format.

V. *Site Selection*

Site Location Criteria

An initial site location at the I-87 Adirondack Northway northbound Clifton Park Rest Area north of Interchange 9 was evaluated for compatibility with the system. Based upon the proximity of the Interchange 9 exit and entrance ramps to the rest area facility it was determined that there was not sufficient separation to allow for safe direction and channelization of commercial vehicles into the right hand lane for passage through the reader system. The proximity of the interchange to the rest area would result in excessive conflict potential for the commercial vehicles with traffic exiting or entering the interstate. The proximity of the Interchange and U.S. Route 9 also lends itself to commercial vehicles, potentially non-compliant ones, avoiding the sites and using alternate routes. The Clifton Park Rest Area site has been dismissed as a feasible candidate for the demonstration site.

Upon dismissal of the Clifton Park site, three other existing rest area sites were evaluated for compatibility. The two existing rest areas in the northbound and southbound lanes of I-87 in Queensbury, just south of Interchange 18, were evaluated and dismissed due to site constraints adjacent to the rest area approaches. The existing topography and cross-section approaching these sites would make placement of the portable equipment difficult. The final site, which is recommended for the demonstration test site, is the existing utilitarian rest area facility which services the westbound direction of I-90 in Schodack, located to the west of Interchange 12. The approach conditions to the site and the rest area facility itself are conducive to accommodating the test equipment and signage. The Schodack site provides adequate sight distance and gently to moderately sloped topography adjacent to the interstate (within the media and on the outside of the travel way) which is cleared and graded to make access, placement and maintenance of the portable equipment readily possible.

The process of assessing those sites has lead to some conclusions and recommendations regarding site selection. Despite the fact that this is to be a mobile system, each location will have to be assessed and possibly prepared in advance based on the following issues. Specifications, guidelines and remediation for site-specific issues will be developed as part of Task 4, Detailed Design.

Communications

Since a mobile system is being developed, communications will be achieved by radio frequency technology. Since Model MACS requires communications with each device through a separate communications port, individual radio frequency modems will be used. The most common frequencies these devices use are 900MHz and 2.4GHz. Both frequencies work best with good line of sight, though lower frequencies are more flexible and tolerant of some interruption in line of site. Issues potentially effecting communications are:

Geometry

Highway geometry can have an impact. If the site is laid out along a curved section, the line of site may be through the median, or worse, off the right of way, leading to a higher potential for signal obstruction.

Topography

Steep hills have the potential to block the communication signals, particularly if there is a rise and fall in between any of the devices. A steep hill at a consistent slope may require adjustments to the antenna alignment.

Obstructions

Obstructions such as trees, embankments, bridges and signs can have serious negative impacts on reliable communications. While the mobile equipment used on this project will offer sufficient height and flexibility to avoid many roadside obstructions, each site and placement location will have to be screened for compatibility with the system.

Access

Since the mobile screening system cannot be placed on the highway shoulder. Access issues become potential major obstacles to implementing a screening system at a given site. The mobile equipment to be used for this project will be trailers that will need to be towed into place prior to use. Long stretches of guide rail will hinder vehicle access. Steep embankments will require earthwork to create a somewhat level platform for the equipment. A combination of guide rail and steep embankment may also require the construction of an access road, possibly making that site economically or physically unfeasible.

Safety

Screening sites should be located at least $\frac{3}{4}$ mile beyond any interchange to avoid safety issues such as traffic merging through a heavy concentration of commercial vehicles.

Signage

Sites should have sufficient flexibility for advance signage. Signage should be placed sufficiently in advance of the Detection Reader and WIM to allow commercial vehicles to have sufficient time to safely move to the right hand lane.

Vehicle Storage

Sufficient space must be available to set up inspection operations and to hold a queue of vehicles which have been given a pull-in signal.

Recommendations

The Schodack Rest Area on I-90 Westbound represents the best location of the 4 reviewed for performing the operational test of the mobile electronic screening system. Its favorable geometry and topography will allow the focus to be on the system and process, rather than on the difficulties some sites may face.

As part of any future deployment at other sites, each site will have to be reviewed in regards to the site location criteria outlined above. Specific sites may have characteristics beyond those mentioned that may make them unsuitable for mobile electronic screening, or may require additional technology or site work to make them viable.

Appendix A

Reader Comparison Table

ISL (Information Systems Laboratories, Inc.) Signal Processing Systems Division

Link Reader

Compatibility:

- Stated CVISN compliant
- Designed for & works with Model MACS off the shelf

Durability:

- ISL makes avionics equipment that includes vibration dampening. Cabinet size approximately 24x30x14

Availability:

- Normally 6-12 units in backlog, otherwise 60 day turnaround

Pricing:

- \$15,000 - Includes avionics cabinet with vibration dampening & antenna module
- \$500 for antenna

Other:

- Can include RF link as part of purchase

Mark IV IHVS Division

Fusion Reader

Compatibility:

- Not designed for & never been tested with Model MACS. It might work, but someone will have to test it (suggested Johns Hopkins). Otherwise, either Model MACS will have to be rewritten, or MarkIV will have to rewrite reader firmware.

Durability:

- Mark IV does not make vibration resistant unit. "No guarantee" on vibration resistance
- Designs units only for ground fixed environment.

Availability:

- 16 week turnaround plus time to retrofit for Model MACS & custom cabinet
- May be able to retrofit older units if available

Pricing:

- \$6,600 – Reader
- \$2,300 for antenna module
- \$1100 cabinet
- \$100 attenuator
- \$5000 approximate support cost

Other:

- Technician available to check for and troubleshoot RF interference
- Have built systems for any standard communications protocol

General Reader Potential Issues

- Reader/Antenna requires FCC point license. Will have to contact FCC for direction. May need to predetermine sites & apply for licenses at each.
- RF Modems may need to operate at different frequency than reader (915mh). Kentucky has an RF site using 900mh RF modems without problem, but it is a fixed, well tuned site.
- Performance data is not available from a roadside vs. overhead application. There is a greater possibility for missed tags or phantom reports.
- Readers must be at least 1 mile from E-ZPass.

Appendix B

Commercial Vehicle Electronic Screening System

Statement of Work

Abstract:

New York State Department of Transportation seeks to develop a pilot system for mainline commercial vehicle screening (CVIEW screening) as part of achieving federally mandated CVISN Level I compliance. Clough, Harbour & Associates LLP and its affiliate CHA Tech Services LLC have been awarded a contract to research and implement this system.

A design and price estimate is sought for the procurement of an automated, RF based commercial vehicle electronic screening system to be used by State agencies. Please itemize system components and indicate the turnaround time once an order has been placed. Include support options and related pricing, if any.

The system will be based on the following characteristics:

General Setup:

Figure 1 shows a generalized set up for a mobile RF based commercial vehicle screening system. The mobile platform is not part of this statement of work however its specifications are listed in appendix 1 to ensure system compatibility.

This statement of work is for design and procurement of any necessary items shown on figure 1 except for a weigh in motion system (WIM) which is to be supplied by a separate vendor.

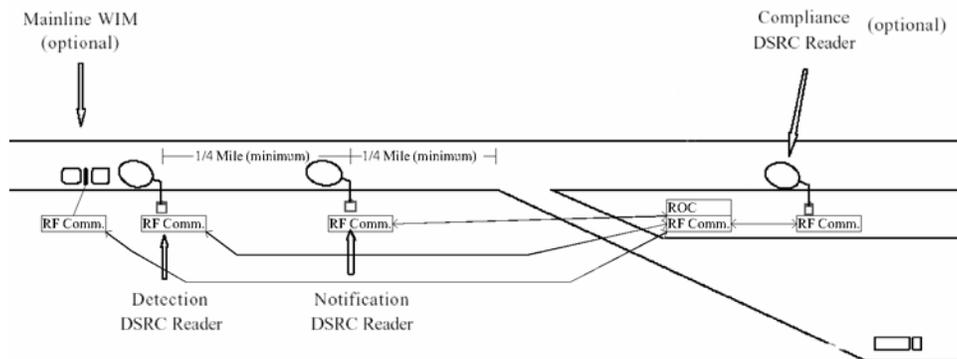


Figure 1

Expected system components include (but not limited to): detection reader system, notification reader system, roadside operations antenna/signal processor system (excluding computer) and any necessary associated radio modems, antennas, cabling and software. Please include as a separate item an option for adding a compliance reader system, including communications. The system must detect, via antenna system and radio frequency communications, commercial truck transponders using the NORPASS transponder system and communicate with that transponder, process data from the trucks transponder, send data from detection reader to the Roadside Operations Computer (ROC). The ROC will then communicate back to the Notification Reader via RF communications and on to the trucks transponder to change its specialized NORPASS transponder red or green to indicate whether the truck needs to pull into a checkpoint.

Specific Requirements:

- The system must interface with NORPASS transponders using industry standard Dedicated Short Range Communications (DRSC) technology. New York State Department of Transportation is specifically interested in being able to support Mark IV fusion transponders, enabling the use of one transponder for both electronic screening as well as electronic toll collection.
- Any necessary communications between Detection Reader, Roadside Operations Computer (ROC), and Notification Reader should be via RF communications.
- The system must include communications between the WIM device and the ROC via an RF communications link. The WIM device will be provided by others and will be compatible with Model MACS. The device will communicate via either RS232 or RS422 connections.
- System must be able to operate in an outdoor roadside environment under extreme temperature conditions.
- Electronics packages must be portable (lifted by one person with ease) and have the ability to be transported in a non specialized vehicle. The electronics packages must be in a ruggedized, weather proof container or box. This box will be mounted to an outdoor rack inside another box which is permanently mounted on the mobile platform. The electronics package must be designed with the consideration that it will be mounted and unmounted to the mobile platform frequently
- System must be compatible with the Model MACS software platform (Specifications found in Appendix 2). ROC antenna and signal processor system must be compatible with a standard laptop computer running windows 2000 or XP operating system loaded with Model MACS software and a standard multi-port serial adaptor.
- System needs to be rugged, simple and user friendly.
- The minimum anticipated screening zone is ½ mile with a ¼ mile distance between the detection reader and the notification reader. The maximum anticipated communication distance is ¾ mile total.
- RF communications should consider roadside geometry and possible obstructions such as vegetation and signage that may cause reflection or refraction of RF communications. RF communications also should not be disrupted or interfered with other normal RF frequencies commonly used along and adjacent to roadways. The RF communications must not require an FCC License or permit.
- RF and antenna system must be compatible with mobile platform's mast/tower system. It is expected that the mast will be approximately 30 feet high and that it will be located approximately 30 feet from the shoulder of the road. In some instances (due to local topography) the height of the antenna above the road surface may only be 19 to 20 feet.

Statement of Work – Appendix 1

Base Platform:

- Single axel steel welded trailer
- 2” adjustable ball hitch
- single drop torsion suspension or approved equivalent
- DOT approved lighting package to include electrical brake lights
- Self lubricating wheel spindles
- Telescopic manual outriggers with adjustable jacks sized to counter full mast extension (See Mast Specifications).
- Heavy duty safety chains
- 1 Spare tire and wheel, tire tool, operation manual
- A minimum of two locking tool boxes
- Equipment installation platform (unistrut or other approved) to allow attachment of up to a 3’ wide by 3’ tall by 16 “ deep electronics box.
- Maximum trailer size including tongue-12 ft long by 7 feet wide by 6 feet high.

This trailer is intended to be pulled off road shoulders and down small gentle grassy embankments common to most federal and state highways.

Tower or Mast:

- 28- 32 foot maximum height of extension with capability to mount antennas at 20’, 25’ or top (ie. 28 -32’)
- Hand wench operation with safety lock
- Cable storage reel
- Cable guide rings
- T arm mount at top of tower capable of holding up to two 20 lb antennas each antenna with a sail area of 3 square feet (Total of 6 sq. feet)
- Tower or mast must be able to be deployed by one person with minimum amount of time and effort.
- Tower should be telescoping type with one hinge for nesting parallel to trailer bed.
- Maximum nested length of tower or mast is 10 ft.
- Tower or mast must be mounted on trailer to provide stability when deployed as well as when broken down and towed on road ways.
- Tower or mast should have the ability to be easily rotated (for antenna alignment) even when fully deployed and have a locking mechanism once desired azimuth is obtained.
- Tower or mast and all associated cables, accessories should be constructed of non corrosive heavy duty metal.
- No guide wires will be permitted for stabilization of tower or mast and must be capable of operating at 45 mph wind speed when fully deployed. A Survival wind speed of 100 mph is required.

Power Supply:

- The primary power supply will be battery operated.
- A 12 volt Battery system will have the capability of delivering 1200 watts or 100 amps of total power over a 20 hour period (C20) without requiring a charge while maintaining 60% of its total rated capacity. A minimum 2500cycle life is required assuming the maximum discharge in a cycle is 60% of total rated capacity.
- The primary charging method will be via solar panel(s) with a minimum of 50 watts charging power.
- A 3.5 to 6 hp gasoline powered backup generator will also be required to charge batteries and provide auxiliary power for lighting or hand tools used for short durations. The generator should have at least 5 gallon fuel tank.
- All critical cabling should be run in “Artic Flex” or equivalent cable with an operational temperature of -70° to +130°F.
- Battery charging must be automatic with automatic switchover from solar to generator before batteries reach manufactures recommended drawdown level. Automatic high voltage cut off during charging must be included to ensure batteries are not overcharged above the manufacturers recommended level.
- A minimum of 3 convenience outlets are required to provide AC power for hand tools etc. run off the generator. All outlets should be GFI type rated for outdoor wet location use.



Figure 2 - Idealized Mobile Platform

Statement of Work – Appendix 2

Model MACS requires distinct communication with each device in the system via a dedicated communications port using a multi-port serial adaptor (see figure 2).

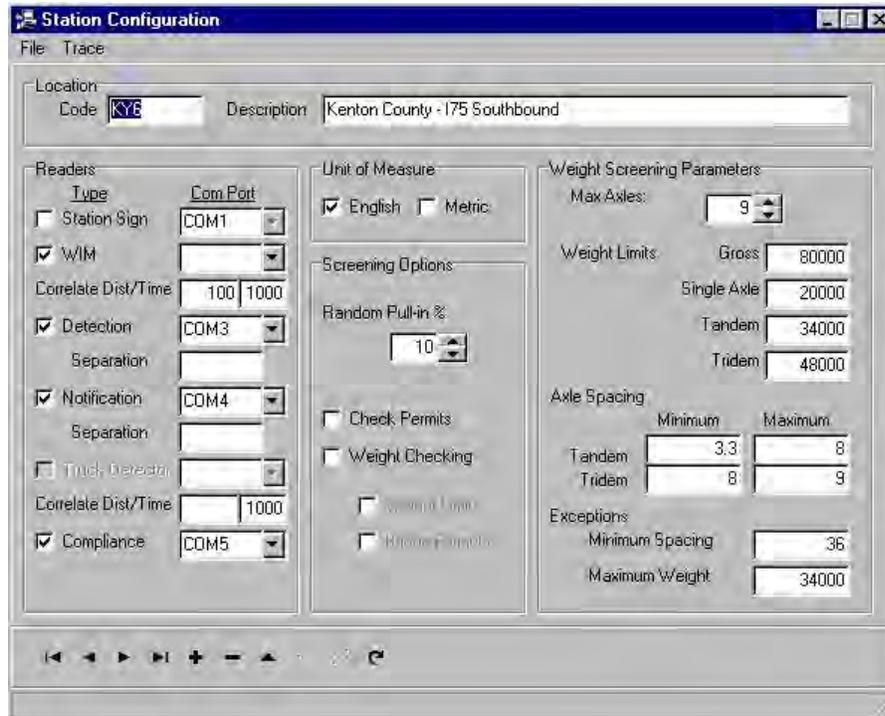


Figure 3

Please refer to the Model MACS user guide sent along with this statement of work for additional information.

Appendix C

Mark IV Response

It seems that certain readers from Mark IV, Hughes/Smith can read "V6" TDMA tags but the way they interface to host systems is completely different. I spoke to Rob Spilker at Northrop-Grumman about the situation. He stated that the Hughes "reader" (now Smith Industries) has a completely different interface than the Fusion Reader. The "ICD" for the interface between Model Macs and the "reader" is a Smith's Industries proprietary document so Mr. Spilker could not reveal specific details. It seems the "reader" equipment used on I-75 is more than just a reader. It probably has embedded functionality to process bypass transactions, not just read and report tag ID's. It does some internal processing. We do not have these functions in the Fusion Reader and do not have the equivalent of an Application Processor. It seems that Model Macs was designed to talk to the reader through the application processor (black box) supplied by Hughes/Smith Industries. The protocol between Model Macs and the Application processor is completely different than the interface between the reader and the application processor, so Model Macs software is not able to communicate directly with a Mark IV reader. Fusion readers lack some of the functionality used by Model Macs to process bypass transactions. I presume that our Fusion reader could talk to the Hughes Application Processor but that does not help if we cannot provide the Application Processor. A significant software change would be required to Model Macs or to the reader design in order to combine the two in a system.

If we had a detailed functional specification of the reader + application processor, plus the ICD for the application processor, we could consider developing a comparable product. Otherwise, the host software would need to be created to make use of the Fusion reader. Reader design changes for a few units are possible given a reasonable market opportunity but we need concrete information. If circumstances change, I would be happy to re-assess our ability to participate.

Sincerely,

Paul Manuel

Vice President - Sales and Marketing

Mark IV IVHS, Inc.

Tel: 905-624-3025

Fax: 905-624-4572

E-Mail: pmanuel@ivhs.com

Website: <http://www.ivhs.com>

Appendix D

Model MACS Data File Format

TECHNICAL FIELD NAME	DATA TYPE	START POSITION	FIELD LENGTH	DESCRIPTION
TRANSPONDER	Char	0	10	Transponder ID
VEHICLE_VIN	Char	10	17	Vehicle Identification Number
VEHICLE_LICENSE_PLATE	Char	27	15	State ID with plate number
VEHICLE_UNIT_NO	Char	42	5	Vehicle unit number
VEHICLE_NMVTIS_CHECK_FLAG	Char	47	3	National Motor Vehicle Titling Information System. A Value of "Check" Means pull in.
VEHICLE_IRP_CHECK_FLAG	Char	50	15	International Registration Plan. A value of "Check" Means pull in.
VEHICLE_IRP_ACCOUNT_NO	Char	53	20	Report number associated with flag
VEHICLE_INSP_OOS_FLAG	Char	68	3	Indicates whether or not the last inspection resulted in an out-of-service order. A value of "Check" Means pull in.
VEHICLE_INSP_OOS_REPORT	Char	71	20	Report number associated with flag
VEHICLE_PERMIT	Char	91	3	Vehicle has permit (Y/N)
VEHICLE_PERMIT_TYPE	Char	94	20	Vehicle permit type
VEHICLE_PERMIT_NO	Char	114	20	Permit number
VEHICLE_PERMIT_CHECKED	Char	134	3	Flag field indicating whether the permit has been checked
CARRIER_ISSUING_AUTHORITY	Char	137	15	US for DOT Numbers, State Identification Code for Intrastate with no DOT
CARRIER_USDOT_STATE_ID	Char	152	20	Federally assigned US DOT motor carrier ID number for all Carriers that have one, State assigned for intrastate carriers that do not have DOT numbers.
CARRIER_SUBCODE	Char	172	10	Carrier assigned code to indicate different service locations, fleets, etc.
CARRIER_SUBCODE_DESC	Char	182	55	Description of Carrier assigned code to indicate different service locations, fleets, etc. (used in Hot List lookups)
CARRIER_NAME	Char	237	55	Carrier Doing Business As Name otherwise defaults to Legal Name
CARRIER_SAFETY_MULTIPLIER	Long Int	292	11	Calculated from safestat score
CARRIER_WEIGHT_MULTIPLIER	Long Int	303	11	Calculated from Weight Compliance Rating
CARRIER_IRP_STATUS_FLAG	Char	314	3	International Registration Plan violation
CARRIER_IRP_ACCOUNT_NO	Char	317	15	Account number associated with flag
CARRIER_OOS_FLAG	Char	332	3	Indicates whether or not the carrier is currently out of service.
CARRIER_OOS_REPORT_NO	Char	335	20	Report number associated with flag
CARRIER_INSURANCE_FLAG	Char	355	3	Indicates problem with insurance.
CARRIER_IFTA_REG_FLAG	Char	358	3	International Fuel Tax Agreement violation
CARRIER_IFTA_REG_ACCOUNT_NO	Char	361	20	Account number associated with flag
LAST_BUILD	Timestamp	381	30	Time stamp of EVL Build
FLAG_VIOLATION	Char	411	3	Calculated from flag fields. A value of Yes indicates one or more violations
MACS75_CREDENTIALS	Char	414	1	<i>Leave blank. Obsolete field.</i>
VEHICLE_PERMIT_WEIGHT	Long Integer	415	11	Vehicle permit weight
VEHICLE_REGISTERED_WEIGHT	Long Integer	426	11	Vehicle's registered weight
CARRIER_STATUS	Char	437	25	<i>Leave blank. Obsolete field.</i>
AUTO_ACTION	Char	462	10	<i>Leave blank. Obsolete field.</i>

Appendix E

Mobile Platforms



Conceptual High Level Design Diagram

Commercial Vehicle Information Exchange Window (CVIEW) Roadside Enforcement/Compliance Project

**NYSERDA Agreement Number (6764C-3)
Comptrollers Contract No. (C012668)
NYSDOT Task Assignment (C-01-66C)
PIN (R020.47.881)**

August 7, 2003

Submitted to:

**New York State Energy Research and Development Authority
And
New York State Department of Transportation**

Submitted by:

**Clough, Harbour & Associates LLP
III Winners Circle, Albany, New York 12205**

PREFACE

The New York State Energy Research and Development Authority (NYSERDA) is a public benefit corporation created in 1975 by the New York State Legislature. For more than a quarter century, NYSERDA has been working on finding innovative solutions to the energy and environmental issues that face residents of the Empire State. As part of that mission, the Authority has sought answers that would benefit not only New York's energy and environmental future, but the economy as well. To do so, NYSERDA has traditionally partnered with other state agencies, as well as industrial, commercial, environmental and economic development groups all across New York State.

In 1999, the New York State Department of Transportation (NYSDOT) had just completed a three-year contractual research relationship with a consortium of seven New York State universities, colleges and research institutions. Based on the success of that experience, the Department sought to establish additional partnering arrangements with research consortia to carry out basic and applied research, technology transfer, and short-term consultation services in the fields of engineering, operations, public transportation, management and finance, public policy, and human resources.

As a complement to a university-based constituency, NYSERDA organized a Transportation Infrastructure Research Consortium comprised of seventeen private-sector research entities. The membership is characterized as businesses, not-for-profits, and professionals that have a track record of performing transportation-related research, development, and demonstration as a normal part of their service-related or internal operations. Many of the organizations also have strong relationships with universities, state agencies and authorities, and federal funding agencies, and are already performing collaborative research through those relationships.

In June of 2001, New York State Comptroller=s Contract C012668 was executed and governs the activities of the NYSERDA-administered Transportation Infrastructure Research Consortium. The term of the agreement is for five years, extending from March 1, 2001 through February 28, 2006. The direct and dynamic linkages between transportation, energy, and the environment have continually reinforced the cooperative relationship formed between NYSDOT and NYSERDA. Since its inception, numerous collaborative efforts have been undertaken and the report that follows is a product of that relationship.

NOTICE

This report was prepared by Clough, Harbour & Associates LLP in the course of performing work contracted for and sponsored by the New York State Energy Research and Development Authority and the New York State Department of Transportation (hereafter the "Sponsors"). The opinions expressed in this report do not necessarily reflect those of the Sponsors or the State of New York, and reference to any specific product, service, process, or method does not constitute an implied or expressed recommendation or endorsement of it. Further, the Sponsors and the State of New York make no warranties or representations, expressed or implied, as to the fitness for particular purpose or merchantability of any product, apparatus, or service, or the usefulness, completeness, or accuracy of any processes, methods, or other information contained, described, disclosed, or referred to in this report. The Sponsors, the State of New York, and the contractor make no representation that the use of any product, apparatus, process, method, or other information will not infringe privately owned rights and will assume no liability for any loss, injury, or damage resulting from, or occurring in connection with, the use of information contained, described, disclosed, or referred to in this report.

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- System Requirements
- Data Flow Diagram
- Hardware & Software List
- Screening Flow Diagram
- Screening Process Overview
- Conceptual Site Diagrams
- Schodack Evaluation & Improvements
 - Schodack Evaluation Graphics
 - Signing / Maintenance and Protection of Traffic Provisions

System Requirements

Model MACS (v 1.1.1.367) will be installed on a laptop for maximum portability. Power will be supplied via a power inverter plugged into the inspection vehicle's standard cigarette lighter jack. Due to the large number of communications devices in the screening system, the laptop must have a USB adapter with an operating system capable of supporting it.

Recommended Specifications:

2GHz Pentium 4 processor

256MB RAM

30GB hard drive

Microsoft Windows XP Pro

56k Modem

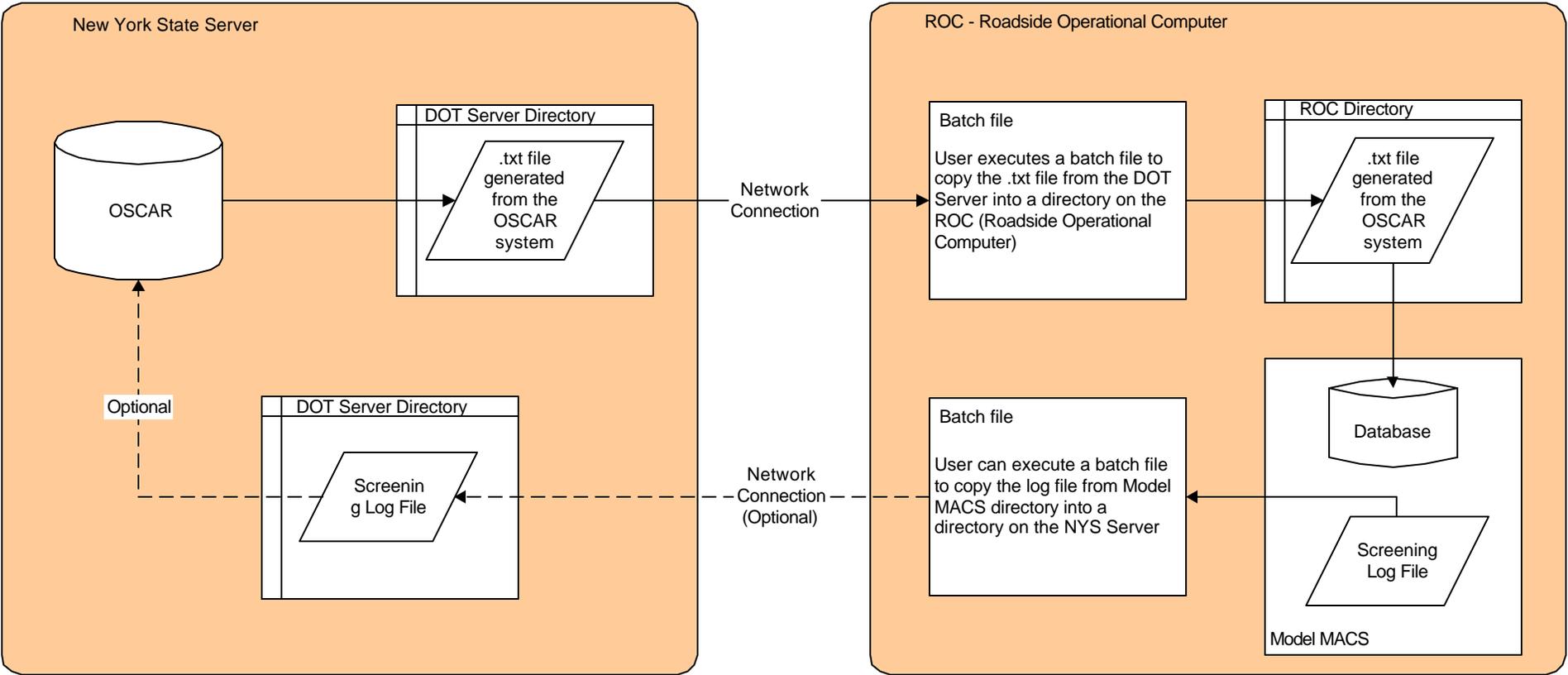
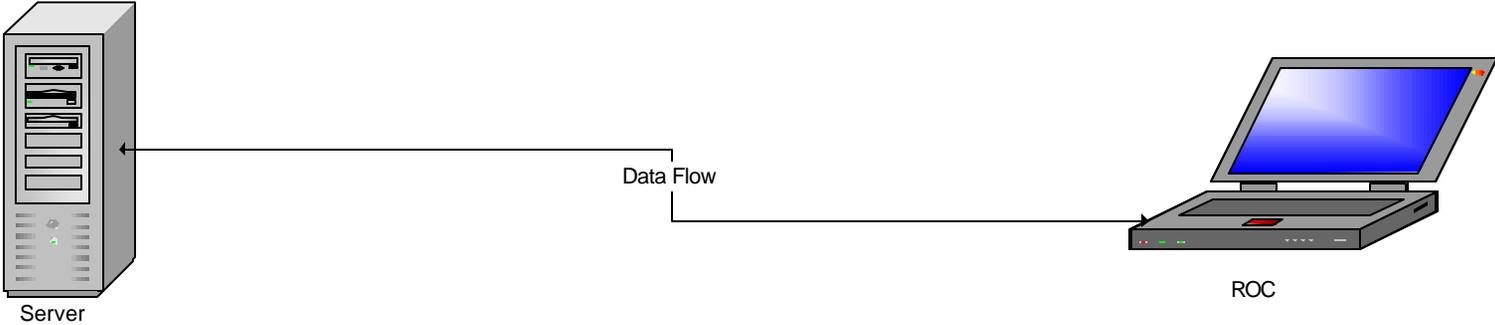
Wireless NIC

24x CD-ROM

USB port

An optional specification for a laptop mounting system & installation may be made if desired once a determination is made as to what type(s) of vehicle will be used at the ROC. Typical prices range from \$60-\$500.

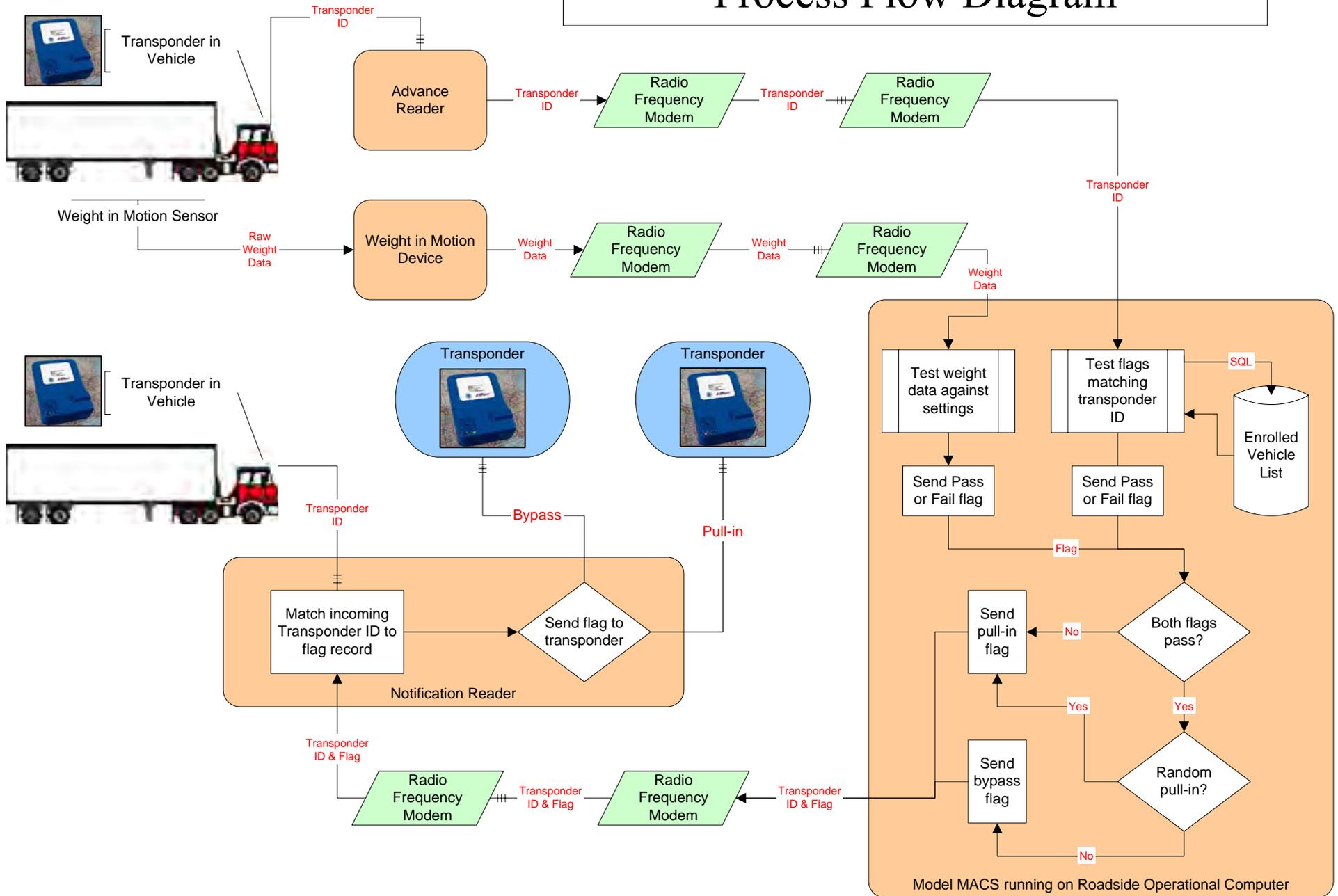
CVIEW Mobile Electronic Screening Data Flow Diagram



Hardware & Software List

<u>Description</u>	<u>Quantity</u>	<u>Notes</u>
<u>Mobile Equipment</u>		
CVIEW Mobile Base Platform	2	
ROC Mobile Antenna Platform	1	
<u>Transponders, Readers & Communications</u>		
MarkIV Fusion Transponder	10	For testing
Model M200 DSRC Reader	2	ISL
DC to AC Inverter	2	"
DSRC Detection Antenna	1	"
DSRC Notification Antenna	1	"
DSRC Wireless Modems	4	"
WIM Wireless Modem	1	"
DSRC Modem Omnidirectional Antenna	2	"
DSRC Modem Directional Antenna	2	"
WIM Modem Directional Antenna	1	"
Harnesses and Cabling	1	"
<u>Computer Equipment</u>		
Laptop Computer	1	To be purchased by NYSDOT. Major Specifications include: 2GHz Pentium 4, 256MB RAM, 30GB hard drive, Windows XP Pro, 56k Modem, Wireless NIC, 24x CD-ROM, USB. An optional specification for a laptop mounting system & installation may be made if desired once a determination is made as to what type(s) of vehicle will be used at the ROC. Typical prices range from \$60-\$500.
Car Power Adaptor for Laptop	1	
USB Com Port Expander (4 port)	1	
Communications Cabling	5	
<u>Signage</u>		
Reflective Fabric Panel with Folding Portable Base	10	
<u>Software</u>		
Model MACS		To be acquired from the State of Kentucky

CVIEW Mobile Electronic Screening Process Flow Diagram



Screening Process Overview

A commercial vehicle approaching an active screening location is notified and then directed by signage to move to the right hand lane. For two lane undivided roads, vehicles are simply notified of an inspection ahead.

Vehicles cross an optional Weight-in-Motion (WIM) sensor at the same time the Advance Reader detects their transponder. Both the weight record and transponder ID are sent to the Model MACS screening software running on the roadside Operational Computer (ROC). Model MACS checks the transponder ID against the enrolled vehicle list in its database. If the vehicle has any flags set as a violation, Model MACS generates a pull-in record for that vehicle. Otherwise, the weight data is checked. An overweight vehicle, or a vehicle without a valid weight record, will also generate a pull-in record.

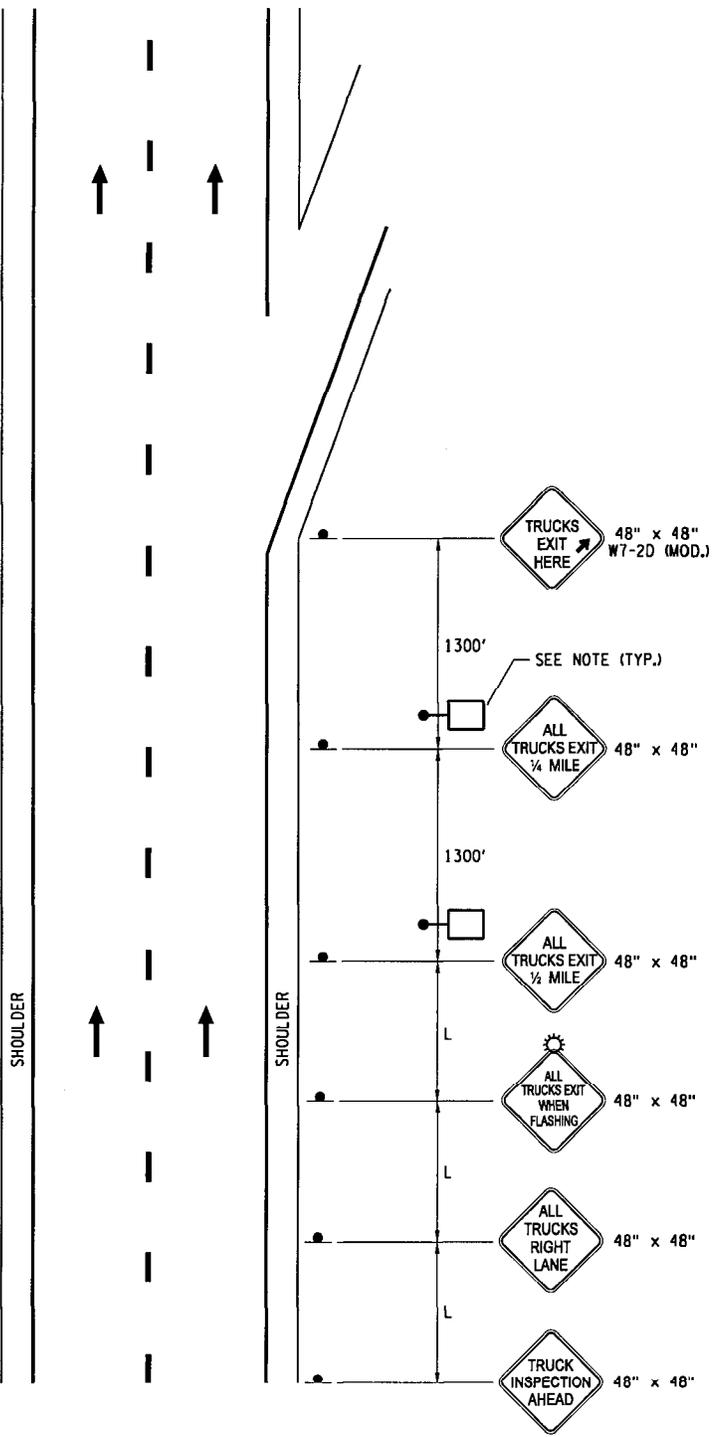
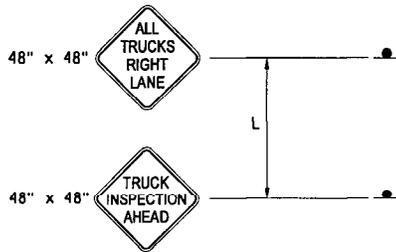
Vehicles that pass the initial screening are still subject to a random pull-in. The inspector can choose the percentage of vehicles that will be pulled in from 0 to 100%. Inspectors also may “Hot List” a single vehicle or entire carrier. Vehicles in the “Hot List” will always be pulled in.

Once Model MACS has processed a vehicle it sends the transponder ID along with the pull-in or bypass flag to the Notification Reader. When the vehicle reaches the Notification Reader, the reader reads its transponder ID and sends the appropriate flag back to the transponder. If the transponder receives a pull-in flag, the transponder will display a red light. A bypass flag will generate a green light.

Vehicles with a green light are allowed to bypass the inspection station. Vehicles with a red light must pull-in. Vehicles with transponders that are not found in the enrolled vehicle list will be required to pull in. Vehicles without transponders must obey the signage and pull in as in a standard inspection.

ADVANCED POSTING DISTANCE TABLE	
POSTED SPEED LIMIT (M.P.H.)	L (FT) MIN.
45	600
50	600
55	1500
60	1500
65	1500

NOTE: DSRC READER LOCATION BASED ON CLEAR ZONE OR DEFLECTION DISTANCES. SEE TABLE ON MOBILE TRUCK COMPLIANCE LAYOUT GENERAL NOTES SHEET.



FILE NAME = \N12565\mtr012-janeb.dwg
DATE/TIME = 6/5/2003
USER = 597



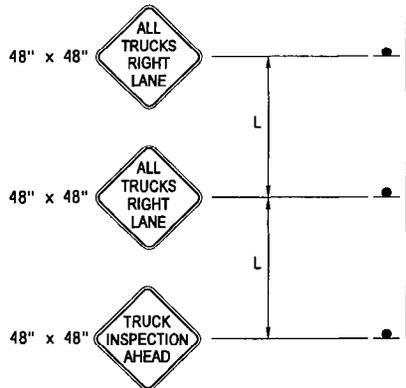
LEGEND	
	DIRECTION OF TRAFFIC
	DSRC READER
	ADVANCED WARNING SIGN

MOBILE TRUCK COMPLIANCE LAYOUT
FOUR-LANE DIVIDED HIGHWAY

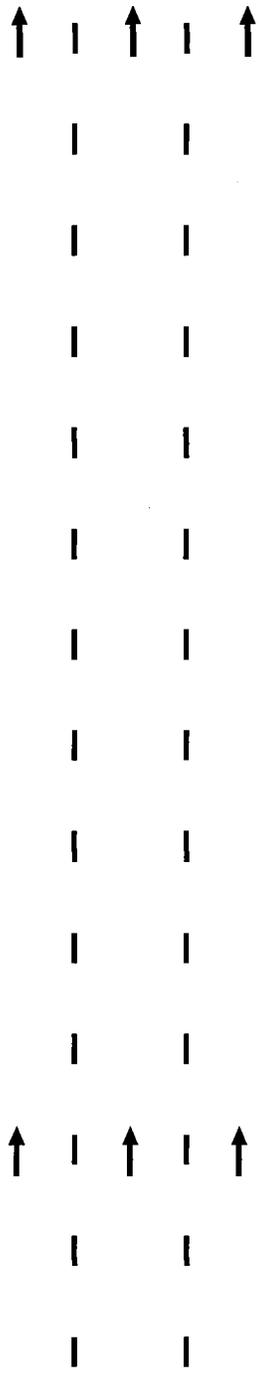
CHA CLOUGH, HARBOUR & ASSOCIATES LLP
ENGINEERS, SURVEYORS, PLANNERS & LANDSCAPE ARCHITECTS
111 WINNERS CIRCLE ALBANY, NEW YORK, 12205

ADVANCED POSTING DISTANCE TABLE	
POSTED SPEED LIMIT (M.P.H.)	L (FT) MIN.
45	600
50	600
55	1500
60	1500
65	1500

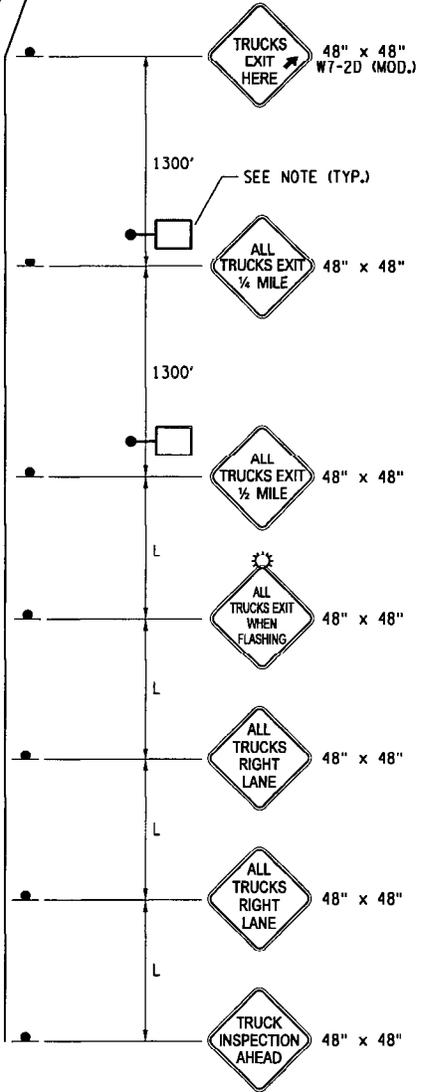
NOTE: DSRC READER LOCATION BASED ON CLEAR ZONE OR DEFLECTION DISTANCES. SEE TABLE ON MOBILE TRUCK COMPLIANCE LAYOUT GENERAL NOTES SHEET.



SHOULDER



SHOULDER



FILE NAME = w:\12256\mact\3-janeq.owl
DATE/TIME = 8/5/2003
USER = 517



LEGEND	
	DIRECTION OF TRAFFIC
	DSRC READER
	ADVANCED WARNING SIGN

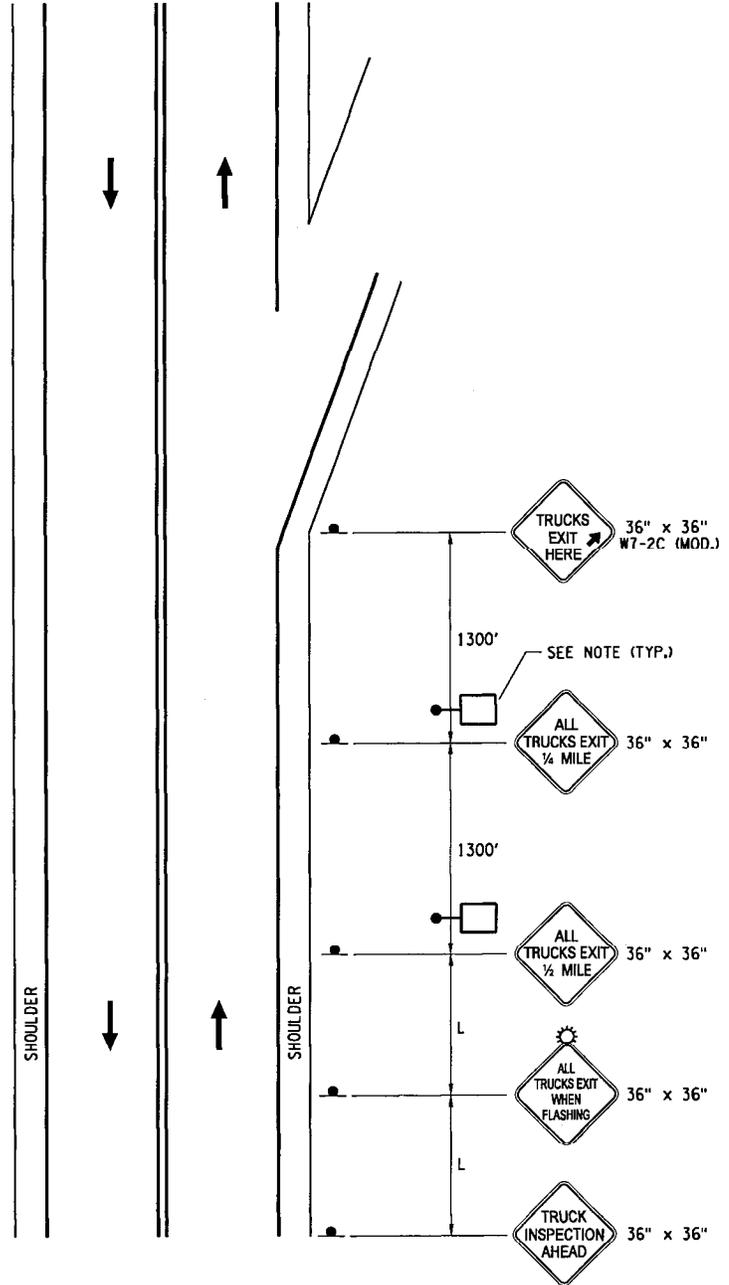
MOBILE TRUCK COMPLIANCE LAYOUT

SIX-LANE DIVIDED HIGHWAY

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111 WINNERS CIRCLE ALBANY, NEW YORK, 12205

**ADVANCED POSTING
DISTANCE TABLE**

POSTED SPEED LIMIT (M.P.H.)	L (FT) MIN.
30	200
35	200
40	200
45	600
50	600
55	1500



NOTE: DSRC READER LOCATION BASED ON CLEAR ZONE OR DEFLECTION DISTANCES. SEE TABLE ON MOBILE TRUCK COMPLIANCE LAYOUT GENERAL NOTES SHEET.

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USER = 587



LEGEND

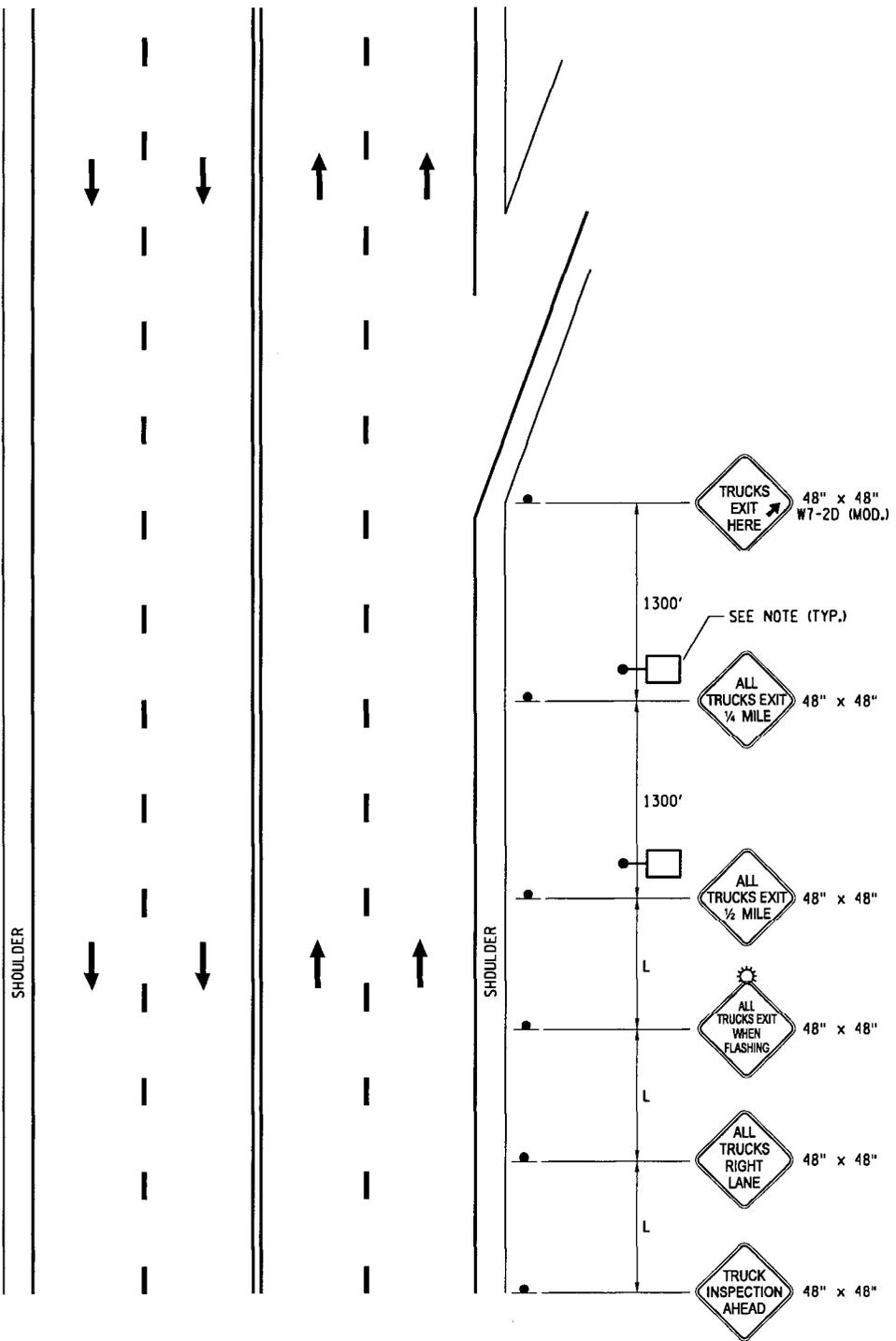
- DIRECTION OF TRAFFIC
- DSRC READER
- ADVANCED WARNING SIGN

MOBILE TRUCK COMPLIANCE LAYOUT

TWO-LANE UNDIVIDED ROAD

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111 WINNERS CIRCLE ALBANY, NEW YORK, 12205

ADVANCED POSTING DISTANCE TABLE	
POSTED SPEED LIMIT (M.P.H.)	L (FT) MIN.
30	200
35	200
40	200
45	600
50	600
55	1500



NOTE: DSRC READER LOCATION BASED ON CLEAR ZONE OR DEFLECTION DISTANCES. SEE TABLE ON MOBILE TRUCK COMPLIANCE LAYOUT GENERAL NOTES SHEET.

LEGEND	
	DIRECTION OF TRAFFIC
	DSRC READER
	ADVANCED WARNING SIGN

MOBILE TRUCK COMPLIANCE LAYOUT
FOUR-LANE UNDIVIDED HIGHWAY

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ENGINEERS, SURVEYORS, PLANNERS & LANDSCAPE ARCHITECTS
111 WINNERS CIRCLE ALBANY, NEW YORK, 12205

FILE NAME = 112255\mstr\A2-1.msc.dwg
DATE/TIME = 12/17/2003 10:57
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Schodack Rest Area Evaluation

The westbound section of I-90 just west of Interchange 12 in the Town of Schodack, Rensselaer County between mile markers 19.3 to 18.6 was evaluated for use as the electronic screening area for the pilot study. The following factors must be evaluated when determining the feasibility of a site for placement, operations and maintenance of the proposed mobile electronic screening system:

- The adequacy of the roadway geometrics to ensure a safe operational environment.
- Opportunities for an unobstructed line of site for the necessary length of the screening zone
- Accessibility to an appropriate and adequate area for vehicles to pull off the main line should they be so directed.
- Proximity to interchange ramps or access points within, or adjacent to, the screening zone.
- Appropriate topography and roadside edge conditions at key points in the screening zone for the placement of the mobile equipment platform trailers.

The proposed equipment platform is a single axle trailer approximately 12 feet long and 7 feet wide. It contains four manual outriggers that are deployed for stability. The trailer should be placed in relatively flat and well drained location. The outriggers and associated blocking can be used to level the platform where minor changes of grade exist. A grade of 10:1 (10%) or shallower is recommended when identifying areas of appropriate topography for the equipment platform location. It is intended that the mobile platform will be towed with a pickup truck or similar support truck type vehicle and that adequate access is required into and out of the area where the equipment platform is to be located.

The I-90 Schodack rest area site and its westbound approach are typically consistent with the above mentioned criteria. With minimal improvements the pilot study area will satisfy the necessary requirements to host the pilot test set up and operation. The existing topography where the Notification Reader is to be placed is not readily conducive, in its present state, for rapid deployment of the equipment platform. At the Notification Reader location, the drainage ditch running parallel to I-90, although grass-lined, is graded steeper and narrower than would be easily accessible for a conventional vehicle and trailer. Based upon our field observation of the site, this ditch will remain very soft during periods of wet weather.

It is recommended that in order to facilitate safe and easy access for the notification reader mobile equipment platform, the ditch in this area be modified. It is suggested that approximately a 40 foot long section of the ditch in this area be filled with suitable gravel fill. A culvert should be placed as a means of ditch conveyance at the bottom of the constructed gravel platform. Construction of the temporary embankment platform will require closure of the travel lane and reduction of the posted travel speed for the area adjacent to the proposed work zone. In order to facilitate removal of this temporary embankment platform we recommend that a geotextile fabric mat be placed on top of the existing grade prior to the placement of any gravel. The limits of the geotextile fabric should extend to the toe of the gravel embankment slope at all areas. This will allow proper access for the notification reader equipment platform. Access for the equipment shall be from the edge of shoulder onto the gravel platform. Because no guide rail exists at this location, the equipment must be placed a minimum of 30ft. from the edge of travel way.

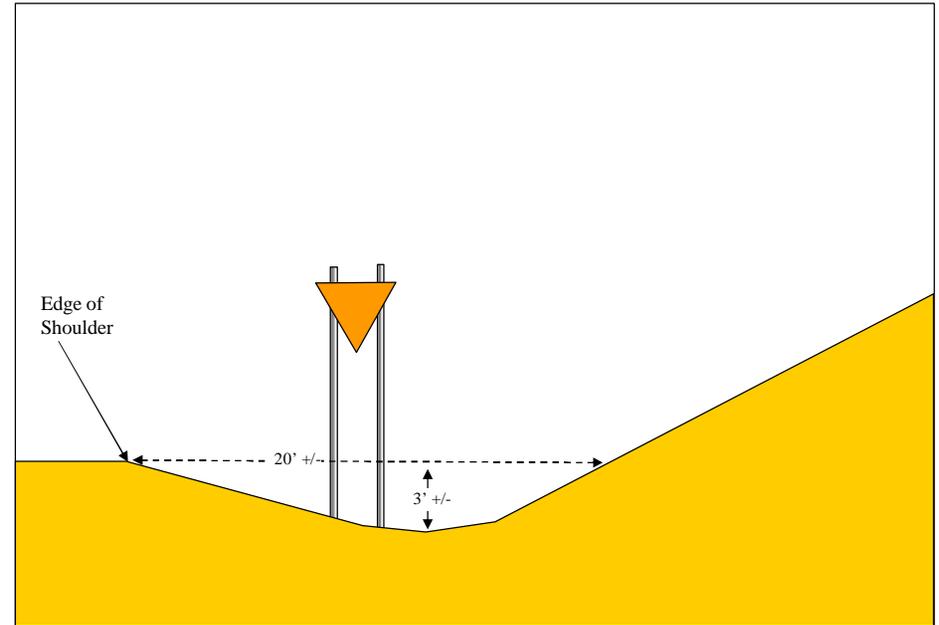
The remaining locations to be used within the pilot study site, being the Advance Reader location and Roadside Operations (ROC) location, are acceptable for the placement and maintenance of the necessary mobile equipment. Adequate access and grading is readily available at these two proposed locations in there existing conditions. Access for the equipment shall be from the edge of shoulder onto the existing grassed ditch line. Because no guide rail exists at either location, the equipment must be placed a minimum of 30ft. from the edge of travel way.

The median area (between the eastbound and westbound lanes of the divided highway cross-section) and the outside safety area adjacent to the westbound travel lanes are adequate for the placement and unobstructed visibility of the necessary advance signing arrangements.

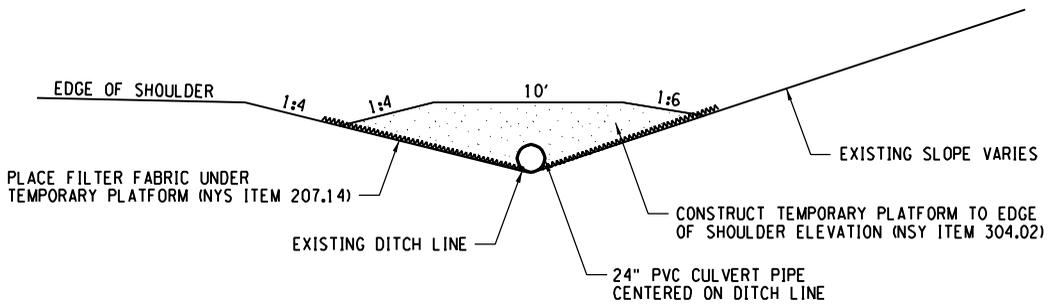
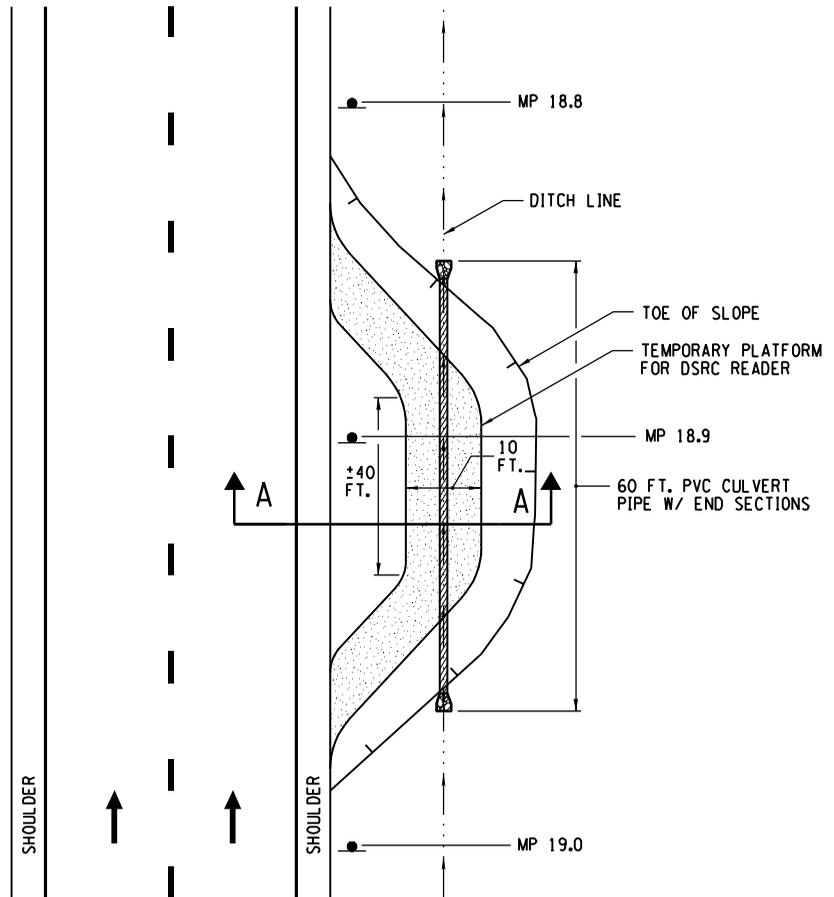
The actual rest area/comfort station site provides adequate geometrics on the entrance and exit ramps as well as providing ample parking/staging areas to facilitate the screening or inspection of commercial vehicles.



NOTIFICATION READER LOCATION JUST PAST MM 18.9



IDEALIZED PROFILE AT PROPOSED NOTIFICATION READER LOCATION



SECTION A-A

FILE NAME = c:\Documents and Settings\8338\Desktop\SDLS.dgn
 DATE/TIME = 8/12/2003
 USER = 838



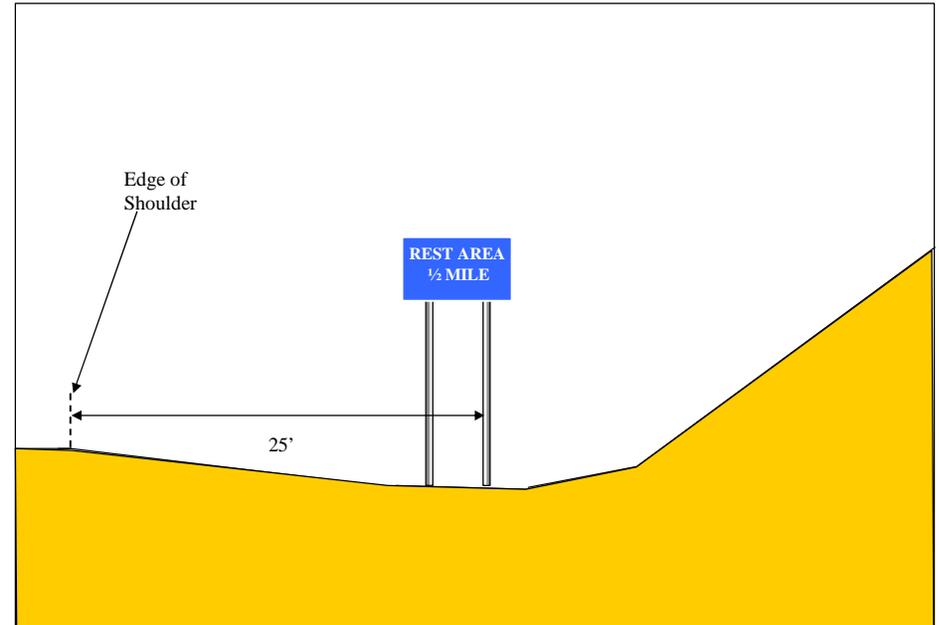
TEMPORARY PLATFORM CONSTRUCTION DETAIL

FOR MOBILE TRUCK COMPLIANCE READER

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 ENGINEERS, SURVEYORS, PLANNERS & LANDSCAPE ARCHITECTS
 111 WINNERS CIRCLE ALBANY, NEW YORK, 12205



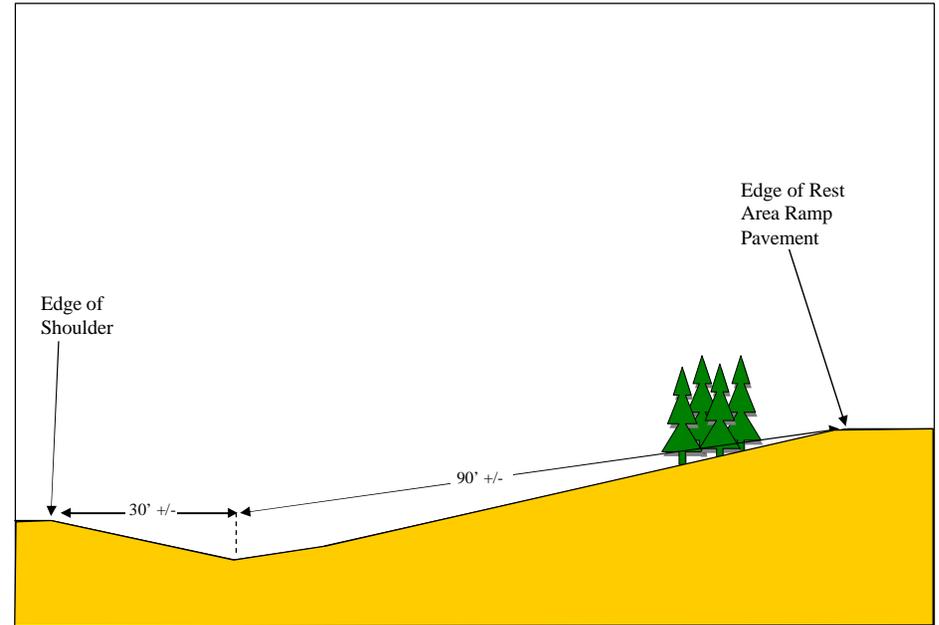
ADVANCE READER LOCATION JUST PAST MM 19.2 LOOKING WEST



IDEALIZED DITCH PROFILE AT ADVANCE READER LOCATION

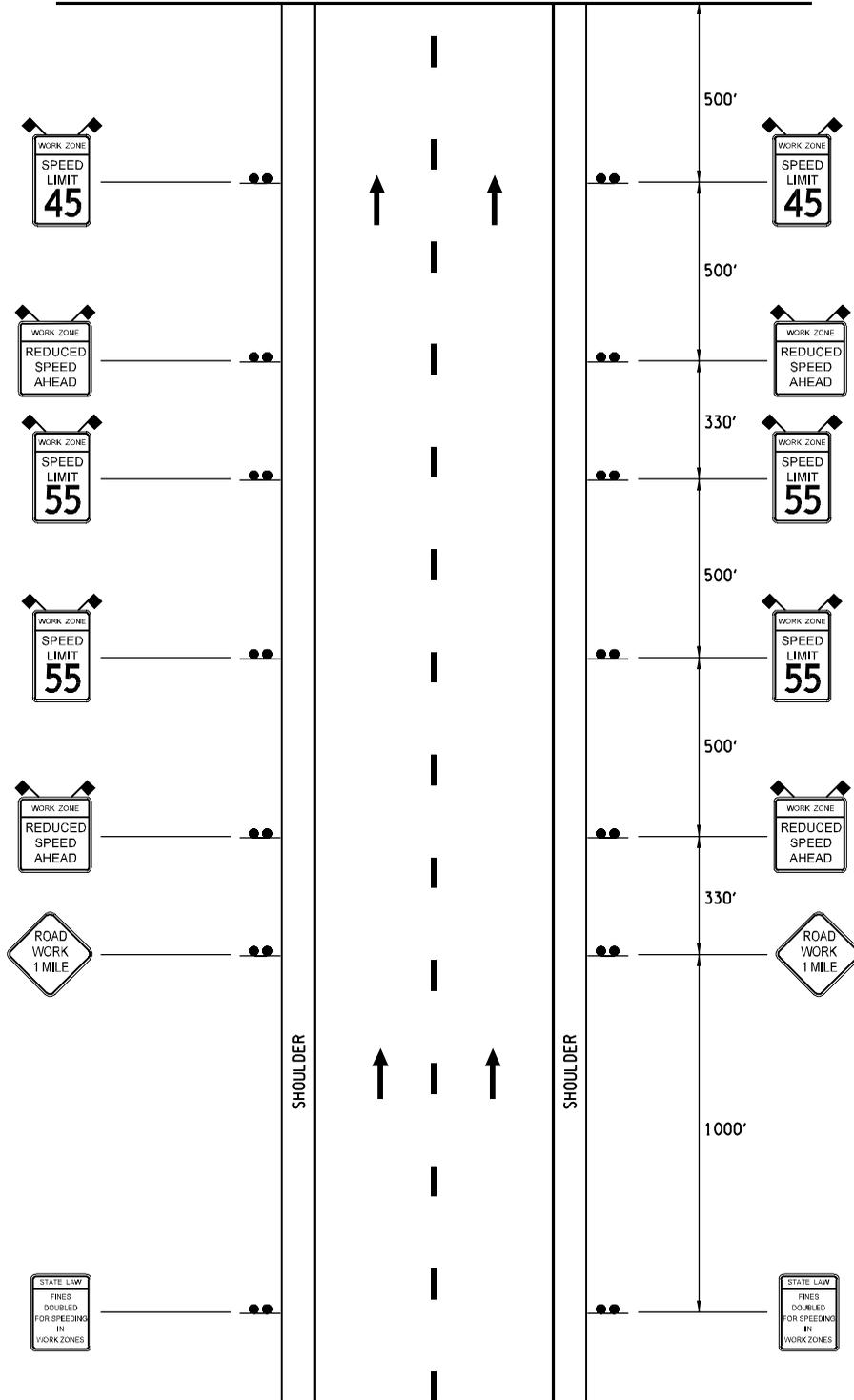


ROADSIDE OPERATIONS COMPUTER (ROC) LOCATION



IDEALIZED PROFILE AT PROPOSED ROADSIDE OPERATIONS COMPUTER LOCATION

SEE LANE AND SHOULDER CLOSURE FOR
CONSTRUCTION OF TEMPORARY PLATFORM DRAWING



LEGEND

-  DIRECTION OF TRAFFIC
-  CONSTRUCTION SIGN
-  FLAG

SIGNING REQUIREMENTS FOR REDUCING

65 MPH SPEED LIMITS IN WORK ZONES

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111 WINNERS CIRCLE ALBANY, NEW YORK, 12205



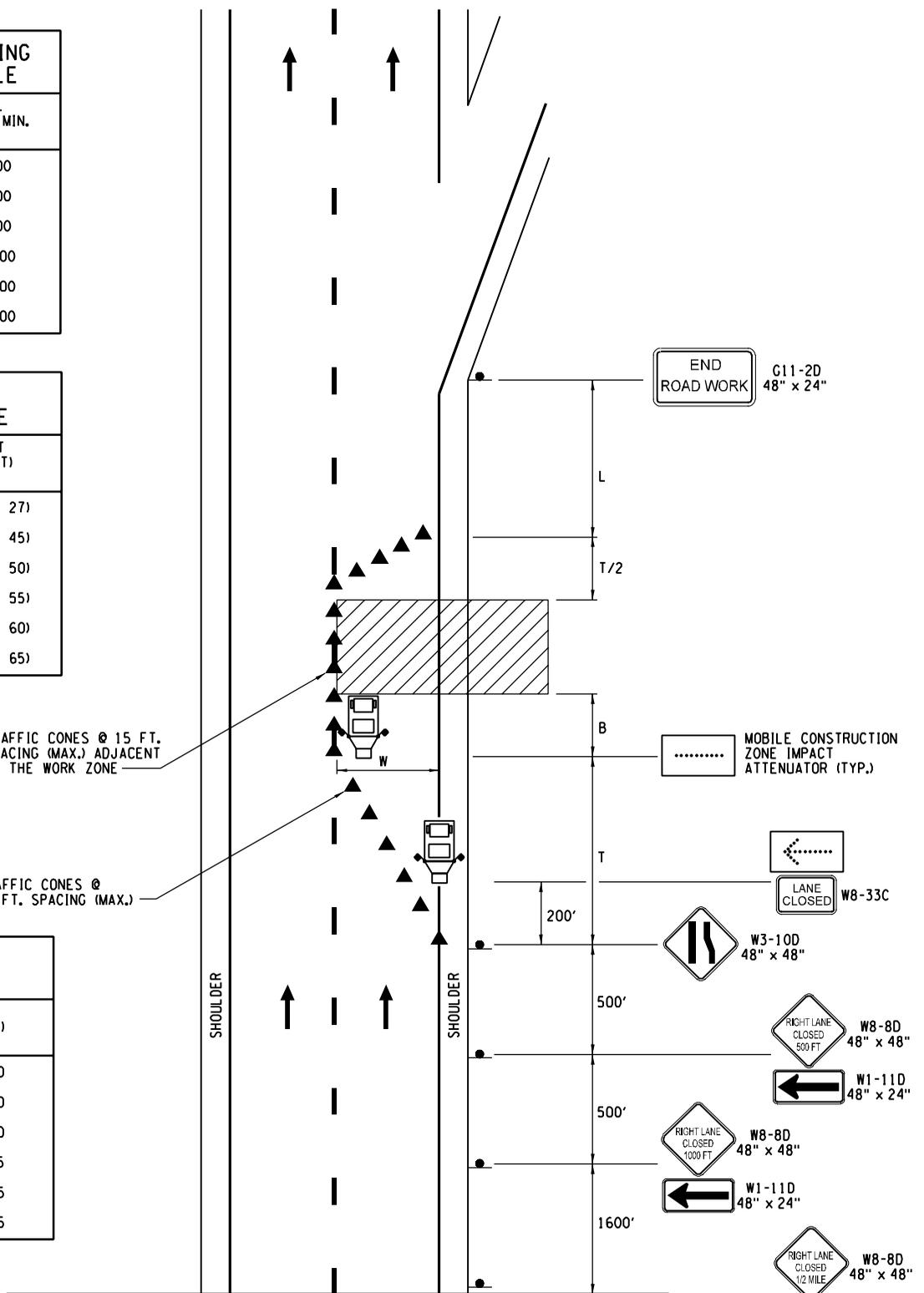
ADVANCED POSTING DISTANCE TABLE	
POSTED SPEED LIMIT (M.P.H.)	L (FT) MIN.
40	600
45	600
50	600
55	1500
60	1500
65	1500

TAPER LENGTH TABLE	
POSTED SPEED LIMIT (M.P.H.)	T (FT)
40	(W x 27)
45	(W x 45)
50	(W x 50)
55	(W x 55)
60	(W x 60)
65	(W x 65)

BUFFER LENGTH TABLE	
POSTED SPEED LIMIT (M.P.H.)	B (FT)
40	170
45	220
50	280
55	335
60	415
65	485

TRAFFIC CONES @ 15 FT. SPACING (MAX.) ADJACENT TO THE WORK ZONE

TRAFFIC CONES @ 30 FT. SPACING (MAX.)



SEE SIGNING REQUIREMENTS FOR REDUCING 65 MPH SPEED LIMITS IN WORK ZONES DRAWING

LEGEND

- DIRECTION OF TRAFFIC
- TRAFFIC CONE
- WORK ZONE
- CONSTRUCTION SIGN
- IMPACT ATTENUATOR

LANE AND SHOULDER CLOSURE FOR CONSTRUCTION OF TEMPORARY PLATFORM

CHA CLOUGH, HARBOUR & ASSOCIATES LLP
 ENGINEERS, SURVEYORS, PLANNERS & LANDSCAPE ARCHITECTS
 111 WINNERS CIRCLE ALBANY, NEW YORK, 12205



Detailed Design of Process

Commercial Vehicle Information Exchange Window (CVIEW) Roadside Enforcement/Compliance Project

**NYSERDA Agreement Number (6764C-3)
Comptrollers Contract No. (C012668)
NYSDOT Task Assignment (C-01-66C)
PIN (R020.47.881)**

October 23, 2003

Submitted to:

**New York State Energy Research and Development Authority
And
New York State Department of Transportation**

Submitted by:

**Clough, Harbour & Associates LLP
III Winners Circle, Albany, New York 12205**

PREFACE

The New York State Energy Research and Development Authority (NYSERDA) is a public benefit corporation created in 1975 by the New York State Legislature. For more than a quarter century, NYSERDA has been working on finding innovative solutions to the energy and environmental issues that face residents of the Empire State. As part of that mission, the Authority has sought answers that would benefit not only New York's energy and environmental future, but the economy as well. To do so, NYSERDA has traditionally partnered with other state agencies, as well as industrial, commercial, environmental and economic development groups all across New York State.

In 1999, the New York State Department of Transportation (NYSDOT) had just completed a three-year contractual research relationship with a consortium of seven New York State universities, colleges and research institutions. Based on the success of that experience, the Department sought to establish additional partnering arrangements with research consortia to carry out basic and applied research, technology transfer, and short-term consultation services in the fields of engineering, operations, public transportation, management and finance, public policy, and human resources.

As a complement to a university-based constituency, NYSERDA organized a Transportation Infrastructure Research Consortium comprised of seventeen private-sector research entities. The membership is characterized as businesses, not-for-profits, and professionals that have a track record of performing transportation-related research, development, and demonstration as a normal part of their service-related or internal operations. Many of the organizations also have strong relationships with universities, state agencies and authorities, and federal funding agencies, and are already performing collaborative research through those relationships.

In June of 2001, New York State Comptroller's Contract C012668 was executed and governs the activities of the NYSERDA-administered Transportation Infrastructure Research Consortium. The term of the agreement is for five years, extending from March 1, 2001 through February 28, 2006. The direct and dynamic linkages between transportation, energy, and the environment have continually reinforced the cooperative relationship formed between NYSDOT and NYSERDA. Since its inception, numerous collaborative efforts have been undertaken and the report that follows is a product of that relationship.

NOTICE

This report was prepared by Clough, Harbour & Associates LLP in the course of performing work contracted for and sponsored by the New York State Energy Research and Development Authority and the New York State Department of Transportation (hereafter the "Sponsors"). The opinions expressed in this report do not necessarily reflect those of the Sponsors or the State of New York, and reference to any specific product, service, process, or method does not constitute an implied or expressed recommendation or endorsement of it. Further, the Sponsors and the State of New York make no warranties or representations, expressed or implied, as to the fitness for particular purpose or merchantability of any product, apparatus, or service, or the usefulness, completeness, or accuracy of any processes, methods, or other information contained, described, disclosed, or referred to in this report. The Sponsors, the State of New York, and the contractor make no representation that the use of any product, apparatus, process, method, or other information will not infringe privately owned rights and will assume no liability for any loss, injury, or damage resulting from, or occurring in connection with, the use of information contained, described, disclosed, or referred to in this report.

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 - General Notes
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 - Detection & Notification Setup
 - ROC Setup
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 - ROC Breakdown
- Mobile System Operations & Maintenance
 - ROC Components
 - Detection Reader Components
 - Notification Reader Component

System Requirements

Mobile Equipment

The mobile equipment consists of 3 trailers with varying functions and electronics packages; the advance or detection reader unit, the notification reader unit and the ROC (Roadside Operational Computer) communications unit.

Each trailer is towed into position using a standard 2" ball trailer hitch. Since the majority of sites will require placement off paved or gravel surfaces, 4 wheel drive vehicles are recommended for trailer transportation and placement.

The inspection vehicle must be located within 100' of the ROC communications trailer, offering greater flexibility for access purposes. Local conditions at each inspection site may require 4 wheel drive and/or high clearance vehicles.

ROC (Roadside Operational Computer)

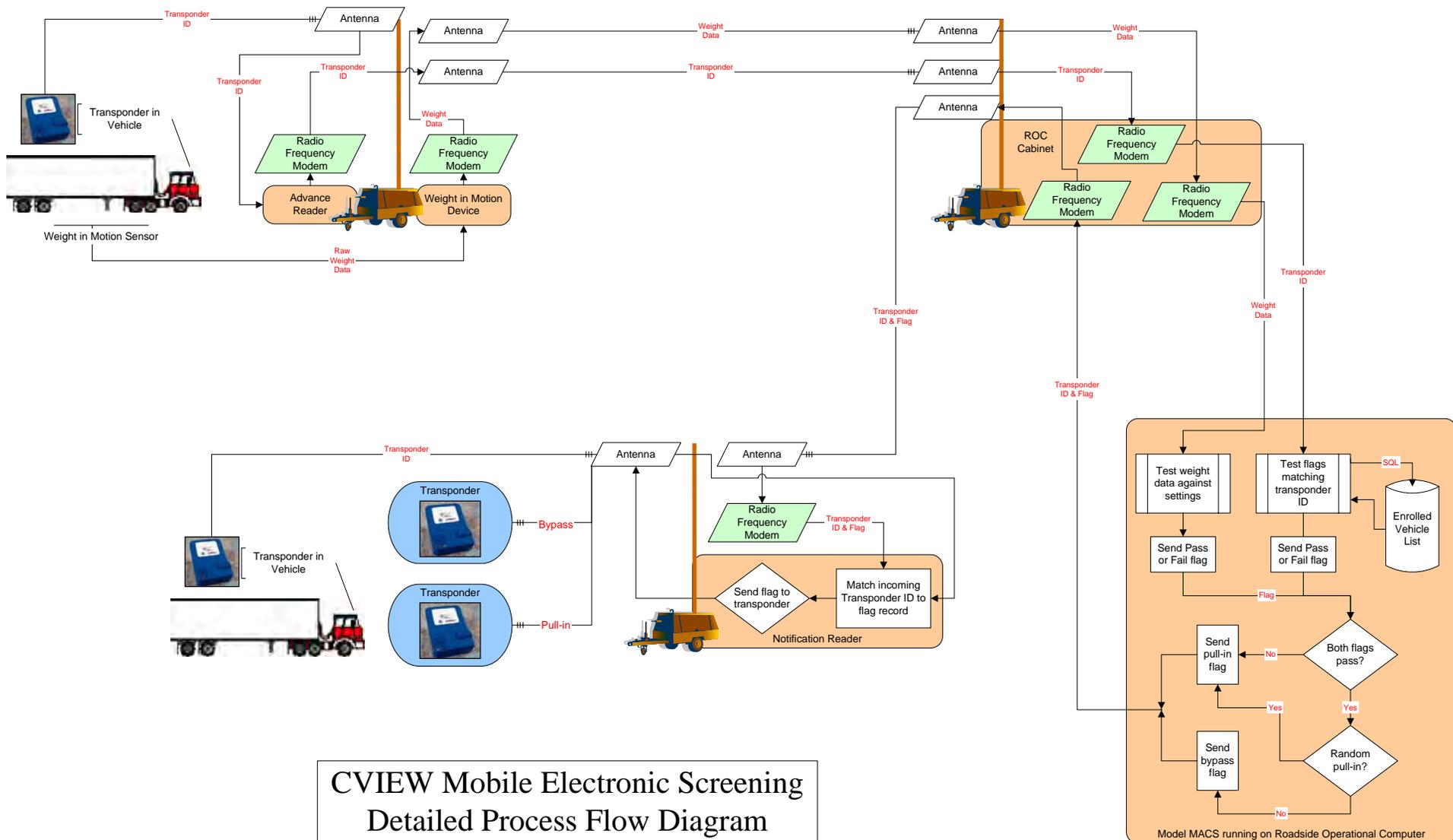
Model MACS (v 1.1.1.367) will be installed on a laptop for maximum portability. Power will be supplied via a power inverter plugged into the inspection vehicle's standard cigarette lighter jack. Due to the large number of communications devices in the screening system, the laptop must have a USB adapter with an operating system capable of supporting it.

The inspection vehicle must have a standard cigarette lighter jack as well as sufficient space for the user to operate the laptop

Recommended Specifications:

2GHz Pentium 4 processor
256MB RAM
30GB hard drive
Microsoft Windows XP Pro*
56k Modem
Wireless NIC
24x CD-ROM
USB port

*Note: While Microsoft Windows XP Pro is the preferred operating system, system tests have shown that Model MACS (v 1.1.1.367) does not work properly on that operating system with the NYSDOT system image loaded. It is unclear whether the incompatibility is with the operating system or with the image however. Model MACS has been successfully used on Windows 2000 without the NYSDOT system image.



CVIEW Mobile Electronic Screening
Detailed Process Flow Diagram

Model MASC Screening (from the Model MACS User Guide)

The Screening Process

The MACS software is continuously monitoring messages from the roadside transponder readers. Whenever a transponder is detected, the reader sends the transponder id to the host computer. The MACS software checks the screening database to determine if the transponder is enrolled. Transponders that are not enrolled are ignored.

If the transponder is not on a Hot List, the screening algorithms are applied using the database information to produce a pullin or bypass decision. The decision is sent to the notification reader, which sends the appropriate signal to the vehicle.

Monitoring the Screening Process

The main monitor form shown in Figure 1 provides an overview of the screening process. It is the form that opens when the application is started. The weigh station operators use this form to monitor the screening activity. Enrolled vehicles are displayed in the current vehicle list when detected by the advance reader. Once the screening decision has been made, the vehicle display is transferred to either the pullin or bypass lists, depending on the decision.

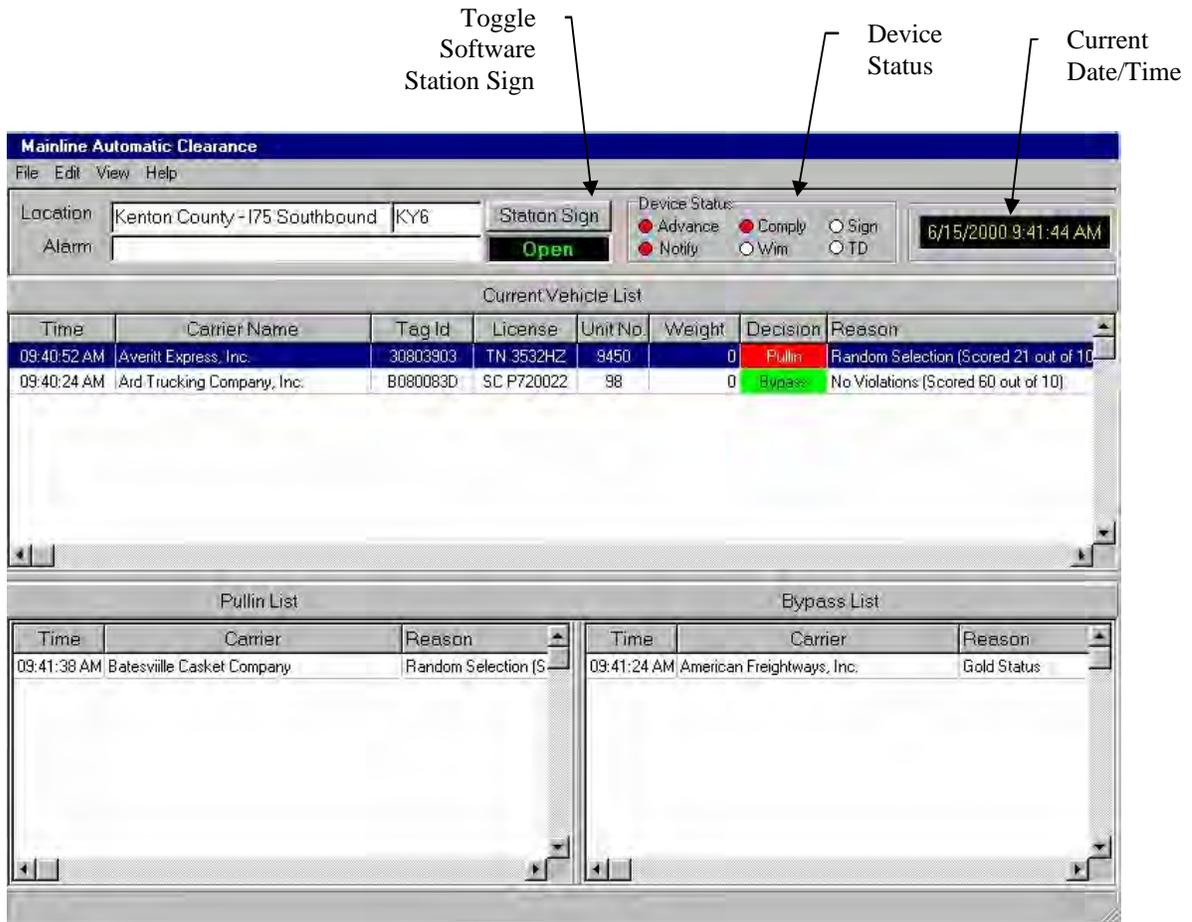


Figure 1 Model MACS Main

Main Menu

The menu categories are

- File – load EVL and exit MACS application
- Edit - modify application parameters
- View - manage weigh station activity logs and view devices
- Help - view information about the Model MACS application

File Menu

The Model MACS file menu shown in Figure 2 is used to perform the following:

- Load EVL - manually load the EVL
- Purge Logs - purge various system logs
- Exit MACS - exit the MACS application

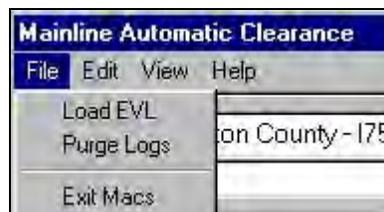


Figure 2 Model MACS File Menu

Edit Menu

The edit menu shown in Figure 3 is used to accomplish the following:

- Refresh - refreshes the screening/main monitor form
- Station - opens the station configuration form
- Hot List - opens the hot list form to force screening decisions
- Trace Flags - opens the trace flags form



Figure 3 Model MACS Edit Menu

View Menu

The View menu shown in Figure 4 allows viewing of the status of devices, the station logs, the console window and the control panel.



Figure 4 Model MACS View Menu

- Device Status - open control windows to the various field devices
- Station Log - opens the weigh station decision log form
- Event Log - opens the weigh station event log form
- Console Log - opens the weigh station console window
- Control Panel - opens the Model MACS control panel

Viewing Vehicle Details

The main monitor form displays minimum information about a vehicle. Additional details can be viewed by double-clicking an entry in any of the vehicle lists. The detailed vehicle information form is shown in Figure 5. The data fields are described in table 1.

Detailed Vehicle Information

File

Carrier

Name: American Freightways, Inc. Carrier IRP Status

Issuing Auth: US DOT/State ID: 239039 Carrier OOS

Subcode: 1 Harrison Carrier Insurance

IRP Acct: OOS Rept: Carrier IFTA

IFTA Acct: 710562003 Multipliers: Safety 15 Weight 3 Gold

Vehicle

Ident. Number: 2HSFLAHN3TC033215 Unit: 2503 Vehicle NMVTIS

Tag No: 30803E14 License Plate: TN B685HZ Vehicle IRP

IRP Acct: OOS Rept: Vehicle Insp OOS

Permit: No:

Permit Checked

Last Weight Measurement

Classification	Axles	Gross Wt	Length
1-2 2-3 3-4 4-5 5-6 6-7 7-8 8-9		lbs	ft
Spacings (ft)			
Weights (lbs)			

Bridge Formula Results:

<input checked="" type="checkbox"/> Steering Axle	<input checked="" type="checkbox"/> Unbalanced Load
<input checked="" type="checkbox"/> Single Axle	<input checked="" type="checkbox"/> Axle Group (Individual)
<input checked="" type="checkbox"/> Tandem Axle	<input checked="" type="checkbox"/> Axle Group (Combination)
<input checked="" type="checkbox"/> Tridem Axle	<input checked="" type="checkbox"/> Over Gross Weight

Date/Time of last measurement →

View Violation History →

Violation History Close

Figure 5 Detailed Vehicle Information

Table 1 Detailed Vehicle Information Data Fields

Item	Description
Carrier	
Name	Carrier name
Issuing Authority	Jurisdiction that issued DOT/US ID (US or State/Province)
DOT/State ID	Federally assigned US DOT motor carrier ID number for all carriers that have one; If no DOT number, The state ID should be entered
Subcode	Carrier assigned code to indicate different service locations or terminals
Subcode Description	Text description of subcode
IRP Account	Carrier's International Registration Plan account number
OOS Report	Carrier's Out of service report number, if applicable
IFTA Account	Carrier's International Fuel Tax Agreement Account number
Carrier IRP Status	Check indicates a problem with the Carrier's IRP status

Table 1 Detailed Vehicle Information Data Fields (Continued...)

Carrier OOS	Check indicates Carrier placed out of service
Carrier Insurance	Check indicates problem with Carrier's insurance
Carrier IFTA	Check indicates problem with Carrier's IFTA status
Gold	Status granted to preferred carriers
Safety Multiplier	Safety performance multiplier used in pull-in calculation
Weight multiplier	Weight compliance rating multiplier used in pull-in calculation
Vehicle	
Ident. Number	Vehicle Identification Number (VIN)
Unit Number	Vehicle unit number (assigned by carrier)
Tag No	Transponder identification number
License Plate	Vehicle license plate number
IRP Acct	International Registration Plan account number
OOS Rept	Vehicle out of service report number
Vehicle NMVTIS	National Motor Vehicle Titling Information System: check indicates a problem
Vehicle IRP	Check indicates problem with vehicle's IRP status
Vehicle Insp OOS	Check indicates last vehicle inspection resulted in an out of service order
Permit	Check indicates vehicle has a permit
Permit Number	Permit identification number
Permit Checked	Check indicates that permit has been previously checked
Last Weight Measurement	
Time	Date/time
Code	Vehicle classification code
Classification	Vehicle classification description
Axles	Number of axles
Gross Wt	Gross weight of vehicle
Length	Reported length of vehicle
Spacings	Axle spacings
Weights	Axle weights
Bridge Formula Results	<i>A check in any of these indicates a violation</i>
Steering Axle	Steering axle weight violation
Single Axle	Single axle weight violation
Tandem Axle	Tandem axle weight violation
Tridem Axle	Tridem axle weight violation
Unbalanced Load	Detected unbalanced load
Axle Group (Individual)	Axle group weight violation
Axle Group (Combination)	Combination axle group violation
Over Gross Weight	Gross weight violation

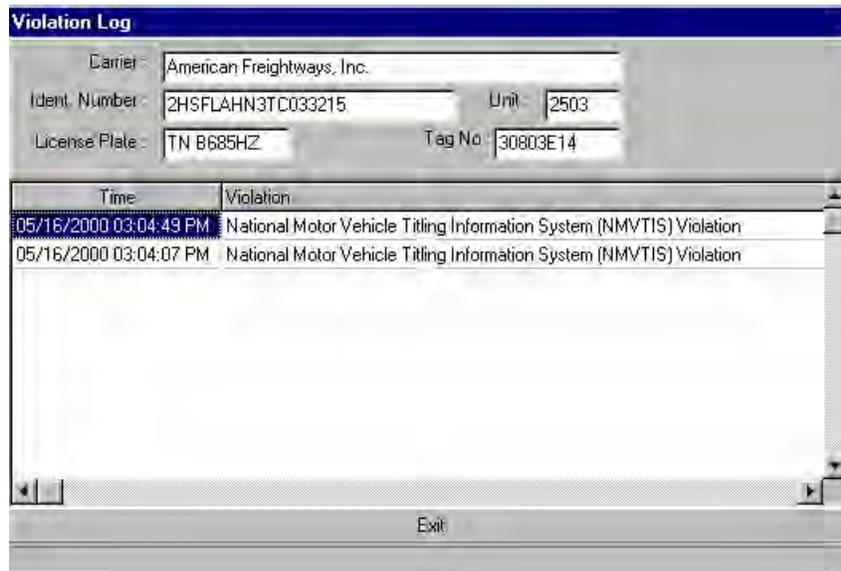
A vehicle screening report, shown in Figure 6, is generated from the file menu of the Detailed Vehicle Information form.

Vehicle Screening Report		5/17/2000 4:38:19 PM	
Carrier:	American		
Issuing Authority:	US		
DOT/State ID:	239039		
Subcode:	1	Harrison	
Carrier Checklist			
IFTA Violation:	No	IFTA Acct:	710562003
IRP Violation:	No	IRP Acct:	
Out Of Service:	No	OOS Report:	
Insurance Violation:	No		
Vehicle Identification:	4VA7BAPF6XN750770		
Unit:	3350		
License:	TN HB08HY		
Tag Number:	30803E85		
Registered Weight:	0		
Vehicle Checklist			
Special Status:	Gold		
NMVTIS Violation:	Yes		
IRP Violation:	No	IRP Acct:	
Out of Service:	No	OOS Report:	
Special Permit:	No		
Permit Type:			
Limit:	0		
Vehicle Class:			
Number of Axles:			
Gross Weight:			
Length:			
Axle Spacing			
Axle Weights			
Bridge Formula Results			
	Steering Axle:		Unbalanced Load:
	Single Axle:		Axle Group (Individual):
	Tridem Axle:		Axle Group (Combination):
	Tandem Axle:		Unspecified:

Figure 6 Vehicle Screening Report

Viewing the Violation Log

The violation history button on the Detailed Vehicle Information form opens the form shown in Figure 7. The violation history lists all pullins and violations for the vehicle at the weigh station since the last system log purge.



The screenshot shows a window titled "Violation Log". At the top, there are several input fields for vehicle information:

- Carrier: American Freightways, Inc.
- Ident. Number: 2HSFLAHN3TC033215
- Unit: 2503
- License Plate: TN B685HZ
- Tag No: 30803E14

Below these fields is a table with two columns: "Time" and "Violation". The table contains two entries:

Time	Violation
05/16/2000 03:04:49 PM	National Motor Vehicle Titling Information System (NMVTIS) Violation
05/16/2000 03:04:07 PM	National Motor Vehicle Titling Information System (NMVTIS) Violation

At the bottom of the window, there is an "Exit" button.

Figure 7 Violation Log

Forcing Screening Decisions With the Hot List

The MACS application can force a screening decision for one vehicle or all vehicles associated with a particular carrier. The Hot List form is opened by selecting Hot List from the Edit menu and is shown in Figure 8. Once a carrier is selected in the drop down list, the action to be taken when the vehicle passes through the weigh station can be modified. The data fields are described in Table 2.

To select multiple vehicles press and hold the 'Ctrl' key while selecting each vehicle.

The change button will apply the selected action to all selected vehicles. Similarly, the right mouse button activates a popup menu from which an action item can be selected.

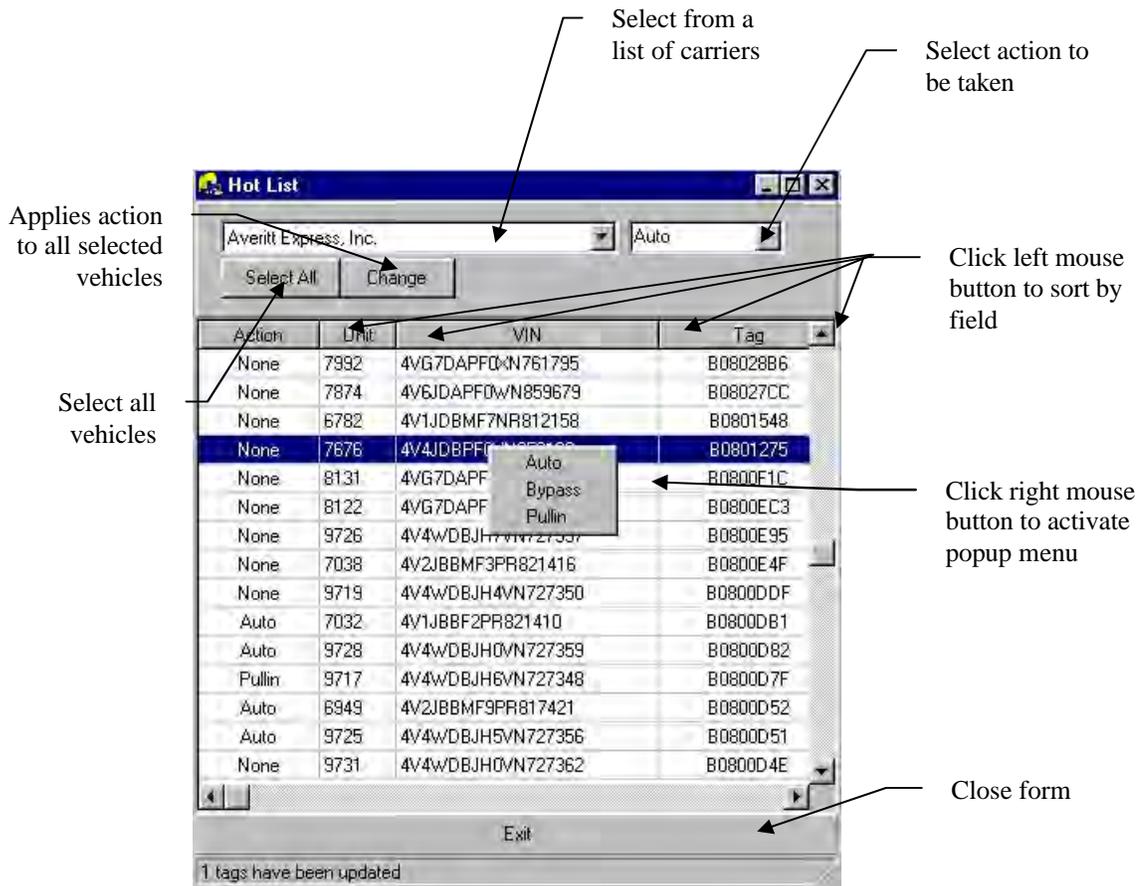


Figure 8 Hot List Form

Table 2 Hot List Data Fields

Item	Description
Action	Action to be taken when vehicle is detected
Unit	Vehicle unit number
VIN	Vehicle Identification Number
Tag	Transponder identification number

Configuring the Weigh Station

The configuration parameters are stored in the database and are accessed using the station configuration screen shown in Figure 9. Selecting Station from the main monitor form's Edit menu opens the screen. Only the system administrator should modify the configuration parameters. The data fields are described in table 3.

The Truck Detector option in the Readers section is intended to be implemented at a later date and has therefore been disabled.

Type	Com Port
<input type="checkbox"/> Station Sign	COM1
<input checked="" type="checkbox"/> WIM	
Correlate Dist/Time	100 1000
<input checked="" type="checkbox"/> Detection	COM3
Separation	
<input checked="" type="checkbox"/> Notification	COM4
Separation	
<input type="checkbox"/> Truck Detector	
Correlate Dist/Time	
<input checked="" type="checkbox"/> Compliance	COM5

	Minimum	Maximum
Tandem	3.3	8
Tridem	8	9

Figure 9 Station Configuration Screen

Table 3 Station Configuration Data Fields

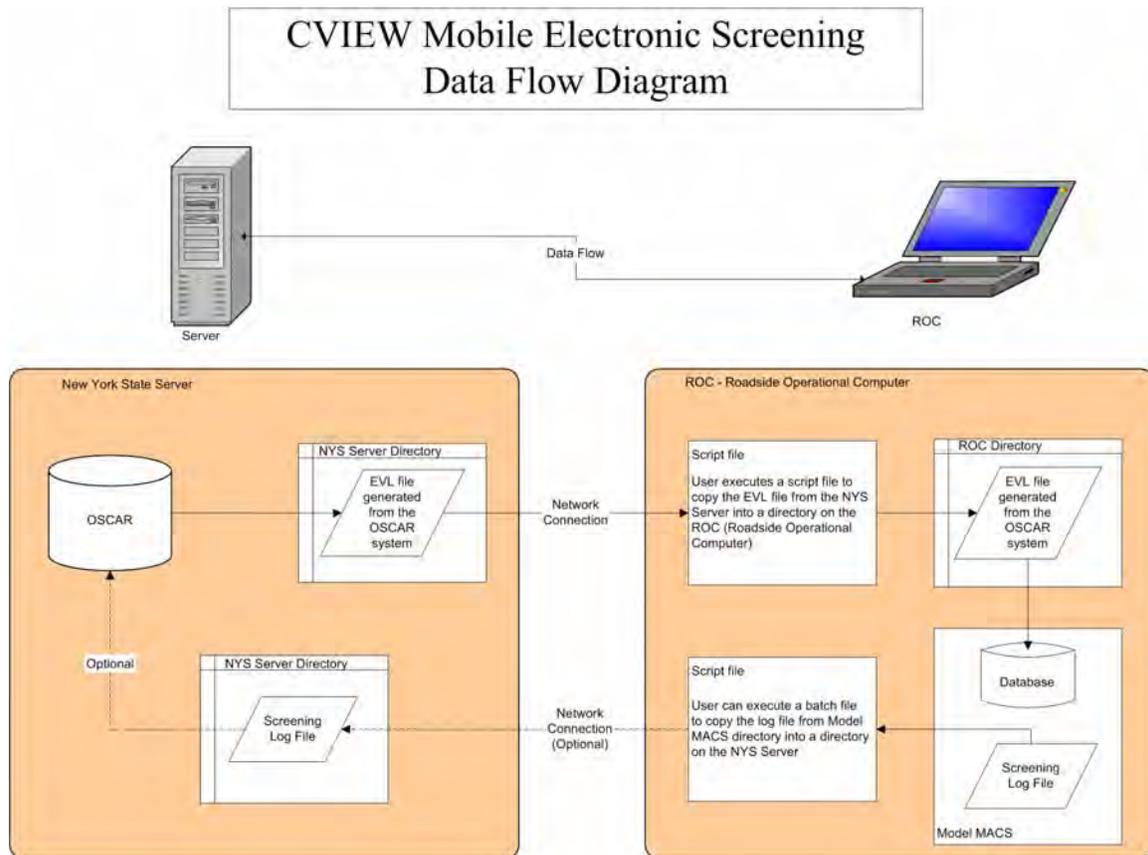
Field Name	Description
Location code	Station identifier
Location description	Station identifier description
Readers	
Station Sign	Signifies if station is open or closed
WIM	Weigh-In-Motion scale
Correlate Dist/Time	WIM correlation parameters
Detection	Reader device
Separation	Distance between WIM and reader (feet)
Notification	Reader device
Separation	Distance between detector and reader (feet)
Truck Detector	Detector device
Correlate Dist/Time	Detector correlation parameters
Compliance	Reader device
Unit of Measure	
English	English unit measure
Metric	Metric unit measure
Screening Options	
Random Pull-in %	Station base pull in percentage (used in random pull in calculation)
Check Permits	Signifies whether Model MACS will check for permits
Weight Checking	Signifies whether Model MACS will check for weight
Weight Limits	Signifies whether Model MACS will check weight limits
Bridge Formula	Signifies whether Model MACS will check the Federal bridge formula
Weight Screening Parameters	
Max Axles	Max number of axles per vehicle
Gross Weight Limit	Max weight limit for vehicle
Single Axle Weight Limit	Max weight limit for single axle
Tandem Weight Limit	Max weight limit for tandem axle
Tridem Weight Limit	Max weight limit for tridem axle
Maximum Tandem Axle Spacing	Minimum Tandem Axle Spacing for vehicle weight screening
Minimum Tandem Axle Spacing	Minimum Tandem Axle Spacing for vehicle weight screening
Maximum Tandem Axle Spacing	Maximum Tandem Axle Spacing for vehicle weight screening
Minimum Tridem Axle Spacing	Minimum Tridem Axle Spacing for vehicle weight screening
Maximum Tridem Axle Spacing	Maximum Tridem Axle Spacing for vehicle weight screening
Minimum Spacing Exception	Minimum Spacing Exception for vehicle weight screening
Maximum Weight Exception	Maximum Weight Exception for vehicle weight screening

Data Transfer Process

Model MACS imports its data by polling a local directory on the screening computer looking for the presence of a new EVL (Enrolled Vehicle List) file. The EVL file is a length delimited ASCII text file containing transponder IDs, vehicle and carrier information and screening flags. If a new ELV file is found, Model MACS automatically imports it into its database.

New EVL files will be stored at a standard location on a New York State server. Prior to performing electronic screening, inspection personnel will connect to the appropriate network in the manner indicated by New York State. Once connected, the inspection personnel will run a VBScript which will check for the existence of the network connection. If a connection is found, the new EVL file will be copied from the server to the Model MACS database directory. If no connection is found, or if the EVL file does not exist, a warning message box will appear.

Optionally a similar additional script can be created or incorporated into the original that will automatically transfer screening log files from the laptop to a location on a New York State server.



General Site Evaluation and Set-up

The following factors must be evaluated when determining the feasibility of a site for placement, operations and maintenance of the proposed mobile electronic screening system:

- The adequacy of the roadway geometrics to ensure a safe operational environment.
- Opportunities for an unobstructed line of site for the necessary length of the screening zone
- Accessibility to an appropriate and adequate area for vehicles to pull off the main line should they be so directed.
- Proximity to interchange ramps or access points within, or adjacent to, the screening zone.
- Appropriate topography and roadside edge conditions at key points in the screening zone for the placement of the mobile equipment platform trailers.

The Commercial Vehicle Information Exchange Window (CVIEW) requires the use of three mobile equipment platforms and they consist of the Advanced Reader, Notification Reader and Compliance Reader/Roadside Operations (ROC). The Advanced Reader is located ½ mile from the proposed inspection exit. The Notification Reader is located ¼ mile from the proposed inspection exit or divergence area. The Compliance Reader/Roadside Operations (ROC) is typically located in close proximity to the gore of the proposed inspection exit ramp or divergence area.

The proposed equipment platform is a single axle trailer approximately 12 feet long and 7 feet wide. It contains four manual outriggers that are deployed for stability. The trailer should be placed in relatively flat and well drained location. The outriggers and associated blocking can be used to level the platform where minor changes of grade exist. A grade of 10:1 (10%) or shallower is recommended when identifying areas of appropriate topography for the equipment platform location. It is intended that the mobile platform will be towed with a pickup truck or similar support truck type vehicle and that adequate access is required into and out of the area where the equipment platform is to be located.

If the existing topography where the platform is to be placed is conducive for rapid deployment of the unit, access shall be from the edge of shoulder onto the existing grassed ditch line. Deployment and pick up of the electronic screening equipment may require short duration shoulder closures in the vicinity of the proposed platform locations. If no guide rail exists, placement of the mobile platform must be at a distance from the edge of travel lane to provide an adequate clear zone area for traffic traveling adjacent to the proposed unit location.

At some locations, the existing topography may not be readily conducive, in its present state, for rapid deployment of the equipment platform. With minimal improvements, these locations can be adjusted to provide easy access for a conventional vehicle and trailer. For locations of steep embankment or locations that contain a ditch section, it is

recommended in order to facilitate safe and easy access for the mobile equipment platform, that a temporary embankment platform be constructed (see attached). This temporary embankment platform is suggested to be approximately 40 feet in length and consist of suitable gravel fill. If the anticipated construction area involves placement of embankment material within an active ditch line during periods of wet weather, a culvert should be placed as a means of ditch conveyance at the bottom of the constructed gravel platform. Construction of the temporary embankment platform will, at a minimum, require closure of the shoulder but could also require closure of the adjacent travel lane. For high speed roadways, reduction of the posted travel speed for the area adjacent to the proposed work zone may also be necessary. In order to facilitate removal of this temporary embankment platform it is recommended that a geotextile fabric mat be placed on top of the existing grade prior to the placement of any gravel. The limits of the geotextile fabric should extend to the toe of the gravel embankment slope at all areas. This will allow proper access for the mobile equipment platform. Access for the equipment shall be from the edge of shoulder onto the gravel platform.

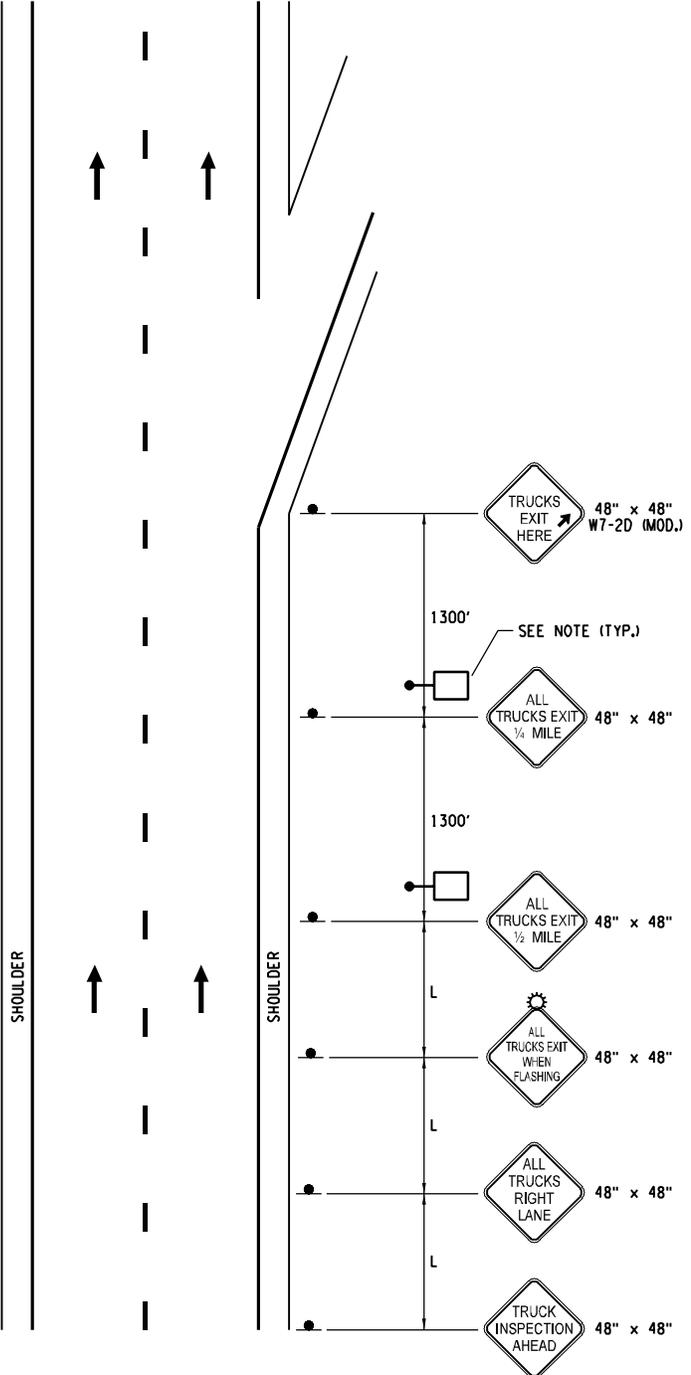
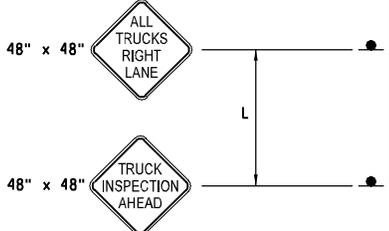
Once the mobile equipment platforms are in place, the proper advanced signing is necessary for adequate driver notification. The posting of signs is dependent on the existing speed of the roadway. It is required that the area outside of the adjacent travel lanes provides adequate safety for the placement and unobstructed visibility of the necessary advance signing arrangements.

The actual rest area/comfort station site shall provide adequate geometrics on the entrance and exit ramps as well as providing ample parking/staging areas to facilitate the screening or inspection of commercial vehicles.

Typical maintenance and protection of traffic plans for various roadway configurations and operating speeds are provided as a basis for the deployment, maintenance and removal of the electronic screening equipment.

ADVANCED POSTING DISTANCE TABLE	
POSTED SPEED LIMIT (M.P.H.)	L (FT) MIN.
45	1200
50	1200
55	2500
60	2500
65	2500

NOTE: DSRC READER LOCATION BASED ON CLEAR ZONE OR DEFLECTION DISTANCES. SEE TABLE ON MOBILE TRUCK COMPLIANCE LAYOUT GENERAL NOTES SHEET.



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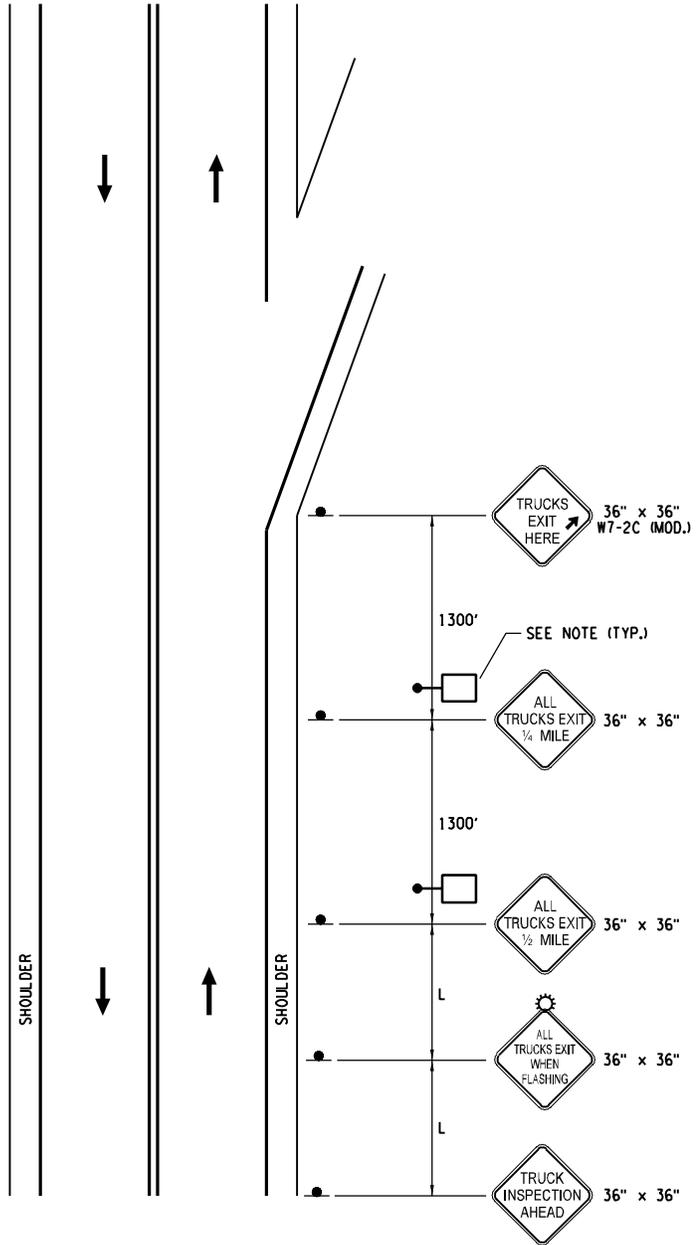
LEGEND	
	DIRECTION OF TRAFFIC
	DSRC READER
	ADVANCED WARNING SIGN

MOBILE TRUCK COMPLIANCE LAYOUT

FOUR-LANE DIVIDED HIGHWAY

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 111 WINNERS CIRCLE ALBANY, NEW YORK, 12205

ADVANCED POSTING DISTANCE TABLE	
POSTED SPEED LIMIT (M.P.H.)	L (FT) MIN.
30	200
35	200
40	200
45	600
50	600
55	1500



NOTE: DSRC READER LOCATION BASED ON CLEAR ZONE OR DEFLECTION DISTANCES. SEE TABLE ON MOBILE TRUCK COMPLIANCE LAYOUT GENERAL NOTES SHEET.

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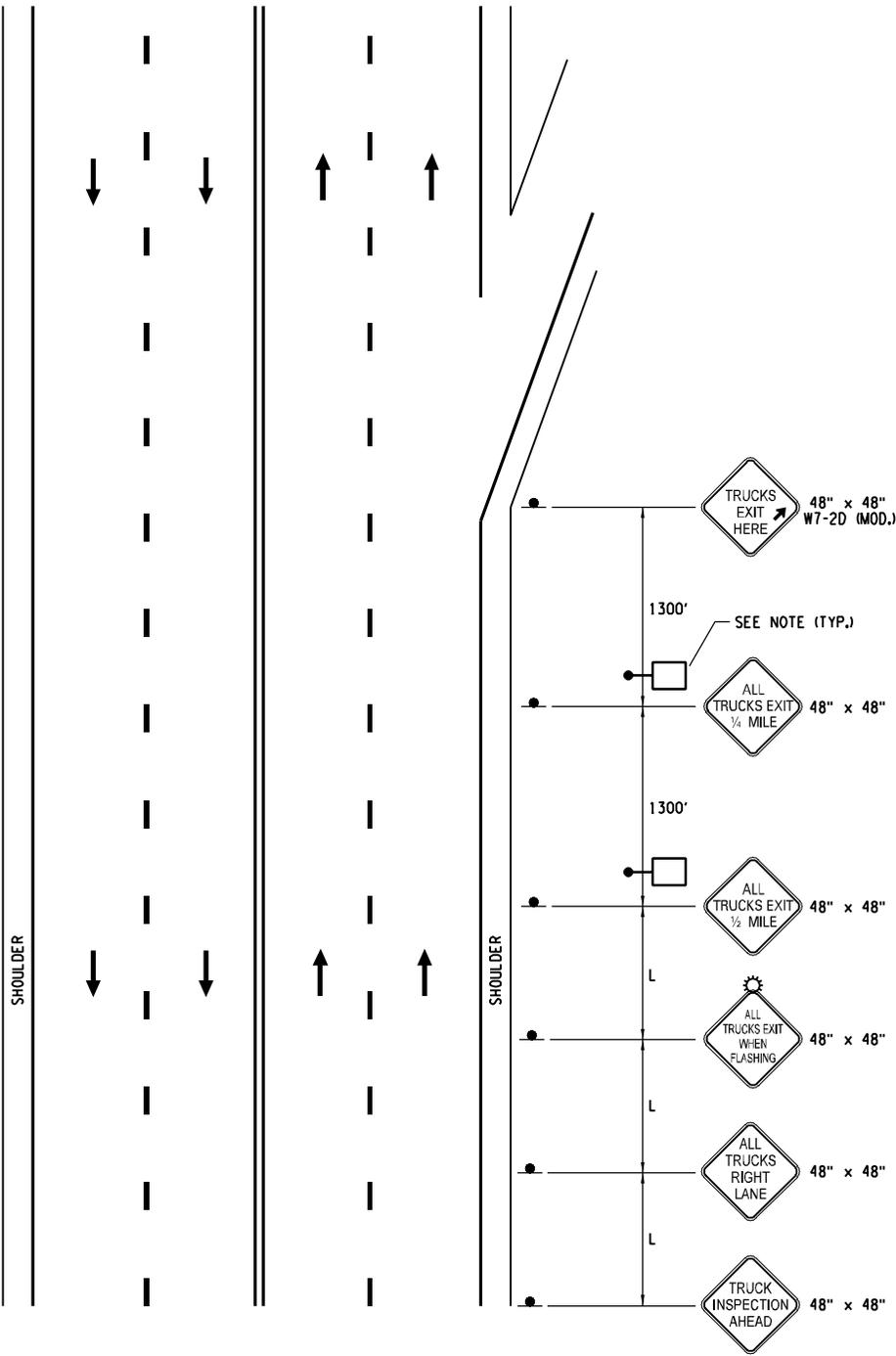
LEGEND	
	DIRECTION OF TRAFFIC
	DSRC READER
	ADVANCED WARNING SIGN

MOBILE TRUCK COMPLIANCE LAYOUT

TWO-LANE UNDIVIDED ROAD

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ADVANCED POSTING DISTANCE TABLE	
POSTED SPEED LIMIT (M.P.H.)	L (FT) MIN.
30	200
35	200
40	200
45	600
50	600
55	1500



NOTE: DSRC READER LOCATION BASED ON CLEAR ZONE OR DEFLECTION DISTANCES. SEE TABLE ON MOBILE TRUCK COMPLIANCE LAYOUT GENERAL NOTES SHEET.

LEGEND	
	DIRECTION OF TRAFFIC
	DSRC READER
	ADVANCED WARNING SIGN

MOBILE TRUCK COMPLIANCE LAYOUT
FOUR-LANE UNDIVIDED HIGHWAY

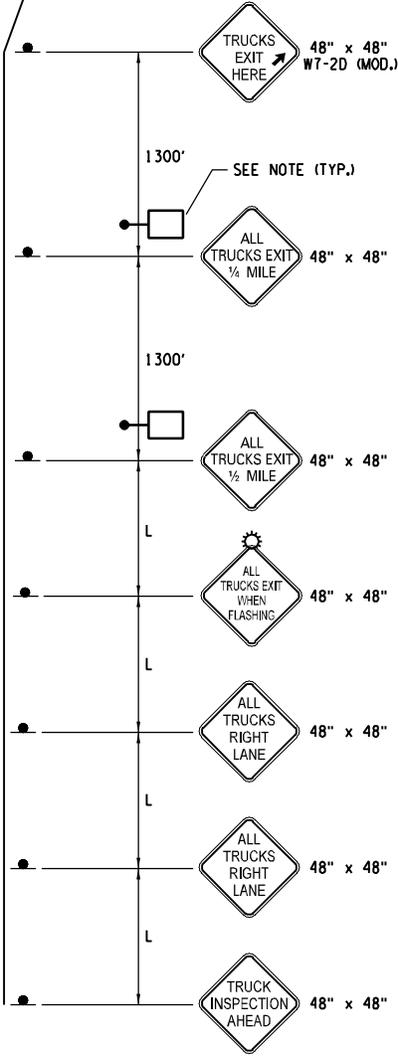
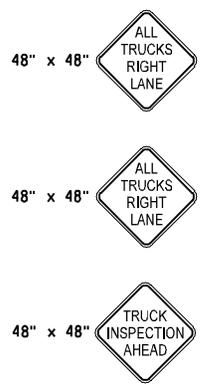
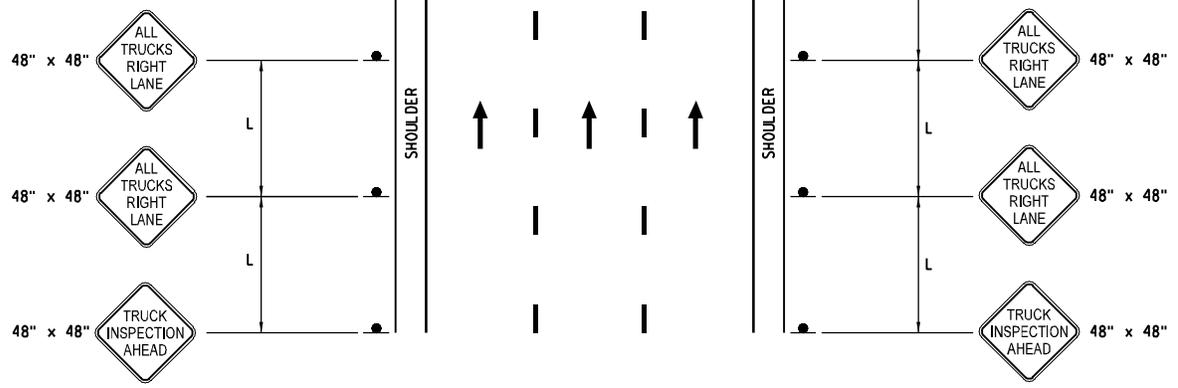
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 USER : B99



ADVANCED POSTING DISTANCE TABLE	
POSTED SPEED LIMIT (M.P.H.)	L (FT) MIN.
45	1200
50	1200
55	2500
60	2500
65	2500

NOTE: DSRC READER LOCATION BASED ON CLEAR ZONE OR DEFLECTION DISTANCES. SEE TABLE ON MOBILE TRUCK COMPLIANCE LAYOUT GENERAL NOTES SHEET.

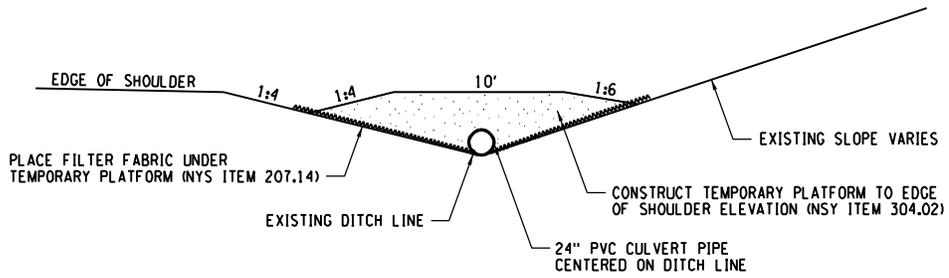
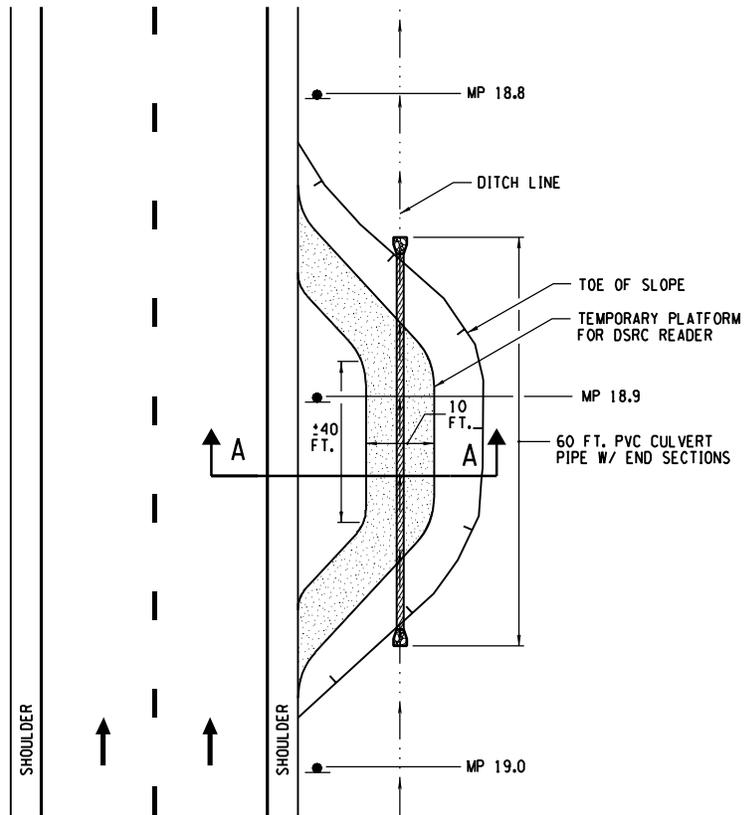


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LEGEND	
	DIRECTION OF TRAFFIC
	DSRC READER
	ADVANCED WARNING SIGN

MOBILE TRUCK COMPLIANCE LAYOUT	
SIX-LANE DIVIDED HIGHWAY	
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SECTION A-A

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TEMPORARY PLATFORM CONSTRUCTION DETAIL

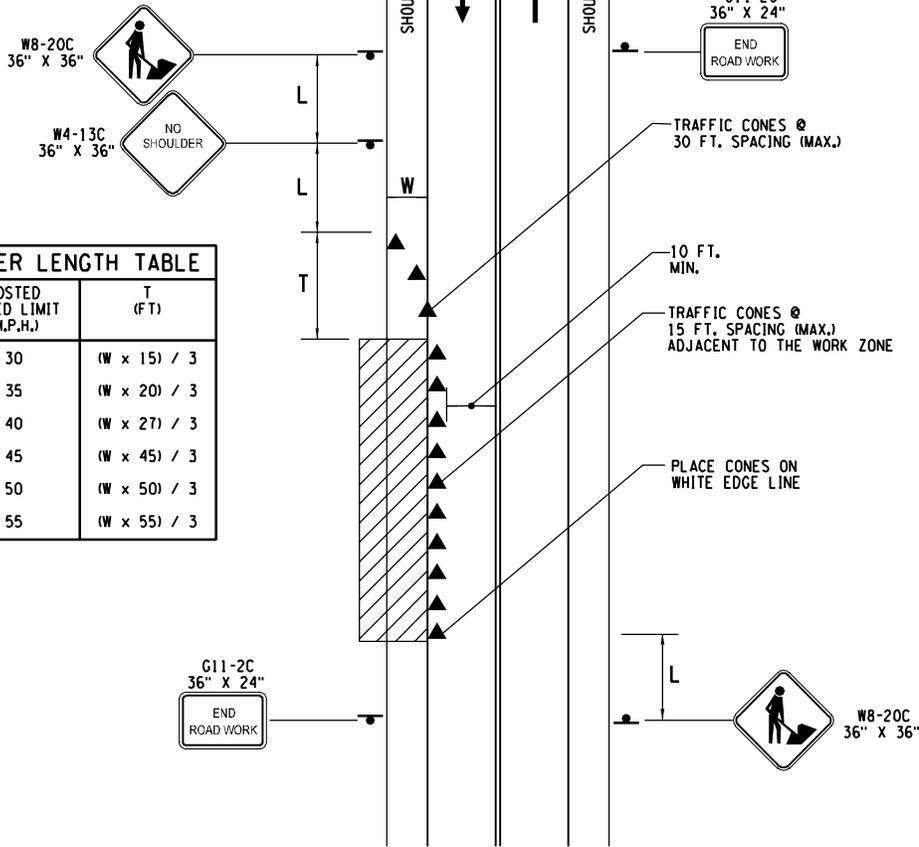
FOR MOBILE TRUCK COMPLIANCE READER

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 111 WINNERS CIRCLE ALBANY, NEW YORK, 12205

ADVANCED POSTING DISTANCE TABLE	
POSTED SPEED LIMIT (M.P.H.)	L (FT) MIN.
30	200
35	200
40	200
45	300
50	300
55	300

LEGEND	
	DIRECTION OF TRAFFIC
	TRAFFIC CONE
	WORK ZONE
	CONSTRUCTION SIGN

TAPER LENGTH TABLE	
POSTED SPEED LIMIT (M.P.H.)	T (FT)
30	(W x 15) / 3
35	(W x 20) / 3
40	(W x 27) / 3
45	(W x 45) / 3
50	(W x 50) / 3
55	(W x 55) / 3



**TRAFFIC CONTROL
FOR SHORT DURATION SHOULDER CLOSURES**

N.T.S.

NOTE:
1.) ANYTIME THE WORK ZONE ENCRACHES INTO THE TRAVEL LANE,
THE TRAVEL LANE MUST BE CLOSED USING THE APPROPRIATE
LANE CLOSURE DETAILS.

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M & PT SHOULDER WORK AREA

FOR LOW SPEED ROADWAYS

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& LANDSCAPE ARCHITECTS
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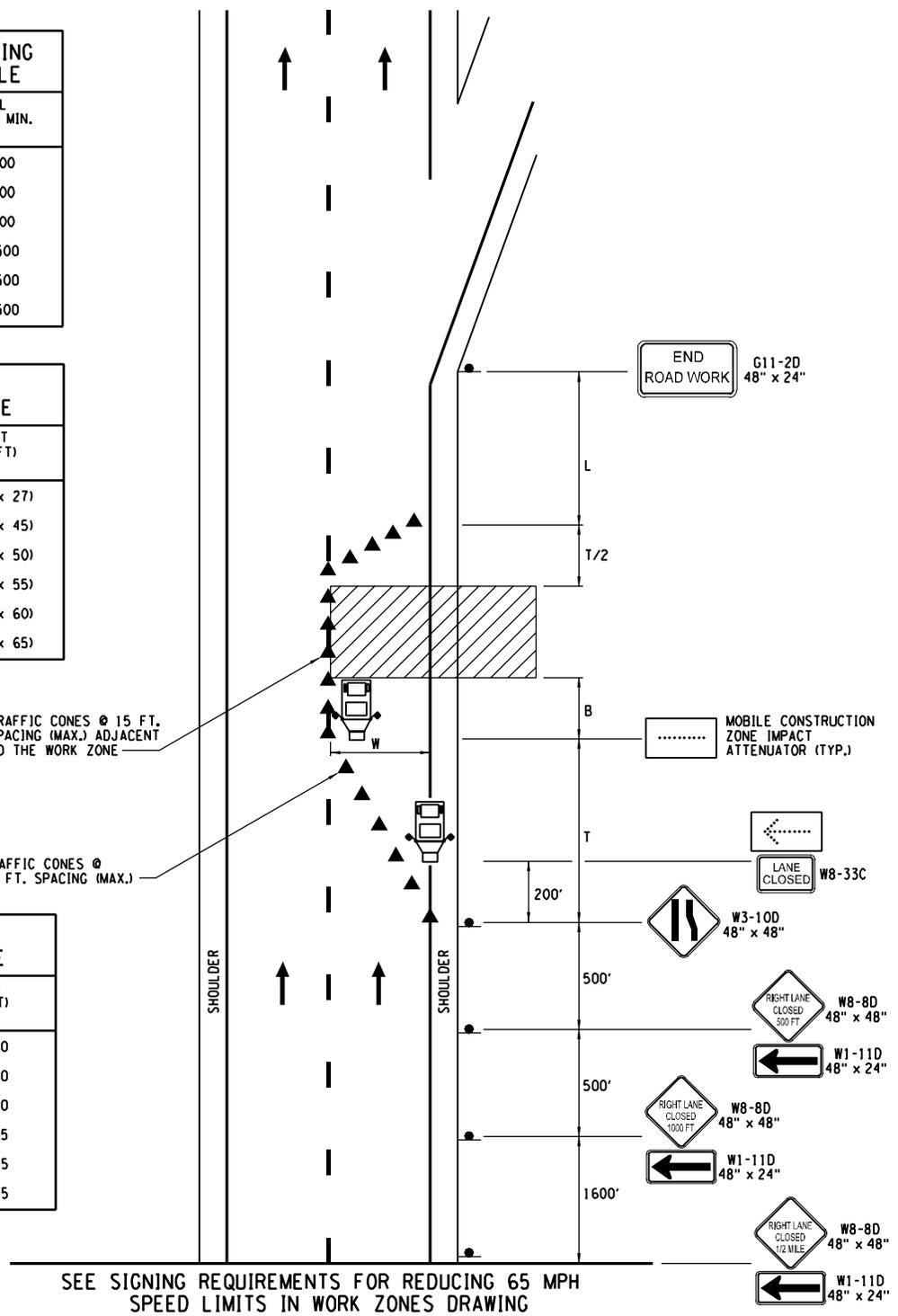
ADVANCED POSTING DISTANCE TABLE	
POSTED SPEED LIMIT (M.P.H.)	L (FT) MIN.
40	600
45	600
50	600
55	1500
60	1500
65	1500

TAPER LENGTH TABLE	
POSTED SPEED LIMIT (M.P.H.)	T (FT)
40	(W x 27)
45	(W x 45)
50	(W x 50)
55	(W x 55)
60	(W x 60)
65	(W x 65)

BUFFER LENGTH TABLE	
POSTED SPEED LIMIT (M.P.H.)	B (FT)
40	170
45	220
50	280
55	335
60	415
65	485

TRAFFIC CONES @ 15 FT. SPACING (MAX.) ADJACENT TO THE WORK ZONE

TRAFFIC CONES @ 30 FT. SPACING (MAX.)



SEE SIGNING REQUIREMENTS FOR REDUCING 65 MPH SPEED LIMITS IN WORK ZONES DRAWING

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LEGEND	
	DIRECTION OF TRAFFIC
	TRAFFIC CONE
	WORK ZONE
	CONSTRUCTION SIGN
	IMPACT ATTENUATOR

**LANE AND SHOULDER CLOSURE FOR
CONSTRUCTION OF TEMPORARY PLATFORM**

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111 WINNERS CIRCLE ALBANY, NEW YORK, 12205

NOTES:

1. TRAFFIC CONTROL SHALL BE PROVIDED FOR THE LENGTH AND DURATION OF THE ELECTRONIC SCREENING PROCESS IN ACCORDANCE WITH THE PROVISIONS CONTAINED IN THE PLANS.
2. DIAMOND-SHAPED ADVANCE WARNING SIGNS SHALL BE USED FOR ALL ADVANCE WARNING SIGNS SHOWN ON THE PLANS. COLOR REQUIREMENTS SHALL BE BLACK TEXT ON YELLOW BACKGROUND.
3. THE CORRECT SEQUENCE AND SPACING OF SIGNS MUST BE MAINTAINED AT ALL TIMES IN ACCORDANCE WITH THE TRAFFIC CONTROL PLANS. ALL SIGNS, SHALL INDICATE ACTUAL FIELD CONDITIONS AT ALL TIMES AND SHALL BE COVERED, MOVED, REMOVED, OR CHANGED IMMEDIATELY IF FIELD CONDITIONS CHANGE.
4. LATERAL PLACEMENT OF SIGNS SHALL BE SUCH THAT THE LATERAL CLEARANCE FROM THE EDGE OF THE TRAVEL LANE TO THE EDGE OF SIGN SHALL BE A MINIMUM OF 10 FEET. WHERE THE 10 FOOT OFFSET IS UNOBTAINABLE DUE TO PHYSICAL CONSTRAINTS, THE SIGN MAY BE INSTALLED A MINIMUM OF 2 FEET FROM THE TRAVEL LANE. THE BOTTOM OF ALL SIGNS SHALL BE 7 FEET ABOVE THE SURFACE.
5. LONGITUDINAL PLACEMENT OF SIGNS SHALL BE AS SHOWN ON THESE PLANS.
6. EQUIPMENT SHALL BE REMOVED FROM THE ROADSIDE AREA DURING NON-WORKING HOURS. THE CLEAR ROADSIDE AREA IS DEFINED AS THE AREA BETWEEN THE DSRC AND THE EDGE OF PAVEMENT.
7. NO SIGNS OR EQUIPMENT ARE TO BE PLACED WITHIN THE CLEAR ROADSIDE AREA EXCEPT THAT WHICH IS TO BE USED THAT DAY.
8. DSRC READER LOCATION BASED ON CLEAR ZONE OR GUIDERAIL DEFLECTION DISTANCES. SEE DSRC READER LOCATION TABLE BELOW FOR OFFSET DISTANCES.

DSRC READER LOCATION TABLE

POSTED SPEED LIMIT (M.P.H.)	NO RAIL (DISTANCE FROM EDGE OF LANE* IN FEET)	CABLE RAIL	W-BEAM RAIL	BOX BEAM RAIL
30	15.0	6.0	5.0	4.0
35	16.5	7.0	6.0	4.0
40	18.0	8.0	6.0	4.0
45	23.0	9.0	7.0	4.0
50	26.0	10.0	7.0	4.0
55	28.5	11.0	8.0	5.0
60	30.0	11.0	8.0	5.0
65	30.0	12.0	9.0	6.0

* THE EDGE OF LANE IS DEFINED AS THE WHITE PAVEMENT MARKING SEPARATING THE TRAVELWAY FROM THE SHOULDER. IN CASES WHERE A WHITE PAVEMENT MARKING (EDGE STRIPE) IS NOT READILY IDENTIFIABLE, THEN THE EDGE OF THE PAVEMENT SHALL BE USED.

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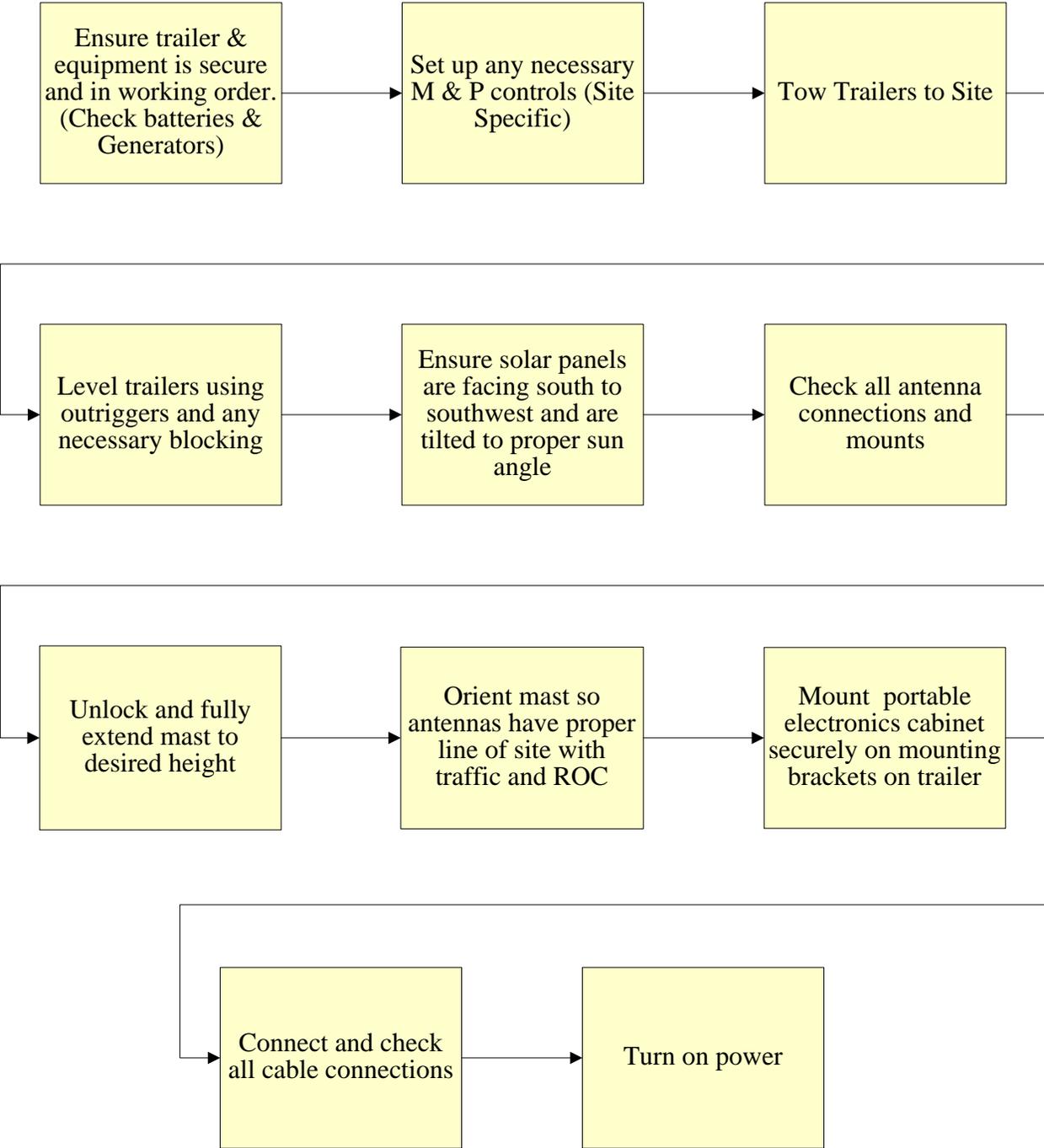


MOBILE TRUCK COMPLIANCE LAYOUT

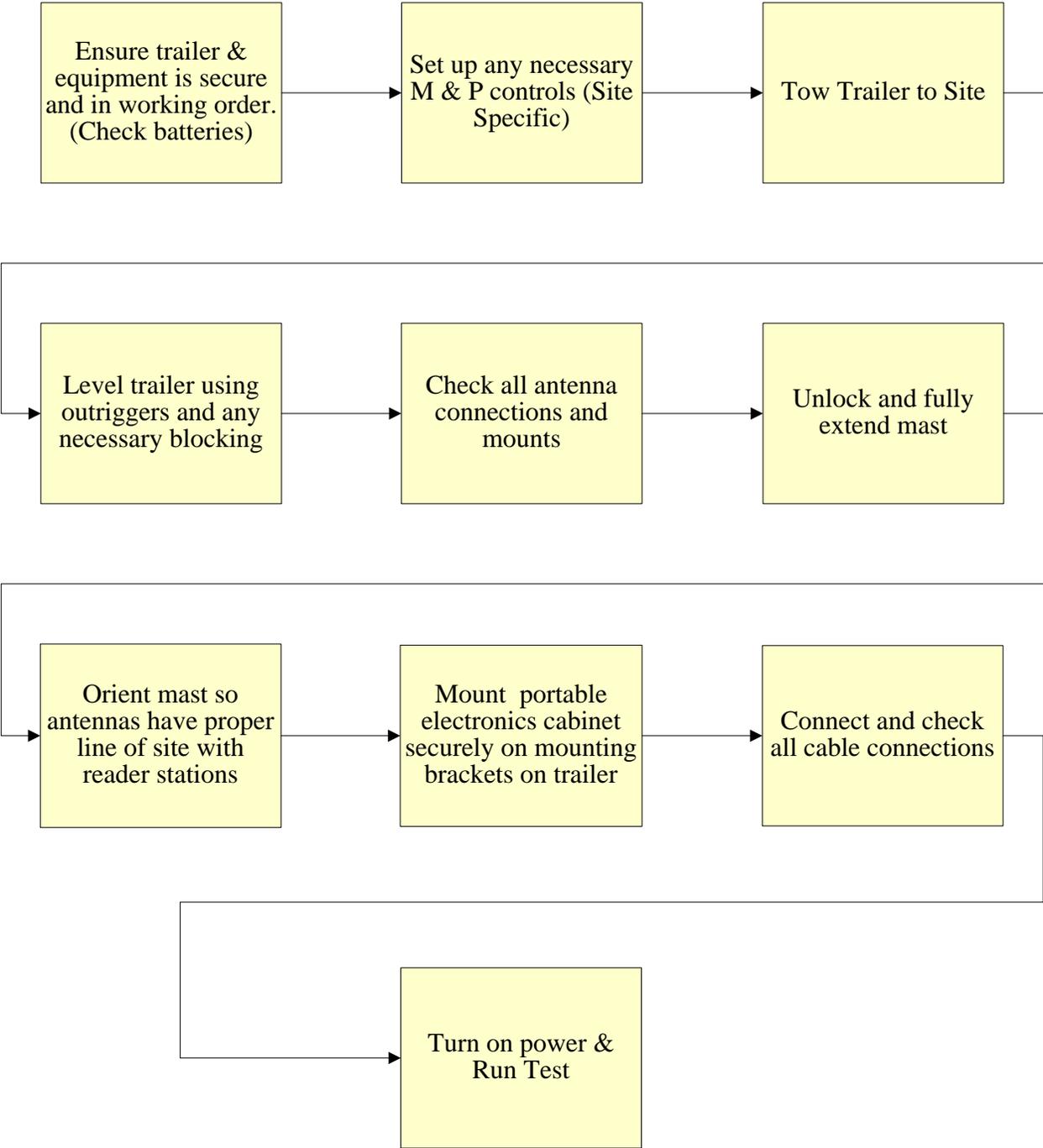
GENERAL NOTES SHEET

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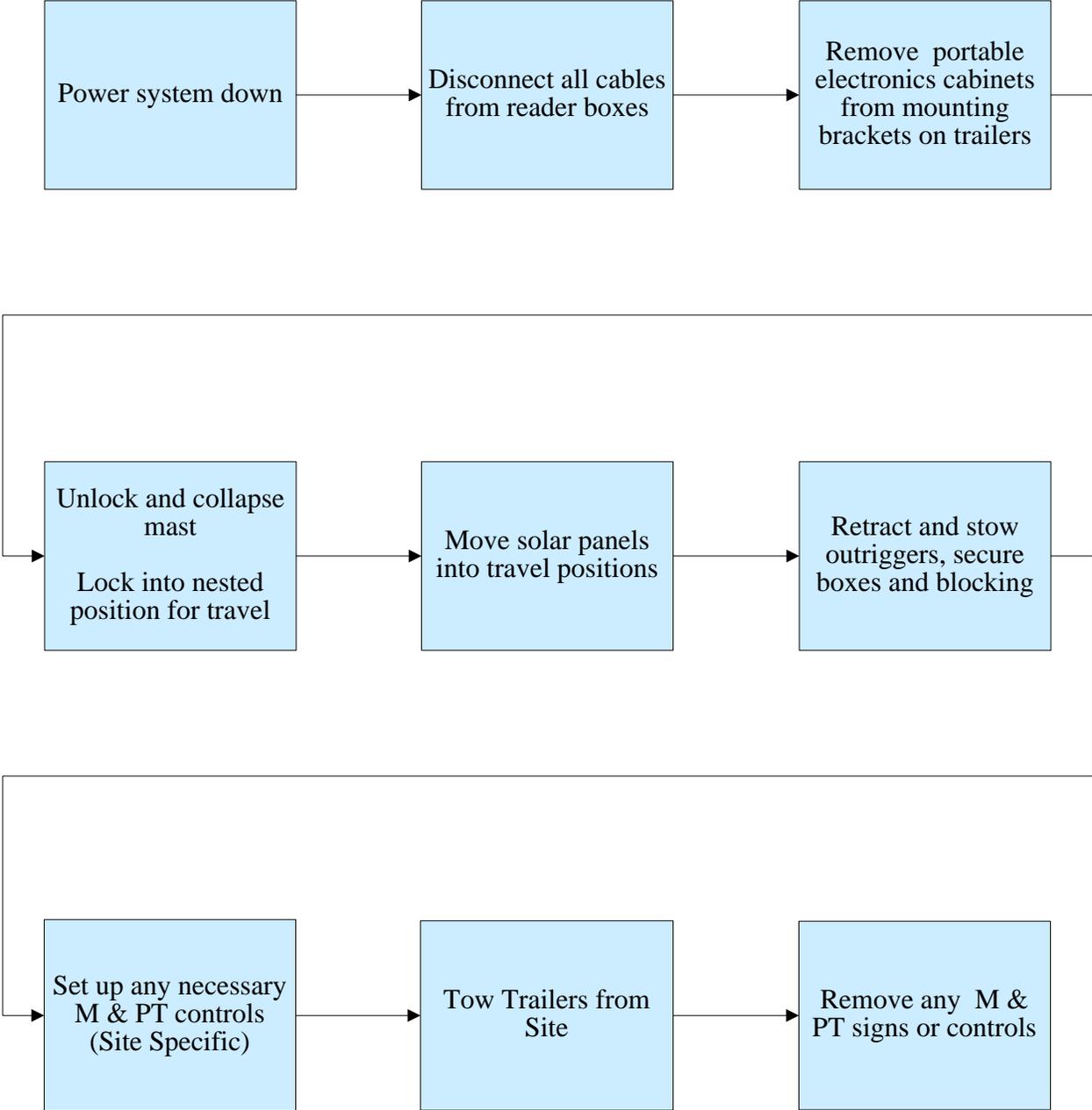
CVIEW Mobile Electronic Screening
Detection & Notification Reader Platform
Setup Process Flow Diagram



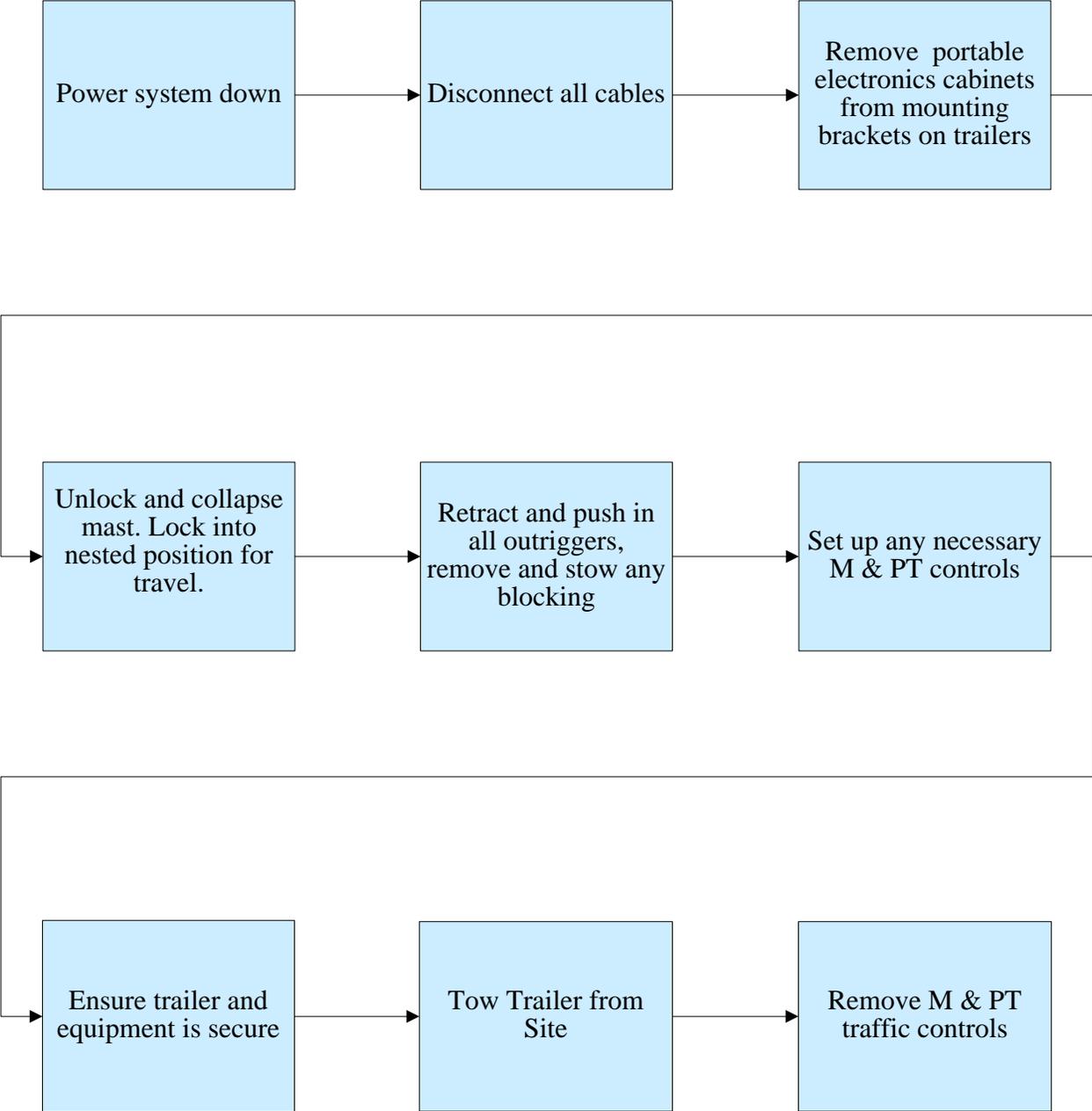
CVIEW Mobile Electronic Screening ROC Communications Platform Setup Process Flow Diagram



CVIEW Mobile Electronic Screening
Detection & Notification Reader Platform
Breakdown Process Flow Diagram



**CVIEW Mobile Electronic Screening
ROC Communications Platform
Breakdown Process Flow Diagram**



**CVIEW MOBILE PROTOTYPE SYSTEM
OPERATIONS AND MAINTENANCE MANUAL**

OCTOBER 2003



Provided to the NEW YORK STATE DEPARTMENT OF TRANSPORTATION

By

CHA TECH SERVICES LLC

**CVIEW MOBILE PROTOTYPE SYSTEM
OPERATIONS AND MAINTENANCE MANUAL
OCTOBER 2003**

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I. PURPOSE.....1

II. GENERAL SYSTEM DESCRIPTION.....1

III. SAFETY PRECAUTIONS2

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VI. NOTIFICATION READER COMPONENTS and OPERATION 16

I. PURPOSE

This manual is written to describe the functions, operations and maintenance of a newly developed mobile system for screening commercial vehicles. The program is called Commercial Vehicle Information Exchange Window or CVIEW. The platforms described in this document are fully functional preliminary prototypes. A more standardized platform system can be developed from the data collected from this preliminary study. This preliminary study did not include a weigh in motion device, although linking a weigh in motion device to the detection system is technically feasible based on internal research conducted. In addition, a fourth reader platform called the confirmation reader placed approximately ¼ mile past the ROC was not a requirement of this study but could be added to the system at a later date.

II. GENERAL SYSTEM DESCRIPTION

This prototype system consists of three major components- the Roadside Operations Computer (ROC), the Detection Reader, and the Notification Reader. The system is designed to be deployed to a site on a temporary basis and can be moved to different locations across the state. Based on this mobile requirement, the system was required to provide its own power. Since hardwire communications for a mobile based system is not practical, radio wave communications are utilized between the three platforms. Separate users manuals for the removable reader electronics packages and communications systems are provided and are not described in this O & M manual.





III. SAFETY PRECAUTIONS

Since each system consists of a 30 foot high retractable mast on a single axle trailer, the following safety precautions should be observed:

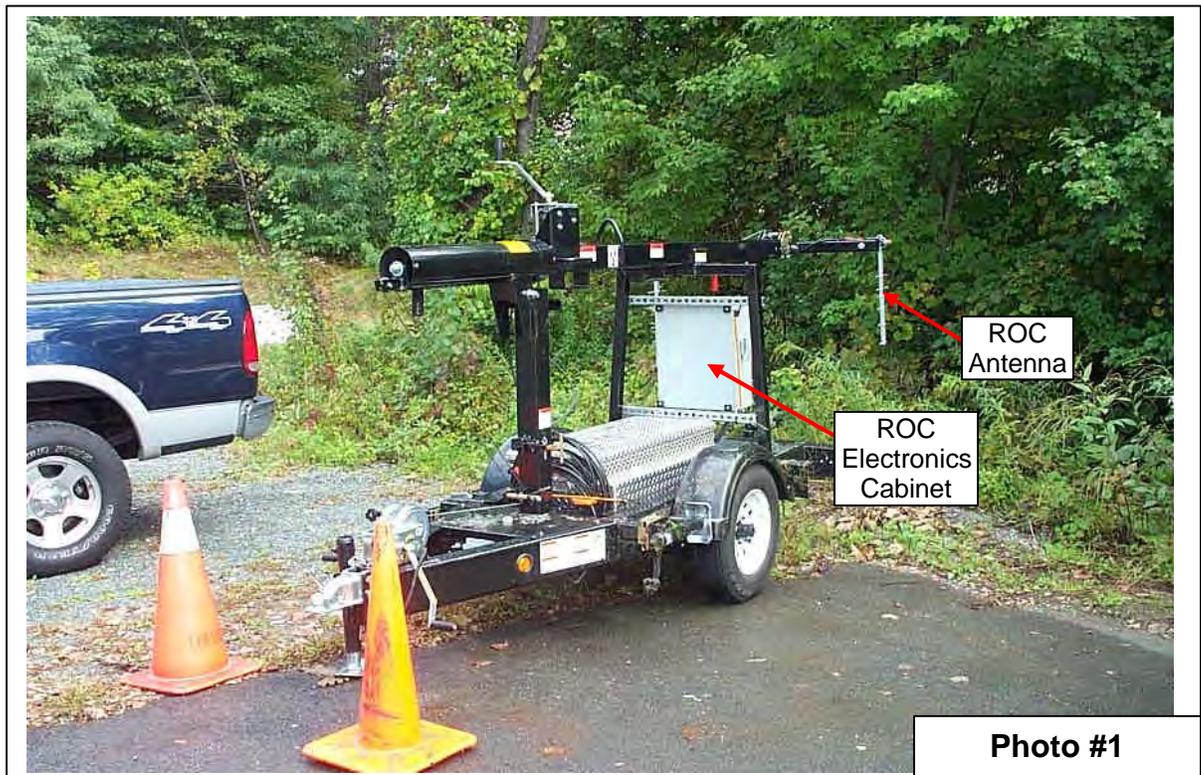
- A) The systems should **not** be operated during thunderstorms due to lightening hazards. All attempts should be made to shut power off and retract the masts before thunderstorms arrive.
- B) The trailers should be leveled using the outriggers before raising the mast. If the trailer is on level ground the outriggers should still be deployed for stability of the platform before the mast is extended.
- C) Before raising the mast ensure that no overhead wires or other obstructions are near the mast. Ensure all antenna cables are free before extending the mast.
- D) Follow all warning labels provided on each platform. Ensure that the mast is properly locked in place after the mast is moved from its horizontal travel position to its vertical position before the winch to extend the mast is utilized.
- E) Ensure the manual winch cables are not frayed nor any obstructions are near the winches that could get tangled in the winch cable during operation.
- F) Keep extremities away from the winch cable during operation and ensure that clothing will not get caught by the winch system.
- G) Operating the system during heavy rain or ice is not recommended. Covering the winch reels during inclement weather or if left outside is also recommended.

- H) The platforms include electrical lights that should be hooked into the towing vehicles towing light plug. Ensure that the systems lights are in working order before towing.
- I) Ensure the safety chains provided are hooked to the bumper of the towing vehicle.
- J) Ground the platform to either an existing roadside grounded feature (sign or guard rail) or ground to a driven ground rod provided with each trailer system. Use the grounding clamp provided with each trailer.
- I) Ensure that the trailer tires are properly inflated and that all items are properly secured on each platform before towing.

IV. ROC COMPONENTS and OPERATION

The ROC platform consists of a 30 foot mast with two directional RF antennas attached, associated cables, an electronics box housing two RF modems, a tool box containing spare parts, battery charger and three deep cycle standard 12 volt marine batteries.

The ROC is the communications center for the system. It communicates via radio waves to each reader platform (Detection and Notification) as well as sending the reader data the to the lap top computer. The Lap Top computer is connected to the ROC via two 100 foot long data quality cables.





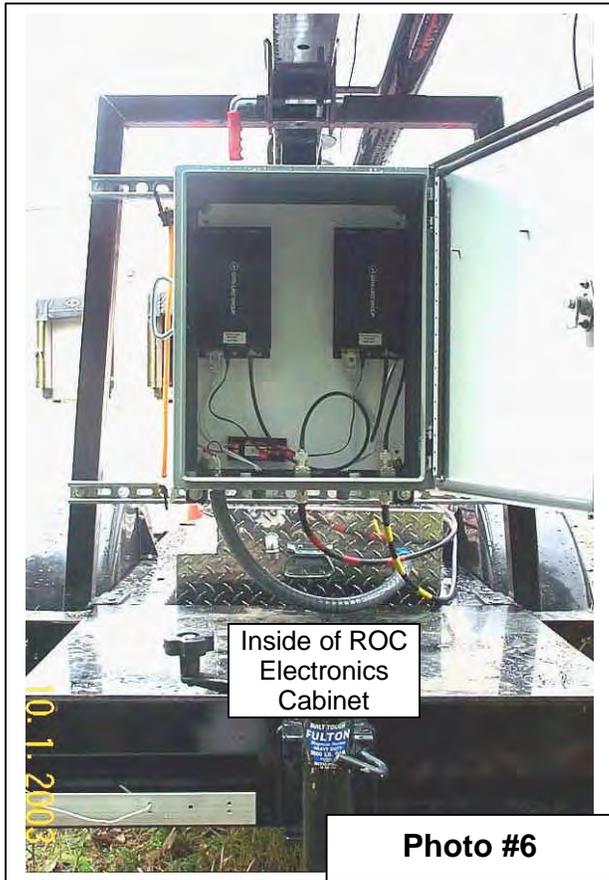
12 Volt Battery
Charger

Photo #4



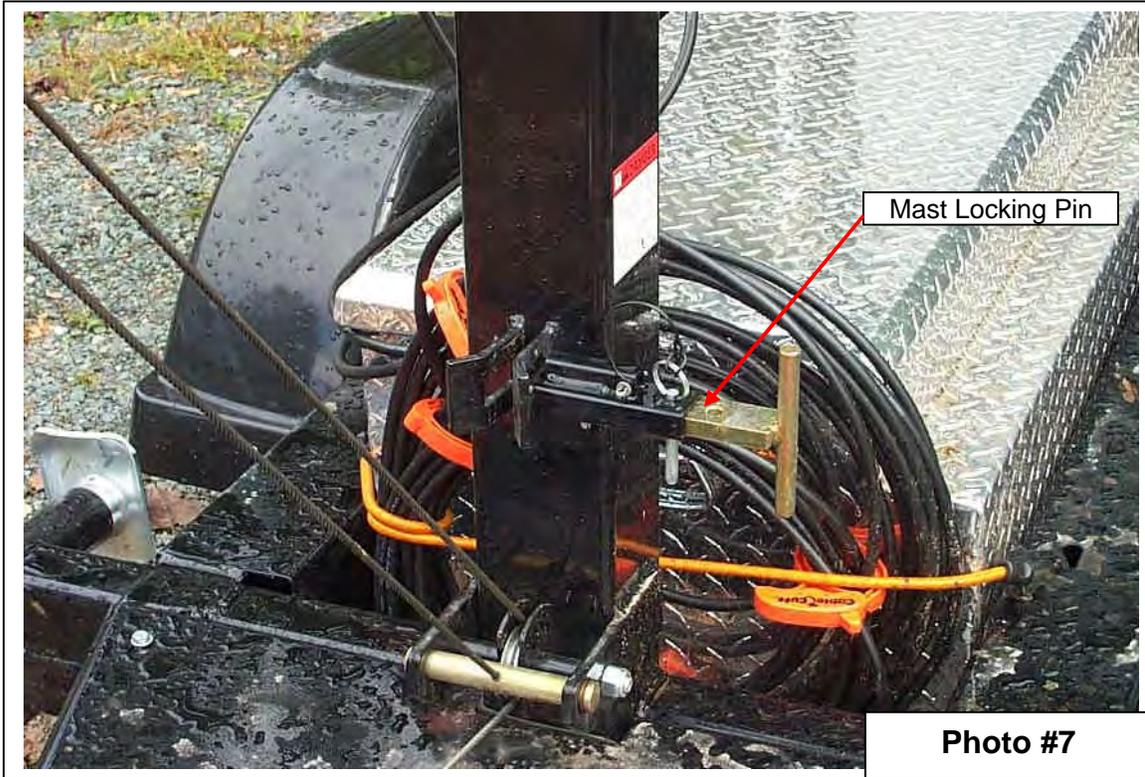
ROC
Electronics
Cabinet

Photo #5



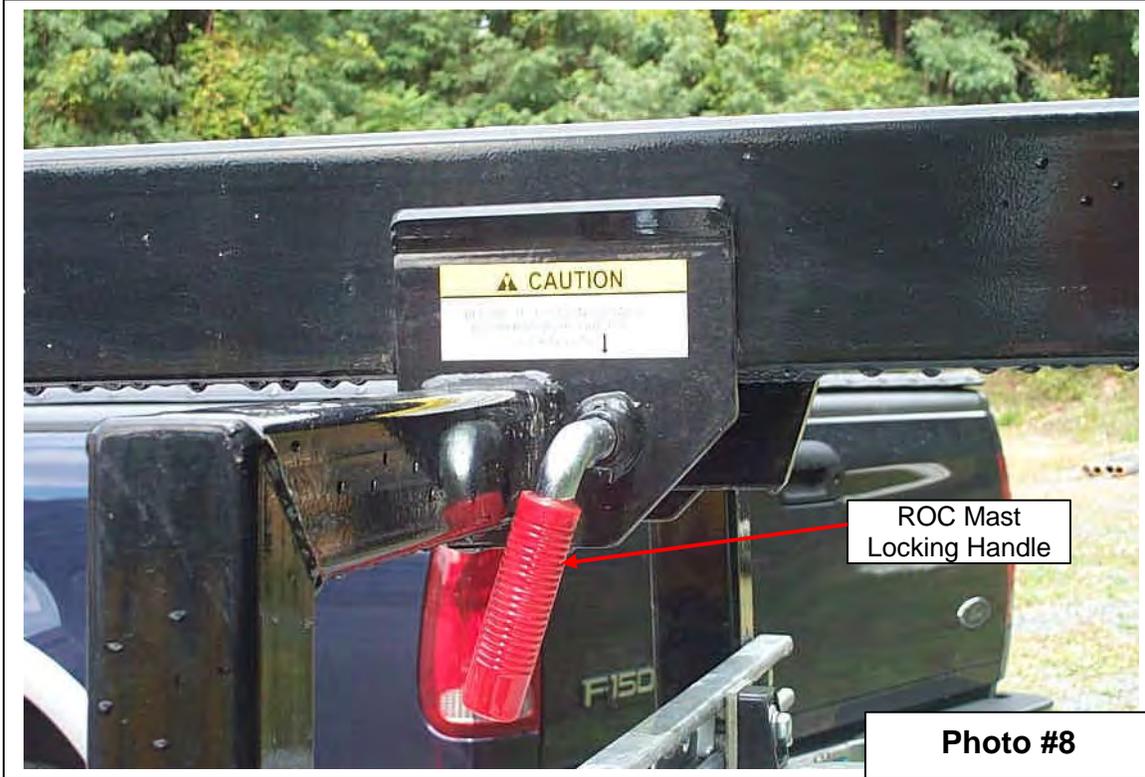
Inside of ROC
Electronics
Cabinet

Photo #6



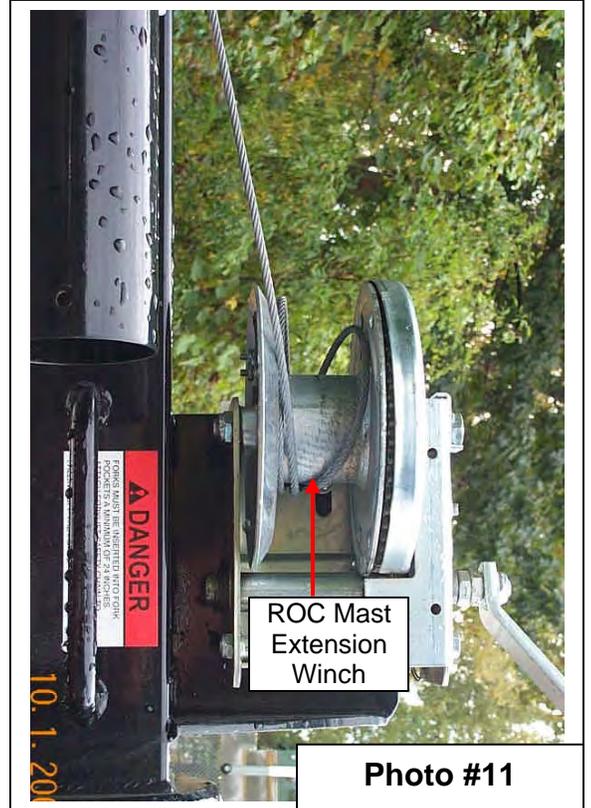
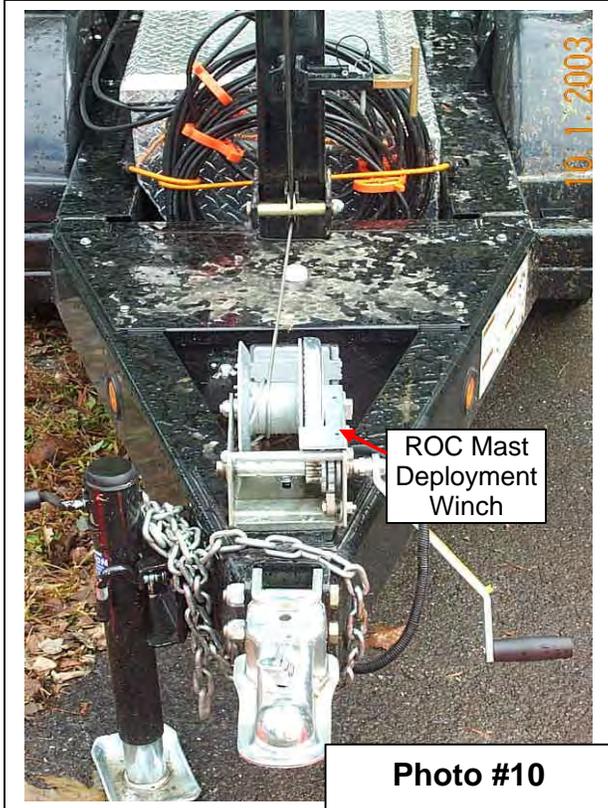
Mast Locking Pin

Photo #7



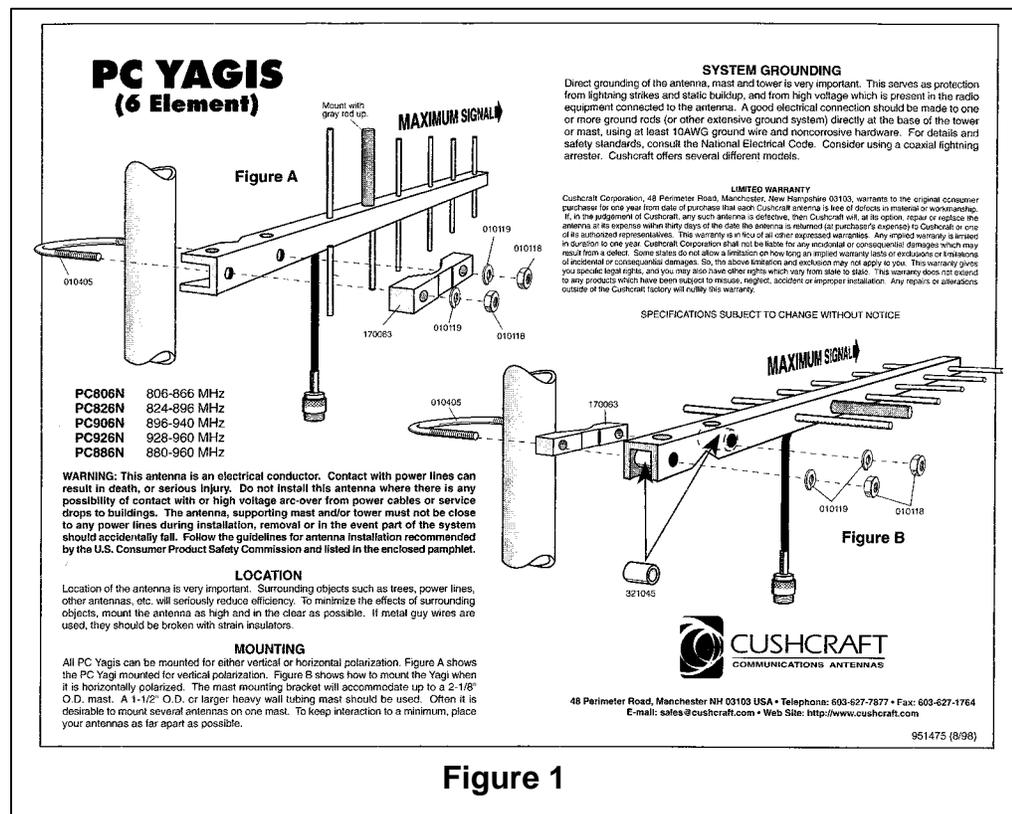
ROC Mast Locking Handle

Photo #8



The following steps should be followed in setting up the ROC system:

1. Select a reasonably flat location with a good line of site to the Detection Reader and Notification Reader. Ensure there are no overhead obstructions at the location selected.
2. Deploy the ROC's outriggers and level the platform using the bubble level on the platform. Use blocking under the outriggers if necessary.
3. Ensure the antenna cables are unobstructed and ready for the deployment of the mast.
4. Ensure antennas are secure on the mast. Ensure the cables are connected to the antennas tightly. The ROC direction Yagi antennas should be separated by at least 3 feet vertically and should be in a vertically polarized position (antenna spines in vertical position with the gray cylinder pointed upward). See Figure A on Figure 1 below.



4. Unlock the mast locking handle (photo #8).

5. Crank the winch located on the tongue until the mast is vertical and lock mast locking pin in position (Photo #7). Extend mast using the winch mounted on the mast until it is extended to the desired height. The winch will lock when the maximum height is reached.
6. Turn the antennas to their desired azimuth by unscrewing the knob (Photo #9) on the mast and turning the antennas to their desired azimuth. Ensure that the antenna cables do not get kinked or twisted when rotating the mast. Tighten the knob when finished.
7. Attach the ROC Electronics cabinet to the unistrut frame using the four mounting screws. This will require two people- one to hold the cabinet and one to mount the screws. Ensure the cabinet is not set down on the connection plugs located on the bottom of the unit.
8. Connect the antenna cables to their proper plugs at the bottom of the cabinet.
9. Connect the data cables to the bottom of the cabinet and then to their proper plugs at the ROC computer.
10. Slip the power plug lead cord through the gray plastic liquid tight tube and connect to the power plug at the bottom of the cabinet. Ensure the red clamp is clamped securely on the positive battery terminal and the black is securely connected to the post of the manual battery switch (Photo #3). Close the switch to connect the power. Check to ensure the modems are receiving power by looking at the led lights at the bottom of each modem. The red and orange led light should light up.

WARNING- Ensure the Power is hooked up properly or damage may occur to the electronics in the ROC Cabinet.

11. **ROC Breakdown-** Follow steps 1-10 in reverse order to breakdown the ROC and prepare for removal from the site. Ensure that that the mast is turned to original position before lowering it into its nested travel position (the winch should be facing directly towards the tongue of the trailer). This should be accomplished before unlocking the mast locking pin and cranking down into its nested position.

Ensure the mast locking handle is engaged before traveling with the platform. Check that all items are securely fastened on the platform and that the antennas are securely mounted to the mast and mounting pipes.

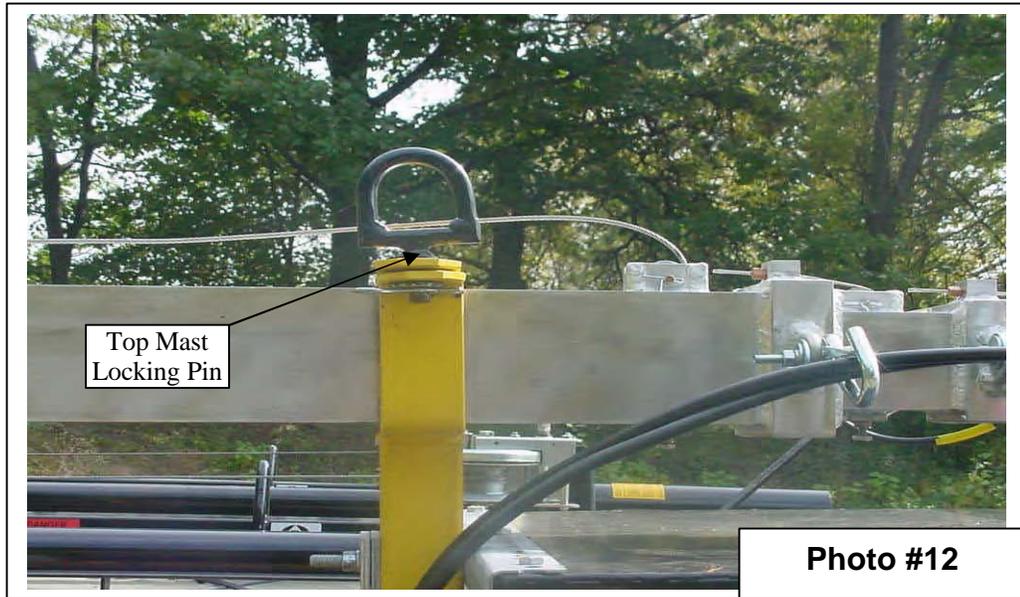
V. DETECTION READER COMPONENTS and OPERATION

The Detection Reader platform consists of a 30 foot mast with one omni-directional communications antenna and one square reader antenna, associated cables, and an electronics box housing the detection reader system. The power supply for this platform consists of one deep cycle marine 12 volt gel cell battery, and one 6 volt battery to supply power for the generator automatic start system. Since the detection reader system requires 120 volt AC power, an inverter is hardwired to the 12 volt battery. The power cable for the reader electronics box is plugged into this inverter. The 12 volt battery system is charged via a high efficiency solar panel. If solar power is not sufficient or unavailable, a gasoline powered back up generator will automatically start and charge the 12 volt battery if the battery reaches a critical low level. Once the battery becomes fully charged, the generator will automatically shut off.

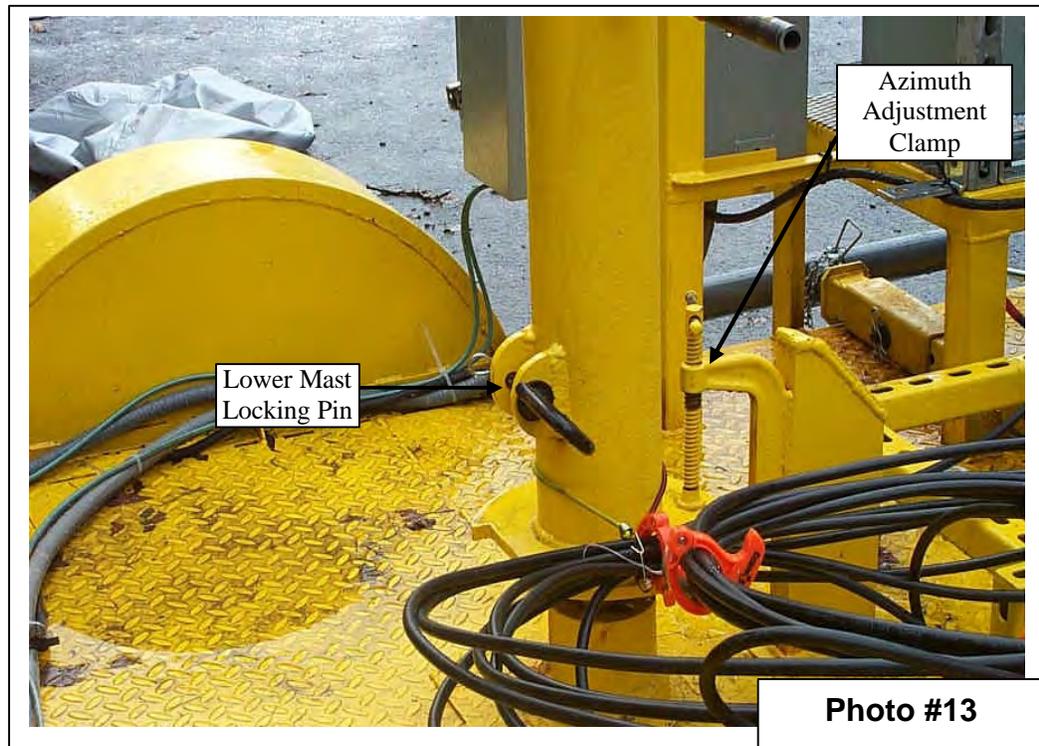
The Detection Reader platform detects commercial vehicle transponder signals via the receive function on the square reader antenna. This signal is processed in the electronics box and sent via a radio modem from the omni directional antenna to the directional antenna on the ROC which downloads the signal via the modem and sends the data over the hard data line into the ROC Lap Top Computer.

The following steps should be followed for setting up the detection reader platform:

1. Select a reasonably flat location with a good line of site to the ROC. The detection reader system should be at least ½ mile from the truck pull off ramp. Ensure there are no overhead obstructions at the location selected.
2. Deploy the detection reader's outriggers and level the platform using the bubble level located on the platform. Use blocking under the outriggers if necessary.
3. Ensure the antenna cables are unobstructed and ready for the deployment of the mast.
4. Ensure antennas are secure on the mast. Ensure the cables are connected to the antennas tightly. Remove the top mast locking pin located near the front of the mast. Push the mast from the back to vertical and lock the mast in this position using the lower locking pin (Photo #13).



5. Remove the internal mast locking pin located through the mast (Photo #14). Extend the mast using the winch mounted on the mast until it is extended to the desired height. Ensure the mast is not elevated past the caution tape on the mast indicating the maximum height has been reached.





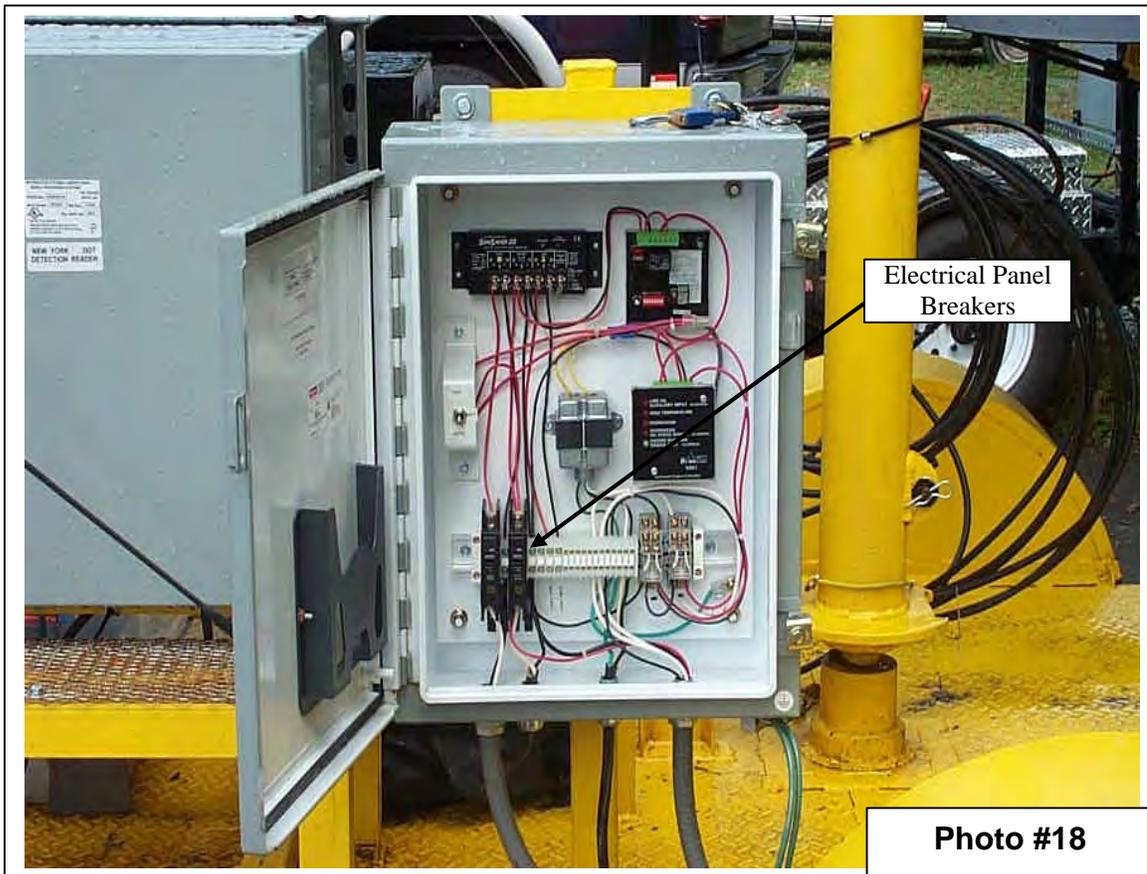
6. Turn the antennas to their desired azimuth by unscrewing the C clamp at the bottom of the mast (Photo #13). Ensure that the antenna cables do not get kinked or twisted when rotating the mast. Tighten the clamp when finished.
7. Attach the detection reader electronics cabinet to the unistrut frame using the top two mounting screws. This will require two people- one to hold the cabinet and one to mount the screws. Ensure the cabinet is not set down on the connection plugs located on the bottom of the unit.
8. Connect the antenna cables to their proper plugs at the bottom of the cabinet.
9. Ensure the solar panel is uncovered and tilted towards the sun or at least horizontal to ground if the sun is at a high angle in the sky. The locking pin and two angle adjustment screws are located under the panel.



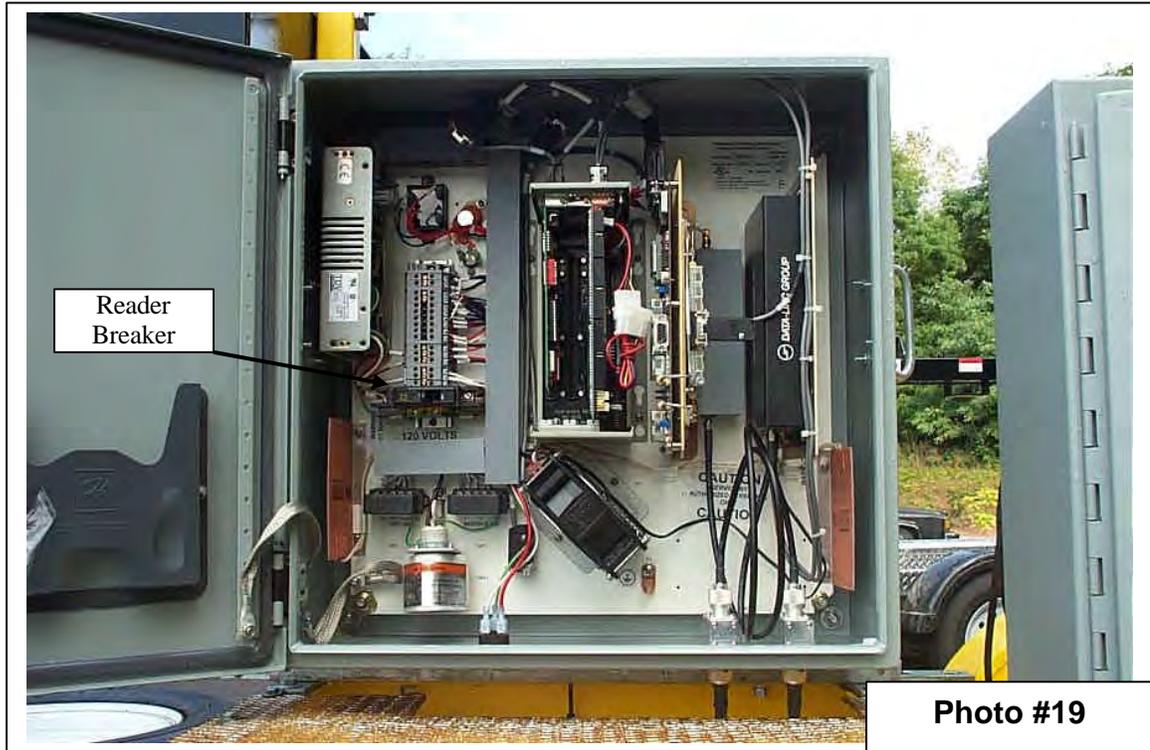
10. Uncover the generator and turn the key to the on position. Do not start the generator. Leave the auto-throttle switch off and ensure the voltage switch is set to 120 volts.



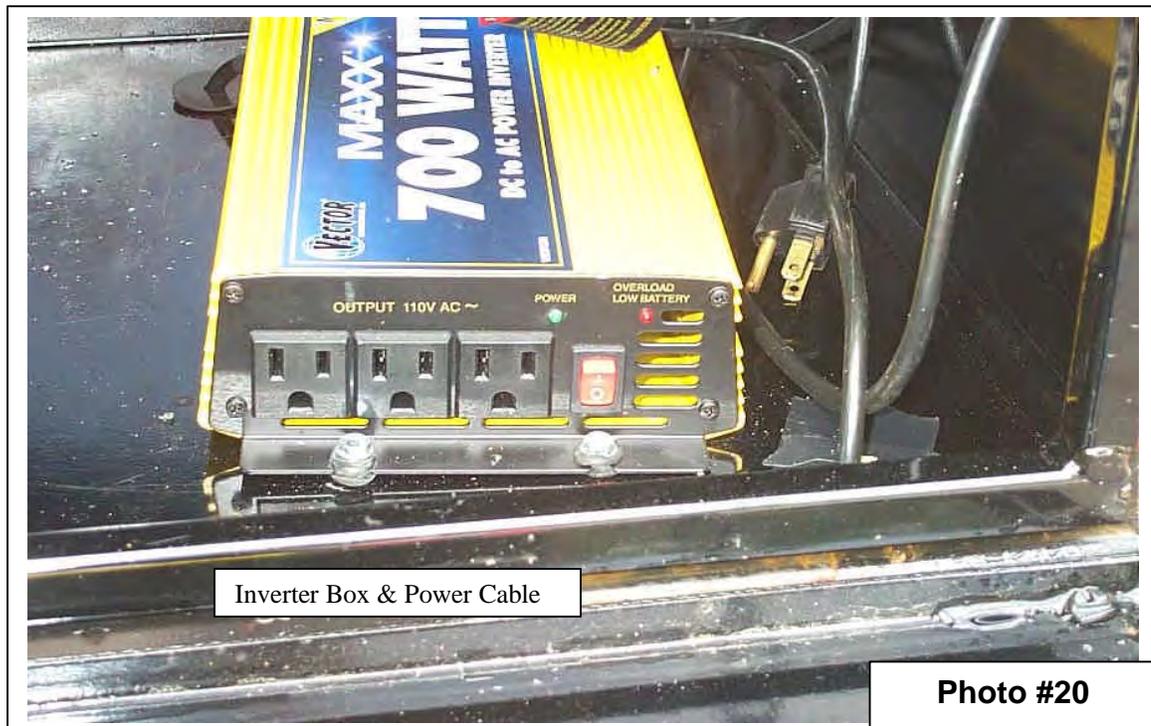
11. Open the electrical panel box and turn both breakers to the on position.



12. Open the reader panel cabinet and turn on the breaker.



13. Plug the power cable into the front of the inverter and the end into the power plug on the bottom of the reader box. Turn the inverter on. Check to see if the reader box powers up.

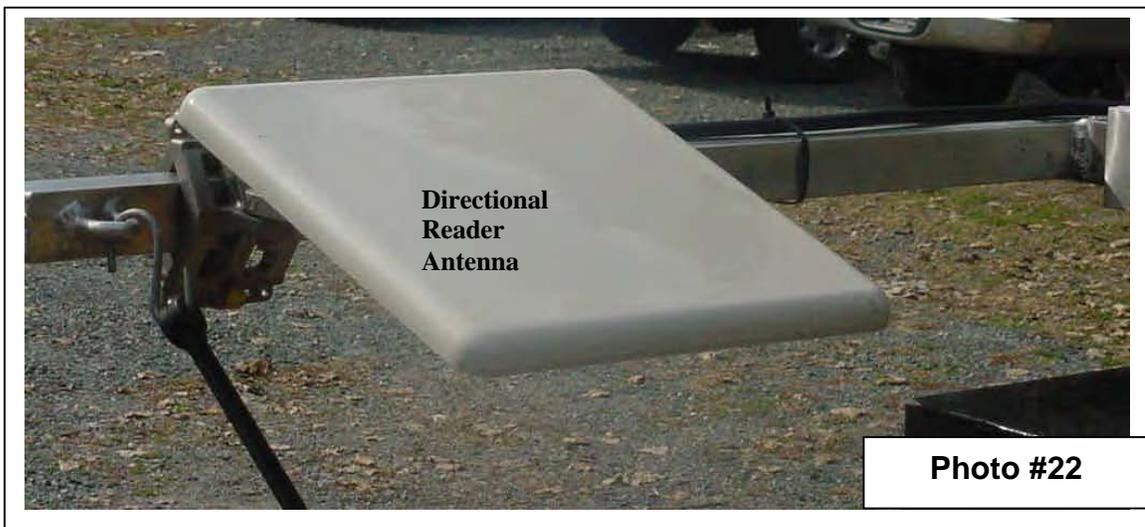
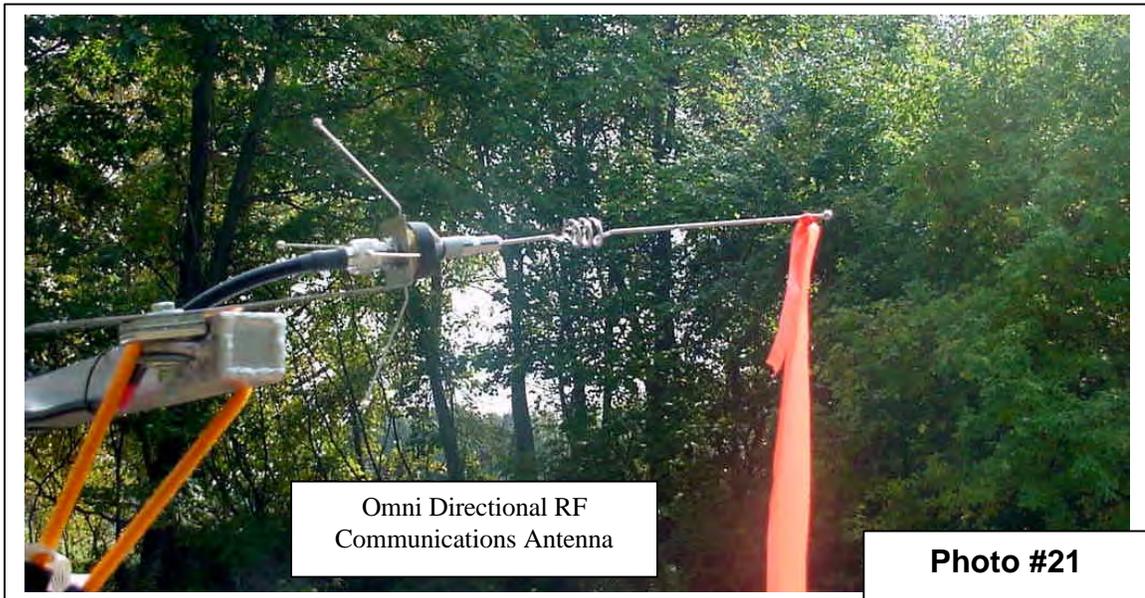


Detection Reader Breakdown- Follow steps 1-13 in reverse order.

Ensure that the mast is turned to its original position before lowering it into the nested travel position.

Ensure the mast locking pin is engaged before traveling with the platform. It may be necessary to loosen the cable to lock down the latch by turning the winch handle.

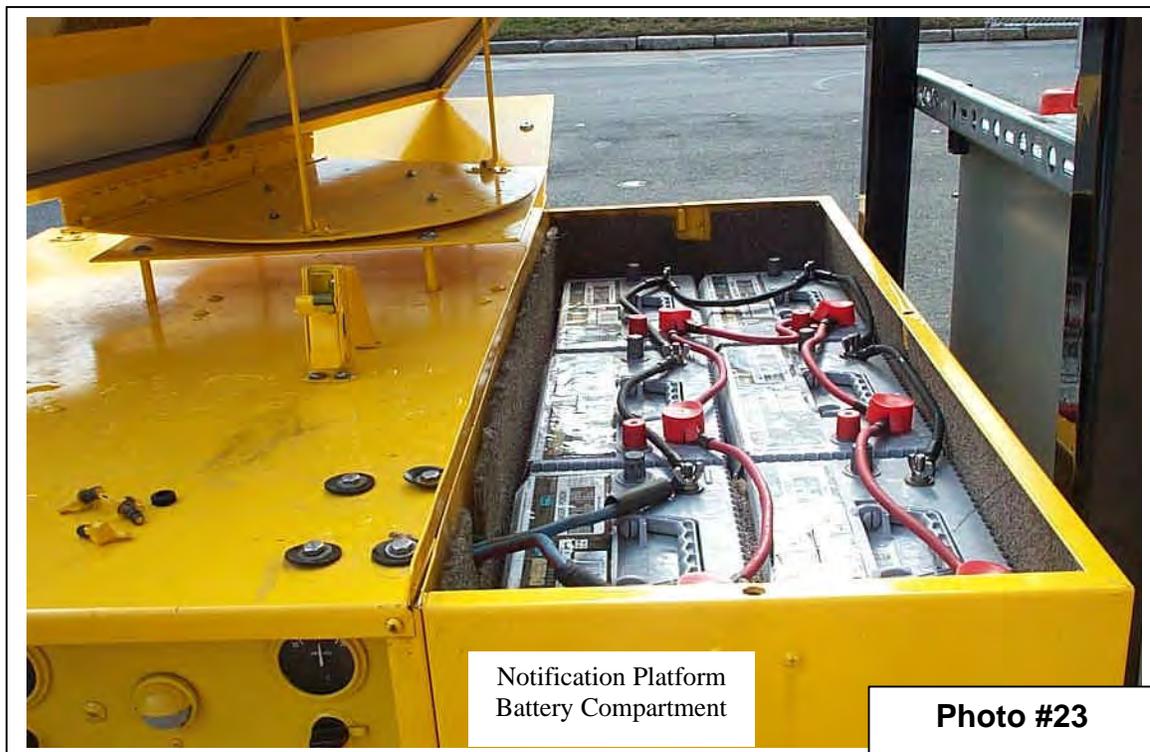
Check that all items are securely fastened on the platform and that the antennas are securely mounted to the mast and mounting pipes.

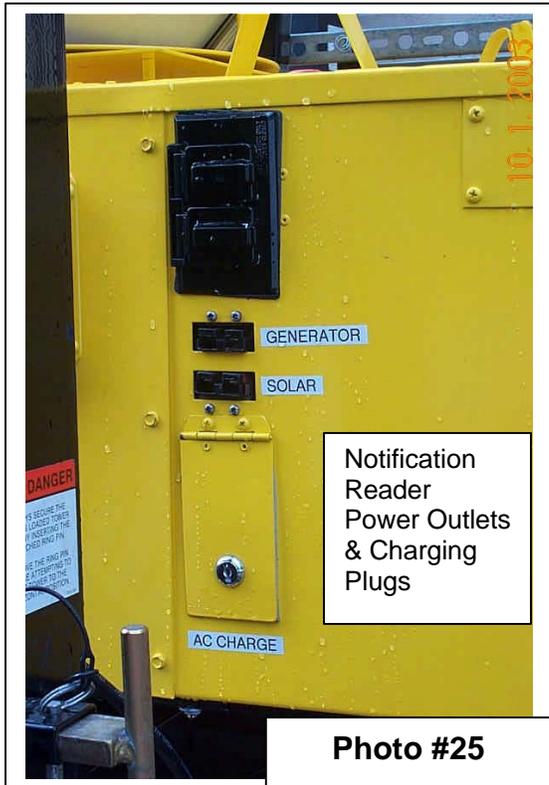
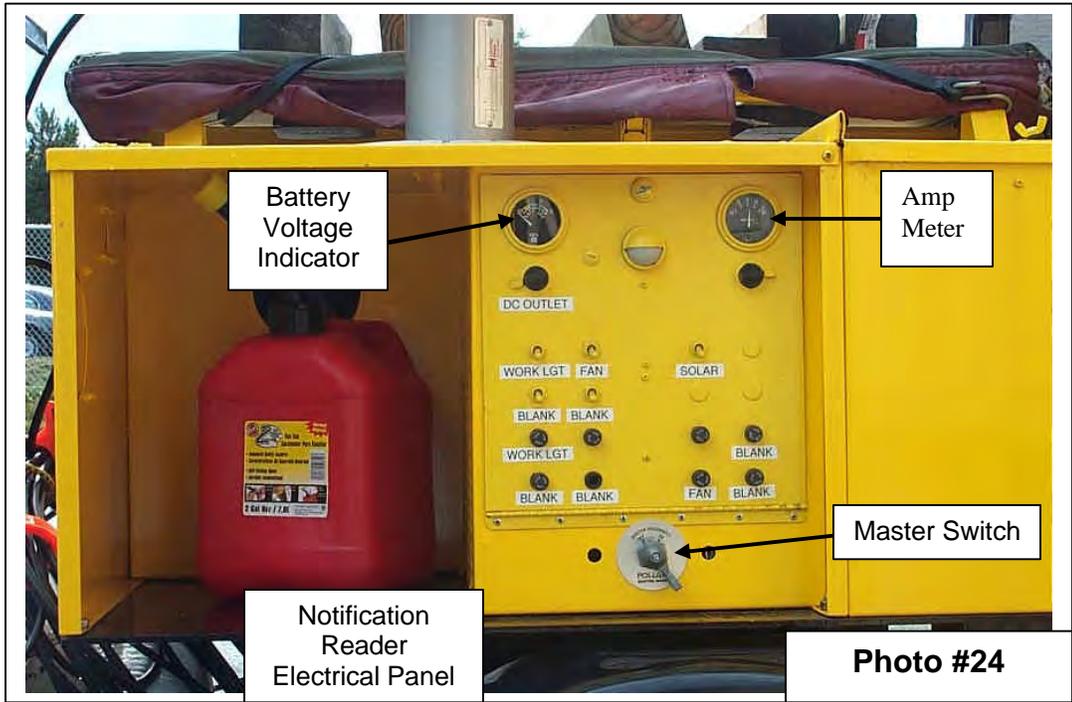


VI. NOTIFICATION READER COMPONENTS and OPERATION

The Notification Reader platform consists of a 30 foot mast with one omni-directional communications antenna and one square reader antenna, associated cables, and an electronics box housing the notification reader system. The power supply for this platform consists of six deep cycle marine 12 volt gel cell batteries. The 12 volt battery system can be manually charged via a high efficiency solar panel. If solar power is not sufficient or unavailable, a gasoline powered back up generator is also provided to charge the 12 volt battery. An AC power plug is also provided to plug the batteries into if AC power is available. The charging is maintained by an automatic battery charge manager and inverter that supplies AC to the two AC outlets. These outlets are used to supply power to the reader cabinet via a removable power cable.

The Notification Reader platform receives its instructions from the ROC and sends a signal directly to the commercial vehicle's transponder via the reader antenna instructing it to either bypass the vehicle inspection station or pull in.





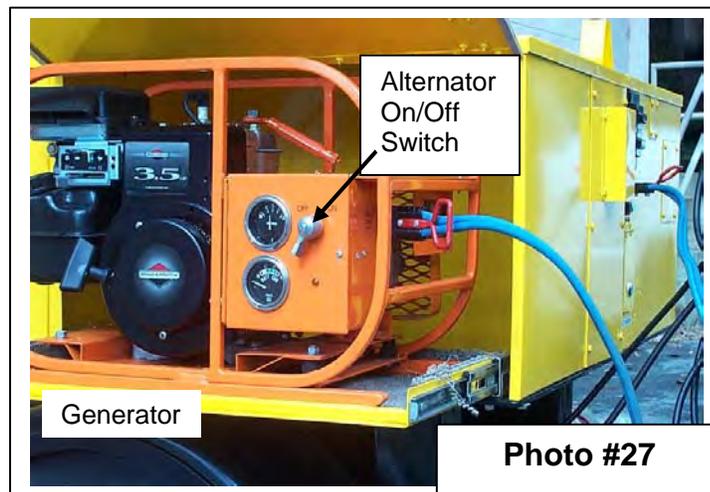
The following steps should be followed in setting up the Notification Reader system:

1. Select a reasonably flat location with a good line of site to the ROC. Ensure there are no overhead obstructions at the location selected.
2. Deploy the outriggers and level the platform using the bubble level on the platform. Use blocking under the outriggers if necessary.
3. Ensure the antenna cables are unobstructed and ready for the deployment of the mast.
4. Ensure antennas are secure on the mast. Ensure the cables are connected to the antennas tightly.
5. Unlock the mast locking handle.
6. Crank the winch located on the tongue until the mast is vertical and lock mast locking pin in position.
7. Extend mast using the winch mounted on the mast until it is extended to the desired height. The winch will lock when the maximum height is reached.
8. Turn the antennas to their desired azimuth by unscrewing the knob on the mast and turning the antennas to their desired azimuth. Ensure that the antenna cables do not get kinked or twisted when rotating the mast. Tighten the knob when finished.
9. Attach the ROC Electronics cabinet to the unistrut frame using the four mounting screws. This will require two people- one to hold the cabinet and one to mount the screws. Ensure the cabinet is not set down on the connection plugs located on the bottom of the unit.
10. Connect the antenna cables to their proper plugs at the bottom of the cabinet.
11. Ensure the solar panel is uncovered and tilted towards the sun. Plug the charging cable into the back of the solar panel and into the solar panel charging outlet (Photo # 26).
12. Open the electrical panel box and turn the master switch on. Turn on the Solar toggle switch. (Photo #25). If this is not turned on the batteries will not charge via the solar panel.
13. Plug the power cable into the AC outlet on the outside of the reader power supply box, run the cable to the reader cabinet and plug into the bottom AC power plug.

14. Open the reader panel cabinet and turn on the breaker. The reader should now have power.

Note: If the power on the voltmeter falls below 12.5 volts during usage and the system is charging via solar power, or the solar is not plugged in due to inadequate solar conditions, then the generator should be used to charge the battery system. This is accomplished by the following steps:

1. Open the side compartment housing the generator.
2. Ensure that the generator has fuel and oil.
3. Start the generator by adjusting the choke to start and pulling on the cord. Adjust the choke and idle to run once it has started.
4. Plug the charging cord into the generators charging outlet and plug the remaining end into the outlet marked generator on the notification reader power supply box.
5. Ensure the solar toggle switch is turned to off.
6. Ensure the master switch is turned on.
7. Turn the switch from the alternator of the generator to the on position. The batteries are now charging from the generator.
8. The generator should be left on until the battery voltage reads 13.5 volts or power to the reader box is no longer required.



The battery bank supplies a total of 3600 DC amps. With moderate solar charging the system should be able to run for 7-10 days without requiring the generator or AC charging.

During long periods of inactivity the batteries should be trickle charged with the AC power plug once every other month. To charge by AC power- plug a short lead cord into an AC power source and plug the lead cord into the cord located behind the access door marked “AC charging.”

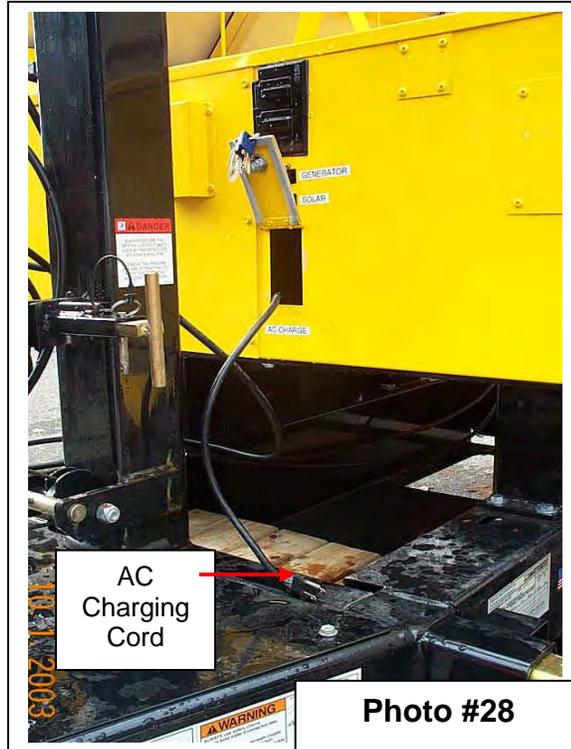


Photo #28

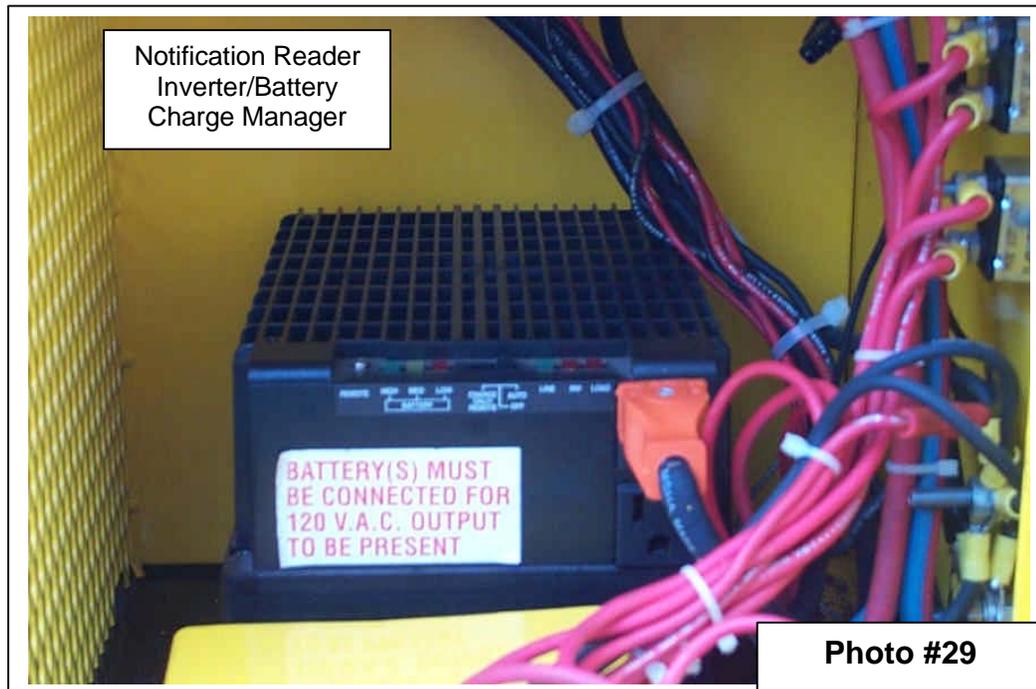
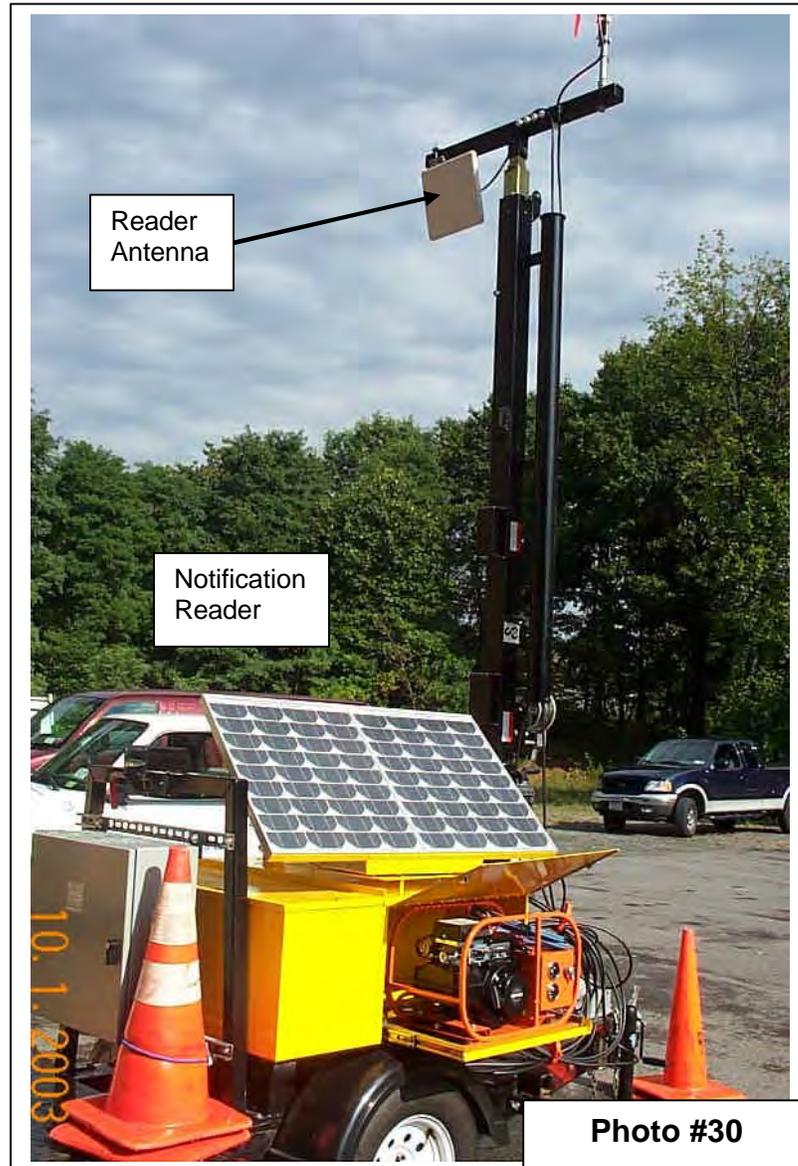


Photo #29



Notification Reader Breakdown- Follow steps 1-14 in reverse order.

Ensure that the mast is turned to original position before lowering it into its nested travel position (the winch should be facing directly towards the tongue of the trailer). This should be accomplished before unlocking the mast locking pin and retracting the mast into its nested position.

Ensure the mast locking handle is engaged before traveling with the platform.

Check that all items are securely fastened on the platform and that the antennas are securely mounted to the mast and mounting pipes

Final Report

Commercial Vehicle Information Exchange Window (CVIEW) Roadside Enforcement/Compliance Project

**NYSERDA Agreement Number (6764C-3)
Comptrollers Contract No. (C012668)
NYSDOT Task Assignment (C-01-66C)
PIN (R020.47.881)**

March 19, 2004

Submitted to:

**New York State Energy Research and Development Authority
And
New York State Department of Transportation**

Submitted by:

**Clough, Harbour & Associates LLP
III Winners Circle, Albany, New York 12205**

PREFACE

The New York State Energy Research and Development Authority (NYSERDA) is a public benefit corporation created in 1975 by the New York State Legislature. For more than a quarter century, NYSERDA has been working on finding innovative solutions to the energy and environmental issues that face residents of the Empire State. As part of that mission, the Authority has sought answers that would benefit not only New York's energy and environmental future, but the economy as well. To do so, NYSERDA has traditionally partnered with other state agencies, as well as industrial, commercial, environmental and economic development groups all across New York State.

In 1999, the New York State Department of Transportation (NYSDOT) had just completed a three-year contractual research relationship with a consortium of seven New York State universities, colleges and research institutions. Based on the success of that experience, the Department sought to establish additional partnering arrangements with research consortia to carry out basic and applied research, technology transfer, and short-term consultation services in the fields of engineering, operations, public transportation, management and finance, public policy, and human resources.

As a complement to a university-based constituency, NYSERDA organized a Transportation Infrastructure Research Consortium comprised of seventeen private-sector research entities. The membership is characterized as businesses, not-for-profits, and professionals that have a track record of performing transportation-related research, development, and demonstration as a normal part of their service-related or internal operations. Many of the organizations also have strong relationships with universities, state agencies and authorities, and federal funding agencies, and are already performing collaborative research through those relationships.

In June of 2001, New York State Comptroller=s Contract C012668 was executed and governs the activities of the NYSERDA-administered Transportation Infrastructure Research Consortium. The term of the agreement is for five years, extending from March 1, 2001 through February 28, 2006. The direct and dynamic linkages between transportation, energy, and the environment have continually reinforced the cooperative relationship formed between NYSDOT and NYSERDA. Since its inception, numerous collaborative efforts have been undertaken and the report that follows is a product of that relationship.

NOTICE

This report was prepared by Clough, Harbour & Associates LLP in the course of performing work contracted for and sponsored by the New York State Energy Research and Development Authority and the New York State Department of Transportation (hereafter the "Sponsors"). The opinions expressed in this report do not necessarily reflect those of the Sponsors or the State of New York, and reference to any specific product, service, process, or method does not constitute an implied or expressed recommendation or endorsement of it. Further, the Sponsors and the State of New York make no warranties or representations, expressed or implied, as to the fitness for particular purpose or merchantability of any product, apparatus, or service, or the usefulness, completeness, or accuracy of any processes, methods, or other information contained, described, disclosed, or referred to in this report. The Sponsors, the State of New York, and the contractor make no representation that the use of any product, apparatus, process, method, or other information will not infringe privately owned rights and will assume no liability for any loss, injury, or damage resulting from, or occurring in connection with, the use of information contained, described, disclosed, or referred to in this report.

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OVERVIEW



Figure 1 – Notification Reader Platform

Beginning in late April 2003 Clough, Harbour & Associates LLP (CHA) began researching methods of developing and deploying a mobile CVIEW Electronic Screening System. We performed extensive research on systems other states have deployed to date, particularly Kentucky's, which developed and deployed a number of screening sites using their own Model MACS software. We contacted vendors of various transponder reader equipment for technical information and pricing. We also held a number of in-depth meetings with members of New York State's CVISN team.

Based on our research we developed a mobile screening system consisting of several components: an Advance Reader, a Notification Reader and a Roadside Operations Computer (ROC) System.

Both the Advance and Notification Readers consist of a trailer with an extendable mast. The reader electronics package is housed in a cabinet mounted to the trailer and is powered by a bank of storage batteries. These batteries are charged via a solar panel, with a gas generator backup. A patch antenna located at the top of the mast communicates with the transponders, and a radio frequency modem provides communications with the ROC. We obtained the readers and communications equipment from the Information Systems Laboratories, Inc. Signal Processing Systems Division (ISL).

The ROC System also consists of a trailer and extendable mast, but supports only communications equipment. Radio frequency (RF) modems are housed in a cabinet mounted to the trailer and are powered by a bank of batteries. Corresponding antennas are mounted to the top of the mast. A pair of 100 foot serial cables connects the radio frequency modems to the ROC through a USB COM port expander. The ROC screens vehicles using Model MACS screening software developed by the State of Kentucky.



Figure 2 – Detection Reader Platform



Figure 3 – Roadside Operation Platform

During the month of September 2003 we assembled the trailer and electronics components. We performed basic and long range testing at our Albany, NY location.

On Monday, September 29th we set up the system at the rest area on I-90 westbound in the Town of Schodack, and began testing and tuning the equipment for optimal performance. On the morning of Tuesday, September 30th we completed the system tuning and began successfully screening vehicles. On the afternoon of the 30th we held an official operational test with representatives from various state and federal agencies. We demonstrated the system at the roadside, with some attendees driving through the system with test transponders. With that day's successful screening we showed that this mobile system is a viable solution for providing electronic screening of commercial vehicles.

OPERATIONAL TEST RESULTS

On Tuesday, September 30th, 2003 Clough, Harbour & Associates LLP (CHA) performed an operational test of the Mobile CVIEW Electronic Screening System developed for the New York State Department of Transportation (NYSDOT) under a contract with the New York State Energy Research and Development Authority (NYSERDA). The purpose of this test was to successfully screen a commercial vehicle as part of a requirement for becoming CVISN Level I compliant.



Figure 4 – Operational Test

During the test we were able to both successfully screen vehicles and demonstrate the system for those in attendance, who included members of the Interagency Motor Carrier Task Force, the Federal Highway Administration, NYSDOT, NYSERDA, and members of CHA's project team.

Since the system was deployed for three days and operational for approximately ten hours, we were not able to capture enough information to gauge true system accuracy or long term performance. However, we were able to show conclusively that screening from the roadside on mobile platforms works, and is a potentially viable solution for deployment.

SYSTEM LIMITATIONS



Figure 5 – Poor Access for Mobile Equipment

During the course of the project and operational test certain limitations became apparent. Despite being a mobile system, it quickly became clear that not every site would be suitable for this system. Since the system must be located off the highway shoulder, access and slope are issues to consider. Long sections of guide rail also prevent easy trailer access. Although the trailers can be leveled on minor slopes, excessive slopes would require potentially significant site work for both a trailer platform and for vehicle access.

Weather conditions can also cause an impact. Snow pack and snow banks from plowing operations can completely limit access for the trailer systems. Setting up or breaking down the system during electrical storms is particularly hazardous, and lightning strikes can result in system damage despite adequate grounding.

The location of the screening site relative to highway entrance and exit ramps is important. For safest operation assuming interstate speeds, a screening site typically requires at least one mile from the first notification signs to the point where the commercial vehicle must pull in. The existence of entrance or exit ramps within this zone results in reduced safety as well as reduced effectiveness of the site due to easy bypass.

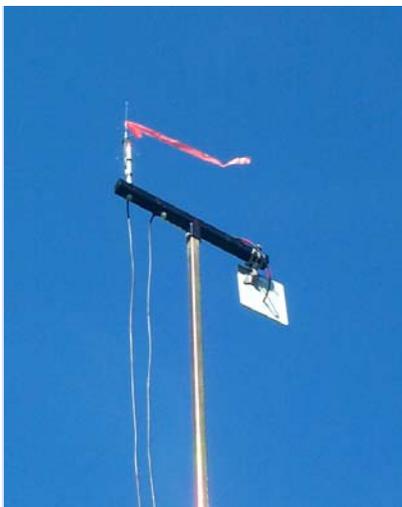


Figure 6 – RF and Transponder Antennas

The system relies on radio frequency (RF) modems and antennas to provide for communication between each unit. While the communication systems performed extremely well in testing, the potential for problems exists at some sites, particularly those with substantial highway curvature where vegetation could block the line-of-sight radio signal. Bridges or other large obstructions could also be problematic. Since the RF modems use the common 900 MHz frequency there is also the possibility of local interference with other devices sharing the same bandwidth. Further testing would be required to determine the practical limitations of the RF equipment, but communications requirements must be considered at each potential deployment site.

Transponder readers and antennas located off the roadside have a longer distance to communicate with the transponders in the vehicles, potentially resulting in decreased accuracy or missed transponders. While our limited field testing produced good results, further testing would be required to determine with confidence the true accuracy of such a system. The roadside location also requires aiming the antenna at a more oblique angle to the roadside. This has the potential to result in signal reflections from roadside signs, signal interference between readers and false reads of transponders in vehicles in the opposite travel lane, all of which we saw to a degree during the operational test.

ASSESSMENT OF SYSTEM COMPONENTS

Mobile Platform

Three mobile platforms for electronic screening were purchased for this project. Each platform consists of three major components, a trailer upon which all equipment is mounted, an extendable mast for communications and Automatic Vehicle Identification (AVI) antennas, and a power supply. For the purposes of comparing hardware and vendor performance, two different platforms were purchased, one from Floatograph Technologies and two from Mobile Equipment International.

Performance

Choosing two different platform vendors allowed for direct system performance comparisons between the low bid vendors that matched the original specifications. Both system platforms performed adequately and each provided a unique solution to the written specifications.

► Floatograph System



Figure 7 – Floatograph Detection Platform

This system is comprised of a single axle, 12-foot long steel trailer platform with a 30-foot telescoping aluminum mast.

The primary power for the on-board RF communications system and the reader system is a manually adjustable solar panel. The solar power charges a 12 volt deep cell battery. A 1500 watt inverter converts the 12 volt DC battery power to AC, with an onboard Honda Generator supplying backup power. An automatic battery charge manager monitors the battery power level. If the battery reaches a user-selectable critical level, the automatic charge manager activates the backup generator which charges the battery system. This occurs automatically with no loss of power to the electronics systems.

The telescoping mast system operates by manually pushing the mast to a vertical position and then extending the mast via a manual hand winch. Due to the lack of RF cable loop guides, additional care is required in deploying the mast system. CHA Tech Services installed temporary cable guides to improve the RF cable deployment. This system performed adequately, however, extending and collapsing the mast system proved cumbersome.

This system did not completely meet the specification to provide AC power to the electronics package and required some retrofitting by CHA Tech Services. We also altered the layout for tool boxes and the electronics cabinet to provide a more user friendly design.

The solar panel attachment and swivel set up is cumbersome and has limited azimuth and elevation adjustments. This requires more careful platform orientation than is desirable.

➔ Mobile Equipment International System - Notification Platform



Figure 8 – Mobile Equipment International System Notification Platform

This system consists of a single axle trailer with a manually deployed telescoping winch mast. A solar panel provides power for the notification platform. Power is stored in six gel-cell deep-cycle 12 volt batteries connected in parallel, and provided to the electronics cabinet through a power inverter. The batteries can be manually charged if necessary using the supplied 3hp generator or via an internal trickle charger powered by standard 120 volt AC power.

The operation of the manually deployed mast system using the two manual winches is smooth and simple. Existing power cables extended through a circular feed-tube attached to the mast were removed, allowing an ideal place to run the RF cables for the systems antennas.

The solar panel mount is a simple, rugged design which allows a full range of motion for orientation to the sun. The supplied generator failed after one use due to a minor structural defect. A replacement part corrected the problem and the generator performed properly after the repair.

The power supply cabinet was oriented so that the batteries faced towards the rear of the platform. This created a slight imbalance of the platform, causing it to tip backward when the electronics cabinet was in place. To correct this we removed, rotated and remounted the power cabinet so the batteries faced forward. We also repaired some minor structural defects in the cabinet doors.

➔ Mobile Equipment International System - ROC Platform



Figure 9 – Mobile International System Platform (ROC)

The ROC platform consists of the same single axle trailer and mast system as the Notification platform. The main difference with this platform is that no AC power supply cabinet is required. In place of the AC power supply system, CHA Tech Services installed a weatherproof equipment and battery compartment. This enclosure stores antennas, RF cables, miscellaneous equipment as well as three 12 volt deep-cycle batteries connected in parallel. The batteries connect directly into the ROC electronics cabinet which contains only RF communications modems requiring 12 volt DC power.

The ROC platform performed as expected and we experienced no problems.

Alternatives

➔ Semi-mobile System Alternative 1

To avoid some of the site limitations such as vehicle access and slope, a hybrid mobile system could be developed. Telescoping masts could be permanently installed at predefined sites. Using this option, only the system electronics (reader, communications antenna, cables, and AVI antenna) would be moved from site to site as needed. In addition to avoiding site limitations, this option would not require the towing of three trailers when each site is set up.

➔ Semi-mobile System Alternative 2

This option is similar to the previous option, but utilizes fixed as opposed to telescoping masts. The mast can be either a monopole or a mast arm structure over the highway travel lane. This option requires the communications and AVI antennas to be permanently mounted and cabled. Only the reader cabinet would be transported from site to site. A breakaway mounted pole at the shoulder of the road similar to those used for roadside call boxes may be a simple and functional design for this alternative.

A key advantage with this method would be that the placement and aiming of the antennas would be fine tuned for the site, requiring no further adjustment.

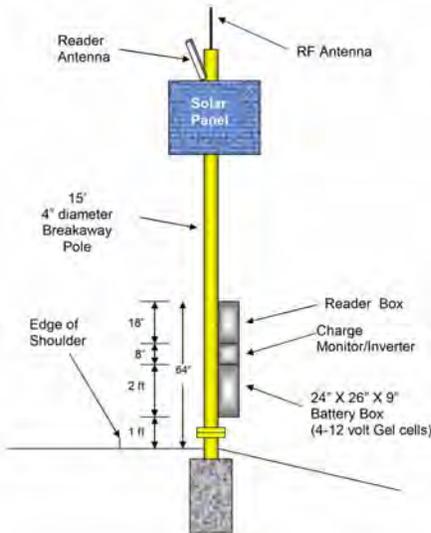


Figure 10 Breakaway Pole Design

➔ Mobile or Semi-mobile System Plus Data Collection

If full time data collection is desired, one permanent reader installation can be constructed, most likely at the detection reader location. This reader would be online at all times collecting data. When screening operations commence, the mobile detection reader and ROC would be deployed.

Suggested Improvements

The two different platform vendors allowed for a comparison of system components. If future mobile platforms are procured, then we recommend developing a composite of these systems, combining the best features of each.

The Mobile Equipment International System trailer and mast system should be used with the power control system similar to that supplied with the Floatograph system. If field testing shows that a generator backup is still necessary, then a more secure mounting system would be required for a gasoline powered generator. A system that automatically turns the generator on and off at certain battery levels would be preferred.

The solar panel mounts need to be modified and improved once a final platform layout is selected. Specific cable types, antennas and connectors can also be optimized for the final platform design.

A clear understanding of how the system will be used will be a great help in determining the improved design. Specifics should be addressed such as how long it is expected to operate continuously, how close it can be to the shoulder, power and redundancy requirements, as well as whether the system will be operated year-round.

A smaller and more efficient power system design can be constructed if the reader system can be redesigned to run on 12 volt DC power instead of 120 Volt AC power. ISL indicated that they can provide their readers with a DC power option if a sufficient market is demonstrated for them.

AVI Hardware & Communications

When researching and asking for bids on AVI transponder readers it became apparent that there was only one vendor, ISL, which was able to meet the key specification of compatibility with Model MACS screening software. The other major vendor of AVI equipment, Mark IV, declined to participate since they would have to redesign their readers and did not feel there was sufficient market justification to do so.

Besides being the only qualified vendor for the readers, ISL was also able to provide integrated Radio Frequency (RF) communications as part of their electronics package.

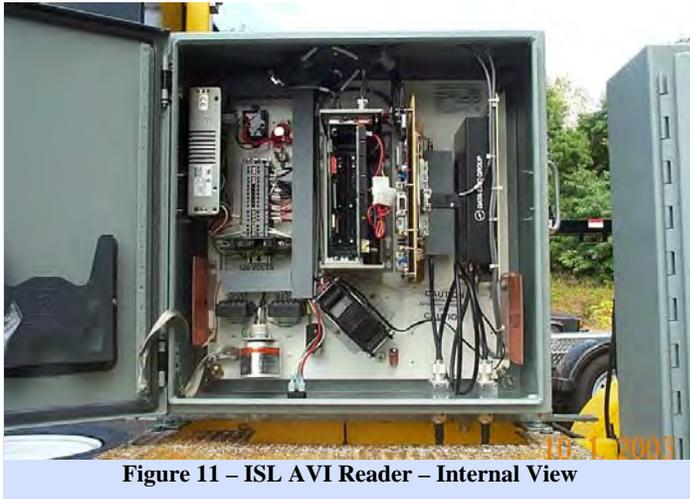


Figure 11 – ISL AVI Reader – Internal View

Performance

The reader units arrived tuned for very short range communications, which is typical in the over-the-travel-lane mast-arm configuration in electronic screening operations. Since we needed considerably more range for our roadside implementation we needed to make adjustments to the system gain.

When deployed for the operational test we noticed that the gain setting was important for optimal accuracy. With the setting too low, transponder detection was intermittent, and antenna aiming needed to be very precise. With the setting adjusted higher, we began noticing the degrading effects apparently from signals reflecting off of signs, interference between the notification and detection readers, and reading transponders in the opposite travel lane.

By the time of the operational test we had the system tuned adequately to achieve reliable readings from our test transponders. The short duration of the operational test, however, prevented us from determining the optimal system tuning, the workable range of system settings or antenna orientation.

We experienced an early problem with a failed power converter on one of the RF modems used for communications, but after replacing the part communications were flawless. We had no trouble communicating between the ROC and the readers at full deployment distances. Aiming of the directional antennas at the ROC was simple and did not require much precision. However, the Schodack site is quite open, and precise antenna placement and aiming may be important under more challenging conditions.

Suggested Improvements

The ISL reader, antenna and communication system was well built and worked reliably in our field tests. The major area of improvement we see with this system is the communication protocol. Currently the readers communicate with the Model MACS screening software via dedicated serial communications (RS232, RS422). This creates a limitation when using RF modems, particularly in areas of poor line of sight. If communication cannot be established between the reader and the ROC, one or more dedicated repeater modems must be used separately for each reader.

Using a TCP/IP (network) protocol instead of serial communications offers two significant advantages. Wireless Ethernet radio modems can serve as both transmitter/receivers as well as repeaters. This can greatly extend the range of communications, particularly for the more distant detection reader, which in turn reduces some of the line of sight limitations that potential screening sites may have, without increasing system costs.

Perhaps the more important advantage using TCP/IP offers is the ability to communicate with the reader remotely for data collection or remote enforcement operations. It also may allow easier integration with other devices such as Weigh-in-Motion (WIM) and license plate recognition systems. Remote communications can be established using wireless networking or hardwired cable, DSL or fiber optic lines if available at the site.

An alternative to real-time data collection would be to have add on storage and software built into the advance reader. Transponder reads would be stored at the reader for later retrieval. ISL has proposed a data collection add-on using compact flash memory cards which can be removed and downloaded manually.

Implementing TCP/IP would require modification not only to the reader systems, but to Model MACS as well.

Model MACS Electronic Screening Software

Model MACS was the software specified for this project. It was developed for the State of Kentucky through the Kentucky Transportation Center and programmed by TRW Inc., now part of Northrop Grumman.

Performance

Model MACS is a straightforward application with a well designed main interface. For general operation it is easy to learn and use, requiring only basic computer skills. Configuration is also

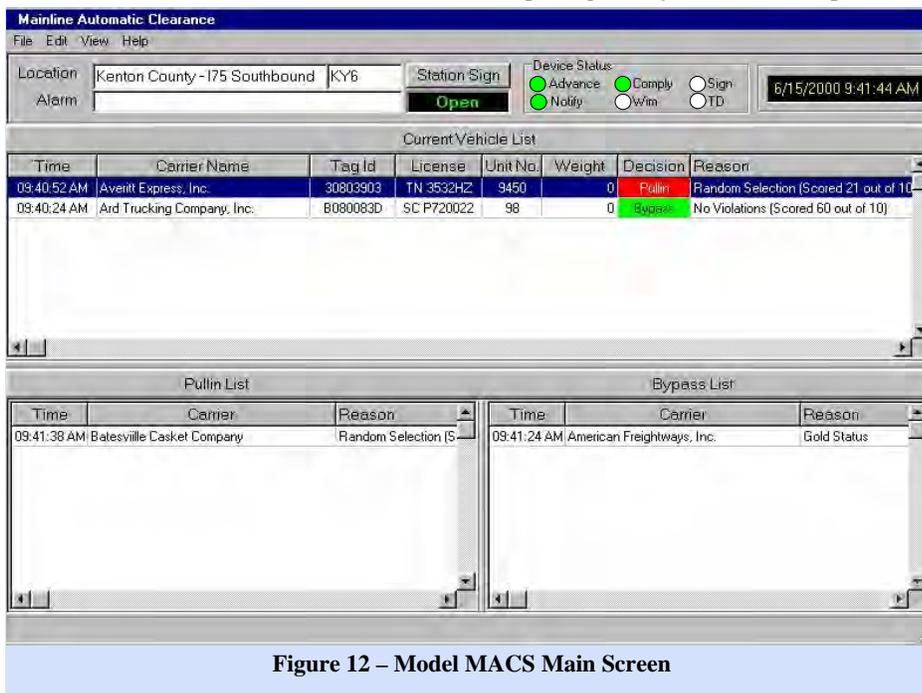


Figure 12 – Model MACS Main Screen

straightforward, requiring only knowledge of which COM port is assigned to a certain device. WIM configuration appears to be more complex, but no WIM was used during the operational test.

Updating enrollment data is automatic and occurs either periodically, or when the application first launches if a new data file is present. Both the period and the “watched” folder are configurable. Load times on large data sets can be significant. Loading the entire NORPASS enrollment file took approximately one half hour.

The program prominently displays the communications status of the various devices, making it easy to determine that the system is operating correctly. In testing we noticed that when Model MACS started up, communications with the detection reader would occasionally time out. Manually resetting the reader restored communications, which from that point stayed online throughout the screening session. It is unclear if this issue is related to Model MACS or the reader.

The main working screen of Model MACS is broken into three primary windows. The top window is the Current Vehicle List. It shows vehicles which have passed the detection reader, but not yet passed the notification reader. It prominently displays the screening decision based on the screening flags and random pull-in percentage using either red or green cell backgrounds. It also displays the reason for the screening decision, carrier name, tag ID, license, unit number and weight (if WIM is installed).

The other two screens are the Pull-in and Bypass lists. Records from the Current Vehicle List get sorted into these lists when the corresponding vehicle passes the notification reader. Vehicles remain in the lists for a configurable period of time as a record of recent screening activity. Double clicking any of the records brings up a detailed information screen for that particular vehicle.

This method of tracking screened vehicles is logical and easy to follow, which is particularly significant during high volume periods.

Recommendations

The current version is apparently not compatible with Windows XP, primarily due to the fact that it utilizes an old version of Borland Interbase as its data platform. As part of this project, NYSDOT staff loaded Model MACS on two laptops, one running Windows XP, the other running Windows 2000. The XP machine had a NYSDOT image loaded on it, which may or may not have contributed to the incompatibility. The 2000 machine had a clean installation of the operating system with no additional software loaded. Model MACS worked well on this machine. We recommend that Model MACS be upgraded to be fully supported on Windows XP.

A significant feature of the screening software is the ability to adjust the random pull-in percentages. However, this feature did not work properly in field testing. Regardless of the setting we entered, the software always used 10%, which is the default out-of-the-box setting. It is possible that this is a symptom of an operating system compatibility with the database in Model MACS, but it needs to be addressed.

Station Log Export to text file function truncates the data, resulting in an incomplete log record. Export options should be broader, and at least include the ability to export comma delimited ASCII text files.

After reviewing the data fields Model MACS supports with members of the Electronic Screening Data Working Group, it became clear that Model MACS would greatly benefit from the addition of at least five custom fields. New York State requires fields such as the Highway Use Tax (HUT) be used as screening flags. We were able to work around this limitation by setting standard Model MACS flags, since if any flag is set a vehicle will be pulled in. Although this works in the field, it is undesirable, as it will be impossible for inspectors to tell exactly why a particular vehicle has been pulled in. Similarly, the screening logs will be inaccurate.

If for some reason communication is lost between Model MACS and one of the screening devices, the program indicates the failure in a device status window. At this point communications will remain offline until the device is manually reset. A more robust option would be for Model MACS to periodically attempt to reestablish communications on its own. This is less of an issue with hard-wired systems, but when using RF modems, temporary communication loss may be more common.

As with the reader systems, using TCP/IP would greatly improve the flexibility of Model MACS. While it would be possible for the readers to use both TCP/IP and serial communications, having Model MACS use TCP/IP offers significant advantages beyond improved RF communications options. For example, it could be run remotely as a real time data collection system even when there is no active inspection taking place.

The Station Log Export should have more export options. Currently only text files are supported, and those are truncated. At the very least the log files should be exported in comma delimited ASCII format to allow them to be imported into a wider variety of software such as other database applications and spreadsheets.

RECOMMENDATIONS

Further Testing Required

Our assessment of the performance of the mobile CVIEW Electronic Screening System outlined in this report is based on a very brief assembly, testing and demonstration period. The total time in active roadside operation was under 10 hours. While we were able to prove that the system works, we do not have enough data to show how well.

We recommend proceeding with a pilot or test phase similar to what was originally proposed as part of this project. Only by operating the system over a longer period will we be able to properly gauge the effectiveness of certain system components, particularly the power systems. Having a Model MACS compatible WIM device installed for the pilot would allow for a complete test of the screening system components.

Even if a decision is made to deploy fixed screening sites in the future, it will still be valuable to further evaluate the accuracy of roadside screening. The ability to utilize a single vertical pole as opposed to a mast arm would reduce equipment and construction costs. This design would also allow for screening multiple lanes using a single antenna, although correlating with multiple-lane WIM devices would not be possible.

A key to successful testing would be to have more commercial carriers enrolled in NORPASS. At the time of the Operational Test on September 30th only 49 New York State registered vehicles were enrolled. While we could open screening to all vehicles enrolled in NORPASS, the information for them may be out of date by as much as 30 days. To improve this, online clearinghouses for the sharing of state-specific enrollment data could be established. Near the end of the Operational Test we loaded the entire NORPASS enrollment file into Model MACS and still saw few enrolled vehicles, although we only screened for a short time.

Lacking a large enrollment in NOPPASS, alternative technologies could be used to screen vehicles. Of those, Licence Plate Reader (LPR) systems hold the most immediate promise. NORPASS transponders are correlated to one specific vehicle with one specific license plate. Since this data is contained in the enrollment database, a system capable of interpreting the characters on a plate could be used to screen commercial vehicles in a similar fashion to DSRC screening. There are some significant differences however. If an LPR cannot distinguish between the states or provinces on the plates, there is a chance that multiple records will match the vehicle in the screening database. LPR systems have a lower accuracy rate compared to DSRC systems, which could also result in false pullins or bypasses.

Another difference with LPR is the notification method. DSRC systems use on-board transponders with lights to notify drivers of their status. LPR systems would have to incorporate signage to alert drivers. These signs will have to be well designed to avoid driver confusion, with the most accurate system possibly requiring a second LPR device. Another method would not use roadside notification at all. All vehicles lacking transponders would exit the highway. Those vehicles having their license plates successfully read and passed the screening could be manually signaled to pass through the inspection site.

Screening software may have to have special handling built in for vehicles with transponders, since two inputs will be made into the screening system; one from the plate, the other from the transponder. It may prove to be acceptable for both systems to operate independently, however. Screening software such as Model MACS would have to be modified to accept a different input source and use a different field (Plate) for the database comparison.

Communications

Electronic screening systems currently developed around the Model MACS software work well but are essentially self-contained. Using serial communications greatly limits their flexibility, not only at a given site, but also as part of a more comprehensive data gathering, safety and enforcement system. Converting to network-based communications using a protocol such as TCP/IP has the potential to remove that limitation.

A reader accessible through a network could become part of an integrated system which could include standard screening operations, remote screening on potential bypass routes, or collection of screening data outside of active inspections. Data comparisons between collection devices that require time matching would benefit from the ability to automatically synchronize system times.

Network communications can be configured in a variety of ways. For example, a screening system can act as a stand alone network, used solely for internal communications. Readers can be connected and

accessed through standard local internet services such as digital cable DSL or high-speed wireless. Other configurations may include tapping into existing fiber-optic networks or state-wide wireless networks. Networked screening systems could potentially work off of a single, centrally stored enrollment database, effectively allowing for real time updates of screening flags. The success of this model would depend on the speed and traffic on the particular network connection used.

DSRC readers, depending on their placement, can also have alternate uses in addition to electronic screening. They can supply data to applications such as wait time detection and reporting at border crossing facilities, or responsive ramp metering in place of traditional loop sensors. These add-on applications may operate simultaneously with active electronic screening operations.

APPENDIX I – RECENT DEVELOPMENTS

Utah Port of Entry Frequency Interference

The State of Utah has been implementing screening systems at its Port of Entry sites. At their Wendover site they have been experiencing interference from nearby military radiolocation stations. Since the military has the preemptive right to use the 915 MHz frequency without interference, Utah has been advised to cease its screening operations at all Ports of Entry pending further direction from the Federal Highway Administration and the Federal Communications Commission (FCC).

The power output of radiolocation systems is substantially greater than the output of DSRC readers. The maximum output of ISL's Link reader is only one watt, as opposed to thousands of watts for aircraft radiolocation. It is highly unlikely that any interference to the radiolocation systems will ever result from such low power DSRC equipment, however, this issue has the potential to alter the process or equipment used in deploying CVISN electronic screening, and should be closely monitored.

5.9 GHz Band Allocated for ITS

On Wednesday, December 17, 2003, the FCC adopted licensing and service rules for the 5.9 GHz Band (5.850-5.925 GHz band) allocated in 1999 for DSRC in the Intelligent Transportation Systems Radio Service. A key provision is that the bandwidth be used primarily for public safety purposes. While this clearly could include CVISN electronic screening, utilizing this frequency would require redesigning and replacing portions of existing screenings systems, as well as the development and distribution of new vehicle transponders.

The advantage of using this frequency would be decreased interference from electronic toll collection systems, cell phones and the many other wireless devices currently sharing the 900 MHz frequency.

The current standard of 915 MHz for ITS DSRC remains in place, but may change as a result of this action.

Task 8 Research Report

Research and Analysis to Provide a Weigh-In-Motion (WIM) Installation for Integration with the Mobile CVIEW Electronic Screening System and Traffic Monitoring Capabilities (Phase II)

Commercial Vehicle Information Exchange Window (CVIEW) Roadside Enforcement/Compliance Project

**NYSERDA Agreement Number (6764C-3)
Comptrollers Contract No. (C012668)
NYSDOT Task Assignment (C-01-66C)
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January 5, 2006

Submitted to:

**New York State Energy Research and Development Authority
and
New York State Department of Transportation**

Submitted by:

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PREFACE

The New York State Energy Research and Development Authority (NYSERDA) is a public benefit corporation created in 1975 by the New York State Legislature. For more than a quarter century, NYSERDA has been working on finding innovative solutions to the energy and environmental issues that face residents of the Empire State. As part of that mission, the Authority has sought answers that would benefit not only New York's energy and environmental future, but the economy as well. To do so, NYSERDA has traditionally partnered with other state agencies, as well as industrial, commercial, environmental and economic development groups all across New York State.

In 1999, the New York State Department of Transportation (NYSDOT) had just completed a three-year contractual research relationship with a consortium of seven New York State universities, colleges and research institutions. Based on the success of that experience, the department sought to establish additional partnering arrangements with research consortia to carry out basic and applied research, technology transfer, and short-term consultation services in the fields of engineering, operations, public transportation, management and finance, public policy, and human resources.

As a complement to a university-based constituency, NYSERDA organized a Transportation Infrastructure Research Consortium comprised of 17 private-sector research entities. The membership is characterized as businesses, not-for-profit organizations, and professionals that have a track record of performing transportation-related research, development, and demonstration as a normal part of their service-related or internal operations. Many of the organizations also have strong relationships with universities, state agencies and authorities, and federal funding agencies, and are already performing collaborative research through those relationships.

In June of 2001, New York State Comptroller=s Contract C012668 was executed and governs the activities of the NYSERDA-administered Transportation Infrastructure Research Consortium. The term of the agreement is five years, extending from March 1, 2001 through February 28, 2006. The direct and dynamic linkages between transportation, energy, and the environment have continually reinforced the cooperative relationship formed between NYSDOT and NYSERDA. Since its inception, numerous collaborative efforts have been undertaken and the report that follows is a product of that relationship.

NOTICE

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Introduction

The purpose of this task is to research Weigh-In-Motion (WIM) devices suitable for meeting New York State Department of Transportation's (NYSDOT's) existing needs for data collection and traffic monitoring, while also being capable of being integrated with the existing mobile commercial vehicle electronic screening system developed in prior phases of this project.

Included is research into wireless communications for electronic screening as well as data retrieval and remote monitoring. Recent advances in both WIM technology and transponder readers will allow for improvement in data storage and retrieval, but the most significant advantages lie in the use of wireless Internet communications as a means for remote access to these devices. The ability to log into a device from any authorized computer or handheld device allows current WIM systems to be used as "Virtual" or unmanned WIMs, and also allows for potential future applications such as server-based screening and real-time data collection.

Site selection is critical to the performance of any WIM system, regardless of the sensor type employed. This report outlines some problems with the Schodack site due to pavement conditions and proximity to a heavily used entrance ramp, but also includes inherent advantages such as good wireless communications and the potential for wired power and Internet access.

Finally, tables are included to indicate approximate costs of hardware, installation and maintenance for the various system components.

Site Selection

There are a number of criteria which affect site selection for WIMs as a part of an electronic screening system. The requirements of the Advance AVI Reader, while more flexible than the WIM, must also be considered, particularly in relation to communications and distance to the Notification Reader and rest area.

AVI Integration

The Advance Reader is typically installed 60 feet to 100 feet downstream of the WIM to allow for roughly simultaneous readings; therefore the location of the WIM is constrained by the operational requirements of the Advance Reader. These requirements are driven by the distance from the Notification Reader and the rest area exit ramp, and in the case of Schodack, good line-of-site for wireless communications to the Roadside Operations Computer (ROC).

Due to straight horizontal alignment and open right-of-way, the Schodack site offers substantial flexibility for the Advance Reader location.

Communications

As discussed in the Communications section of this report, there are three primary modes of operation for the WIM system, requiring two distinct modes of communication: wireless Internet access for data collection and virtual WIM, and radio frequency (RF) serial or network modem for electronic screening.

As in the case for the Advance Reader, communication conditions for electronic screening at the Schodack site are ideal, resulting in a great deal of flexibility. Wireless Internet access is available from multiple carriers on a tower 0.9 miles to the south, with line-of-sight throughout the potential installation range (see Figure 1).



Figure 1 - Wireless Communications Tower from Optimal WIM Location

Horizontal Alignment

American Society for Testing and Materials (ASTM) specifications for all WIM systems require a horizontal alignment having a radius of not less than 5700 feet for 200 feet before the WIM sensors and 100 feet after. The Schodack site meets this requirement throughout its operational range, which is from the end of the Route 9 South entrance ramp acceleration lane to the rest area exit ramp.

Longitudinal Alignment

ASTM specifications for type I (data collection), II (data collection minus wheel load) and III (screening) WIM systems require a longitudinal alignment not exceeding 2% for 200 feet before the WIM sensors and 100 feet after. The Schodack site meets this requirement throughout its operational range.

Cross Slope

ASTM specifications for type I, II and III WIM systems require a cross slope not exceeding 3% for 200 feet before the WIM sensors and 100 feet after. The Schodack site meets this requirement throughout its operational range.

Lane Width

ASTM specifications for all WIM systems require a lane width of 12 to 14 feet. The Schodack site meets this requirement throughout its operational range.

Surface Smoothness & Sub-surface Conditions

ASTM standards contain a very stringent requirement for surface smoothness for 200 feet before the WIM sensors and 100 feet after. A 6 inch diameter, 0.125 inch thick plate cannot pass under a 20 foot straight edge along a number of positions, as indicated in the standard. This requirement is designed to produce the most accurate results by avoiding unbalanced tire and axle loads, but is generally seen as unworkable in northern states due to excessive freeze/thaw conditions. ASTM suggests 300 feet of rigid (cement concrete), either continuous or with 20 foot transverse joints.

Based on visual inspection, conditions at Schodack clearly do not meet ASTM standards throughout the operational range. Severe cracking and depressions exist in the asphalt at each apparent transverse joint in the underlying concrete, indicating sub-surface structural problems (figures 2 and 3).



Figure 2 - Transverse Joint Cracking & Subsidence



Figure 3 - Transverse Joint Cracking

Also present throughout the operational range are wheel ruts, which are significant in both travel lanes. Wheel ruts are a particularly significant problem when installing a flat structure such as a WIM sensor.



Figure 4 - Wheel Ruts

Acceleration

Acceleration and deceleration can significantly impact weight distribution among the axels and wheels, greatly decreasing the accuracy of WIM systems. Therefore, areas prone to rapid acceleration or deceleration (such as interchanges, toll barriers, etc.) are poor locations for Type III WIM systems.

The Schodack site is located close to both an interchange and a toll barrier (see Schodack Site Diagram below). The Route 9 North entrance ramp to I-90 and the toll barrier are each sufficiently distant from the site to allow a majority of commercial vehicle traffic from those locations to achieve highway speed prior to reaching the optimal WIM location.

The Route 9 South entrance ramp to I-90, however, is problematic. Since its acceleration lane ends just under ½ mile from the next rest area, relocating the WIM to avoid the effects of acceleration from this entrance is not possible. This ramp also experiences a high volume of commercial vehicle traffic traveling to a regional grocery chain's major distribution center, thus compounding the problematic impact of this location.

Appropriate signage urging vehicles to maintain speed may possibly mitigate some of the acceleration effect, but may also cause increased traffic safety concerns due to merging. ASTM considers acceleration of more than 2 ft/s^2 a violation. This is the standard value programmed into WIM systems, although it can be overridden with a different value if desired.

Additional acceleration may be caused by the increase in speed limit to 65 mph just 0.12 miles past the optimal WIM location. Drivers will likely begin to accelerate when they see this sign, which will be almost directly at the WIM location. This could be mitigated simply by relocating the speed limit increase sign, ideally past the rest area.



Figure 5 - Speed Limit Increase

Recommendations

Although this study has shown some significant issues with selecting the I-90 westbound Schodack rest area as a WIM site, alternate sites have been found deficient for other reasons during earlier phases of this project. If the location, which is convenient to NYSDOT offices on Wolf Road in Albany, is still desired as a test site, we have the following recommendations:

1. Conduct a site visit with the WIM vendor who is awarded the winning bid in Task 11 of this project to assess the impact of the site and pavement conditions; have them indicate the conditions' impact on system performance; and have them recommend potential mitigation or corrections which may improve performance without requiring a major investment of resources. Current site conditions appear to limit the option of sensors to Quartz-Piezo technology. These sensors can be ground to conform to pavement irregularities, but are rated ASTM Type I (Gross Vehicle Weight: +/- 10% @ 2s).
2. Determine whether the section of I-90 under consideration is programmed for surface improvements in the near future. If so, integrate improvements based on ASTM specifications for pavement structure into the program for the 300 foot WIM location. This may require reinstalling the WIM sensor.
3. If no improvements are planned, it may be desirable to further investigate the cost of roadway improvements solely in the 300 foot WIM location.

Despite the issues mentioned, Schodack does have good geometry, excellent wireless communication options and relatively close access to power and broadband cable. Based on the location factors above, the prime location for the WIM and Advance Reader is near milepost 19.1, from N1334773, E712404 to N 1335059, E 712316 (NY State Plane NAD83 Feet).



Schodack Site Diagram

Standards Compatibility

All vendors contacted indicated that they can meet, and actually exceed, current NYSDOT equipment standards and specifications. The vendors indicate that their systems are flexible and can be upgraded easily to support multiple output formats such as the Advantage 75 protocol used by Model MACS.

Compliance with the draft Traffic Management Systems Standardization Plan is assumed based on its heavy reliance on the National Transportation Communications for ITS Protocol (NTCIP), though specific mention of WIM or electronic screening is absent.

Other States' Real World Experiences with WIM Technology

Methodology

We created a list of standard questions to ask contacts regarding their WIM installations. Due to the electronic screening system being the focus of this project, we focused our questions on experiences related to using WIMs for screening, and aimed our contact efforts at states with known programs.

We recorded the manufacturer of the equipment, the sensor type, and the configuration(s) they were used in. We questioned contacts on communications, screening software, data collection and retrieval, maintenance programs and associated costs, and plans for system expansion. We also asked them to rate their equipment on reliability, accuracy, equipment cost, installation cost, and maintenance cost.

Results

Our nine successful contacts yielded results that are best summarized as “all across the board.” With the exception of International Road Dynamics, Inc. (IRD) being the most utilized equipment manufacturer, each category yielded a range of results. For example, maintenance programs ranged from “only when needed” to fixed-interval detailed programs and vendor supplied maintenance contracts. Responses for ramp sorting only were analyzed separately from others since they operate at low speeds. For instance, Metler/Toledo does not manufacture high speed WIM sensors.

Communications options for data collection varied as well. Where data was collected, methods included manual retrieval via floppy disk, dial-in phone connection, fiber optic network connections and wireless networking.

None of our contacted states or provinces uses Model MACS as screening software. The most common were Help/Prepass and IRD. Indiana and Washington use programs developed specifically for their states.

When asked about future development plans, Kistler or quartz-piezo installations came up most often. Notably, Purdue University is currently interested in performing a study at one site

comparing four different sensor technologies. The results of this study if initiated should be closely monitored for future equipment decisions.

Our WIM ratings (see WIM rating comparison Chart below) did not reveal any significant advantages of one technology over another, though there were a few standouts. The Province of Alberta has had bad experiences with IRD bending plates, rating them 0 for reliability and 3 for accuracy on a scale of 1 to 10. They have plans for installing 14 new sites, but will be using load cell technology instead.

Another standout was the State of Montana, which was the only respondent using Electronique Controle Mesure (ECM) with Kistler sensors. They had the best reliability-accuracy per cost ratio of any other equipment combination. They also use bending plate technology which scored slightly lower for reliability and accuracy, though much higher for costs. Montana is expanding their system with 3 ECM/Kistler installations.

Please refer to Appendix I for detailed contact logs.

WIM Rating Comparison Chart

	Captain Guy Boruff Indiana State Police (317) 615-7401			Captain Ron Cordova New Mexico Department of Public Safety, Motor Transportation Division (505) 827-0302		Dennis Hult Montana Department of Transportation (406) 444-9237			Craig Wilson Florida Department of Transportation (850) 245-7932	
WIM Brand/Type	Toledo/Load Cell	IRD/Load Cell	IRD/Piezoelectric	IRD/Bending Plate	Piezoelectric/Quartz Piezo	ECM/Kistler	PAT/Bending Plate	IRD/Recorder PAT Plates	Metler Toledo/Bending Plate	IRD/Single load cell
Reliability	10	9	7	7	7	9	8	8	9	7
Accuracy	10	6*	10	9	7	9	8	8	9	7
Equipment cost	3.5	10	10	10	6	2	7	6	N/A	N/A
Installation cost	4	10	10	10	6	2	7	7	N/A	N/A
Maintenance cost	2	3	5	6	6	2	4	6	1	1
Use	Ramp Sorting	Single & Multi Lane Screening	Single & Multi Lane Screening	Ramp Sorting, Single Lane Screening	Ramp Sorting, Single Lane Screening	Multi Lane Screening	Multi Lane Screening	Multi Lane Screening	Ramp Sorting	Ramp Sorting
		* Low score based on poor pavement conditions								

	Mike Akridge Florida Dept. of Transportation (850) 410-5607		Steve Calahan Commercial Vehicle Enforcement Province of Alberta (403) 340-5225	C.T. Wicker Virginia Department of Motor Vehicles (804) 367-7031		Debbie Bax Missouri State Highway Patrol (573) 526-6261		Jim Stuart Washington Department of Transportation (360) 705-7987	
WIM Brand/Type	Metler Toledo/Bending Plate	IRD/Single load cell	IRD/Bending Plate	IRD/BP	IRD/SLC	Cardinal/Peizoelectric	Cardinal/Load cell	Piezoelectric IRD	Single load cell IRD
Reliability	10	10	0	8	9	8	6	8	9
Accuracy	10	10	3	7	8	7	7	8	9
Equipment cost	N/A	N/A	5	6	6	6	6	9	9
Installation cost	N/A	N/A	5	5	5	7	6	8	8
Maintenance cost	N/A	N/A	6	5	5	5	5	8	8
Use	Ramp Sorting	Ramp Sorting	Ramp Sorting, Single Lane Screening	Ramp Sorting, Single Lane Screening	Ramp Sorting, Single Lane Screening	Ramp Sorting	Ramp Sorting	Single & Multi Lane Screening	Single & Multi Lane Screening

Next Generation Transponder Reader

Telematics Wireless FP-300ASL

The dedicated short-range communications (DSRC) reader market is broken into two primary segments: electronic toll collection, and ITS applications such as electronic screening. Manufacturers of toll collection systems work with currently proprietary protocols which are not available for use in electronic screening applications.

There are only two known vendors supplying the small but growing market for Commercial Vehicle Information Systems and Networks (CVISN) compatible DSRC readers, Information Systems Laboratories (ISL) and Telematics Wireless. ISL readers are currently being used in the mobile screening system developed earlier in this project. They weigh 70 pounds, measure 18"x20"x9", require heating in cold weather, and consume large amounts of power. They have no data collection capability, or remote monitoring ability. They are difficult to adjust and tune, requiring unmarked turns of tiny set screws to adjust power and range. For years these readers have been the standard in electronic screening systems, but there were no alternatives. ISL has expressed interest in developing a new generation reader with a smaller form factor, but has not released a new product to date.

Telematics Wireless is an Israeli company actively developing a line of DSRC readers, both traditional and handheld, as well as transponders and cargo seals. Their readers use modern electronics, resulting in sufficiently low power consumption to allow for continuous operation (including wireless communications) using solar power with only four hours of sunlight a week (manufacturer's claim). They have an operating range of -40°F to 185°F. The solar ready weatherproof model (FP-300ASL) is 14.2"x 9.4"x 4.7", making it ideal for both mobile units and areas lacking ready access to power.

Telematics readers are compatible with the Advantage 75 protocol used by Model MACS, and are being deployed with WIM systems by vendors such as Cardinal and IRD. The FP-300ASL is designed for wireless networking and includes a General Packet Radio Service (GPRS) cellular modem for remote access to stored data. It has a memory capacity capable of storing up to 2 million vehicle records. Data is retrieved remotely via the Internet and can be updated automatically or manually with supplied software. Automatic retrieval may require server software and vendor provided protocol customization.

The FP-300ASL has extremely low maintenance requirements, and automatically tunes itself based on weather conditions, requiring no routine user calibration. For screening, integration with the WIM occurs in the screening software based on the arrival of the signal. For data collection and analysis, each data record has a timestamp of 0.1 seconds, allowing it to be correlated with similarly time stamped data for the WIM. The reader's internal clock is synchronized via the wireless Internet connection.

FP-300ASL ASTM v6 Solar Reader



The Telematics Wireless FP-300ASL is a compact-size, solar-powered, standalone, weatherproof ASTM v6 TDMA Reader.

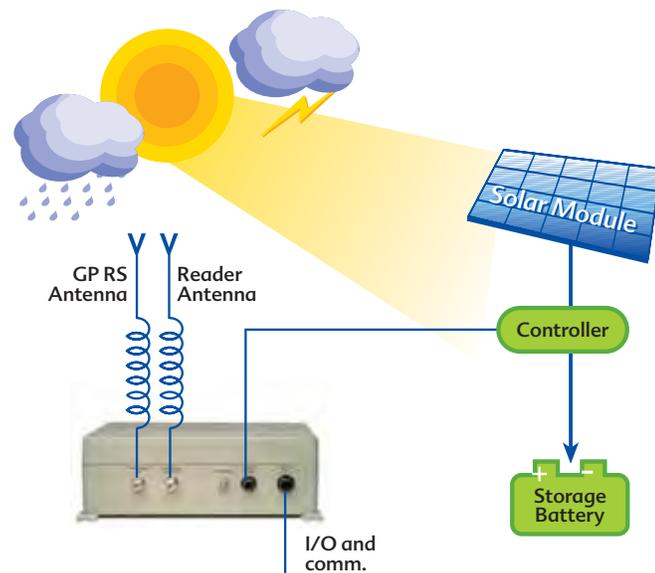
Based on the field-proven Telematics Wireless FP-100RA Reader, the FP-300ASL is contained within a rugged, lightning-protected, all-weather enclosure. Its power consumption is a low 4.5W for continuous operation including wireless communication.

With a standard 50W solar panel, the FP-300ASL can operate for a full 10 days on only 4 hours of sunshine.

The FP-300ASL's standalone feature makes it the ideal solution for line-power independent RF applications. With its wireless modem add-on, it is the ultimate solution for remote, out-of-the-way stations.

Architecture

The FP-300ASL Reader is based on Telematics Wireless FP-100RA and FP-300RA Readers.



This architecture enables the flexibility and programmability of the reader for future applications and customer-specific requirements.

FP-300ASL **ASTM v6** **Solar Reader**



Solar Reader Features

- Slotted Aloha protocol – compatible with ASTM v6
- Physical Layer compatible with ASTM PS111-98
- Transmit & Receive frequencies within the ISM band 902–928 MHz
- Transmit and Receive data rate of 500 Kb/sec
- Connection to external devices via RS-232 (option)
- 2 inputs (open circuit/GND) and 2 outputs with maximum sink current capability of 200 mA @ 24VDC
- Size: 360x240x120 (LxWxD) mm
- Easy mounting
- Full performance under all weather conditions
- Operating temperature: -40°C to +85°C (-40°F to +185°F)
- Lightning Protection:
 - antenna(s): max surge: 20kA IEC 6100-4-5 8/20 μ S waveform
 - I/Os: max surge: 100A Bellcore 1089 10/100 μ S waveform

Applications

- ITS applications at remote sites where no line-power is readily available
- Mobile (virtual) re-locatable Weigh-station bypass sites
- Portable, easily re-assignable Traffic Management data sites
- Interim and trial Toll collection locations
- Access control to temporarily restricted areas, urban centers
- Variably locatable Border crossing sites
- Quick setup security monitoring of CVO trailers/containers
- Road-construction dependent CVO traffic monitoring
- Quick setup HAZMAT monitoring at strategic sites



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Mobile CVIEW Modifications to Support Multi-lane WIM

There are two primary modifications to the existing mobile electronic screening system to support multi-lane WIM. First, the WIM requires a permanent installation, which also fixes the location of the Advance Reader. An additional communications channel is required to send the WIM signal to Model MACS, but this is simply accomplished by adding an additional set of RF modems to the system. There are two options for integrating the Advance Reader:

Option 1 - WIM Installation with Mobile AVI

This option assumes a permanent two lane WIM installation, integrating the existing mobile Advance Reader. The WIM is a permanent data collection station, but when an inspection is active the Advance Reader is towed into place and the RF modems are turned on.

However, this will allow for single lane screening only since there is no way for one reader antenna to distinguish which lane the transponder signal has originated from. It is technically possible to locate another reader on the median, but due to the angle and distance from the travel lane the active ranges of the two readers may easily overlap, causing erroneous readings. Since these ranges vary with temperature, weather, solar conditions, and antenna aiming precision it is impractical, if even possible, to properly tune the readers in this configuration.

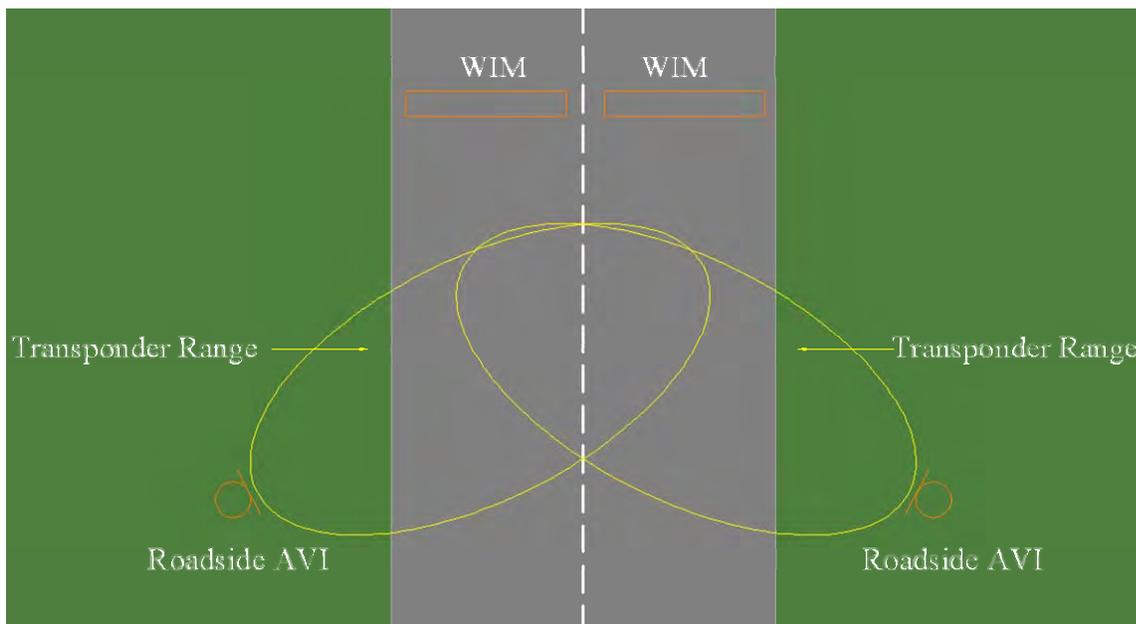


Figure 6 - Roadside Transponder Ranges

Option 2 - WIM Installation with Fixed AVI

This option also assumes a permanent two lane WIM installation, but includes a fixed Advance Reader. The Reader and the WIM are permanent data collection stations, both capable of remote data access. When an active inspection begins, inspectors simply turn on the RF modems. A

fixed Advance Reader can be configured with one or more (usually up to 4) antennas, but to perform accurate multi-lane screening, the antennas should be installed overhead, directly over the lanes. This is also the optimal configuration for license plate reading cameras. A rear-facing antenna could be included for future applications such as cargo seal tracking.

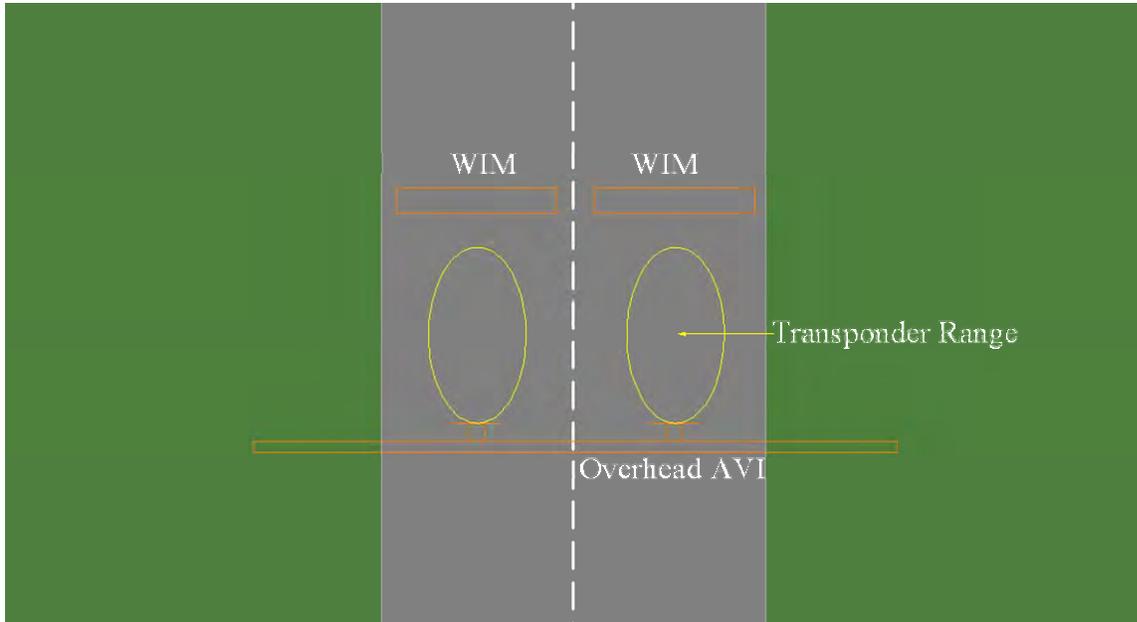


Figure 7 - Overhead Transponder Ranges

Software

The second change requires the revision or replacement of the screening software to support lane discrimination. The current version of Model MACS only supports a single lane WIM and Advance Reader. Model MACS correlates the transponder ID with the WIM reading based on the time the signals are received. Without support for a lane data tag, transponder IDs may get correlated with WIM data from the incorrect lane. This is a relatively minor program change; and the State of Connecticut has commissioned a version of this software for themselves.

The implementation and testing phases of this project call for a single lane screening scenario.

Wireless Communications Options

This project includes two basic communications requirements for WIM systems: they need to be able to output a signal to integrate into the existing mobile electronic screening system, and they also need to connect to remote systems for monitoring and data retrieval.

Mobile Electronic Screening

Integrating with the existing mobile electronic screening system is a straightforward process. The current system uses serial RF modems operating at 900 MHz. Integrating WIM into the system would require adding two additional RF modems, one at the WIM and another at the ROC to receive the signal. All WIM systems researched to date have the ability for multiple bands of communication, and support the serial communications necessary to work with Model MACS.

Remote Monitoring and Data Retrieval

Data retrieval can be accomplished simply by driving up to a device and swapping media, or downloading data to a laptop or USB drive as some states currently do. However, this method has an obvious inherent lag time. For applications that do not require frequent or near-real time data updates this may be sufficient, but there is no way to know whether the device is working properly or if data storage is nearing or exceeding capacity.

GPRS is becoming more widely available as wireless providers expand Global System for Mobile Communications (GSM) coverage. Utilizing GPRS allows for much greater flexibility and functionality in system design. Not only is remote data collection feasible and cost effective, the opportunity exists for real-time applications and remote monitoring.

Most WIM vendors offer support for remote data collection, at least through direct connection or point to point wireless solutions. However, some vendors are now developing sophisticated applications that allow for direct access to their devices through Internet Protocol (IP) addresses, giving anyone with Internet access and sufficient rights the ability to monitor them. This is the principle used in modern “virtual WIM” sites, which allow enforcement personnel to actively monitor any WIM using this technology for violations.

Recommendation

GPRS communications is our recommended requirement for remote monitoring and data retrieval. The next generation transponder reader manufactured by Telematics Wireless includes a GPRS modem for remote monitoring and data collection. This protocol offers the most flexibility in designing future applications such as network-based screening.

Based on coverage maps and system provider contacts, the Schodack site should offer good GPRS communications. Unlimited data transfer plans cost up to \$80 per month, with limited plans starting at \$40.

Recommendations

Our recommendation for WIM equipment across both lanes at the I-90 westbound test site in Schodack New York is to install a system that can be operated as a “Virtual WIM” at all times while collecting traffic monitoring data, and be operated with the mobile electronic screening system during active inspections. While virtual WIMs are considered a great choice for bypass routes, the same technology (with the exception of cameras, which will be researched in Task 9) is required for them. Since the Schodack site is a test bed for future operations elsewhere, we feel that this is a prime opportunity to go beyond data collection and test the merits of this type of configuration. There will be no loss of functionality for data collection or electronic screening.

Recommended Key WIM Controller Specifications

- Must support NYSDOT traffic data collection and traffic monitoring standards
- Must support serial input/output with the Advantage 75 protocol for integration with the existing mobile electronic screening system
- Must support GPRS communications with IP addressable monitoring software suitable as a “Virtual WIM” site
- Must be able to be powered by solar panels

WIM Sensors

Poor pavement conditions at the Schodack site will limit the choice of WIM sensors considerably, and accuracy will suffer as a result. If installation is to take place prior to any road surface improvements we recommend a less expensive sensor be used such as a quartz-piezo or Kistler sensor. Some of these sensors can be shaped to match a degree of roadway deformation, but further contact and site visits by the winning vendor will be required to determine exact suitability.

Our research indicated that bending-plate sensors, while capable of fairly high accuracies, have a fairly poor reliability record, particularly in northern states. Therefore we cannot recommend them.

Pre-cast single-load cells appear to be the lowest cost long-term solution, with the best accuracy and single-day installation, but require prime pavement structure to operate. These sensors should be considered at newly constructed roadway sites such as new border crossing facilities, or when substantially rebuilding sections of highway along existing WIM installations used in conjunction with Type III applications such as electronic screening.

Recommended Key AVI Specifications

- Must support remote monitoring via GPRS communications with included software
- Must include antenna tuning via a connected laptop for initial setup
- Must be self-tuning to adjust for temperature variations

- Must support multiple antennas with lane differentiation, though single lane screening is specified for this project
- Must be weatherproof
- Must be able to be efficiently powered by solar panels
- The AVI antenna will be permanently mounted on a pole at the roadside for single lane screening. Multi-lane screening will require an overhead structure.

Recommended Communications

GPRS modems should be used for remote access on all devices at the WIM site to allow for efficient data transfer as well as current and future remote monitoring applications. For integration with the existing mobile electronic screening system each device should be equipped with a serial RF modem and permanently mounted directional antenna fixed to the same roadside pole as the AVI antenna.

Time Critical Purchases

Based on an assumed schedule of a late summer installation of the WIM equipment there are no time-critical purchases. However, to avoid any potential delays and the necessity to further investigate roadway surface conditions, we recommend proceeding directly with the WIM procurement phase so that a suitable system vendor can be identified and brought into the project at an early stage.

Cost Table - Quartz Piezo				
Item	Quantity	Unit Cost	Total	
Two Lane WIM (Quartz Piezo)	1	\$ 40,000.00	\$ 40,000.00	
WIM Installation	1	\$ 24,000.00	\$ 24,000.00	
GPRS modem (remote access/data collection)	1	\$ 225.00	\$ 225.00	
900 MHz RF Serial Modem	2	\$ 300.00	\$ 600.00	One each for WIM and AVI Reader
Next Generation Reader (single lane, solar capable, includes GPRS modem)	1	\$ 10,000.00	\$ 10,000.00	
Total			\$ 74,825.00	
Annualized Cost @ 6 Year Service Life			\$ 12,470.83	Quartz Piezo service life
Periodic Costs				
Item	Quantity	Unit Cost	Total	
WIM Maintenance	1	\$ 3,360.00	\$ 3,360.00	*Annual - This approximate figure may be substantially less if part of a larger state-wide maintenance contract
Wireless Internet Account	2	\$ 960.00	\$ 1,920.00	*Annual cost. Highest cost listed (unlimited). Lower bandwidth/limited monthly transfer options can bring this cost down to as low as \$40 per month.
Total			\$ 5,280.00	
Cost Table - Load Cell				
Item	Quantity	Unit Cost	Total	
Two Lane WIM (Load Cell)	1	\$ 78,000.00	\$ 78,000.00	
WIM Installation	1	\$ 42,000.00	\$ 42,000.00	
GPRS modem (remote access/data collection)	1	\$ 225.00	\$ 225.00	
900 MHz RF Serial Modem	2	\$ 300.00	\$ 600.00	One each for WIM and AVI Reader
Next Generation Reader (single lane, solar capable, includes GPRS modem)	1	\$ 10,000.00	\$ 10,000.00	
Total			\$ 130,825.00	
Annualized Cost @ 20 Year Service Life			\$ 6,541.25	Single Load Cell service life
Periodic Costs				
Item	Quantity	Unit Cost	Total	
WIM Maintenance	1	\$ 5,880.00	\$ 5,880.00	*Annual - This approximate figure may be substantially less if part of a larger state-wide maintenance contract
Wireless Internet Account	2	\$ 960.00	\$ 1,920.00	*Annual cost. Highest cost listed (unlimited). Lower bandwidth/limited monthly transfer options can bring this cost down to as low as \$40 per month.
Total			\$ 7,800.00	

Appendix I - Contact Logs

Other States Real World Experiences with WIM Technology

CHA Caller: Henry Kovacs

Person Contacted: Steve Calahan, 403-340-5225

Title: Executive Director

Affiliation: **Commercial Vehicle Enforcement, Province of Alberta**

Sample Introduction:

I'm _____ from Clough Harbour & Associates LLP. I'm working on behalf of the New York State Department of Transportation on a project for Don Baker. We're conducting a study on Weight in Motion (WIM) systems, particularly mainline systems and those used in conjunction with commercial vehicle screening systems. May I ask you a few questions?

Are you the appropriate individual I can discuss this with? Yes

If not, can you provide me with the contact information of the appropriate individual?

Do you use WIM in conjunction with commercial vehicle electronic screening? Previous program was abandoned approximately three years ago.

If so, what configuration do you use?

Single Lane X
Multi-lane _____
Ramp Sorting X
Other _____

What screening software do you use? IRD

Do you use wireless communications? No

If so, what configuration? _____

E.g. cell modem, serial modem, GRS

Do you collect data for other uses? Yes

If so, how do you retrieve the data? Individual drives to site, removes floppy and loads data onto laptop.

What type and brand of WIM do you use?

Brand(s): IRD

Sensor Type:

Piezoelectric	_____
Bending Plate	X
Single load cell	_____
Kistler	_____

How would you rate them 1(low)-10(high)

Reliability 0

Accuracy 3

Equipment cost 5

Installation cost 5

Maintenance cost 6

Can you describe you maintenance program? As needed

Cost Unsure but thought cost was included as part of installation cost.

Frequency Once a week

How many sites do you have? 2

Do you plan on expanding your program? Yes

How? Fourteen full bypass with load cell sites are planned.

Additional Notes: None

CHA Caller: Henry Kovacs

Person Contacted: Jim Stuart (360) 705-7987

Title: Acting Administrator of Commercial Vehicle Systems

Affiliation: **Washington Department of Transportation**

Sample Introduction:

I'm _____ from Clough Harbour & Associates LLP. I'm working on behalf of the New York State Department of Transportation on a project for Don Baker. We're conducting a study on Weight in Motion (WIM) systems, particularly mainline systems and those used in conjunction with commercial vehicle screening systems. May I ask you a few questions?

Are you the appropriate individual I can discuss this with? Yes

If not, can you provide me with the contact information of the appropriate individual?

Do you use WIM in conjunction with commercial vehicle electronic screening? Yes

If so, what configuration do you use?

Single Lane X
Multi-lane X
Ramp Sorting _____
Other _____

What screening software do you use? Built their own

Do you use wireless communications? No

If so, what configuration? _____

E.g. cell modem, serial modem, GRS

Do you collect data for other uses? Yes

If so, how do you retrieve the data?

Linked by fiber or T-1 lines to their server.

What type and brand of WIM do you use?

Brand(s):

Sensor Type:

Piezoelectric	X
Bending Plate	_____
Single load cell	X
Kistler	_____

How would you rate them 1(low)-10(high)

	Piezoelectric	Single load cell
Reliability	8	9
Accuracy	8	9
Equipment cost	9	9
Installation cost	8	8
Maintenance cost	8	8

Can you describe you maintenance program?

Maintenance contract with IRD. Equipment checked on a semi-annual basis. IRD are also on call.

Cost \$25,000 per site per year

Frequency Semi annual

How many sites do you have? 10 (all have single load cells)

Do you plan on expanding your program? Yes

How? Now deploying 2 new WIM systems

Additional Notes: IRD maintenance and support could be improved.

CHA Caller: Henry Kovacs

Person Contacted: Mike Akridge, 850-410-5607

Title: Deputy State Traffic Engineer

Affiliation: **Florida DOT**

Sample Introduction:

I'm _____ from Clough Harbour & Associates LLP. I'm working on behalf of the New York State Department of Transportation on a project for Don Baker. We're conducting a study on Weight in Motion (WIM) systems, particularly mainline systems and those used in conjunction with commercial vehicle screening systems. May I ask you a few questions?

Are you the appropriate individual I can discuss this with? Yes

If not, can you provide me with the contact information of the appropriate individual?
N/A

Do you use WIM in conjunction with commercial vehicle electronic screening? Yes

If so, what configuration do you use?

Single Lane _____
Multi-lane _____
Ramp Sorting X
Other _____

What screening software do you use? PrePass standard software

Do you use wireless communications? No

If so, what configuration? _____

E.g. cell modem, serial modem, GRS

Do you collect data for other uses? No

If so, how do you retrieve the data? _____

What type and brand of WIM do you use?

Brand(s): Metler Toledo and IRD

Sensor Type:

Piezoelectric	_____
Bending Plate	X
Single load cell	X
Kistler	_____

How would you rate them 1(low)-10(high)

	<u>Metler</u>	<u>IRD</u>
Reliability	10	10
Accuracy	10	10
Equipment cost	NA	NA
Installation cost	NA	NA
Maintenance cost	NA	NA

Can you describe you maintenance program?

At this point, I was referred to the Motor Compliance Manager, Craig Wilson, 850-245-7932.

Cost NA

Frequency NA

How many sites do you have? 7 Metler Toledo and 1 IRD

Do you plan on expanding your program? Yes

How? Plans for prepass, WIM and virtual weigh station systems along state and interstate roadways.

Additional Notes: None

CHA Caller: Henry Kovacs

Person Contacted: Craig Wilson 850-245-7932

Title: Motor Vehicle Compliance Manager

Affiliation: **Florida Department of Transportation**

Sample Introduction:

I'm _____ from Clough Harbour & Associates LLP. I'm working on behalf of the New York State Department of Transportation on a project for Don Baker. We're conducting a study on Weight in Motion (WIM) systems, particularly mainline systems and those used in conjunction with commercial vehicle screening systems. May I ask you a few questions?

Are you the appropriate individual I can discuss this with? Yes

If not, can you provide me with the contact information of the appropriate individual?

Do you use WIM in conjunction with commercial vehicle electronic screening? Yes

If so, what configuration do you use?

Single Lane _____
Multi-lane _____
Ramp Sorting X
Other _____

What screening software do you use? Prepass standard software

Do you use wireless communications? No for WIM, yes for PrePass

If so, what configuration? _____

E.g. cell modem, serial modem, GRS

Do you collect data for other uses? Yes

If so, how do you retrieve the data?

Fiber optic connection allows for data to be placed on network in automated fashion.

What type and brand of WIM do you use?

Brand(s): Metler Toledo and IRD

Sensor Type:

Piezoelectric	_____
Bending Plate	X
Single load cell	X
Kistler	_____

How would you rate them 1(low)-10(high)

	Metler	IRD
Reliability	9	7
Accuracy	9	7
Equipment cost	NA	NA
Installation cost	NA	NA
Maintenance cost	1	1

Can you describe you maintenance program?

Maintenance is bid out to Melter Toledo

Cost \$700,000

Frequency Preventative maintenance

How many sites do you have? 7 Metler Toledo and 1 IRD

Do you plan on expanding your program? Yes

How? They are building two new facilities with prepass and WIMS. There are plans for virtual weight station with camera sites.

Additional Notes: None

CHA Caller: Henry Kovacs

Person Contacted: Captain Guy Boruff

Title: Assistant Division Commander of Commercial Vehicle Enforcement Division

Affiliation: **Indiana State Police**

Sample Introduction:

I'm _____ from Clough Harbour & Associates LLP. I'm working on behalf of the New York State Department of Transportation on a project for Don Baker. We're conducting a study on Weight in Motion (WIM) systems, particularly mainline systems and those used in conjunction with commercial vehicle screening systems. May I ask you a few questions?

Are you the appropriate individual I can discuss this with? Yes

If not, can you provide me with the contact information of the appropriate individual?

Do you use WIM in conjunction with commercial vehicle electronic screening? Yes

If so, what configuration do you use?

Single Lane X

Multi-lane X

Ramp Sorting X

Other _____

What screening software do you use? Software created by Purdue University

Do you use wireless communications? Yes

If so, what configuration? Cell modem, dedicated short-range category

E.g. cell modem, serial modem, GRS

Do you collect data for other uses? Yes

If so, how do you retrieve the data? State Highway location data is downloaded via phone line for use by Purdue University

What type and brand of WIM do you use?

Brand(s): Toledo load cell, IRD with hydraulic load cell, IRD with load cell and piezoelectric

Sensor Type:

Piezoelectric	X
Bending Plate	X
Single load cell	X
Kistler	_____

How would you rate them 1(low)-10(high)

	Toledo	IRD/Load Cell	IRD/Piezoelectri
Reliability	10	9	7
Accuracy	10	6 *	10
Equipment cost	3.5	10	10
Installation cost	4	10	10
Maintenance cost	2	3	5

* Low score attributed to pavement, not equipment.

Can you describe you maintenance program?

No formal maintenance program currently exists. Systems are repaired on an as needed basis. Equipment receives an annual check.

Cost NA

Frequency Annual equipment check.

How many sites do you have? 6 WIMS sorters, 38 Sites that are a mix of or IRD, load and piezo.

Do you plan on expanding your program? Yes

How? Additional screening sites are desired. They would like to try Quartz Sensor. The University of Purdue wants to create a site with four different sensor types as a way to compare systems.

Additional Notes:

University of Purdue contact: Professor Darcy Bullock, Head of Civil Engineering, 765-494-2226

CHA Caller: Henry Kovacs

Person Contacted: Lieutenant Debbie Bax, (573) 526-6261

Title: Assistant Director of Common Vehicle Enforcement Division

Affiliation: **Missouri State Highway Patrol**

Sample Introduction:

I'm _____ from Clough Harbour & Associates LLP. I'm working on behalf of the New York State Department of Transportation on a project for Don Baker. We're conducting a study on Weight in Motion (WIM) systems, particularly mainline systems and those used in conjunction with commercial vehicle screening systems. May I ask you a few questions?

Are you the appropriate individual I can discuss this with? Yes

If not, can you provide me with the contact information of the appropriate individual?

Do you use WIM in conjunction with commercial vehicle electronic screening? Yes

If so, what configuration do you use?

Single Lane _____
Multi-lane _____
Ramp Sorting X
Other _____

What screening software do you use? Cardinal

Do you use wireless communications? No

If so, what configuration? _____

E.g. cell modem, serial modem, GRS

Do you collect data for other uses? Yes

If so, how do you retrieve the data? Fiber optic

What type and brand of WIM do you use?

Brand(s): Cardinal

Sensor Type:

Piezoelectric	X
Bending Plate	_____
Single load cell	_____
Kistler	_____
Four load cell	X

How would you rate them 1(low)-10(high)

	Cardinal Peizoelectric	Cardinal load cell
Reliability	8	6
Accuracy	7	7
Equipment cost	6	6
Installation cost	7	6
Maintenance cost	5	5

Can you describe you maintenance program?

All maintenance and most repair work is done in house and on as needed basis. Test weights are used 2/year to calibrate systems.

Cost Approx. \$2,000

Frequency As needed

How many sites do you have? 2 sites with four buildings

Do you plan on expanding your program? No

How? If they had the money, the would add Cardinal piezoelectric sites.

Additional Notes: None

CHA Caller: Henry Kovacs

Person Contacted: Dennis Hult

Title: Technology Manager, 406-444-9237

Affiliation: **Montana Department of Transportation**

Sample Introduction:

I'm _____ from Clough Harbour & Associates LLP. I'm working on behalf of the New York State Department of Transportation on a project for Don Baker. We're conducting a study on Weight in Motion (WIM) systems, particularly mainline systems and those used in conjunction with commercial vehicle screening systems. May I ask you a few questions?

Are you the appropriate individual I can discuss this with? Yes

If not, can you provide me with the contact information of the appropriate individual?

Do you use WIM in conjunction with commercial vehicle electronic screening?

If so, what configuration do you use?

Single Lane _____
Multi-lane X
Ramp Sorting _____
Other _____

What screening software do you use? Help Prepass

Do you use wireless communications? Yes

If so, what configuration? Air net communication with Sysco protocol

E.g. cell modem, serial modem, GRS

Do you collect data for other uses? Yes

If so, how do you retrieve the data? With public switch telephone lines, manually and in automated fashion.

What type and brand of WIM do you use?

Brand(s): ECM, PAT Bender Plates, IRD Recorder PAT Plates

Sensor Type:

Piezoelectric	_____
Bending Plate	X
Single load cell	_____
Kistler	X

How would you rate them 1(low)-10(high)

	ECM	PAT	IRD
Reliability	9	8	8
Accuracy	9	8	8
Equipment cost	2	7	6
Installation cost	2	7	7
Maintenance cost	2	4	6

Can you describe you maintenance program?

For high speed sorting systems -- once per quarter officers collect static scale and WIMS info of 50 trucks for each lane. The data is used to calculate error and determine adjustments. Once adjustments are made each lane is checked a second time.

For IRD and PAT Bender plates – technicians inspect site and evaluate any hardware wear or damage and need for repair.

ECM Kistler System – four times per year each system is tested and error is calculated using a truck with known weight.

Cost NA

Frequency see above

How many sites do you have? 2 ECM, 3 PAT Bender, 1 IRD

Do you plan on expanding your program? Yes

How? Three additional high speed WIM sites that will be ECM with Kistler.

Additional Notes: None

CHA Caller: Henry Kovacs

Person Contacted: Captain Ron Cordova, 505-827-0302

Title: Captain, Headquarters Operations

Affiliation: **New Mexico Department of Public Safety – Motor Transportation Division**

Sample Introduction:

I'm _____ from Clough Harbour & Associates LLP. I'm working on behalf of the New York State Department of Transportation on a project for Don Baker. We're conducting a study on Weight in Motion (WIM) systems, particularly mainline systems and those used in conjunction with commercial vehicle screening systems. May I ask you a few questions?

Are you the appropriate individual I can discuss this with? Yes

If not, can you provide me with the contact information of the appropriate individual?

Do you use WIM in conjunction with commercial vehicle electronic screening? Yes

If so, what configuration do you use?

Single Lane X
Multi-lane _____
Ramp Sorting X
Other _____

What screening software do you use? IRD

Do you use wireless communications? No

If so, what configuration? _____

E.g. cell modem, serial modem, GRS

Do you collect data for other uses? Yes

If so, how do you retrieve the data? ?????? need to call back

What type and brand of WIM do you use?

Brand(s): IRD and Quartz Piezo

Sensor Type:

Piezoelectric	X *
Bending Plate	X
Single load cell	_____
Kistler	_____

* Individual responded that sensor type is a quartz piezo.

How would you rate them 1(low)-10(high)

	IRD	Piezo
Reliability	7	7
Accuracy	9	7
Equipment cost	10	6
Installation cost	10	6
Maintenance cost	6	6

Can you describe you maintenance program?

Quarterly inspection to evaluate for damage to confirm equipment functions properly. Quarterly checks against static system with truck of known weight.

Cost \$50,000/year

Frequency See above

How many sites do you have? 1 mainline, 2 ramp WIMS

Do you plan on expanding your program? Yes

How? When funding becomes available, they would like additional Bending plate IRD systems.

Additional Notes: None

CHA Caller: Henry Kovacs

Person Contacted: C.T. Wicker

Title: Manager of Technical Services

Affiliation: **Virginia Department of Motor Vehicles**

Sample Introduction:

I'm _____ from Clough Harbour & Associates LLP. I'm working on behalf of the New York State Department of Transportation on a project for Don Baker. We're conducting a study on Weight in Motion (WIM) systems, particularly mainline systems and those used in conjunction with commercial vehicle screening systems. May I ask you a few questions?

Are you the appropriate individual I can discuss this with? Yes

If not, can you provide me with the contact information of the appropriate individual?

Do you use WIM in conjunction with commercial vehicle electronic screening? Yes

If so, what configuration do you use?

Single Lane X
Multi-lane _____
Ramp Sorting X
Other _____

What screening software do you use? IRD

Do you use wireless communications? No, but vehicles with Prepass transponders will send data ahead to weigh station. Communication via dedicated short range communication.

If so, what configuration? _____

E.g. cell modem, serial modem, GRS

Do you collect data for other uses? Yes

If so, how do you retrieve the data? Data routinely downloaded on automated basis over network connection from each site.

What type and brand of WIM do you use?

Brand(s): IRD

Sensor Type:

Piezoelectric	_____
Bending Plate	X
Single load cell	X
Kistler	_____

How would you rate them 1(low)-10(high)

	IRD/BP	IRD/SLC
Reliability	8	9
Accuracy	7	8
Equipment cost	6	6
Installation cost	5	5
Maintenance cost	5	5

Can you describe you maintenance program?

Maintenance contract with IRD which includes 4 preventive maintenance visits per year and service calls as needed. Systems are calibrated against static system using general public traffic.

Cost NA

Frequency 4 time per year

How many sites do you have? 7 sites total; 4 are mainline and the other 3 are mainline with ramp. All 7 sites are single load cell. The 3 mainline with ramp are comprised of 2 bending plate and one single load cell.

Do you plan on expanding your program? Not at this time.

How? However, if monies were available, they would add sites to monitor secondary roads.

Task 9 Research Report

*Research and Analysis of License Plate Readers and Video Recognition
Subsystems for Integration with the Mobile CVIEW Electronic Screening System
(Phase II)*

Commercial Vehicle Information Exchange Window (CVIEW) Roadside Enforcement/Compliance Project

**NYSERDA Agreement Number (6764C-3)
Comptrollers Contract No. (C012668)
NYSDOT Task Assignment (C-01-66C)
PIN (R020.47.881)**

March 30, 2006

Submitted to:

**New York State Energy Research and Development Authority
And
New York State Department of Transportation**

Submitted by:

**Clough Harbour & Associates LLP
III Winners Circle, Albany, New York 12205**

PREFACE

The New York State Energy Research and Development Authority (NYSERDA) is a public benefit corporation created in 1975 by the New York State Legislature. For more than a quarter century, NYSERDA has been working on finding innovative solutions to the energy and environmental issues that face residents of the Empire State. As part of that mission, the Authority has sought answers that would benefit not only New York's energy and environmental future, but the economy as well. To do so, NYSERDA has traditionally partnered with other state agencies, as well as industrial, commercial, environmental and economic development groups all across New York State.

In 1999, the New York State Department of Transportation (NYSDOT) had just completed a three-year contractual research relationship with a consortium of seven New York State universities, colleges and research institutions. Based on the success of that experience, the Department sought to establish additional partnering arrangements with research consortia to carry out basic and applied research, technology transfer, and short-term consultation services in the fields of engineering, operations, public transportation, management and finance, public policy, and human resources.

As a complement to a university-based constituency, NYSERDA organized a Transportation Infrastructure Research Consortium comprised of seventeen private-sector research entities. The membership is characterized as businesses, not-for-profits, and professionals that have a track record of performing transportation-related research, development, and demonstration as a normal part of their service-related or internal operations. Many of the organizations also have strong relationships with universities, state agencies and authorities, and federal funding agencies, and are already performing collaborative research through those relationships.

In June of 2001, New York State Comptroller=s Contract C012668 was executed and governs the activities of the NYSERDA-administered Transportation Infrastructure Research Consortium. The term of the agreement is for five years, extending from March 1, 2001 through February 28, 2006. The direct and dynamic linkages between transportation, energy, and the environment have continually reinforced the cooperative relationship formed between NYSDOT and NYSERDA. Since its inception, numerous collaborative efforts have been undertaken and the report that follows is a product of that relationship.

NOTICE

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Introduction

The purpose of this task is to research License Plate Recognition (LPR) technology capable of being integrated with the existing mobile commercial vehicle electronic screening system developed in this project, including Weigh-In-Motion (WIM), Automatic Vehicle Identification (AVI) transponder readers and the ModelMACS or equivalent screening software. The ability to reliably capture license plate readings is intended to supplement the capacity of the AVI readers by including vehicles without transponders in the electronic screening process.

Much of the research included has been compiled from interaction with various system vendors. While real-world applications using LPR technology are plentiful, particularly in the area of toll collection enforcement, we found no existing state programs or applications similar enough to the demands of roadside screening. The most relevant information pertaining to a “real-world” attempt to utilize LPR was the License Plate Reader Evaluation (CVO Electronic Clearance/Screening Field Operational Test 9, November 1, 2003) performed by the Virginia Department of Transportation for the I-95 Corridor Coalition and the Federal Highway Administration. The results of this study are fairly disappointing, especially in the area of repeatability, a key requirement for mainline electronic screening. Repeatability in this case is the ability of one camera to read the same plate correctly at two different points in time, or the ability of two separately located cameras to correctly read the same plate at any given point in time.

Given the reliance on vendor supplied information we developed a detailed standardized questionnaire in order to be able to accurately compare results from each of the vendors. Responding vendors included Computer Recognition Systems, JAI PULNiX, Pips Technology and Remington Eltag. Northrup Grumman and International Road Dynamics did not respond. The questionnaire is included as Appendix I. Several vendors included proprietary information in their responses and requested it not be released, so they are not included. This information has been provided to the New York State Department of Transportation as a separate confidential document.

Cost tables are included to indicate approximate costs of hardware, operation and maintenance for the various system components. Due to the range of responses, the number of possible system configurations, and the precision required at installation these numbers most likely are well below actual costs likely to be incurred.

Additional Uses for License Plate Recognition Systems

Each vendor’s response reflected agreement that due to the specialized design of LPR cameras, there are limitations to additional uses of the technology. Since they are designed to image and capture license plates, they are incapable of dimensioning vehicles. Additionally, incident management and travel time applications would require multiple permanent camera locations since a single camera is incapable of measuring vehicle speed.

The specific design of LPR cameras makes them best suited for the image capture of a small area of the front or rear of a vehicle. The most direct additional use of these devices would be to use the plate reads for enforcement purposes. License plate data could be compared to a hotlist of vehicles which may be stolen, have outstanding warrants against their owners, etc.

Wireless Communications

Wireless communications options for LPR are similar to those outlined for WIM and transponder readers as outlined in Task 8. The only data required for screening and data collection purposes would be the text captured from the plate, making wireless communications via GPRS modem practical. For image capture and transmission in real time, the currently available GSM wireless connection should suffice, based on industry standard 100kbs-150kbs data throughput. It should be noted, however, that as with any wireless coverage, conditions may vary due to weather and usage of the particular cell tower. The use of imagery would be most common for virtual WIM applications and data verification.

Time-Critical Purchases

This project's schedule does not indicate there will be time critical purchases. As with most high-tech sensor equipment, at least eight weeks should be allocated for a purchase of LPR equipment. However, the most time consuming effort will be the development or alteration of the screening software to accommodate the addition of license plate data. Depending on the ultimate system configuration and software supplier, this could take from several months to over a year.

Hardware Analysis

License plate readers consist of four primary components: the camera, illumination, a triggering device, and a processor.

Camera

LPR cameras are high speed digital cameras which usually take black and white images, though some models produce color images. They are specially designed to be sensitive to infrared or near-infrared lighting. These wavelengths are ideal for highlighting the details of license plates while minimizing the effects of glare, some environmental conditions, and a limited amount of dirt on the plate. They are not, however, capable of producing readable images in direct sunlight, heavy rain, snow, fog, or if the plate is partially or wholly obscured.

Most cameras operate in temperatures ranging from -5F to 10F at the low end through 120F to 160F. Some units are available with built-in heaters to extend the low temperature range to -60F to -40F. These units are robust and can continue to capture images in high-vibration environments.

LPR cameras require precise aiming and focusing for optimum results. Location and geometry are important factors as well. The maximum lateral oblique angle (i.e. the angle at which a plate can be read from the side) is typically 20 degrees. While cameras are available that can read plates at a distance of up to 110 feet, this is just under the distance required if the camera were to be installed 30 feet off the travel lane of the highway. For mainline applications, overhead installation is therefore preferable. Each travel lane would require its own camera system, which with some systems would involve two cameras to achieve a single lane of coverage.

Periodic manufacturer maintenance is recommended by most vendors, primarily to update onboard software. Routine maintenance performed by the user includes periodically checking electrical and mounting connections as well as cleaning. Cleaning of the cameras will be required more frequently in high-deposition environments such as areas with dusty conditions and road spray. This regular cleaning can become costly in overhead installations or high-mounted roadside locations due to safety considerations for both maintenance personnel and vehicle traffic. Cameras with even minor deposits will yield a much lower percentage of plate reads.

Illumination

Illumination is important not only for nighttime operations, but also for emphasizing the plates. Methods of illumination range from strobe to fixed, continuous lighting. Many recent camera models are built with self-contained infrared LED (Light Emitting Diode) lighting. LEDs are advantageous in that they are extremely power efficient and require little maintenance. However, the illumination they provide is sufficient only for overhead structures, not for cameras placed 30 feet off the travel lane.

Triggering

Most LPR cameras do not continually capture images. They require a means of triggering to capture the optimal image for character recognition. Many devices are capable of serving as a trigger; and some cameras are self-triggering. Ultimately, it is the application which dictates the appropriate trigger. Standard triggers include laser, infrared beams and detection loops.

For electronic screening with LPR it is important to trigger the camera only when a commercial vehicle is present. Systems with WIM devices have a distinct advantage since the WIM is already classifying the vehicle, thereby making an ideal trigger. Many currently deployed virtual WIMs use this technique for image capture.

Processor

The processor is a computer that has three primary functions: it takes the signal from the trigger and fires the camera; it provides for communications with external devices; and it is responsible for performing Optical Character Recognition (OCR) on the images. The processor is sometimes included within the camera itself, but it could also be housed in an external box. Some LPR systems require an additional computer, called a host computer, which handles the communications and data storage. In these systems, the processor only performs the OCR function.

Bad License Plate Reads

It is inevitable that a certain percentage of license plates will not be read correctly or at all in any weather condition. We can break them into two categories: no reads and incorrect reads. No reads are situations in which the camera is triggered, but is unable to solve the license plate at all due to a dirty or damaged plate or poor environmental conditions. Once the camera has been triggered, most systems will output an error message in place of the plate number. Any software developed for LPR based screening will have to accommodate these errors.

Incorrect reads can be more of a challenge. For instance, a 0 can often be read as an O. The LPR cannot distinguish that the read is incorrect. It is therefore up to the screening software to handle these situations. It is possible for a plate with an incorrect read to be matched to the correct vehicle by using something called “fuzzy logic.” This method will search the database for all plates that are similar, but not necessarily identical to the recorded plate number. If a unique value is identified, most likely it will be the correct result. However, there is potential for error with this method, which increases exponentially if multiple characters of the plate read are incorrect. There is no way to know when this situation occurs.

Certain plate types are more difficult for LPR systems to read. Since the systems rely most often on infrared light to capture the best images, plates with red letters are difficult or impossible to read. States such as Massachusetts have particularly difficult plates due to red lettering. Certain vendors have had to create specific cameras with visible illumination to detect these plates.

State Recognition

Due to the variation of plate designs and colors in the United States and Canada it is possible only to capture several state or province’s plates through a particular processor. Since the LPR processor must be trained specifically to recognize each type of plate, adding more than several jurisdictions causes processing time to degrade to the point where the system cannot keep up with incoming images. Some vendors suggest that

adding an additional processor and camera is the only practical way to expand to include additional states, though full North America coverage is not currently possible.

State recognition by the processor is also important for electronic screening if the database contains records from many states. It is possible for vehicles from several states to have the same plate number. False matches can be avoided by training the processor to distinguish various states and provinces' information. Although this is the only way the systems can correctly capture the information, not all systems can actually report the state or province to the screening software.

Reliability/Repeatability

The reliability of an accurate license plate read is of significant importance when pull-in or bypass decisions are being made. It is in the interest of system vendors to advertise the highest capture rates achievable by their systems. Some advertised rates are as high as 98%. However, the majority of our respondents indicated between 80% and 90% accuracy in good conditions (good weather, good plates and precise aiming and setup).

For scenarios involving a second license plate read, such as with arrow notification as described later in this report, repeatability is crucially important. In this scenario, the same plate information must be captured from the same vehicle twice. Here the vendors disagree. Some state that if the plate is read correctly the first time, there is a 98% chance that second read will also be correct. Other vendors point out that since the conditions at each camera will be different, such high rates of repeatability are not achievable. Permanently installed cameras have a far better chance of repeatability than either a partial or fully mobile system.

The Virginia Department of Transportation performed a study of the applicability of LPRs for electronic screening. While systems have improved since the date of their study, the results are telling. Below is a table showing reads of plates over the course of two days, intended to reflect the effects of sun angles on repeatability. Four distinct plates were each driven past the camera four times at each time interval indicated in the table. Keep in mind that this test was performed with *one* camera, not two.

April 18, 2001 Van facing NW – 315 degrees magnetic

Plate/Time	8:30	9:30	10:30	11:30	12:30	1:30	2:30	3:30	4:30
10147S	X	R	X	R	X	R	R	X	R
ZMNM8257	R	R	R	X	R	R	R	R	R
WLQ193	X	X	X	X	X	X	X	X	X
10147S	X	R	R	X	R	R	R	R	X
ZMNM8257	X	R	R	R	R	R	X	R	R
WLQ193	X	X	X	X	X	X	X	X	X
10147S	X	X	X	R	R	R	R	X	R
ZMNM8257	R	R	R	R	R	R	R	R	R
WLQ193	X	X	X	X	X	X	X	X	X

10147S	R	X	R	R	R	R	X	R	X	
ZMNM8257	R	R	R	R	R	X	R	X	R	
WLQ193	X	X	X	X	X	X	X	X	X	
10147S	X	X	X	R	R	R	R	R	X	
ZMNM8257	R	R	R	R	R	R	R	X	R	
WLQ193	X	X	X	X	X	X	X	X	X	
										Day Avg
TOTAL READ %	33	47	47	53	60	60	53	40	47	49
10147S READ %	20	40	40	80	80	100	80	60	40	60
ZMN8257 READ %	80	100	100	80	100	80	80	60	100	87
WLQ193 READ %	0	0	0	0	0	0	0	0	0	0

April 19, 2001 Van facing SE – 130 degrees magnetic

Plate/Time	8:30	9:30	10:30	11:30	12:30	1:30	2:30	3:30	4:30	
10147S	X	R	R	R	X	X	R	X	X	
ZMNM8257	R	R	X	R	X	X	X	R	R	
WLQ193	X	X	X	X	X	X	X	X	X	
10147S	R	R	R	R	R	R	X	X	R	
ZMNM8257	R	R	R	R	X	X	R	X	R	
WLQ193	X	X	X	X	X	X	X	X	X	
10147S	R	R	R	R	R	R	X	R	R	
ZMNM8257	X	R	X	R	R	R	R	R	R	
WLQ193	X	X	X	X	X	X	X	X	X	
10147S	R	R	R	R	X	X	X	X	R	
ZMNM8257	R	R	R	R	R	R	X	R	R	
WLQ193	X	X	X	X	X	X	X	X	X	
10147S	R	R	X	R	R	R	X	R	R	
ZMNM8257	R	R	X	R	R	R	R	X	R	
WLQ193	X	X	X	X	X	X	X	X	X	
										Day Avg
TOTAL READ %	53	67	37	67	40	40	27	30	60	47
10147S READ %	80	100	80	100	60	60	20	40	80	69
ZMN8257 READ %	80	100	40	100	60	40	60	60	100	71
WLQ193 READ %	0	0	0	0	0	0	0	0	0	0

Truth Table R= plate read correctly X= plate misread

License Plate Reader Evaluation (CVO Electronic Clearance/Screening Field Operational Test 9, November 1, 2003) performed by the Virginia Department of Transportation for the I-95 Corridor Coalition and the Federal Highway Administration

New Technology

New technology relating to LPR is in a state of rapid development. Faster, higher resolution cameras are constantly being developed which can push the reliability rate up while potentially reducing system costs. Faster processing and higher memory capacities also offer the potential for improved accuracy and an increased number of states being recognized.

The use of fingerprinting technology, while not new, offers some promise for use in electronic screening. This technique does not actually read the license plate, but identifies key features in the vehicle image, much as human fingerprints are identified. The processing times for fingerprinting are extremely fast: as little as 0.3 milliseconds, with accuracy and repeatability rates up to 98%. Fingerprinting is a promising technology for applications such as travel time tracking and parking collection. There is, however, a substantial drawback to its use in screening or enforcement. Fingerprinting can only identify a vehicle if its fingerprint is already in a database and matched with the vehicle identification. The first to deploy this technology would be required to develop a database by matching vehicle fingerprints to their respective IDs.

LPR Screening Scenarios

Accuracy and repeatability are important factors when considering the use of LPRs in electronic screening systems. Assuming that read accuracy rates are operationally acceptable, the next biggest challenge is driver notification. Transponder based screening offers the distinct advantage of safe and efficient in-vehicle notification. The Vehicle Infrastructure Integration (VII) initiative offers some promise toward all vehicles having a means of receiving notification from the roadside, but widespread implementation of the required vehicle hardware and roadside infrastructure are many years out. The current concept as put forth by the U.S. Department of Transportation states that, "Data collected via VII will be completely anonymous. There will be no vehicle or other personal identification associated with the data." If this is the case, using VII to notify a specific vehicle may not be allowed.

For LPR-based screening today, we are left with roadside or overhead communication as the only practical means of driver notification. We have developed two potential means of driver notification for mainline screening and two similar options for ramp sorting and border crossing environments. Each scenario requires modification of current electronic screening software to handle and screen incoming license plate readings, compare the results to the transponder hot list, and send notification signals to the appropriate device as outlined in each scenario.

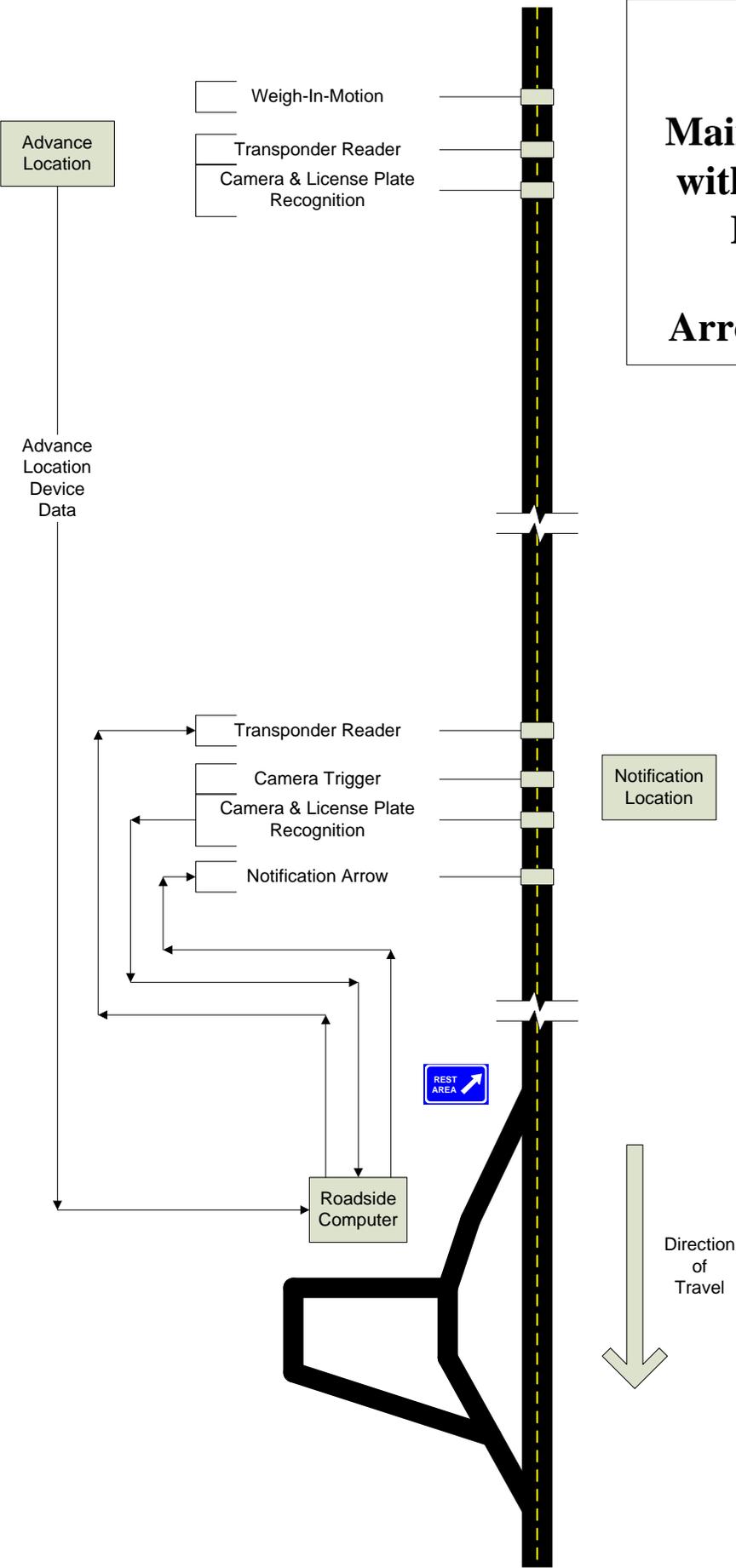
Scenario One – Arrow Notification

Arrow notification involves the use of a changeable message sign which displays a red arrow pointing to the rest area indicating the need for a pull-in, or a green arrow pointing straight ahead indicating clearance to bypass the inspection

station. The most effective location for this type of notification is on an overhead structure that is shielded so that only the appropriate driver sees the arrow. A mobile roadside sign, while possible, would be more difficult to aim and less visible to the driver.

This system requires an LPR to be located at the advance location, along with the WIM and transponder reader. The plate read is sent to the Roadside Operational Computer (ROC), where the screening software compares it to the CVIEW snapshot stored in a database to determine whether the information matches and make a screening decision. As the vehicle approaches the notification location, a second LPR is triggered and reads the plate again. This read is either sent to the ROC or another computer at the notification location which stores the hotlist of vehicles to be pulled in. If a match is found, the arrow notification sign is triggered in the appropriate manner. Installation for a multi-lane highway would require an LPR and associated sign for each lane. Triggers would be required at the notification location, though classification would not be necessary since only commercial vehicles would be hot listed.

Figure 1
Mainline Screening
with License Plate
Recognition
Arrow Notification



Scenario Two – License Plate Notification

License Plate Notification involves the use of a Variable Message Sign (VMS) that displays the license plates of vehicles identified for pull-in. The VMS could be permanent or mobile at the roadside, or mounted on an overhead structure.

This system also requires an LPR to be located at the advance location along with the WIM and transponder reader. In this case, however, there is no need to re-identify the vehicle when it approaches the notification location. The initial plate read is sent to the ROC for screening. The screening software then sends a signal updating the VMS to include vehicles that have recently passed the LPR, or remove those which have pulled into the rest area.

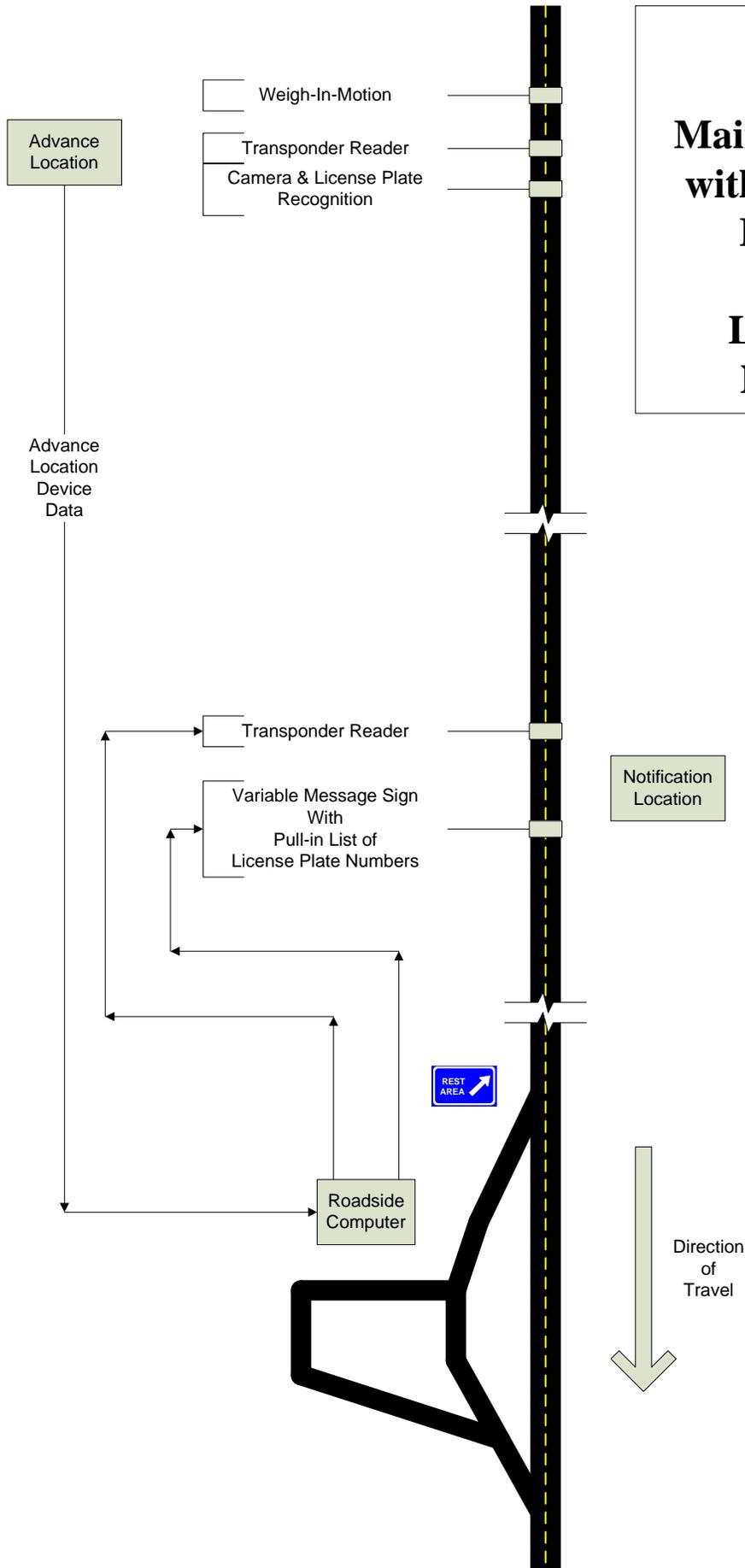


Figure 2
Mainline Screening with License Plate Recognition
License Plate Notification

Scenario Three – Ramp and Border Sorting

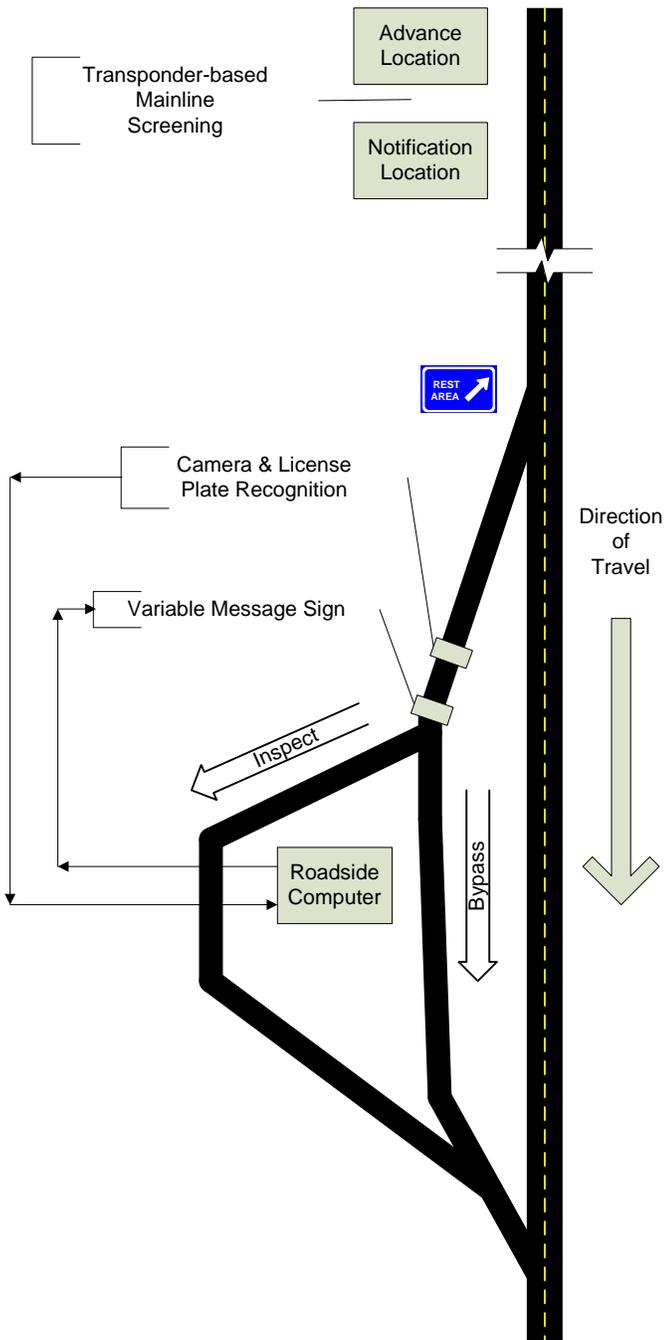
While mainline LPRs work in much the same way as traditional transponder screening, ramp sorting uses an LPR only on the exit ramp of the rest area. At this location, the only commercial vehicles approaching on the single lane will be vehicles without transponders, vehicles with transponders which have been given a pull-in signal and those whose driver wishes to use the rest area facilities.

A single LPR sends the plate read to the ROC for screening. Vehicles that have a transponder with a red light and those that fail the plate screening will see an arrow on the VMS sign indicating the need to pull in. Others will be given a green arrow indicating permission to bypass. Non-commercial vehicles will be given no signal.

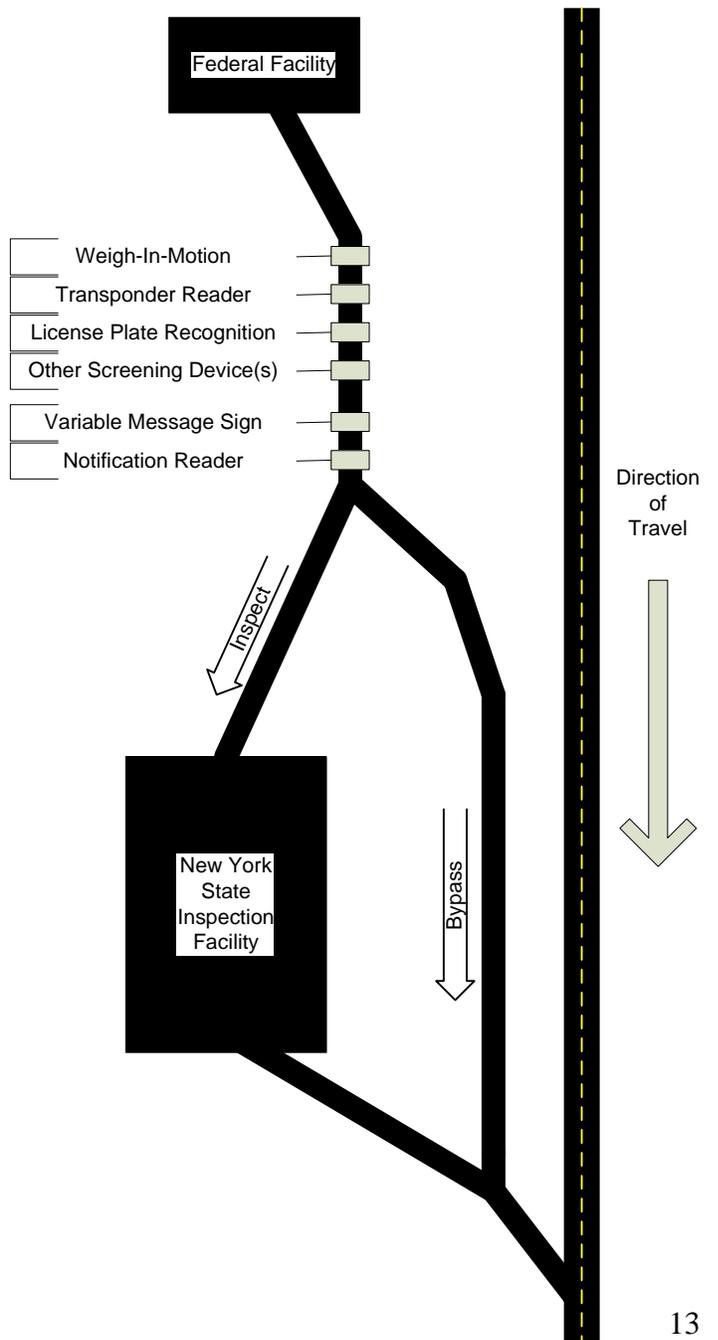
Border sorting is similar in that only one lane is screened. In this case, the LPR sorting takes place in conjunction with the more traditional transponder-based screening. There is a single point of diversion for both the LPR and transponder-based systems. This is an ideal scenario since only commercial vehicles will be in the traffic stream.

Figure 3

Ramp Sorting with License Plate Recognition



Border Sorting with License Plate Recognition



Cost Table

	Scenario One: Arrow Notification	Scenario Two: License Plate Notification	Scenario Three: Ramp and Border Sorting
Worst-Case System Cost			
Camera Cost Per Lane	\$ 20,000	\$ 20,000	\$ 11,000
Illumination Cost Per Lane	\$ 1,500	\$ 1,500	\$ 1,500
LPR Software Cost Per Lane	\$ 15,000	\$ 15,000	\$ 15,000
Initial Vendor Setup	\$ 8,200	\$ 8,200	\$ 8,200
Total Lane Cost	\$ 44,700	\$ 44,700	\$ 35,700
Number of Lanes	2	2	1
Number of Camera Locations	2	1	1
Total LPR Cost	\$ 178,800	\$ 89,400	\$ 35,700
Signage	\$ 20,000	\$ 10,000	\$ 5,000
Screening Software Enhancements			
Maintenance Cost	\$ 26,820	\$ 13,410	\$ 5,355
Total Cost	\$ 225,620	\$ 112,810	\$ 46,055

	Scenario One: Arrow Notification	Scenario Two: License Plate Notification	Scenario Three: Ramp and Border Sorting
Best-Case System Cost			
Camera Cost Per Lane	\$ 13,350	\$ 13,350	\$ 11,000
Illumination Cost Per Lane			
Processor Cost Per Lane	\$ 3,000	\$ 3,000	\$ 3,000
Initial Vendor Setup			
Total Lane Cost	\$ 16,350	\$ 16,350	\$ 14,000
Number of Lanes	2	2	1
Number of Camera Locations	2	1	1
Total LPR Cost	\$ 65,400	\$ 32,700	\$ 14,000
Signage	\$ 20,000	\$ 10,000	\$ 5,000
Screening Software Enhancements			
Maintenance Cost	\$ 9,810	\$ 4,905	\$ 2,100
Total Cost	\$ 95,210	\$ 47,605	\$ 21,100

Due to the wide range in projected costs reported by the selected system vendors, both the high and low costs for each of the three scenarios are included in this analysis. Due to the system's complexity and uncertainty of success, we recommend using the worst case costs for decision making. Since overhead mounting is preferred but not required, we have not included overhead structure installation costs.

Analysis of LPR Screening Scenarios

Mainline Screening

Notification

An issue of primary concern using LPR as a means to accomplish mainline screening of commercial vehicles is driver notification. We have identified two scenarios which would accomplish notification for vehicles that do not have registered transponders: using a sign with a changeable arrow, or using a sign with a list of license plates.

Changeable Arrow

The changeable arrow option offers the best out-of-vehicle notification due to the simplicity of reading its signals. It is unambiguous, can be read by speakers of any language, and can be designed to be viewable only by the intended driver. It works best as an overhead sign, but can be modified to operate at the roadside if stationed behind a guide rail, as it is less effective 30 feet off the travel lane.

The significant downside with this option is that it requires a second LPR to work. It is important that the sign give the correct driver the appropriate signal. The only way to do so is to re-identify the vehicle so that the proper signal is displayed. For mobility purposes, it is theoretically possible to mount this second LPR on the trailer used for the notification transponder reader. However, the requirements for accurately aiming and focusing the camera would make this impossible in many, if not most, circumstances. A permanent installation would yield the most reliable results.

The placement of the signage relative to the camera is also critical since the notification must be synchronized with the passing of the vehicle. One LPR system and associated sign would be required for each lane.

Another major issue with this scenario is that a high rate of repeatability is required. The tests that the Virginia Department of Transportation conducted as well as comments from some system vendors indicate that high repeatability rates would be difficult to achieve. Without real world repeatability tests it seems risky to invest in such a system.

License Plate Notification

The license plate notification option is less costly since additional LPR systems do not need to be installed at the notification location. A standard mobile VMS sign is suitable for displaying the plate list.

There are, however, substantial issues with this type of notification. The plate list itself may be difficult to read, even in good weather conditions. As vehicles move through the system, the sign will constantly be updating, and the order of the plates will constantly be shifting. In low volumes this might be acceptable. At high volumes drivers may not safely be able to read the plates. Another consideration is that drivers of fleet vehicles may not be aware of their cab's plate number. Finally, a bad license plate read will show up on the sign incorrectly. Drivers may be confused by this, or perhaps think they can bypass when they are actually being pulled in. Enforcement will be difficult.

Education

The current transponder registration process is an ideal situation through which to educate drivers regarding the protocol of electronic screening. Drivers with transponders understand what is currently expected of them as they drive through inspection facilities. The drivers we are trying to capture with LPR have not had that education. To safely pass through the facility they will require additional upstream signage indicating that they will be screened. They will also need to know what the arrows indicate or what the license plate signs signify.

There also exists the issue of mixed messages. A driver may get a green light on the transponder, but the arrow or signage may indicate that he/she must pull in (this will occur if there is a bad read such as 0 vs. O). It should be made clear to drivers which technology takes priority.

Multilane Screening

In addition to the cost required to cover each lane with LPR equipment, safety issues must be addressed. Multilane readings occurring at the advance location pose no specific safety risk. However, the use of LPR equipment for multilane freeway screenings would require careful lateral placement of equipment to allow adequate distance for vehicles to exit the freeway at the inspection station.

It is assumed that most commercial vehicles traveling in the left lane of a two-lane freeway will be running at an average speed of 65 mph. The message board should be located an adequate distance downstream from the reader, to allow the commercial vehicle operators to recognize and comprehend the messages directing them to exit. Assuming that the driver would need to comprehend two bits of information (e.g. "license plate number" and "exit for inspection" messages) the distance required would be 350 feet, based on Exhibit 2-27 in the American Association of State Highway and Transportation Officials (AASHTO) A Policy on Geometric Design of Highways and Streets, 2004, which determines that an 85th-percentile driver reacting to two bits of unexpected information would require 3.5 seconds to comprehend and react to that information.

Once notified to exit, the driver would be required to find an adequate gap in traffic to change lanes, and to perform the lane change in sufficient time to prepare for the exit to the inspection station. This distance would vary based on the site conditions including traffic volume, traffic gaps, actual running speeds, and the up- or down-grade of the freeway. A general distance can be determined based on the assumption that this maneuver is similar to a lane reduction scenario.

Based on the NYS Manual of Uniform Traffic Control Devices (NYSMUTCD), a lane reduction for a vehicle moving at 65 mph is initially posted a distance of 500 feet before the actual reduction begins. This allows the driver to identify adequate gaps in traffic and prepare to merge into the traffic stream. The lane reduction is then accomplished over an 800 foot taper for a running speed of 65 mph.

Upon entering the right lane, the driver would need to decelerate to a speed appropriate for exiting the freeway. It is assumed that the inspection stations will be located at existing rest areas with properly-designed deceleration lanes. In any case, a distance of approximately 600 feet should be provided for the commercial vehicle to properly decelerate to a speed of 40 mph before exiting the freeway. The total required distance between the notification sign and the inspection exit point should be 1900 feet. The LPR should be located approximately 350 feet upstream of the notification sign to allow adequate display time for the driver to read and comprehend the message. It should be noted that these distances are based on the general assumptions outlined above, and do not take into consideration site-specific conditions that would necessitate a longer deceleration distance.

This scenario has several safety concerns related to commercial vehicles attempting to quickly exit the traffic stream. Variables related to the placement of signs and equipment may also make this scenario impractical for certain sites. For example, the Schodack site cannot accommodate the 2250 feet required between the LPR and the exit point. Placing a notification LPR at that site would only allow for a 400 foot gap between it and the LPR at the advance location, which cannot be moved further upstream due to its proximity to I90 exit 12. A 400 foot gap would be insufficient for communications and the screening software to make a screening decision.

Ramp Screening

Ramp screening with LPR offers some advantages over the mainline. It is a simpler system requiring less equipment. It operates on a single lane, with lower vehicle speeds, which increases system safety. Since most vehicles with transponders will have already bypassed the site, a large percentage of commercial vehicles will be those without.

While this scenario is perhaps the easiest to mobilize, LPR cameras require precise setup, calibration and aiming. Even systems designed specifically for mobile use take a trained operator at least 30 minutes to set up. Due to system geometry, the notification sign and

the camera may not be collocated. Another consideration is that unless a WIM is installed on the ramp, this scenario will not screen for weight.

Border Screening

Since a border facility is a permanent structure, it is the most likely place to employ LPR technology. The permanent single lane location will allow optimum placement of the camera, and may allow, depending on site geometry, the use of only one camera system. Assuming the site is staffed more regularly than typical inspection sites, routine cleaning of the camera will also be more easily accomplished.

Software

Using LPR for screening will require a substantial degree of software integration. The screening software must be able to accept the incoming license plate, process it against the database, and compare it to its list of transponder readings. Plate reads that do not match with vehicles identified by transponder IDs then need to be run through the screening algorithm. Notification devices will need to be controlled by the screening software as well.

Each scenario described in this report requires a specific software modification. Modifying or procuring software to meet the needs of all of these will increase costs substantially.

Recommendations

We recommend that License Plate Readers not be integrated into New York State's electronic screening program at this time. Although equipment has improved to a degree since the Virginia Department of Transportation performed their study, we agree with their assessment that "Based on the low percentage of correctly identified license plates the LPRs are not suitable for an application that requires a high degree of accuracy such as commercial vehicle enforcement. Therefore the overall conclusion is that the LPRs are not recommended as a viable means of automatic vehicle identification especially in a mobile environment."

We see the integration of LPR into mainline screening as overly complex and expensive with a high chance of yielding unsatisfactory results. The notification systems have a potential to be confusing and unsafe, particularly if there is not a high expectation of correct plate reads. Through vendor questionnaire responses, as well as direct discussion, we have continually heard comments such as "if the camera is perfectly aimed" or "the exact camera required depends on the specifics of each site." When we as systems integrators hear various comments that include "if" and "it depends," we get concerned that when we get the system out in the field there will be one problem after the next.

We don't have any doubt that LPR has useful applications in security, parking, and travel time applications. However, it is not ready for, and in fact may never be best suited for mainline screening. We do have the following recommendations for moving forward:

1. Install LPR as part of a Virtual WIM style installation at the advance location. This LPR should be used primarily as a data collection device and a test bed for future use of the technology at border crossings. The data collected can be post processed to provide a clear reflection of the system's accuracy, and also to capture data on vehicles in violation which do not have registered transponders. These LPR device(s) will not be used for active mainline screening, but fit in with the network-based screening concept to be discussed as part of Task 10.
2. Use the funds that might have been spent on LPR screening and apply them to regional transponder enrollment efforts. Transponders will always offer a safer, more accurate method of commercial vehicle screening.
3. Work with vendors of LPR and screening software to guide them into developing software enhancements to allow the use of LPR for screening at border sites. The goal would be to have the software developed for purchase as opposed to entering into a costly custom development effort.

Appendix I

Vendor Questionnaire

Research into the integration of License Plate Recognition Systems with New York State's Commercial Vehicle Electronic Screening Program

Project Background

Clough Harbour & Associates LLP is working on a project for the New York State Department of Transportation to enhance a previously developed CVISN mobile commercial vehicle electronic screening system. This system allows for commercial vehicles with good safety records, tax records etc. to potentially bypass state inspection sites.

The current system consists of three primary components; an advance reader, a notification reader and a roadside computer. Electronic screening in this system works using an Automatic Vehicle Identification (AVI) transponder to identify vehicles. As a vehicle passes the first AVI reader, the transponder ID is sent wirelessly to the roadside computer where a database check is performed. The vehicle is screened for a variety of criteria. The roadside computer sends the screening results (pass/fail) along with the transponder ID to the notification reader. As the vehicle passes through its range, the notification reader sends a signal to the transponder in the cab of the vehicle, which responds by displaying a red or green light to the driver. If a vehicle gets a red light it must pull in.

Current Project

A significant shortcoming to relying solely on AVI transponders is that not all vehicles have them, or have them enrolled to allow for electronic screening. As part of this project we are researching alternative methods for identifying commercial vehicles for screening as well as data collection.

We have identified two potential scenarios to research the integration of license plate recognition technology into NY's commercial vehicle screening program.

Scenario One – Mainline Screening

The use of license plate recognition for mainline screening would essentially mimic the existing AVI-based system. Commercial vehicles approach the inspection site and have their license plate read. The plate number is transmitted to the roadside computer, which uses it to perform the screening operation. The roadside computer sends the results to a notification site closer to the inspection entrance. As the vehicles approach their plate is

read again and a variable message sign indicates if the driver can bypass or not. Vehicles whose plates cannot be read must enter the inspection site.

Typical layout of this type of screening calls for the initial vehicle read to occur approximately one-half mile prior to the exit to the inspection site. The notification location is approximately one-quarter mile from the ramp.

Scenario Two – Ramp Sorting

Ramp sorting takes place after vehicles have left the highway and are entering the inspection site. They will be traveling at speeds significantly lower than on the highway. The vehicle's plate is read at a point where they can either proceed back onto the highway or pull in to the inspection site. The plate number is again sent to the roadside computer where the screening algorithm is run. The driver is notified by variable message sign, or optionally by inspection personnel.

Questionnaire

The purpose of this questionnaire is to gather research on the feasibility, accuracy and cost of deploying license plate recognition systems for use in commercial vehicle electronic screening systems. We recognize that changes to the software used for AVI-based screening will need to be considered, and we don't anticipate those changes as part of your response. However, if you have, or are aware of an existing solution similar to what we are attempting, particularly for the ramp sorting scenario, please include that information.

1. Scenario One – Mainline Screening

- a) Do you feel that mainline screening as outlined above is feasible?
- b) If not, why?
- c) Are you developing, or do you anticipate advances in technology in the next several years that will better meet our project objectives? Please explain if non-proprietary.
- d) What percentage of plates would your system be capable of successfully reading from two separate cameras? For example, what is the likelihood that if a plate is read by the first camera that it will successfully be read by the second?
- e) What would be the impact of having the cameras pole mounted and located 30 feet off the travel lane of the highway, as opposed to being located on an overhead structure? Is there a maximum distance and lateral oblique angle from the camera to the target?

- f) Will your system read a steady stream of vehicles traveling at highway speeds at the same rate as with lower traffic volumes?
- g) Notification via variable message signage relies on fairly precise timing so that drivers are not confused as to their pull-in status. Does your system output plate numbers sufficiently fast and consistent to accomplish this?
- h) Do you have alternate suggestions for driver notification?

2. Scenario Two – Ramp Sorting

- a) Do you feel that the ramp sorting application as outlined above is feasible?
- b) If not, why?
- c) Will the accuracy of the plate reads be impacted if the camera is placed to the side of the ramp as opposed to on an overhead structure?

3. Other Uses

- a) Is your system able to be utilized for other purposes of interest to NYSDOT while also capturing license plates? Examples would be vehicle dimensioning for over-height and over-width detection, incident management and traffic monitoring.

System specifications

4. Accuracy

Please indicate the percentage of license plate text successfully recognized under the following conditions:

- a) Clear daylight
- b) Clear nighttime
- c) Rain
- d) Snow
- e) Fog
- f) Retro-reflective plate
- g) Non- Retro-reflective plate

- h) Is there any impact due to temperature extremes?
- i) Can your system differentiate different states and provinces?
- j) What occurs when a vehicle read is bad or partial?
- k) Can your system differentiate vehicle classes (e.g. commercial vs. passenger)

5. Timing

- a) What is the processing time from image capture to recognized plate output?
- b) Does your system output a timestamp?
- c) If so, how does the time get synchronized, and to what accuracy is it recorded?

6. Power

- a) What are the system's power requirements?
- b) Can your system be operated by solar power in New York?

7. Communications

- a) What protocols does your system output to? (e.g. RS232, TCPIP)
- b) Does your system support remote monitoring?
- c) If so, how is that accomplished?
- d) What is the output format of the image and license plate text?

8. Data storage

- a) Does your system have the ability to store data internally?
- b) If so, what is the capacity?
- c) Does it support remote downloading of the data?

9. Portability

- a) Our current system is based on a mobile platform. Can your system be easily transported?
- b) Does it require precise aiming or calibration?
- c) Can it handle vibration?

10. Software

- a) Does your system come with any software?
- b) If so please describe its function and/or include and documentation with your reply.

11. Maintenance

- a) What annual maintenance tasks should be performed and on what schedule? Please differentiate maintenance which can be performed by NYSDOT personnel from that supplied by you or others.
- b) What would be the estimated annual maintenance cost?

12. System Cost

- a) Please supply an approximate cost for your system based on each scenario described above. Include all items supplied by you, such as cameras, processors, software, triggering, etc. It is not necessary to include communications equipment or mounting hardware unless specifically required by your system.

13. Other Information

- a) Please include any other information about your system which may be useful in our research.

Task 10 Research Report

*Research and Analysis of Converting the Prototype Roadside Electronic Screening System to a Network Based, Integrated Communications System
(Phase II)*

Commercial Vehicle Information Exchange Window (CVIEW) Roadside Enforcement/Compliance Project

**NYSERDA Agreement Number (6764C-3)
Comptrollers Contract No. (C012668)
NYSDOT Task Assignment (C-01-66C)
PIN (R020.47.881)**

June 7, 2006

Submitted to:

**New York State Energy Research and Development Authority
And
New York State Department of Transportation**

Submitted by:

**Clough Harbour & Associates LLP
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PREFACE

The New York State Energy Research and Development Authority (NYSERDA) is a public benefit corporation created in 1975 by the New York State Legislature. For more than a quarter century, NYSERDA has been working on finding innovative solutions to the energy and environmental issues that face residents of the Empire State. As part of that mission, the Authority has sought answers that would benefit not only New York's energy and environmental future, but the economy as well. To do so, NYSERDA has traditionally partnered with other state agencies, as well as industrial, commercial, environmental and economic development groups all across New York State.

In 1999, the New York State Department of Transportation (NYSDOT) had just completed a three-year contractual research relationship with a consortium of seven New York State universities, colleges and research institutions. Based on the success of that experience, the Department sought to establish additional partnering arrangements with research consortia to carry out basic and applied research, technology transfer, and short-term consultation services in the fields of engineering, operations, public transportation, management and finance, public policy, and human resources.

As a complement to a university-based constituency, NYSERDA organized a Transportation Infrastructure Research Consortium comprised of seventeen private-sector research entities. The membership is characterized as businesses, not-for-profits, and professionals that have a track record of performing transportation-related research, development, and demonstration as a normal part of their service-related or internal operations. Many of the organizations also have strong relationships with universities, state agencies and authorities, and federal funding agencies, and are already performing collaborative research through those relationships.

In June of 2001, New York State Comptroller's Contract C012668 was executed and governs the activities of the NYSERDA-administered Transportation Infrastructure Research Consortium. The term of the agreement is for five years, extending from March 1, 2001 through February 28, 2006. The direct and dynamic linkages between transportation, energy, and the environment have continually reinforced the cooperative relationship formed between NYSDOT and NYSERDA. Since its inception, numerous collaborative efforts have been undertaken and the report that follows is a product of that relationship.

NOTICE

This report was prepared by Clough, Harbour & Associates LLP in the course of performing work contracted for and sponsored by the New York State Energy Research and Development Authority and the New York State Department of Transportation (hereafter the "Sponsors"). The opinions expressed in this report do not necessarily reflect those of the Sponsors or the State of New York, and reference to any specific product, service, process, or method does not constitute an implied or expressed recommendation or endorsement of it. Further, the Sponsors and the State of New York make no warranties or representations, expressed or implied, as to the fitness for particular purpose or merchantability of any product, apparatus, or service, or the usefulness, completeness, or accuracy of any processes, methods, or other information contained, described, disclosed, or referred to in this report. The Sponsors, the State of New York, and the contractor make no representation that the use of any product, apparatus, process, method, or other information will not infringe privately owned rights and will assume no liability for any loss, injury, or damage resulting from, or occurring in connection with, the use of information contained, described, disclosed, or referred to in this report.

Introduction

The purpose of this task was to research transforming the existing prototype mobile CVIEW Electronic Screening system into an integrated network based communication system. Throughout the research for this and previous tasks it became clear that the key components to make network compliant are those located at the advance location. While using network based communication for traditional mainline screening may have advantages in some wireless settings, it is unnecessary for achieving the goal of network-based screening and data collection.

We have researched ModelMACS under this context, identified its deficiencies, and indicated corrective actions for it to work properly within the context of a networked environment. We have looked at alternatives to Model MACS, including commercially available software and custom development.

We have also developed conceptual diagrams and an analysis of system components necessary to integrate a project such as the In-Bond Container Visibility Project proposed by Johns Hopkins University.

Screening Software

During earlier phases of this project a number of deficiencies and limitations with the ModelMACS electronic screening software were identified. We have identified three options for correcting those deficiencies, as well as enhancing the software to meet the present and future needs of NYSDOT's electronic screening program.

Option 1 – Upgrade ModelMACS

The process of upgrading ModelMACS was begun in 2004 with the creation of a ModelMACS User Group. It was formed as a loose group of representatives from NORPASS, Northrop Grumman (the current software developer for ModelMACS), states using ModelMACS, and Clough Harbour & Associates LLP.

The group met sporadically in 2004 and identified immediate, short-term, and long-term needs for the software. However, the group has not met since. The next step identified within the meetings was for Northrop Grumman to evaluate costs to upgrade ModelMACS, but this step was never completed. This effort would have addressed the deficiencies listed below, as well as wish list items from other states. Attempts in the early part of 2006 to restart the User Group have not been successful to date.

ModelMACS Deficiencies:

- The ModelMACS database is obsolete and no longer supported. Users are required to purchase a license of Interbase, but the version on which the database is written is no longer available.

- Corrective Action

Update ModelMACS with a new database engine.

- Degree of Difficulty

Updating the database would be a substantial endeavor since it is essentially the “guts” of the system. The true effort would depend on the selected replacement database. Northrop Grumman identified the two lowest cost options as Interbase 7, a replacement which would require the purchase of a license for each user, and IBPhoenix (aka Firebird), an open-source database built on Interbase requiring no licensing fee.

Migrating to other databases such as MySQL, Oracle or MSDE would require a substantial reworking due to the amount of programming written in and around Interbase.

- Relative Importance

High – The database must be updated for ModelMACS to be a viable eScreening software.

- The software does not have the ability to accept user fields for screening.

While this issue can be worked around by preprocessing the screening snapshot and using a single existing field for setting flags, inspectors will have no way of knowing which screening flag was violated, nor will it be stored correctly in the logs.

- Corrective Action

Add five user fields to ModelMACS. This change would require alterations to the database structure to accommodate the extra fields, as well as the field definitions.

- Degree of Difficulty

While these changes could be time consuming, they would not require alterations to the screening algorithm or communications protocols, and therefore would be relatively easy to accomplish.

- Relative Importance

High – This must be corrected to achieve the desired functionality for electronic screening in New York.
- Lack of Windows XP compatibility.
 - Corrective Action

Upgrade the database (see above) and recompile the application.
 - Degree of Difficulty

This is a fairly straightforward programming change.
 - Relative Importance

High – This must be corrected for ModelMACS to be a viable screening software. Older operating systems are no longer being fully supported, and cannot be purchased with new computer equipment.
- Inability to support multiple hardware vendors.
 - Corrective Action

Change ModelMACS from supporting devices via hard coding (i.e. device support would be written directly into the program code) to using a “driver” paradigm. Each device could have a “driver” which would allow it to communicate with ModelMACS.
 - Degree of Difficulty

Moderate – This approach would require research of other vendors’ protocols, some of which may be proprietary.
 - Relative Importance

Moderate – Most hardware vendors claim to be able to output the format required by ModelMACS. This has yet to be seen, and may impact system cost if the selected vendor has to develop the internal software for its devices.
- Inability to support other screening inputs, particularly License Plate Recognition (LPR).

- Corrective Action

Add additional device types to the communications set. Screen vehicles based on those devices, and send notifications to appropriate signage based on the results.

- Degree of Difficulty

Moderate – While the screening algorithm would remain basically unchanged, substantial logic would need to be created. The system must know if a vehicle has already been screened via a transponder, and only notify the vehicle via the transponder. Plate reads that have one incorrect character could still be utilized if “fuzzy logic” is used to determine whether there is a unique match in the database.

- Relative Importance

If LPR is to be utilized for electronic screening, this would be a high priority. If not, it would be a low priority, but desired for future functionality.

- Station log reports are truncated. Improved export options are desired.

- Corrective Action

Modernize the reporting functionality of Model MACS.

- Degree of Difficulty

Low

- Relative Importance

Moderate – Screening logs should be in a format readable by other applications as well as the human eye.

- With long-term use, ModelMACS data files could expand to fill up the Roadside Operational Computer (ROC) hard drive.

- Corrective Action

Upgrade ModelMACS with a new database engine

- Degree of Difficulty

Substantial (see first bullet under ModelMACS Deficiencies heading above).

- Relative Importance

High – ModelMACS’ database performance capacity needs to be at modern standards.

- TRW (now Northrop Grumman) developed a two lane version of ModelMACS for the state of Connecticut. The User Group requested support for additional lanes.

- Corrective Action

Add capacity in ModelMACS to support more lanes.

- Degree of Difficulty

Northrop Grumman states that adding support for additional lanes would be a simple change. However, hardware limitations may come into play. Currently available Dedicated Short Range Communications (DSRC) readers support up to four antennas. Reading additional lanes may therefore require additional readers, which would also require additional communications ports. Weigh-in-Motion (WIM) systems would also require additional processors for each lane added.

- Relative Importance

This change is not currently a high priority in NYS. Two lane screening will suffice in most locations. Traditional screening in two or more mainline lanes may cause dangerous vehicle weaving, as vehicles assigned to pull-in to the station attempt to merge to the rest area ramp. Border crossing facilities will also most likely be single lane.

- Add network based communications (TCP/IP).

1. Screening Hardware (WIM, AVI, etc) to ROC

- Corrective Action

Replace serial communications with TCP/IP communications.

- Degree of Difficulty

Substantial – This would require an overhaul of ModelMACS communication. More significantly, it would also require hardware vendors to upgrade their equipment.

- Relative Importance

Low – Having ModelMACS (or any screening software) communicate with the hardware devices via TCP/IP is not necessary to develop a network based system. These communications are for real-time use by the screening system. The hardware devices themselves need to be TCP/IP compatible. Also, it is possible to take a serial data source, convert it to TCP/IP for transmission, and then convert it back to serial.

2. Internet to ROC

- Corrective Action

Add a web service to ModelMACS to allow for remote monitoring.

- Degree of Difficulty

Moderate – This action would require additional programming, a web server running on the ROC, and a reliable high speed Internet connection.

- Relative Importance

Low – This solution would be aimed at fixed weigh stations that have ModelMACS running at all times. It would be of little use in a mobile environment, though it may provide limited benefit at the border.

Time Frame:

Most likely a new version of ModelMACS could have been produced by Northrop Grumman during the 1.5 years that the User Group has been inactive. ModelMACS is not a priority for Northrop Grumman, and would have to be scheduled behind other projects. Due to the inactivity of the User Group, Northrop Grumman has yet to provide a time estimate for updating ModelMACS.

Costs:

Due to the inactivity of the User Group, Northrop Grumman has yet to provide a cost estimate for updating ModelMACS.

Option 2 – Create NYS Custom Screening Software

This option would call for a custom commercial vehicle screening application to be developed for the State of New York.

- Advantages:

All electronic screening features requested by NYSDOT would be included.

NYS would be able to control the development cycle, and institute changes and upgrades as the need arises.

- Disadvantages:

Custom software would involve a long development time. In addition to the programming effort, rigorous testing would be required before going live with the initial version.

This approach would entail high development and maintenance costs, which would be solely incurred by NYS. Other options would allow for cost sharing.

- Time Frame:

One year from needs assessment to having a tested version ready for use in the field.

- Cost

The ultimate cost to develop a complete custom electronic screening system would depend on the desired features of the program. These features would be determined through a needs analysis completed prior to system development. Based on currently identified needs and existing software functionality, we estimate a minimum cost to \$200,000.

Option 3 – Replace with Other Existing Software

There are several alternative electronic screening software packages available:

- Johns Hopkins

An early version of an electronic screening software was developed by the Johns Hopkins Applied Physics Lab. This software is currently in use in Maryland, but they are looking to replace it due to major inadequacies. It is the precursor to ModelMACS.

- PrePass

PrePass screening software is available to PrePass states only, so it is currently not applicable to NYS.

- iROC

International Road Dynamics (IRD) has a commercially available electronic screening software package called iROC. Based on documentation and discussion with IRD this software appears to meet the majority of NYSDOT needs.

Time Frame – This software is available immediately.

Costs –

Software	
Single License	\$ 49,000
Block of 5 Licenses	\$ 180,000
State Wide Licensing	\$ 300,000
Annual Maintenance	
Single License	\$ 5,000
Block of 5 Licenses	\$ 20,000
State Wide Licensing	\$ 30,000

- Mettler Toledo

Mettler Toledo provides integrated mainline and virtual WIM systems which include proprietary screening software. While their focus is primarily on low speed ramp sorting solutions, they do offer high speed mainline capability. Mettler Toledo uses single load cell WIM systems exclusively.

Costs - Mettler Toledo's software is included in the purchase of integrated weigh station systems.

Convert the Existing System to a Network-Based Platform

To achieve the maximum benefits of a network based communications platform, particularly one that will serve as a foundation for future operations such as data collection, virtual weigh stations, and freight tracking, a permanent installation of equipment at the advance location would be required. Please refer to Task 8 for information on WIM in relation to network based operations.

System Deficiencies

The Information Systems Laboratories (ISL) DSRC reader has no built-in data storage, and only one serial communication output.

- Corrective Action:

Replace the Advance Reader with a next generation transponder reader that has onboard data storage and remote retrieval via TCP/IP, can be remotely monitored via TCP/IP, and can operate with existing and future electronic screening software. Add a rear facing antenna to capture cargo seals.

- Degree of Difficulty:

Low – Next generation readers are currently available to meet system needs. They support up to four individual antennas.

- Relative Importance:

High - Modifying the existing ISL readers will be more costly than purchasing new ones. The current ISL readers will not meet the system needs.

Readers will need to be permanently on site to support continuous data collection.

- Corrective Action

Permanently install a next generation transponder reader at the advance location. The installation would need to be coordinated with the WIM installation, since the location is critical to allow synchronization of the WIM reading and the transponder reading.

- Degree of Difficulty

Low – Next generation readers are currently available to meet system needs. They support up to four individual antennas.

- Relative Importance

Moderate – The next generation readers can be mounted on the existing mobile platforms and left at the roadside indefinitely as an alternative to permanent installation.

Time Frame

Next generation replacement readers are currently on the market and are simple to install, including installation on the mobile platform.

Cost \$10,000 including wireless Internet communications.

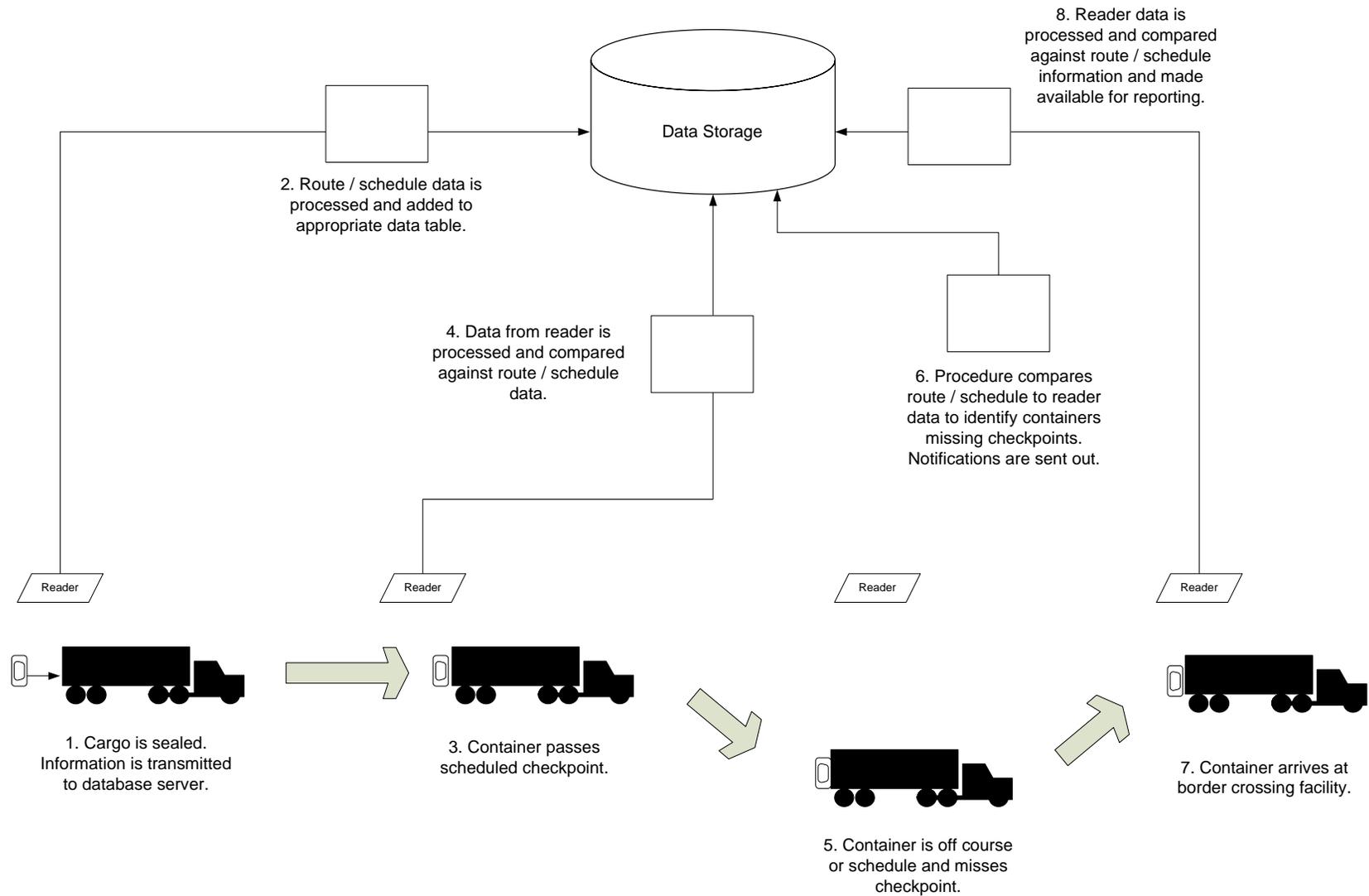
In-Bond Container Visibility Project Issues Assessment

In order to perform a viable in-field demonstration and test of the freight container tracking concept, NYS would need to deploy additional equipment as well as computer hardware and software components. With the exception of DSRC equipment along the NYS Thruway at Coxsackie, there is no infrastructure currently in place to support freight tracking in New York. Due to the limitations of the existing ISL DSRC readers (e.g., lack of onboard data storage, and lack of remote access capability), they have little value for this effort without substantial and costly modification. Next generation DSRC readers are available which will meet the needs of a freight container tracking system as well as modern commercial vehicle electronic screening programs. Please refer to the Task 8 report for additional details on next generation readers.

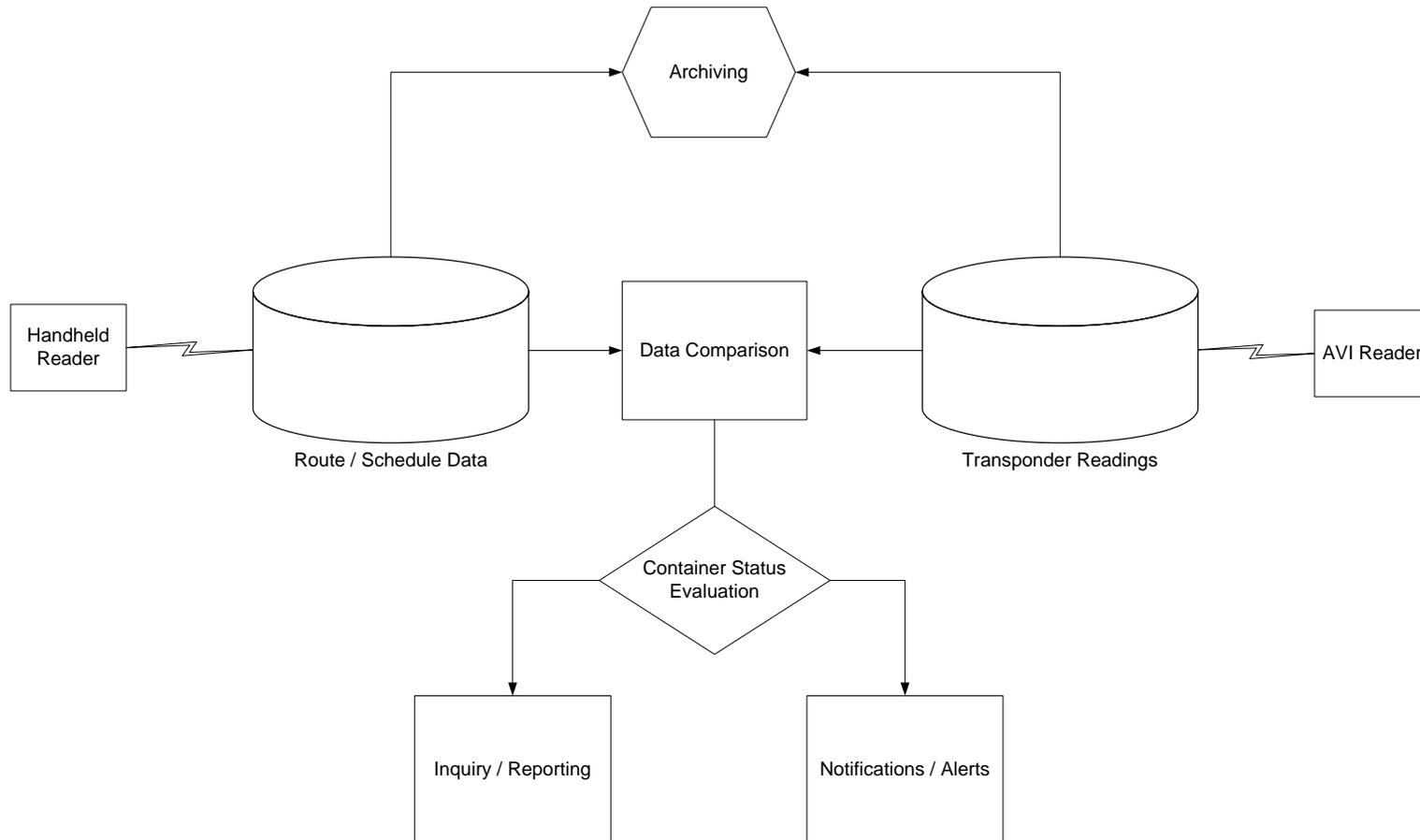
A central database would also need to be established to manage and store container tracking data transmitted from the DSRC readers. Ideally, the database would be deployed on an existing NYSDOT server if available. A communications protocol, and procedures for processing and comparing these readings against proposed route and schedule data, would also need to be developed. We also recommend development of a user interface application designed to facilitate data analysis and generate report output.

NYSDOT may be able to realize some cost savings in implementing a freight container tracking system by housing the database on a pre-existing server available through Port Authority of New York and New Jersey or another agency. This would allow NYSDOT to minimize the time and money required to purchase and configure new server hardware and database management software. However, this would not impact the cost and effort associated with developing the database structure itself or any associated procedures.

In Freight Container Tracking Conceptual Process Flow Diagram



In Freight Container Tracking Conceptual Data Storage and Processing Architecture Diagram



Recommendations for Converting or Replacing ModelMACS

We recommend the purchase a commercial electronic screening software package. There are three primary benefits to this approach:

- 1) Commercial software is available now. Custom development may take one year or more. Waiting for ModelMACS to be updated may take longer, with a fair degree of uncertainty for future maintenance.
- 2) Annual maintenance fees help software keep up with changing technologies in addition to allowing new features to be added based on user recommendations. These fees are known annual costs which can be budgeted for.
- 3) Costs of updating the software are spread out among all users, greatly reducing long term software costs.

The primary disadvantage of commercial software is that NYS would be locked into a single vendor whose software may work exclusively, or most effectively, with that vendor's hardware. Annual maintenance costs would have to be budgeted for.

We recommend maintaining involvement with the ModelMACS User Group. Despite its current deficiencies, ModelMACS is a capable software package with solid functional logic. If the User Group is able to bring about the needed changes, and can establish a cost effective way to deal with future maintenance, ModelMACS may once again become a viable choice for electronic screening in New York State.

Recommendations for Converting the Existing Self-contained System to a Network Based Communications System

The most important location in the electronic screening system is the first set of sensors the vehicle crosses. These devices, including the Advance DSCR Reader and WIM, are the primary data gathering tools for use not only in making the screening decision, but also for the collection of useful data.

The notification reader or other downstream device serves the sole function of providing notification to the vehicle's driver, and therefore networking these devices is a substantially lower priority. While changing the communications protocol from serial- to network-based may have some advantages when using wireless communications in certain circumstances, it is not necessary to redesign the hardware and screening software.

The Roadside Computer also requires a network connection to receive screening snapshots and upload screening logs. This is accomplished using standard PC networking techniques and would require no change to the system.

Our recommendations are as follows:

1. A key specification for all equipment purchased for electronic screening is the capability to:
 - a. Store data internally
 - b. Communicate via TCP/IP networking protocol
 - c. Communicate with electronic screening software
 - d. Accurately timestamp data
 - e. Be remotely monitored
 - f. Come supplied with software for automatic data retrieval to a network database
2. For the existing prototype system, replace the ISL DSRC Advance Reader with one meeting the above specifications. The ISL reader can be utilized as a Compliance Reader or as a Notification Reader in another system.
3. Equipment at the advance location such as the WIM and DSRC reader should be permanently installed, allowing for both full-time data collection and electronic screening as needed. The rest of the system may continue to be mobile, with the exception of permanent locations such as border crossing facilities, where permanent installation of all equipment is recommended.
4. Establish reliable network communications to equipment at the Advance Reader location. This could be accomplished via several methods which would be site specific. A site having direct access to high speed Internet such as cable, DSL or fiber optic should utilize those resources. A site requiring substantial trenching or long cable runs may be better suited to wireless data access if available.

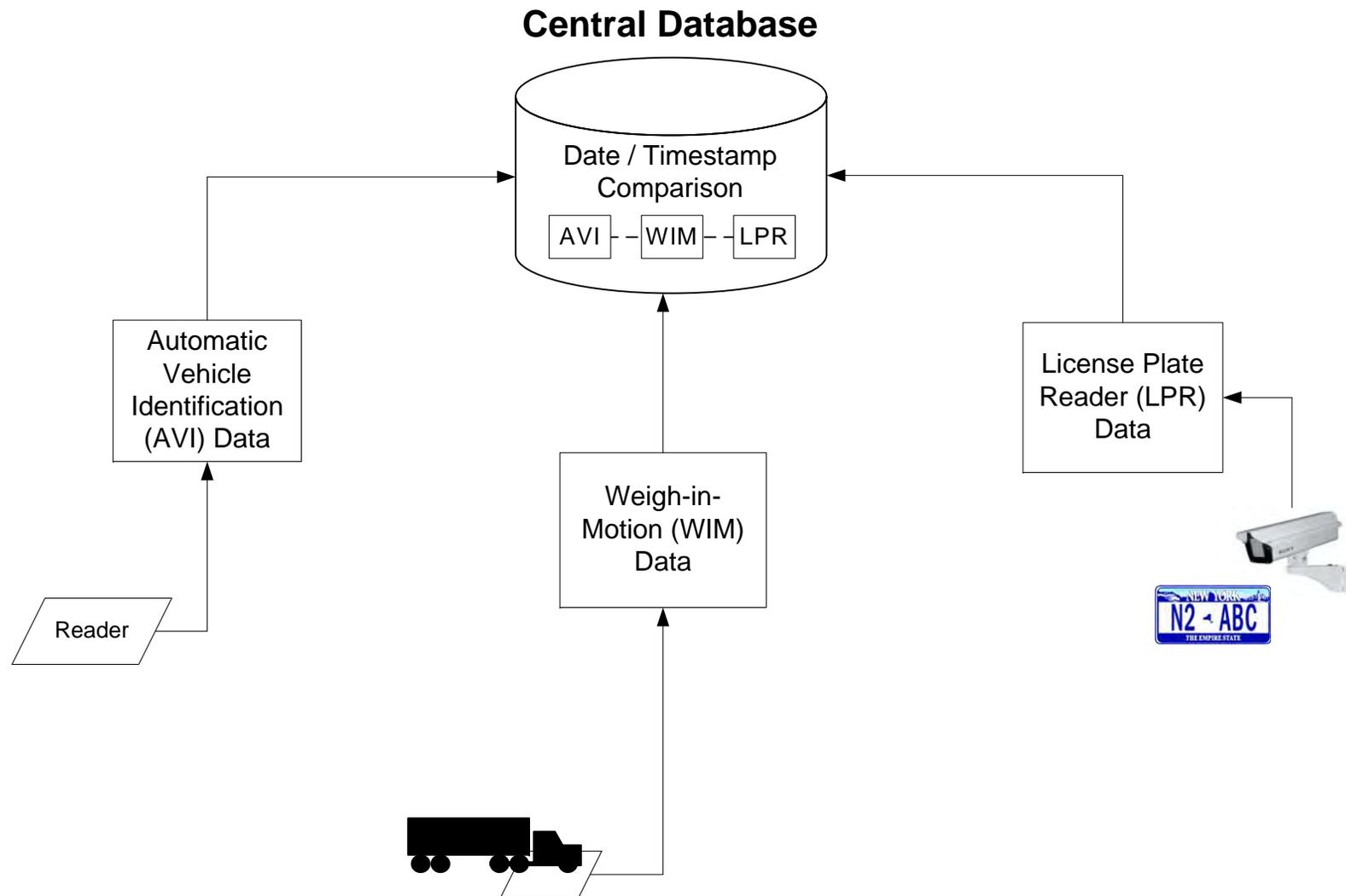
CVISN Electronic Screening from a Central Network Server

CVISN Electronic Screening from a central network server differs from standard roadside screening in that the screening decision takes place not on a ROC but in a central database.

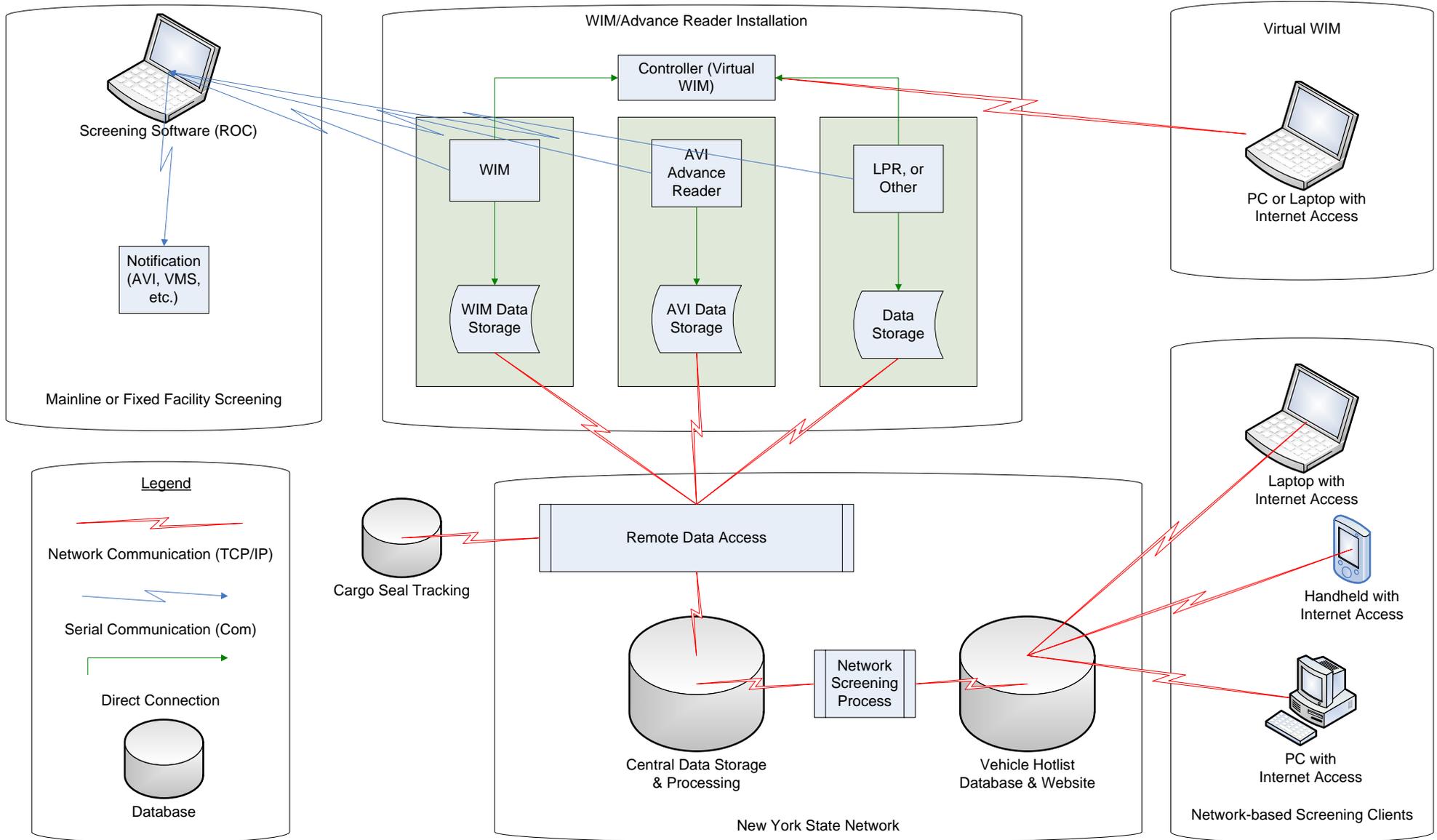
The data collected from devices such as WIM and AVI readers at the advance location of roadside screening sites or virtual WIM locations would be joined together by location and timestamp. The data for each vehicle would then be processed against the CVIEW snapshot data to create a “virtual pull-in list”. This list could then be accessed via standard database reporting, or via a secure web portal. The list could also be loaded into standard roadside screening ROCs as vehicle hotlists, causing those vehicles to receive pull-in decisions.

Vehicles records on the “virtual pull-in list” would expire after a period of time to be determined by operational needs. Vehicles subsequently pulled in for inspection would also be cleared from the list.

eScreening Data Collection Configuration



Concept: Network-Based Commercial Vehicle Electronic Screening



Costs

The costs associated with developing network based screening are difficult to determine, since key components such as the central database and web portal will likely be part of a more comprehensive data solution for NYSDOT. Ultimate costs will be driven by the results of the needs assessment and implementation plans outlined below.

1. Integration and Configuration for E-Screening Data Collection \$30,000

This cost includes installation and configuration of data retrieval software for three equipment types: WIM, AVI and LPR; development of any processes necessary for data formatting; and integration of the data into a common standard format such as an Microsoft Access database which may then be accessed by other software programs, or integrated into a central NYSDOT database.

2. Organizational Needs Assessment for Central Data Storage and Retrieval \$30,000

The organizational needs assessment is a high level document developed by working with NYSDOT to determine the organizational needs and required data flow processes for centralized data storage and retrieval. This is a necessary first step that would occur prior to the development of detailed specifications and implementation plans.

3. System Specification Development and Implementation Plan \$125,000-\$380,000

The System Specification Development and Implementation Plan provides detailed documentation and recommendations regarding the architecture of the central data storage and retrieval system. It includes details regarding the data inputs required from within the department as well as from other agencies. It outlines the hardware and software requirements for data storage as well as for end-user applications. It also includes an action plan and expected associated timeline for implementing the system. The ultimate cost to develop the plan will depend largely on the results of the organizational needs assessment.

Advantages

- Network based screening would supplement, rather than replace, the current roadside system. It would allow greater flexibility and a near real time view of violations on a state-wide level.
- At minimum, the data collection and analysis portions of network based screening would be required to capture data on violations that occur when inspections are not active.

- Network based screening would allow for the collection of data far from the inspection site, or in locations where inspection sites are not practical.
- Mobile units could potentially be used to pull over flagged vehicles using handheld DSRC readers or license plate entries.

Disadvantages

Network based screening cannot replace the direct communications of traditional roadside electronic screening, due to the lag time of data transfer as well as processing to and from the central database. Future improvements in wireless connection speeds and bandwidths may allow for this, and will have the potential to reduce the implementation costs of mainline electronic screening sites.

The New York State Police have indicated concern that network based screening and virtual WIM sites may raise issues with probable cause. They say that unless they physically observe a violation they cannot pull over a vehicle regardless of remote monitoring or data collection. While this does not reduce the value of such systems for data collection and analysis, the probable cause issue will need to be legally reviewed prior to using virtual WIM sites to pull over vehicles, or developing network based screening systems.

Development Time

Network based screening can be developed in phases as noted below. The first two phases are required for collection and analysis of vehicle data and should be developed soon after the deployment of the data collection devices. We estimate that effort would take four months. The remaining three phases are dependent upon the results of the organizational needs assessment and development plan, which will determine in more detail the desired features, costs and development time required.

1. Develop database tables for storing data from each device (WIM, DSRC, etc.).
2. Develop procedure in database for merging records from each device based on the timestamp of the data. Store in a database table (event table).
3. Develop screening algorithm in database to develop hotlist of violators and set a violation flag in the event table. Develop hotlist table in database to store violators. This hotlist table would be used to view current violators.
4. Develop web server application for inspection and enforcement personnel to view, and search hotlist data by license plate.
5. Deploy handheld DSRC readers, enabling enforcement or inspection personnel to detect hotlisted vehicles with transponders.

Task 14

Revisions to the Conceptual High Level Design Diagram (Phase II)

Commercial Vehicle Information Exchange Window (CVIEW) Roadside Enforcement/Compliance Project

NYSERDA Agreement Number (6764C-3)

Comptrollers Contract No. (C012668)

NYSDOT Task Assignment (C-01-66C)

PIN (R020.47.881)

June 28, 2010

Submitted to:

**New York State Energy Research and Development Authority
And
New York State Department of Transportation**

Submitted by:

**Clough Harbour & Associates LLP
III Winners Circle, Albany, New York 12205**

PREFACE

The New York State Energy Research and Development Authority (NYSERDA) is a public benefit corporation created in 1975 by the New York State Legislature. For more than a quarter century, NYSEDA has been working on finding innovative solutions to the energy and environmental issues that face residents of the Empire State. As part of that mission, the Authority has sought answers that would benefit not only New York's energy and environmental future, but the economy as well. To do so, NYSEDA has traditionally partnered with other state agencies, as well as industrial, commercial, environmental and economic development groups all across New York State.

In 1999, the New York State Department of Transportation (NYSDOT) had just completed a three-year contractual research relationship with a consortium of seven New York State universities, colleges and research institutions. Based on the success of that experience, the Department sought to establish additional partnering arrangements with research consortia to carry out basic and applied research, technology transfer, and short-term consultation services in the fields of engineering, operations, public transportation, management and finance, public policy, and human resources.

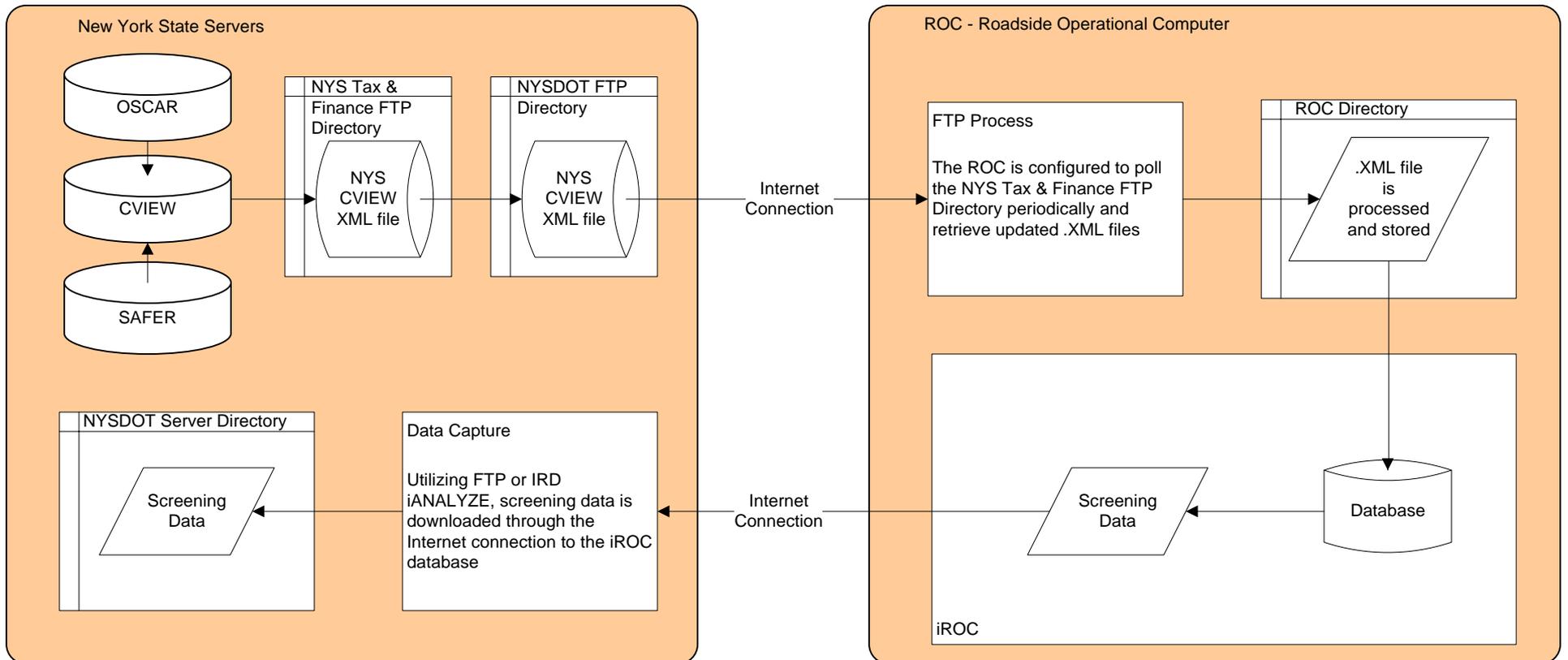
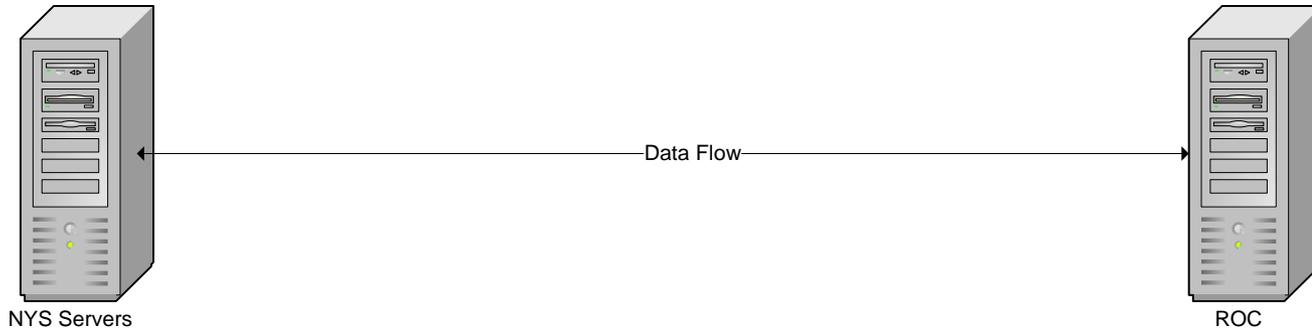
As a complement to a university-based constituency, NYSEDA organized a Transportation Infrastructure Research Consortium comprised of seventeen private-sector research entities. The membership is characterized as businesses, not-for-profits, and professionals that have a track record of performing transportation-related research, development, and demonstration as a normal part of their service-related or internal operations. Many of the organizations also have strong relationships with universities, state agencies and authorities, and federal funding agencies, and are already performing collaborative research through those relationships.

In June of 2001, New York State Comptroller's Contract C012668 was executed and governs the activities of the NYSEDA-administered Transportation Infrastructure Research Consortium. The term of the agreement is for five years, extending from March 1, 2001 through February 28, 2006. The direct and dynamic linkages between transportation, energy, and the environment have continually reinforced the cooperative relationship formed between NYSDOT and NYSEDA. Since its inception, numerous collaborative efforts have been undertaken and the report that follows is a product of that relationship.

NOTICE

This report was prepared by Clough, Harbour & Associates LLP in the course of performing work contracted for and sponsored by the New York State Energy Research and Development Authority and the New York State Department of Transportation (hereafter the "Sponsors"). The opinions expressed in this report do not necessarily reflect those of the Sponsors or the State of New York, and reference to any specific product, service, process, or method does not constitute an implied or expressed recommendation or endorsement of it. Further, the Sponsors and the State of New York make no warranties or representations, expressed or implied, as to the fitness for particular purpose or merchantability of any product, apparatus, or service, or the usefulness, completeness, or accuracy of any processes, methods, or other information contained, described, disclosed, or referred to in this report. The Sponsors, the State of New York, and the contractor make no representation that the use of any product, apparatus, process, method, or other information will not infringe privately owned rights and will assume no liability for any loss, injury, or damage resulting from, or occurring in connection with, the use of information contained, described, disclosed, or referred to in this report.

CVIEW Electronic Screening Data Flow Diagram

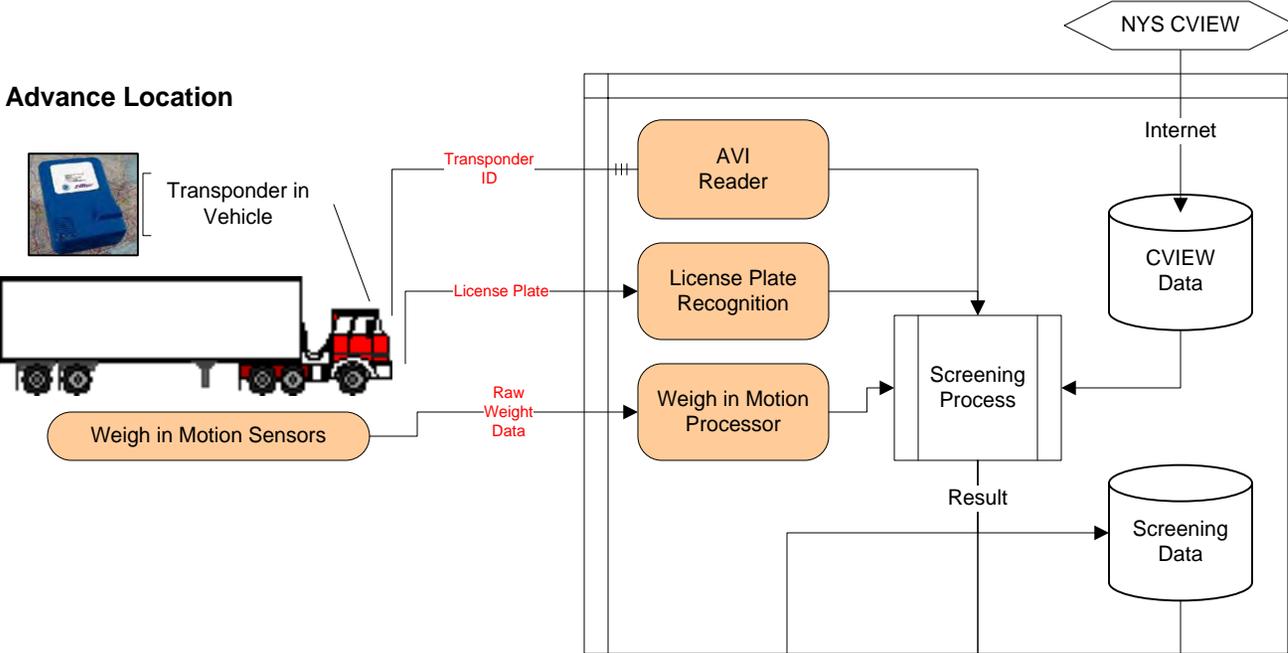


CVIEW Electronic Screening Process Flow Diagram

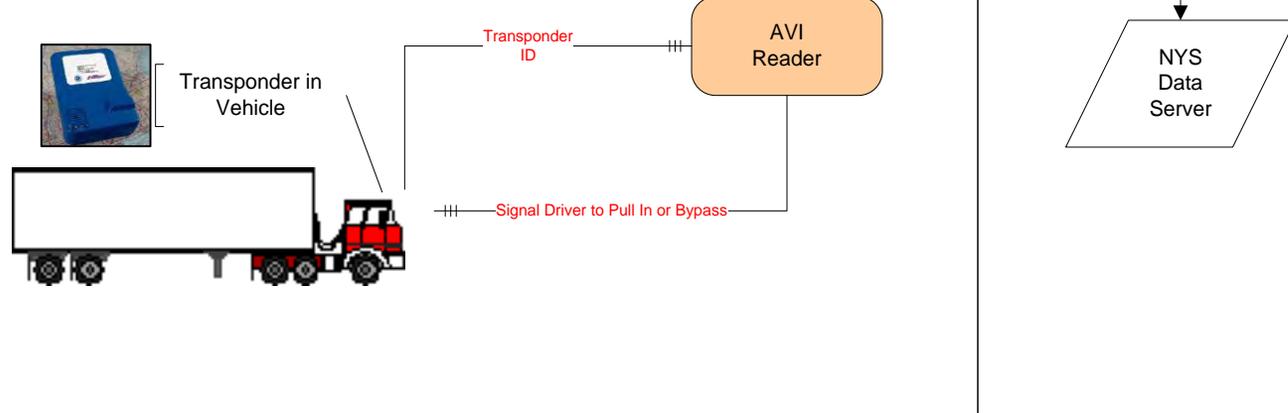
Site Overview



Advance Location



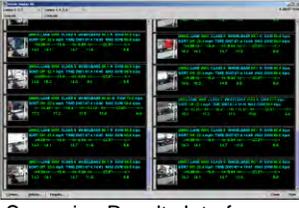
Notification Location



Remote Location



Inspection Location



Internet

Screening Process Overview

A commercial vehicle approaching an active screening location is notified and then directed by signage to move to the right hand lane. For two lane undivided roads, vehicles are simply notified of an inspection ahead.

There are two User Display options for viewing the Virtual Weigh in Motion (WIM) site data. The first option is to use a Web browser to view the Virtual WIM Web site. The second option is to use the IRD Electronic Screening program, which is a stand-alone application that runs on the MS Windows operating system. This functional description covers the operation of the IRD Electronic Screening software application. Viewing the Virtual WIM data using the Web site provides most of the same information with the exception of CVISN screening details. The Web interface only indicates when a Credential failure has occurred, but presents no details regarding the reasons for the failure.

A vehicle passing through the IRD Electronic Screening system is processed as follows:

1. Vehicles in the right hand lane passing over the piezo-loop-piezo sensors and the loop-Kistler-Kistler-loop sensors have their axle spacings, axle weights, axle configuration, vehicle speed, vehicle weight and GVW recorded. This information is used for data collection only. Each vehicle's data is matched as the vehicle travels over each set of WIM sensors, so there will be one vehicle ID number associated with all of the data for a given vehicle.

Vehicles travelling on the opposite side of the highway will pass over piezo-loop-piezo sensors, and their WIM data will also be recorded.

2. Commercial vehicles travelling in the left hand lane will be detected by the piezo-loop-piezo sensors in that lane. The WIM data from this lane can be shown on the Operator Display, and a warning indicating that a commercial vehicle is travelling in the wrong lane will be displayed.

3. When vehicles reach the loop-scale-piezo-loop sensors, again their WIM data is measured. A vehicle passing over the first loop also triggers the License Plate Reader (LPR) system to capture an image of the vehicle's license plate, an overview image of the vehicle and a reading of the license plate and jurisdiction.

Vehicles with AVI transponders transmit their identification information to the Roadside Operating Computer (ROC). If a vehicle has had a successful license plate read by the LPR system, this information will be sent to the ROC. The ROC system uses the transponder ID number or license plate number to look through the CVIEW database for the records of the vehicle and carrier that match the transponder ID or license number.

Knowing the length of the vehicle, the number of axles, and the distance between axles, the IROC determines the class of the truck by comparing it to vehicle classification tables. It then compares the measurements for the vehicle against the state class compliance table to identify any violations. Overweight and over length vehicles are subject to optional permit checks.

With the information from the vehicle and carrier records, the system performs compliance, credential and safety checks and, in combination with the WIM measurements, determines whether the vehicle should be directed to report or bypass the inspection station. The IROC maintains hot-lists of vehicles and carriers that must report regardless of compliance and credentials.

In addition to the screening functions described above, the Station Control System can be set for random pull-ins. The operator defines a random selection percentage for vehicles that otherwise may not have been directed to report.

Figure 1 below shows the main Vehicle Display Screen. Each column of data represents a lane. Vehicle images may not be available for all lanes (depending on system configuration), and for some lanes there may be a choice of images

displayed on this screen (for example, vehicle overview image or license plate image).



Figure 1 - Vehicle Display Screen

By clicking on any vehicle record window on the screen or the Vehicle button at the bottom of the screen, the operator can view detailed information on a specific vehicle. Figures 2, 3 and 4 show examples of the detailed weight information, CVISN data and vehicle images that can be viewed in the Vehicle Detail screens.

4. When an AVI equipped vehicle reaches the In-Cab Notification antenna location, the sorting decision is transmitted to the vehicle operator directing them to either report or bypass. There is no method of signaling vehicles without AVI transponders to report, aside from signing on the roadside.

If a violation or random selection has occurred, the vehicle is instructed to report. If an AVI equipped vehicle has been directed to report and continues on in the bypass lane instead, the AVI Compliance antenna detects this and the station Operator is notified with a Warning indicator on the vehicle record display.

The workstation displays the reasons why a vehicle is being signaled to report. Records of vehicle and carrier information are stored on the Workstation for a specified time and are available for viewing by any operator.

Operators with the appropriate access privileges can adjust the screening criteria, credential overrides, and system settings. All users can view this information.

Original Screening Results

Vehicle

(4) LANE Ramp WIM CLASS 11 TOTAL AXLE SPAN 42.9 ft GVW 60.8 kips BAR L JONES
 Report SPEED 21.7 mph TIME 11:24 MAX GWV 74.0 kips
 6.9 16.4 9.8 9.8
 14.3 14.1 14.7 11.0 6.6
 Credential Failed

Previous
Next

Results	Identification	Images									
Axle	Spacing(ft)	Left Wt	Right Wt	Total Wt	Allowed ...	Permit Wt	Permit Spa..	Violations	Grp	Total wt	Perm wt
1				6.6	2.5			No violation	1	6.6(s)	
2	9.8			11.0	20.0			No violation	2	11.0(s)	
3	9.8			14.7	20.0			No violation	3	14.7(s)	
4	16.4			14.1	20.0			No violation	4	14.1(s)	
5	6.9			14.3	20.0			No violation	5	14.3(s)	

GVW: 60.8
WIM Compliance

Random Pull-In:
 Errored Vehicle:
 Overheight:
 Overlength:
 Overweight:

Hotlists

Type Use
 Vehicle:
 Carrier:

Potential Violations

Ovrd	Used	Credential/Safety Item	Vehicle/Snapshot Value	Screening Value
<input type="checkbox"/>	<input checked="" type="checkbox"/>	IFTA License is Expired		Jul 01, 2004 10:50:37
<input type="checkbox"/>	<input checked="" type="checkbox"/>	Out-of-State and No IFTA Credential	60785	26000
<input type="checkbox"/>	<input checked="" type="checkbox"/>	IRP Registration is Invalid	INV	
<input type="checkbox"/>	<input checked="" type="checkbox"/>	IRP Registration is Expired		Jul 01, 2004 10:50:37
<input type="checkbox"/>	<input checked="" type="checkbox"/>	Out-of-State and No IRP Credential	60785	26000

Warnings:

Snapshots: Vehicle... Carrier... Overrides: Vehicle... Carrier... Screening Criteria...

International Road Dynamics Inc. Close Screen Again... Print Report

Figure 2 - Vehicle Results Detail Screen

Original Screening Results

Vehicle

(10089) LANE WIM CLASS 9 WHEELBASE 56.17 ft GVW 60.8 kips
 SORT Off 22.0 mph TIME 2007-07-4 15:03 MAX GVW 80.0 kips
 6.92-16.42-9.83-23.0-
 14.3 14.1 14.7 11.0 6.6

Previous
Next

Results Identification Images

Transponder Information

Tag ID:
 VIN:
 Carrier:
 Driver:

◀ ▶ ◀ ▶ Snapshots: Vehicle... Carrier...

LPR Information

License: SD FAT033 SD FAT033
 VIN: FATVIN33
 Carrier: FATCARRIER33 Carrier Number33

◀ ▶ ◀ ▶ Snapshots: Vehicle... Carrier... Driver...

Used for Screening

Tag ID: SD FAT033
 VIN:
 Carrier:
 Driver:

Snapshots: Vehicle... Carrier... Overrides: Vehicle... Carrier... Screening Criteria...

International Road Dynamics Inc. Close Screen Again... Print Report

Figure 3 - Vehicle ID Details Screen

Original Screening Results

Vehicle

(4) LANE Ramp WIM CLASS 11 TOTAL AXLE SPAN 42.9 ft GVW 60.8 kips BARRY LEE JOHNSON
Report SPEED 21.7 mph TIME 11:24 MAX GWV 74.0 kips
6.9 16.4 9.8 9.8
14.3 14.1 14.7 11.0 6.6
Credential Failed

Previous
Next

Results Images



International Road Dynamics Inc.

Close Print Report

Figure 4 - Vehicle Images Detail Screen

Task 15

Revisions to the Detailed High Level Design Diagram (Phase II)

Commercial Vehicle Information Exchange Window (CVIEW) Roadside Enforcement/Compliance Project

NYSERDA Agreement Number (6764C-3)

Comptrollers Contract No. (C012668)

NYSDOT Task Assignment (C-01-66C)

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Submitted to:

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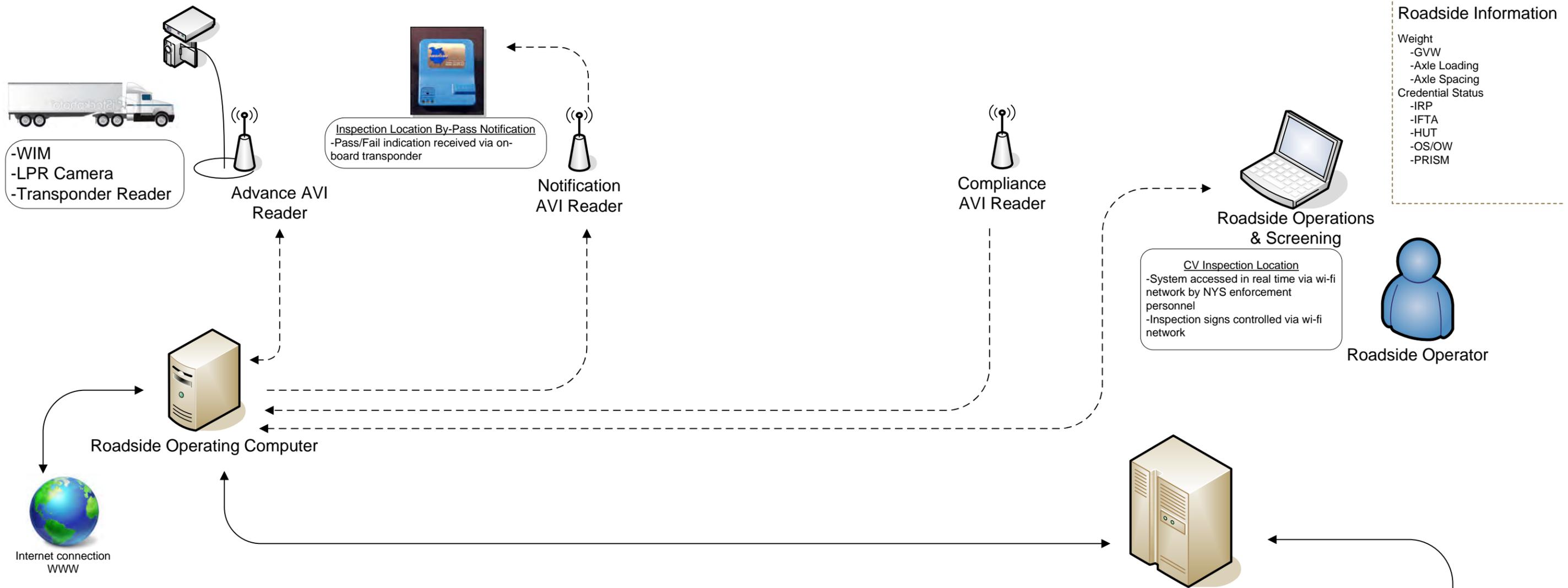
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NOTICE

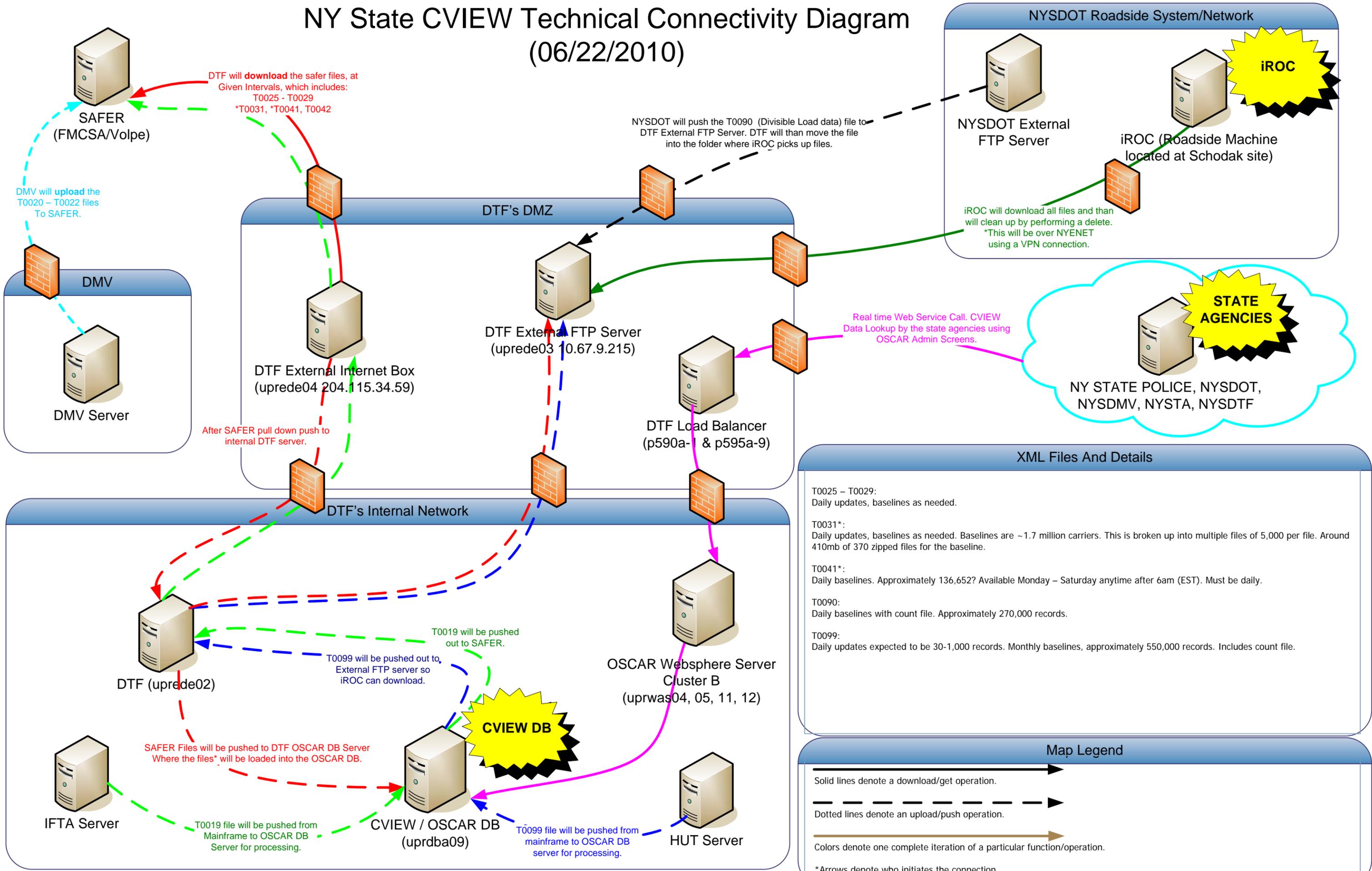
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915 MHz Electronic Screening System Architectural Diagram



- ## Roadside Inspection Screening Operational Procedure
1. Commercial vehicle crosses WIM device
 2. WIM device triggers LPR image
 3. Transponder reader reads 915 MHz NORPASS transponder if available.
 4. Vehicle weighed via WIM and identified via transponder reader or LPR camera
 5. Screening file is checked against NYS CVIEW/OSCAR database which includes State and Federal level data
 6. Vehicle is screened for credentials status and weight compliance
 7. If NORPASS transponder available, roadside operator controls system notification
 - green light (bypass)
 - red light (pull in)
 8. All other vehicles must pull in to inspection site (no transponder)

NY State CVIEW Technical Connectivity Diagram (06/22/2010)



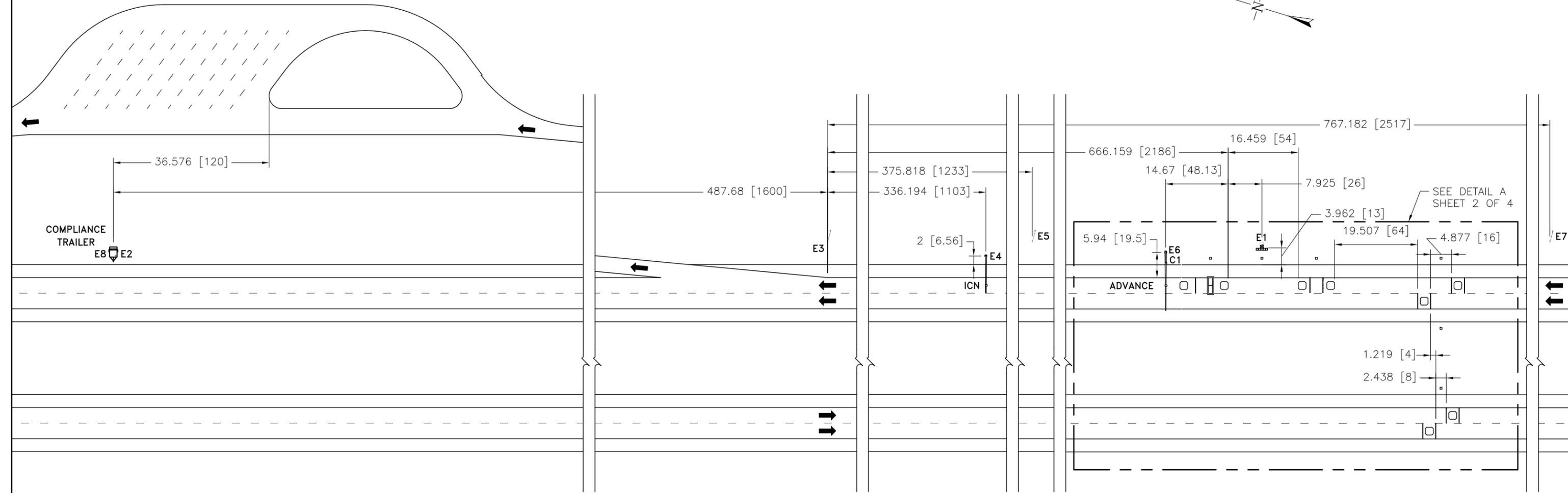
XML Files And Details

T0025 - T0029:	Daily updates, baselines as needed.
T0031*:	Daily updates, baselines as needed. Baselines are ~1.7 million carriers. This is broken up into multiple files of 5,000 per file. Around 410mb of 370 zipped files for the baseline.
T0041*:	Daily baselines. Approximately 136,652? Available Monday - Saturday anytime after 6am (EST). Must be daily.
T0090:	Daily baselines with count file. Approximately 270,000 records.
T0099:	Daily updates expected to be 30-1,000 records. Monthly baselines, approximately 550,000 records. Includes count file.

Map Legend

- Solid lines denote a download/get operation.
- Dotted lines denote an upload/push operation.
- Colors denote one complete iteration of a particular function/operation.
- *Arrows denote who initiates the connection.

*This document is maintained by NY STATE TAX AND FINANCE and created by Simeon Cloutier.



GENERAL NOTES:

ALL CONNECTIONS BETWEEN SENSORS AND LEAD CABLES ARE DONE IN PULL BOX AND ARE SOLDERED THEN SEALED FOR WATERPROOFING. NUMBER AND PLACEMENT OF PULL BOXES NOT SHOWN.

POWER CABLES MUST BE RUN IN SEPARATE CONDUITS/PULLBOXES FROM SIGNAL CABLES.

ROAD SURFACE PAVEMENT CONDITIONS MUST MEET CURRENT ASTM E1318 REQUIREMENTS TO ACHIEVE OPTIMAL SYSTEM PERFORMANCE FOR 61m [200'] BEFORE WIM SENSORS AND 30.5m [100'] AFTER. AREA IS INDICATED BY CROSS HATCHING.

CABLES MUST BE PROTECTED BY PVC SLEEVES WHERE THEY CROSS PAVEMENT JOINTS/CRACKS.

PIEZO SENSORS MUST BE A MINIMUM OF 1.83m [6'] AWAY FROM CRACKS, JOINTS OR SAWCUTS WHEN POSSIBLE.

ADDITIONAL DRAINAGE MAY BE REQUIRED DEPENDING ON SLOPE OF ROADWAY. DRAINAGE CONSISTS OF 1-1/2" ABS PIPE SLOPED TO RIP RAP DRAINAGE PIT IN DITCH.

IRD RECOMMENDS THAT PULL BOXES BE NO FURTHER THAN 61m [200'] APART. IRD RECOMMENDS THE MINIMUM SIZE FOR PULL BOXES IS 45.7cm [18"] X 45.7cm [18"] X 30.5cm [12"].

EXACT ROUTING OF CONDUIT TO BE DETERMINED ON SITE. CONDUITS ARE LABELED LEFT TO RIGHT, TOP TO BOTTOM.

DRAWING NOT TO SCALE.

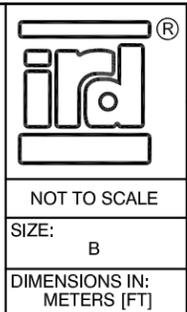
LEGEND:

- L - INDUCTIVE LOOP
- P - PIEZOELECTRIC SENSOR
- S - SINGLE LOAD CELL SCALE
- C - CAMERA
- Q - KISTLER QUARTZ SENSOR
- T - TEMPERATURE SENSOR
- E - ENCLOSURE
- ICN - IN CAB NOTIFICATION

ORIGINAL

REV.	DESCRIPTION	DWN/DSN	APPR.	APPR.	DATE
A	INITIAL RELEASE	JGi/YMa	TRo	MGa	OCT 22/07
B	RELOCATE CAMERA AS PER REDLINES - ECO-01.	JGi/YMa	MGa	MLo	Nov 7/07
C	ON SHEET 1, ADD DIMENSION FOR ICN POLE LOCATION. ON SHEET 4, CHANGE CONDUIT NOTE 20. ECO-02.	JGi/YMa	MLo	MGa	Nov 20/07
D	ADD REST AREA; MOVE TRAILER; ADJUST DISTANCES FROM E3 - SHEET 1 - ECO-05.	JGi/NKI	NKI	MGa	Oct 28/08

CONFIDENTIAL
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INTERNATIONAL ROAD DYNAMICS INC. SASKATOON SASKATCHEWAN CANADA

DWG. TITLE: **SITE LAYOUT VIRTUAL WEIGH STATION NYS DOT**

NOT TO SCALE

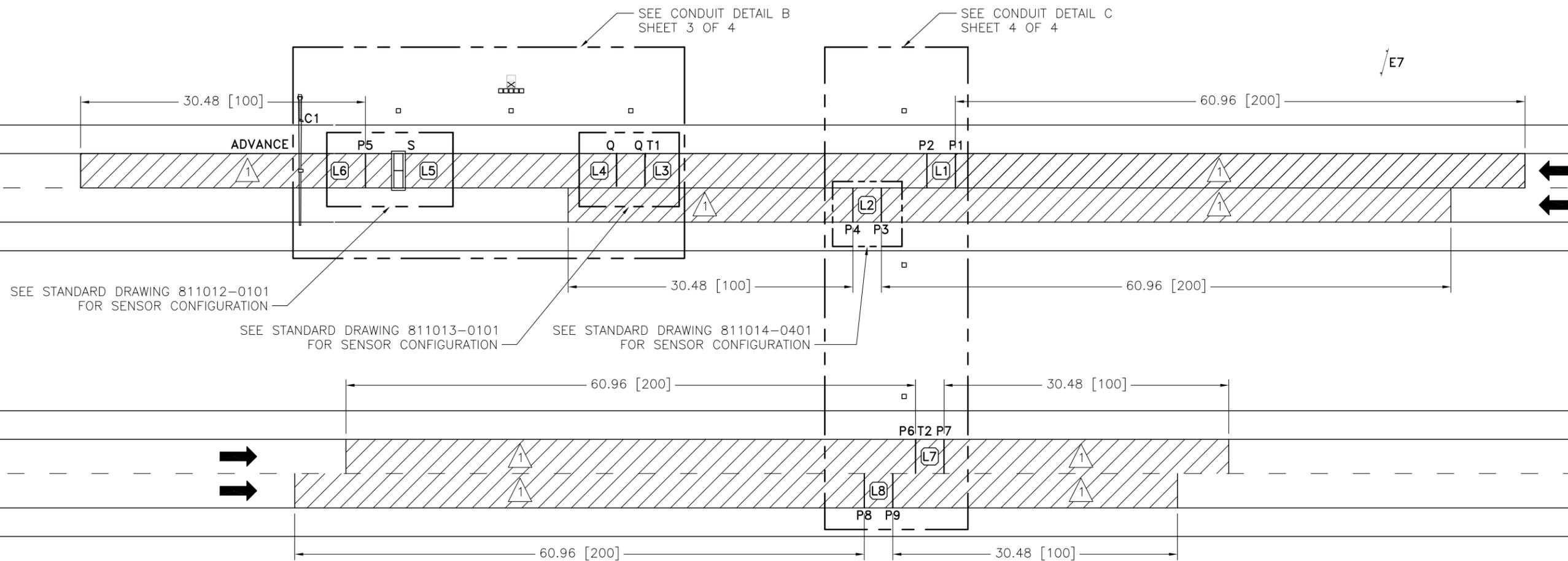
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DIMENSIONS IN: METERS [FT]

DWG. No. **C10811003** REV.: D

CAD FILE: C10811003.DWG SHEET 1 OF 4

DETAIL A



ORIGINAL

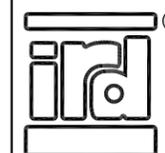
NOTES: (THIS SHEET ONLY)

1 SITE CONDITIONS AS PER ASTM E1318.

REV.	DESCRIPTION	DWN/DSN	APPR.	APPR.	DATE
A	INITIAL RELEASE	JGi/YMa	TRo	MGa	OCT 22/07
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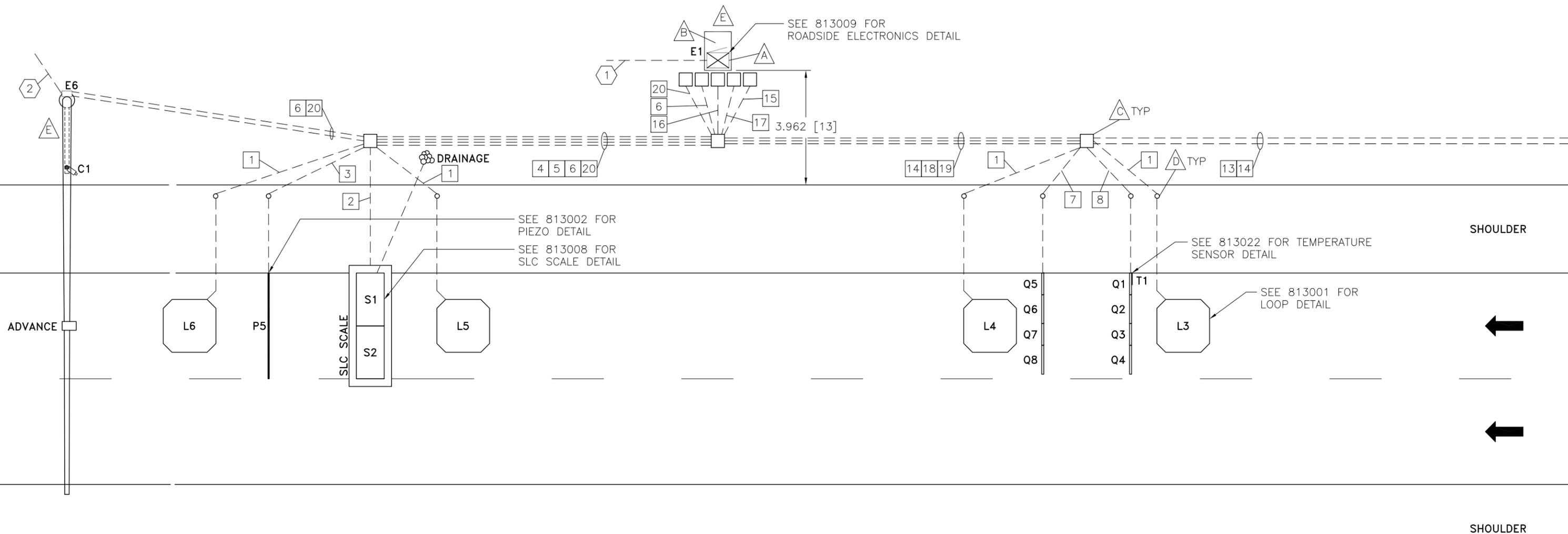
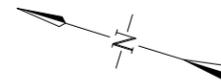
INTERNATIONAL ROAD DYNAMICS INC. SASKATOON SASKATCHEWAN CANADA

DWG. TITLE: **SITE LAYOUT VIRTUAL WEIGH STATION NYS DOT**

DWG. No. **C10811003** REV.: D

CAD FILE: C10811003.DWG SHEET 2 OF 4

CONDUIT DETAIL B



POWER CONDUITS:

- ① PRIMARY ENCLOSURE (WIM CABINET) SEE 81300907
- ② SECONDARY ENCLOSURE (AT MAST ARM) SEE 81300907

NOTES: (THIS SHEET ONLY)

- △ A CABINET WITH WIM ELECTRONICS.
- △ B CABINET BASE.
- △ C PULL BOX.
- △ D DRILL THROUGH SHOULDER FOR CONDUIT.
- △ E MAST ARM AND CABINET TO BE PROTECTED BY GUIDE RAIL AS PER LOCAL CODE.

ORIGINAL

REV.	DESCRIPTION	DWN/DSN	APPR.	APPR.	DATE
A	INITIAL RELEASE	JGi/YMa	TRo	MGa	OCT 22/07
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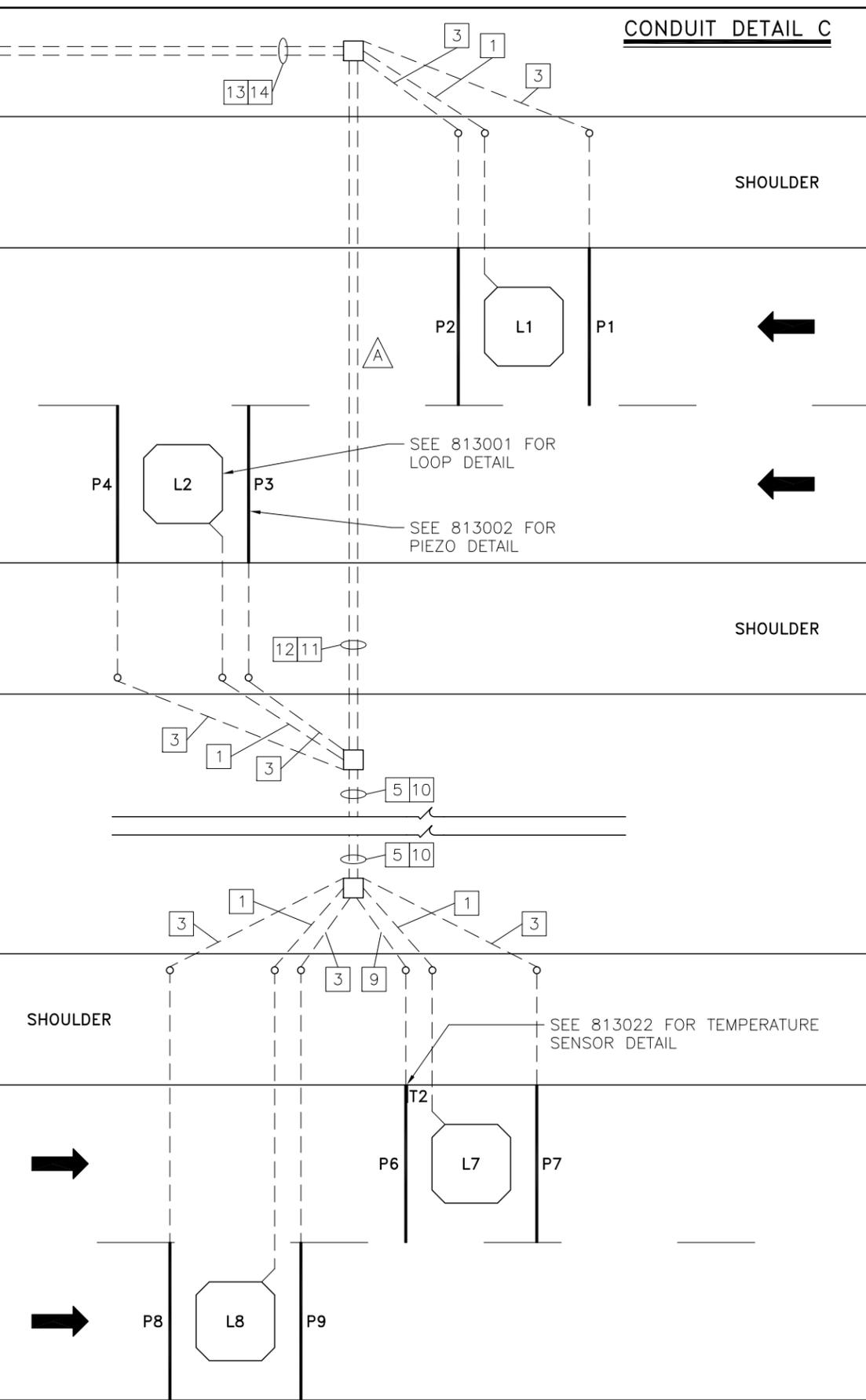
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 DIMENSIONS IN: METERS [FT]

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DWG. No. **C10811003** REV.: D
 CAD FILE: C10811003.DWG SHEET 3 OF 4

CONDUIT DETAIL C



SIGNAL CONDUITS:

- 1 1" CONDUIT
1-LOOP WIRE
- 2 1-1/2" CONDUIT
1-3PR SLC LEADS
2-2C OFF-SCALE LEADS
- 3 1" CONDUIT
1-PIEZO LEAD
- 4 2" CONDUIT
1-3PR SLC LEADS
2-2C OFF-SCALE LEADS
1-PIEZO LEAD
- 5 2" CONDUIT
2-LOOP LEADS
- 6 2" CONDUIT
1-4 STRAND MULTIMODE FIBER OPTIC CABLE (AVI, CAMERA)
- 7 2" CONDUIT
4-KISTLER LEADS
- 8 2" CONDUIT
4-KISTLER LEADS
1-TEMPERATURE SENSOR LEAD
- 9 2" CONDUIT
1-PIEZO LEAD
1-TEMPERATURE SENSOR LEAD
- 10 2" CONDUIT
4-PIEZO LEADS
1-TEMPERATURE SENSOR LEAD
- 11 2" CONDUIT
3-LOOP LEADS
- 12 2" CONDUIT
6-PIEZO LEADS
1-TEMPERATURE SENSOR LEAD
- 13 2" CONDUIT
4-LOOP LEADS
- 14 2" CONDUIT
8-PIEZO LEADS
1-TEMPERATURE SENSOR LEAD
- 15 3" CONDUIT
8-LOOP LEADS
- 16 3" CONDUIT
9-PIEZO LEADS
2-TEMPERATURE SENSOR LEADS
- 17 3" CONDUIT
1-3PR SLC LEADS
2-2C OFF-SCALE LEADS
8-KISTLER LEADS
- 18 2" CONDUIT
6-LOOP LEADS
- 19 2" CONDUIT
8-KISTLER LEADS
1-TEMPERATURE SENSOR LEADS
- 20 2" CONDUIT
1-CAT5 (NETWORK)

NOTES: (THIS SHEET ONLY)

UNDERBORE.

ORIGINAL

REV.	DESCRIPTION	DWN/DSN	APPR.	APPR.	DATE
A	INITIAL RELEASE	JGi/YMa	TRo	MGa	OCT 22/07
B	RELOCATE CAMERA AS PER REDLINES - ECO-01.	JGi/YMa	MGa	MLo	Nov 7/07
C	ON SHEET 1, ADD DIMENSION FOR ICN POLE LOCATION. ON SHEET 4, CHANGE CONDUIT NOTE 20. ECO-02.	JGi/YMa	MLo	MGa	Nov 20/07
D	ADD REST AREA; MOVE TRAILER; ADJUST DISTANCES FROM E3 - SHEET 1 - ECO-05.	JGi/NKI	NKI	MGa	Oct 28/08

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NOT TO SCALE
SIZE: B
DIMENSIONS IN: METERS (FT)

INTERNATIONAL ROAD DYNAMICS INC. SASKATOON SASKATCHEWAN CANADA

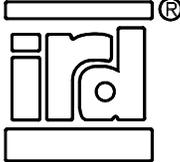
DWG. TITLE: **SITE LAYOUT VIRTUAL WEIGH STATION NYS DOT**

DWG. No. **C10811003** REV.: D

CAD FILE: C10811003.DWG SHEET 4 OF 4

Network Diagram Mobile CVISN/Virtual Pilot Site NY

ORIGINAL

REV.	DESCRIPTION	DRAWN	APPR.	APPR.	DATE	CONFIDENTIAL THIS DOCUMENT CONTAINS INFORMATION PROPRIETARY TO IRD AND IS THEREFORE NOT TO BE DISCLOSED TO OTHERS OR USED FOR PRODUCTION WITHOUT WRITTEN PERMISSION FROM INTERNATIONAL ROAD DYNAMICS INC.		INTERNATIONAL ROAD DYNAMICS INC. SASKATOON SASKATCHEWAN CANADA		
1	INITIAL RELEASE	ATs	ATs	JRo	Feb 5/08		DWG. TITLE: Network Diagram Mobile CVISN/Virtual Pilot Site NY	DWG. No. C10811008 REV.: 3		
2	Adding Firewall	ATs	ATs	JRo	Jun 2/08					
3	Adding Web Relays, E3B and E8	JRo	TRo	JRo	Oct 29/08					
							SIZE: A	FILENAME: C10811008.DOC		SHEET 1 OF 38
						DIMENSIONS IN: N/A				

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1 INTRODUCTION

1.1 Purpose

This document describes the:

- Network architecture.
- Device IP addresses.
- Device network configuration.

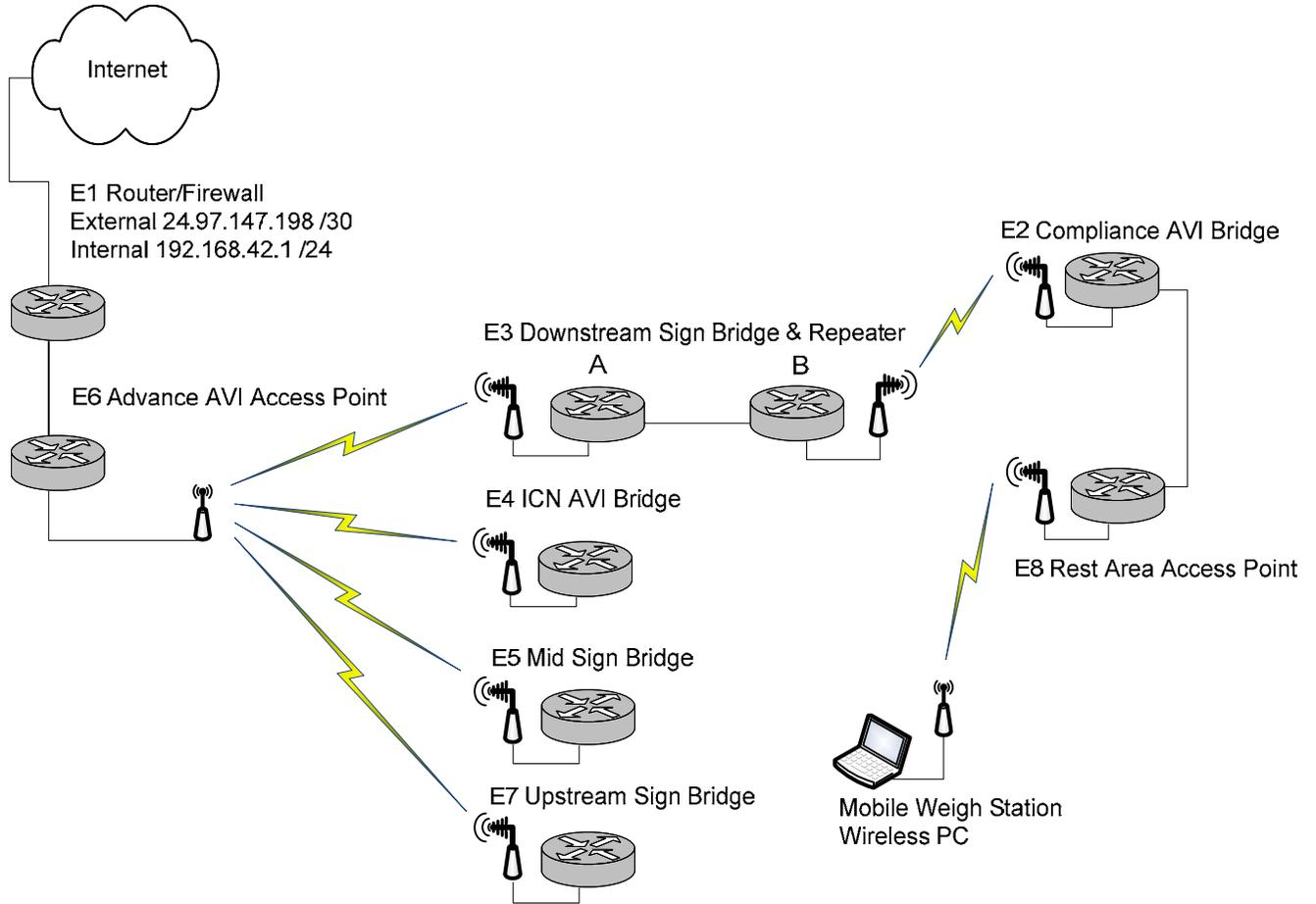
1.2 Applicable Document

System Definition Document
Site Layout
Site Termination

IRD Dwg No C10811001
IRD Dwg No C10811003
IRD Dwg No C10811007

2 NETWORK DIAGRAM

2.1 Site Network



3 *DEVICE IP ADDRESS*

Device	IP Address
E1 SonicWall	192.168.42.1
E1 iROC (future)	192.168.42.21
E1 iSINC	192.168.42.11
E1 SCO UNIX	192.168.42.12
E1 UPS	192.168.42.91
E1 Camera 1	192.168.42.61
E2 Compliance AVI Location	
E2 RS910W LAN Interface	192.168.42.2
E2 RS910W Wireless Bridge Interface	192.168.42.72
E2 Relay 2	192.168.42.92
E2 Digi Terminal Server	192.168.42.52
E3 Downstream Sign Location	
E3A RS910W LAN Interface	192.168.42.3
E3A RS910W Wireless Bridge Interface	192.168.42.73
E3A Relay 3	192.168.42.93
E3B RS910W LAN Interface	192.168.42.9
E3B RS910W Wireless Bridge Interface	192.168.42.79
E3B Relay 9	192.168.42.99
E4 ICN AVI Location	
E4 RS910W LAN Interface	192.168.42.4
E4 RS910W Wireless Bridge Interface	192.168.42.74
E4 Relay 4	192.168.42.94
E4 Digi Terminal Server	192.168.42.54
E5 Mid Sign Location	
E5 RS910W LAN Interface	192.168.42.5
E5 RS910W Wireless Bridge Interface	192.168.42.75
E5 Relay 5	192.168.42.95
E6 Camera + Advanced AVI Location	
E6 RS900W LAN Interface	192.168.42.6
E6 RS900W Wireless AP Interface	192.168.42.76
E6 LPR Camera	192.168.42.61
E6 Relay 6	192.168.42.96
E7 Upstream Sign Location	
E7 RS910W LAN Interface	192.168.42.7
E7 RS910W Wireless Bridge Interface	192.168.42.77
E7 Relay 7	192.168.42.97
E8 Rest Area Access Point	
E8 RS900W LAN Interface	192.168.42.8
E8 RS900W Wireless AP Interface	192.168.42.78

E8 Relay 8	192.168.42.98
------------	---------------

There is no State VPN connection required to connect to site.

The firewall/router Sonicwall TZ-190 is directly connected to the Internet.

The following information is used by the site router:

- Public routable WAN IP address is 24.97.147.198.
- Net mask for WAN is 255.255.255.252.
- Gateway IP address is 24.97.147.197.
- Primary DNS IP address is 24.92.226.11.
- Secondary DNS IP address is 24.92.226.12
- Private Internal IP address is 192.168.42.1.
- Net mask for LAN is 255.255.255.0.
- The external access to the router's administration web pages:
 - Sonicwall TZ-190: <http://24.97.147.198:88>
 - Sonicwall TZ-190: <https://24.97.147.198:1443>
- The internal access to the router's administration web pages:
 - Sonicwall TZ-190: <http://192.168.42.1:88>
- The password for the Sonicwall TZ-190 is "ird518dps".
- With the Sonicwall TZ-190, VPN is used to access the IP devices in the CR B site. The VPN shared secret is "A147FA3BF9B7578C". The VPN username is "irdadmin". The VPN password is "ird306".
- The external access ports for IRD Autopoll from IRD and NY State IP addresses only:
 - Port 20 (FTP) to 192.168.42.12
 - Port:21 (FTP) to 192.168.42.12
 - Port 23 (Telnet) to 192.168.42.12

The 1-port server and video server's user name is "admin" and password is "ird306".

The following address translation was being set up on the Sonicwall TZ-190:

4 **TERMINAL SERVER (DIGI PORTSERVER TS 1 H MEI)**

The Real Port Profile is used for all ports.

5 **RUGGEDCOM WIRELESS DEVICES**

57600 baud is used to connect to the local RS-232 console port. The default username is admin. The default password is admin.

	E6	E2	E3A	E3B	E4	E5	E7	E8
Model #	RS900W	RS910W	RS910W	RS910W	RS910W	RS910W	RS910W	RS900W
Administration								
Configure IP Interface								
Type	VLAN							
ID	1							
Mgmt	Yes							
IP Address Type	Static							
IP Address	192.168.42.6	192.168.42.2	192.168.42.3	192.168.42.9	192.168.42.5	192.168.42.5	192.168.42.7	192.168.42.8
Subnet	255.255.255.0							
Gateway	192.168.42.1							
Configure IP Services								
Inactivity Timeout	Disabled							
Telnet Sessions Allowed	4							
Web Server Users Allowed	16							
TFTP Server	Get Only							
ModBus Address	Disabled							
SSH Sessions Allowed	4							
RSH Server	Enabled							
Configure System Identification								
System Name	E6	E2	E3A	E3B	E4	E5	E7	E8
Location	Camera	AVI Location	Sign Location	Sign Location	AVI Location	Sign Location	Sign Location	AVI Location
Configure Passwords								
Guest Password	ups518							
Operator Password	ups518							
Admin Password	ird518							
DHCP Relay Agent								
DHCP Server Address	192.168.42.1							
DHCP Client Ports	All							
WLAN Interface								
Addressing Parameters								
Operation Mode	AP	Client Bridge	Client Bridge	Client Bridge	Client Bridge	Client Bridge	Client Bridge	AP
RF MAC	00-0A-DC-11-D7-5E	00-0A-DC-11-F8-1E	00-0A-DC-11-FB-9E		00-0A-DC-11-F7-5E	00-0A-DC-11-FA-1E	00-0A-DC-11-F9-1E	
Ethernet MAC	00-0A-DC-11-D7-5F	00-0A-DC-11-F8-1F	00-0A-DC-11-FB-9F		00-0A-DC-11-F7-5F	00-0A-DC-11-FA-1F	00-0A-DC-11-F9-1F	
IP Address	192.168.42.76	192.168.42.72	192.168.42.73	192.168.42.79	192.168.42.74	192.168.42.75	192.168.42.77	192.168.42.78

	E6	E2	E3A	E3B	E4	E5	E7	E8
Subnet Mask	255.255.255.0	255.255.255.0	255.255.255.0	255.255.255.0	255.255.255.0	255.255.255.0	255.255.255.0	255.255.255.0
Gateway	192.168.42.1	192.168.42.1	192.168.42.1	192.168.42.1	192.168.42.1	192.168.42.1	192.168.42.1	192.168.42.1
Network Parameters								
Wireless Mode	11b				Auto			11b
Network Name					MobileVirtual			
RF Channel	1				Auto			6
Suppress SSID	Enable							Enable
Security Parameters								
Authentication					wpa-psk			
Encryption					Tkip			
Passphrase					ird518virtualWeightStation			
Group Key Renewal	600 sec							600 sec
Advanced Parameters								
Data Rate					Best			
Power					20			
WDS	Enable	n/a	n/a		n/a	n/a	n/a	Enable
WMM					Disable			
Short Preamble					Disable			
Distance		300	300		300			
Miscellaneous Parameters								
RF Transmitter					Enable			
Serial Protocols								
Configure Serial Ports								
Port 1								
Name		Port 1	Port 1	Port 1	Port 1	Port 1	Port 1	
Protocol		RawSocket	RawSocket	RawSocket	RawSocket	RawSocket	RawSocket	
Type		RS232	RS232	RS232	RS232	RS232	RS232	
Baud		9600	9600	9600	9600	9600	9600	
Data Bits		8	8	8	8	8	8	
Stop		1	1	1	1	1	1	
Parity		None	None	None	None	None	None	
Turnaround		0 ms	0 ms	0 ms	0 ms	0 ms	0 ms	
DSCP		0	0	0	0	0	0	
Port 2								
Name		Port 2	Port 2	Port 2	Port 2	Port 2	Port 2	
Protocol		RawSocket	RawSocket	RawSocket	RawSocket	RawSocket	RawSocket	
Type		RS232	RS232	RS232	RS232	RS232	RS232	
Baud		9600	9600	9600	9600	9600	9600	
Data Bits		8	8	8	8	8	8	
Stop		1	1	1	1	1	1	
Parity		None	None	None	None	None	None	
Turnaround		0 ms	0 ms	0 ms	0 ms	0 ms	0 ms	
DSCP		0	0	0	0	0	0	
Configure Protocols								
Configure Raw Socket								
Port 1								
Pack Char		Off	Off	Off	Off	Off	Off	
Pack Timer		5 ms	5 ms	5 ms	5 ms	5 ms	5 ms	
Flow Control		None	None	None	None	None	None	
Transport		TCP	TCP	TCP	TCP	TCP	TCP	
Call Dir		In	In	In	In	In	In	
Max Conns		1	1	1	1	1	1	
Loc Port		50001	50001	50001	50001	50001	50001	
Rem Port		50001	50001	50001	50001	50001	50001	
IP Address		192.168.42.2	192.168.42.3	192.168.42.9	192.168.42.4	192.168.42.5	192.168.42.7	
Link Status		Enabled	Enabled	Enabled	Enabled	Enabled	Enabled	
Port 1								
Pack Char		Off	Off	Off	Off	Off	Off	
Pack Timer		5 ms	5 ms	5 ms	5 ms	5 ms	5 ms	
Flow Control		None	None	None	None	None	None	
Transport		TCP	TCP	TCP	TCP	TCP	TCP	
Call Dir		In	In	In	In	In	In	
Max Conns		1	1	1	1	1	1	
Loc Port		50002	50002	50002	50002	50002	50002	
Rem Port		50002	50002	50002	50002	50002	50002	
IP Address		192.168.42.2	192.168.42.3	192.168.42.9	192.168.42.4	192.168.42.5	192.168.42.7	

	E6	E2	E3A	E3B	E4	E5	E7	E8
Link Status		Enabled	Enabled	Enabled	Enabled	Enabled	Enabled	
Virtual VLANs								
Global VLAN Parameters								
VLAN-aware		No						

6 SONICWALL FIREWALL CONFIGURATION

The SonicWall System Status window:

System > Status
Wizards...
?

System Messages

- **WARNING: A rule exists allowing HTTP/HTTPS management from the WAN. This is a potential vulnerability. Choose a good password.**
- **Log messages cannot be sent because you have not specified an outbound SMTP server address.**

System Information

Model:	TZ 190 Enhanced
Serial Number:	0017C5094EB0
Authentication Code:	DL3L-DUYW
Firmware Version:	SonicOS Enhanced 3.8.0.4-40e
ROM Version:	SonicROM 3.6.0.0
CPU (10s average):	1.50% - SonicWALL Security Processor
Total Memory:	128MB RAM, 16MB Flash
System Time:	03/10/2008 10:43:00
Up Time:	2 Days 15:27:24
Current Connections:	12
Last Modified By:	Unmodified since reboot
Registration Code:	K93BU52N

Security Services

Service Name	Status
Nodes/Users	Licensed - Unlimited Nodes
VPN	Licensed
Global VPN Client	Licensed - 2 Licenses (1 in use)
CFS (Content Filter)	Licensed
Client AV Enforcement	Not Licensed
Gateway Anti-Virus	Licensed
Anti-Spyware	Licensed
Intrusion Prevention	Licensed
E-Mail Filter	Licensed
ViewPoint	Licensed

Latest Alerts

No Alerts

Network Interfaces

Name	IP Address	Link Status
LAN (LAN)	192.168.42.1	100 Mbps full-duplex
WAN (WAN)	24.97.147.198	100 Mbps full-duplex
OPT (Unassigned)	0.0.0.0	No link
WWAN (WAN)	0.0.0.0	Disconnected

Modify the SonicWall web management ports.

Web Management Settings

HTTP Port:

HTTPS Port:

Certificate Selection:

Certificate Common Name:

Table Size: items per page

SSH Management Settings

SSH Port:

Add address objects and address groups.

Network > Address Objects
Public Server Wizard...
?

Address Groups

Items to 1 (of 1) ⏪ ⏩

View Style: All Address Objects Custom Address Objects Default Address Objects

# Name	Address Detail	Type	Zone	Configure
<input type="checkbox"/> 1 Autopoll Clients		Group		
▶ IRD-Saskatoon Subnet	192.75.185.1 - 192.75.185.254	Range	WAN	
▶ NY DOT Subnet	170.3.0.0/255.255.0.0	Network	WAN	

Add Group...
Delete
Delete All

Address Objects

Items to 3 (of 3) ⏪ ⏩

# Name	Address Detail	Type	Zone	Configure
<input type="checkbox"/> 1 IRD-Saskatoon Subnet	192.75.185.1 - 192.75.185.254	Range	WAN	
<input type="checkbox"/> 2 Virtual WIM - SCO	192.168.42.12/255.255.255.255	Host	LAN	
<input type="checkbox"/> 3 NY DOT Subnet	170.3.0.0/255.255.0.0	Network	WAN	

Add...
Delete
Delete All

Add Services for the web pages.

Firewall > Services ?

Service Groups Items 1 to 2 (of 2) [Navigation icons]

View Style: All Services Custom Services Default Services

<input type="checkbox"/>	#	Name	Protocol	Port Start	Port End	Configure
<input type="checkbox"/>	1	Virtual WIM Autopoll				
		▶ Telnet	TCP	23	23	
		▶ FTP (All)				
<input type="checkbox"/>	2	Virtual WIM Web Pages				
		▶ HTTP	TCP	80	80	
		▶ HTTPS	TCP	443	443	

Add NAT two policies for the Virtual Weight Station web site.

Network > NAT Policies ?

NAT Policies Items 1 to 6 (of 6) [Navigation icons]

View Style: All Policies Custom Policies Default Policies

<input type="checkbox"/>	#	Source	Destination	Service	Interface	Priority	Comment	Enable	Configure				
		Original	Translated	Original	Translated	Inbound	Outbound						
<input type="checkbox"/>	1	Virtual WIM - SCO	WAN Primary IP	Any	Original	Virtual WIM Web Pages	Original	Any	WAN	11		<input checked="" type="checkbox"/>	
<input type="checkbox"/>	2	Virtual WIM - SCO	WAN Primary IP	Any	Original	Virtual WIM Autopoll	Original	Any	WAN	12		<input checked="" type="checkbox"/>	
<input type="checkbox"/>	3	Any	Original	WAN Primary IP	Virtual WIM - SCO	Virtual WIM Web Pages	Original	WAN	Any	13		<input checked="" type="checkbox"/>	
<input type="checkbox"/>	4	Any	Original	WAN Primary IP	Virtual WIM - SCO	Virtual WIM Autopoll	Original	WAN	Any	14		<input checked="" type="checkbox"/>	
<input type="checkbox"/>	5	Any	WWAN IP	Any	Original	Any	Original	LAN	WWAN	15		<input checked="" type="checkbox"/>	
<input type="checkbox"/>	6	Any	WAN Primary IP	Any	Original	Any	Original	LAN	WAN	16		<input checked="" type="checkbox"/>	

Enable DHCP server with specific IP range,

Network > DHCP Server Apply Cancel ?

DHCP Server Settings

Enable DHCP Server
 Enable Conflict Detection

DHCP Server Lease Scopes Items 1 to 1 (of 1)

View Style: All Dynamic Static

#	Type	Lease Scope	Interface	Details	Enable	Configure
1	Dynamic	Range: 192.168.42.100 - 192.168.42.199	LAN		<input checked="" type="checkbox"/>	

Add Dynamic Add Static Delete Delete All

Add firewall rules to allow access to the LAN.

Firewall > Access Rules > ALL > LAN Public Server Wizard... Clear Statistics Restore Defaults... ?

Access Rules (ALL > LAN) Items 1 to 14 (of 14)

View Style: All Rules Matrix Drop-down Boxes

#	From Zone	Priority	Source	Destination	Service	Action	Users	Comment	Enable	Configure
LAN										
1	LAN	1	Any	All LAN Management IP	Ping	Allow	All		<input checked="" type="checkbox"/>	
2	LAN	2	Any	All LAN Management IP	SSH Management	Allow	All		<input checked="" type="checkbox"/>	
3	LAN	3	Any	All LAN Management IP	HTTPS Management	Allow	All		<input checked="" type="checkbox"/>	
4	LAN	4	Any	All LAN Management IP	HTTP Management	Allow	All		<input checked="" type="checkbox"/>	
5	LAN	5	Any	Any	Any	Allow	All		<input checked="" type="checkbox"/>	
VPN										
6	VPN	1	Any	All LAN Management IP	HTTPS Management	Allow	All		<input checked="" type="checkbox"/>	
7	VPN	2	Any	All LAN Management IP	HTTP Management	Allow	All		<input checked="" type="checkbox"/>	
8	VPN	3	Any	All LAN Management IP	SNMP	Allow	All		<input checked="" type="checkbox"/>	
9	VPN	4	Any	All LAN Management IP	Ping	Allow	All		<input checked="" type="checkbox"/>	
10	VPN	5	Any	WLAN RemoteAccess Networks	Any	Allow	All		<input type="checkbox"/>	
11	VPN	6	Vpn DHCP Clients	WAN RemoteAccess Networks	Any	Allow	All		<input checked="" type="checkbox"/>	
WAN										
12	WAN	1	Any	WAN Primary IP	Virtual WIM Web Pages	Allow	All		<input checked="" type="checkbox"/>	
13	WAN	2	Autopoll Clients	WAN Primary IP	Virtual WIM Autopoll	Allow	All		<input checked="" type="checkbox"/>	
14	WAN	3	Any	Any	Any	Deny	All		<input checked="" type="checkbox"/>	

Add... Delete Restore Defaults...

Add firewall rules to allow access to the WAN.

Firewall > Access Rules > ALL > WAN Public Server Wizard... Clear Statistics Restore Defaults... ?

Access Rules (ALL > WAN) Items 1 to 7 (of 7)

View Style: All Rules Matrix Drop-down Boxes

#	From Zone	Priority	Source	Destination	Service	Action	Users	Comment	Enable	Configure
LAN										
1	LAN	1	Any	Any	Any	Allow	All		<input checked="" type="checkbox"/>	
VPN										
2	VPN	1	Any	WLAN RemoteAccess Networks	Any	Allow	All		<input type="checkbox"/>	
3	VPN	2	Vpn DHCP Clients	WAN RemoteAccess Networks	Any	Allow	All		<input checked="" type="checkbox"/>	
WAN										
4	WAN	1	Any	All WAN Management IP	HTTPS Management	Allow	All		<input checked="" type="checkbox"/>	
5	WAN	2	Any	All WAN Management IP	HTTP Management	Allow	All		<input checked="" type="checkbox"/>	
6	WAN	3	WAN Interface IP	Any	IKE	Allow	All		<input checked="" type="checkbox"/>	
7	WAN	4	Any	WAN Interface IP	IKE	Allow	All		<input checked="" type="checkbox"/>	

Add... Delete Restore Defaults...

Add firewall rules to allow access to the WAN.

Firewall > Access Rules > ALL > VPN Public Server Wizard... Clear Statistics Restore Defaults... ?

Access Rules (ALL > VPN) Items 1 to 6 (of 6)

View Style: All Rules Matrix Drop-down Boxes

#	From Zone	Priority	Source	Destination	Service	Action	Users	Comment	Enable	Configure
LAN										
1	LAN	1	WLAN RemoteAccess Networks	Any	Any	Allow	All		<input type="checkbox"/>	
2	LAN	2	WAN RemoteAccess Networks	Vpn DHCP Clients	Any	Allow	All		<input checked="" type="checkbox"/>	
VPN										
3	VPN	1	WLAN RemoteAccess Networks	Any	Any	Allow	All		<input type="checkbox"/>	
4	VPN	2	Any	WLAN RemoteAccess Networks	Any	Allow	All		<input type="checkbox"/>	
5	VPN	3	WAN RemoteAccess Networks	Vpn DHCP Clients	Any	Allow	All		<input checked="" type="checkbox"/>	
6	VPN	4	Vpn DHCP Clients	WAN RemoteAccess Networks	Any	Allow	All		<input checked="" type="checkbox"/>	

Add... Delete Restore Defaults...

Add VPN connection.

VPN Policies Items 1 to 2 (of 2)

#	Name	Gateway	Destinations	Crypto Suite	Enable	Configure
1	WAN GroupVPN			ESP AES-256 HMAC SHA1 (IKE)	<input checked="" type="checkbox"/>	
2	WLAN GroupVPN			ESP 3DES HMAC SHA1 (IKE)	<input type="checkbox"/>	

Configure VPN general window.

General **Proposals** Advanced Client

Security Policy

Authentication Method:

Name:

Shared Secret:

Configure VPN proposals window.

General	Proposals	Advanced	Client
---------	-----------	----------	--------

IKE (Phase 1) Proposal

DH Group:

Encryption:

Authentication:

Life Time (seconds):

Ipssec (Phase 2) Proposal

Protocol:

Encryption:

Authentication:

Enable Perfect Forward Secrecy

DH Group:

Life Time (seconds):

Configure VPN advanced window.

General	Proposals	Advanced	Client
---------	-----------	----------	--------

Advanced Settings

Enable Windows Networking (NetBIOS) Broadcast

Enable Multicast

Management via this SA: HTTP HTTPS

Default Gateway:

Client Authentication

Require Authentication of VPN Clients via XAUTH

User Group for XAUTH users:

Allow Unauthenticated VPN Client Access:

Configure VPN client window.

General	Proposals	Advanced	Client
---------	-----------	----------	--------

User Name and Password Caching

Cache XAUTH User Name and Password on Client:

Client Connections

Virtual Adapter settings:

Allow Connections to:

Set Default Route as this Gateway

Require Global Security Client for this Connection

Client Initial Provisioning

Use Default Key for Simple Client Provisioning

Configure VPN advanced window.

VPN > Advanced VPN Settings

Advanced VPN Settings

Enable IKE Dead Peer Detection

Dead Peer Detection Interval (seconds)

Failure Trigger Level (missed heartbeats)

Enable Dead Peer Detection for Idle VPN sessions

Dead Peer Detection Interval for Idle VPN sessions (seconds)

Enable Fragmented Packet Handling

Ignore DF (Don't Fragment) Bit

Enable NAT Traversal

Clean up Active tunnels when Peer Gateway DNS name resolves to a different IP Address

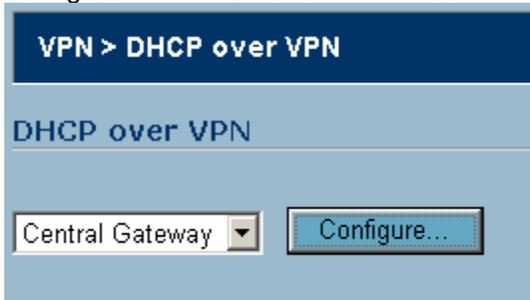
Preserve IKE Port for Pass Through Connections

Enable OCSP Checking

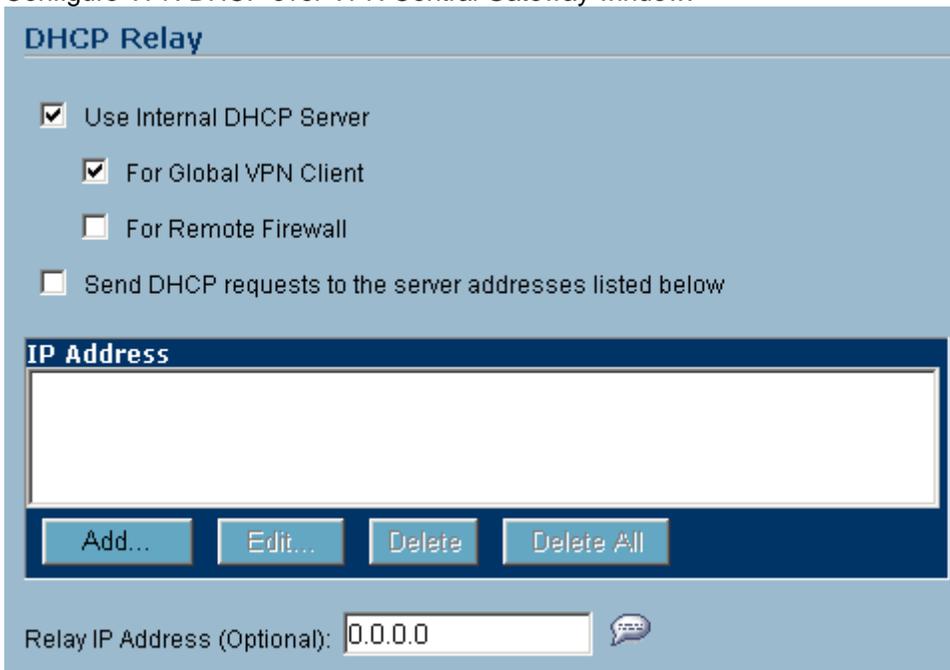
Send VPN Tunnel Traps only when tunnel status changes

Send IKEv2 Cookie Notify

Configure VPN DHCP over VPN window.



Configure VPN DHCP over VPN Central Gateway window.



Add user name irdadmin to Users Local Users window.



Configure Users Local Users Settings window.

Settings | **Groups** | VPN Access

User Settings

Name:

Password:

Confirm Password:

Comment:

Configure Users Local Users Groups window.

Settings | **Groups** | VPN Access

Group Memberships

User Groups:

- Content Filtering Bypass
- Guest Services
- Limited Administrators

Member Of:

- Everyone
- Trusted Users

Add All -> <- Remove All

Configure Users Local Users VPN Access window.

Settings | **VPN Access** | Groups

VPN Client Access Networks

Networks:

- All Interface IP
- All LAN Management IP
- All WAN IP
- All WAN Management IP
- Default SonicPoint ACL Allow Gro

Access List:

- LAN Primary Subnet

-> <- Remove All

7 WEB RELAYS CONFIGURATION

To configure the webrelay, use the link <http://192.168.42.9x/setup.html>. The username is "admin". The password is "ird306".

7.1 E2 Compliance AVI Web Relay

7.1.1 Operator Control Page

7.1.2 Configuration

7.2 E3 Downstream Sign Web Relay

7.2.1 Operator Control Page



7.2.2 Configuration


Setup

Network
Password
Relay 1/Input 1
Relay 2/Input 2
Events
Control Page Setup 1
Control Page Setup 2
Relay Control Page

Network: Network parameters require reboot before they take effect.

IP Address:	<input type="text" value="192"/>	<input type="text" value="168"/>	<input type="text" value="42"/>	<input type="text" value="93"/>
Netmask:	<input type="text" value="255"/>	<input type="text" value="255"/>	<input type="text" value="255"/>	<input type="text" value="0"/>
Broadcast:	<input type="text" value="192"/>	<input type="text" value="168"/>	<input type="text" value="42"/>	<input type="text" value="255"/>
Gateway:	<input type="text" value="192"/>	<input type="text" value="168"/>	<input type="text" value="42"/>	<input type="text" value="1"/>
TCP Port:	<input type="text" value="80"/>			
Modbus Port:	<input type="text" value="502"/>			

Speed: 10 Mbps 100 Mbps
 Mode: Half Duplex Full Duplex

Submit
Reset

WEBRelay™
Dual-LS

Setup

Network | **Password** | **Relay 1/Input 1** | **Relay 2/Input 2** | **Events** | **Control Page Setup 1** | **Control Page Setup 2** | **Relay Control Page**

Relay 1/Input 1:

Pulse Duration: secs
Relay 1 Options:
Remote Relay 1 Options:
Remote Relay IP Address: . . .
Remote TCP Port:
Relay #:
Password:
Keep Alive:

WEBRelay™
Dual-LS

Setup

Network | **Password** | **Relay 1/Input 1** | **Relay 2/Input 2** | **Events** | **Control Page Setup 1** | **Control Page Setup 2** | **Relay Control Page**

Relay 2/Input 2:

Pulse Duration: secs
Relay 2 Options:
Remote Relay 2 Options:
Remote Relay IP Address: . . .
Remote TCP Port:
Relay #:
Password:
Keep Alive:



Setup

Network | Password | Relay 1/Input 1 | Relay 2/Input 2 | Events | Control Page Setup 1 | Control Page Setup 2 | Relay Control Page

Event Scheduler:

Current Time: Fri, 18 Jan 2008 07:15:19

Date (MM/DD/YY): 01 / 01 / 00

Time (HH:MM:SS): 00 : 00 : 00

Select Event to Edit: event1

Event 1 Settings:

Start Date (MM/DD/YY): 01 / 01 / 00

Start Time (HH:MM:SS): 00 : 00 : 00

Period (0 = disable event): 0 Seconds Minutes Hours Days Weeks

Count: 1 (Enter 0 for continuous occurrence.)

Relay #: relay 1

Relay Action: turn relay on

Pulse Duration: 1.5 secs



Setup

NetworkPasswordRelay 1/Input 1Relay 2/Input 2EventsControl Page Setup 1Control Page Setup 2Relay Control Page

Control Page Setup 1:

Main Header Text:	<input type="text" value="Sign Control"/>
Auto Refresh Page:	Yes <input checked="" type="radio"/> No <input type="radio"/>
Duration:	<input type="text" value="3"/> sec
Relay 1 Description:	<input type="text" value="Sign Control"/>
Display Relay 1 Status:	Yes <input checked="" type="radio"/> No <input type="radio"/>
Status ON Color:	Gr <input checked="" type="radio"/> Rd <input type="radio"/> Yllw <input type="radio"/> Bl <input type="radio"/>
Status ON Text:	<input type="text" value="Relay1 ON"/>
Status OFF Color:	Gr <input type="radio"/> Rd <input checked="" type="radio"/> Yllw <input type="radio"/> Bl <input type="radio"/>
Status OFF Text:	<input type="text" value="Relay1 OFF"/>
ON/OFF Button:	Yes <input checked="" type="radio"/> No <input type="radio"/>
ON/OFF Button Label	<input type="text" value="ON/OFF"/>
Pulse Button:	Yes <input type="radio"/> No <input checked="" type="radio"/>
Pulse Button Label	<input type="text" value="Pulse"/>
Display Input 1 Status:	Yes <input type="radio"/> No <input checked="" type="radio"/>
Input 1 Description:	<input type="text" value="Input 1 Description"/>
Input 1 ON Color:	Gr <input checked="" type="radio"/> Rd <input type="radio"/> Yllw <input type="radio"/> Bl <input type="radio"/>
Input 1 ON Text:	<input type="text" value="Input 1 ON"/>
Input 1 OFF Color:	Gr <input type="radio"/> Rd <input checked="" type="radio"/> Yllw <input type="radio"/> Bl <input type="radio"/>
Input 1 OFF Text:	<input type="text" value="Input 1 OFF"/>

SubmitReset

WEBRelay™ Dual-LS

Setup

Control Page Setup 2:

Relay 2 Description:

Display Relay 2 Status: Yes No

Status ON Color: Gr Rd Yllw Bl

Status ON Text:

Status OFF Color: Gr Rd Yllw Bl

Status OFF Text:

ON/OFF Button: Yes No

ON/OFF Button Label:

Pulse Button: Yes No

Pulse Button Label:

Display Input 2 Status: Yes No

Input 2 Description:

Input 2 ON Color: Gr Rd Yllw Bl

Input 2 ON Text:

Input 2 OFF Color: Gr Rd Yllw Bl

Input 2 OFF Text:

7.3 E4 ICN AVI Web Relay

7.3.1 Operator Control Page

7.3.2 Configuration

7.4 E5 Mid Sign Web Relay

7.4.1 Operator Control Page



7.4.2 Configuration



Setup

Network | Password | Relay 1/Input 1 | Relay 2/Input 2 | Events | Control Page Setup 1 | Control Page Setup 2 | Relay Control Page

Network: Network parameters require reboot before they take effect.

IP Address:	<input type="text" value="192"/>	<input type="text" value="168"/>	<input type="text" value="42"/>	<input type="text" value="95"/>
Netmask:	<input type="text" value="255"/>	<input type="text" value="255"/>	<input type="text" value="255"/>	<input type="text" value="0"/>
Broadcast:	<input type="text" value="192"/>	<input type="text" value="168"/>	<input type="text" value="42"/>	<input type="text" value="255"/>
Gateway:	<input type="text" value="192"/>	<input type="text" value="168"/>	<input type="text" value="42"/>	<input type="text" value="1"/>
TCP Port:	<input type="text" value="80"/>			
Modbus Port:	<input type="text" value="502"/>			
Speed:	10 Mbps <input type="radio"/> 100 Mbps <input checked="" type="radio"/>			
Mode:	Half Duplex <input type="radio"/> Full Duplex <input checked="" type="radio"/>			



Setup

Network | Password | **Relay 1/Input 1** | Relay 2/Input 2 | Events | Control Page Setup 1 | Control Page Setup 2 | Relay Control Page

Relay 1/Input 1:

Pulse Duration:	<input type="text" value="1.5"/>	secs		
Relay 1 Options:	<input type="text" value="no local relay 1 control"/>			
Remote Relay 1 Options:	<input type="text" value="remote relay equals local relay 1"/>			
Remote Relay IP Address:	<input type="text" value="192"/>	<input type="text" value="168"/>	<input type="text" value="42"/>	<input type="text" value="97"/>
Remote TCP Port:	<input type="text" value="80"/>			
Relay #:	<input type="text" value="1"/>			
Password:	<input type="password" value="*****"/>			
Keep Alive:	<input type="text" value="YES(No TX State)"/>			

WEBRelay™ Dual-LS **Setup**

Network | Password | Relay 1/Input 1 | Relay 2/Input 2 | Events | Control Page Setup 1 | Control Page Setup 2 | Relay Control Page

Relay 2/Input 2:

Pulse Duration: secs

Relay 2 Options:

Remote Relay 2 Options:

Remote Relay IP Address: . . .

Remote TCP Port:

Relay #:

Password:

Keep Alive:

WEBRelay™ Dual-LS **Setup**

Network | Password | Relay 1/Input 1 | Relay 2/Input 2 | Events | Control Page Setup 1 | Control Page Setup 2 | Relay Control Page

Event Scheduler:

Current Time:

Date (MM/DD/YY): / /

Time (HH:MM:SS): : :

Select Event to Edit:

Event 1 Settings:

Start Date (MM/DD/YY): / /

Start Time (HH:MM:SS): : :

Period (0 = disable event): Seconds Minutes Hours Days Weeks

Count: (Enter 0 for continuous occurrence.)

Relay #:

Relay Action:

Pulse Duration: secs



Setup

NetworkPasswordRelay 1/Input 1Relay 2/Input 2EventsControl Page Setup 1Control Page Setup 2Relay Control Page

Control Page Setup 1:

Main Header Text:

Auto Refresh Page: Yes No

Duration: sec

Relay 1 Description:

Display Relay 1 Status: Yes No

Status ON Color: Gr Rd Yllw Bl

Status ON Text:

Status OFF Color: Gr Rd Yllw Bl

Status OFF Text:

ON/OFF Button: Yes No

ON/OFF Button Label:

Pulse Button: Yes No

Pulse Button Label:

Display Input 1 Status: Yes No

Input 1 Description:

Input 1 ON Color: Gr Rd Yllw Bl

Input 1 ON Text:

Input 1 OFF Color: Gr Rd Yllw Bl

Input 1 OFF Text:

WEBRelay™ Dual-LS **Setup**

Network Password Relay 1/Input 1 Relay 2/Input 2 Events Control Page Setup 1 Control Page Setup 2 Relay Control Page

Control Page Setup 2:

Relay 2 Description:

Display Relay 2 Status: Yes No

Status ON Color: Gr Rd Yllw Bl

Status ON Text:

Status OFF Color: Gr Rd Yllw Bl

Status OFF Text:

ON/OFF Button: Yes No

ON/OFF Button Label:

Pulse Button: Yes No

Pulse Button Label:

Display Input 2 Status: Yes No

Input 2 Description:

Input 2 ON Color: Gr Rd Yllw Bl

Input 2 ON Text:

Input 2 OFF Color: Gr Rd Yllw Bl

Input 2 OFF Text:

7.5 E6 Camera Wiper Web Relay

7.5.1 Operator Control Page



7.5.2 Configuration



Setup

Network | Password | Relay 1/Input 1 | Relay 2/Input 2 | Events | Control Page Setup 1 | Control Page Setup 2 | Relay Control Page

Network: Network parameters require reboot before they take effect.

IP Address:	<input type="text" value="192"/>	<input type="text" value="168"/>	<input type="text" value="42"/>	<input type="text" value="96"/>
Netmask:	<input type="text" value="255"/>	<input type="text" value="255"/>	<input type="text" value="255"/>	<input type="text" value="0"/>
Broadcast:	<input type="text" value="192"/>	<input type="text" value="168"/>	<input type="text" value="42"/>	<input type="text" value="255"/>
Gateway:	<input type="text" value="192"/>	<input type="text" value="168"/>	<input type="text" value="42"/>	<input type="text" value="1"/>
TCP Port:	<input type="text" value="80"/>			
Modbus Port:	<input type="text" value="502"/>			
Speed:	10 Mbps <input type="radio"/> 100 Mbps <input checked="" type="radio"/>			
Mode:	Half Duplex <input type="radio"/> Full Duplex <input checked="" type="radio"/>			



Setup

Network | Password | **Relay 1/Input 1** | Relay 2/Input 2 | Events | Control Page Setup 1 | Control Page Setup 2 | Relay Control Page

Relay 1/Input 1:

Pulse Duration:	<input type="text" value="2.0"/> secs			
Relay 1 Options:	<input type="text" value="no local relay 1 control"/>			
Remote Relay 1 Options:	<input type="text" value="no remote relay control"/>			
Remote Relay IP Address:	<input type="text" value="192"/>	<input type="text" value="168"/>	<input type="text" value="42"/>	<input type="text" value="3"/>
Remote TCP Port:	<input type="text" value="80"/>			
Relay #:	<input type="text" value="0"/>			
Password:	<input type="password" value="....."/>			
Keep Alive:	<input type="text" value="YES(No TX State)"/>			

WEBRelay™ Dual-LS **Setup**

Network | Password | Relay 1/Input 1 | **Relay 2/Input 2** | Events | Control Page Setup 1 | Control Page Setup 2 | Relay Control Page

Relay 2/Input 2:

Pulse Duration: 1.5 secs

Relay 2 Options: set relay 2 equal input 2 (init at powerup)

Remote Relay 2 Options: no remote relay control

Remote Relay IP Address: 192 . 168 . 1 . 3

Remote TCP Port: 80

Relay #: 0

Password: ●●●●●●●●

Keep Alive: YES(No TX State)

Submit | Reset

WEBRelay™ Dual-LS **Setup**

Network | Password | Relay 1/Input 1 | **Relay 2/Input 2** | **Events** | Control Page Setup 1 | Control Page Setup 2 | Relay Control Page

Event Scheduler:

Current Time: Thu, 4 May 1978 07:54:01

Date (MM/DD/YY): 01 / 01 / 00

Time (HH:MM:SS): 00 : 00 : 00

Select Event to Edit: event1

Event 1 Settings:

Start Date (MM/DD/YY): 01 / 01 / 00

Start Time (HH:MM:SS): 00 : 00 : 00

Period (0 = disable event): 0 Seconds Minutes Hours Days Weeks

Count: 1 (Enter 0 for continuous occurrence.)

Relay #: relay 1

Relay Action: turn relay on

Pulse Duration: 1.5 secs

Submit | Reset



Setup

NetworkPasswordRelay 1/Input 1Relay 2/Input 2EventsControl Page Setup 1Control Page Setup 2Relay Control Page

Control Page Setup 1:

Main Header Text:	<input type="text" value="Camera Wiper Control"/>
Auto Refresh Page:	Yes <input checked="" type="radio"/> No <input type="radio"/>
Duration:	<input type="text" value="3"/> sec
Relay 1 Description:	<input type="text" value="Wiper Control"/>
Display Relay 1 Status:	Yes <input checked="" type="radio"/> No <input type="radio"/>
Status ON Color:	Gr <input checked="" type="radio"/> Rd <input type="radio"/> Yllw <input type="radio"/> Bl <input type="radio"/>
Status ON Text:	<input type="text" value="Wiper ON"/>
Status OFF Color:	Gr <input type="radio"/> Rd <input checked="" type="radio"/> Yllw <input type="radio"/> Bl <input type="radio"/>
Status OFF Text:	<input type="text" value="Wiper OFF"/>
ON/OFF Button:	Yes <input type="radio"/> No <input checked="" type="radio"/>
ON/OFF Button Label	<input type="text" value="ON/OFF"/>
Pulse Button:	Yes <input checked="" type="radio"/> No <input type="radio"/>
Pulse Button Label	<input type="text" value="Pulse"/>
Display Input 1 Status:	Yes <input type="radio"/> No <input checked="" type="radio"/>
Input 1 Description:	<input type="text" value="Input 1 Description"/>
Input 1 ON Color:	Gr <input checked="" type="radio"/> Rd <input type="radio"/> Yllw <input type="radio"/> Bl <input type="radio"/>
Input 1 ON Text:	<input type="text" value="Input 1 ON"/>
Input 1 OFF Color:	Gr <input type="radio"/> Rd <input checked="" type="radio"/> Yllw <input type="radio"/> Bl <input type="radio"/>
Input 1 OFF Text:	<input type="text" value="Input 1 OFF"/>

SubmitReset

The screenshot shows the 'Setup' interface for a WEBRelay Dual-LS device. The 'Control Page Setup 2' tab is selected. The configuration area is divided into two columns. The left column contains labels for various settings, and the right column contains the corresponding input fields and radio buttons. At the bottom, there are 'Submit' and 'Reset' buttons.

Relay 2 Description:	<input type="text" value="Relay 2 Description"/>
Display Relay 2 Status:	Yes <input type="radio"/> No <input checked="" type="radio"/>
Status ON Color:	Gr <input checked="" type="radio"/> Rd <input type="radio"/> Yllw <input type="radio"/> Bl <input type="radio"/>
Status ON Text:	<input type="text" value="Relay 2 ON"/>
Status OFF Color:	Gr <input type="radio"/> Rd <input checked="" type="radio"/> Yllw <input type="radio"/> Bl <input type="radio"/>
Status OFF Text:	<input type="text" value="Relay 2 OFF"/>
ON/OFF Button:	Yes <input type="radio"/> No <input checked="" type="radio"/>
ON/OFF Button Label:	<input type="text" value="ON/OFF"/>
Pulse Button:	Yes <input type="radio"/> No <input checked="" type="radio"/>
Pulse Button Label:	<input type="text" value="Pulse"/>
Display Input 2 Status:	Yes <input type="radio"/> No <input checked="" type="radio"/>
Input 2 Description:	<input type="text" value="Input 2 Description"/>
Input 2 ON Color:	Gr <input checked="" type="radio"/> Rd <input type="radio"/> Yllw <input type="radio"/> Bl <input type="radio"/>
Input 2 ON Text:	<input type="text" value="Input 2 ON"/>
Input 2 OFF Color:	Gr <input type="radio"/> Rd <input checked="" type="radio"/> Yllw <input type="radio"/> Bl <input type="radio"/>
Input 2 OFF Text:	<input type="text" value="Input 2 OFF"/>

Submit Reset

7.6 E7 Upstream Sign Web Relay

7.6.1 Operator Control Page



7.6.2 Configuration



Setup

- Network
- Password
- Relay 1/Input 1
- Relay 2/Input 2
- Events
- Control Page Setup 1
- Control Page Setup 2
- Relay Control Page

Network: Network parameters require reboot before they take effect.

IP Address:

Netmask:

Broadcast:

Gateway:

TCP Port:

Modbus Port:

Speed: 10 Mbps 100 Mbps

Mode: Half Duplex Full Duplex



Setup

- Network
- Password
- Relay 1/Input 1
- Relay 2/Input 2
- Events
- Control Page Setup 1
- Control Page Setup 2
- Relay Control Page

Relay 1/Input 1:

Pulse Duration: secs

Relay 1 Options:

Remote Relay 1 Options:

Remote Relay IP Address:

Remote TCP Port:

Relay #:

Password:

Keep Alive:

WEBRelay™ Dual-LS **Setup**

Network | **Password** | **Relay 1/Input 1** | **Relay 2/Input 2** | **Events** | **Control Page Setup 1** | **Control Page Setup 2** | **Relay Control Page**

Relay 2/Input 2:

Pulse Duration: secs

Relay 2 Options:

Remote Relay 2 Options:

Remote Relay IP Address: ...

Remote TCP Port:

Relay #:

Password:

Keep Alive:

WEBRelay™ Dual-LS **Setup**

Network | **Password** | **Relay 1/Input 1** | **Relay 2/Input 2** | **Events** | **Control Page Setup 1** | **Control Page Setup 2** | **Relay Control Page**

Event Scheduler:

Current Time:

Date (MM/DD/YY): //

Time (HH:MM:SS): ::

Select Event to Edit:

Event 1 Settings:

Start Date (MM/DD/YY): //

Start Time (HH:MM:SS): ::

Period (0 = disable event): Seconds Minutes Hours Days Weeks

Count: (Enter 0 for continuous occurrence.)

Relay #:

Relay Action:

Pulse Duration: secs



Setup

NetworkPasswordRelay 1/Input 1Relay 2/Input 2EventsControl Page Setup 1Control Page Setup 2Relay Control Page

Control Page Setup 1:

Main Header Text:	<input type="text" value="Sign Control"/>
Auto Refresh Page:	Yes <input checked="" type="radio"/> No <input type="radio"/>
Duration:	<input type="text" value="3"/> sec
Relay 1 Description:	<input type="text" value="Sign Control"/>
Display Relay 1 Status:	Yes <input checked="" type="radio"/> No <input type="radio"/>
Status ON Color:	Gr <input checked="" type="radio"/> Rd <input type="radio"/> Yllw <input type="radio"/> Bl <input type="radio"/>
Status ON Text:	<input type="text" value="Relay1 ON"/>
Status OFF Color:	Gr <input type="radio"/> Rd <input checked="" type="radio"/> Yllw <input type="radio"/> Bl <input type="radio"/>
Status OFF Text:	<input type="text" value="Relay1 OFF"/>
ON/OFF Button:	Yes <input checked="" type="radio"/> No <input type="radio"/>
ON/OFF Button Label	<input type="text" value="ON/OFF"/>
Pulse Button:	Yes <input type="radio"/> No <input checked="" type="radio"/>
Pulse Button Label	<input type="text" value="Pulse"/>
Display Input 1 Status:	Yes <input type="radio"/> No <input checked="" type="radio"/>
Input 1 Description:	<input type="text" value="Input 1 Description"/>
Input 1 ON Color:	Gr <input checked="" type="radio"/> Rd <input type="radio"/> Yllw <input type="radio"/> Bl <input type="radio"/>
Input 1 ON Text:	<input type="text" value="Input 1 ON"/>
Input 1 OFF Color:	Gr <input type="radio"/> Rd <input checked="" type="radio"/> Yllw <input type="radio"/> Bl <input type="radio"/>
Input 1 OFF Text:	<input type="text" value="Input 1 OFF"/>

SubmitReset



Setup

Network | Password | Relay 1/Input 1 | Relay 2/Input 2 | Events | Control Page Setup 1 | **Control Page Setup 2** | Relay Control Page

Control Page Setup 2:

Relay 2 Description:

Display Relay 2 Status: Yes No

Status ON Color: Gr Rd Yllw Bl

Status ON Text:

Status OFF Color: Gr Rd Yllw Bl

Status OFF Text:

ON/OFF Button: Yes No

ON/OFF Button Label:

Pulse Button: Yes No

Pulse Button Label:

Display Input 2 Status: Yes No

Input 2 Description:

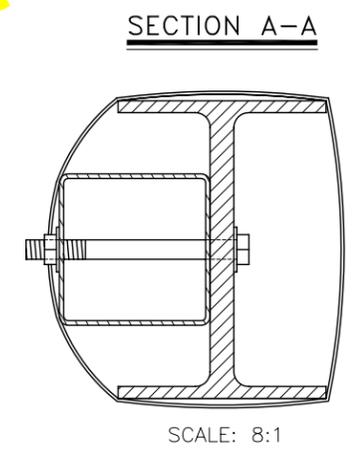
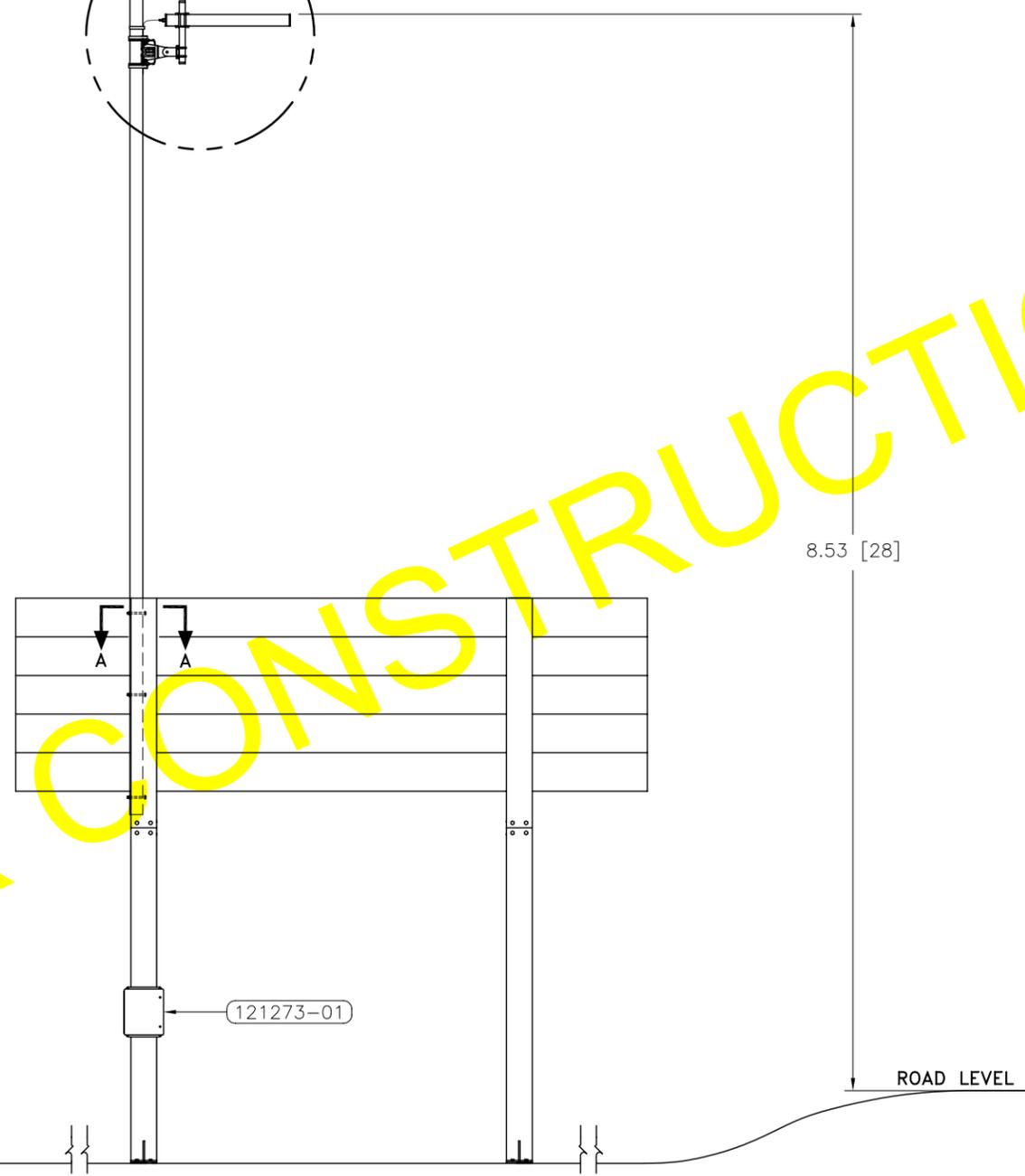
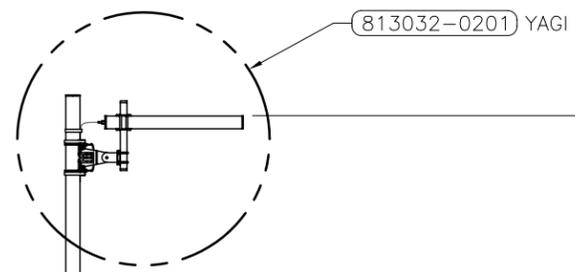
Input 2 ON Color: Gr Rd Yllw Bl

Input 2 ON Text:

Input 2 OFF Color: Gr Rd Yllw Bl

Input 2 OFF Text:

OPEN/CLOSED SIGN – ASSEMBLY – BACK VIEW



NOT FOR CONSTRUCTION

REV.	DESCRIPTION	DWN/DSN	APPR.	APPR.	DATE
1	PRELIMINARY RELEASE	JGi/TRo	MLo	MGa	DEC 18/07

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DIMENSIONS IN: METERS [FT]

**INTERNATIONAL ROAD DYNAMICS INC.
SASKATOON SASKATCHEWAN CANADA**

DWG. TITLE: **SIGN DETAILS
VIRTUAL WEIGH STATION
NYS DOT**

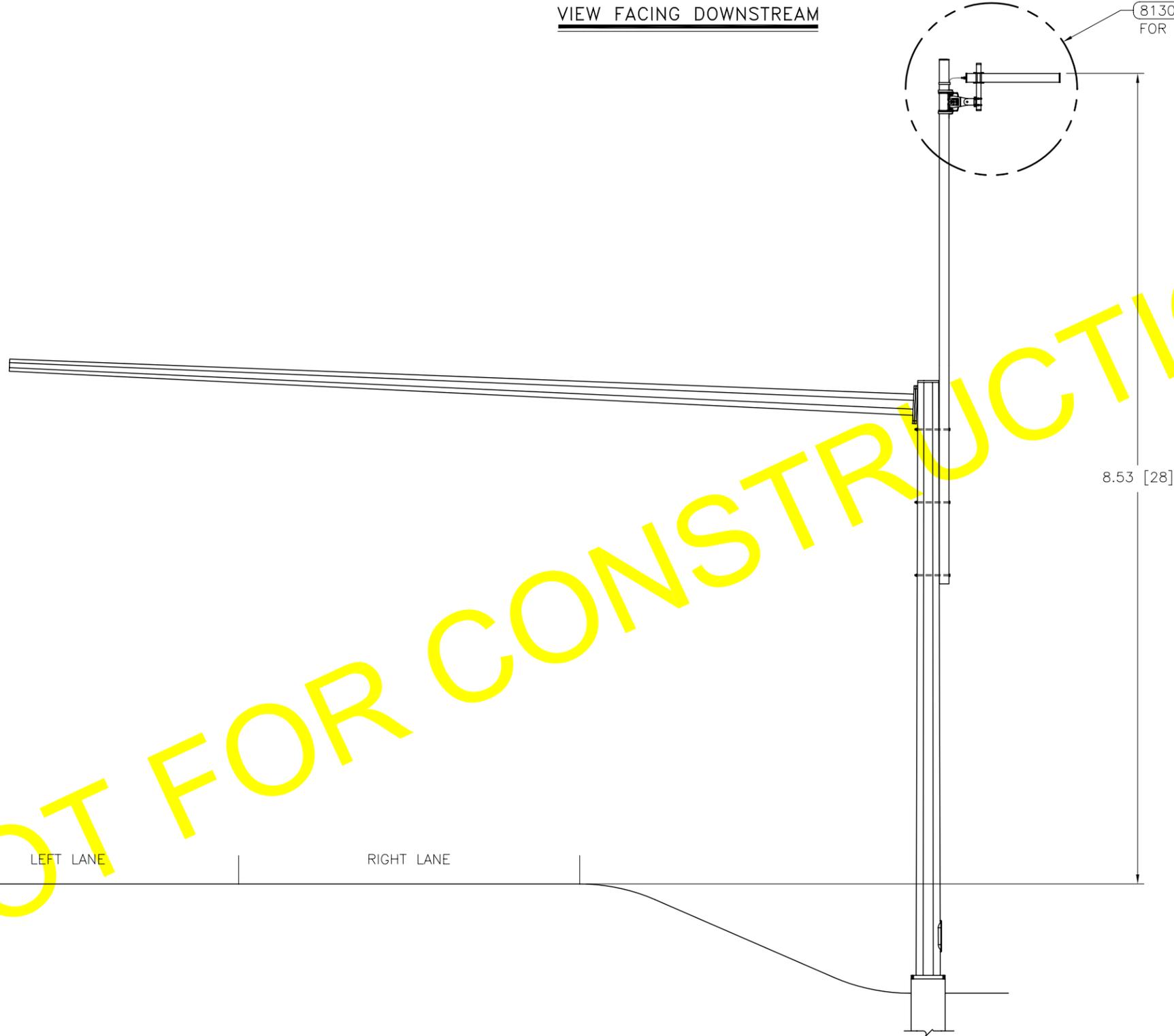
DWG. No. **C10811006** REV.: 1

CAD FILE: C10811006.DWG SHEET 1 OF 2

EQUIPMENT MOUNTING
VIEW FACING DOWNSTREAM

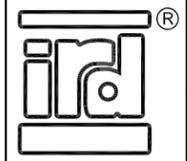
(813032-0201) YAGI
FOR COMPLIANCE LOCATION, REFER TO (813032-0401) OMNI

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REV.	DESCRIPTION	DWN/DSN	APPR.	APPR.	DATE
1	PRELIMINARY RELEASE	JGi/TRo	MLo	MGa	DEC 18/07

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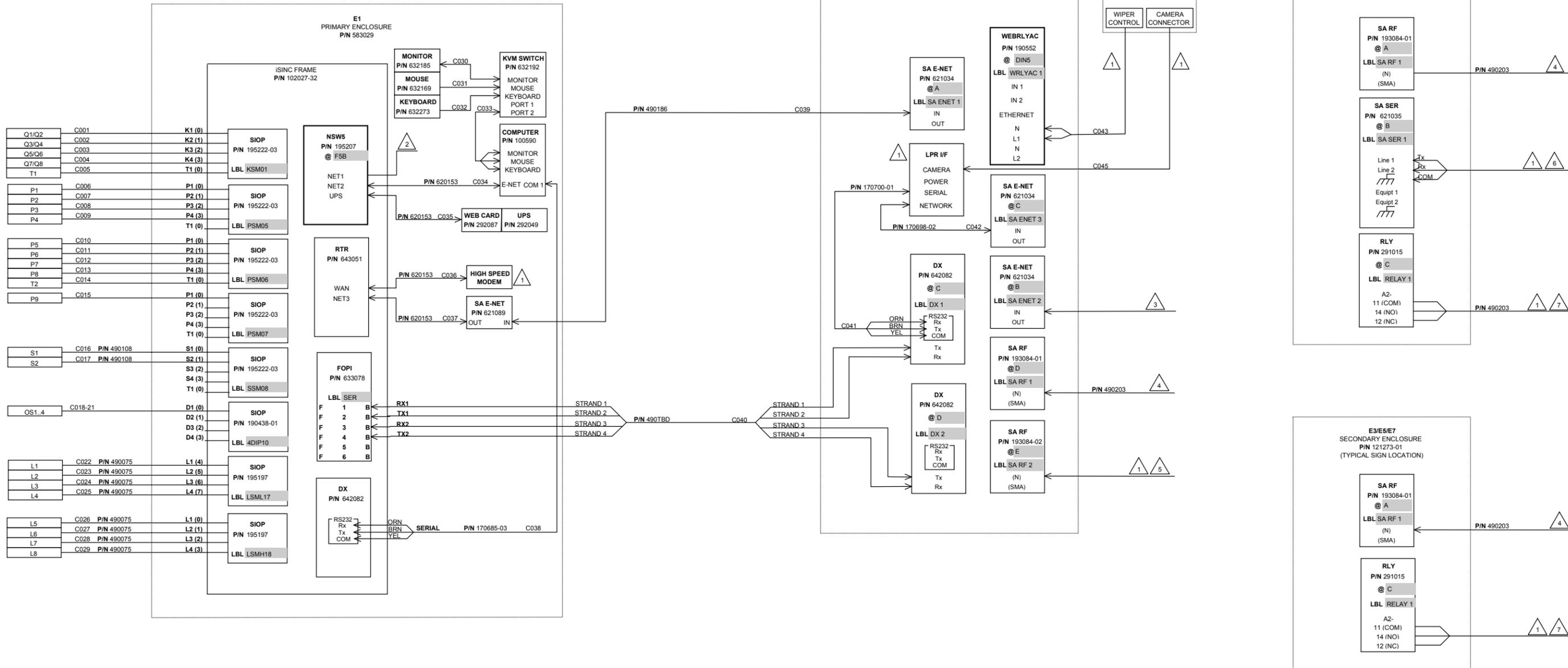


NOT TO SCALE
SIZE: B
DIMENSIONS IN:
METERS (FT)

INTERNATIONAL ROAD DYNAMICS INC.
SASKATOON SASKATCHEWAN CANADA

DWG. TITLE:
**SIGN DETAILS
VIRTUAL WEIGH STATION
NYS DOT**

DWG. No. **C10811006** REV.: 1
CAD FILE: C10811006.DWG SHEET 2 OF 2



NOTES: (THIS SHEET ONLY)

- 1 NOT SUPPLIED BY IRD.
- 2 RESERVED FOR ADDITIONAL COMPUTER.
- 3 RESERVED FOR OPTIONAL SIDEFIRE CAMERA.
- 4 WIFI ANTENNA CONNECTION. FOR E2/E6 REFER TO STANDARD DRAWING 813032-04. FOR E3/E4/E5/E7 REFER TO STANDARD DRAWING 813032-02.
- 5 AVI ANTENNA CONNECTION. REFER TO 813026 STANDARD DRAWING SERIES.
- 6 SERIAL CONNECTION TO EXTERNAL AVI READER
- 7 REMOTE CONTROLLED RELAY CONTACTS AVAILABLE FOR SWITCHING POWER TO EXTERNAL DEVICES. WIRE BETWEEN COMMON (COM) AND NORMALLY OPEN (NO) OR NORMALLY CLOSED (NC) FOR FAIL SAFE OR FAIL SECURE FUNCTIONALITY RESPECTIVELY.

REV.	DESCRIPTION	DRAWN	APPR.	APPR.	DATE
A	Previously released as rev 3	MGa	MGa	MLo	Mar 10/08

CONFIDENTIAL

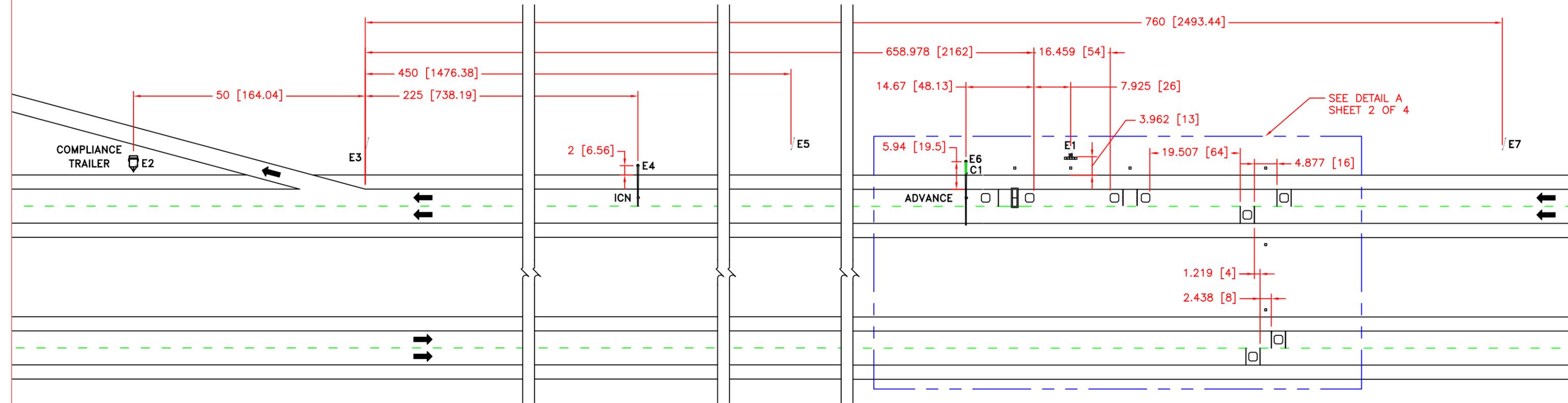
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INTERNATIONAL ROAD DYNAMICS INC. SASKATOON SASKATCHEWAN CANADA

DWG. TITLE: **SITE TERMINATIONS VIRTUAL WEIGH STATION NYS DOT**

DWG. No. **C10811007** REV.: **A**
 DIMENSIONS IN: N/A FILENAME: **C10811007.vthought** SHEET **1** OF **1**



GENERAL NOTES:

ALL CONNECTIONS BETWEEN SENSORS AND LEAD CABLES ARE DONE IN PULL BOX AND ARE SOLDERED THEN SEALED FOR WATERPROOFING. NUMBER AND PLACEMENT OF PULL BOXES NOT SHOWN.

POWER CABLES MUST BE RUN IN SEPARATE CONDUITS/PULLBOXES FROM SIGNAL CABLES.

ROAD SURFACE PAVEMENT CONDITIONS MUST MEET CURRENT ASTM E1318 REQUIREMENTS TO ACHIEVE OPTIMAL SYSTEM PERFORMANCE FOR 61m [200'] BEFORE WIM SENSORS AND 30.5m [100'] AFTER. AREA IS INDICATED BY CROSS HATCHING.

CABLES MUST BE PROTECTED BY PVC SLEEVES WHERE THEY CROSS PAVEMENT JOINTS/CRACKS.

PIEZO SENSORS MUST BE A MINIMUM OF 1.83m [6'] AWAY FROM CRACKS, JOINTS OR SAWCUTS WHEN POSSIBLE.

ADDITIONAL DRAINAGE MAY BE REQUIRED DEPENDING ON SLOPE OF ROADWAY. DRAINAGE CONSISTS OF 1-1/2" ABS PIPE SLOPED TO RIP RAP DRAINAGE PIT IN DITCH.

IRD RECOMMENDS THAT PULL BOXES BE NO FURTHER THAN 61m [200'] APART. IRD RECOMMENDS THE MINIMUM SIZE FOR PULL BOXES IS 45.7cm [18"] X 45.7cm [18"] X 30.5cm [12"].

EXACT ROUTING OF CONDUIT TO BE DETERMINED ON SITE. CONDUITS ARE LABELED LEFT TO RIGHT, TOP TO BOTTOM.

DRAWING NOT TO SCALE.

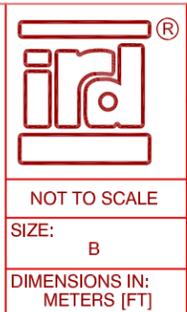
LEGEND:

- L - INDUCTIVE LOOP
- P - PIEZOELECTRIC SENSOR
- S - SINGLE LOAD CELL SCALE
- C - CAMERA
- Q - KISTLER QUARTZ SENSOR
- T - TEMPERATURE SENSOR
- E - ENCLOSURE
- ICN - IN CAB NOTIFICATION

REV.	DESCRIPTION	DWN/DSN	APPR.	APPR.	DATE
A	INITIAL RELEASE	JGi/YMa	TRo	MGa	OCT 22/07
B	RELOCATE CAMERA AS PER REDLINES - ECO-01.	JGi/YMa	MGa	MLo	Nov 7/07
C	ON SHEET 1, ADD DIMENSION FOR ICN POLE LOCATION. ON SHEET 4, CHANGE CONDUIT NOTE 20. ECO-02.	JGi/YMa	MLo	MGa	Nov 20/07

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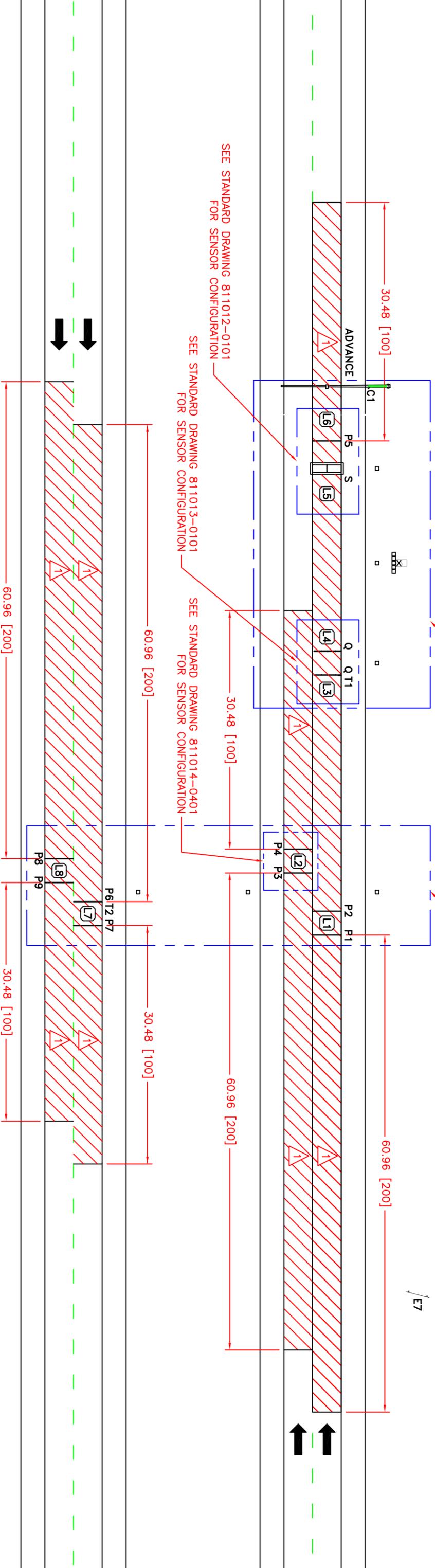
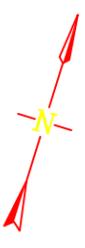
INTERNATIONAL ROAD DYNAMICS INC. SASKATOON SASKATCHEWAN CANADA

DWG. TITLE: **SITE LAYOUT VIRTUAL WEIGH STATION NYS DOT**

DWG. No. **C10811003** REV.: C

CAD FILE: C10811003.DWG SHEET 1 OF 4

DETAIL A



SEE CONDUIT DETAIL B
SHEET 3 OF 4

SEE CONDUIT DETAIL C
SHEET 4 OF 4

NOTES: (THIS SHEET ONLY)
 SITE CONDITIONS AS PER ASTM E1318.

REV.	DESCRIPTION	DWN/DNSN	APPR.	APPR.	DATE
A	INITIAL RELEASE	JGI/YMa	TRO	MGa	OCT 22/07
B	RELOCATE CAMERA AS PER REDLINES - ECO-01.	JGI/YMa	MGa	MLO	Nov 7/07
C	ON SHEET 1, ADD DIMENSION FOR ICD POLE LOCATION. ON SHEET 4, CHANGE CONDUIT NOTE 20, ECO-02.	JGI/YMa	MLO	MGa	Nov 20/07

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NOT TO SCALE
 SIZE: B
 DIMENSIONS IN:
 METERS [M]

INTERNATIONAL ROAD DYNAMICS INC.
SASKATOON SASKATCHEWAN CANADA

DWG. TITLE:
**SITE LAYOUT
 VIRTUAL WEIGH STATION
 NYS DOT**

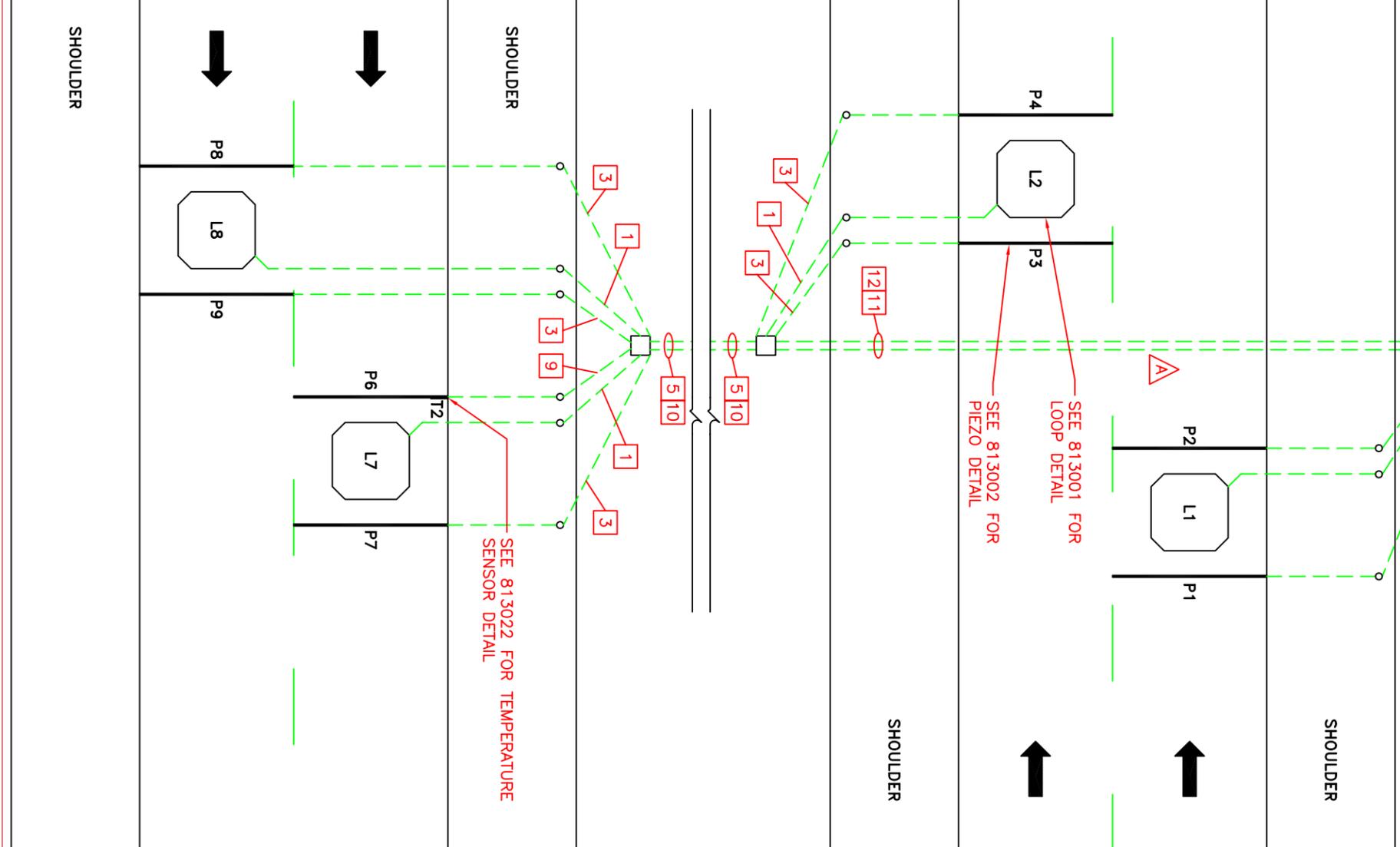
DWG. No. **C10811003** REV.: C
 CAD FILE: C:10811003.DWG SHEET 2 OF 4

CONDUIT DETAIL C



SIGNAL CONDUITS:

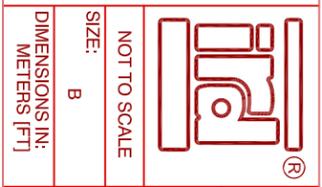
- 1 1" CONDUIT
1-LOOP WIRE
- 2 1-1/2" CONDUIT
1-3PR SLC LEADS
2-2C OFF-SCALE LEADS
- 3 1" CONDUIT
1-PIEZO LEAD
- 4 2" CONDUIT
1-3PR SLC LEADS
2-2C OFF-SCALE LEADS
1-PIEZO LEAD
- 5 2" CONDUIT
2-LOOP LEADS
- 6 2" CONDUIT
1-4 STRAND MULTIMODE FIBER OPTIC CABLE (AVI, CAMERA)
- 7 2" CONDUIT
4-KISTLER LEADS
- 8 2" CONDUIT
4-KISTLER LEADS
1-TEMPERATURE SENSOR LEAD
- 9 2" CONDUIT
1-PIEZO LEAD
1-TEMPERATURE SENSOR LEAD
- 10 2" CONDUIT
4-PIEZO LEADS
1-TEMPERATURE SENSOR LEAD
- 11 2" CONDUIT
3-LOOP LEADS
- 12 2" CONDUIT
6-PIEZO LEADS
1-TEMPERATURE SENSOR LEAD
- 13 2" CONDUIT
4-LOOP LEADS
- 14 2" CONDUIT
8-PIEZO LEADS
1-TEMPERATURE SENSOR LEAD
- 15 3" CONDUIT
8-LOOP LEADS
- 16 3" CONDUIT
9-PIEZO LEADS
2-TEMPERATURE SENSOR LEADS
- 17 3" CONDUIT
1-3PR SLC LEADS
2-2C OFF-SCALE LEADS
8-KISTLER LEADS
- 18 2" CONDUIT
6-LOOP LEADS
- 19 2" CONDUIT
8-KISTLER LEADS
1-TEMPERATURE SENSOR LEADS
- 20 2" CONDUIT
1-CATS (NETWORK)



NOTES: (THIS SHEET ONLY)
 ▲ UNDERBORE.

REV.	DESCRIPTION	DWN/DNSN	APPR.	APPR.	DATE
A	INITIAL RELEASE	JGI/YMa	TRo	MGa	OCT 22/07
B	RELOCATE CAMERA AS PER REDLINES - ECO-01.	JGI/YMa	MGa	MLo	Nov 7/07
C	ON SHEET 1, ADD DIMENSION FOR ICN POLE LOCATION. ON SHEET 4, CHANGE CONDUIT NOTE 20. ECO-02.	JGI/YMa	MLo	MGa	Nov 20/07

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DWG. TITLE:
**INTERNATIONAL ROAD DYNAMICS INC.
 SASKATOON SASKATCHEWAN CANADA**

DWG. No. **C10811003**

SITE LAYOUT
 VIRTUAL WEIGH STATION
 NYS DOT

CAD FILE: C:10811003.DWG

REV.: C

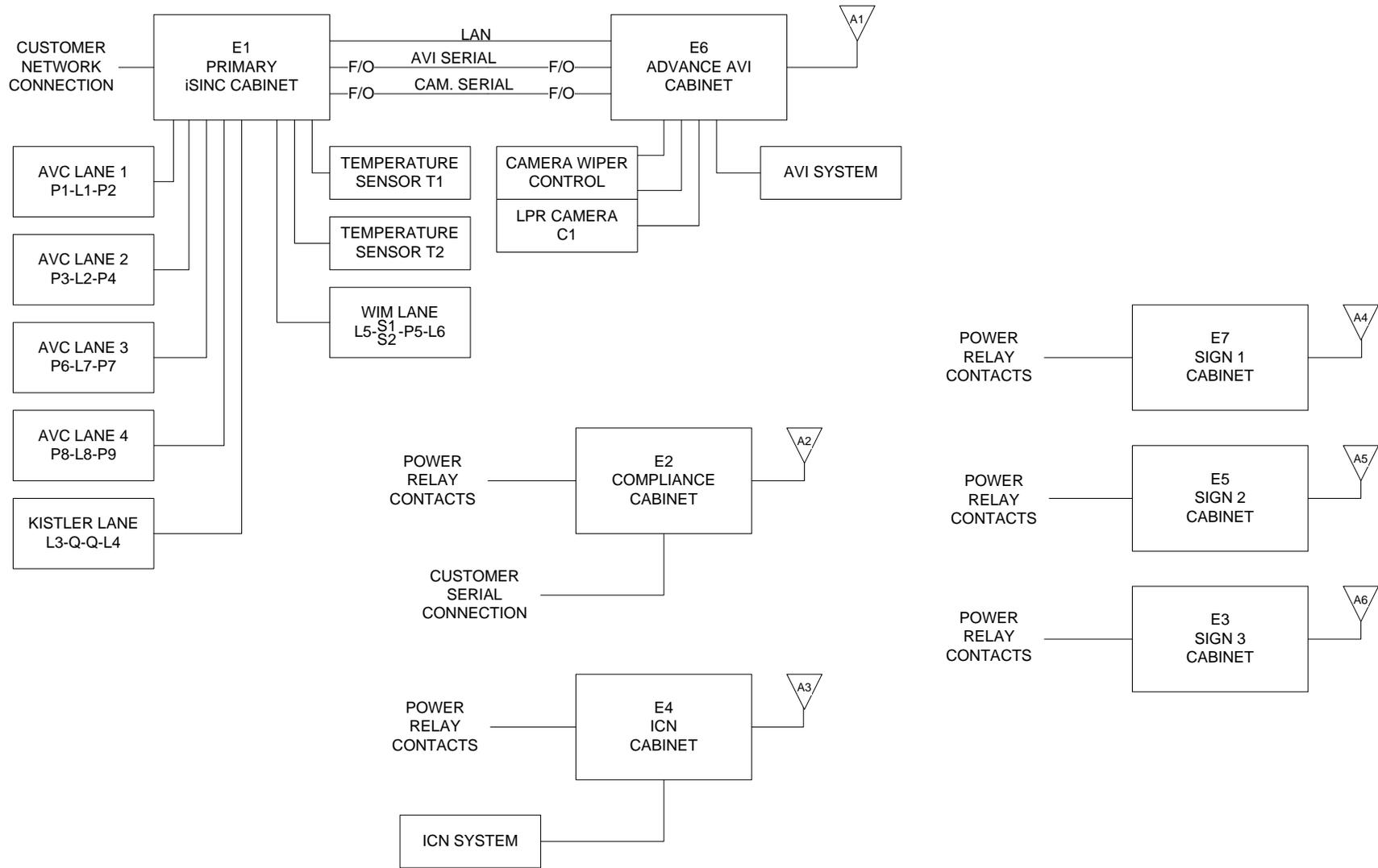
SHEET 4 OF 4

SYSTEM BLOCK DIAGRAM 10811 MOBILE CVISN / VWIM NEW YORK

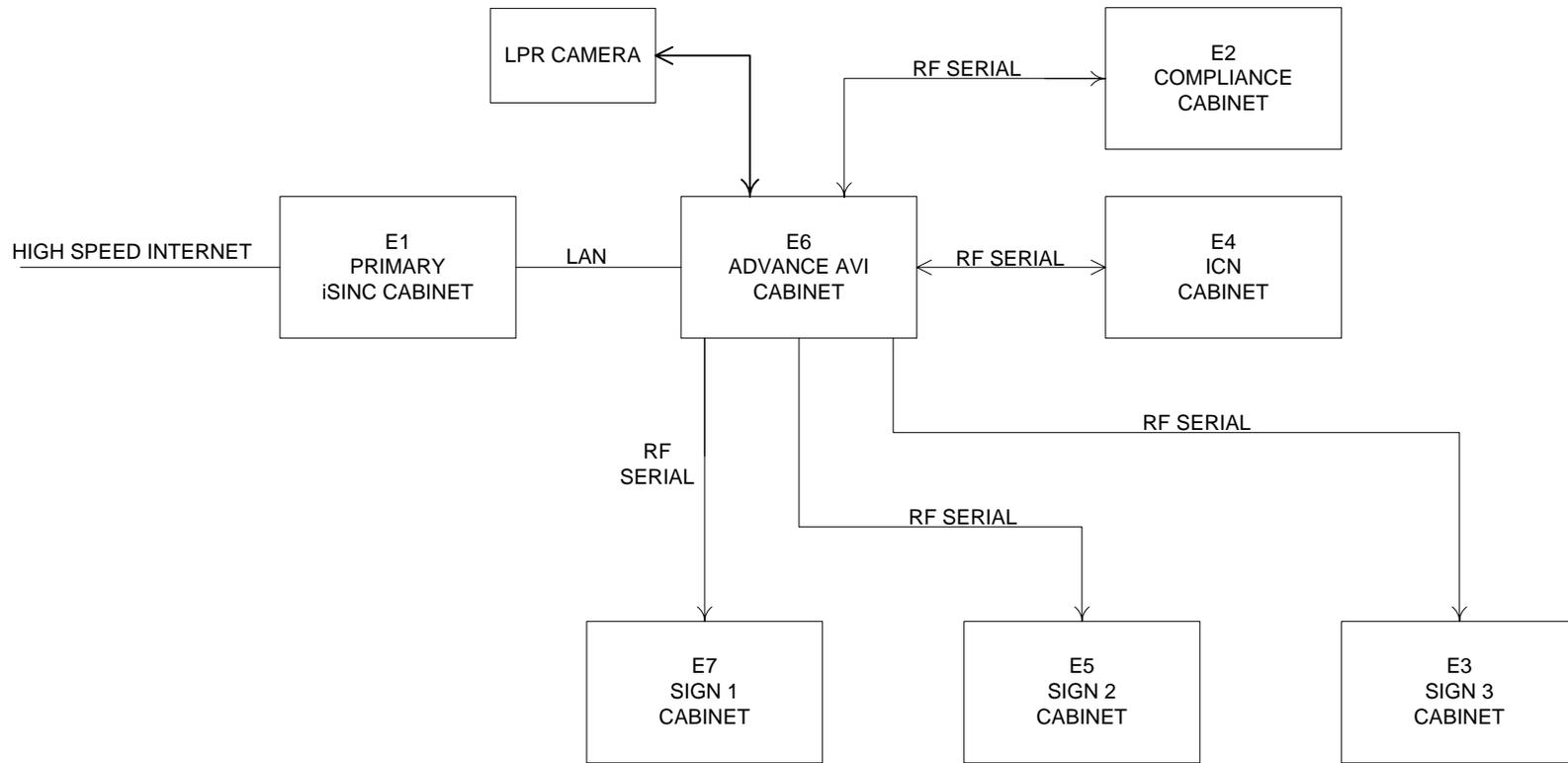
REV.	DESCRIPTION	DRAWN	APPR.	APPR.	DATE	CONFIDENTIAL THIS DOCUMENT CONTAINS INFORMATION PROPRIETARY TO IRD AND IS THEREFORE NOT TO BE DISCLOSED TO OTHERS OR USED FOR PRODUCTION WITHOUT WRITTEN PERMISSION FROM INTERNATIONAL ROAD DYNAMICS INC.		INTERNATIONAL ROAD DYNAMICS INC. SASKATOON SASKATCHEWAN CANADA			
A	INITIAL RELEASE	NKI	DBo	TRo	Mar 10/08			DWG. TITLE: SYSTEM BLOCK DIAGRAM 10811 MOBILE CVISN / VWIM NEW YORK	SYSTEM BLOCK DIAGRAM 10811 MOBILE CVISN / VWIM NEW YORK		
						SIZE: A	DWG. No. C10811010	REV.: A			
						DIMENSIONS IN: N/A	FILENAME: C10811010.DOC	SHEET 1 OF 3			

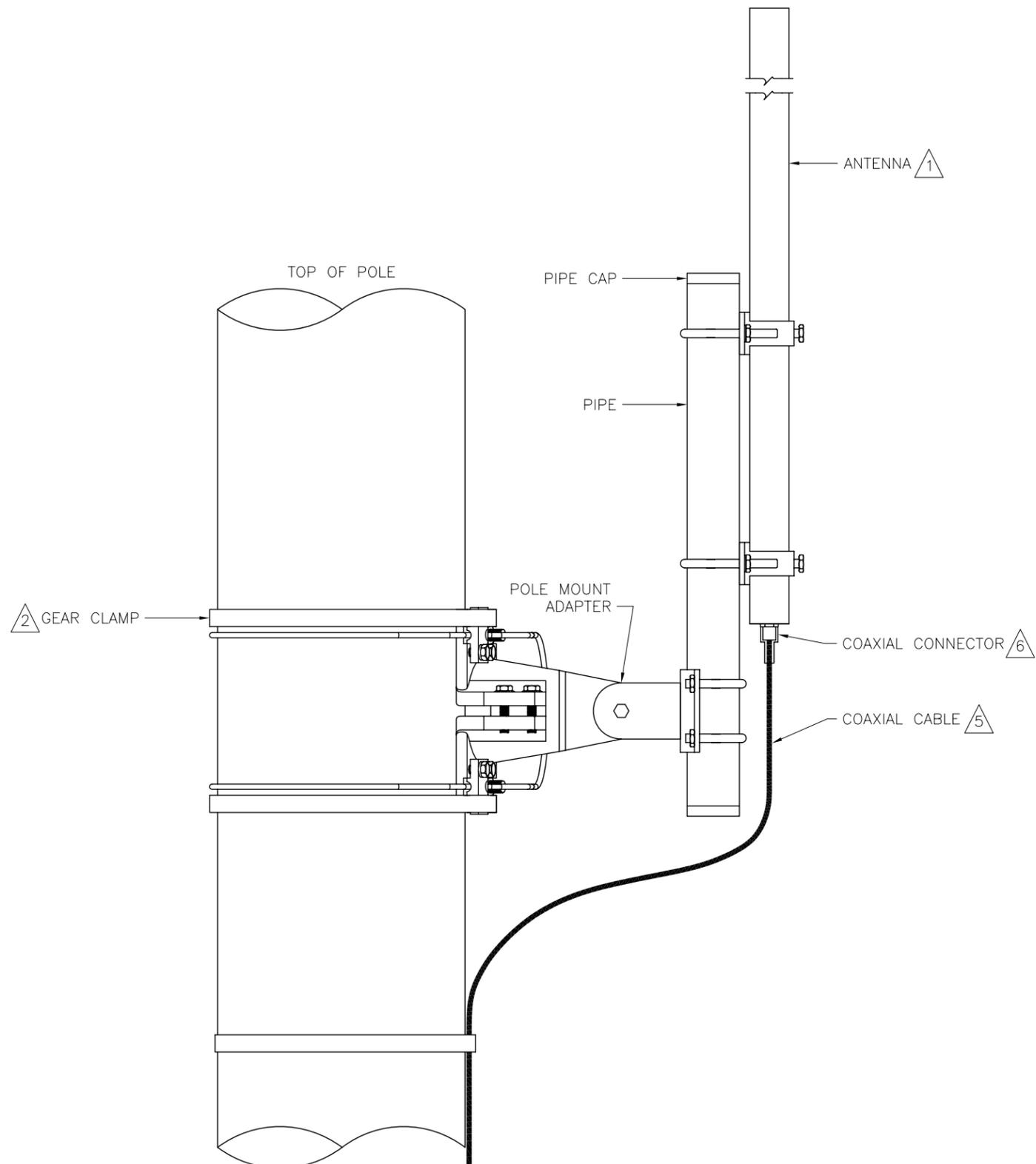
SYSTEM BLOCK DIAGRAM

NEW YORK



LOGICAL COMMUNICATIONS DIAGRAM





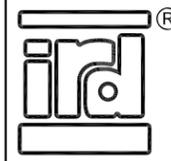
NOTES:

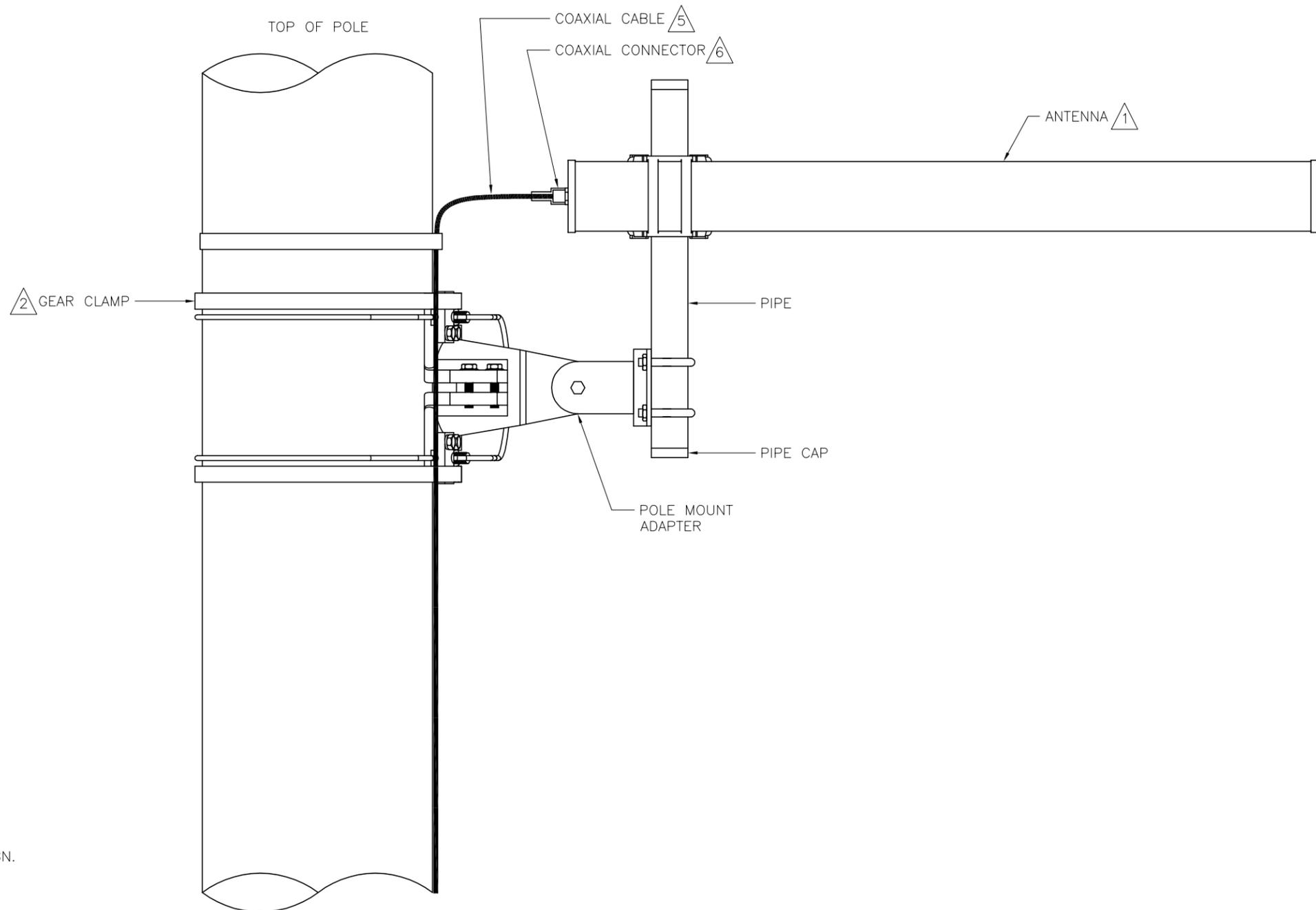
- 1 ANTENNA AIMING AND HEIGHT REQUIREMENTS ARE DEPENDENT ON SITE DESIGN.
- 2 FOR REDUNDANCY AND SUPPORT, USE BOTH MOUNTING CABLES SUPPLIED WITH POLE MOUNT ADAPTER AND GEAR CLAMPS TO SECURE ADAPTER TO POLE. THIS HARDWARE WILL SUPPORT POLE DIAMETERS FROM 6 [152.4] TO 11.6 [294.6]
- 3 PROVIDE APPROPRIATE LIGHTNING PROTECTION AS PER NFPA 780.
- 4 ALL ELECTRICAL DEVICES, GROUNDING, BONDING, WIRING AND MOUNTING MUST MEET THE CANADIAN ELECTRICAL CODE PART I AND/OR NATIONAL ELECTRICAL CODE NFPA 70 AND LOCAL ELECTRICAL CODE.
- 5 SECURE CABLE EVERY 10' [3.1m] USING GEAR CLAMPS.
- 6 COAXIAL CONNECTORS PROVIDED FOR BOTH ENDS OF CABLE. WEATHERIZE EXTERNAL CONNECTION USING ANDREW 3M™ COLDSHRINK™ AND 3M™ SCOTCHKOTE™ ELECTRICAL COATING OR EQUIVALENT.
- 7 ALL PARTS SHOWN ARE INCLUDED IN KIT P/N 190553-XX.

REV.	DESCRIPTION	DWN/DSN	APPR.	APPR.	DATE
A	INITIAL RELEASE	JGi/MGa	MLo	MGa	Dec 10/07

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		INTERNATIONAL ROAD DYNAMICS INC. SASKATOON SASKATCHEWAN CANADA	
NOT TO SCALE		DWG. TITLE: INSTALLATION 2.4 GHz OMNI POLE MOUNT COMM RF ANTENNA	
SIZE: B	DWG. No. 813032-0401	REV.: A	
DIMENSIONS IN: INCHES [mm]	CAD FILE: 813032-0401.DWG	SHEET 1 OF 1	

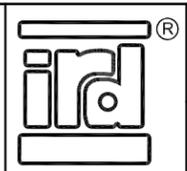


NOTES:

- 1 ANTENNA AIMING AND HEIGHT REQUIREMENTS ARE DEPENDENT ON SITE DESIGN. EACH ANTENNA PAIR MUST HAVE MATCHING POLARIZATION. TWO CO-LOCATED ANTENNAS MUST HAVE DIFFERENT POLARIZATION.
- 2 FOR REDUNDANCY AND SUPPORT, USE BOTH MOUNTING CABLES SUPPLIED WITH POLE MOUNT ADAPTER AND GEAR CLAMPS TO SECURE ADAPTER TO POLE. THIS HARDWARE WILL SUPPORT POLE DIAMETERS FROM 6 [152.4] TO 11.6 [294.6]
- 3 PROVIDE APPROPRIATE LIGHTNING PROTECTION AS PER NFPA 780.
- 4 ALL ELECTRICAL DEVICES, GROUNDING, BONDING, WIRING AND MOUNTING MUST MEET THE CANADIAN ELECTRICAL CODE PART I AND/OR NATIONAL ELECTRICAL CODE NFPA 70 AND LOCAL ELECTRICAL CODE.
- 5 SECURE CABLE EVERY 10' [3.1m] USING GEAR CLAMPS.
- 6 COAXIAL CONNECTORS PROVIDED FOR BOTH ENDS OF CABLE. WEATHERIZE EXTERNAL CONNECTION USING ANDREW 3M™ COLDSHRINK™ AND 3M™ SCOTCHKOTE™ ELECTRICAL COATING OR EQUIVALENT.
- 7 ALL PARTS SHOWN ARE INCLUDED IN KIT P/N 190553-XX.

REV.	DESCRIPTION	DWN/DSN	APPR.	APPR.	DATE
A	INITIAL RELEASE	JGi/YMa	MGa	DPr	MAR 20/07
B	AS PER REDLINES - ECO-01.	JGi/MGa	MLo	MGa	Dec 11/07

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NOT TO SCALE
 SIZE: B
 DIMENSIONS IN: INCHES [mm]

INTERNATIONAL ROAD DYNAMICS INC. SASKATOON SASKATCHEWAN CANADA

DWG. TITLE: **INSTALLATION 2.4 GHz YAGI POLE MOUNT COMM RF ANTENNA**

DWG. No. **813032-0201** REV.: B

CAD FILE: 813032-0201.DWG SHEET 1 OF 1

INTRODUCTION

There are two User Display options for viewing the Virtual Weigh in Motion (WIM) site data. The first option is to use a Web browser to view the Virtual WIM Web site. The second option is to use the IRD Electronic Screening program, which is a stand-alone application that runs on the MS Windows operating system. This functional description covers the operation of the IRD Electronic Screening software application. Viewing the Virtual WIM data using the Web site provides most of the same information with the exception of CVISN screening details. The Web interface only indicates when a Credential failure has occurred, but presents no details regarding the reasons for the failure.

ELECTRONIC SCREENING SYSTEM WALKTHROUGH

A vehicle passing through the IRD Electronic Screening system is processed as follows:

1) Vehicles in the right hand lane passing over the piezo-loop-piezo sensors and the loop-Kistler-Kistler-loop sensors have their axle spacings, axle weights, axle configuration, vehicle speed, vehicle weight and GWW recorded. This information is used for data collection only. Each vehicle's data is matched as the vehicle travels over each set of WIM sensors, so there will be one vehicle ID number associated with all of the data for a given vehicle.

Vehicles travelling on the opposite side of the highway will pass over piezo-loop-piezo sensors, and their WIM data will also be recorded.

2) Commercial vehicles travelling in the left hand lane will be detected by the piezo-loop-piezo sensors in that lane. The WIM data from this lane can be shown on the Operator Display, and a warning indicating that a commercial vehicle is travelling in the wrong lane will be displayed.

3) When vehicles reach the loop-scale-piezo-loop sensors, again their WIM data is measured. A vehicle passing over the first loop also triggers the License Plate Reader (LPR) system to capture an image of the vehicle's license plate, an overview image of the vehicle and a reading of the license plate and jurisdiction.

Vehicles with AVI transponders transmit their identification information to the Roadside Operating Computer (ROC). If a vehicle has had a successful license plate read by the LPR system, this information will be sent to the ROC. The ROC system uses the transponder ID number or license plate number to look through the CVIEW database for the records of the vehicle and carrier that match the transponder ID or license number.

Knowing the length of the vehicle, the number of axles, and the distance between axles, the IROC determines the class of the truck by comparing it to vehicle classification tables. It then compares the measurements for the vehicle against the state class compliance table to identify any violations. Overweight and overlength vehicles are subject to optional permit checks.

With the information from the vehicle and carrier records, the system performs compliance, credential and safety checks and, in combination with the WIM measurements, determines whether the vehicle should be directed to report or bypass the inspection station. The IROC maintains hot-lists of vehicles and carriers that must report regardless of compliance and credentials.

In addition to the screening functions described above, the Station Control System can be set for random pull-ins. The operator defines a random selection percentage for vehicles that otherwise may not have been directed to report.

Figure 1 below shows the main Vehicle Display Screen. Each column of data represents a lane. Vehicle images may not be available for all lanes (depending on system configuration), and for some lanes there may be a choice of images displayed on this screen (for example, vehicle overview image or license plate image).



Figure 1 - Vehicle Display Screen

By clicking on any vehicle record window on the screen or the Vehicle button at the bottom of the screen, the operator can view detailed information on a specific vehicle. Figures 2, 3 and 4 show examples of the detailed weight information, CVISN data and vehicle images that can be viewed in the Vehicle Detail screens.

4) When an AVI equipped vehicle reaches the In-Cab Notification antenna location, the sorting decision is transmitted to the vehicle operator directing them to either report or bypass. There is no method of signaling vehicles without AVI transponders to report, aside from signing on the roadside.

If a violation or random selection has occurred, the vehicle is instructed to report. If an AVI equipped vehicle has been directed to report and continues on in the bypass lane instead, the AVI Compliance antenna detects this and the station Operator is notified with a Warning indicator on the vehicle record display.

The workstation displays the reasons why a vehicle is being signaled to report. Records of vehicle and carrier information are stored on the Workstation for a specified time and are available for viewing by any operator.

Operators with the appropriate access privileges can adjust the screening criteria, credential overrides, and system settings. All users can view this information.

Original Screening Results

Vehicle

(4) LANE Ramp WIM CLASS 11 TOTAL AXLE SPAN 42.9 ft GVW 60.8 kips BAR L JONES
 Report SPEED 21.7 mph TIME 11:24 MAX GWV 74.0 kips
 6.9 16.4 9.8 9.8 14.3 14.1 14.7 11.0 6.6
Credential Failed

Previous
Next

Results Identification Images

Axle	Spacing (ft)	Left Wt	Right Wt	Total Wt	Allowed ...	Permit Wt	Permit Spa...	Violations	Grp	Total wt	Perm wt
1				6.6	12.5			No violation	1	6.6(s)	
2	9.8			11.0	20.0			No violation	2	11.0(s)	
3	9.8			14.7	20.0			No violation	3	14.7(s)	
4	16.4			14.1	20.0			No violation	4	14.1(s)	
5	6.9			14.3	20.0			No violation	5	14.3(s)	

GVW: 60.8

Hotlists

Type Use

Vehicle: _____

Carrier: _____

WIM Compliance

Random Pull-In:

Errored Vehicle:

Overheight:

Overlength:

Overweight:

Potential Violations

Ovrd	Used	Credential/Safety Item	Vehicle/Snapshot Value	Screening Value
<input type="checkbox"/>	<input checked="" type="checkbox"/>	IFTA License is Expired		Jul 01, 2004 10:50:37
<input type="checkbox"/>	<input checked="" type="checkbox"/>	Out-of-State and No IFTA Credential	60785	26000
<input type="checkbox"/>	<input checked="" type="checkbox"/>	IRP Registration is Invalid	INV	
<input type="checkbox"/>	<input checked="" type="checkbox"/>	IRP Registration is Expired		Jul 01, 2004 10:50:37
<input type="checkbox"/>	<input checked="" type="checkbox"/>	Out-of-State and No IRP Credential	60785	26000

Warnings:

Snapshots: Overrides:

International Road Dynamics Inc.

Figure 2 - Vehicle Results Detail Screen

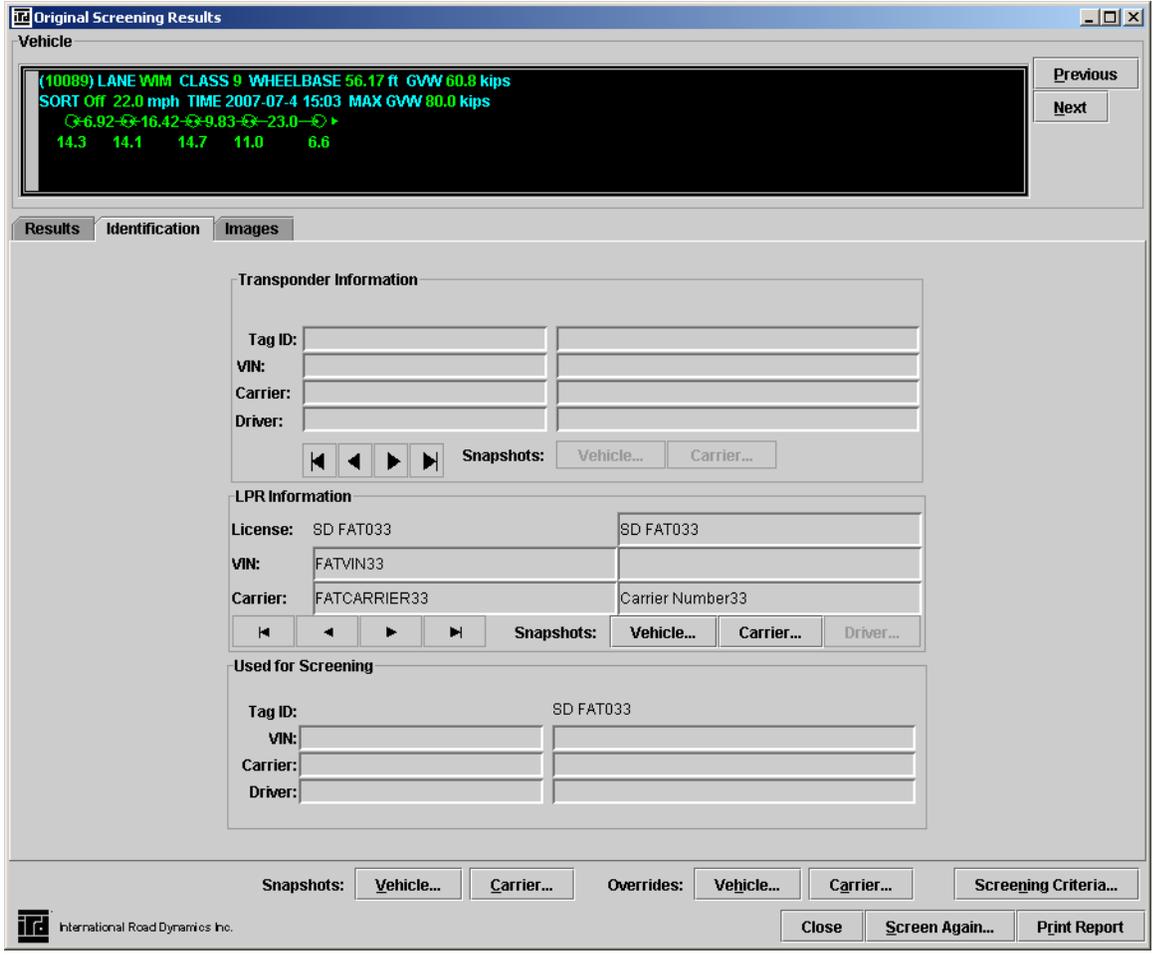


Figure 3 - Vehicle ID Details Screen

Original Screening Results

Vehicle

(4) LANE Ramp WIM CLASS 11 TOTAL AXLE SPAN 42.9 ft GVW 60.8 kips BARRY LEE JOHNSON
Report SPEED 21.7 mph TIME 11:24 MAX GWV 74.0 kips
6.9 16.4 9.8 9.8
14.3 14.1 14.7 11.0 6.6
Credential Failed

Previous
Next

Results Images



International Road Dynamics, Inc.

Close Print Report

Figure 4 - Vehicle Images Detail Screen