Minnesota Statewide Commercial Vehicle Weight Compliance Strategic Plan

6/30/05

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Executive Summary

Purpose

This Commercial Vehicle Weight Compliance Strategic Plan was created to help the State of Minnesota improve compliance with truck weight regulations. This Plan is based on the belief that better weight compliance will significantly help protect the State's highway infrastructure and improve safety.

This Plan was created for the following reasons:

- To clarify and redefine roles, expectations and relationships for greater inter-agency coordination.
- To identify optimal weight enforcement practices.
- To identify strategies for maximizing economic benefits.
- To establish direction for improving weight compliance strategies.

This strategic plan also helps the responsible agencies identify emerging trends so they can better position themselves to address these new demands on the system. The organizational changes suggested in this Plan establish an oversight process that can adjust the compliance program in response to these trends.

This Strategic Plan recommends integrating agency functions to eliminate duplication of effort, ushering in new technologies that can streamline processes, and promoting research that can answer the difficult questions associated with proposed truck size and weight legislation. Early in the development of this Plan it was recognized that achieving the primary goal of truck weight compliance is a very complex process that requires a comprehensive set of initiatives that extend beyond enforcement.

The Strategic Plan was developed through a comprehensive process including workshops, interviews, and committee meetings. Primary weight compliance problems and needs were identified and used to develop specific recommendations. In summary, the following needs, issues and conditions were identified that affect the overall success of the Weight Compliance Program:

- Extremely overweight vehicles cause an inordinately large amount of damage to pavements, bridges and rail crossings. The results of this study produced an estimate of the total damage to be in range of $30 million per year. (A modest portion of this includes damage from legally permitted overweights.)
- A 1% reduction in the ESALs due to overweight vehicles has the potential of saving Mn/DOT approximately $3,000,000 annually.
- Weight compliance in Minnesota has not been comprehensively measured, but evidence suggests that compliance is a significant problem.
- Weight enforcement at the fixed scale sites rarely finds weight violators; however, these scale operations do serve other useful purposes, particularly safety inspections.
- Performance measures are not currently being used to drive compliance program investment decisions.
- A number of opportunities for improved interagency coordination were identified.
- The existing weigh in motion scales (WIMs) are currently only being used for highway planning purposes. The weight compliance data has additional uses related to weight enforcement.
- Mn/DOT's Electrical Systems Section staff has limited availability for WIM installation, repair and maintenance due to other obligations.
- Providing adequate human resources for WIM scale maintenance, data management, and routine calibration will be essential for reaching targeted results.
- Adjacent states have WIMs near the Minnesota border and there is a need to identify potential data sharing opportunities.
- The human resource aspects of the weight compliance program create major challenges. It is becoming increasingly difficult to attract qualified inspectors under existing pay scales.
- The number of available troopers has always been limited, and weight enforcement is just one of many demands on their time. Staff shortages can create serious constraints on enforcement activities.

Recommended Changes

Several initiatives will make the weight compliance program more effective. These include:

- Use the existing Mn/DOT Transportation Operations and Communication Centers (TOCCs) as regional hubs for administering weight enforcement resources.
- Create a Liaison position to serve as the State's weight compliance "Champion." This individual or team would chair an Oversight Committee composed of key stakeholders within the State including key Mn/DOT and Minnesota State Patrol (MSP) staff, local law enforcement representatives and various related industry representatives.
- Establish an extensive network of Weigh-In-Motion (WIM) scales to measure compliance and to help target enforcement efforts. To be successful this will require a close interaction between Mn/DOT's Transportation Data Analysis (TDA) office, the MSP, and the Mn/DOT planning functions.
- Other forms of enforcement (mobile, roadside and civil weight) show great promise for improving compliance and therefore, their frequency of use should be increased.
- A network of Virtual Weigh Stations (VWS) should be strategically positioned on high freight corridors throughout the state. VWS technologies enable the identification of weight violators and the categorization of data.
- Multiple use of the WIM equipment is also recommended. WIM sites can support other forms of non-disruptive mainline detection such as speed, acoustic, radioactivity, air quality and infrared (for tires and brakes). These additional functions can help Mn/DOT improve highway safety, homeland security, and air quality to a level that has never been achieved before, and at very affordable costs.
- It is recommended that Civil Weight Enforcement be integrated with the VWS program to target specific carriers to improve the "hit rate" of Civil Weight Enforcement inspectors.
- Mn/DOT's weight enforcement training program should be continued and expanded in several areas due to the introduction of several new processes. As performance measures uncover compliance trends, training itself can become a countermeasure for chronic compliance problems.
- Mn/DOT's construction field offices will need to play a more active role in monitoring the weight compliance of contractor vehicles and assuring that permits are in place. This involves Mn/DOT's field personnel exercising their right to refuse payment for that portion of a load that exceeds legal limits if they drive on public roads.

To accomplish these goals this Plan suggests a four phase migration plan.

- Phase One: The weight compliance program will be initiated by establishing the Liaison position, forming an Oversight Committee, defining regional TOCC hub activities, initiating the Virtual Weigh Station program, establishing a baseline for performance measures, and creating a full system vision.
- Phase Two: The program will begin comparing weight compliance to the baselines developed in Phase One, establish a quality assurance program that insures consistent reliable data collection and processing, continue the build out of the WIM scales, develop VWS equipment and site standards, and promote vehicle weight compliance research to answer relevant questions about the program.
- Phase Three: The efforts from the first two Phases will continue along with the enhancement of the existing outreach/training programs. During this point in the process it is estimated that the number of remote WIM scales will be sufficient to justify a VWS Central Operating System that would greatly refine the WIM maintenance process, generate statewide compliance reports, suggest targeted enforcement schedules, produce WIM diagnostic reports and perform many other functions. The Central Operating System would be created around a Geographic Information System (GIS) database that is populated with WIM information and other data that is updated frequently through remote electronic transactions with the WIM sites.
- Phase Four: Represents all the out years of a fully developed system. During this Phase, the Oversight Committee would monitor performance, build relationships and make mid-course corrections.

Funding

The Technical Committee overseeing this study determined that the program will need to be funded from various sources. These include the following.

- **Capital Improvement Program:** During the first year approximately $150,000 (derived from funds allocated for portable scales) will be used to install new or to modify existing WIM sites so they can be used as VWSs. The existing five WIMs will be upgraded to VWS sites using Federal

Funding currently being pursued by Mn/DOT. During subsequent rollout years this Strategic Plan calls for an annual capital allocation of $250,000 to $350,000 to expand the system. The development of the Central Operating System would be funded through a pooled fund approach in concert with several other states that are pursuing similar programs in order to distribute the cost.

- **State Operations Funding:** Operations funds would be the primary source for maintenance services, operations equipment, administrative labor and enforcement labor as described below. This would include funding for the Liaison position. During the first years of the program the operations funding would remain approximately the same as current levels. As the number of field devices increases, additional operations funding will be needed for maintenance, calibration and communications. Conceivably these funds could come from lower operating costs derived by taking one or more fixed scale facilities out of service or reduced hours of operation - should the Oversight Committee's research suggest these courses of action. These decisions would be based upon WIM scale data and MSP citation records (i.e. performance based). No new fixed scale facilities are recommended at this time, but might be reconsidered in the future if conditions and circumstances warrant that change. The labor required for monitoring and processing the WIM and other data streams will need to be covered by at least one of the partnering agencies. Eventually, much of this effort will be automated with the Central Operating System, but there will always be a need to process and deliver a variety of reports to the members. Arranging for these human resources will be an early task of the Oversight Committee. Funding for this effort will most likely be covered as Operations expenses. During the out years resources will be needed to replace aging equipment. This would include minor deployments such as radar detectors, planning counter/classifier sites and portable scales. The on-going communications costs will also need to be covered by State funds.
- **Research funding:** Research funding might prove to be a short term source for covering modest operations costs as an interim measure until more permanent sources are established. This is justifiable (and potentially eligible for Federal funding) if it can be used to study new approaches that may improve infrastructure protection, improve safety, reduce air pollution or reduce crash rates.
- **State Patrol Funds:** It is anticipated that the existing staff of enforcement officers and inspectors will need to be expanded from the level that they are now because they are well below the level required to operate an effective program even today. While the Virtual Weigh Station program is expected to change the operations at the fixed scales, it is important to recognize that staff size needs to be a function of the compliance rate as determined by performance measures. These metrics will gauge the effectiveness of any current program and suggest staff changes to meet the demand at the least cost.

Initially the costs for the additional labor at the TOCCs are expected to be absorbed by the Mn/DOT and State Patrol TOCC budgets. The Oversight Committee will need to be alert to the burden this imposes on the TOCC staff, and to respond with additional resources as task levels increase or change.

Quality Assurance

There is a growing trend among transportation agencies to base resource allocation on system performance. It follows that a quality assurance system should be implemented to guarantee that the program is maintained at a high level or else resources could be allocated at inappropriate levels. Aspects of the recommended Quality Assurance (Q/A) program include detailed work procedures to define key processes, a modest level of routine deliverable audits to insure that appropriate information is delivered on time, memoranda of understanding between member agencies to clarify relationships and annual stakeholder workshops to keep the program focused. For this program to be effective the network of WIMs also need to be operating at a high level or else vehicles will be detained unnecessarily and enforcement officers will lose confidence in the system. VWSs can be used to produce a very efficient continuous WIM calibration process insuring a high confidence level.

Research Recommendations

The State of Minnesota is fortunate to have some outstanding transportation research resources. Since there are many unknowns related to the issue of weight compliance, the Oversight Committee is encouraged to submit research proposals on subjects that might lead to advancements. To get the Committee started, the Plan suggests a few initial topics that might be appropriate candidates for research efforts, including studies on the impact of excess weight on truck crash rates, potential additional screening functions (other than weight such as speed or tire temperature detection), various commodity studies to identify changing trends in heavy vehicle movements, statistical strategies for estimating compliance on non-instrumented roadways, and database mining to determine subtle or obscure trends.

Purpose of this Plan

This Weight Compliance Strategic Plan is intended to help the Minnesota Department of Transportation (Mn/DOT) balance the need for effective weight enforcement to protect roadway infrastructure with the need to advance Minnesota's economy through competitive truck transport. This Plan can help Mn/DOT plot a wise decision-making course that recognizes the desire by shippers to maximize vehicle loads on the one hand and limiting vehicle loads (to minimize infrastructure damage) on the other.

This Plan is also intended to improve the efficiency and effectiveness of enforcement operations conducted by the Minnesota State Patrol. The use of new and existing technologies combined with creative enforcement strategies can encourage compliance with weight laws. This can be accomplished by increasing the risk to carriers of being caught for operating illegally to a level that makes it a better business decision to operate legally than to run overweight.

It is important to recognize in this Plan that the Motor Carrier industry and the regulating agencies are truly partners who depend on each other's cooperation to maximize their successful outcomes. Effective regulation can actually stimulate economic benefits by preserving efficient, sustainable roadway network. Cooperation and compliance on the part of the carriers can help lessen pavement and bridge deterioration and lower the cost of repair and enforcement. An effective enforcement program can also "level the playing field" for the majority of carriers who choose to comply with weight regulations but have a difficult time competing with violators.

This plan was further motivated by the following needs:

To clarify and redefine interagency roles, expectations and relationships

The process of weight enforcement is complex and reaches across agency, jurisdictional, and geographical borders. To be effective and promote cooperation, it is important to clarify participating agency roles and expectations. Part of this effort is to identify key interagency relationships and communications to determine if improvements are possible.

To identify optimal weight enforcement practices

There are a number of existing and emerging trends in the transportation industry that are dramatically affecting truck freight patterns, and it is important that enforcement efforts address these changes. Examples of such trends include "Just-in-Time" shipping; containerized transport; larger, more powerful engines and suspension systems; and tighter profit margins. The trends listed above have an impact on enforcement because they either promote heavier loads or more frequent trips. Both of these outcomes increase the burden on the enforcement agencies.

New intelligent transportation system (ITS) technologies and innovative enforcement processes are also emerging, and there is much to be gained by taking advantage of these new tools. These new concepts are emerging not only from local agencies and equipment venders, but also from other departments of transportation.

This Strategic Plan sets the stage for Mn/DOT to incorporate and stay abreast of the latest engineering and scientific knowledge in weight monitoring. This Strategic Plan is also designed to establish a more consistent process for identifying and implementing effective countermeasures that promote weight compliance.

To identify strategies for maximizing economic benefits

Fundamental to a region's economic vitality is its ability to efficiently move people and goods, and this vitality is directly related to the condition of its roadway infrastructure. Over many years Minnesota has developed a comprehensive transportation system that has helped sustain its economy. Due to constrained resources and deteriorating infrastructure, Mn/DOT must balance replacement and maintenance costs against the cost of building roads and bridges to higher design standards. The challenge for Mn/DOT is to establish a program that effectively protects the infrastructure by promoting compliance with weight regulations while minimizing enforcement delays for the carriers.

Unfortunately, the damage experienced from vehicle loads does not increase proportionately as loads increase, but rather at an accelerated rate.

One challenge is to identify sound engineering methods for identifying what loading the current system can safely and economically withstand as well as establishing the costs due to damage from overweight loads. A second challenge is to establish effective enforcement strategies that insure that illegal overweight axle loads are not allowed to operate on the network while allowing vehicles with legal permits to operate within the limits of their authorization.

From the carriers' perspective, one of the efficiency issues that affects their bottom line is the cost of manpower and delay they experience when obtaining permits, paying taxes, passing through scale inspections and other transactions needed to operate legally in Minnesota. This report will address some opportunities for improving these processes.

To establish direction for improving weight compliance strategies

Weight compliance is an ever changing problem that needs dynamic solutions. To be successful the program must contain a vigilant monitoring system and operate through effective interagency relationships. Furthermore, the process must be somewhat formalized in the sense that it needs to transcend the careers of agency "champions." This plan documents a framework around which agencies can develop their individual roles while maintaining a statewide solution for weight compliance issues. The program must be flexible enough to enable adaptation of emerging technologies that offer advantages in efficiency or expand functionality.

Why is a Weight Compliance Strategic Plan Needed?

The consequences of excessive axle and gross vehicle weights are so great they demand a comprehensive approach to ensure truck weight compliance. This need was evident in a report entitled, "Directions and Recommendations for Weight Enforcement" published by the Weight Enforcement Planning Work Group in July of 2001. The group consisted of members from several Mn/DOT offices as well as the State Patrol, and their recommendations closely parallel those found in this Strategic Plan.

This section provides some fundamental background about the issues that will be covered later in more detail.

A. Negative Impacts of overweight vehicles

Pavement Damage

By far, the most important goal for this plan is to limit damage to the pavement infrastructure due to overweight loads. This is extremely important because of the severe costs associated with this type of damage. Studies have shown that roadway damage from excessive loading is a non-linear function. This means that even a small number of significantly overweight trucks (in the range of 1% to 3%) can cause damage that reduces pavement lifecycles by 25% or more.

Bridge Damage

Another serious ramification of poor weight compliance is accelerated wear to bridge structures. The performance of bridge structures is very different from that of roadways and has a lot to do with structural member fatigue and repetitive loading. The end results are the same, however - shortened life spans and/or increased maintenance costs.

Rail Crossing Damage

Heavy trucks also damage railroad crossings prematurely. Currently there are about 4440 rail crossings in Minnesota, and 95% of those crossings are on local routes. Mn/DOT's Rail Planning and Development section assumes a minimum rail crossing life expectancy of five to ten years. This varies considerably due to different traffic volumes (both truck and rail traffic). For planning purposes they estimate twenty years. Restoring crossing surfaces is costly from both the rail and highway sides. Shorter crossing life spans translate into more frequent maintenance activities, motorist frustration and increased risks. Depending on the type of crossing, resurfacing costs can run from $300 to $1000 per linear foot of crossing width.

Vehicle Safety and Operating Costs

Overloaded trucks are also proven to compromise safety by increasing stopping distances, slowing accelerations, and increasing wear on the suspension systems. The greater the truck weight, the greater the kinetic energy that is stored, thereby increasing risk for smaller vehicles. Truck/car collisions have a higher probability of serious fatalities or injuries for the non-truck drivers and passengers. Pavement rutting also increases the risk of vehicle hydroplaning in wet weather. Studies have also shown that pavement smoothness has a direct correlation to vehicle operating costs. The rutting and pavement breakup caused by overweight trucks can significantly increase fuel consumption, tire wear and suspension maintenance costs. Assessing the increased operating expense due to poor infrastructure is beyond the scope of this Plan. It is mentioned here because it is known to be a significant issue for the carrier industry, and it will improve as weight compliance improves. It is being suggested later in this Plan as a topic for further research.

B. Need for greater inter-agency coordination

The process of achieving desirable compliance rates is complex. Member agencies must work together to produce the desired results, and each organization has a particular role in weight compliance that reflects a unique organizational mission. Staffing turnover further challenges programmatic consistency and coordination between organizations. This Strategic Plan is intended to help bring greater understanding of the overall process to the different roles played by each of these agencies. It is also designed to provide consistency over time and across agency boundaries. Communication fosters cooperation. The diagrams that follow demonstrate the number and complexity of transactions that must take place. This mapping can potentially be used to help identify duplication of effort, and it can become a basis for developing detailed work procedures for agency personnel.

The process of developing a Strategic Plan enables agencies to identify opportunities for collaboration that can reduce costs and improve efficiency and service to their customers. Taking this broader look at interagency relationships can improve cooperation and stimulate creative problem solving.

Cooperation extends to the private sector as well. The industry typically estimates costs for delay at approximate $70 per hour or more. This means that streamlined enforcement processes, focusing on non-compliant vehicles and minimizing delays to legal vehicles, economically benefit the vast majority of carriers striving to conduct business legally. One example of this cooperation that has been proposed is a certification program that would limit roadside inspections for carriers with good track records.

C. Funding challenges

A strategic plan can help member agencies deal more effectively with their funding challenges. This can include a determination of how much resource should be expended to achieve certain performance levels (compliance in this case). A strategic plan can also help determine budgetary level estimates of new scale facilities and updates to existing facilities. In a similar fashion, operating costs can also be estimated for budgeting purposes.

A strategic plan helps agencies sort out potential funding needs, establish funding priorities and possibly suggest applicable funding sources. These sources may include state and local funds, federal funds, and revenue generated from citations.

D. Enforcement personnel safety

There is an inherent danger associated with conducting roadside inspections. Working in close proximity to live traffic places a large burden on inspectors to exercise extra care. This strategic plan addresses that issue by establishing safer roadside inspection sites, by encouraging greater cooperation with the carrier industry with outreach and training programs, and by identifying habitual offenders who can be then cited without the need to stop their vehicles roadside. Weigh-in-Motion screening processes can increase the odds that a detained truck is actually overweight, thereby reducing the number of unsuccessful inspections and minimizing risk exposure during roadside inspections.

E. Carrier and motorist safety

A strategic plan promotes safety not only for enforcement personnel, but also for the truck drivers and the motoring public as well because it minimizes the detaining of vehicles at the scale houses and roadside. Bringing large vehicles to a stop is dangerous because it disturbs the flow of traffic as they stop and again as they accelerate from the scale. Any strategy that effectively reduces the need for these starting and stopping movements will directly reduce this exposure. In addition, keeping grossly overweight trucks off the roads minimizes the potential for these cumbersome vehicles to conflict with lighter vehicles. One of Minnesota's goals is to reduce CMV related fatalities, and this Strategic Plan helps move the state toward accomplishing that goal.

F. Emerging Trends

This strategic plan also helps the member agencies identify emerging trends so they can better position themselves to address these new demands on the system. These trends are described in more detail later, but a few examples include "just-in- time" shipping, substantial increases in freight movements expected over the next ten years, and new technologies for screening axle loads. The organizational changes suggested in this Plan establish an oversight program that can steer the compliance program as these trends come and go. This guidance includes integrating functions between agencies, eliminating duplicate efforts, ushering new technologies that can streamline processes and promoting research that can answer the difficult questions associated with legislation.

G. Staffing Challenges

The human aspects of the weight compliance program create major challenges, the most important of which is staff size. Due to funding constraints it has become increasingly difficult to maintain adequate staffing for the fixed scale facilities. For example, the St.Croix scale opened in 1987 with 25 people operating three shifts per day. They now operate only one shift each day with a staff of 4 to 5 people. Minnesota's statutory requirement, that only a licensed peace officer can stop a vehicle, further complicates this staffing issue. There have traditionally been a limited number of troopers available, and they have a broad range of responsibilities that extend well beyond weight enforcement. The Strategic Plan can help determine appropriate staffing levels and it can also help identify better ways of using civil weight enforcement inspectors who can support the troopers, effectively extending their reach. The introduction of virtual weigh stations will also have a major impact on these staffing issues because they provide useful data for more effective scheduling of existing enforcement human resources, because they make enforcement less predictable, and because they improve the inspectors' ability to single out violators without disturbing legal vehicles. This may prove to be particularly true when the Virtual Weigh Stations are coupled with the Civil Weight Enforcement, minimizing the need for roadside inspections while achieving the goal of reducing the number of overweight loads from chronic offenders.

Strategic Plan Development Process

Working together to accomplish all of the above goals, Mn/DOT and the Minnesota State Patrol used the following approach described below. This project was accomplished under the direction of the Mn/DOT project management team and facilitated by URS Corporation. Key stakeholders were also key members of the team, and their input and review of the Plan were essential. They helped define the scope of the Plan as part of Workshop #1. The implementation issues, (Organizational changes, schedule and budget) were detailed with their assistance in Workshop #2.

The Plan as a Working Document

This Plan was designed to be a working document that not only provides a strategic level overview of weight compliance in Minnesota, but also provides detailed reference information and system details in the appendices. The intent is for this document to provide guidance on an on-going basis for achieving and sustaining an acceptable level of weight compliance on all roadways within the State.

This project was a collaborative effort between participating stakeholder agencies. A three-step process was used...

Step One included research of available resources and interviews with key stakeholders.

Step Two included a draft plan with two workshops with a Technical Steering Committee to provide detailed input and edits to the content.

Step Three involved refining the Plan and delivering the final report. This included frequent interaction that engaged the weight compliance "champions" throughout the development process.

There are many uses for this Plan. Applications include…

- ✓ Educating new members and practitioners
- ✓ Clarifying roles and interactions
- ✓ Using the material as a reference file system
- ✓ Promoting consensus when conditions change
- ✓ Encouraging integrated operations
- ✓ Quickly educating new administrators
- ✓ Identifying funding sources and justifying expenditures

Plan Maintenance

Part of this Plan includes recommendations on how the Strategic Plan can be kept up to date. It is suggested that the Technical Steering Committee remain intact and the membership expanded as necessary to include the key stakeholders. It is also suggested that they schedule routine meetings (perhaps on an annual basis and more often when circumstances dictate) to review the Plan and suggest appropriate changes. This serves to keep the Plan maintained and to encourage the continued support of these stakeholders who represent the key agencies involved in weight compliance. The suggested membership of this Committee, a proposed annual agenda and a recommended phased action schedule are included in the Appendix to facilitate this on-going effort.

How this project fits into Mn/DOT's program

The Minnesota Department of Transportation has established a Mission, Directions and Objectives for its transportation program. All three of these statements are listed in the first frame below. The highlighted areas represent those portions of these statements that apply to this project.

This Project's Mission and Objectives are more specific and are listed in the second frame. It should be noted that all three Strategic Directions apply directly to both Mn/DOT as a whole and to this project specifically.

Mn/DOT's MISSION STATEMENT:

"To develop a coordinated transportation network by preserving, managing, and improving the state's highway system; by promoting and supporting transit, air, rail, waterways, bicycle, and pedestrian systems; by promoting non-travel alternatives; and by promoting and supporting connections among transportation systems."

Mn/DOT's STRATEGIC DIRECTIONS:

- Safeguard what exists;
- Make the network operate better; and,
- Make Mn/DOT work better.

Mn/DOT/s STRATEGIC OBJECTIVES

Multimodal – To increase travel options for moving people and goods

Program Delivery – To streamline the highway construction/maintenance program delivery process while improving quality and cost-effectiveness

Interregional Corridors – To ensure that corridors of statewide significance link the state's regional trade centers

Information – To listen to our customers and respond with accurate, timely information upon which they can rely

PLAN MISSION STATEMENT:

The Mission of the Statewide Commercial Vehicle Weight Compliance Strategic Plan is to improve compliance for the preservation of infrastructure and to improve safety.

PROJECT STRATEGIC OBJECTIVES:

- To help clarify agency and office roles and responsibilities regarding weight compliance
- To give future direction for truck weight compliance strategies
- To enhance coordination of Minnesota Department of Transportation weight oriented enforcement activities with those of the Minnesota State Patrol, Commercial Vehicle Enforcement Section (MSP) and local road authorities.

Damage assessment from overweight trucks

There will always be damage costs associated with moving people and goods. Even legal trucks damage roadways, but this damage is typically factored into the design life of the facilities. What this Strategic Plan addresses is the significant portion of the excessive damage that is avoidable if all trucks operated within legal weight limits.

A good understanding of the costs associated with overweight truck damage is essential to this Strategic Plan. Stated in the simplest possible terms, overweight loading prematurely ages three network features: roadways, bridges and rail crossings. The goal of this section is to outline a defendable process for estimating the annualized costs incurred as a result of this shortened lifespan. This information then has three primary uses:

- The initial use is for justifying investment in a program of countermeasures that can help prevent future damage. This was done in this report using a macroscopic methodology to get a feel for the order of magnitude of the problem.
- A second use is for developing performance measures that can be used to evaluate and refine the effectiveness of these countermeasures using a microscopic (link level) methodology that can fine tune the countermeasures.
- A third use is for improving the input data for future annual system compliance estimates. This will amount to an upgrade of the initial order of magnitude estimate each year based on better information that is collected as the system is rolled out.

The general process for calculating these three is the same; the only differences are the level of detail and sources of input data. This process includes five basic steps:

1) Determine the weight compliance rate in corresponding ESALS due to overweight vehicles.
2) Calculate the remaining expected useful projected life for each roadway feature (assuming perfect compliance - no overweights)
3) Calculate the remaining expected useful life for each roadway feature (including the overweights)
4) Calculate the annualized cost for both of the above two life expectancies.
5) Then subtract these annualized costs to yield an annualized damage estimate.

What follows is an overview of how the above steps can be applied to estimate infrastructure damage. It begins with a statement of assumptions and then explains the 5-step process outlined above.

Assumptions

The initial infrastructure damage estimate is intended only to be an order of magnitude calculation because of the limited data available. To do this, certain simplifying assumptions must be made. This approach is appropriate as an effective means for supporting a go/no-go decision to proceed with further investment in the program. These assumptions include:

- Rail crossing damage was considered negligible for the initial estimate because the forces applied to crossings are very complicated to assess, there is very little data available to make the estimate, and leaving them out of the calculation yields a more conservative estimate.
- Bridge damage other than decks (driving surface) was also left out of the calculation for the same reasons as the rail crossings. Bridge supporting members are typically designed using a factor of safety to prevent catastrophic failure, therefore it may be that the issue of

overweight truck damage on bridge supporting structures is more of a problem with encroachment on the safety margin rather than a shortening of the lifespan.

- Bridge decks, on the other hand, are included in the estimate. For this calculation, their wear rates are considered equal to that of their adjacent approach pavements. The only differences are that their replacement costs per square foot are higher than the approach pavement's, and their design life expectancies are also greater.
- Replacement costs are based upon information provided by Mn/DOT, and are as follows:
  - ✓ Interstate 4-lane concrete …….$7.10/sq ft
  - ✓ Non Interstate 2-lane concrete…..$7.10/sq ft
  - ✓ Non Interstate 2-lane asphalt..…..$4.65/sq ft
  - ✓ Bridge deck replacement……...$40.00/sq ft
- Percentage of ESALS due to overweight vehicles were provided by Mn/DOT and are as follows:
  - ✓ 1% on the Interstates
  - ✓ 9.3% on all other pavement types
- Concrete pavement life is estimated at 30 years
- Asphalt pavement life is estimated at 25 years
- The above estimated pavement lives are based on field performance.
- Intermediate pavement maintenance (overlays, joint repairs, etc.) were neglected because these investments would occur at approximately the same frequency with or without the overweight trucks.
- Annualized interest rate is assumed to be 5%
- Salvage value is considered to be zero at the end of the useful life. This renders the calculation more conservative.
- Because the predominant heavy commercial vehicles in Minnesota are class 9 trucks, they were considered to be the only axle configuration used in the calculation.
- ESALs due to overweight vehicles were derived from existing WIM sites and extrapolated to the other similar roadway types that do not have WIM sites. This information will improve in future years as more WIM sites are deployed and data utilized.
- An empty class 9 truck are assumed to have axle loads of 9k-10k-10k
- A fully loaded, legal class 9 truck is assumed to have axle loads of 12k-34k-34k.
- The remaining life expectancy was estimated using standard Equivalent Single Axle Load (ESAL) methodology. This normalizes the data between different trucks with differing loads and enables a lifespan calculation to be made.
- Minnesota, as most other states, designs their pavements with an allowance for a certain number of overweight vehicles. Removing the overweight vehicles from the traffic stream effectively extends the life of the pavements.
- The total loading transported by overweight trucks was

considered to remain constant. This means that the overweight portions of all overloaded trucks would be hauled on additional legally loaded class 9 trucks operating within legal limits.

- Perfect compliance will never be achieved. Therefore, annual goals need to be set at reducing a realistically achievable reduction of the total overweight ESALs.

Pavement damage

Equivalent Single Axle Load (ESAL) design methodology was used in this study. This process calculates damage from axle configurations – single, tandem, etc.

The process for estimating the impacts of excessive weight on pavement life spans can begin by breaking the roadway network down into groups of pavement types with each type represented as one record in a spreadsheet. This is presented in the spreadsheet that follows this section.

Based on their current level of information Mn/DOT produced an estimated annual ESAL percentage of overweights. The axle loads of all trucks were converted to ESALs and the numbers used in this calculation represent that portion of the total ESALs resulting from overweight vehicles.

The difference between the design life and the estimated life spans reflects the premature aging that results from overweight trucks. Annualized cost estimates were then made for both life spans using standard engineering economics procedures. Subtracting the two products (annualized cost with overweights – annualized cost without) yields the annualized pavement damage estimate due to overweights.

Whatever portion of this damage that can be reduced by a weight compliance program then becomes the “Benefits” portion of the Benefit/Cost ratio. For purposes of an initial justification for this program, it was assumed that the non-compliance rate can be improved by only 10%. This is measured in terms of the percentage of annual ESAL % overweights, and this 10% goal is likely to be a conservative value. By way of comparison, in the second year of the Montana STARS program when they conducted enforcement, they realized a 22 % reduction in the number of overweight trucks with an average reduction of 16% for each overweight truck. The program outlined in this Plan should exceed those results because the proposed enforcement efforts will be more dynamically applied using a comprehensive network of strategically located WIM sites.

Road type/link	Lane Mileage	SqFt of Pavement	Replace-ment costs/sqft	Replace-ment Cost	Annual ESAL % due to over-weights	Design Life	Expected pavement life with current weight compliance rate	Annualized Cost (Based on theoretical design life)	Annualized Cost (considering overweights)	Potential Savings (with 100% compliance)	Projected Annual ESAL % due to overweights (includes 10% reduction goal)	Estimated program benefit
Interstate (4-Lane) (Concrete)	3,660	231,897,600	$7.10	1,646,472,960	1	30	29.7	107,105,429	107,582,944	477,515	0.90	47,752
US TH (4-lane) (Concrete)	3,940	249,638,400	$7.10	1,772,432,640	9.3	30	27.21	115,299,287	120,593,005	5,293,718	8.37	529,372
US TH (2-lane) (Asphalt)	4,430	280,684,800	$4.65	1,305,184,320	9.3	25	22.675	92,606,035	97,514,608	4,908,573	8.37	490,857
Mn TH (4-lane) (Asphalt)	1,740	110,246,400	$4.65	512,645,760	9.3	25	22.675	36,373,476	38,301,449	1,927,972	8.37	192,797
Mn TH (2-lane) (Asphalt)	14,510	919,353,600	$4.65	4,274,994,240	9.3	25	22.675	303,321,346	319,398,862	16,077,516	8.37	1,607,752
Bridge Decks			$40.00	1,514,680,000	7.685	40	36.926	88,272,765	90,702,703	2,429,938	6.92	242,994
Totals								742,978,338	774,093,571	31,115,233		3,111,523

Table Variables:	
Interest Rate	5%
Target compliance reduction goal	10%

Estimated annualized benefit from a 10% reduction in the ESALs due to overweights

Bridge damage

Bridge damage is difficult to calculate because the wear is due to dynamic loads applied through a complex network of structural members. For the purposes of an order of magnitude measurement, and given the difficulty of calculating damage other than bridge deck reduction of life, bridge damages are not included in this estimate. This yields a more conservative estimate.

This simplified approach also suggests that bridge decks could be treated as continuations of their approach pavements, and wear from excessive loading would occur at approximately the same rate as the approach pavements. The only differences would be the replacement cost per square foot and the design life. This can be seen in the spreadsheet on the previous page.

Rail crossing damage

There are 208 at-grade rail crossings on Minnesota's trunk highway system and 4230 crossings on local routes. One way to address this problem is to use an approach similar to that described earlier for bridge decks. The percentage of reduced pavement design life would be applied to the shorter rail crossing design lives to yield a shortened life expectancy for the rail crossings. The increase in annual costs would then become an additional "Benefit" of the compliance program. For the purposes of this report, however, the process just described for rail crossing damage estimates is recommended only for future reports and was not included in this initial estimate. This yields a more conservative initial estimate.

Annual Damage Estimate

Based on the above assumptions and the best current data available to Mn/DOT, the total estimate of annual damage due to overweight trucks is estimated to be ~ $30 million.

Program Justification

To justify the investment in a weight compliance strategic plan, the damage estimate produced in the methodology described above becomes the potential "benefit" portion of the benefit/cost ratio. The "cost" portion of the formula becomes the summation of all additional costs required to conduct the program (additional WIMs, labor, communications, research, etc.).

According to this calculation, an annual investment of approximately $300,000 can produce a B/C ratio of 10:1. Given this strong B/C ratio, an investment of this magnitude is readily justifiable.

Performance Measures

Once a compliance improvement program is operational, it is important to monitor and refine the operation using performance measures. The data from these performance measures would enable the State Patrol to target the worst areas first and then work their way down a prioritized list. This includes non-enforcement countermeasures that might also be strategically applied to those areas. The topic of performance measures is covered in more detail in a later section of this Strategic Plan, but the discussion here centers

on the need for data that can refine operations and improve performance measure that justify future investments.

In addition, these measures can also be useful for justifying and targeting specific investments in the weight enforcement program budget, equipment and staff to keep the program focused on the most pressing needs. Because it is not likely that each link will be instrumented, some procedure is needed to establish the compliance rate for every link. Several options are possible.

- Use WIM data where available.
- For non-instrumented links estimate by using WIM data from similar roadways (i.e. similar total volumes, same commodities, and similar numbers of trucks).
- If classification sites are available use truck volume data and assume an overweight percentage from a similar roadway that is equipped with a WIM site.
- If sidefire radar detector is available, use truck volume data and assume an overweight percentage from a similar roadway that is equipped with a WIM site.
- Use a statistically sound random sampling of roadside enforcement to derive the compliance rate for non-instrumented links in areas frequented by trucks known to haul heavy commodities.
- Use commodity studies to identify those links most likely to experience heavy loads, and then apply one or more of the above strategies.

Relevant Trends Affecting Weight Compliance

There are a number of significant trends affecting weight compliance. These trends relate to the ability of the roadway system to withstand increasing traffic loading. Government services can experience trends as well because they are subject to changing regulations and economic pressures. Their services include such things as permit application processes and weigh station capacities that directly affect carrier operating expenses. In addition, changes in technology, new products and more efficient processes can significantly affect truck volumes, truck configurations and loads. These trends are important to the weight compliance program because they significantly affect the bottom line for both the enforcement agencies and the carriers.

Even a casual review of these trends brings to light the fact that responsibility for weight compliance goes far beyond what has been traditionally viewed as a State Patrol enforcement function. This has been indicated by the term “Compliance” rather than “Enforcement” in the title of this program to indicate that the issuing of tickets is not the only strategy that can be used to protect the infrastructure. Other strategies can be applied that promote both infrastructure preservation and economic vitality.

This is no small task, however, and requires diligence, commitment, collaboration, and some expenditure of resources to achieve a successful long-term program. The issue of weight compliance is becoming increasingly more important. Truck volumes are expected to double nationwide over the next 10 to 15 years according to the Federal Motor Carrier Safety Administration (FMCSA). Currently there are 675,000 carriers nationally - more than tripled since the 1980s, and approximately 50,000 new carriers enter the business each year. The American Trucking Association estimates that trucking represents 11% of the Nation's economy, and 70% of all freight is currently moved by trucks. In 2003 there were in excess of 24 million trucks in the United States (not counting farm trucks or utility vehicles). That same year there were 44 billion truck miles traveled across the country.

In Minnesota freight movement is essential for manufacturing, retail, wholesale, and agricultural business. Together these industries employ nearly 50% of all Minnesota workers. With a baseline year of 2001, freight moved in Minnesota is expected to grow 60% by the year 2020 to 1019 billion tons.

In Minnesota, relatively equal amounts of Interstate freight are transported in the form of outbound, inbound, and through movements across the State. Trucks carry the largest share of freight by weight in Minnesota. Freight movements to and from warehouses are especially significant in the Twin Cities area, a major distribution center for the upper Midwest. (Minnesota Statewide Freight Plan--2005). Unfortunately, while the demand for compliance has been increasing, enforcement resources in Minnesota have steadily diminished. This is in part due to state government budget cuts and increased operating expenses.

What follows in the remainder of this section is a listing of the trends that are affecting weight compliance. This section provides a basic overview of the problems and demonstrates the complexity of the issues. The sections that follow will then address the current approaches and will begin a discussion about potential alternatives and organizational improvement strategies.

The trends listed below describe the current and near future "terrain" within which weight enforcement is conducted. They outline the ever-changing constraints that affect Minnesota's capacity to manage truck weights within the state. An awareness of these trends is important because they impact expenditures of public funds. Effective follow through for a Strategic Plan hinges upon public administrators being well informed so they can make wise decisions and mid-course corrections to their programs.

Trends in weight enforcement facilities

Functions

Fixed scale house Functions are changing. Currently Minnesota has seven fixed scale facilities (see map in the Appendix for details). It is important to keep in mind that they serve many purposes besides measuring weights. In fact there are typically about eighteen other points of inspection that can be conducted by an officer. (An example of the State Patrol's inspection form is also included in the Appendix) This brings up the question about what the proper function of fixed scale facilities should be. Considering that the cost of a new scale facility can be in the $10 to $20 million dollar range, the answer to that question is resource and demand driven. Deciding on a new fixed scale facility is a complex process and is highly location specific. For locations along natural boundaries and limited crossings like the Mississippi River, a fixed scale can efficiently screen all trucks entering the State through that choke point. For other locations with numerous alternate routes, this strategy is less effective. In an effort to be efficient, it also makes sense to position and operate fixed scale facilities on those roadway links that have the greatest truck volumes. These typically are the Interstates that carry over half of Minnesota's total truck traffic. Widespread use of CB radios, however, now makes getting current information about scale status almost effortless, making them ineffective for weight enforcement. They still have value for safety and regulatory enforcement, however. One emerging trend is to incorporate these facilities into regional systems that support a variety of compliance promoting strategies.

Fixed Scale enforcement has not been very effective at promoting weight compliance. This is believed to be the result of widespread use of the Citizens Band (CB) radio system, which makes evasion very simple and reliable. The Minnesota State Patrol's "Overweight Citations Issued Table" below demonstrates this by contrasting the performances of fixed scales vs. the more covert mobile enforcement sites. This is particularly evident as the overweight loading increases. For example, nearly 90% of all the >10,000 lb citations were issued by mobile enforcement.

Overweight Citations Issued By Minnesota State Patrol FFY 2004			
	Fixed Scales	Mobile Scales	Total Citations*
Trucks Weighed	527,374 (98.7%)	7,015 (1.3%)	
Trucks w/Violations > 1,000#	2,073 (87.9%)	285 (12.1%)	2,625
Trucks w/Violations > 5,000#	66 (14.4%)	393 (85.6%)	491
Trucks w/Violations >10,000#	34 (10.6%)	287 (89.4%)	346
*Includes all citations issued for violations > 1,000 pounds overweight. More than one citation may have been issued for one overweight vehicle.			

Carrier Services

One-Stop-Shops is another trend in the use of fixed scale facilities. This provides carriers with a convenient place to pay their taxes, get their licenses, permits, or transponders as well as information about how to stay legal. Some agencies have even proposed that a program be established in which truck drivers could voluntarily approach the facility and formally request inspection with the understanding that they would be immune from citation as long as they took all the necessary actions to become legal before they proceeded on their trip. This non-punitive approach has advantages for state entry points where Minnesota has differing regulations from their neighbors. It could also have benefits for smaller carriers who cannot afford a staff of company personnel who specialize in handling the complex regulations necessary to stay legal. This encourages compliance without the need for enforcement action. This approach is analogous to the voluntary employee drug treatment programs that some companies have instituted. The underlying philosophy is to establish a partnership between the entities to address a chronic problem.

Operations Funding

Leaner government spending for operations is a national trend that is seriously affecting weight enforcement. Add to this the increasing difficulties in attracting and retaining qualified inspectors due to non-competitive salaries, and the end result is a strong need for greater efficiencies that can meet or exceed current compliance rates.

Technology changes

New Technologies are also affecting the design and location

of fixed scale facilities. Achieving higher levels of enforcement efficiency often means incorporating technology solutions into the fixed scale houses. For example, weigh-in-motion scales (WIMs) used as ramp sorters can dramatically reduce the carrier delay and minimize dangerous stopped traffic due to ramp backups. Mainline WIMs near the scale houses can be very useful for determining what hours the scale needs to be open and optimizing enforcement labor hours. Virtual weigh stations (VWS) can, in some cases, eliminate the need for a fixed scale entirely when weight enforcement is the primary objective. (A virtual weigh station is a system that uses as a WIM as a screening device. Enforcement officers use the data from the WIM to identify non-compliant vehicles and then conduct roadside inspections downstream from the WIM.) Web based permit application processes, automated permit routing systems and systems like CARS (Condition Acquisition and Reporting System – see Appendix for details) for knowing where road restrictions exist can influence the design of a scale house by requiring that they have substantial IT infrastructures and qualified staff to process and communicate large amounts of information. Other emerging technological innovations include remote sensors on by-pass roadways that are monitored at the scale houses, and license plate readers on the incoming scale ramps that are being used by some agencies to screen for stolen, out of service or other suspect vehicles. One of the most significant recent changes affecting scale house design is the widespread use of transponder based systems like PrePass, NorPass or Operation Green Light programs for enabling legal scale by-passes. They can also be used to monitor the movements of hazardous or permitted vehicles.

Virtual Weigh Stations

Weigh In Motion technologies A significant movement is developing around the country in the form of weigh-in-motion (WIM) technologies used as virtual weigh stations (VWS). WIMs have been in use by planners for many years, but taking advantage of the extensive truck weight information for enforcement purposes has only recently occurred. Current practice in enforcement is to use the WIMs as screening tools for identifying seriously overweight vehicles (i.e. gross, axle or bridge formula violations). Some, such as the Montana STARS program, have successfully used the archived WIM data as a simple basis for scheduling selective enforcement. Others, such as Indiana, have used the data stream from the WIMs as a screening tool to identify serious offenders in the immediate vicinity of the WIM sites. Kentucky has had success by simply using classification sites coupled with digital images of the trucks to screen for potential fixed scale evaders on by-pass routes.

WIM technologies are also being incorporated into some of the PrePass and NorPass programs. These programs enable trucks with good track records to carry on-board transponders that communicate with roadside readers immediately in front of fixed scale entrance ramps. These vehicles are given the privilege of legally by-passing the scale most of the time. The WIM scale is used to validate the weight indicating that the

truck is operating legally. The WIM can also be used when the scale house is closed to determine if the hours of operation need to be altered. This can be an effective means for trimming labor costs without sacrificing quality of service. Minnesota has been a PrePass state in the past, but currently does not participate in the program.

Trends in regulations

Minnesota State Regulations

The Minnesota State Legislature has experienced considerable lobbying efforts to promote laws that allow heavier weights, and long, combination vehicles. This pressure comes from a variety of industries in an attempt to lower their operating costs and make them more competitive with their regional counterparts. A review of size and weight statutes and permit fees is currently underway, and this could lead to new legislation. This leaves Mn/DOT with the difficult problem of anticipating the impact these potential changes could have on life cycles of the State's roads and bridges.

Minnesota Timber Hauling Legislation

Recent legislation allows higher than normal legal loads for trucks that haul timber. As a result of this legislation, many bridges will have to be load posted because the operating rating for these bridges is less than that allowed for timber hauling. This can have far reaching effects and sometimes substantial budgetary implications.

NAFTA

The **NAFTA** program will undoubtedly introduce more trucks through Minnesota as they travel from Mexico to Canada. This has several expected ramifications:

- Increase in number of through trips
- Greater likelihood of non-compliant vehicles
- Many non-English speaking drivers
- Increased backups at border crossings due to need for more inspections
- High probability for ignorance of Minnesota laws and regulations

FMCSA

(The Federal Motor Carrier Safety Administration) programs are primarily focused on non-weight enforcement initiatives; however, weight is a safety issue, making FMCSA indirectly a stakeholder in weight compliance. Their Motor Carrier Safety Assistance Program (MCSAP) allows funding for weight enforcement provided other safety inspection efforts are conducted simultaneously. The following are opportunities to integrate size and weight regulation training for carriers into existing programs.

FMCSA's Inspection Program has three aspects:

- Fixed (Conventional fixed scale enforcement)
- Roadside (Roadside enforcement)
- At carrier site (On-site reviews of carrier records)

All three of these inspection types are currently in use by Mn/DOT as part of their weight compliance program.

Compliance Review Program encourages a partnership arrangement with states like Minnesota. The states are asked to assist FMCSA with building a case for regulatory compliance by conducting compliance reviews (CRs). Once a case is established FMCSA would then prosecute.

New Entrant Audit Program educates new carriers within the first 18 months after they begin their business. This establishes formal notice of their obligations concerning commercial vehicle regulations. This program was considered important enough that it currently offers 100% Federal Funding - a strong statement from FMCSA.

Fatality Reduction Program has measured the 2003 national average at 2.3 fatals/100 million truck miles. Their goal is now set at 1.65 fatals/100 million truck miles. This is important because overweight trucks exhibit much slower capabilities for evasive maneuvering, suggesting potential research studying the correlation between weight and fatal crashes.

FMCSA's Commercial Vehicle Information System Network (CVISN)

FMCSA's CVISN program does not specifically have a weight related objective. However, based on studies done in Oregon of vehicles involved in crashes, there was a high incidence of overweight trucks that were over represented in their crash study. Therefore, it is appropriate to point out how the FMCSA initiatives relate to safety and weight:

Weight Related CVISN Initiatives
FMCSA's Driver Snapshot program will provide the inspecting officer a quick overview of the driver's Commercial Driver's License (CDL) history. This will enable inspecting officers to identify other issues during the weight inspection process.
Their Access to Driver Data capability will provide inspecting officers with the ability to get detailed information once they suspect a violation has occurred. This does not include weight violation histories, however, which makes it difficult to identify repeat offenders. This could lead to better choices when selecting vehicles for roadside enforcement.
FMCSA's Safety Data Quality initiative will help refine the databases reducing the number of false calls and unnecessary inspection efforts.
Their Carrier Access to Data Quality initiative will enable the carriers to have access to the databases so they can take corrective actions and so they can help keep the data quality high, again improving the accuracy of inspections and improving weight compliance.
Their Roadside Access to Data program is developing the communications technologies needed to make all of the database information available in the field.
Their E-Credentialing initiative is helping establish standards for electronic credentialing services. This will affect overweight, over dimension permits.
Their Access to Credential Data is similar to their Access to Driver Data. This program could lead to transponder based permits for overweight/over dimension vehicles enabling electronic roadside screening of permitted vehicles.
Their Virtual Roadside Sites program is intended to screen for safety factors. Weight will likely be the first form of detection that current technology will support, with radiation, contraband, acoustic, tire and brake condition sensing following in the years to come.

Emerging FHWA Interest Areas

The Federal Highway Administration is a major stakeholder interested in preserving the highway infrastructure.

FHWA Areas of Interest - Operations Focus. The FHWA has always had an interest in truck sizes and weights. This is evident in their regulations such as the requirement for an annual weight enforcement plan due each July 1st and effective each subsequent October 1st. In addition, the Governor has designated that his Public Safety Commissioner annually certify that he is enforcing the Federal regulations and state laws in a separate document due each January 1st.

Their interest in CVO was significant enough that the USDOT established a separate division, the Federal Motor Carrier Safety Administration, to address the safety aspects of the trucking industry. The FHWA interest has always been focused on protecting highway infrastructure, and they are now increasing emphasis on highway operations. They sponsor numerous technology research and deployment programs, and they are currently undergoing significant changes in their organization. Since weight enforcement is a major operational issue, this emerging trend towards operations may produce additional FHWA resources, standards, and research initiatives. Below are some FHWA areas of interest

Construction will always be a prime interest area for the FHWA, and this affects weight compliance in several ways:

- Overweight trucks significantly accelerate the need for road and bridge rehabilitation
- Work zones frequently have vulnerable pavements such as shoulders used for temporary lanes.
- Heavier trucks do not perform as well as lighter vehicles as they navigate through the work zones.
- Work zones have higher than normal crash rates, increasing the potential for negative outcomes.
- Work zones have a significant potential for secondary crashes due to accel/decel truck movements.

Traffic Volumes are expected to increase steadily over the next 10 to 15 years. This will tend to use up the useful life of existing pavements at a faster rate. The FHWA is committed to the development of a high quality roadway infrastructure. Accelerated deterioration from overweight trucks runs counter to their goals.

Air Quality is another area of interest to the FHWA. Recent research suggests that road construction equipment may be a significant contributor to mobile source emissions. Extending pavement life cycles can help reduce this problem by minimizing the number of construction work zones.

Highway user costs are a bottom line measure for the

FHWA. Maximizing the infrastructure performance by controlling excessive loads has a direct correlation to user costs. This translates into savings due to fewer construction work zones and smoother pavements.
Performance Measures are becoming very important tools for the FHWA. They are looking at performance measures as a valid means for justifying investments, refining operations, and prioritizing needs. Weight Compliance program performance measures will be discussed in greater detail later in this Plan.

FHWA Strategic Plan Objectives

FHWA Strategic Plan Objectives also relate to weight compliance, and they are committed to working with Mn/DOT to achieve successful results. Their objectives include the following.

- Preserve and enhance the infrastructure of Federal-aid highways with emphasis on the NHS.
- Increase the percentage of kilometers (miles) on the NHS that meet Owner-Agency managed pavement performance for acceptable ride quality to over 93 percent within 10 years. (International Roughness Index less than or equal to 2.68m/km (170 inches/mile)).
- Improve the condition of NHS bridges so that less than 20 percent are classified as deficient in 10 years,
- Improve the condition of all bridges so that less than 25 percent are classified as deficient in 10 years.

ITS Architectures

Regional ITS Architectures are now required (as of April 2005) for projects that spend Federal funding on ITS initiatives. Minnesota currently has statewide and regional architectures in place to meet this requirement. Any ITS projects that will be funded with Federal funds will now require a project architecture. These essentially are extracted from the regional or state architectures.

Permit Process Trends

Streamlining the Permit Process has been a key focus for Mn/DOT and many other agencies around the country in recent years. This is an important issue because Mn/DOT issues approximately 75,000 permits annually, and because the permit process directly affects weight enforcement practices. Electronic and Web based permit applications are becoming well received by the trucking industry. They dramatically reduce the turn-around time for permit applications, thus lowering operating costs for both the DOTs and the trucking firms. These electronic tools also offer the potential, at least, for the enforcement personnel to have in-vehicle access to the permit databases so the inspectors can be better informed about a vehicle's level of authority to operate. In Minnesota this trend is appearing in the form of the RouteBuilder program for automating the permit process. Some members on both sides of the table are also promoting the use of seasonal or blanket permits that reduce the number of transactions required for overweight or over dimension

vehicle permits.

State Regulation Trends

The "Divisible Load" issue is becoming more of a problem as larger construction equipment is appearing on the market. The underlying principle is that a permit will not be issued if the load can be divided into legal sized pieces and hauled separately, but taking large construction equipment apart can be very costly and time consuming. The problem becomes one of interpretation - theoretically, just about every large object could be divided, but this is often impractical. A consistent interpretation among the authorities on what is or is not divisible would help resolve this issue.

"First Haul" Issue

Current Minnesota State Law contains specific "first haul" weight law exemptions for farm and forest products under certain circumstances described in the excerpt from Section 168.013 shown below.

> "(3) Clause (1) does not apply to the first haul of unprocessed or raw farm products or unfinished forest products when the registered gross weight is not exceeded by more than ten percent. For purposes of this clause" first haul" means
> (i) the first continuous transportation of unprocessed or raw farm products from the place of production or on-farm storage site to any other location within 50 miles of the place of production or on-farm storage site or
> (ii) the continuous or noncontinuous transportation of unfinished forest products from the place of production to the place of final processing or manufacture located within 200 miles of the place of production.

"Clause (1)" in the first line refers to the normal 5% weight limit allowance for gross or axle loading. The intent of this law was to give an additional allowance to the producers of these products because of the difficulty they have in remote field weighing. The effect of this law is that it increases the legal load limits for many of the Minnesota roads that have a large number of vehicles falling under this exemption. This exemption does not apply to any vehicle on a road or bridge posted for weight limitations. In those cases the posted gross weight limits would supercede all other exemptions including permits.

County Level Issues

In meetings with the County Engineers the following trend issues were identified.

- Counties often have limited support in terms of enforcement efforts from the County Boards and County Sheriffs, and this support varies significantly from county to county. For the most part this is caused by limited resources.
- County engineers believe that there is a higher rate of non-compliance on the local system than on the trunk highway system.
- Weight enforcement seems to be more of a priority

during the spring season than any other time of the year.

- Some county engineers endorse designating more ten ton systems, and then increasing enforcement on those routes. How this would be funded is a major concern.
- The county engineers are willing to investigate additional agreements with State Patrol that would increase enforcement on local routes. Protection of the infrastructure was given as the primary motivation.
- The counties recognize the value of the weight education program and believe that additional outreach is needed for the judicial community (judges, county attorneys and county prosecutors).

Trends in Highway Design

Road design

It is very likely that the newer Mechanistic Pavement Design practices will replace the older Equivalent Single Axle Load (ESAL) methods for road design. This implies a need for more detailed data collection practices with the benefit of improved designs yielding stronger, more durable pavements at affordable costs. It follows that this could also lead to more refined estimates of damage from weight abuse.

Minnesota's roadway and bridge Infrastructure is becoming increasingly vulnerable due to aging facilities. The Interstate system is now in excess of 30 years old, which means that much of its useful life is used up. Major rehabilitation programs are underway and this suggests two important needs for weight compliance: One is to preserve the aging infrastructure until it can be upgraded, and the other is to protect the newer facilities to maximize their useful life.

Local truck route system

A local truck route system has been recommended in Minnesota by several transportation stakeholders, both public and private. This would consist of a broader network of local roads built to a heavier “10-ton” standard that could adequately support 80,000 lb. five-axle semis. These roads would provide connections between freight generating facilities (manufacturing plants, etc.) and higher type, heavy duty state trunk roads and Interstates. This would keep heavier trucks off the “9-ton” routes that have a 73,280 pound limit for five-axle semis. This would also address some of the "Last mile" issues by minimizing the potential for weight damage on local routes and giving shippers an affordable yet legal path to their customers.

Commodity trends

According to the Minnesota Statewide Freight Plan (2005), key commodities transported in the State are farm products, nonmetallic minerals, food products, metallic ores and coal. A comprehensive weight compliance program needs to be flexible in order to address changes that occur as a result of commodity trends. Here are a few examples.

- The source of some crops can change such as lumber

that has reached maturity. This can sometimes affect the access routes.

- New products and markets are emerging for some major commodities. Ethanol production is an example that demonstrates how new uses for existing crops can impact shipping practices, as more grain is processed locally or regionally in Minnesota rather than exported nationally or internationally. Similarly, taconite production on the Irog Range has increased to meet the demand for steel in China.
- To be competitive, the size of farms has increased dramatically in order to minimize unit costs. This has implications in the form of demands for larger loads and different (i.e. larger) harvesting equipment.
- Modern automated timber harvesting equipment is larger and this affects permit requirements, shipping patterns and truck configurations.
- Mining has by its very nature, a need to change sites as older sources are depleted and new sources are discovered. This requires an ever changing need to strengthen and reconfigure the roadway networks serving those areas. Larger and larger mining equipment is being built to meet the production demands at competitive costs. These also affect weight compliance because this equipment is too large to fit within standard size and weight limits, and it is cost prohibitive to dismantle the equipment into divisible loads.

Vehicle trends

Vehicles are also undergoing an evolution. For example, in-vehicle self diagnostics are being introduced to the fleet enabling closer monitoring of the equipment's "health". Improving on-board weighing technology may reach a satisfactory level soon enabling the carriers to weigh their vehicles at the source of the haul. This could be a useful tool for improving both compliance and efficiency. On-board weighing equipment might also provide Mn/DOT with a new opportunity to offer incentives for carriers who desire to cooperate in the form of certified electronic in-vehicle self inspections.

Wireless communication systems enable remote dispatch coordination in real time (including electronic document transfer and routing information). This results in more efficient operations with fewer trips, but with a higher percentage of fully loaded trucks as backhauls are more efficiently booked.

Shipping industry trends

The shipping industry is also changing. Here are a few examples of some key trends, all of which have implications on weight compliance:

An NCHRP study on truck weights indicated that there has been a substantial increase in the number of permits issued.

This could lead to a requirement for more extensive weight limit posting on substandard bridges because a truck is not allowed to exceed the weight limit posted on a bridge even if a permit has been issued.
There has also been a recent increase in the number of international shipments, particularly in the form of containerized shipping. This implies a need for entirely new enforcement strategies at intermodal shipping interfaces, truck destinations, and manufacturing load pickup points.
Emerging foreign economies (China in particular) have developed an almost insatiable demand for raw materials, and this will undoubtedly have impacts on weight compliance as the volume of commodity movements increases.
The number of trucks per carrier is increasing to keep abreast of foreign and domestic competition.
According to the Minnesota Statewide Freight Plan, a major portion of all loads in Minnesota touch the Twin Cities area at some point in their trip because the Twin Cities are a major distribution center for the Midwest. This is likely to increase as the projected number of US truck trips doubles over the next 10 to 20 years.
Changes in railroad practices are affecting local shipping. The large railroads are trending toward a primary interest in long haul carload and containerized shipments, leaving the local trips to the trucking industry. They railroads are also quickly reaching capacity on many of their routes, leaving no alternative but for trucks to pick up the remaining trips. This increase in truck trips is projected to be around 80%. Local roads have effectively become the branch lines for the major railroads as rail networks are consolidated.

Trend Implications

Following the trends described above, it quickly becomes evident that the resolution of the fundamental conflicting forces mentioned in the Introduction (protecting the infrastructure vs. promoting Minnesota's economy) is a complicated problem that requires complex, dynamic solutions. It is therefore unrealistic to assume that enforcement alone could ever fully achieve the compliance goals of this program.

To be successful, a weight compliance strategy must, therefore, reflect processes that are flexible, create accurate information on a timely basis, encourage cooperation and establish sustained oversight and coordination among the stakeholders. The result can be well informed decisions along with increased compliance that achieves the best possible balance over time. These topics will be discussed in the next chapters of this Strategic Plan.

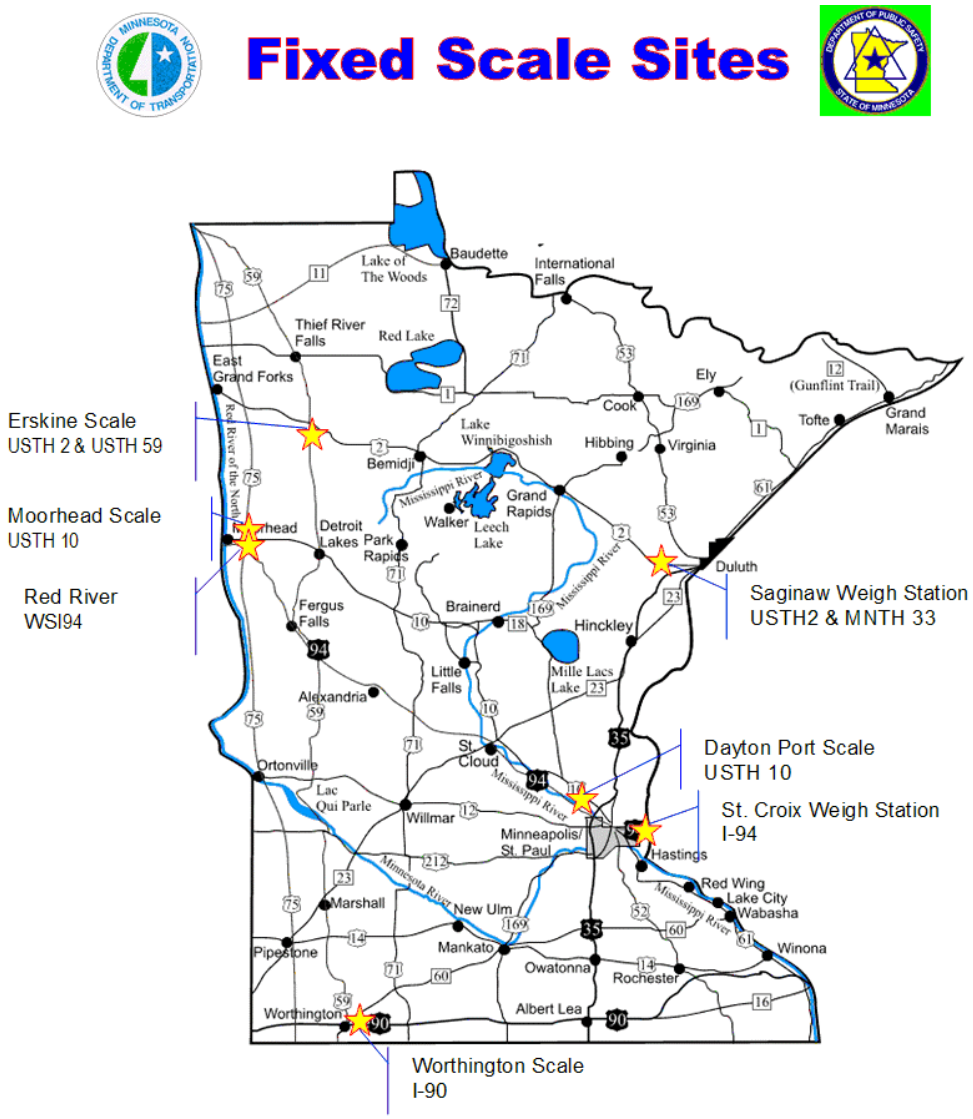
Overview of Current CVE Program

This chapter presents the current status of the weight enforcement program in Minnesota. Included is an overview of the organization, the facilities and some of the key operational practices. Also included are comments received from stakeholders about issues and unmet needs.

Current weight compliance enforcement methods

Minnesota State Patrol currently uses four weight enforcement strategies to promote compliance.

Fixed scale enforcement is conducted at 7 weigh stations in Minnesota located as shown on the map below. These are typically located on routes with high truck volumes and near the state's entry points.



Mobile Enforcement is similar to Fixed Scale enforcement except that the facilities are

very modest. Typically mobile enforcement is conducted on non-Interstate routes using mobile (trailer mounted) scales. During Mobile Enforcement, Commercial Vehicle Inspectors set up an inspection site, post a sign two miles ahead, and then flag vehicles into the pull off areas for inspection. If safety inspections are included, the labor for this effort can be reimbursed to the State under MCSAP funding. This work can include dyed fuel inspections (to identify illegal use of non-taxed fuel).

Roadside Enforcement is conducted by State Patrol Troopers, Commercial Vehicle Inspectors, or a combination thereof. Suspect vehicles are selected and then pulled over for safety and weight inspections. This can be done on any public road within the State, and the inspection is conducted on the shoulder or other nearby safe location not obstructing traffic. If safety inspections are included, the labor for this effort can be reimbursed to the State under MCSAP funding. Typically, officers select trucks with obvious safety deficiencies and then include weighing the truck as part of the process. The weighing is typically done with portable scales. This work can also include dyed fuel inspections (to identify illegal use of non-taxed fuel).

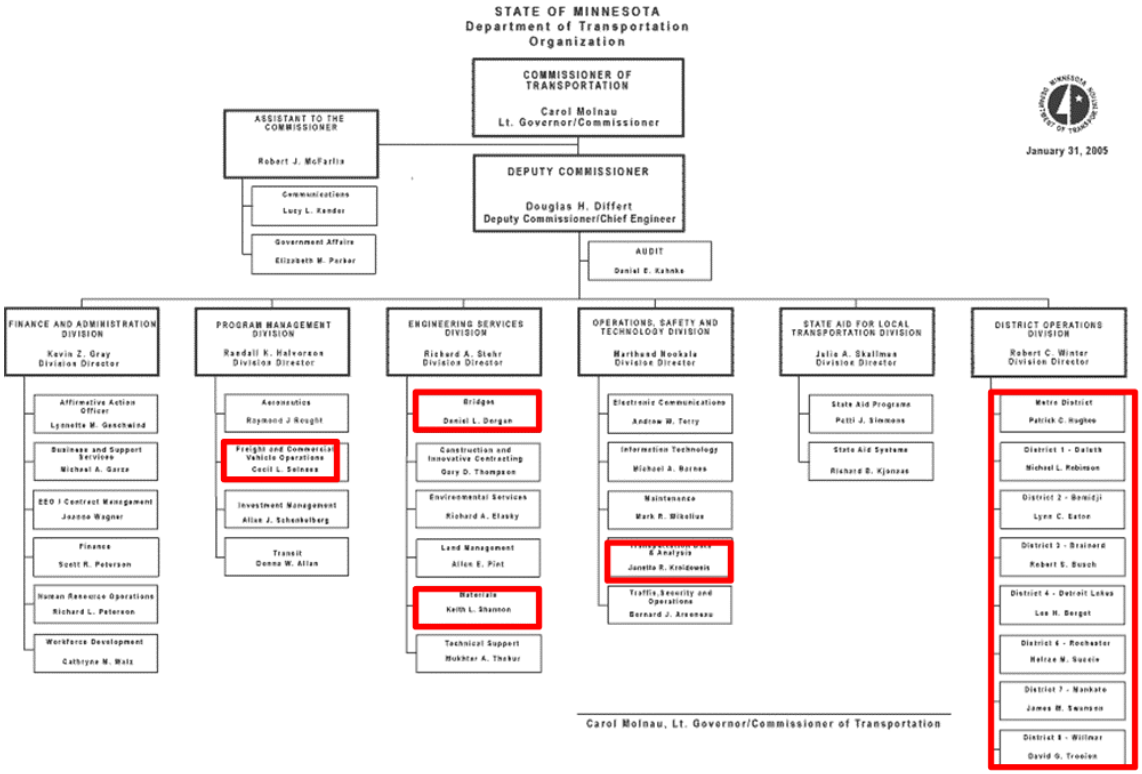
Civil Weight Enforcement is based on the Relevant Evidence Law passed in 1980 that enables the State Patrol is to go into facilities that record weight transactions (bills of lading) and serve civil penalties notices to violators. There is a $10,000 cap on the citation, and they can only go back into the records fourteen days. State Patrol routinely uses this method of enforcement to supplement their enforcement program.

Key Issues regarding enforcement methods include:

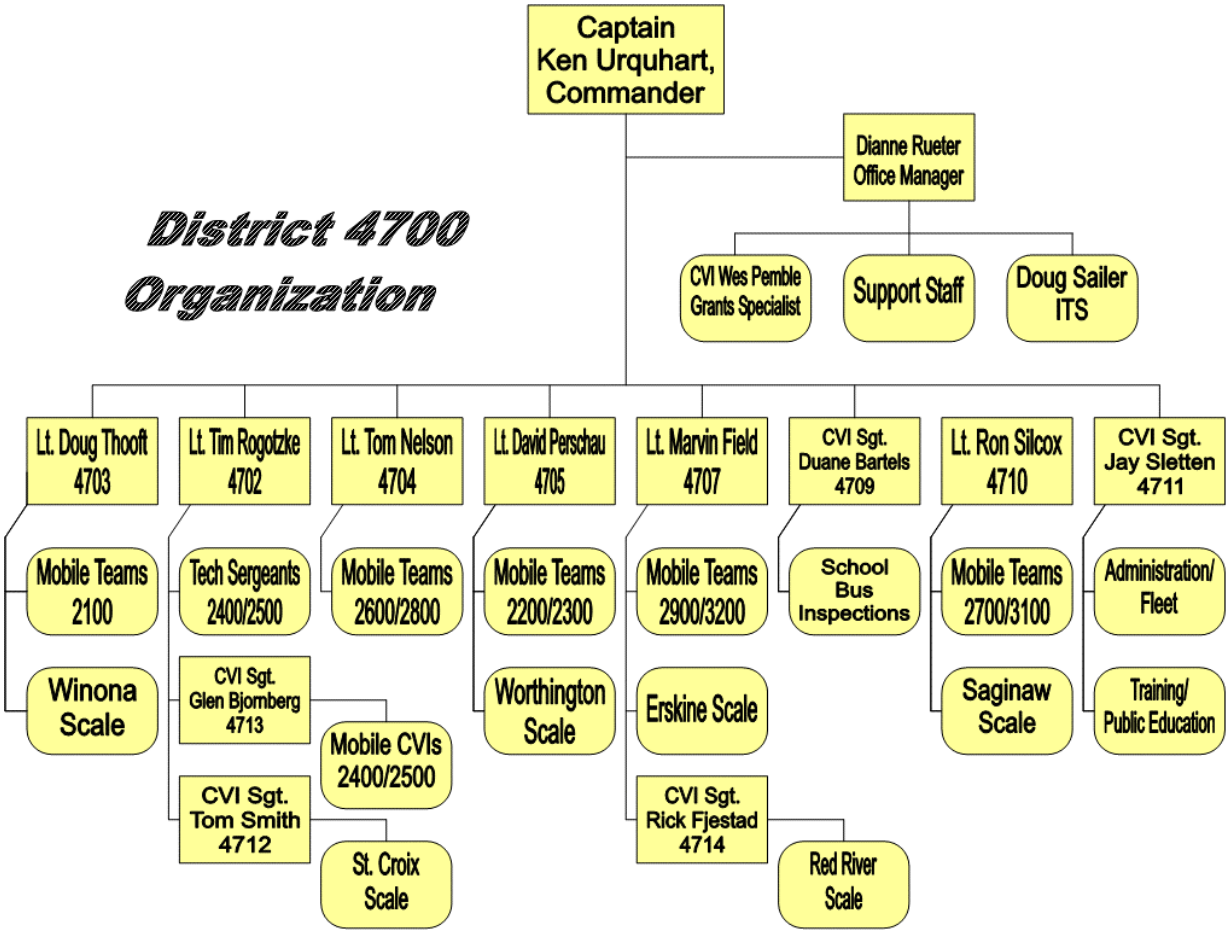
- Scale by-passing is prevalent around the fixed sites
- There are no fixed weigh stations on I-35
- The is only one fixed weigh station on I-90
- Enforcement resources (staff and funding) are limited
- The Relevant Evidence Law is useful but could be taken away by the Legislature at any time.
- No performance measures are currently being used to guide decision makers
- The current and historical axle and gross weight compliance rates are not established or recorded.
- Some fixed weigh stations are not optimally located
- Safe roadside enforcement sites are sometimes not available.
- Overweight trucks with no obvious safety deficiencies can often get past the inspectors
- Many of the fixed scales are 35 to 40 years old
- Staffing is a serious resource issue
  (Example, St. Croix used 25 people in '87 covering 3 shifts and now uses only 4 to 5 people during one shift per day)

Current Organizational structures

Mn/DOT: The key weight compliance stakeholders at Mn/DOT are highlighted in the attached Organizational Chart. The work is primarily driven by the Freight and Commercial Vehicle Operations group with involvement from Bridge and Road designers, the Transportation Data Analysis Section and the Mn/DOT Districts.


STATE OF MINNESOTA
Department of Transportation
Organization
COMMISSIONER OF TRANSPORTATION
Carol Molnau
Lt. Governor/Commissioner
ASSISTANT TO THE COMMISSIONER
Robert J. McFarlin
Communications
Lucy L. Kender
Government Affairs
Elizabeth M. Parker
DEPUTY COMMISSIONER
Douglas H. Differt
Deputy Commissioner/Chief Engineer
AUDIT
Daniel E. Kahnke
January 31, 2005
FINANCE AND ADMINISTRATION DIVISION
Kevin Z. Gray
Division Director
Affirmative Action Officer
Lynnette M. Geschwind
Business and Support Services
Michael A. Garza
EEO / Contract Management
Joanne Wagner
Finance
Scott R. Peterson
Human Resource Operations
Richard L. Peterson
Workforce Development
Cathryne M. Walz
PROGRAM MANAGEMENT DIVISION
Randall K. Halvorson
Division Director
Aeronautics
Raymond J Rought
Freight and Commercial Vehicle Operations
Cecil L. Selness
Investment Management
Allen J. Schonhoiberg
Transit
Donna W. Allen
ENGINEERING SERVICES DIVISION
Richard A. Stehr
Division Director
Bridges
Daniel L. Dorgan
Construction and Innovative Contracting
Gary D. Thompson
Environmental Services
Richard A. Elasky
Land Management
Allen E. Pint
Materials
Keith L. Shannon
Technical Support
Mukhtar A. Thakur
OPERATIONS, SAFETY AND TECHNOLOGY DIVISION
Marthand Nookala
Division Director
Electronic Communications
Andrew W. Terry
Information Technology
Michael A. Barnes
Maintenance
Mark R. Mikolius
& Analysis
Janette R. Knidgewis
Traffic, Security and Operations
Bernard J. Arseneau
STATE AID FOR LOCAL TRANSPORTATION DIVISION
Julie A. Skallman
Division Director
State Aid Programs
Patti J. Simmons
State Aid Systems
Richard B. Kjonaas
DISTRICT OPERATIONS DIVISION
Robert C. Winter
Division Director
Metro District
Patrick C. Hughes
District 1 - Duluth
Michael L. Robinson
District 2 - Bemidji
Lynn C. Eaton
District 3 - Brainerd
Robert S. Busch
District 4 - Detroit Lakes
Lee H. Berget
District 6 - Rochester
Melrae M. Succio
District 7 - Mankato
James M. Swanson
District 8 - Willmar
David G. Troolen
Carol Molnau, Lt. Governor/Commissioner of Transportation

MSP: The State Patrol includes a Commercial Vehicle Enforcement Division, and their staff conducts the enforcement activities by means of State Patrol Troopers and Commercial Vehicle Inspectors. The Organizational Chart for this Division is shown below.



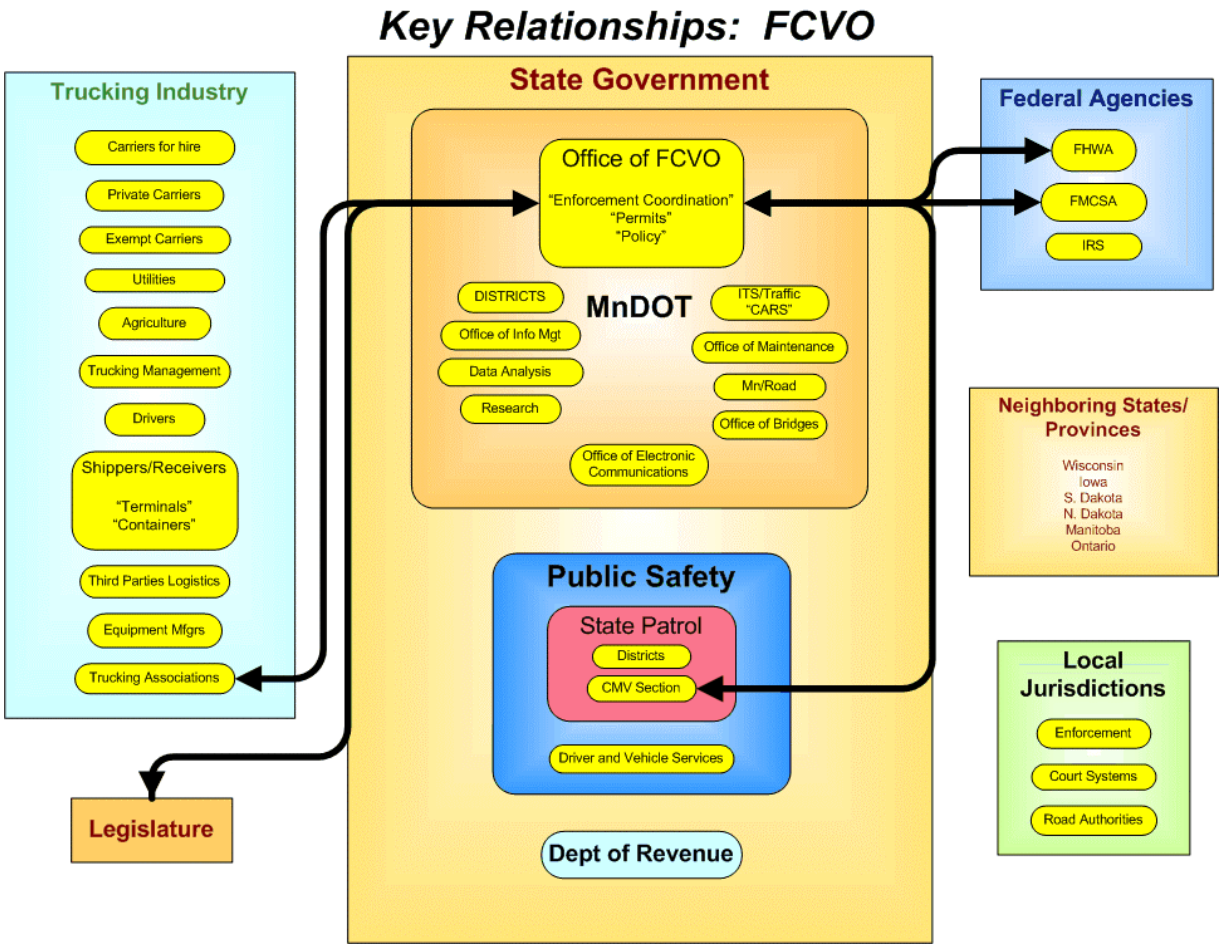
Communication Flows

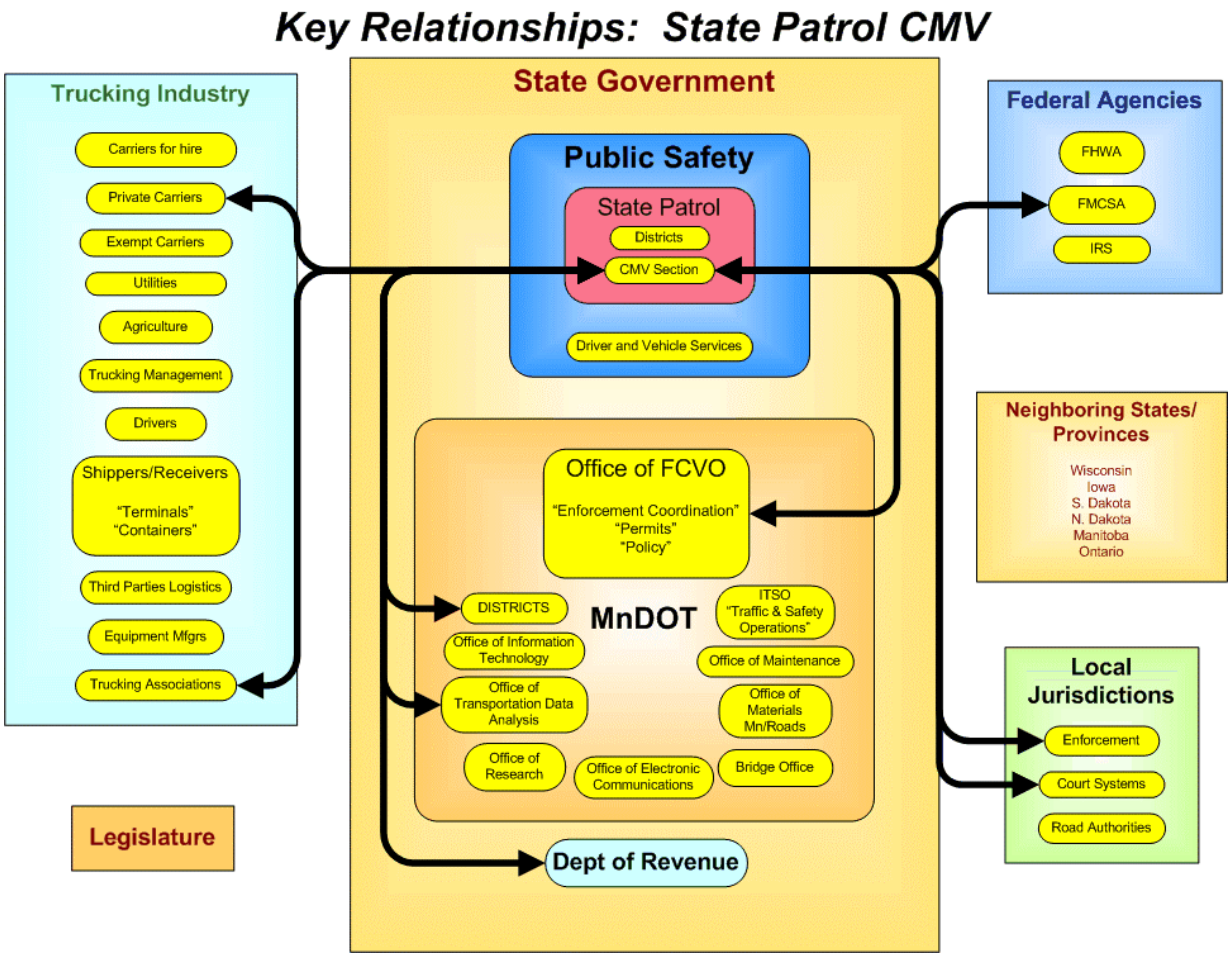
Besides Mn/DOT and the State Patrol, there are a number of other agencies that are also stakeholders in weight compliance. A high level map can be found on the next page showing how information flows between these agencies. Each diagram is centered on one agency with the primary communication flows drawn for each of the other key agencies. A quick look at these maps demonstrates the complex network of communications required to operate this program. This also points out the challenge of a strategic plan to get consensus and cooperation among the key stakeholders. These charts have several purposes. First, they help agencies clarify roles and reporting mechanisms. Second, they help administrators become aware of how the agencies need to interact so policies, work procedures and reporting formats can be developed. Third, they become an agreed upon document that can be used as a reference for how information is communicated in order to maintain continuity as personnel changes occur over time.

Key Issues regarding the organizational structures that were brought out during the Strategic Planning process include the following:

- Fixed scale functionality needs to be redefined in light of changing needs and availability of resources.

- The communication flows between agencies need to be further refined and incorporated into detailed work procedures.
- Team relationships between troopers and inspectors can be challenging due to the differences in authority granted each classification.
- A formal Liaison position has been suggested. This organizational change would provide an important link between Mn/DOT and the State Patrol to coordinate the multitude of actions between the two organizations.




Key Relationships: State Patrol CMV
Trucking Industry
Carriers for hire
Private Carriers
Exempt Carriers
Utilities
Agriculture
Trucking Management
Drivers
Shippers/Receivers
"Terminals"
"Containers"
Third Parties Logistics
Equipment Mfgrs
Trucking Associations
Legislature
State Government
Public Safety
State Patrol
Districts
CMV Section
Driver and Vehicle Services
Office of FCVO
"Enforcement Coordination"
"Permits"
"Policy"
DISTRICTS
MnDOT
ITSO
"Traffic & Safety Operations"
Office of Information Technology
Office of Maintenance
Office of Transportation Data Analysis
Office of Materials Mn/Roads
Office of Research
Office of Electronic Communications
Bridge Office
Dept of Revenue
Federal Agencies
FHWA
FMCSA
IRS
Neighboring States/ Provinces
Wisconsin
Iowa
S. Dakota
N. Dakota
Manitoba
Ontario
Local Jurisdictions
Enforcement
Court Systems
Road Authorities

Current Enforcement Facilities

Current Enforcement Facilities include the following:

Fixed Scale sites vary around the State. Currently there are seven fixed scale facilities in Minnesota. Three are located on Interstate highways and the rest are on the trunk highway system. The newest facility is the St. Croix scale on I-94. It is an effective site in terms of the number of inspections conducted, but most of the other sites need to be upgraded. The Saginaw facility functions at an acceptable level, but truck by-passing is a serious problem there. Due to staffing limitations there are no fixed sites that operate 24/7. There has been some discussion that the location of the next fixed scale site would be on I-35 near Albert Lea. More information about the sites mentioned above is available in the latest version of Minnesota's Weight Enforcement Plan.

Mobile Scales are used by Minnesota to increase their coverage and address problem areas. They serve as a middle solution between fixed scale enforcement and virtual enforcement. Mobile scales are towed to the site and set up. They enable enforcement officers to weigh more vehicles per day than for the portable scales described below, but they take longer to place into service. While they would be impractical for use on the Interstate system, they serve as "temporary fixed scales" on US or state routes.

Portable scales are used for roadside enforcement in Minnesota. They are typically used by an officer who has reason to suspect a specific vehicle is in violation of weight laws. It is fortunate that the Minnesota enforcement staff currently has a "fleet" of 207 portable scales because these scales will be an essential component of the Virtual Weigh Station initiative. No additional procurement of portable scales is anticipated at this time. State Patrol also has an excellent in-house program for certifying their portable scales. This program minimizes downtime when scales need to be serviced or re-certified. This assures long term continuity for sustaining the roadside enforcement function.

Weigh-In Motion Sites have been in use in Minnesota for some time, but only recently has there been an interest in using them to help support weight enforcement. All of the former bending plate scales have now been removed or disabled and a new program is underway to replace them with redundant quartz scales. These new scales have demonstrated good results to date. Negotiations are currently underway to enable the data from these WIMs to be used as the basis for a proposed virtual weigh station network in the State. Some of the new WIM sites have been installed by Mn/DOT's Electronic Services Section (ESS) and some have been installed by contractors. Mn/DOT currently has 5 Kistler WIM sites in service (see attached map) with 5 more planned for the next 18 months. Weigh-in-motion sites provide axle weights, gross vehicle weights, classification counts by axle configuration and vehicle speeds along with the time and date of arrival.

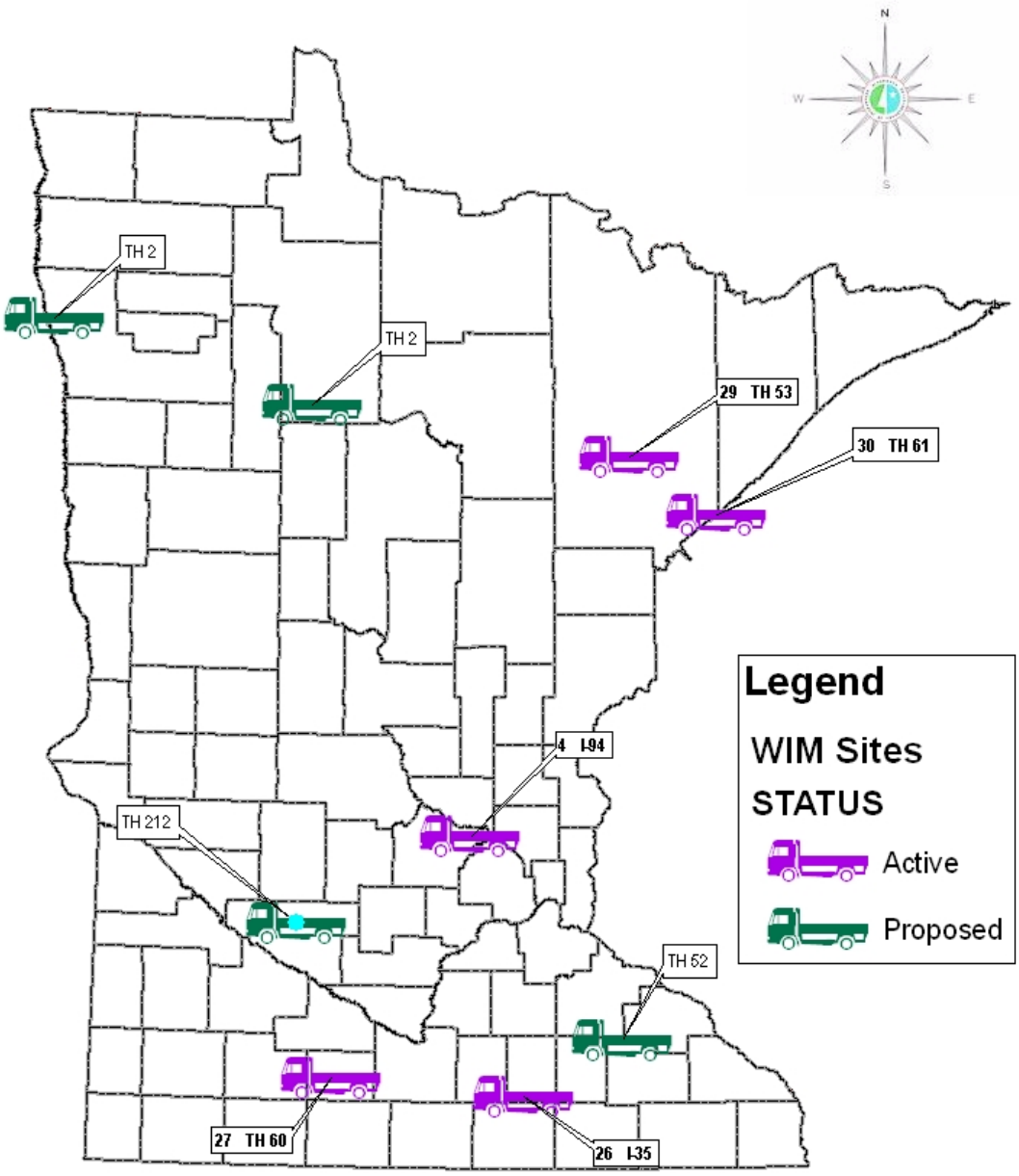
Classification Sites are also managed by Mn/DOT's Traffic Data Analysis Office. Mn/DOT has 25 vehicle classification sites in service (installed by ESS), and also has 45 other sites that

continuously count vehicles. The projected five-year program is to upgrade all counting sites to classification sites. These sites provide counts by vehicle axle configuration along with vehicle speed.

Key Issues regarding facilities include:

- Weight enforcement at fixed sites tends to be ineffective for weight enforcement within a few minutes after a scale facility opens.
- This is not to say that fixed scale sites are not included in the overall compliance program. Fixed scale sites will continue to be used for weight enforcement and safety inspections on high volume highways as they are now. Portable scales will become the main tool for lower volume highways.
- Planning WIMs will be made available for enforcement while maintaining data integrity necessary for planning.
- ESS support (installation, repair and maintenance) is qualified, but very limited due to other obligations.
- A listing of mainline WIMs used by adjacent states needs to be developed to identify potential sharing opportunities.
- There is concern about the availability of resources for WIM scale maintenance, data management, and routine calibration. Inaccurate WIM data are considered to be worse than no reading at all because they destroy officer confidence in the technology.

Weigh-in-Motion Locations



Map prepared by: Office of Transportation Data and Analysis
January 2005
www.dot.state.mn.us/tda

Current Reporting Systems

Currently weight information reporting is not shared outside the Department of Public Safety, and could be of use to the Department of Transportation.

An annual size and weight enforcement plan is submitted to the FHWA each year. This includes a spreadsheet on civil weight enforcement, and the number of permits issued annually.

Coordination of Mn/DOT's Pavement Ride Index with traffic and overweight data is planned for the near future.

Custom reports are also generated as needed in response to Legislative inquiries.

Key Issues about weight information reporting are:

- Weight compliance performance measures are not being tracked.
- The current compliance rate is unknown.
- Staff resources will be needed to calculate and report performance measures.
- The potential review and impending changes of weight statutes are being discussed by the Legislature. Mn/DOT's current ability to explain the impacts of these legislative changes is limited due to this lack of documentation.
- Current weight laws are complex and require some education on an annual basis to promote compliance.

Current Permits Program

Currently, Mn/DOT issues about 75,000 permits each year. The permits program is handled primarily at the Truck Administration Center in Mendota Heights. The RouteBuilder program for over dimension vehicles will significantly simplify the process of issuing over weight and over dimension permits.

Key Issues regarding the Minnesota permits program include:

- The Mendota Heights carrier services may be in jeopardy of being closed for budgetary reasons.
- Field Inspectors have no way of knowing if a vehicle has a permit prior to pulling the vehicle over, and this complicates roadside enforcement.
- A mechanism for multi-state permitting agreements has been suggested to reduce costs for both the carriers and the permit issuing agencies.
- Escorts of permitted vehicles are rarely monitored, making it easy for the drivers to violate special speed and bridge loading requirements.
- Current wait and processing times of permits during the transition to RouteBuilder has been identified as a major concern by customers.

Current Outreach

The outreach program related to weight compliance in Minnesota

is comprehensive. There are a number of useful tools being used including:

- Mandatory Construction Truck Operator training
- Mn/DOT's training program for truckers
- New entrants training
- Permit training for Troopers is very effective
- Northland College training is supported by industry
- State Patrol has 5 staff members dedicated to all education programs (weight included)

Key Issues regarding compliance outreach include:

- The training programs need to be sustained and expanded to keep abreast of increasing needs.
- Performance measures need to be developed to create outreach reports for administrators, enforcement personnel and the public.
- FHWA and FMCSA are not included in facility deployment decisions.
- Local enforcement agencies are currently engaged in the outreach program, but due to the large population of local agency personnel, there will always be a need to find effective strategies for improving these relationships.

Current Research

Current Research efforts include:

- A major truck size and weight study is underway and will be used to provide information to the legislature regarding costs of increasing the legal size and weight of trucks.
- A Statewide Heavy Vehicle Safety Plan (SHVSP) study is currently underway.
- The Minnesota Statewide Freight Plan was recently completed and identifies a variety of issues related to trucking and highway infrastructure.

Key Issues relating to research in Minnesota include:

- Research is needed to develop statistically sound routine compliance reporting methodologies
- Research is needed to help establish and refine practical performance measures for weight enforcement that are effective and affordable.

Proposed CVE Program Elements

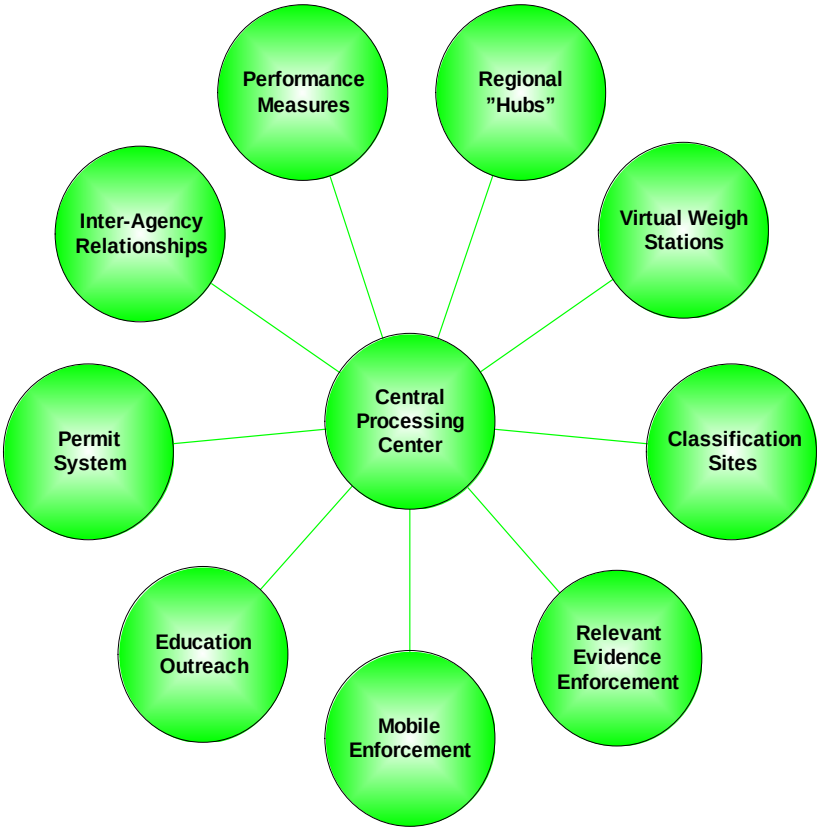
In any discussion about alternatives it is important to keep in mind that there will always be an infinite number of options available. It is also important to remember that any program is never really "set in stone", but will always be in a dynamic state of change. These two thoughts establish an open perspective and lead to innovative solutions that are rigid enough to provide direction for the foreseeable future while being flexible enough to adapt to changing circumstances.

One useful approach is to envision an ideal vision of the future, identify what elements of the current condition fit into that picture, and then identify what needs to be in place to complete the vision. In this case, the ideal vision has the following characteristics:

- ✓ All commercial carriers choosing to operate within legal limits
- ✓ A cooperative arrangement of public sector agencies who monitor this compliance with a minimal investment of manpower, equipment and funding
- ✓ A system in place that tracks performance in order to make mid-course program corrections
- ✓ An integrated arrangement of compliance tools that serve more than one purpose.

The recommended vision for the Minnesota Weight Compliance Strategic Plan includes a number of components that are depicted in the following diagram. These are all described in more detail throughout this report.

Weight Compliance System Components



Central Operating System

The Central Operating System is the "brains" of the compliance monitoring system. Built around a GIS database with connections to all the fixed scales, TOCCs, WIMs and other field devices, it is a central point for data collection and information processing. From this center, staff can monitor the WIM "health" using statistical methods developed by Minnesota and others. These methods provide a means of determining remotely if a scale is operating properly. They can also diagnose failing data trends coming from a WIM often at a point when the data still has value. This produces more lead time for maintenance efforts to be mobilized while the scale is still producing useful data.

The Central Operating System also produces a new method for recalibrating the WIMs remotely based on the weight information provided by the roadside enforcement officers – a much more cost effective method than the conventional practice of using a test vehicle of known weight. WIMs generally fail in one of two ways: they can consistently weigh too high or too low (a simple calibration problem), or they can produce scattered readings (a hardware problem). The former is correctable remotely or the data can be adjusted after it is collected. The latter requires field maintenance of the scale equipment or pavement surrounding the scale.

A primary function of the central operating system is to produce recommendations for selective enforcement schedules based on changing trend information derived from a variety of sources. These trends include vulnerable infrastructure reports (from Mn/DOT engineers), seasonal commodity movements (from various commodity studies), and link violation rates (from WIM scales and citation logs). The Central System would also generate a number of reports ranging from routine compliance reports, performance measure reports, enforcement activity summaries and others as required by the program.

Initially, it is recommended that this center be established as a modest workstation in one of Mn/DOT's facilities where secured high speed communication links are available. This could evolve into a more sophisticated operation as the performance measures, work procedures and WIM infrastructure are developed. At some point each of the hubs (located at the existing TOCCs) would also be equipped to monitor in real time their respective WIM and classification sites so that they can run regional VWS enforcement details, supporting multiple officers who are mobile and covert. The personnel at the hubs would produce weekly enforcement predictions from trend information generated by the central operating system. They would refine their enforcement schedule each day based on their specific regional information.

The Office of Transportation Data Analysis (TDA) currently operates the existing WIMs and classification sites for planning purposes with no connection to enforcement. Under this new Weight Compliance Program the Office of Freight and Commercial Vehicle Operations (OFCVO) would share the data that is currently available from the International Road Dynamics

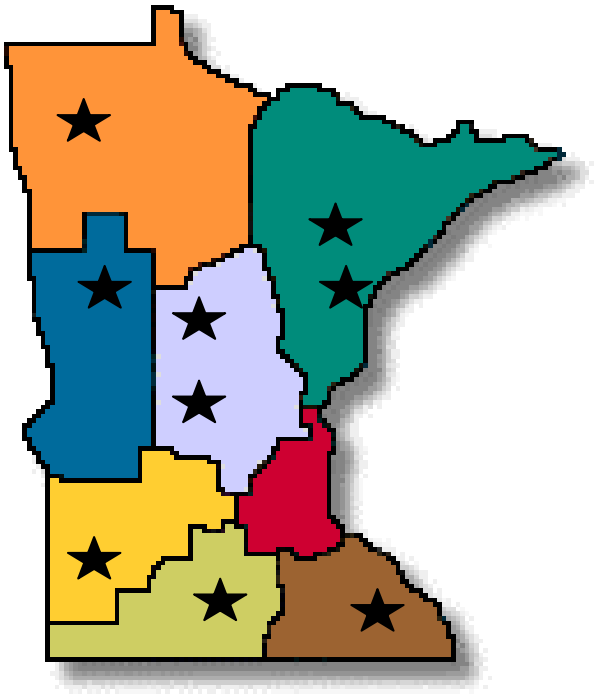
(IRD) controllers. These controllers acquire and report the data from the five quartz scales. The associated software has the ability to split the data stream and serve both planning and enforcement purposes. The OFCVO could manipulate them to produce the desired information described above.

The IRD controllers also have the ability to split the data streams and enable both planning type data collection and real time monitoring of vehicle data for VWS enforcement purposes. In return for the WIM and classification data, the OFCVO can share the true weights of inspected vehicles (as measured by the inspectors' portable scales) with TDA. This data can then be used by TDA to recalibrate their equipment, improving their ability to maintain reliable WIMs at a lower cost. The statistical diagnostics for WIM maintenance can be accomplished by either TDA or OFCVO depending on the agreement between the two offices and the availability of staff. Ultimately, the central operating system would produce automated diagnostic reports on a routine basis to simplify this process of calibration and troubleshooting. The intent is to leverage the data and turn it into useful information for both offices without overburdening either.

Regional Hubs at the TOCCs

Regional Hubs would function out of what are now the Traffic Operations and Communication Centers (TOCC) shown below.

Minnesota Transportation Operations Communication Centers
(TOCC)



Brainerd
Duluth
Detroit Lakes
Mankato
Marshall
Rochester
St. Cloud
Virginia
Thief River Falls

Many different transactions can occur between the two agencies at these TOCCs. Both Mn/DOT and SP personnel have established operations at these centers for a wide variety of traffic operations purposes, commercial vehicle enforcement being one of them. They would function essentially in much the same way they do now with a few additional features. Again, the intent is not to overburden either agency, but to enhance their functionality with some new tools.

The coordinators at the TOCCs would take the performance data supplied to them by the Central Operating System and translate that information into enforcement schedules for the next week's activities. This might include routine cooperation between adjacent TOCCs and also between the State Patrol and local enforcement as well. The reverse of this process would involve feeding "intelligence" information about commodity movements up to the Central Operating System for

inclusion in future reports.

For example, assume that the Central Operating System identifies a high number of fixed scale by-passing at one of the scale facilities. The diagram that follows shows how the various components might be arranged to address this problem. The mainline WIM at the fixed scale sites would be used to identify the optimal hours for conventional operation of the fixed scale, and this would be partially based on the presence of overweight vehicles in the stream of traffic. Ramp sorter WIMs are commonly used in modern scale facilities to improve operational efficiency and prevent backups onto the Interstate. The VWS WIMs on the primary by-pass route are then used to capture those trucks that are overweight and are attempting to circumvent enforcement. The classification sites on the secondary by-pass routes are a low cost measure to identify when and where other scale by-pass activity is occurring. Portable classification equipment (tube counters and sidefire radar units) can also be used to field test a suspected by-pass route for activity prior to investing in a full VWS WIM or a classifier on that route.

The communication equipment at the TOCC could also enable full One-Stop-Shop capabilities at these hubs to facilitate carrier licensing and registration transactions if the authorizing agencies desired to make these services available. The current trend for CVO services is toward electronic filing, however, so this functionality may not be required. Should transponders ever be required for vehicles carrying permits in the future, the TOCCs could become convenient distribution centers.

These hubs could effectively provide regional coordination of all commercial vehicle enforcement activities, including coordination with local enforcement and outreach. The regional hubs would also serve as training sites for local enforcement staff. Local transportation agencies would be encouraged to participate in the program by conducting VWS enforcement on their routes in conjunction with the regional hubs. (They could even fund WIMs or classifiers on key local by-pass routes effectively integrating them into Mn/DOT's system). They would be valuable sources of information about changing commodity movements, vulnerable local pavements and "intelligence" about local habitual offenders. This "intelligence" would be fed back to the Central Operating System via the local TOCC.

Fixed Scales

This Plan recommends that the Oversight Committee carefully evaluate existing fixed scale facilities in regard to their function, their location, their condition, and staff availability. Records show that weight violators are rarely caught at fixed scale facilities, and this is believed to be due to the extensive CB radio system used by most truckers, making evasion easy. Border crossing issues, driver logs, safety inspections, brake inspections etc. will always be needed, so these facilities still have important functions, but their continued use and schedule should be performance driven.

Along with their conventional CVO enforcement activities, the

fixed scales could also be used as sites for a ticket free compliance testing/correction program (suggested earlier in this report).

Mn/DOT typically spends about $100,000 annually per fixed scale site for maintenance and operation of the facility. (This does not include enforcement labor costs.)

Virtual Weigh Stations

Virtual Weigh Stations (VWS) are an emerging phenomenon in the field of weight enforcement. They are a system built around Weigh-in-Motion (WIM) scales embedded in the pavement. Wireless communication with nearby enforcement vehicles enables the officers to screen for specific overweight trucks without disturbing the compliant vehicles. The official weighing of the truck is done at predetermined inspection sites (pull off areas) downstream from the WIM. A full featured VWS has digital imaging technology to help identify the suspect vehicle enabling the officer to be positioned downstream and out of sight. It could also include optical character recognition technology to read the trucks' license numbers. This information would further identify the vehicle and could also be used to identify habitual offenders. A well integrated system of VWSs would be located on the by-pass routes of the fixed scale sites and could even include connections to the nearby WIMs from adjacent states under the authority of cooperative agreements. This creates an advantage because the fixed scales are typically located at state entry points, resulting in the state borders becoming boundaries for bypass enforcement. An officer using another state's WIM data can intercept the bypassing vehicle as they enter their own state, or they can team with the adjacent state officers to conduct joint operations.

This Plan recommends a network of approximately 45 sites (basic WIMs or WIMs upgraded to full VWSs) strategically located across the state. Refinement of these locations and conversion to virtual WIM capabilities will be accomplished by the Oversight Committee over time as funding, performance and staff resource information becomes available.

During the workshop the development team determined that the Regional and Interregional Corridor Routes with Heavy Commercial Average Daily Traffic (HCADT) volumes greater than 500 vehicles per day would be considered primary candidates for VWS sites. Input from Department of Transportation and Department of Public Safety offices were also identified as key selection criteria. Other issues relating to good site selection for WIMs include the following:

- Mainline roadways in front of fixed weigh stations
- Primary, known by-pass routes for fixed weigh stations
- Ramp sorters at fixed weigh stations
- Trunk highways with substantial truck volumes
- Highways that experience heavy commodity movements (large agricultural sources, manufacturing centers, warehousing and industrial processing

centers, aggregate pits, etc.)

- Highway links that contain one or more vulnerable bridge structures (older, sub-standard bridges that are posted for weight limits)
- Newly rehabilitated roadways with significant truck volumes

One of the primary advantages of these WIM sites is that they work 24 hrs per day, recording all weight related information, and they can simultaneously provide live feeds to the TOCCs.

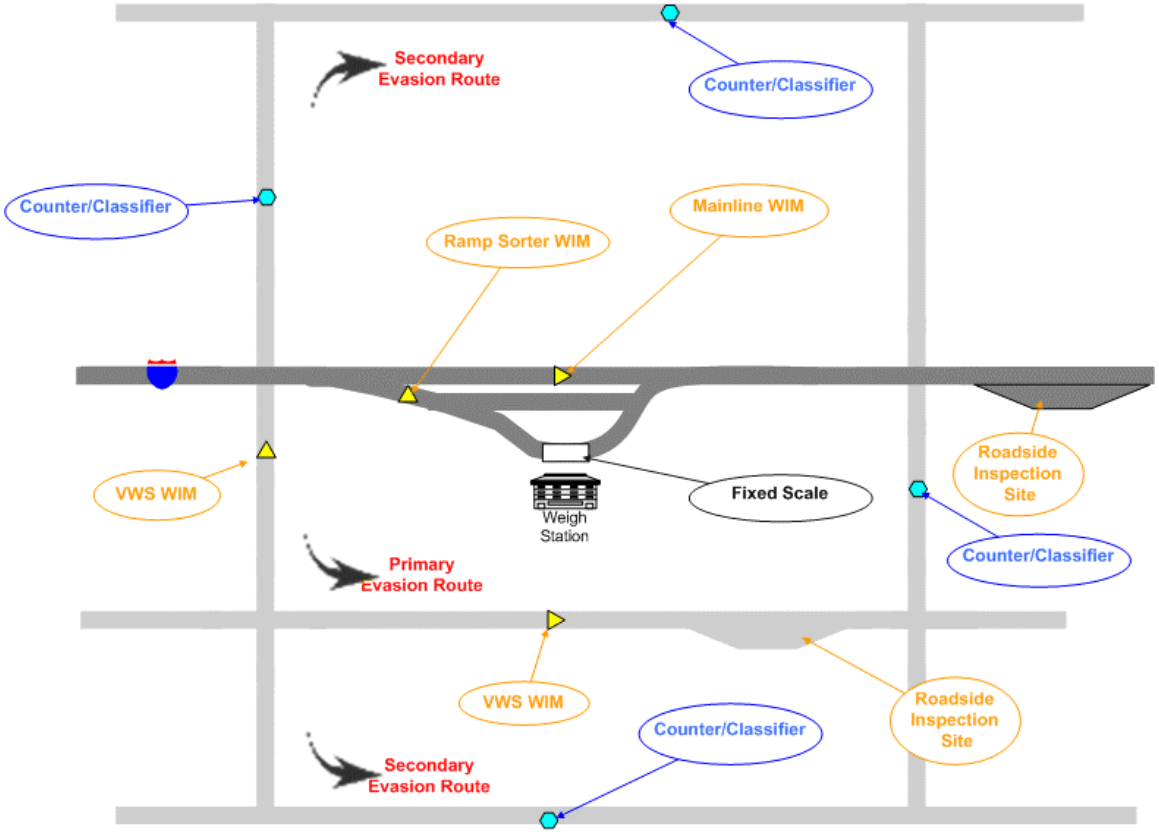
This program is made more affordable by the fact that implementation will occur "one WIM at a Time", some of which will be included in pavement rehabilitation contracts to be fiscally prudent and maximize the benefit. This is a particularly useful procurement strategy because it is important that the approach pavement to the WIM scale be smooth and durable. Pavement rehabilitation provides the opportunity to construct the approaches to a high level of quality. This time of installation is also important because a new pavement is "protected" by the VWS enforcement for the full life of the roadway. This gradual rollout also enables Mn/DOT to adequately ramp up to manage the ever increasing data from the operating sites.

The following estimates are provided to give a perspective on the costs of Virtual vs. Fixed weight enforcement.

- Approximately 100 WIM sites could be built for the cost of one fixed scale site (Assumes $15,000,000 for fixed site construction and $150,000 for one WIM site with no pavement improvements required)
- Annual costs for 100 WIM sites would be about 25% of the annual cost for one fixed scale site.

In addition to the lower costs, a network of WIM scales provides a substantial amount of new vehicle counting and classification data for planning and research purposes, which can potentially translate into additional savings or improved service. If Mn/DOT should ever choose to require pavement warrantees in the future, these sites become the ideal tool for the capturing the required weight data needed for measuring new pavement performance.

The diagram on the next page provides an overview of how a network of VWS technologies can be configured around a fixed scale site to address the problem of trucks evading the scale.



This diagram depicts a symbiotic arrangement of fixed scales, weigh-in-motions scales and counter/ classifier sites. WIMs are used on the fixed scale ramp lane to sort trucks and keep the ramp from backing up on to the mainline roadway. The Mainline WIM at the scale is used to optimize enforcement hours of operation. The VWSs on the primary by-pass route are used to capture scale evaders. The Counter/ Classifers are used to monitor truck activity changes on the secondary by-pass routes. They can be portable units, depending on the need. They can be upgraded to full VWSs if the changes in truck movements warrant.

Concept for Dealing with Fixed Scale Evasion

Classification Sites

Classification Sites are also a valuable part of the program. Due to their lower cost, they can be deployed on secondary by-pass routes and local roads to monitor for significant changes in truck movements, suggesting a need for a change in enforcement patterns. Classification equipment can be permanent (such as the existing Mn/DOT traffic counting sites) or portable (such as tube counters and sidefire radar units that count and classify). An important use for this equipment would be to "field test" a site for truck activity prior to investing in the more expensive WIM or fixed scale equipment. If designed properly, a permanent classification site can be upgraded to a full WIM site by adding the scale equipment.

Good sites for classification equipment (both portable and permanent) include:

- Secondary fixed weigh station by-pass routes
- Local routes that experience heavy truck volumes and

might be used as a by-pass for a fixed weigh station.

- Major alternate routes to mainline roadways
- Roadway links with vulnerable bridge structures
- Newly rehabilitated roadways with significant truck volumes
- Locations where a WIM would be appropriate, but current funding is limited

Pull off Areas

Pull off areas are locations where roadside and mobile enforcement take place. Safety is the primary consideration for pull off area site selection, and this can be seen in the following selection criteria.

- Adequate distance to identify, notify and stop vehicles without extreme accelerations or decelerations
- Safe sight distance for motorists passing by
- Minimal vertical grade in the longitudinal direction
- Enough width to provide inspectors a safe work area around the vehicle and a buffer between them and the edge line
- Adequate parking to position enforcement vehicles as barriers upstream from the inspected vehicle
- Enough room to provide inspected vehicles with an acceleration area that maintains appropriate sight distance for approaching motorists

In some cases where enforcement activity occurs very frequently it may be appropriate to construct dedicated pull off areas for roadside or mobile enforcement. For those locations, detailed site selection and design criteria are provided in the Appendix in the form of a handbook developed by the State of Indiana.

Relevant Evidence

Civil Weight Enforcement is a powerful tool for promoting compliance because it can effectively deter habitual offenders. The key to maximizing the benefit of this strategy is in knowing which carriers to investigate. The information derived from the VWS program can help with that selection process in three ways. 1) If roadside inspections routinely find a particular carrier, then they are candidates for relevant evidence enforcement. 2) A VWS's digital imaging and optical character recognition systems can help ID those suspect carriers. 3) An observer at the VWS could simply make a list of suspect carriers from the WIM data and not conduct any roadside enforcement. This would be useful near the perimeter of heavy commodities such as agricultural products or mining operations where only a few carriers would be involved.

Civil weight enforcement can also be triggered by trends in heavy commodity movements, by season of the year and by 'mining' other databases. (While Minnesota has not advanced as far as some states with the FMCSA's CVISN program, it is

anticipated that this national program will be incorporated into Minnesota's operations at some point in the future. This system will provide a wealth of information about carriers regardless of their state of origin.) These "intelligence gathering" functions could be performed both at the central operating system level and the TOCC level, producing very specific relevant evidence enforcement schedules for efficient enforcement.

Mobile Enforcement

Mobile Inspection sites are currently used in Minnesota. A mobile enforcement site is similar to a fixed scale site but does not have the building facilities. Essentially they are off ramps connected to a work area slab and then connected back with an on ramp. This is a tool that can be used successfully on lower volume roads with heavy truck percentages. They can include a certified fixed scale or provision for mobile scales to be quickly positioned for operation. Once set up, all or most of the trucks are required to pull through the scale and inspection is conducted in the same manner as the conventional fixed stations. This diversion is accomplished with signs that can be setup or turned on when needed. (For the purposes of this document, the term "roadside enforcement" will be used strictly in reference to the inspection of a single vehicle identified for inspection so as not to confuse it with the term "mobile enforcement" as described above.)

In this plan mobile enforcement will remain an important tool for maintaining a visible enforcement presence over large areas and for keeping compliance affordable. Mobile scales have been proven to be more effective at finding overweight vehicles than fixed weigh stations, and they cost considerably less to build and operate (facility maintenance, utility costs, etc.). The inspection staff can operate from standard cruisers. They operate for short intervals and then move on to the next site to remain covert and stay ahead of the CB network. The advantage of a mobile site is that it enables more inspection services than just weight enforcement. In a 24 hour day the crew might move to several different sites in a pattern suggested by the central operating system for optimal performance.

The current Mn/DOT investment in mobile sites will be enhanced by the additional WIM sites. The data from the WIMs will be used to target high non-compliance locations where mobile enforcement can be used to bring compliance back to acceptable levels. In return, the data from the mobile scales can be used to substantiate the WIM data.

Mobile enforcement sites are not intended to replace conventional enforcement at the fixed scales where truck volumes warrant permanent facilities that enable a high volume of more detailed safety inspections.

Education and Outreach

Education and Outreach are essential to an efficient compliance strategy. Minnesota currently conducts several very effective education and outreach programs. It is important that this functionality be maintained as an effective tool for

minimizing non-compliance due to ignorance. Under the integrated program being outlined here, the training and outreach program would be focused by emphasizing areas where compliance is lacking. An example is in the area of bridge violations. Inexperienced drivers and suppliers can unknowingly load a truck within legal gross or axle weights but still be non-compliant in terms of the bridge formula. To be cost effective, this training can be conducted in concert with CVO safety training.

Permit System

Mn/DOT's Permit System is currently migrating towards an e-filing system. It is important that these new procedures be fully integrated into the new strategic weight compliance efforts for several reasons. The process for using technology to screen for overweights will ultimately need to be augmented by information about whether or not a vehicle has a permit to operate. Trends in the number of permits being issued will be useful as input when new regulations and policies are being considered. Ultimately, the VWS system could incorporate a frequently updated “look-up” table that is available to the inspectors to quickly determine if specific overweight vehicles have a permit. This interaction with the permit database is essential during civil weight enforcement for the same reasons.

Relationships

Relationships are a major component of the plan. It is recommended that an initial team of "Champions" be assembled from key stakeholder agencies to coordinate all program development and, in some cases at first, to prioritize and perform several of the functions. Gradually this team would transition into an Oversight Committee that would continue to steer the program, arrange resources and establish policy and procedures. As the central operating system evolves, some of the manual functions would become automated. A subcommittee of private sector participants is also recommended to provide a “customer” perspective. This can be useful for helping to avoid problems with new policies and procedures. They can point out the subtle negative impacts that new regulations sometimes have, and can suggest opportunities for introductory outreach sessions when changes occur and need to be advertised.

Enforcement requests from local government representatives (Engineers, Sheriff’s, Government officials) are another form of relationship that can be very effective. The locals can, in many cases, identify habitual offenders reported by other carriers or by their own observations. The local agencies can also recommend vulnerable roadway facilities that need to be protected, thereby influencing the schedule. Local agencies are also in touch with new commodity sources or changes in commodity movements.

Collaboration with neighboring states is another aspect of this recommended program. Remote WIM data (from across state borders) can be shared, thereby expanding the network for both states.

The permit database information needs to be made available to

all enforcement staff, both in the field (for screening purposes) and at the central operating center for data processing purposes.

Integration of planning and operations functions will be an integral element of this Plan. An internal agreement by which existing and proposed WIMS will be used for dual purposes of enforcement and planning is provided in the Appendix. This agreement outlines data management and other elements necessary to meet the needs of enforcement, planning, and the protection of Mn/DOT's infrastructure. The planners will provide insight into the information they need to fine tune their programs. The operations staff can provide information to the planners on how the weight enforcement devices will be deployed (most affordably during normal road rehabilitation projects). Both parties can share information about the extent of damage from overweight trucks to steer and fund maintenance programs as well as long term enforcement resources. The planners and the operations staff will be able to better coordinate public information releases, update legislators on needs and funding, and they can help field legislative inquiries. It is highly recommended that some sort of quality assurance program be incorporated into this relationship to insure that specific reports are delivered regularly and that enforcement information is considered during rehabilitation project scoping. Planners also need to be represented on the Oversight Committee to ensure that data integrity is maintained. Budget issues will also be shared, as investments will provide information that will be made available to enforcement and vice-versa.

Currently Mn/DOT operates 5 WIM sites that will be used by enforcement within the terms of the agreement. Mn/DOT plans to install a number of additional WIMs over the next few years that will also be multi-purpose. TDA will be involved in locating and utilizing data from those sites.

Liaison

To effectively create and sustain all of the above relationships, it is highly recommended that a Liaison position be created to cultivate all of the relationships described above, to chair the steering committee, to troubleshoot non-routine problems, and to coordinate policy and procedure decisions. This individual is the "Champion" who coordinates the efforts of the various members, deals with conflicts, and promotes communication. These activities can effectively build momentum for the weight compliance program and keep it from becoming sidetracked.

Potential future functionality

While not recommended during the initial rollout of this Strategic Plan, there are a number of potential screening functions that could be added to the Virtual Weigh Station program. These include screening for the following.

- Speed violations
- Illegal radioactive materials
- Profiled vehicles ID'd by Intelligence agencies
- Noise violations

- Hot tires and cold brakes using infrared detection
- Underbody inspections
- Contraband

In addition to screening functions there are other Mn/DOT operations that could be integrated with the weight enforcement network. These include:

- Roadside weather stations (including pavement sensors)
- Vehicle to roadside communications (for future telematics applications)
- Hazmat permit transponder tracking (including blanket permit applications)
- Oversize permit transponder tracking (also including blanket permit applications)
- Air quality monitoring, particularly for PM 2.5 emissions from diesel vehicles.
- Communication "hot-spots" that establish low cost data communication links for field personnel.

PrePass/NorPass/Operation Greenlight

Mn/DOT had been a member of the PrePass program for the last decade, and recently terminated their participation. Mn/DOT does not intend to reestablish this relationship or join any of the other transponder based programs because they have not seen a reasonable return on their previous investment. In addition, it is reasonable to assume that the weight compliance program might reduce the hours of operation at fixed weigh stations, thereby negating the advantage of using transponders to by-pass the scales. This reduction in fixed weigh station operation might occur if covert enforcement using virtual weigh stations successfully improves the compliance rate. Additionally, the mainline WIMs in front of the fixed weigh stations can identify the hours of operation when enforcement is needed and verify that they were not needed when closed. However, this decision ought to be revisited in the event that Mn/DOT ever decides to expand their network of mobile enforcement sites because transponder by-passes for those scales would have significant advantages. The PrePass program can be engineered to operate during mobile enforcement operations.

Performance Measures

In order to improve on the way business is conducted it is important that some sort of performance measuring system be in place. In the past, managers just trusted their common sense to judge how well an operation was doing. With a complex system such as Minnesota's weight compliance program, that approach is no longer adequate. Some sort of metric is needed to assess the complex outcomes resulting from policy and procedural decisions or there can be no reliable way to make mid-course corrections. This section will present some background about what performance measures are and how they can be implemented as part of this Strategic Plan.

What are performance Measures?

What is a performance measure and how do they apply to this Strategic Plan? Simply put, a performance measure is a yardstick for assessing how well a system is achieving its intended purpose. Just about any aspect of an operation can be measured. The challenge is to find measures that accurately gauge system performance but are not costly to produce and do not place too large a burden on the system operators. State Patrol already has some experience with performance measures because they do keep records and create reports on performance. An example is the July '01 report entitled "Directions and Recommendations for Weight Enforcement" found in the Appendix that summarizes a number of enforcement activities. What is being proposed here is a more formalized approach with very specific measures and routine reporting procedures.

It is also important that performance measures do not leave an agency vulnerable to litigation or to unfair criticism from external entities. This problem is most likely to occur with performance measures that assess an agency's performance (such as the number of tickets issued) rather than the system's outcomes (such as the weight compliance rating).

Typically an agency will decide on a specific measure then establish a baseline rating. Future measurements are then compared to that baseline to determine if the system improved. Operational changes are then made and the process is repeated, again comparing new results with the baselines. An analogy is taking a person's pulse. The baseline measurement is taken when the person is at rest, and then the pulse is taken again under a variety of conditions to assess how well the individual's cardiovascular system responds to stress. This Plan recommends the following weight enforcement performance measures, and they can be grouped into three categories as shown in the table below.

Condition (simply measuring the infrastructure or the loading on the system)
Scale facilities
Road miles covered by enforcement
Troopers and Inspectors
Heavy vehicle miles traveled
Annual Tons of overweight livery

Percentage of vehicles with weight permits
Enforcement Effort (measuring the agency's level of effort)
Stops/hour worked
Inspections per day
Citations issued
Inspections per million CVO miles driven
System Outcomes (presented for each link and summarized for the entire system)
Percentage of vehicles over legal gross (0-10%, 10% -20%, > 20% categories)
Percentage of vehicles with over legal axle loads (0-10%, 10%-20%, >20%)
$$$ saved from reduced pavement damage (annually)
$$$ saved from reduced bridge damage (annually)
Overall Weight compliance rating (% vehicles running legal)
citations issued vs. # vehicles inspected (roadside)
citations issued vs. # vehicles inspected (mobile)
citations issued vs. # vehicles inspected (fixed scale)

Why use performance measures?

There are many good reasons for using performance measures. The underlying philosophy is that they can be used to improve business operations. Currently there has been significant emphasis from the FHWA to use performance measures to better coordinate Operations and Planning functions. Historically, these two groups have operated rather independently even though they influence each other significantly. Performance measures can effectively serve as a translation interface between the two. The following list describes some of the primary reasons for using performance measures?

- ✓ Refining operational procedures
- ✓ Supporting investment decisions
- ✓ Prioritizing projects
- ✓ Providing information for outreach efforts
- ✓ Responding to legislative inquiries
- ✓ Providing input for organizational changes

Currently available performance data sources

One frequent misconception about performance measures is that they require a whole new set of data collection processes. Often that does not need to be the case. Ideally, performance measure data should come from existing sources to minimize the cost. Minnesota has a number of data sources available as can be seen in the list below. Each of these has potential as data input

sources. The key is to identify practical data extraction procedures from these sources.

Current performance data sources available in Minnesota:

- ✓ Vehicle Classification sites
- ✓ Traffic Volume counters
- ✓ Weigh in Motion scales
- ✓ Relevant Evidence data
- ✓ Pavement Ratings
- ✓ Bridge Sufficiency ratings
- ✓ Safety data

Recommended compliance performance measures

The most significant performance measure would be the damage caused by overweight vehicles. This would be presented in terms of ESALs from overweight trucks in a manner similar to that presented in the chapter on damages. This information can be derived from the WIM data. It is also recommended that the overweight ESALS be aggregated into groups (ex. ESALs from legal trucks, from trucks up to 10% over legal, from trucks between 10% and 20% over legal, and from trucks > 20% over legal).

A second performance measure would be the "Hit" rate. This would be a ratio of the number vehicles that were issued citations for weight violations compared to the number of vehicles inspected. This is an outcome measure and should be distinguished from a simple count of the number of roadside inspections conducted. Counting the number of inspections is misleading. Ideally, the program would cause the number of citations to diminish as the overall compliance rating improves. Simply counting the number of inspections would lead to the erroneous conclusion that the program is not working. The "Hit" rate described earlier normalizes the data and expresses the efficiency of the effort, not the quantity.

Another performance measure could be a measure of repeat offenders. This would be established from a combination of WIM data, digital image technologies and manually entered data. The WIM data of all offenders would be placed in a database and then sorted on the USDOT numbers. A simple macro could then be applied that counts the USDOT numbers and then places them in decreasing order. The resulting table then becomes a prioritized list for the Civil Weight Enforcement Inspectors to use as they schedule their work.

A Bridge Vulnerability Index could be created by combining the gross weight compliance rating for a link with Mn/DOT's bridge sufficiency ratings for all bridges within each link in a spreadsheet. The algorithm would rate those structures with bad compliance and low sufficiency ratings as the most vulnerable. The resulting prioritized table would then be distributed to the State Patrol as a guideline for scheduling enforcement. This would change as bridges are replaced or compliance improves, but the State Patrol would be focusing on the most critical areas first.

A Pavement Vulnerability Index could be generated in a similar

manner to the Bridge Vulnerability Index.

Link Hourly Violation Rates are another useful performance measure. This would amount to a simple count of all weight violations per link per hour of the week. These would be presented as 4-week moving averages to smooth the data and adjust for anomalies. The resulting table would then be sorted to establish targeted enforcement schedules. Historical reviews of this measure over a one year period could suggest seasonal trends that could be referenced to improve future enforcement schedules.

A link ESAL count would be useful to the Designers and Planners. This measure would be derived from the WIMs or estimated on a "similar link" methodology that is based on classification sites.

There are an unlimited number of other performance measures that could be created, but a few issues should be kept in mind as criteria for selection.

- Reports derived from the measure should result in a direct influence over someone's decision processes. (ex. enforcement schedules, planning priorities, operational refinements).
- The measure should be affordable to create and establish.
- The appropriate staff resources needed to support the creation and ultimate application of the measure.
- Ideally, automated processes should be established to collect and manipulate the data to generate reports.
- Mockup reports should be created early in the process and approved by all stakeholders prior to implementing a performance measure to insure that they are appropriate and will be used.

Actions needed

To insure a robust system that is self directing, the following actions are recommended.

1. Need to establish a base line for each measure if possible. If not, the baseline will need to be established over the early months of the implementation
2. Need to establish detailed report output content and format
3. Need to document Work Procedures for producing reports
4. Need to identify Q/A process for each measure to insure long term quality
5. Need a memo of commitment from receiving agencies as to the ultimate use of the measure
6. Need to schedule an annual Oversight Committee review date for each to see if the measure is still appropriate or if modifications are needed.

Baseline Compliance Strategies

This Plan recommends that the baseline data be established by analysing data collected from WIM stations for a period of twelve months after initial installation. During this period of time the WIM sites will not be used for enforcement purposes so as not to bias

the data, and true performance measures can be produced.

There are a number of additional strategies that could be applied to refine the performance measure baselines. They are listed below.

Another strategy for establishing baselines is to sample truck weights using fixed scales, available WIMs and short bursts of statistical random roadside enforcement. Short bursts are needed so as not to bias the data from CB transmissions. 24 hour WIM counts would not be affected by this phenomenon, however, as long as enforcement was not tied to the WIM counts. Portable WIMs can also be considered for baseline measurements.

Sampling can also be conducted using relevant evidence sites chosen based on a random sampling procedure of USDOT and license plate numbers observed along non-instrumented routes. This non-invasively captures the specific truck weights after the trips have been completed without a bias of the data caused by police presence. This does require a bit of detective work, but could be effective in locations with local trucks that repeat their trips frequently.

All of the above sampling could be conducted on a statistical sampling process that is predetermined. In-house statisticians or University of Minnesota staff might be enlisted to help put a plan together that determines sample sizes, random number selection tables, and hours of operation.

For those routes where instrumentation is not available, baseline values can be assumed that are based on similar routes that do have instrumentation or some means of measuring the parameter. This will be particularly true of the Trunk Highway Network.

Another approach to establishing a baseline is to simply begin the program of taking measurements and use a moving average as the baseline. While this does not provide historical values, it does quickly establish a baseline that can be used to compare with future measurements that can indicate when trends are occurring. This approach will not give any indication about the benefits of the initial countermeasures, but will be useful for future countermeasures or changes to existing practices after the baseline is established. Since the initial rollout of this program is likely to be modest and escalate over time, this might be a valid methodology for establishing some of the link baselines.

Compliance rate improvement measures

A discussion about performance measure baselines would not be complete without a brief discussion about countermeasures. The most obvious countermeasure is, of course, enforcement of any type and special "blitzing" enforcement details, but there are others as well, such as educational outreach, relationship building with carrier industry groups to promote self enforcement, programs for improving access to permits, data mining research to discover high probability carriers etc.

Part of the recommendations for this Strategic Weight Compliance Plan includes the development of an Oversight Committee. Developing countermeasures will be a major task for this committee, and this can be broken down into the following sub-tasks:

- Identifying problem areas that need improvement
- Creating potential countermeasure strategies
- Developing an implementation plan for each countermeasure strategy
- Developing an evaluation plan for measuring the impact of that strategy
- Implementing the plan and monitoring performance so that mid-course corrections can be made.

Organizational Changes

This section of the report addresses the organizational changes needed to facilitate this Strategic Plan. The intent is to achieve the goals of this Plan with the least disturbance to the existing organizational structures. This plan cuts across agency boundaries and requires a significant amount of coordination between the various stakeholder agencies. This is good in the sense that it distributes the burden and creates opportunities for cost saving integration of work processes. It is bad in the sense that it requires a high level of cooperation and support from agencies that have different missions and responsibilities.

Establish Oversight Committee

Although not specifically an organizational change, it is important that an effective Oversight Committee be created with representatives from the key stakeholders. To begin this process the Technical Oversight Committee for this Weight Compliance Strategic Plan could temporarily serve this purpose. Initial support from the administrators of these stakeholder agencies is needed in order for the Committee members to have the time and resources necessary to get the program started. Using the timeline, and recommended agenda suggested in this report, this Committee would begin promoting the various program elements.

The Oversight Committee is neutral in the sense that it has no direct authority over any agencies. It accomplishes its goals by promoting cooperation among the various member agencies to achieve synergistic benefits. This approach is effective because it does not require any substantial organizational restructuring. Momentum for the program is developed through successful early initiatives, real improvements (confirmed by performance measures) and the active support of the agency administrators who approved this Strategic Plan.

The functions of the Oversight Committee would include the following.

- Detailing a high level scope/schedule/budget for the program based on this Plan and a specific scope/schedule/budget for each phase of the deployment.
- Pursuing resources to implement the various deployment initiatives of the program.
- Developing the procedures needed to establish performance measures.
- Developing an effective yet affordable quality assurance program.
- Promoting the development of work procedures that integrate various operations, especially across agency boundaries.
- Continually updating agency administrators about the weight compliance program's progress, successes and failures.
- Identifying areas where research is needed and

pursuing projects to satisfy those needs.

- Keeping abreast of trends and legislative initiatives, and responding to those changes.
- Providing guidance for the outreach program
- Conducting routine forums or taking advantage of other venues to promote stakeholder communication and problem solving.

Create a Liaison Position

The single most important strategy for organizational improvement is the establishment of a Liaison who would serve as the champion/s for the weight compliance program. Besides chairing the Oversight Committee, this individual or team would facilitate coordination and communication among and between all the stakeholders. The Liaison would also serve as the quality control manager for the program to insure that all the action items directed by the Oversight Committee are completed effectively. This Liaison would become a point of contact for all outside entities seeking information about the program. Finally, this Liaison would also provide creative leadership for advancing the program as circumstances change. The details concerning salary, background requirements, level of effort (full or part time), who the individual/s should work for, funding source for the salaries, administrative support, and all other details concerning a this function would be developed by the Oversight Committee as their first official task.

Establish Regional Hubs

Establish regional hub functions at the Traffic Operations and Communication Centers would be an additional organizational change. Ideally, this function would be absorbed into the existing TOCC operations with only minor additions by reassigning tasks to existing personnel from Mn/DOT and SP. It is recommended that detailed work procedures be developed for the specific tasks related to TOCC functions in order to standardize the operations among all the TOCCs. This would best be accomplished if one TOCC would take the lead, under the direction of the Liaison, and develop these work procedures. They would then be shared by the other TOCCs as they come on line. Included in the list of procedures would be a weekly scheduling function, monthly performance measure reporting, local oversight of WIM maintenance work, processing of inspection reports (fixed, roadside and civil weight), and local training of enforcement officers and inspectors. Eventually there would also be a need for routine interaction with local transportation agencies to expand enforcement beyond the Trunk Highway System. The services of the TOCCs might also be expanded at some point to include a "one-stop-shop" service for carriers to acquire permits, pay taxes, and get questions answered.

Establish a Central Operator

As the Central Operating System becomes available there will be a need to the appropriate staff to perform the various functions. At first this would amount to one full time position working from a central position, such as Mendota Heights, to

administer the daily polling of WIM data, generating recommended enforcement trend schedules (statewide and regional), producing monthly performance measure reports, and drafting the annual report for the Oversight Committee. This person would also monitor the WIM scale "health" using the diagnostic strategies outlined in the Appendix of this Strategic Plan. From those diagnostic efforts, the individual would request WIM maintenance service and forward that to the State's contract manager as well as the appropriate TOCC operators for follow up inspection. This individual would answer to the Liaison who would make assignments as needed.

Identify Statistical Analysis Support

Because the WIMs and Counters will be multi-purpose field devices, there will always be a relationship needed between the Transportation Data Analysis Section and the other stakeholders. The effort will involve statistical analysis of the data based on work processes developed by the Liaison under the direction of the Oversight Committee. The staff labor required to produce the appropriate reports could come from any of the major stakeholders, including Mn/DOT CVE, Mn/DOT TDA, SP, Planning or one of the TOCCs. Ultimately much of this work would be automated, minimizing the effort.

Establish Quality Assurance Program

To sustain this program, it is highly recommended that a simple quality assurance program be developed by the Liaison. This program would not add staff, but would require the assignment of one or more individuals from Mn/DOT or the SP to conduct some simple routine audits on a quarterly basis. The level of effort would not be intensive, but would involve checking to see if particular tasks are being completed according to the work procedure schedule. For example, they might review the files to see if the weekly and monthly reports were delivered, or a review of the WIM maintenance work orders to determine the frequency and duration of WIM maintenance work, or the WIM downtime. This information would then be reported to the Liaison for discussion with the Oversight Committee to allocate resources for appropriate remedial action, if necessary.

Centralized Court

While it is understood that this would take significant legislative action, it is worth mentioning that a centralized court for adjudicating commercial vehicle violations has potential for improving the citation process. Below is a brief listing of some of these reasons that have been identified in other states.

- ✓ The assessment of fines becomes uniformly applied. This is often not the case, sometimes resulting in large differences in the actual fines levied for similar violations
- ✓ A centralized court more easily enables the State Patrol to identify repeat offenders.
- ✓ This system would lower overall operating expenses for the court system and would lighten the burden of the local court dockets.
- ✓ The court records would more easily enable the identification of regional, temporal and topical trends.

This information would be useful to the State Patrol, Mn/DOT and others.

- ✓ The court records from a single dedicated source such as a centralized court are much easier to summarize than the aggregated records of the entire local court network. This data is, in a real sense, a performance measure that can be used by the Oversight Committee to monitor the program, and to report to the State Legislature when called upon.

An alternative would be to change the weight laws to be all civil and to handle them through a simple administrative process. Another alternative would be to process them in a manner similar to the relevant evident cases that are handled in conciliation court. These ideas should be considered in the recommendation of the weight increase plan.

Relationships with the Counties

Currently the interaction with county officials occurs intermittently. Establishing an Oversight Committee, a Liaison position and a more formalized plan increases the chances for greater interaction and local involvement. These relationships can foster true win/win initiatives. The following suggestions are recommended to promote this interaction.

- Include county representation in the Oversight Committee.
- Expand the current local outreach to focus on counties that have the greatest compliance problems.
- Routinely deliver status reports to all counties via email.
- Invite all counties to an annual stakeholders' meeting.
- Seek opportunities at other venues to "recruit" participation, share information about recent changes, and seek input on weight compliance issues.
- Periodically schedule Liaison visits to counties that do not participate in order to promote their greater involvement.

Phased Migration Plan Timeline

For this plan to be useful it must be implemented in a timely manner. The table shown on the following pages suggests a sequence of phased tasks that would produce a reasonable migration schedule. The outwears portion of this table would be repeated indefinitely as a continuing annual program

Task	Task Details	Issues
	Phase 1	
Establish Oversight Committee	➢ Define committee mission, scope and schedule ➢ Meet monthly ➢ Select Liaison ➢ Establish sub committees… • Infrastructure Development • Performance Measures • Central Ops System • Quality Assurance • Outreach • Annual Report • Others on an as needed basis	✓ Include key agencies ✓ Include Federal agencies ✓ Incorporate industry involvement ✓ Chaired by Liaison
Establish Regional Hubs	➢ Define initial functions and prototype at one or two TOCCs ➢ Develop initial Hub work procedures	✓ Develop functions by utilizing as much existing resource as possible ✓ Monitor the burden to identify staff resource recommendations
Build database of weight enforcement program roadway links	➢ Develop layer in Mn/DOT features inventory	✓ Based upon IRC and HCADT systems ✓ Ultimate Central Operating will be built from the features inventory and will then produce periodic updates to the features inventory.
Develop a prioritized list of field equipment	➢ Includes listing and map of proposed WIM and classification sites. ➢ This “vision” of the completed equipment roll out will be revisited each year by the Oversight Committee. It will also become a reference for project programming.	✓ Needs will be based upon IRC and HCADT systems as a first pass ✓ Prioritization will be partially based on roadway/bridge rehabilitation program
Develop stakeholder MOU's	➢ Seek formal level of cooperation among stakeholders	✓ Determine commitment levels ✓ Identify what each agency needs ✓ Identify what resources each brings to the program ✓ Outline how information will be used ✓ Agree to Q/A program

Task	***Task Details***	***Issues***
Establish Central Operating System Pooled Fund Study	➢ Recruit pooled fund partners ➢ Submit proposal ➢ Secure project approval ➢ Select study consultant	✓ Each member state receives an unpopulated copy of the finished database ✓ Work product will include basic report formats ✓ Minnesota system is populated as a proof check
Complete Guidestar VWS demo	➢ Weight Compliance Oversight Committee = VWS Project Oversight Committee	✓ VWS demo is actually the first deployment by activating the 5 existing WIM sites into VWS enforcement sites
Initiate Infrastructure deployment	➢ Equip 5 existing sites for fundamental VWS enforcement ➢ Acquire 3 sidefire radar equipment applications	✓ Enforcement begins immediately upon activation ✓ Data can be shared with Planning ✓ Sidefire units to be used for field testing future WIM sites
Refine and target basic performance measures	➢ Identify specific measures ➢ Establish baselines ➢ Identify report content, format and reporting frequency	✓ Initial measures to correspond with WIM output data (gross, axle and bridge formula data) ✓ Also includes “hit” rate for inspections (# citations / # inspections)
Identify and commit operations and maintenance resources	➢ Identify resources for field device maintenance tasks ➢ ID central ops system location and staff ➢ Establish initial communication network from Mn/DOT's existing network ➢ Begin formal request for staff and budget	✓ Use a combination of Contract and in-house resources
Begin WIM level enforcement scheduling for enforcement	➢ Calibrate and update existing field devices ➢ Establish work procedures for routine "health" monitoring ➢ Develop work procedures and format for weekly schedule recommendation reports	✓ Includes… • WIMs • Counter/Classifiers
Establish Training Program	➢ Create basic training program for inspectors and law enforcement officers ➢ Create training for WIM data	✓

Task	***Task Details***	***Issues***
	quality checking	
Develop equipment standards	➢ Create procurement level documents that can be used as standards	✓ WIMs and peripherals ✓ Portable scales
Develop Official Inspection Sites	➢ Establish map and listing of sites to support each WIM ➢ Coordinate future sites with construction program	✓ Program new sites areas ✓ Incorporated into other existing sites
Establish Long Range Outreach Program	➢ Define all outreach elements and resources ➢ Conduct at one interactive workshop with carriers	✓ Pursue private industry involvement ✓ Pursue Peer-to-Peer support for interactive workshops

Phase 2		
Expand infrastructure deployment	➢ Construct 3 new WIM sites	✓ Locations must fit long range deployment criteria
Complete Central Ops system	➢ Complete Pooled Fund Study	✓ Populate database with Minnesota data
Refine performance report processes	➢ Assess value of current measures ➢ Initiate new measures as needed ➢ Begin producing routine reports	✓ Automate data collection to maximum extent possible to minimize labor costs
Initiate statewide weight enforcement scheduling system	➢ Begin using WIM data to suggest VWS enforcement schedules	
Pursue research assistance	➢ Expand performance measure report	✓ Develop statistically defendable process for measuring compliance on non-instrumented routes ✓ Utilize civil weight enforcement so as not to bias baseline measurements
Initiate Central Ops weight enforcement scheduling system	➢ Produce system wide schedule reports	✓ Reports suggest problem areas and statewide trends ✓ Regional Hubs then determine their final enforcement schedules accordingly
Oversight Committee	➢ Continue with monthly meetings during year 2 ➢ Revisit subcommittee structure and return on investment ➢ Begin formal monthly reporting ➢ Produce Year #1 Annual Report	✓ Review attendance and seek new representatives where needed
Establish Q/A program	➢ Assign Q/A tasks ➢ Develop Q/A work procedures	✓ Utilize existing personnel ✓ Minimize burden by keeping processes simple
Expand Research	➢ Identify and submit needed research concepts	

Phase 3		
Oversight Committee	➢ Change meeting schedule to every other month ➢ Revisit subcommittee structure and return on investment ➢ Produce Year #2 Annual Report	✓ Review attendance and seek new representatives where needed
Expand VWS infrastructure	➢ Construct 3 WIM sites ➢ Establish 3 mobile enforcement sites	✓ Construct WIM and Inspection sites as part of pavement rehab projects
Upgrade Central Ops system functions	➢ Expand functionality at TOCCs	✓ Automate processes when possible ✓ Include speed monitoring ✓ Add additional reports ✓ Include data mining of related databases
Expand Research	➢ Discover trends	✓ Seasonal ✓ Economic ✓ Commodity ✓ Pavement deterioration ✓ Profiled vehicles
Expand Outreach	➢ Conduct annual stakeholder workshop ➢ Begin using compliance data to focus outreach program	✓ Identify new trends and issues ✓ Develop action plans from workshops
Outyears		
Oversight Committee	➢ Change meeting schedule to quarterly ➢ Revisit subcommittee structure and return on investment ➢ Produce previous year's Annual Report	✓ Review attendance and seek new representatives where needed
Expand VWS infrastructure	➢ Continue constructing new WIM sites until vision is completed ➢ Replace/update existing sites as needed ➢ Monitor Compliance reports to modify infrastructure vision	✓ Continue constructing WIM and Inspection sites as part of pavement rehab projects
Expand Research	➢ Continually be alert for research needs to refine program	

	➢ Routinely request literature searches to keep abreast of related developments	
Expand Outreach	➢ Conduct annual stakeholder workshop ➢ Monitor attendance closely to identify changing needs ➢ Anticipate and respond to Legislative requests	✓ Identify new trends and issues ✓ Develop action plans
Refine processes	➢ Automate functions where possible ➢ Include data mining of related databases ➢ Consider adding other screening functions	✓ Infrared wheel/tire temperature detection ✓ Radiation detection ✓ Contraband detections ✓ Acoustic detection

Budget Issues

This section of the report addresses some of the issues concerning how the Weight Enforcement Compliance Program will be funded. It is important to recognize at the onset that the program is an integrated effort for several agencies; primarily this includes several Mn/DOT divisions, the Commercial Vehicle Enforcement Division of the State Patrol, the Federal Highway Administration, the Federal Motor Carrier Services Administration, and the trucking industry representatives. This distribution of benefits and responsibilities leads to the conclusion that the components of the program will need to be funded in different ways. These are outlined below.

Capital Improvement Program

The State's Capital Improvement program will be a major source of funding to get this program started. The bulk of the physical infrastructure needed for the weight compliance program will involve the deployment of WIM sites around the State. This will also include establishing the communications systems needed to continually monitor and operate these remote devices. It is recommended the Oversight Committee pursue a dedicated funding program from the Capital Improvement funds (similar to the program used in Florida) to be used for deployment and creating infrastructure.

Currently some of the fine revenue goes back to the Trunk Highway Funds based on a 3/8, 5/8 formula while 100% of the civil penalties goes into the Trunk Highway Fund. Ideally, a portion of these funds should be dedicated to advancing and sustaining the weight compliance program.

For the purposes of this Weight Compliance Program a first year cost estimate of $200,000 (derived from funds allocated for portable scales) would be used to install new or modify existing WIM sites. This is in addition to the funding already allocated for the Virtual Weigh Station demonstration project that will augment the existing 5 quartz WIMs so they can function as virtual weigh stations.

During subsequent years this Strategic Plan calls for an annual capital allocation of $250,000 to $350,000 to expand the system.

The development of the Central Operating System would be funded through a pooled fund approach in concert with several other states that are pursuing similar programs.

State Operations Funding

Operations funds would be the primary source for maintenance services, operations equipment, administrative labor and enforcement labor as described below. This would begin with funding for the Liaison position. During the first years of the program the operations funding would remain approximately as they are now. As the number of field devices increases additional operations funding will be needed for maintenance, calibration and communications. Conceivably these funds could come from lower operations costs derived by taking one or more fixed scale facilities out of service - should the Oversight Committee's research suggest that course of action.

Because labor resource funding of the Transportation Data Analysis (TDA) section is currently limited for analyzing data, it

is also recommended that their budget be increased with State operations funds to accommodate the increased load caused by monitoring and processing WIM and other data streams. An alternative would be to assign these tasks to someone from another Mn/DOT or SP division, with the raw data acquired and furnished by the TDA section.

Operations will need to spend resources on replacement equipment as the various equipment life cycles come to an end. This could also include minor deployments such as sidefire radar detectors, and planning counter/classifier sites. These costs cover installation, and labor to operate the units. The on-going communications costs will also need to be covered by State funds.

It may be possible to use these expenditures of State funds as in-kind matching funds for some federal funding programs in the future, particularly research initiatives.

Research funding might also prove to be a short term source for covering operations costs as an interim measure until a more permanent source is established. This investment is justifiable as research (and potentially eligible for Federal research funding) if it can be used to study new approaches that may improve infrastructure protection, improve safety, reduce air pollution or crash rates. All of these are potentially possible with the less disruptive and more comprehensive approach of Virtual Weigh Station enforcement along with the other strategies outlined in this Plan.

State Patrol Funds

It is anticipated that the existing staff of enforcement officers and inspectors will need to be expanded from the level that they are now because they are well below the level required to operate an effective program. Excessive amounts of scale downtime are obvious to the truck drivers who might then be tempted to run overweight. While the Virtual Weigh Station program is expected to change the operations at the fixed scales to some extent, it is important to recognize that the staff size needs to be a function of the compliance rate as determined by the performance measures. These metrics will gauge the effectiveness of any current program level and suggest a degree of change up or down to meet the demand but at the least cost.

If the Oversight Committee recommends that the Central Operating System should be staffed by the State Patrol, additional funding will be needed to cover those additional labor costs, or SP staff positions modified to cover the labor.

Initially the costs for the additional labor at the TOCCs are expected to be absorbed by the Mn/DOT and State Patrol TOCC budgets. The Oversight Committee will need to be alert to the burden this imposes on the TOCC staff, however, and to respond with additional resources both temporary and permanent as task levels increase.

Private Sector Funds

Private Sector support is expected to continue and advance the outreach program because it is in the carriers' best interests to

promote the exchange of information in the form of training and conferences. The reasons for this include the following:

- Weight regulations, both federal and state, are complex.

- New legislation frequently can generate a lot of questions and confusion as procedures change.

- Knowledge gained from the WIM data, enforcement documents, and data mining of related databases, can identify critical areas of compliance that need attention. Many times cooperation from the carriers can resolve this problem with the least amount of disruption to carrier operations.

- Smooth pavements and minimal interruptions of carrier operations by enforcement activities translate into cost savings for the carriers.

Because of these benefits it is anticipated that the industry groups might willingly participate by hosting training sessions presented by state and federal personnel. They could also participate in the hosting of interactive conferences between the private and public sectors in order to promote a better understanding of the problems and needs of both sides. Effective working relationships such as these are proven strategies for problem solving and optimizing benefits. This can also reduce the inclination to lobby for legislative changes or could refine these lobbying efforts to become more palatable requests.

It may also be possible to take advantage of the USDOT's Peer to Peer program to cover the transportation expenses of experts from around the country on specific topics of interest. This resource is a very affordable way to enhance the attractiveness of these interactive conferences.

Budget Tracking

Cost estimates for establishing a budget for the weight compliance program are complicated by the fact that the program is heavily integrated into other operations (Planning, TDA, enforcement etc.) Ultimately, the Oversight Committee will need to monitor and record the actual costs and benefits of this program in their annual report and other documents. It is the recommendation of this Strategic Plan that the weight enforcement program be promoted as a performance based program with funding tied to some measure of return on investment. Initially, funding levels would escalate as the infrastructure is deployed. With a close watch on compliance rates (performance measures) these funding levels would then fall back to maintenance levels with periodic investments in equipment upgrades, investments in research with the hope of improving processes, and adjustments to keep abreast of the increasing demands of the trucking industry.

The following component estimates are presented as a basis for developing a range of budgetary estimates.

Component	Budgetary Cost

Basic Quartz WIM scale (2 lanes)	$70,000
Vehicle imaging add-on to basic WIM	$40,000
Monthly communication charges per WIM	$100
Portable Sidefire Radar unit	$10,000
Mobile scale (trailer mounted)	$125,000
Portable scale	$3800
Annual cellular service per vehicle	$1500
New Fixed Scale site	$14,000,000
Inspection Site upgrade	$0 to $150,000 depending on the needs

Quality Assurance Plan

There is a growing trend among transportation agencies to base resource allocation on system performance; much like private industry has done for some time. Recognizing that this is a reasonable approach for allocating limited resources, and also recognizing that performance based funding is probably the only way that a new program can compete with long standing programs, it makes sense to promote weight compliance in this way. It then follows that a quality assurance system should be implemented to guarantee that the program is maintained at a high level or resources could be allocated at inappropriate levels. What follows are the key aspects of such a program.

Work Procedures

Under the immediate direction of the Liaison and guidance from the Oversight Committee, detailed work procedures would be developed for critical tasks. These are best developed by the end user or operator who performs the task and approved by the immediate supervisor or section head. To be truly effective, the official copies of these work procedures should be kept by a designated "librarian" who maintains a detailed log of the file copies including latest revisions, distribution lists, and end user assignments. This detailed log also references those other work procedures that are related to each other to insure that all procedures are updated when one is changed. A sample of a blank work procedure is included in the appendix as a reference. The Liaison determines if a task is critical enough to justify a work procedure, and requests that one be created when needed.

Quality Assurance Audits

While the term "audit" sometimes leads to negative reactions among personnel, it is important that some sort of routine inspection be conducted on a routine basis to insure that the tasks are being performed. This is not to say that the auditor is grading the work. They are simply verifying that the work was completed by an inspection of the paper trail. The quality of the work content is, and should always be under the direction of the employee's immediate supervisor. This simple auditing process is motivated by the fact that inter-agency processes often slow down or get low priority as personnel come and go, or as local agency priorities change.

The auditing process is detailed within each work procedure (described earlier) in regard to its frequency and what the auditor will be reviewing. It is also important that the auditing process be clearly defined in its own work procedure, and that the auditor is someone from a different department or at least by someone who is not directly responsible for the work product being reviewed. The auditor's work procedure will include directions for generating a routine report that would be delivered to the Liaison for review and then submitted to the Oversight Committee.

Stakeholder Memoranda of Understanding

MOU's are a useful tool for establishing a clear understanding of inter-agency roles and responsibilities. They define what an agency will contribute to the program and establish an agreement to produce those results. These agreements can be

written at whatever level of detail is appropriate, but should be high enough to enable some measure of flexibility for the end users. The primary advantage of these agreements is that they transcend time and individual careers. Past experience has shown that a program can languish if key personnel are changed out due to retirements; promotions etc. and the replacement personnel assume command with different priorities or are not clear about the program needs. These agreements insure continuity over time without infringing on the individual agencies' rights to renegotiate with the Oversight Committee when circumstances change. Also, to insure continuity it is a good idea to charter the Oversight Committee to conduct an annual review of the MOUs in an annual CVO enforcement forum.

Annual Stakeholder Workshops

Once a program is in place it is a good idea to conduct stakeholder workshops periodically to review and update this strategic plan, the organizational structure, the infrastructure, performance measures and work procedures. This is also an opportunity to strengthen inter-agency relationships and capture creative thinking that might advance the program. This differs from the annual CVO enforcement forum discussed above in that it is an official task of the Oversight Committee to conduct this review annually. It would be best if this review occurred prior to the Annual Stakeholder Workshop to help frame the workshop and incorporate current trends and changes into the workshop agenda.

Research Recommendations

The State of Minnesota is fortunate to have some outstanding transportation research resources. To capitalize on this resource the Oversight Committee can periodically submit research proposals on subjects that might lead to advancements for the weight compliance program. The list below suggests a few initial topics that might be appropriate candidates for research efforts in the area of weight enforcement.

Crash potential of overweight trucks

It is logical to assume that the stopping distances and acceleration rates of overweight trucks impair the drivers' ability to safely negotiate their vehicles during challenging circumstances, particularly when conflicts occur with the more nimble smaller vehicles. Exceeding vehicle design loads also increases the potential for sudden suspension system and drive train equipment failures.

If this assumption is true, then a methodology for assessing the additional costs to society for overweight trucks from a safety perspective ought to be possible. To aid in that effort, an archive of gross vehicle weights produced by a comprehensive network of WIM scales might provide a source of data that could then be correlated with heavy vehicle crash data to gain some insight into this issue.

Additional screening functions

The WIM cabinet and associated power supply and communication equipment provides a perfect field site for other sensors. Some additional functions might include speed monitoring to identify problem areas and selective enforcement schedules. Another function might be non-invasive infrared detection of the wheels and tires at highway speeds. Hot tires or cold brakes are a clear sign of trouble. Radiation detection equipment and contraband "sniffers" have also been proposed as a means for detecting illegal shipments of dangerous materials. Another function that might be appropriate would be the monitoring of mobile source emissions, particularly the presence of 2.5 micron particulates that have been linked to serious lung cancer risks. Diesel fuel is a major contributor of the 2.5 micron particulates.

Commodity Studies

Commodity movements will change over time and it is a good idea to periodically conduct studies that identify changing trends and predict likely changes in shipping patterns. This information would be useful to the Oversight Committee when they develop their annual plan.

Extrapolations of compliance factors to non-instrumented roadways

It is highly unlikely that Minnesota will ever have enough resources to instrument every roadway link in their network. To get a better idea of the compliance rates on non-instrumented roadways, a methodology needs to be developed that provides a statistically sound sampling of roadside enforcement. Instead of inspecting trucks on these routes based on the inspector's opinion, they would be based upon a pre-determined sampling directive. While these inspection details are being conducted, portable equipment could be operating to capture the vehicle volume and classification data. Researchers routinely design

such studies, which include determining appropriate sampling sizes as well as the random selection procedure for picking candidate trucks for inspection. In Minnesota these inspections could be accomplished as relevant evidence inspections rather than roadside inspections that detain vehicles. The roadside portion of the work would simply involve capturing the truck identification information for the selected vehicles and then conducting the civil enforcement inspection within the 14 day window. Further correlation of the data with regional commodity movements, weather data and seasonal timing could lead to some good compliance estimates for these non-instrumented roadways.

Database research

Universities have at their disposal sophisticated software that can be applied to large and/or multiple databases for the purpose of identifying patterns. By allowing the software to search with multiple degrees of freedom it is sometimes possible to identify patterns that are not obvious to a human observer. These “fishing expeditions” can potentially uncover data relationships that might be exploited to produce better predictions for selective enforcement programs, risk factors for predicting times and locations when crashes are more likely to occur, or profiles of vehicle types that are more likely to have defects.