

**REPORT TO THE GENERAL ASSEMBLY ON
REMOTE SENSING OF VEHICLE EMISSIONS IN VIRGINIA**

October 1, 2003

Virginia Department of Environmental Quality

EXECUTIVE SUMMARY

Background

This report has been prepared in response to Item 383 of the 2003 Budget Bill, which has the following provisions:

C. The Department of Environmental Quality is authorized to use up to \$300,000 each year from the Vehicle Emissions Inspection Program Fund to implement the provisions of Chapter 710, Acts of Assembly of 2002, which authorizes the Department to operate a program to subsidize repairs of vehicles that fail to meet emissions standards established by the Board when the owner of the vehicle is financially unable to have the vehicle repaired.

F.1. The Department of Environmental Quality shall initiate, beginning January 1, 2004, a program for on-road testing of motor vehicle emissions pursuant to § 46.2-1178.1, Code of Virginia, in all areas designated nonattainment for the 1-hour ozone air quality standard as of January 1, 2003. The Department shall develop a plan for implementation of this program and shall include a schedule to phase in on-road testing to enhance the current emissions inspection program, consistent with the federal Clean Air Act.

2. The Department shall also develop a plan to implement a program for on-road testing of motor vehicle emissions pursuant to § 46.2-1178.1, Code of Virginia, in all areas designated nonattainment for the 8-hour ozone air quality standard as of July 1, 2004. This plan may also include on-road testing of emissions in areas that opt into Early Action Compacts for ozone and jurisdictions that are contiguous to designated ozone nonattainment areas. The plan shall include recommendations as to any amendments necessary to the Code of Virginia to implement and provide adequate funding for the program.

3. The Department shall work with the U.S. Environmental Protection Agency to secure approval of on-road sensing to enhance the current emissions inspection program and shall identify any barriers to such approval.

4. In completing these plans and implementing the provisions of subparagraph 1, the Department is authorized to expend such funds as may be required from the Vehicle Emissions Inspection Program Fund. In completing these plans, DEQ shall contract with a private sector vendor which has experience in remote vehicle emission testing.

5. The Department shall provide these plans to the Governor, the Chairmen of the House Agriculture, Chesapeake and Natural Resources, Appropriations, Science and Technology and Transportation Committees and the Senate Agriculture, Conservation and Natural Resources, Finance and Transportation Committees, and the Joint Commission on Technology and Science by October 1, 2003.

The Virginia Department of Environmental Quality (DEQ) has determined that the use of remote sensing devices (RSD) is the only cost effective means of performing “on-road testing” of motor vehicles. Remote sensing has been included in the Virginia State Implementation Plan (SIP) revisions submitted to EPA. DEQ plans to use remote sensing as a supplement to the existing vehicle emissions Inspection and Maintenance (I/M) program in Northern Virginia and is considering using remote sensing as the foundation of a new emission test program in proposed new “8-hour ozone standard” nonattainment areas.

Currently, gasoline powered vehicles up to 10,000 pounds gross vehicle weight rating that are registered in the Northern Virginia I/M area are required to pass (or receive a waiver) an emissions inspection every two years before the vehicle can be registered. The I/M test consists of emission control component checks and a tailpipe test, either the acceleration simulation mode (ASM) test or the two-speed idle (TSI) test, depending on vehicle model year, type and drive train configuration. DEQ plans to implement a new testing procedure, the on board diagnostic (OBD) test, for certain vehicles in 2004.

Plan for Using Remote Sensing Devices (RSD) in the Existing I/M Area

DEQ plans to use remote sensing device (RSD) technology to improve the effectiveness of the existing I/M program operating in Northern Virginia beginning January 2004. A remote sensing program in the Northern Virginia I/M area will accomplish the following:

- Identify high-emitting light duty vehicles operating in the program area for out-of-cycle “confirmation testing” and subsequent repair;
- Identify vehicles operated primarily in the I/M area that have not undergone an emissions inspection at a Virginia DEQ-permitted Emissions Inspection Station; and
- "Clean screen" very clean vehicles, verifying that these vehicles are emitting significantly less than allowable limits, potentially postponing their next regularly scheduled biennial emissions inspection test.

The Northern Virginia remote sensing program will have the following elements:

- Remote sensing tests will be performed on a year round basis at a variety of sites in the Northern Virginia I/M area. DEQ estimates that 600,000 vehicles per year would be tested at the level currently budgeted for data collection.
- DEQ's current vehicle information database (VID) contractor will compile the RSD results into a database. The VID contractor would then analyze the database to identify vehicles that have been seen with excessive emission readings, and those seen with very clean emissions.
- Using lists of vehicles provided by DEQ's VID contractor, and vehicle owner information from DMV, DEQ will notify vehicle owners that their vehicles have been observed to have high emissions. These vehicles must receive a confirmation emission test at an official DEQ I/M station. Both in program area and out of program area vehicle owners would be notified. Out of program area vehicles would be limited to those that appear to

be “operating primarily” in the Northern Virginia I/M area, based upon RSD observations.

- Using lists of vehicles provided by DEQ's VID contractor, and vehicle owner information from DMV, DEQ will notify vehicle owners that their vehicles have been observed to have very low emissions, and that their next periodic I/M test may be postponed.
- The basic remote sensing program in Northern Virginia is estimated to cost \$300,000 per year for data collection. It is estimated to reduce hydrocarbons (HC) and oxides of nitrogen (NOx) emissions by over 350 tons per year in addition to the existing I/M program benefits.

Regulations establishing standards for remote sensing have been developed and have been approved by the Air Board. DEQ plans to release a request for proposals (RFP) in October of 2003 to secure an RSD contractor to begin collecting RSD emissions data in January of 2004. Initially owners of high polluting vehicles would be advised only that their vehicle was observed as a high polluter. After identification and notification procedures are working smoothly, vehicles observed as high emitters would be subject to confirmation testing and repairs if needed.

Plan for Using Remote Sensing in Future Designated 8-Hour Ozone Nonattainment Areas

Several areas in Virginia are likely to be designated as nonattainment for the 8-hour ozone standard. DEQ must develop a state implementation plan (SIP) to show how it would bring these areas into compliance with the ozone standard. One of the strategies under consideration is to identify high emitting vehicles and require that they be repaired. DEQ is considering using remote sensing devices (RSD) in combination with OBD testing as the method to identify these high emitters. Vehicles identified as high emitters by remote sensing would then be subjected to a confirmation test to confirm that the vehicle is indeed a high emitter, or that the problem causing it to be a high emitter has been corrected.

Using remote sensing to identify high emitting vehicles can significantly improve the cost effectiveness of an emission test program in new ozone nonattainment areas. As an example, DEQ evaluated using remote sensing as the basis of an emission test program in the Richmond area, which is expected to be nonattainment for the 8-hour ozone standard. The recommended remote sensing based inspection and maintenance (I/M) program in Richmond would have the following elements:

- All 1996 and newer vehicles would receive a biennial on-board diagnostic (OBD) test at OBD-only testing facilities.
- RSD would be used to identify high emitting vehicles, primarily 1995 and older model vehicles, that would then be subject to a confirmation tailpipe ASM or TSI test at an authorized test facility.
- RSD equipment would be set up and operated throughout the Richmond nonattainment area on a year round basis. Three remote sensing vans would be needed to obtain valid measurements on 80% of the vehicle fleet for an annual cost of \$900,000.
- The RSD contractor would send DEQ's VID contractor test results that would then be compiled into a database.

- The VID contractor would identify vehicles meeting DEQ's high emitter criteria. DEQ would then notify vehicle owners that they must obtain a confirmation test at an authorized test facility.
- DEQ would license confirmation test facilities to test vehicles identified by RSD as being high emitters. Approximately 6 ASM/TSI test facilities would be needed in the Richmond area to perform approximately 21,000 confirmation tailpipe tests in 2007.
- DEQ would license OBD-Only test facilities to test all 1996 and newer vehicles. Approximately 48 OBD-Only test facilities would be needed in the Richmond area to perform approximately 300,000 OBD tests in 2007.
- The program is estimated to reduce HC and NOx emissions in the Richmond area by 2,100 tons in 2007.

Based on the analysis of a remote sensing based emission test program in the Richmond area, DEQ projected the number of confirmation test facilities needed, number of vehicles tested and emission reductions for all the new 8-hour ozone areas.

Number of Stations Needed, Number of Vehicles Tested and Estimated Emission Reductions for Recommended Option (Option 3) in 8-Hour Ozone Nonattainment Areas in 2007

8-Hour Area	# of Confirmation ASM/TSI Test Facilities (could also do OBD tests)	# of OBD-Only Test Facilities	# of Vehicles Receiving Tests (Confirmation & biennial OBD)	Emissions Reductions Tons per Year (HC+NOx)
Roanoke	2	13	86,476	584
Frederick/ Winchester	1	6	39,486	267
Fredericksburg	3	17	117,399	793
Richmond	6	48	324,710	2083
Hampton Roads	8	64	438,403	2960

Plan to Secure Additional Emissions Reduction Credit

DEQ believes the EPA model for calculating emissions reductions may underestimate the effectiveness of both the current Virginia program and the additional remote sensing components discussed here. DEQ plans to present program data, along with data from the 2002 RSD study to EPA in order to support additional emissions reduction credits.

Low Income Repair Assistance

Section C. of the 2003 Budget bill requires DEQ to implement a program to subsidize the repair of vehicles that fail to meet remote sensing emissions standards established by the Board. Vehicle owners may apply to DEQ for repair assistance. DEQ would contact the Department of Social Services (DSS) to determine if applicants are eligible for assistance according to income level criteria provided by DSS. If eligibility criteria are met, DEQ I/M staff would review application records, including repair receipts, and would notify DEQ's Office of Accounts Payable of the amount of subsidy to be sent to the owner. A check would be mailed within 14 days from the notification to Accounts Payable. Currently, \$300,000 per year is authorized for repair assistance (including administrative costs).

Recommendations

The following is a summary of recommendations concerning legislative changes that would enhance the use of remote sensing in Virginia:

New program areas:

- DEQ recommends that emission test programs for new 8-hour ozone nonattainment areas use RSD as a way of identifying high emitting vehicles, primarily 1995 and older, that then must receive ASM/TSI tests. All 1996 and newer vehicles would receive biennial OBD tests. DEQ plans to work with EPA to secure additional emissions reduction credits for this program.

Enforcement:

- Currently, DEQ will have to enforce the remote sensing program through a monetary penalty imposed through the court system. Since the maximum penalty is \$620, it is unknown if collection of this fee would be a priority for collection from the Office of Attorney General. Program enforcement may be more effective if DEQ coordinated with DMV to identify out of compliance vehicles by utilizing the current process used in the Northern Virginia Inspection and Maintenance program. DEQ will work with DMV to explore effective, low-cost enforcement options. Legislation will be required to implement this change.

Northern Virginia area program funding:

- The current budget for the basic remote sensing program in Northern Virginia is \$300,000. Additional funding may be needed if an expanded program is needed to further reduce emissions or if more repair assistance will be provided to citizens. Additional funding could be obtained by charging all motorists an additional fee. Another option would be to collect a fee from vehicles opting to be clean screened in lieu of a visit to a testing station. These funds could then help defer some of the costs associated with running the RSD system. Funding would also be available to increase low-income repair assistance. Currently, DEQ does not have legislative authority to collect clean screen fees. DEQ recommends operating the high emitter identification program for one year in order to determine whether larger scale remote sensing would be cost effective and to assess how many vehicles would be clean screened.

New area program funding:

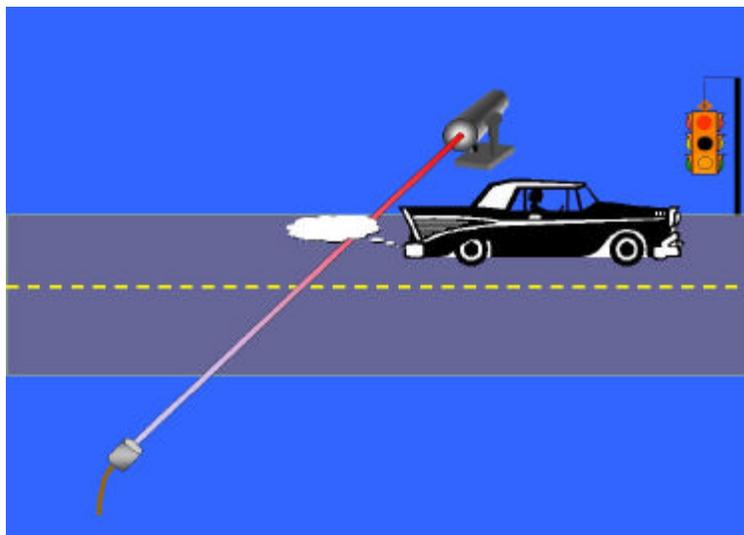
- If emission testing and remote sensing programs are to be implemented in 8-hour ozone nonattainment areas, additional funding will be required. Funding for this new program could be obtained using one of the following options:
 - A fee charged for each registered vehicle per year to cover remote sensing operations and administration, with inspection test fees (both biennial OBD tests and confirmation tests) paid by the vehicle owner to the inspection station
 - A fee charged for each registered vehicle per year to cover both remote sensing administration and confirmation tests. DEQ would reimburse inspection stations on a per test basis.

1.0 INTRODUCTION

Remote sensing has been included in the Virginia State Implementation Plan (SIP) revisions submitted by the Virginia Department of Environmental Quality (DEQ). DEQ plans to use remote sensing as a supplement to the existing emission test program in Northern Virginia. In addition, DEQ is considering using remote sensing as the foundation of a new emission test program in recently designated ozone nonattainment areas. This document presents plans for implementing the use of remote sensing devices (RSD) in the Northern Virginia vehicle emissions Inspection and Maintenance (I/M) program and new 8-hour ozone nonattainment areas.

What are Remote Sensing Devices (RSD)?

Remote sensing devices measure vehicle emissions remotely by passing an infra-red or ultra-violet light beam across a highway to a source detector. When a vehicle passes through the light beam, the changes in the intensity of the transmitted light indicate the concentrations of the exhaust gases being monitored. The source detector measures absolute concentrations of hydrocarbons (HC), carbon monoxide (CO), nitrogen oxide¹ (NO), and carbon dioxide (CO₂) in the diluted exhaust. From these measurements, exhaust concentrations of HC, CO, and NO in the undiluted exhaust are calculated. RSD offers the opportunity to obtain a large number of vehicle emissions measurements quickly and in a relatively non-intrusive manner.



¹ The nitrogen oxide that is emitted by the vehicle is rapidly converted in the atmosphere to nitrogen dioxide (NO₂). Collectively NO and NO₂ are measured as oxides of nitrogen (NO_x), which is a pollutant subject to EPA ambient air standards.

RSD systems include a camera module that takes a picture of the license plate of each vehicle. The vehicle data file contains emission results, pictures of the back of the vehicle, along with speed and emissions data.



Report Organization

The following Section 2 presents details on DEQ's plans for using remote sensing devices in the Northern Virginia Inspection/Maintenance (I/M) area. Section 3 presents a discussion of different options for using remote sensing as the basis for a new emission test program in new 8-hour ozone nonattainment areas. The cost and emission reductions for different emission test options are compared using the Richmond area as an example. A program to provide financial assistance to low income vehicle owners is discussed in Section 4.

2.0 PLAN FOR REMOTE SENSING IMPLEMENTATION IN THE EXISTING NORTHERN VIRGINIA I/M AREA

DEQ plans to use remote sensing devices (RSD) in the Northern Virginia I/M area, beginning January 2004. RSD would be used to enhance the effectiveness of the existing I/M program by doing the following:

- Identifying high emitting vehicles within the I/M area that may have received inadequate repairs or undergone catastrophic emission control system failures, thus requiring repairs in between normal inspection cycles.
- Identifying high emitting vehicles that are registered in Virginia, but outside the Northern Virginia I/M area and that operate primarily within the program area. These vehicles must be brought into compliance with I/M standards.
- Identifying very clean vehicles within the I/M area that have much lower than average emissions, potentially postponing their next regularly scheduled biennial emissions inspection test.

Regulations establishing standards for remote sensing have been developed and have been approved by the Air Board. DEQ plans to release a request for proposals (RFP) in October of 2003 to secure a RSD contractor to begin collecting RSD emissions data in January of 2004. Initially owners of high polluting vehicles would be advised only that their vehicle was observed as a high polluter. After identification and notification procedures are working smoothly, vehicles observed as high emitters would be subject to confirmation testing and repairs if needed.

2.1 Process for Using Remote Sensing Devices (RSD) to Identify High Emitters

The RSD program in Northern Virginia would have the following elements:

1. Collection of RSD Emissions Data;
2. Processing Data and Identification of High and Low Emitters; and
3. Notification of vehicle owner.

2.1.1 Collect RSD Data – RSD Emissions Contractor

Every week, the RSD contractor would provide DEQ with RSD emission results matched with a vehicle plate. The RSD contractor would be responsible for removing any invalid records, along with records taken outside of the acceptable vehicle specific power² (VSP) range.

² Vehicle specific power is a means of determining if a vehicle may be operating under conditions such as high accelerations that cause erroneous RSD readings.

2.1.2 Store and Process RSD Data – Vehicle Information Database (VID) Contractor

DEQ’s current Vehicle Information Database (VID) contractor would establish a data system to store and analyze the RSD emissions data along with vehicle and other data. The specific requirements of the data system are listed below:

- Store RSD emissions and license plate data;
- Store vehicle identification information;
- Apply failure criteria according to DEQ regulations to identify high emitting vehicles that:
 - Are registered in Virginia
 - Exceed High Emitter Cutpoint for at least one pollutant
 - Meet High Emissions Index³ (HEI) criteria
 - Have more than 3 months until the next regularly scheduled emissions test
- Store results of confirmation tests performed on vehicles identified as being high emitters.

2.1.3 Notify High Emitters Registered in the I/M Area – DEQ

The VID contractor will use the data system to identify vehicles that must receive confirmation tests. The VID contractor will provide weekly lists of high emitters to DEQ. DEQ will obtain owner name and address information from DMV. DEQ will send out notices to vehicle owners. Notification procedures will be specifically developed for the following:

- Owners of high emitting vehicles that are registered in the I/M area;
- Owners of high emitters that are registered outside the I/M area, but have been observed to “primarily operate” in the I/M area; and
- Vehicle owners that do not comply with the requirement to receive and pass a confirmation test (or receive a waiver) within 30 days would be subject to a monetary penalty according to the severity of their emission levels. *Currently, DEQ will have to enforce the remote sensing program through a monetary penalty imposed through the court system. Since the maximum penalty is \$620, it is unknown if collection of this fee would be a priority for collection from the Office of Attorney General. Program enforcement may be more effective if DEQ coordinated with DMV to identify out of compliance vehicles by utilizing the current process used in the Northern Virginia Inspection and Maintenance program. DEQ will work with DMV to explore effective, low-cost enforcement options. Legislation will be required to implement this change.*

³ The HEI indicates the relative ranking of a vehicle within a model year group based upon the average failure rate of vehicles with similar combinations of year, make, number of cylinders, and engine sizes. The HEI will be based upon Virginia ASM, OBD and TSI test results.

2.1.4 Perform Confirmatory Tests

DEQ will use existing official emissions inspection stations to confirm that vehicles identified by remote sensing as being high emitters are indeed high emitters and are repaired to correct the emissions problem. High emitting vehicles identified by RSD must pass an ASM⁴ or TSI⁵ emissions test and possibly an OBD⁶ inspection, depending on vehicle model year, type and weight, or receive a waiver at a licensed inspection station.

2.2 Clean Screen in Existing I/M Area

DEQ's I/M regulation currently has provisions for allowing vehicles to be clean screened. Vehicles that are observed multiple times as having low emission rates would be given the opportunity to postpone their next regularly scheduled emissions inspection test. The following specific issues must be resolved by DEQ with regard to a clean screen program:

- **Scope of the clean screen program.** The number of vehicles clean screened will be limited to not more than the number of confirmation tests for high emitters identified by RSD. The I/M regulation caps the percent of vehicles that can be clean-screened to 5% of the fleet. *Expanding the number of vehicles clean screened could jeopardize the emission reductions needed as well as reduce existing emission inspection station revenue.*
- **Cost to vehicle owners to take advantage of the clean screen option.** In other states such as Missouri, the clean screen fee is the same as the inspection fee. The perceived convenience of clean screen justifies this cost. *Virginia could adopt a similar fee structure for its clean screen program. The clean screen program would then help defer some of the costs associated with running the RSD system. This would allow DEQ to expand the scope (number of observations collected) of the RSD program. Clean screen fees also could be used to enhance funds for low-income repair assistance. Currently, DEQ does not have legislative authority to collect clean screen fees.*

2.3 Costs

The basic Northern Virginia RSD data collection is estimated to cost a minimum of \$300,000, based on the cost for the Virginia Pilot RSD study conducted in 2002. This study provided 15

⁴ ASM: Acceleration Simulation Mode test where vehicles are driven at 15 and 25 mph under simulated highway loads. HC, carbon monoxide (CO) and NOx emissions are measured. Vehicles 1981 and newer and up to 8,500 pounds gvwr are subject to the ASM test, except for vehicles with full time traction control or 4-wheel drive.

⁵ TSI: Two-speed idle test where vehicles are tested at idle and high idle (2500 rpm) conditions. HC and CO emissions are measured. Vehicles older than 1981 or greater than 8,500 pounds gvwr receive a TSI test

⁶ OBD systems were mandated by the US EPA to help technicians diagnose and service the computerized engine management systems of modern vehicles. OBD systems monitor all components that make up the engine management system. They can detect malfunctions or deterioration of these components usually well before the vehicle owner becomes aware of any problem. When a problem that could cause a significant increase in emissions is detected, the OBD system turns on a dashboard warning light to alert the driver of the need to have the vehicle checked by a repair technician. All 1996 and newer vehicles use the same type of connector, use common computer "languages" and use the same criteria for evaluating the powertrain systems and indicating problems to the driver and the repair technician. The OBD inspection consists of checking the results of the self-tests that have occurred while the vehicle was driven **before** the time of inspection. Vehicles failing remote sensing would have to pass both a tailpipe test (ASM or TSI) and an OBD test as part of the confirmation test.

RSD van-months⁷ over a 10 month period and resulted the 680,000 valid RSD measurements on 597,000 unique vehicles.

2.4 RSD Emissions Impact

A Northern Virginia RSD program is predicted to identify approximately 12,000 vehicles per year that have serious emissions problems and must be repaired. This is estimated to reduce hydrocarbon and oxide of nitrogen emissions by 368 tons per year, using the EPA model MOBILE6⁸. In addition, the mere presence of the remote sensing program would encourage vehicle owners to correct emission related problems before their next scheduled I/M test. Allowing up to 5% of the fleet to be clean screened would have a small adverse impact on the emissions benefits of the Northern Virginia I/M program.

DEQ also is investigating the possibility of claiming additional credit for the current I/M program (without remote sensing) based on RSD data from I/M and non-I/M areas in Virginia that indicated the emission reductions for the current Northern Virginia I/M program were much greater than MOBILE6-estimated benefits.

⁷ A van-month is one RSD van operated for one month.

⁸ MOBILE6 is the EPA mobile source emission factor model. Typically MOBILE6 is used to estimate the impact of mobile source control programs. However, MOBILE6 does not yet have the ability to directly estimate the impact of using remote sensing to enhance the effectiveness of an existing I/M program. Therefore, DEQ estimated the impact based on the number of additional vehicles that must be repaired because they are identified as high emitters.

3.0 PLAN FOR USING REMOTE SENSING TESTING AS PART OF A COMPLIANCE STRATEGY FOR NEW AREAS IN VIRGINIA THAT EXCEED THE 8-HOUR OZONE AIR QUALITY STANDARD

EPA has recently established a new air quality standard for ozone that requires states to meet an 8-hour ozone standard, in addition to the one-hour ozone standard. Several areas in Virginia⁹ that currently meet the one-hour standard will be designated nonattainment for the new 8-hour ozone standard. DEQ is considering using remote sensing to help identify high emitting vehicles that are operated in new areas that are nonattainment for the 8-hour ozone standard. DEQ is considering several options for a RSD based program in the new nonattainment areas. Following is a discussion of different options and how they compare from a cost and emission reduction standpoint. The Richmond area is used as an example.

3.1 Options for Emission Test Programs in New Ozone Nonattainment Areas

The following options for an emission test program in new ozone nonattainment areas were evaluated:

- **Option 1: ASM/TSI or OBD Tests for all.** This option would be identical to the current Northern Virginia I/M program. With this option, all OBD equipped vehicles (i.e., 1996 and newer models less than 8,500 pounds GVWR powered by gasoline) would get biennial OBD inspections. All remaining vehicles would get biennial ASM or TSI tests. RSD would be deployed to identify additional high emitting vehicles.
- **Option 2: RSD Screened Vehicles Only.** Only vehicles identified as high emitters by RSD would receive confirmation tests. ASM or TSI tests would be used as confirmation tests for high emitting pre-1996 vehicles while high emitting 1996 and newer vehicles would also get an OBD test.
- **Option 3: OBD for all 1996 and newer vehicles + RSD screening for pre-1996 vehicles.** With this option, all OBD vehicles would get biennial OBD inspections. High emitting 1996 and newer vehicles would also be subject to remote sensing. Remaining vehicles (pre-1996) would get ASM or TSI tailpipe tests only if they are identified as high emitters by RSD.

3.2 Estimated Costs of Program Options

The costs of the different emission test program options consider the following cost elements:

- **Vehicle Inspection Fee.** The fee considers the following:
 - **Vehicle test equipment.** Cost of OBD analyzer systems and exhaust emission test systems to perform the ASM or TSI inspection.
 - **Inspection labor.** Labor cost incurred to perform the required inspection.

⁹ Proposed new 8-hour ozone nonattainment areas include the Richmond, Roanoke, Hampton-Roads, Frederick County/Winchester and Fredericksburg areas.

- **Inspection data collection.** Cost to collect and transmit inspection data to a DEQ database.
- **DEQ oversight and enforcement.** Cost to analyze reports, audit inspection stations, and evaluate the inspection program.
- **Remote sensing labor and equipment.** Cost incurred to collect, compile and process remote sensing data.
- **Vehicle repairs.** Cost to repair vehicles failing the inspection.

Costs for the different options assume that decentralized inspection facilities would be licensed to perform inspections in the Richmond area. The total number of inspection facilities for the different options in 2007 is presented below:

- **Option 1: ASM/TSI or OBD Tests for all: approximately 80 ASM/TSI/OBD Stations** (Each station can perform all tests)
- **Option 2: RSD Screened Vehicles Only: approximately 11 ASM/TSI/OBD Stations** (Each station can perform all tests)
- **Option 3: OBD for all 1996 and newer vehicles + RSD screening for pre-1996 vehicles: approximately 48 OBD-Only Stations and 6 ASM/TSI/OBD Stations** (some stations would be able to perform only OBD tests)

Options 2 and 3 that involve RSD screening reduce the number of inspection facilities that would be needed as compared to Option 1.

Total Annual Costs

Table 3-1 presents the total annual costs for the three emission test options.

**Table 3-1
Annual Costs for Emission Test Options in Richmond**

Year	1. ASM/OBD all	2. RSD Screened Vehicles Only	3. OBD + RSD screening with ASM
2005	\$17,244,740	\$5,963,410	\$11,222,174
2007	\$14,857,943	\$4,845,769	\$11,058,472
2010	\$12,510,681	\$3,718,680	\$10,983,859

Option 2 is the least expensive, followed by Option 3. In 2007, for example, Option 3 costs almost \$4,000,000 less than Option 1. Cost savings result from concentrating inspections and repairs on the highest emitting vehicles, thereby reducing the number of vehicles tested and the total number of vehicles repaired.

3.3 Emission Reduction Estimates

Emission reduction estimates are based on MOBILE6 with appropriate adjustments for the percent of excess emissions identified in the group failing the RSD screening criteria. The percent of excess emissions identified is based on the results of the Northern Virginia Remote Sensing Study conducted in 2002. Following is a discussion of how emission reductions are estimated for each option.

- **Option 1: ASM/TSI or OBD Tests for all.** Emission reductions for the ASM/TSI/OBD option are based on MOBILE6.
- **Option 2: RSD Screened Vehicles Only. OBD and ASM/TSI tests used for high emitter confirmation.** The emission reductions for this option were estimated as follows:
 - MOBILE6¹⁰ was used to estimate the emission reductions for the OBD and ASM testing components, assuming they apply to 100% of the fleet.
 - The Northern Virginia Remote Sensing study was used to establish the percent of excess emissions contained in the group of vehicles that failed RSD screening cutpoints. The percent excess emissions identified was calculated for the following groups:
 - pre-1996 vehicles that receive the ASM test if they fail RSD criteria; and
 - 1996 and newer vehicles receive the OBD test if they fail RSD criteria.
 - Total emission reduction credits were based upon the percent excess emissions times the MOBILE6 credit.
- **Option 3: OBD for all 1996 and newer vehicles + RSD screening for pre-1996 vehicles.** The emissions reductions for this option were estimated as follows:
 - MOBILE6 was used to estimate the emission reductions for performing OBD tests on all 1996 and newer vehicles and ASM or TSI tests on all pre-1996 vehicles.
 - The results of the Northern Virginia Remote Sensing study were used to estimate the percent of excess emissions identified among the 1995 and older models.
 - Total credits were calculated by assuming the program receives 100% of the MOBILE6 credit for OBD vehicles plus MOBILE6 credit for the ASM or TSI test times the percent of excess emissions identified.

¹⁰ MOBILE6 does not provide for modeling both a tailpipe test and OBD together. DEQ plans to work with EPA to secure additional emissions reduction credit than the model provides.

Total Annual Emission Reductions

Table 3-2 presents the total emission reductions for the three emission test options, based on the above assumptions.

Table 3-2
Annual Emissions Reductions (HC + NOx Tons/Yr¹¹) for
Emission Test Options in Richmond

Year	1. ASM/TSI/OBD	2. RSD screen for ASM/TSI/OBD	3. OBD + RSD screen for ASM/TSI
2005	2,707	1,513	2,056
2007	2,583	1,399	2,083
2010	2,462	1,257	2,196

Option 1 yields the greatest emissions reductions while Option 2 yields the least.

3.4 Cost-Effectiveness

Cost-effectiveness was calculated in terms of dollars per ton of HC + NOx reduced. Total annual cost based on a 5-year equipment life was divided by total annual emission reductions to calculate dollars per ton of HC + NOx reduced. Results are presented on Table 3-3.

Table 3-3
Cost Effectiveness (\$/ton HC+NOx) of Emission Test Options in Richmond

Year	1. ASM/TSI/OBD	2. RSD screen for ASM/TSI/OBD	3. OBD + RSD screen for ASM/TSI
2005	\$6,371	\$3,940	\$5,457
2007	\$5,752	\$3,464	\$5,309
2010	\$5,081	\$2,967	\$5,010

Option 2 is the most cost effective while Option 1 is the least cost effective. Option 3 may offer the best compromise between emission reductions and cost effectiveness.

3.5 Recommended Emission Test Strategy for New 8-Hour Ozone Nonattainment Areas

Based on total emission reductions and cost per ton of HC+NOx reduced, DEQ recommends that emission test programs for 8-hour ozone areas be patterned after Option 3. With this option, RSD would be used to identifying high emitting vehicles 1995 and older vehicles that

¹¹ Emission reductions are calculated for a typical summer day, but are reported in terms of tons per year.

then must receive ASM/TSI tests. All 1996 and newer vehicles would receive OBD tests. DEQ plans to work with EPA to secure additional emissions reduction credits for this program.

Based on the analysis of a remote sensing based emission test program in the Richmond area, DEQ projected the number of confirmation test facilities needed, number of vehicles tested, and emission reductions for all the 8-hour nonattainment ozone areas (see Table 3-4).

**Table 3-4
Number of Stations Needed, Number of Vehicles Tested and Estimated Emission Reductions for Recommended Option (Option 3) in 8-Hour Ozone Nonattainment areas in 2007**

8-Hour Area	# of Confirmation ASM/TSI Test Facilities (could also do OBD tests)	# of OBD-Only Test Facilities	# of Vehicles Receiving Tests (Confirmation + Biennial OBD)	Emissions Reductions Tons per Year (HC+NOx)
Roanoke	2	13	86,476	584
Frederick/ Winchester	1	6	39,486	267
Fredericksburg	3	17	117,399	793
Richmond	6	48	324,710	2083
Hampton Roads	8	64	438,403	2960

3.6 Implementation Schedule for Emission Test Programs in New 8-Hour Ozone Nonattainment Areas

The implementation plan for an emission test program in new 8-hour ozone areas would include:

- Legislative authority including program funding mechanism;
- Regulations and procedures;
- Test procedures and equipment specifications;
- Procurement of RSD contractor;
- Data system for expanded emission test program;
- Procedures to notify vehicle owners of emission test requirements. If Option 3 is eventually used, this would also include defining procedures for vehicles that must receive periodic OBD tests in addition to defining procedures for high emitters that must receive confirmation tests; and
- Permitting of new inspection and repair stations.

Regulations for an emission test program in the new 8-hour ozone nonattainment areas must address the following:

- How vehicles are to be identified as high emitters? (*DEQ recommends using appropriate RSD standards for HC, CO, and NO*);
- What confirmatory tests would be performed on subject vehicles? (*DEQ recommends that OBD and ASM or TSI tests be performed*);
- What frequency must vehicles be tested? (*Biennial testing for 1996 and newer vehicles, or when the vehicle fails RSD*);
- What would be the waiver criteria? (*Same as current program*); and
- How would the program be funded? (*DEQ recommends that provisions be made to fund the inspection programs in new 8-hour ozone nonattainment areas. Options are:*
 - A fee charged for each registered vehicle per year to cover remote sensing operations and administration, with inspection test fees (both biennial OBD tests and confirmation tests) paid by the vehicle owner to the inspection station
 - A fee charged for each registered vehicle per year to cover both remote sensing, administration and confirmation tests. DEQ would reimburse inspection stations on a per test basis.

4.0 LOW INCOME REPAIR ASSISTANCE

Section C. of the 2003 Budget bill authorizes the Department of Environmental Quality (DEQ) to use up to \$300,000 each year from the Vehicle Emissions Inspection Program Fund to operate a program to subsidize repairs of vehicles that fail to meet on-road emissions standards established by the Board. These funds are intended to assist with repairs when the owner of the vehicle is financially unable to have the vehicle repaired.

Process for Subsidizing Repairs to Vehicles Identified by Remote Sensing as Being High Emitters

The following process would be used to identify vehicle owners that could receive repair assistance:

- RSD contractor collects RSD emissions and license plate data: sends plate data to DMV, requesting registration record data.
- DMV provides data to vehicle information database (VID) contractor: VIN, make, model year, garaged location, registration date, registration expiration date, emissions status, DMV emissions date.
- VID Contractor collects RSD emissions data from RSD contractor: vehicle license plate and Remote Sensing Device (RSD) emissions data.
- VID Contractor identifies and provides the list of high emitters to DEQ. List includes plate number, RSD emission data, make, model year and garage location of vehicle.
- DEQ requests owner information from DMV (name and address on registration records) of those listed as high emitters.
- DEQ sends letters to owners informing them of a violation. Letter contains notification that:
 1. Owner has 30 days from date of notice of violation to provide proof to DEQ that the vehicle has passed an emission inspection or obtained a waiver since the violation.
 2. Owner must get a confirmation emissions inspection at a DEQ-permitted emission inspection station.
 3. If the vehicle passes the inspection, no inspection fee would be charged, no further action would be required of the vehicle owner.
 4. If vehicle fails the inspection, owner must get vehicle repaired and pass another test. If owner spends more than the minimum required waiver expenditure in repair costs he would be eligible for a waiver.

5. Owner may apply to DEQ for repair assistance. Assistance would be allowed for total repair costs over \$100 to cover up to 50% of the repair costs, up to a maximum of 50% of waiver amount. (Director would have discretion to increase or decrease the amount depending on volume of requests received, average amount of the repair costs, and amount of funds available.)

- DEQ would contact Department of Social Services (DSS) to determine if applicants are eligible for assistance according to family income criteria provided by DSS.
- If eligibility criteria are met, DEQ would review application records and notify DEQ Office of Accounts Payable of the amount of subsidy to be sent to the owner. Check would be mailed within 14 days from notification date.

Funding for Repair Assistance

The current legislation stipulates that the costs of implementing and operating the repair assistance program would be borne by the Vehicle Emissions Inspection Program Fund. Currently, \$300,000 per year is authorized for repair assistance.

5.0 RECOMMENDATIONS

Following is a summary of recommendations concerning legislative changes that would enhance the use of remote sensing in Virginia:

New program areas:

- DEQ recommends that emission test programs for new 8-hour ozone nonattainment areas use RSD as a way of identifying high emitting vehicles, primarily 1995 and older, that then must receive ASM/TSI tests. All 1996 and newer vehicles would receive biennial OBD tests. DEQ plans to work with EPA to secure additional emissions reduction credits for this program.

Enforcement:

- Currently, DEQ will have to enforce the remote sensing program through a monetary penalty imposed through the court system. Since the maximum penalty is \$620, it is unknown if collection of this fee would be a priority for collection from the Office of Attorney General. Program enforcement may be more effective if DEQ coordinated with DMV to identify out of compliance vehicles by utilizing the current process used in the Northern Virginia Inspection and Maintenance program. DEQ will work with DMV to explore effective, low-cost enforcement options. Legislation will be required to implement this change.

Northern Virginia area program funding:

- The current budget for the basic remote sensing program in Northern Virginia is \$300,000. Additional funding may be needed if an expanded program is needed to further reduce emissions or if more repair assistance will be provided to citizens. Additional funding could be obtained by charging all motorists an additional fee. Another option would be to collect a fee from vehicles opting to be clean screened in lieu of a visit to a testing station. These funds could then help defer some of the costs associated with running the RSD system. Funding would also be available to increase low-income repair assistance. Currently, DEQ does not have legislative authority to collect clean screen fees. DEQ recommends operating the high emitter identification program for one year in order to determine whether larger scale remote sensing would be cost effective and to assess how many vehicles would be clean screened.

New area program funding:

- DEQ recommends that provisions be made to fund the inspection programs in new 8-hour ozone nonattainment areas. If emission testing and remote sensing programs are to be implemented in 8-hour ozone nonattainment areas, additional funding will be required. Funding for this new program could be obtained using one of the following options:
 - A fee charged for each registered vehicle per year to cover remote sensing operations and administration, with inspection test fees (both biennial OBD tests and confirmation tests) paid by the vehicle owner to the inspection station
 - A fee charged for each registered vehicle per year to cover both remote sensing administration and confirmation tests. DEQ would reimburse inspection stations on a per test basis.

APPENDIX
COST ASSUMPTIONS FOR RICHMOND EMISSION TEST PROGRAM

Cost Assumptions: Inspection

Cost assumptions for confirmation inspections are presented below:

- 3,120 hrs of operation/station per year
- Inspector \$/hr -- \$14 + 30%
- Test time -- 20 minutes for ASM, 10 minutes for OBD
- Bay space lease cost -- \$32/sf/yr (only applied when test lane is in use -- assumes alternate revenue generating activities would occur in that area when not testing)
- Capital cost -- \$40,000 ASM, \$8,000 OBD
- ASM installation -- \$4,000 (in-ground)
- Warranty -- \$5,000 per yr ASM, \$1,000 OBD
- Utilities -- \$1,200 / yr ASM, \$0 OBD
- Span gases -- \$384 / yr ASM, \$0 OBD
- Zero gases -- \$0.45 /test ASM,\$0 OBD
- Program Administration and Enforcement -- \$1.00 per vehicle per year
- Utilization factor – 35%
- Repair costs: ASM and OBD: \$300
- Profit margin: 20%

Percent Receiving Confirmation Tests

% Tested (% Fail Screen)	1. ASM/OBD	2. RSD + ASM/OBD	3. OBD + RSD/ASM
1996+	100%	6%	100%
Pre-1996	100%	25%	25%

Number Receiving Confirmation Tests

# Receiving Confirmation Tests 2005	1. ASM/OBD	2. RSD+ASM/OBD	3. OBD + RSD/ASM
OBD	255412	16244	255412
ASM or TSI	125800	31450	31450
TOTAL	381211	47694	286862
# Receiving Confirmation Tests 2007	1. ASM/OBD	2. RSD + ASM/OBD	3. OBD + RSD/ASM
OBD	303322	19291	303322
ASM or TSI	85552	21388	21388
TOTAL	388874	40679	324710
# Receiving Confirmation Tests 2010	1. ASM/OBD	2. RSD + ASM/OBD	3. OBD + RSD/ASM
OBD	356585	22679	356585
ASM or TSI	44072	11018	11018
TOTAL	400657	33697	367603

Percent Failing Confirmation Tests

% Fail Confirmation Tests	1. ASM/OBD	2. RSD+ASM/OBD	3. OBDI + RSD/ASM
OBD	3%	15%	3%
ASM or TSI	19%	32%	32%

Based on the above assumptions, costs per vehicle confirmation test are as follows:

- **Option 1: ASM/OBD: \$17-\$20 depending on evaluation year (2005, 2007, 2010)**
- **Option 2 ASM/OBD: \$22-\$28 depending on evaluation year (2005, 2007, 2010)**
- **Option 3: OBD tests: \$16**
- **Option 3: ASM tests: \$36**

Cost Assumptions: RSD

Records indicate that 740,000 light-duty vehicles are registered in the 4-county Richmond area. In a given year, half these vehicles (370,000) would be inspected in a biennial emission test

program. Data from the Northern Virginia RSD Study indicate that we need valid RSD observations totaling twice this number to cover 70% of the registered vehicles (a higher % of driven vehicles would be covered). For this analysis we assumed that we need RSD observations equal to 1.5 times the number of vehicles registered in the area (1.1 million RSD observations/yr). From the Northern Virginia study we also determined that 30,000 valid observations can be made on vehicles registered in the Richmond area per van month¹². From this we calculate that about 36 van-months or about 3 vans per year would be needed to adequately cover the Richmond Area fleet. Each van year is estimated to cost \$300,000, so the total annual cost for RSD is \$900,000.

¹² Each van averaged 47,000 valid observations per month. Adjusting this number for the percent matched (97%), percent with valid VSP (90%), and the percent of observations in the 4-county area that are on vehicles registered in the 4-county area (72%) yielded 30,000 valid observations per van-month.