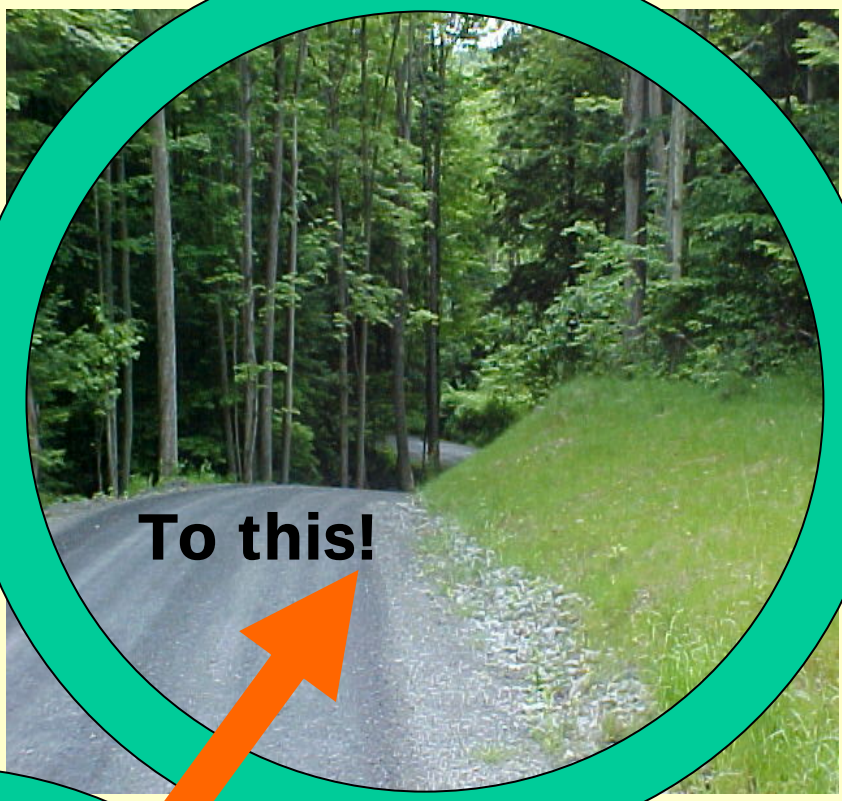
Environmentally Sensitive Maintenance for Dirt and Gravel Roads

- Better Roads
- Better Environment
- Better Community
- Less Maintenance



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NOTICE

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16. Abstract

This is a nonpoint source pollution project that identifies, documents, and encourages the use of environmentally sensitive maintenance of dirt and gravel roads. Specifically, this project involved the development of a reference manual and related technical information sheets on *Environmentally Sensitive Maintenance of Dirt and Gravel Roads* for national use.

The manual will provide insight into using natural systems and innovative technologies to reduce erosion, sediment and dust pollution while more effectively and efficiently maintaining dirt and gravel roads. The manual will address the environment of forests, mountainous terrain, and rolling hills. Various states already employ some of the more common practices, particularly forestry departments. These states and their local governments are prime targets for deploying the additional practices to be addressed in the manual. The manual will give the users a 'tool box' full of environmentally sensitive maintenance 'tools' or practices, recognizing that not one tool can fit every situation or site or solve all their problems in maintaining their dirt and gravel roads and protecting the environment.

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Environmentally Sensitive Maintenance For Dirt and Gravel Roads

A Manual to provide guidance
using natural systems and innovative technologies to reduce erosion, sediment and dust pollution while more effectively and efficiently maintaining dirt and gravel roads.

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In addition, although they are no longer part of the PA program, a special appreciation has to go to Woodrow "Woody" Colbert, Morris Perot, Kate Thompson, Denise Wardrup, and Phil Dux, for their early work and shared experiences with the Pennsylvania Program from which we drew upon in developing this manual. (Note: Both authors were actively involved in the initiation and development of the Pennsylvania Dirt and Gravel Road Program, providing administration, training and training development, technical assistance, and project support during the early years of the program.)

Our sincere thanks to the South Dakota Local Transportation Assistance Program (SD LTAP) for allowing unlimited use of material from their Gravel Roads Maintenance and Design Manual (Ken Skorseth and Ali Selim, Ph.D., P.E.), a product that has become an essential standard resource for gravel road maintenance personnel across the United States.

Our thanks to the national Rural Roads Group comprised of individuals from the U.S. Environmental Protection Agency, Forest Service (U.S. Department of Agriculture), Federal Highway Administration, Bureau of Indian Affairs (U.S. Department of the Interior), Bureau of Land Management (U.S. Department of the Interior), National Association of County Engineers (NACE), National Association of Counties, National Transportation Library, Maryland Transportation Technology Transfer Center, the APWA LTAP Clearinghouse, and particularly to Tony Giancola, Executive Director of NACE, and associates, for their valuable reviews and critiques of this manual throughout the development task.

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Lastly, thanks to the various organizations and entities as credited throughout the manual for allowing use of graphics and photos for the enhancement of this manual resource.

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Foreword

This manual was written for Road Maintenance Personnel.

To use this manual, do the following two things:

1. Review the underlying basis, mission and major objectives for this manual:

Basis of the Manual: The following facts are the driving force behind development of this manual:
1. Over 1.6 million miles of dirt and gravel roads exist within the United States, and they provide a vital service as part of the nation's transportation system.
2. Dirt and gravel roads will remain important and significant in mileage and use into the future.
3. The depositing of unwanted sediments into our streams and waterways represents one of the largest pollution problems in North America, and improperly maintained dirt and gravel roads are major contributors to this problem.

The Manual's Mission:
The mission of this manual is to address this pollution problem affecting our streams and stemming from our dirt and gravel roads in the form of erosion, sediment and dust.

Major Objectives to Accomplish the Mission:

1. Provide users with an understanding that *our road system is part of our overall environment, that a vital connection exists between the two, and that this connection needs to be considered in whatever actions we take in regards to constructing and maintaining our road system.* In doing so, we will be able to preserve our environment and more effectively and efficiently prolong the life of our transportation system.
2. Give users a 'tool box' full of environmentally sensitive maintenance 'tools' or practices that support both good roads and a good environment by offering a variety of simple, practical environmentally sensitive maintenance practices and by providing a means for using these practices in routine road maintenance.

The practices presented in this manual are inclined toward use for dirt and gravel roads in forested areas. The user may find, however, that many of the concepts and practices could prove applicable in various types of environments, and possibly require only minor research and development efforts.

2. Look at the Chapter Titles to determine how to effectively use the information presented:

Chapter:
1. Introduction
2. Geology, Rocks and Soils
3. Water, Erosion, Drainage and Road Basics
4. Basics of Natural Systems
5. Environmentally Sensitive Maintenance Practices: Roads and Road Drainage
6. Environmentally Sensitive Maintenance Practices: Roadsides and Streams
7. Environmentally Sensitive Maintenance Practices: Additional Techniques

By looking at the Chapter titles, we see that the maintenance "guts" of this manual are contained in Chapters 5, 6, and 7 on "Environmentally Sensitive Maintenance Practices". These are the chapters that you may want to read all the way through and then use this information with the accompanying "Technical Information Sheets" in implementing these practices for better roads and a better environment.

If this is all you do, however, you will not have a full understanding of why you are doing a particular practice a particular way or how these practices really work to better the road and the environment. This path is the traditional philosophy of telling someone what to do without any explanation of why it works or the reasons or factors upon which the practice is based. Without a full understanding of "why and how it works," the wrong reasoning for doing any work may prevail - "this is the way we always did it." On the other hand, if we fully understand the "why and how it works," we become confident in doing it right and can use this knowledge to actually improve upon the practice and its use in maintaining our roads.

This is where Chapters 1, 2, 3, and 4 become most important. These chapters give background information that enables an understanding of "how and why it works." We feel that it is important for road personnel to have "the whole story" or all the information behind the practices. This will enable them to implement the proper practice when needed or desired. Road personnel should know why and what they are doing, and why and how it benefits both the roads and the environment.

Environmentally Sensitive Maintenance
For
Dirt and Gravel Roads

Chapter 1: Introduction

1.1 Manual Mission & Scope

1.1.1 The Mission. The development of our national road system and the need to sustain it dictated governmental ownership from the start. Today, our state and local governments maintain the vast majority of roads. But our roads are part of our total environment, and just as we are the governmental trustees of our road system, we are also the trustees of our environment and all its resources.

1 - 01 Our roads are part of our total environment.

Beyond this trusteeship lies a greater calling: to be responsible stewards of our environment. The environment is under assault on many fronts, and many of those battles must be fought at the national and international level. But roads and their relationship to the environment are perhaps the one area where state and local governments can make a difference.

Unwanted sediments choke many streams and waterways, representing one of the largest pollution problems in North America. The culprits in many cases are dirt and gravel roads. Our mission, then, is to present proven methods of maintaining our dirt and gravel roads that reduce the erosion, sediment and dust that pollute our streams.

1.1.2 Scope. This manual's mission and philosophy are rooted in the Pennsylvania Program on "*Environmentally Sensitive Maintenance for Dirt and Gravel Roads*." (This Commonwealth program provides funding, training, and technical assistance and is highlighted as a case study for "Essential Programs" in Appendix 1 at the end of this chapter.)

Based on the Pennsylvania model, the practices presented in this manual focus on dirt and gravel roads in forested areas, recognizing that, with only minor research and development, many of the concepts and practices can be applied in various types of environments.

1 - 02 Roads exist as unnatural structures in the natural environment.

This manual will show that our *road system is part of our overall environment, that there is a vital connection between the two,* and that this connection needs to be considered when we construct and maintain our dirt and gravel roads. By doing so, we will be able to preserve our environment and prolong the life of our transportation system.

Roads exist as unnatural structures in the natural environment. Natural forces continually take their toll on our roads, often resulting in degraded roads and environmental damage. The challenge rests in simultaneously preserving our roads and streams in a safe and cost-effective manner. Using a combination of natural systems and road maintenance principles, environmentally sensitive maintenance practices can be integrated into an effective and efficient approach benefiting both the environment and our road transportation system.

Although this manual addresses environmentally sensitive maintenance for dirt and gravel roads, many of the practices, particularly in terms of drainage and vegetation, can be transferred to paved roads and result in benefits to both the paved road and the environment.

1.2 The Importance of Dirt and Gravel Roads

Over 1.6 million miles of dirt and gravel roads criss-cross rural areas of the United States, providing a vital service as part of the nation's transportation system. In many cases, our unpaved roads are the main access for major industries. Unpaved roads provide essential market access for farms, foresters depend on dirt and gravel roads to remove timber from the

1 - 03

forest, and the mining industry could not get minerals out of the mines without these valuable pathways.

In many areas, dirt and gravel roads play a major part in tourism, adding to the economic wealth of the region. Dirt and gravel roads also directly serve millions of rural residents living along them.

Many of our dirt and gravel roads remain unpaved for economic reasons, but, in many areas, residents do not want paved roads, desiring to preserve the rural nature of their area. Dirt and gravel roads are considered the lowest service level in any functional road classification system, usually serving the lowest volumes of traffic. But even as their numbers decline, giving way to more and more paved roads, dirt and gravel roads continue to be a significant part of our road system.

In fact, traffic on dirt and gravel roads is increasing. Further, the vehicles and equipment using these roads are getting larger, meaning the most safe, effective and efficient maintenance practices must be employed to keep pace with the stress these larger vehicles place on the roads.

1.3 The Problem: Roads and the Environment

1.3.1 A Historical Perspective. Read our country's history books and the accounts of our discoverers, trailblazers, pioneers, and early settlements and it becomes clear that roads and streams are connected by their imminent proximity.

1 – 04 Historical development dictated the close proximity of roads and streams.

Early settlements were built next to streams that became the essential water source for drinking, washing, domestic animals, crops, and power generation for sawmills or gristmills. Streams were also used as transportation corridors to haul goods between homesteads. Footpaths developed along these streams to connect the settlements by land. Streamside terrain offered relatively easy slopes for construction and subsequent use by horses and wagons. These footpaths became the roads, many of which survive today as our dirt and gravel roads. *This close proximity of roads and streams, dictated by historical development, began the conflict of erosion and sediment degradation affecting both roads and streams.*

1.3.2 The Connection. Erosion is a natural occurrence in the environment. When roads are constructed, however, they create an interference with the natural systems and collect water, increasing its volume and velocity, resulting in accelerated erosion.

1.3.2.1 Factors Affecting Roads. When we look at all the factors affecting the life of our roads (Figure 1-1), water has to top the list. Alone or combined with other factors, water can be disastrous. The subgrade of the road is what it is built on, the soils. If this foundation is poor, the road's life will be significantly reduced. If the subgrade is water saturated, the condition will be worse.

Most maintained dirt and gravel roads are quite old. Current maintenance crews were not involved in the construction. If poor quality materials were used or the workmanship was substandard, maintenance crews inherit numerous headaches with the road. And even when materials and workmanship are up to standards, the road may not have been built to handle today's heavier traffic loads. Traffic volumes and weights have both increased substantially in the last 20 years. The combination of water and increased traffic loads is potentially disastrous for our roads. That is why maintenance practices are so important. Poor maintenance equals poor roads. If there are drainage problems, however, even the best maintenance is doomed unless drainage problems are taken care of first.

The environment and climate also affect road conditions. The environment, as defined here, refers to vegetation, soil, sand, rocks, drainage conditions, and the overall stability of the area. Climate dictates the local weather conditions. Weather includes rain, freeze-thaw cycles, and hot sun that can dry out soils and road materials.

Looking at all these factors affecting roads, we should ask ourselves "What can we control?"

1.3.2.2 Factors Affecting the Environment. The same factors that affect the road affect the environment. Water feeds vegetation and streams and creates habitats, but also causes erosion, flooding, and sedimentation.

Our roads certainly affect the environment along with our maintenance practices. Poor road structure and material quality, increased traffic levels, and proximity to waterways lead to erosion, sediment and dust pollution problems.

Again, we should ask, "What can we control?"

Figure 1-2
Factors Affecting the Environment

1.3.2.3 The Road-Environment Relationship. Road conditions are deeply intertwined with the surrounding environment. Concentrated water flows accelerate erosion, overloading natural systems. Excess sediment clogs our streams. Dust becomes sediment in our streams, generates complaints from residents and harms plants, animals, people and equipment. Chemical contamination complicates the picture even more because oils, nutrients, pesticides, herbicides, and other toxic substances bind to dust and sediment and go along for the ride to pollute our streams and waterways.

1 – 05 Dirt and gravel roads are a major source of erosion and sediment.

Dirt and gravel roads are a major potential source of these pollutants. Many roads have unstable surfaces and bases. Roads act like dams, concentrating flows that accelerate erosion of road materials and roadsides. Both unstable surfaces and accelerated erosion then lead to sediment and dust.

The close proximity of roads and streams thus establishes the connection. Because road systems are situated close to streams within the natural environment, they affect the natural systems as they are in turn affected by the natural processes that take place there. The two systems – roads and the environment – are interrelated. Thus, in order to fix road problems, we must understand some things regarding each system to find a solution beneficial to both our roads and the environment.

In addition, not only is there a relationship between the roads and the environment, but both the roads and the environment also have an effect on the overall quality of life within your region. John Muir, who has been called the father of our National Park system, summed it up in this statement: **"When we try to pick out anything by itself, we find it hitched to everything else in the universe."**

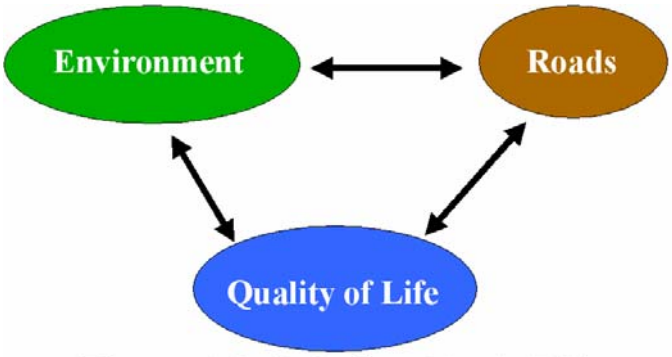


Figure 1-3: Relationship & Effect

1.3.3 Traditional Maintenance Practices. Even though the goal of road maintenance personnel is to maintain good roads, accepted maintenance practices do not always adequately address the road's relationship to the environment.
Why do we do what we do? Because we've always done it that way? There are many things that we do that may not be the best way for the environment or the road. In fact, many existing practices cause damaging sediment pollution, impacting both the road and the environment.

Vegetation management is a major example where many existing practices become counterproductive. Traditional "daylighting" exposes bare soil, disrupts ecological succession and eliminates soil-stabilizing roots, all of which increase erosion and sedimentation, damaging both the road and the environment. In addition, excessive sunlight can dry the roadbed, leading to excessive dust generation. Maybe we should consider leaving existing root structures undisturbed, thinning canopy cover to allow moderate sunlight, and avoid clearing banks just because they are there. Using nature's patterns and forces can result in better roads, less erosion and sediment pollution and lower maintenance costs.

Bank cutting and undercutting results in extensive sediment runoff, blocked ditches, and increased cyclical maintenance. On the other hand, refraining from cutting the toe of slopes, using headwalls to reduce pipe inlet and bank erosion, and using diversion or intercepting swales preserve both road quality and the environment.

Conveying road and ditch runoff to the nearest stream using the most direct route possible has long been an established practice. Any type or amount of sediment being carried by that runoff is also dumped directly into the stream. But directing culvert and ditch outlets (turnouts, bleeders) into a vegetative filtering area will help filter out the sediment, allow water infiltration and groundwater recharge, and protect the stream ecology.

Road aggregate quality directly impacts both the survival of the road and the environment. *Covering the road with poor 'low-bid' material that may wash away is*

another way of paying for sediment pollution, not to mention increased road aggregate replacement costs. Using a good road material that remains in place and prolongs road life will also benefit the total environment.

Undersizing and oversizing water channels, bank armoring, and flow redirection can disrupt stream energy, increasing maintenance costs and causing environmental harm. Understanding stream flows and the natural forces can help to establish better practices to again protect both the road and the environment.

Clearly, many traditional practices are counterproductive. They should be replaced with more productive measures that incorporate our knowledge of roads and natural systems. The result will be better roads, less sediment pollution, and lower maintenance costs.

1.3.4 Combining Goals. The goal of road maintenance personnel has always been good roads through proper maintenance at the lowest cost. We want to keep this goal, but expand our vision. We need to take a different look at our roads and see the total environment in which our roads are contained. This environment affects the life of our roads just as the road affects the environment.

If our goal within this project is to protect the environment through reduction of erosion, sediment and dust pollution, then let's combine our goals. Let's use additional and improved maintenance techniques and practices that benefit both the roads and the environment.

1.3.5 Road Safety. Any effective road maintenance program needs to consider and address safety. A safe transportation system is essential and remains part of our overall goal. Maintaining our roads and environment, however, need not come at the expense of safety. In fact, roads maintained in an environmentally friendly way have more structural strength, suffer less deterioration, and have fewer defects, and, thereby, are also safer. The goals of low-cost, environmentally sensitive maintenance and improved road safety can be combined seamlessly.

1.4 The Manual: Philosophy, Objectives and Contents

1.4.1 The Manual Philosophy. This manual is titled ***Environmentally Sensitive Maintenance for Dirt and Gravel Roads***. The mission, as stated, is to address the pollution problem of erosion, sediment and dust stemming from our dirt and gravel roads and affecting our streams. To meet this mission, the manual centers on an important philosophy or rationale.

To municipal road maintenance personnel, the road has been "sacred." Everything they have been taught about road maintenance has centered on what is good for the road, which has proven at times not to be correct. We need to initiate a change in this thinking. We can no longer afford to think only about the road. We need to understand the relationship between the road and the environment, that everything is interconnected, and

that there are practices that can be implemented that are not only good for the road, but also good for the environment. In addition, we need to make the connection that both good roads and a good environment are important to the welfare of local governments and their residents.

Only when this thinking changes can it be converted into action. In presenting "environmentally sensitive practices," this manual will illustrate to the users how easy these practices are to use and how useful and beneficial they become in prolonging the life of the road and protecting the environment. To accomplish this, however, the practices need to be simple, practical, and easy to incorporate into a routine road maintenance program.

The manual will give the users a "tool box" full of environmentally sensitive maintenance 'tools' or practices, recognizing that no one tool or practice can fit every situation or site or solve all their problems. Because every road and every site along that road is different, we need a toolbox from which we can select the appropriate tool or tools to help solve whatever situation we encounter.

1.4.2 The Manual Objectives. To meet the mission and put "punch" into our philosophy, we set our objectives as follows:

1. Enable the user to recognize the connection between road maintenance and the environment and the importance of good roads and a good environment for good government.
2. Enable the user to recognize sources of erosion, sediment, and dust pollution associated with roads and the importance of preventing these pollution sources.
3. Enable the user to recognize that standards cannot fit every situation and that sound decisions require proper knowledge of basic principles and practices. (Most standards, although often dictated as requirements, should be presented as only guidelines that need to be adjusted or revised to fit each particular site or problem area in the field. To know, however, what "tool" to use or what adjustment is needed, one needs to recognize basic principles and practices not only related to road maintenance but also to the natural systems that influence these roads, leading to our 4th objective.)
4. Arm the user with knowledge on basic principles of nature and natural systems as applied to road maintenance and a healthy environment and on basic road maintenance materials and techniques. (The user needs to know the basics of nature and the natural forces, and how they can be applied to help establish good roads and protect the environment. In addition, to make sure we are "on the same road"; we want to cover the road basics of good materials and techniques.)
5. Arm the user with knowledge on environmentally sensitive maintenance practices and the effective use of these practices in road maintenance. (This is where we provide the "tools" for their toolbox – a variety of simple, practical environmentally sensitive maintenance practices and the means of using these

practices in routine road maintenance to keep both good roads and a good environment.)

1.4.3 The Manual Contents. To accomplish this comprehensive list of objectives, the manual contains 7 chapters.

Chapter 1 – Introduction: Chapter 1 is simply an introduction to the manual. The mission and scope of the manual is introduced, followed by a discussion on the importance of dirt and gravel roads. We then start to make the connection between roads and the environment and discuss the shortcomings of traditional road maintenance practices. The chapter then shows the value of combining the goals of good roads and a good environment. The manual philosophy is then discussed, followed by the objectives and this description of contents. To close, the need for essential programs is covered, with an appendix to describe the Pennsylvania program as a case study.

Chapter 2 – Geology and Soils: This chapter discusses geologic time and relentless natural forces, looking at geological regions, topography, weather, rocks and soils. The chapter demonstrates how geology and natural forces give us what we have to work with and the conditions under which we have to work. Geology dictates the aggregates available for road materials and the soils available to support the natural vegetation.

Chapter 3 – Water, Erosion, Drainage and Road Basics: This chapter starts with basic principles of erosion and how roads cause accelerated erosion and increased sediment and the importance of preventing this pollution, showing the connection between roads and the environment. This module hits hard on the importance of good drainage, discussing the characteristics and effects of water on roads. Discussion then turns to road materials, what's being used and what we need to be concerned with. We then review basic road maintenance techniques for dirt and gravel roads – basic grading operations, road crown, etc. – and end with a discussion on winter maintenance operations.

Chapter 4 – Basics of Natural Systems: This chapter sets the basics on the natural side, presenting guiding principles by defining ecology and discussing three distinct ecosystems: the streams, wetlands, and forests or uplands. We stress the important benefits of these areas and set the stage to discuss, in a later module, how we can use these systems to help in road maintenance. This is unfamiliar area to most road maintenance personnel. The user should read this chapter with an eye to relating roads and road maintenance to natural systems.

Chapter 5 – Environmentally Sensitive Maintenance Practices: Having set the basics for both roads and the natural systems, this chapter presents the environmentally sensitive maintenance practices, with emphasis on road profiles, ditches, culverts, and bridges. Simple, straightforward, easy to implement practices are presented – some of which may already be familiar, or some that may be just tweaking something already in use. Others may be new, but still simple and easy to implement.

We start to fill the user's toolbox with the tools, emphasizing that not one tool or practice or technique will solve all their problems, but a toolbox full of tools will help greatly.

Chapter 6 – Roadsides and Streams: This chapter discusses the value of roadside vegetation management and the important factors affecting bank stability. The chapter then builds on this discussion to show how we can use the forests and natural systems to help reduce road maintenance, introducing more environmentally sensitive maintenance practices. We review common practices and the associated problems that can be detrimental in the long term for both roads and the environment, followed by alternative methods to improve or enhance the existing conditions (e.g., traditional clearcutting practices, stream channel clearing practices). This leads to more environmentally sensitive maintenance practices for vegetation management and bank stabilization, ending with an introduction to a variety of bioengineering techniques for stream banks.

Chapter 7 – Additional Maintenance Techniques: Chapter 7 continues to add tools to the toolbox, discussing three specific areas: dust control, road stabilization (full-depth reclamation), and the world of geosynthetics. The geosynthetics section emphasizes geotextile separation fabrics along with other geosynthetics used in actual road projects including a drainage pipe project case study, demonstrating the variety of functions and uses that geosynthetics play in road maintenance.

1.5 Essential Programs

To successfully fulfill our mission of addressing the national problem of erosion and sediment pollution from our dirt and gravel road system affecting our streams, there is a need not only for a manual but also for comprehensive state programs providing funds, education and training, and technical assistance to the nation's road maintenance personnel.

No change in our environment will occur without a change in thinking. Roads do not exist in isolation. They are an integral part of the environment. A change to the road changes the environment. An environmental shift has consequences for the road. Until those performing maintenance on our roads understand this relationship, both the roads and the environment will continue to suffer.

The way to change thinking is through training and technical assistance, coupled with funding. The message must be clear, simple, and easy to administer. It must be targeted at local and regional road maintenance managers.

As a case study, Appendix 1 presents Pennsylvania's Program as a successful model and resource for other states in meeting this mission. Appendix 1 is a description of the program development and implementation, with a discussion of the essential criteria for a successful program.

APPENDIX 1
Case Study: The Pennsylvania Dirt and Gravel Roads Program

In 1997, Pennsylvania introduced a program that provides an annual $5 million appropriation for "Environmentally Sensitive Maintenance" for our nearly 20,000 miles (38,180 km) of dirt and gravel roads. The program addresses three critical components: Thought and Attitude, Cost Effective Best Management Practices, and Technology Transfer. In developing an understanding of the problem, the program team, spearheaded by the State Conservation Commission, developed a philosophy that simplifies administration, holds the stream sacred, and strives for better roads and reduced maintenance. This exemplifies a major change in "thinking and doing" for road maintenance personnel, where traditionally the road had priority. The program leads them to consider both the road and the environment as important and how natural systems can help with overall road maintenance.

A1.1 Pennsylvania's Dirt and Gravel Roads. Pennsylvania has over 117,000 total miles (188,253 km) of public roads, including both paved and unpaved. Local municipal governments own and maintain two thirds of that total mileage. Of that total mileage, nearly 20,000 miles (32,180 km) are unpaved dirt and gravel roads.

Local municipal governments own and maintain the majority of dirt and gravel roads with over 17,000 miles (27,353 km).The PA Department of Conservation and Natural Resources (DCNR), Bureau of Forestry owns and maintains over 2500 miles (4023 km). The PA Department of Transportation (PENNDOT) has less than 500 miles (805 km). This number continues to decline due to PENNDOT's Turnback Program (PENNDOT pays $2500 per mile as an annual sum added to a municipality's liquid fuels funds for any state roads "turned back" to the municipality to own and maintain). Other agencies having nominal mileage are the DCNR Bureau of State Parks, the PA Fish and Boat Commission, and the PA State Game Commission. Dirt and gravel road mileage continues to decline as development and traffic volumes increase and more and more roads become paved, but dirt and gravel roads will remain a significant part of Pennsylvania road mileage into the future.

Pennsylvania's dirt and gravel roads play an important role for the commonwealth. They provide vital direct access for over 3.6 million PA residents, although probably used by almost all of PA's 12 million people. They also provide vital access to Pennsylvania's industry, namely our top industries of agriculture, forestry, mining and tourism. In fact, tourism is projected to become our state's number one industry, a position that has been held by agriculture. To emphasize, Pennsylvania's dirt and gravel roads have always played an important role, are still playing that role, and will remain playing that role into the future.

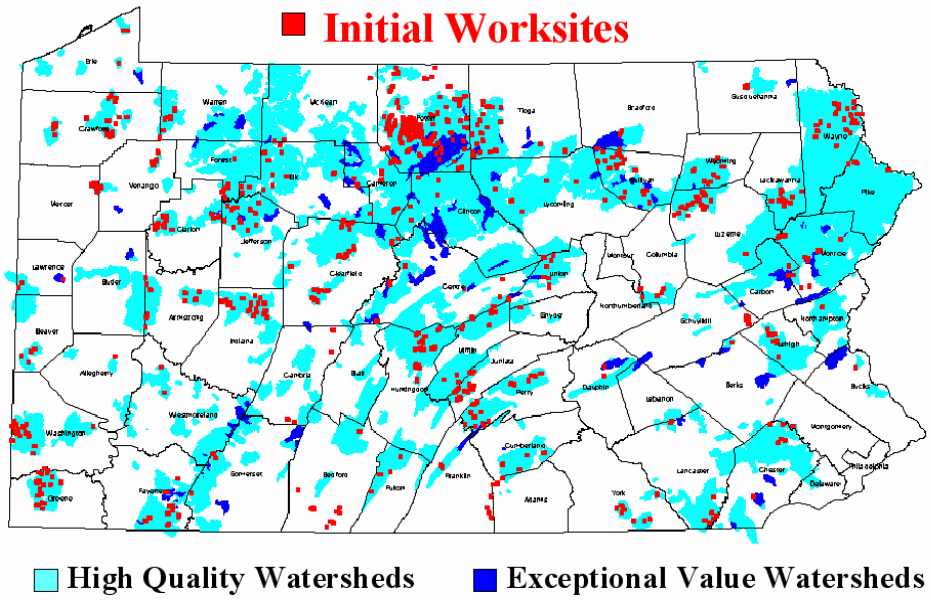
A1.2 Program Origin: A Problem Recognized. In January 1991, a man by the name of James "Bud" Byron, active in Trout Unlimited, instigated a Northcentral Pennsylvania Conference of parties interested in protecting streams from sediment

pollution associated with dirt and gravel roads. The results and publicity of that meeting held in Pleasant Gap, PA, sowed the seeds of the program.

A1.3 Program Origin: A Problem Substantiated. Lead by Trout Unlimited, various individuals, organizations and agencies became active in addressing this problem on a statewide basis. In 1993, they formed the Dirt and Gravel Road Task Force, (Figure A1-1). The Task Force set out to substantiate the extent of the problem. They began by conducting field surveys of roads and streams to identify actual conditions in the affected watersheds. Using volunteers (no funding was available), they zeroed in on protected watersheds identified as Exceptional Value and High Quality. Just surveying these areas was a huge undertaking (Figure A1-2). A great number of volunteers were needed, and Trout Unlimited, with its 55 PA chapters, provided most of the manpower. A simplified manual card system was developed to record actual field conditions. The volunteers received onsite training to help ensure consistent results. These surveys identified actual "trouble spots" of sediment pollution into streams throughout the commonwealth. These pollution trouble spots became the initial worksites and, when viewed plotted on a map (Figure A1-2), substantiated the problem.

Figure A1-1
PA Task Force on Dirt and Gravel Roads

Figure A1-2: Result – A Problem Substantiated



A1.4 A Solution. With the problem substantiated, the Task Force needed to look at a solution. Who was maintaining these dirt and gravel roads? Why were the problems of erosion and sediment occurring? What did they need to do to correct the problems? Municipal governments owned the roads, so the Task Force looked to existing road maintenance. They found that even though the goal was to maintain good roads, existing accepted maintenance practices did not always adequately address environmental concerns. To solve the existing and continually occurring pollution problems required maintenance managers to change their thinking to see the road as part of the environment. This change in thinking had to lead to changes in procedures. Improved maintenance techniques that were good for both the roads and the environment had to be used. To initiate this change, the task force recognized two major needs – training and money.

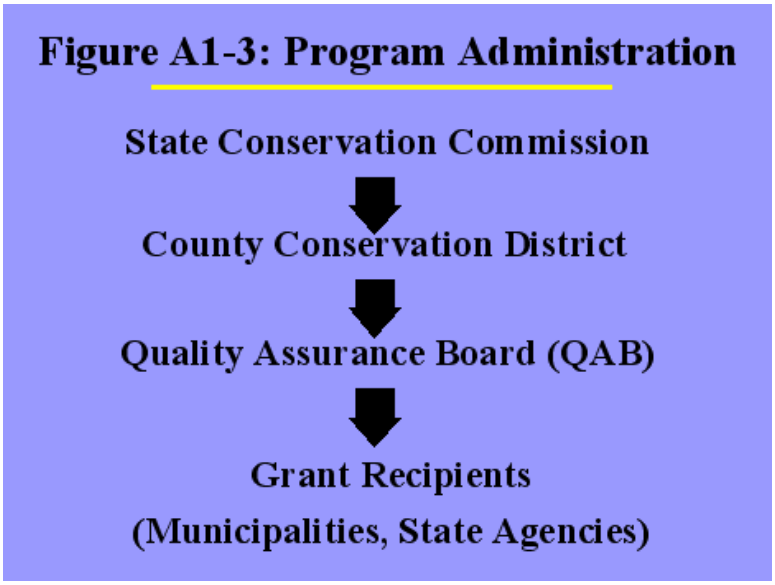
Legislation was necessary to meet these needs. Pennsylvania Senator Doyle Corman became the program champion and drafted legislation, which became part of the PA Transportation Revenue Bill, signed into law as PA Act 3 of 1997. Section 9106 was added to the PA Motor Vehicle Code, initiating the Dirt and Gravel Road Program.

A1.5 The Legislation. Section 9106 created an annual, non-lapsing $5 million appropriation for Dirt and Gravel Road Maintenance to address the pollution problems of erosion, sediment, and dust. Section 9106 took effect July 1, 1997. The legislation provides that $1 million go directly to the Bureau of Forestry for their roads and that the other $4 million go to the State Conservation Commission, the lead agency for the program. This annual $4 million was to be used as grants for environmentally sensitive maintenance projects on dirt and gravel roads.

The legislation stated that the identified "trouble spots" would be the top priority, recognizing the significance of the volunteer work that substantiated the problem and led to the legislation.

The legislation also **required grant recipients to receive training** as a prerequisite to applying for grant funds.

A1.6 Program Organization. The PA State Conservation Commission serves as the lead agency for the program (Figure A1-3). They allocate the money to the County Conservation Districts who are responsible for administering the program at the local level. Each County Conservation District is required to implement a Quality Assurance Board (QAB) who reviews and



prioritizes grant applications and provides assurance of project completion in accordance with the applications. This board provides recommendations back to the County Conservation District for formal approval. To benefit from a variety of background and experiences, the QAB is comprised of four members: a chairman from the County Conservation District (non-voting) and three voting members, one appointed by the County Conservation District, one appointed by the PA Fish and Boat Commission, and one appointed by the National Resource Conservation Service (NRCS).

Grant recipients are the local municipalities or state agencies that own and maintain dirt and gravel roads.

Two major points emphasized through the program legislation are simplicity and local control. The program organization meets these points with a requirement of a one-page grant application form and with the charge given to the County Conservation Districts to implement the program. What better way to keep it simple and have the program handled at the local level?

A1.7 Program Goal. The program's major goal is to reduce the pollution due to erosion, sedimentation, and dust associated with dirt and gravel roads in the commonwealth. To meet this goal, a strong program basis to protect the dirt and gravel roads was formulated. Several decisions were made by the program initiators and agreed upon through the legislation.

First, the program supports maintaining dirt and gravel roads as dirt and gravel. The program will not fund paving these roads. Second, to minimize road maintenance and stretch limited resources, cost effective maintenance practices that are not only good for prolonging road life but also for protecting the environment are essential.

This program goal and basis led to the required training with its own rationale and objectives.

A1.8 Program Training. The Pennsylvania State University, through the Pennsylvania Transportation Institute and the Environmental Resources Research Institute, were originally charged with development and delivery of the training associated with the Dirt and Gravel Road Maintenance Program. Since then, a Center for Dirt and Gravel Road Studies, in conjunction with Penn State University, was funded through contract with the PA State Conservation Commission. This Center now administers the education, training and technical assistance aspects of the program.

The major purpose of the training was simple – to meet the requirements of the legislation which required anyone who applies for program funding to attend a training course as a prerequisite.

The course was simply titled, following the legislation, "Environmentally Sensitive Maintenance for Dirt and Gravel Roads." The program goal, as stated, is to reduce erosion, sediment, and dust pollution relating to dirt and gravel roads. To meet

this major goal, the training centers on the philosophy and rationale as discussed above in Section 1.4.1 for this manual.

To meet the main program goal, objectives similar to the ones outlined above in Section 1.4.2 for this manual were adopted along with an additional objective to provide the trainee with information on associated laws and regulations and with the information on grant funding procedures.

The training gives them a "tool box" full of environmentally sensitive maintenance "tools" or practices, recognizing that not one tool or practice can fit every situation or site or solve all their problems. These practices are mostly simple, practical, cost effective techniques that can be easily implemented. Municipal road crews with available equipment resources can perform most of the practices, incorporating them into their normal routine road maintenance program. Not all practices will apply to any one municipality's roads, but having a full toolbox from which to choose the best tool or tools to address the problem or concern encountered tends toward a more successful solution. Many of these practices can be used in combination and will apply to most dirt and gravel roads in general

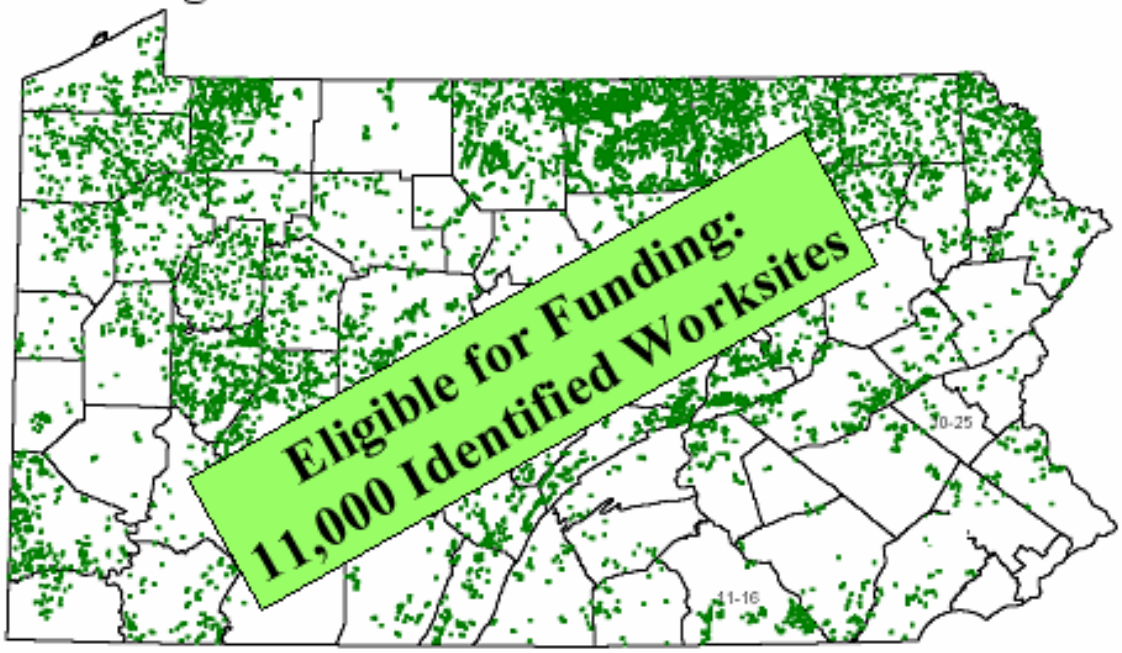
The training is a two-day course and consists of classroom training only. The possibilities of field trips to nearby roads were discussed, but weather and the logistics of coordinating transportation to the site does not lend to the feasibility. The time factor also comes to play an important deterrent.

The training uses PowerPoint® presentations with an LCD projector and projection screen. The PowerPoint® presentations contain all the digitized photos and several video clips to enhance, clarify, or show examples. Trainers also use various samples of products, particularly geosynthetic products.

Training evaluation sheets are distributed at each session. Results have been overwhelmingly favorable on all aspects of the training. Acceptance by municipal road personnel of the many practices presented has been greater than expected. This is a testament to the dedication and concern of local municipal government road personnel.

A1.9 Further Program Development. A new inventory and assessment of PA's dirt and gravel roads were completed with the establishment of the new Center for Dirt and Gravel Roads. County Conservation Districts worked with the local governments to verify unpaved roads via municipal and county maps. All identified roads then received field assessments by the County Conservation Districts for pollution problems affecting streams. This new assessment identified over 11, 000 new sites across the commonwealth which then became eligible for program funding (Figure A1-4).

Figure A1-4: Assessment Phase II Results



County Conservation Districts inspected the roads and identified worksites

A1.10 Program Results. The program has been and continues to be a success. Projects undertaken and completed with program funds have been evaluated. A computerized GIS system is used for project tracking and central reporting with minimal paperwork. An implemented quality assurance/quality control (QA/QC) process continually monitors and evaluates completed projects, verifying that all but one project has met or exceeded expectations.

The following summary of the program data shows 1260 sites (projects) completed by the close of 2004 (Figure A1-5). The summary gives a breakdown of program funding, completed project costs and major work items, and a training summary of sessions and attendees. It should be interesting to note the amount of in-kind contributions, which are the materials and services donated to the projects by the local government grantees. Although contributions are not required and the projects are 100% fundable with program grant monies within the prescribed parameters, the in-kind contributions have averaged 35%. Comparing this to the many federal and state grant programs that require 10 to 25% matching funds, we can see the substantial **voluntary** commitment made by the Pennsylvania local governments. This factor again speaks to the acceptance and success of the program.

Figure A1-5: 2004 - DIRT AND GRAVEL ROAD PROGRAM SUMMARY DATA

-------All Data is CUMULATIVE Based on District Reports as of January 15, 2005-------

FINANCIAL SUMMARY

Total Allocated to Districts -	**$28,131,000**	
2 Spent on administration	$1,580,000	*(5.6% of total received) limit of 10%*
3 Spent on education	$408,000	*(1.4% of total received) limit of 5%*
4 Spent on completed sites (1,260)-	$18,328,000	*(65% of total received) (In-kind not included)*
5 Current contract commitments (236)-	$4,679,000	*(17% of total received) (Partially completed project included here)*
6 TOTAL SPENT/COMMITTED	**$24,995,000**	***(89% of total received)***

****In-Kind Contributions - $6,459,000 *(donated goods/services from participants) (Avg 35¢ per $1 spent)*****

COMPLETED PROJECT COST SUMMARY

Worksites complete - 1,260 -- Length of worksites complete - 597 miles

BREAKDOWN of $18,328,000 Program funds spent on completed sites

$14,878,000 for materials *(81%),* $2,510,000 for equipment *(14%),* $940,000 for labor *(5%)*

BREAKDOWN of $6,459,000 In-kind contributions for completed sites

$1,014,000 materials *(16%),* $2,791,000 equipment *(43%),* $2,375,000 labor *(37%),* $279,000 other *(4%)*

COMPLETED PROJECT WORK SUMMARY

4.6 Acres Drainage Outlets Stabilized	*= 2,007 outlets, each 10' x 10'*
4.3 Acres Eroded Stream Bank Stabilized	*= a steam bank 5 feet high and 7.2 miles long*
48 Acres Vegetative Management	*= an area 10 feet wide and 40 miles long*
57 Acres Eroded Road Ditch Stabilized	*= a ditch 5 feet wide and 94 miles long*
58 Acres Eroded Road Bank Stabilized	*= a road bank 5 feet high and 95 miles long*
87 Acres Separation Fabric Used	*= 40 miles of fabric placed 18 feet wide*
629 Acres Road Surface Stabilized	*= 288 miles of road 18 feet wide*
3,406 Crosspipes Installed	*= 5.7 pipes per mile*
126,000 Feet of Crosspipes Installed	*= 24 miles of pipe; average crosspipe length is 37'*
336,000 Cubic Yards of Road Base Added	*= 28,400 tandem-axle dump truck loads*

COMPLETED PROJECTS

YEAR	# Projects Complete	Money Spent on Completed Projects	Average Spent per Project
Pre-2002	750	$ 9,984,000	$ 13,312
2002	219	$ 3,596,000	$ 16,420
2003	170	$ 2,343,000	$ 13,782
2004	121	$ 2,405,000	$ 19,876
TOTAL	1260	$18,328,000	$ 14,546

2- DAY TOWNSHIP TRAINING SUMMARY:

YEAR	# of Trainings	Municipalities Trained	Counties Represented	Total Attendees
Pre-2002	90	na	all	2615
2002	15	191	45	336
2003	10	146	53	257
2004	8	142	53	294
TOTAL	123	na	all	3,502

The PA Dirt and Gravel Road Program is well established and continues to meet its goal of pollution reduction. The training is constantly under review and changes as more program work projects are completed. The program uses new experiences to develop new practices and test new materials. Environmentally Sensitive Maintenance Practices have been accepted and are being put to use, many of which apply to paved roads as well as unpaved gravel roads. This acceptance, as mentioned before, attests to the dedication and desire to do things better on the part of municipal road personnel. It is best put by one long-time Township Roadmaster who stated: "I wish I would have known these things 30 years ago!"

Resource: The Center for Dirt and Gravel Road Studies
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University Park, PA 16802
Tel: 814-865-5355
Fax: 814-863-6787
Toll-free: 866-NO-TO-MUD (866-668-6683)
Email: dirtandgravel@psu.edu
Website: www.dirtandgravelroads.org