Washington Transportation Plan Update

Health and the Environment

May 16, 2005 DRAFT

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Executive Summary

How can transportation investments be developed, implemented, and used in ways that at the same time enhance our citizens' transportation goals and our citizens' goals for healthy communities and a protected environment?

Transportation systems exist among a myriad of complex health and environmental concerns, including human health, natural ecosystem processes, species protection, climate change, and land uses.

Efforts to protect the environment and human communities at the Washington State Department of Transportation (WSDOT) and other transportation agencies take their cue from the citizen expectations that have been embodied over time in federal, state and local regulations and policies. Public discussion of emerging issues, advances in scientific knowledge, and the evolution of transportation practices can lead to additional enhancement needs.

Overview

This paper explores five ways that transportation systems interact with communities and the environment:

- Air quality
- Active living and healthy communities
- Highway, ferry, and transit noise
- Stormwater runoff
- Protecting and connecting habitat

These issues are closely related and while treated in separate sections here, readers should realize that there is significant overlap. Efforts to address these issues continue to evolve for a number of reasons, including new research findings, new regulations, citizen concerns, and refinement of business practices. In this paper, we discuss for each topic recent trends and scientific findings, current policies and practices, and recommendations for policy corrections and increased investment needs.

WSDOT is developing an analysis of growth management trends and policy recommendations that will be released as a stand-alone paper at a later date.

There are many other important environmental activities that transportation agencies undertake every day, including protecting cultural resources, preserving historic properties, environmental documentation, and more that are not featured here.

What is the purpose for this report?

This paper was drafted as part of the Washington Transportation Plan (WTP) update. The 2005 update to the WTP is a blueprint for transportation programs and investments. The

plan covers all modes of Washington's transportation system: roadways, ferries, public transportation, aviation, freight rail, passenger rail, marine ports and navigation, bicycles and walking. The WTP is required by state and federal law to be regularly updated. The update currently underway will be adopted by the state Transportation Commission in 2005, will cover the period 2007-2026, and will be the basis for an investment proposal to the legislature in 2007.

The WTP Update explores the future of transportation in nine key issues: system preservation, system efficiencies, safety, transportation access, bottlenecks and chokepoints, contributing to a strong economy and good jobs, moving freight, building future visions, and health and the environment.

This paper was designed to assess what current data and research indicates about health and the environment in Washington. The assessment led to the development of policy and investment recommendations to address concerns.

What are the findings?

The main findings for each topic in this paper are listed below.

Air quality

Emissions associated with transportation–from cars, trucks, buses, cargo vessels, cruise ships, ferries, and trains–are major sources of local air pollution and greenhouse gases. Air quality trends for regulated pollutants have improved over the past few decades, even as the state's population and vehicle miles traveled have increased. Concerns remain with air toxics, inhalable soot (small particulate matter), and diesel exhaust. Carbon dioxide is implicated in global warming, and the transportation sector is responsible for over half of the state's carbon dioxide emissions.

Active living and healthy communities

An increasing body of research shows that automobile-oriented land use development limits transportation options, adversely affect air quality and safety, and discourage physical activity. A rapid increase in obesity and Type II diabetes among children and adults is a serious health concern across the United States. Transportation (automobile dependency) has been implicated along with diet and other choices as a potential cause. Transportation investments can be used to promote physical activity, by providing active living facilities and choices for children and adults to incorporate into their daily travels to and from work, school, and errands.

Highway, ferry and transit noise

Highway, ferry, and transit traffic can create a lot of noise, sometimes at levels that are unacceptable for nearby neighborhoods. Federal law and state policy requires noise evaluations for certain types of projects. Before 1976, noise impacts were not accounted for on highway projects. WSDOT's Noise Retrofit Program allows placement of noise barriers on existing highways where homes existed before May 1976. More than 70 locations are on the priority list, subject to funding.

Stormwater runoff

Many of the state highway's stormwater outfalls were built prior to stormwater regulations and have no treatment facilities. To date, only 4,000 of WSDOT's estimated 18,000 to 24,000 outfalls have been inventoried, so adequate data is lacking to prioritize outfalls for retrofit. At the current rate of construction, it will take at least a century to fix all of the locations lacking treatment facilities.

Protecting and connecting habitat

Washington State has a wide diversity of habitats that support more than 650 native fish and wildlife species. As the population increases, and our human footprint expands, added pressure is placed on natural systems that are already heavily stressed in many cases. Many natural resources in Washington are at risk or in decline. Habitat fragmentation, road kill, and wetlands loss are some of the impacts that transportation systems can cause. Innovation and coordination can help transportation agencies better protect natural resources with transportation investments.

What are the recommendations?

Air quality

1. State policy-makers should continue to engage in the policy discussion to address carbon dioxide emissions, following the lead of the West Coast Governor's Global Warming Initiative.

2. Encourage Metropolitan Planning Organizations and Clean Air Agencies to work closely together on the transportation and land use issues that impact air quality.

3. Continue to support commute trip reduction (CTR) programs to reduce the number of single-occupancy vehicles on the road, to promote the use of alternative transportation modes, and to advocate for changes in laws, regulations and policies that will result in improvements to our transportation system.

Active living and healthy communities

4. State resources for pedestrian safety should focus on the most cost-effective solutions and locations that improve modal connections. Existing resources for paths and trails should be applied to statewide priorities that are consistent with local and regional needs.

Highway, ferry and transit noise

5. To continue in good faith to provide noise mitigation for projects that were constructed before the advent of noise regulations, WSDOT recommends reinstating funding for noise barriers to improve the livability of some of the state's older communities affected by increases in traffic noise.

Stormwater runoff

6. WSDOT proposes that the Transportation Commission significantly increase the Stormwater Retrofit Program to fund more retrofits and to expand the stormwater inventory. In order to determine what to fix first, WSDOT needs to continue and expand its inventory of outfalls and stormwater facilities. Only when the inventory is more complete can we be sure that we are addressing the highest priorities and identifying the most cost-effective locations.

Protecting and connecting habitat

7. Increase funding for existing Environmental Retrofit Programs in fish passage and chronic environmental deficiencies. Fish Passage Retrofit funding should be increased to accelerate barrier corrections. This is a critical part of the State's efforts to protect and recover salmon and other aquatic species. The Chronic Environmental Deficiencies (CED) program has so far been funded for startup, project identification, scoping and prioritization, but increased funding is needed to implement more retrofit projects.

8. The legislature should establish a new I-4 funding category for habitat connectivity– this would support identification and prioritization of problem areas, development of design guidance and coordination with agencies for planning for connectivity.

Introduction

Transportation systems touch and are touched by a myriad of complex health and environment issues, including human health, natural ecosystem processes, species protection, climate change and land use issues that are very important to transportation but are also controversial.

Environmental goals are reflected in state and federal law and they in turn reflect what the citizens of the state want: a protected and enhanced environment. Environmental compliance and commitment cuts across all transportation systems–from planning to construction to system operations and maintenance–for all modes, including roadways, ferries, transit, aviation and passenger and freight rail.

Transportation construction projects for highways and ferry terminals have environmental components that are integrated into project scope and budget, and are integral to project construction. Many environmental investments respond to specific permit requirements or other good practice purposes, such as wetland mitigation, erosion control, and stormwater treatment.

There are also some stand-alone environmental improvements in the state transportation program, in particular, retrofitting structures and facilities that were built to different standards than what we recognize as acceptable today. These projects are funded out of the I-4 budget program. Retrofit projects include fish passage barriers, stormwater treatment, and noise walls.

State highway investments also contribute to pedestrian and bicycling facilities. Two million dollars in safety funding is dedicated biennially to improving pedestrian accident locations; these projects are typically associated with state highway accident locations. In addition, the Washington State Department of Transportation's construction project budgets contain a dedicated percentage for paths, trails and sidewalks (three-tenths of one percent of the state and federal construction budget–about $3 million to $4 million annually). These types of facilities are typically part of an overall plan (often a regional plan) for creating an interconnected network for walking or bicycling. State law requires that the improvements made by highway revenues focus on transportation needs.[1] Transportation funds may not be used to build recreational paths and trails like those found in a park, for example.

This paper focuses on emerging issues and new state and local initiatives to improve the transportation system and the environment. WSDOT and others undertake many important everyday environmental activities, including protecting cultural resources, historic preservation, programmatic permits, environmental documentation, and other

[1] License fees and gas taxes fund state highway transportation improvements. The 18th amendment of the Washington State Constitution states that all fees collected as license fees for motor vehicles and all excise taxes on the sale, distribution, or use of motor vehicle fuel shall be used exclusively for highway purposes.

activities, that are not featured here. For a more complete description of WSDOT's environmental work, visit www.wsdot.wa.gov/environment.

Key issues selected for study in this paper on human health and the environment include:

- Air quality
- Active living and healthy communities
- Highway, ferry, and transit noise
- Stormwater runoff
- Protecting and connecting habitat

The following chapter presents trends, current programs, and preliminary recommendations in each of these areas.

Air Quality

The air we breathe

Regulated pollutants

The federal Clean Air Act, first passed in 1963, strengthened in 1970, and substantially amended in 1990, gives the Environmental Protection Agency (EPA) the authority to establish how much of a pollutant can be in the air anywhere in the United States. EPA established air quality concentration standards (National Ambient Air Quality Standards (NAAQS)) for six principal ("criteria") pollutants: particulate matter, carbon monoxide, ground level ozone, lead, nitrogen dioxide, and sulfur dioxide. Of the six criteria pollutants, three are currently and historically most important for air quality in Washington: particulate matter, carbon monoxide, and ozone.

Air pollutants come from four types of sources:

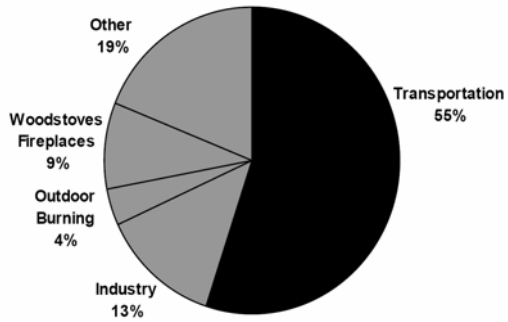
- Point sources such as factories and power plants.
- Mobile sources such as cars, trucks, and airplanes.
- Biogenic sources such as trees, vegetation, and gas seeps.
- Area sources such as dry cleaners, home heating systems, and lawn mowers.

It is estimated that transportation-related sources, mostly privately owned vehicles, are responsible for over half of the emissions of the six regulated air pollutants in Washington.

Mobile sources have historically emitted varying portions of all six criteria pollutants:

- Lead is a metal found naturally in the environment and in manufactured

Sources of Six Regulated Air Pollutants



Source: Washington State Department of Ecology, 2001

products. It affects the circulatory and nervous systems and can damage organs. Although the major sources of lead emissions have historically been motor vehicles and industry, the phase-out of lead in gasoline has nearly eliminated this air pollutant from transportation sources.

- Ozone is a gas composed of three oxygen atoms (O_3) and is a main ingredient in urban smog. At the ground level it is created during hot, dry, sunny weather from a chemical reaction between nitrogen oxides and hydrocarbons (volatile organic compounds (VOCs)). Motor vehicle exhaust and industrial emissions, gasoline vapors, and chemical solvents are the major sources of nitrogen oxides and VOCs. Ozone occurs naturally in the earth's stratosphere high above the earth and protects against harmful solar radiation. However, ground-level ozone triggers a variety of health-related problems at low exposures, can cause permanent lung damage, and damages plants and ecosystems.

- Nitrogen dioxide (NO_2) is one gas in a category of highly reactive gases (generically known as NO_x) formed when fuel is burned at high temperatures. Motor vehicles account for about half of the nation's emissions of NO_x. NO_x reacts with VOCs on hot still days to form ozone, as mentioned above; it reacts with sulfur dioxide and other substances to form acid rain; and it reacts with moisture, ammonia and other compounds to form potentially harmful particles. In addition, increased nitrogen loading in water bodies upsets the chemical balance of nutrients used by aquatic plants and animals.[2]

- Particulate matter (PM) is the term for particles found in the air, such as dust, dirt, soot, smoke, and liquid droplets.[3] In the past, EPA only regulated larger particulates (PM_{10}). Recently, however, researchers have come to believe that particulates smaller than PM_{10} are more harmful to human health, and in 1997, EPA initiated a standard for very small ("fine") particulate matter 2.5 microns in size (a micron is smaller than the human eye can see–30 microns are about the thickness of a finger nail). Some particles are directly emitted into the air and some are formed in the air from chemical changes of gases. Sources of particulates include motor vehicles, industrial boilers, wood stoves, open burning, and dust from roads, quarries, and construction activities. PM is associated with serious health effects and is a major source of haze. High PM concentrations occur in fall and winter during stagnant air periods and with the increased use of wood for heating. At times PM can be a regional and local "hot spot" problem in areas with a lot of diesel activity (such as major transit stations and truck loading areas).

[2] Environmental Protection Agency. Office of Air and Radiation. "Six Common Air Pollutants." Accessed from www.epa.gov/air/urbanair/6poll.html. 2004.
[3] Ibid.

- Carbon monoxide (CO) is a colorless, odorless gas that reduces the oxygen-carrying capacity of the blood. Motor vehicle exhaust contributes about 56 percent of CO emissions nationwide.[4] Other non-road engines and vehicles contribute another 22 percent of emissions. Industry, wood stoves, and slash burns are other major sources. CO exposure can lead to acute and chronic health effects and death at high levels of exposure. High CO concentrations are usually localized "hot spots," occurring near congested roadways and intersections during fall and winter.

- Sulfur dioxide (SO_2) reacts with nitrogen oxides and other substances to form acid rain, which can damage plants, water, and buildings. SO_2 can also cause respiratory problems. SO_x gases are formed when fuel-containing sulfur, such as coal and oil, is burned, and when gasoline is extracted from oil or metals are extracted from ore. The primary source of SO_2 is electric utilities, especially those that burn coal. Other sources of SO_2 are industrial facilities such as petroleum refineries, cement manufacturing, and metal processing facilities. Locomotives, large ships, and some non-road diesel equipment that currently burn high sulfur fuel also release SO_2 emissions to the air. The reduction of sulfur in gasoline starting in 2004, on-road diesel fuel in 2007, and many forms of off-road diesel from 2009 to 2012 should substantially reduce SO_2 emissions from transportation.

Commercial aircraft. Aviation operations also contribute to regional air quality, and facility operations and expansion projects are affected by regulations. There are a number of sources of airport emissions, and the contribution of individual sources is often not well understood.

In 1997 the EPA estimated that commercial, military, and general aircraft are responsible for about one percent of the total national ground-level emissions from mobile sources. A number of studies across the United States have concluded that the impact of aircraft on local air quality around airports is small relative to other sources such as motor vehicles. Within the airport boundary, a substantial contribution comes from aircraft engines at idle, taxiing and as the airplane begins to take-off. Other contributions come from the ground transport vehicles used for service and maintenance on the airport. There are other smaller sources, such as emissions from solvents used in cleaning engine parts and chemicals used in fire protection and air conditioning systems.

Air quality is generally assessed in terms of whether or not concentrations of air pollutants are higher or lower than the NAAQS, which are set to protect human health

[4] ibid.

and welfare. The EPA, the state Department of Ecology (also known as Ecology), and local clean air authorities establish regulations governing how unacceptable concentrations of pollutants will be handled.

Ecology and EPA designate regions as "attainment" or "non-attainment" areas based on their compliance with air quality standards. Once a non-attainment area achieves compliance with the NAAQS, the area is considered a "maintenance" area until the standard has been maintained for 10 years or more.

Diesel exhaust and inhalable soot

Diesel exhaust is a major source of $PM_{2.5}$ and other diesel particulate matter (DPM). These fine particles are especially damaging because they can be inhaled deeply into people's lungs, lodge there, and absorb organic compounds known to have mutagenic and carcinogenic properties. Diesel engines and fuels have received specific regulatory attention in recent years because diesel engines account for an estimated 66 percent of the particulate pollution from on-road sources. Other sources of $PM_{2.5}$ include agricultural burning, forest fires, residential heating, construction activities, and factory and utility smokestacks.

The short- and long-term health effects of $PM_{2.5}$ are matters of widespread concern in the public health community. The American Lung Association believes that $PM_{2.5}$ is especially harmful to people with heart disease and respiratory problems (especially the young and elderly) and that it can cause lung cancer. California classifies diesel exhaust as a toxic air contaminant and EPA classifies it as a possible carcinogen. There are currently no $PM_{2.5}$ non-attainment areas designated in Washington state.

Unregulated pollutants: Air toxics

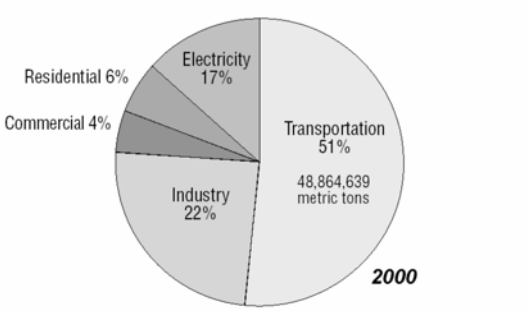
There are a number of unregulated hazardous pollutants referred to generally as air toxics that are known or suspected to cause cancer or other serious health effects. EPA has identified 188 air toxic compounds; 21 of these are related to transportation and are known as Mobile Source Air Toxics (MSATs). EPA has identified six "priority" MSATs with the greatest influence on health–benzene, 1,3 butadiene, formaldehyde, acrolein, acetaldehyde, and diesel particulate matter. There are growing concerns about these, especially benzene and diesel particulate matter, but EPA has not yet provided any air quality concentration standards of air toxics for cars and trucks. Approximately 90 percent of the cancer risk from air toxics in Washington comes from diesel particulate.[5]

Organizations such as the Sierra Club in its recent *Highway Health Hazards* report[6] and the American Lung Association expect transportation to minimize its air toxics contribution. However, monitoring has not produced stable, consistent results and we still have limited understanding of the quantity of emissions, ambient concentrations, and potential effects on human health and the environment of toxics in Washington's air.

[5] Washington State Department of Ecology. Air Quality Program Comments on Washington Transportation Plan Update. March 14, 2005.
[6] Sierra Club. *Highway Health Hazards*. 2004.

Unregulated emissions: Greenhouse gases and climate change

Carbon Dioxide (CO2) Emissions in Washington State by Source



Source: Washington State University Energy Program

Greenhouse gases are another emerging area of concern and a highly controversial topic in this country. Our planet has a natural "greenhouse effect:" carbon dioxide (CO_2), methane, water vapor and other gases help trap heat from the sun by allowing the sun's radiant energy to pass through the atmosphere while absorbing the Earth's lower wavelength radiant energy. There is strong scientific consensus that human activities are increasing the atmospheric concentrations of greenhouse gases, enhancing the "greenhouse effect" and contributing to warmer atmospheric temperatures. While other factors cannot be completely ruled out, most of the warming observed since 1950 is likely attributable to human activities.[7] In order to slow the rate of warming predicted by scientists, greenhouse gas emissions must be curbed.

Carbon dioxide and methane are the primary greenhouse gases increasing as a result of human activities (since 1750, carbon dioxide has increased 32 percent, methane has increased 150 percent). Internal combustion engines are large contributors to the increase in carbon dioxide.

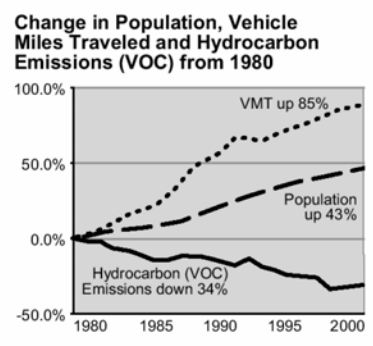
The accompanying chart shows that about half (51 percent) of the carbon dioxide emitted in Washington State comes from transportation sources. This is a higher proportion than in most of the United States, because our state's primary source of electricity (hydropower) does not emit carbon dioxide during electrical generation. Eastern states use coal-fired power plants that produce carbon dioxide during electricity generation and transportation sources make up a lesser proportion of the total emissions there. For the nation as a whole, roughly one-third of all carbon dioxide emissions come from transportation sources, and the transportation contribution is growing more rapidly than other sectors.

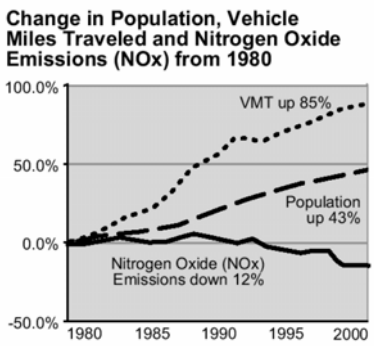
Although the effects of global warming are not certain, scientists predict dramatic economic and environmental consequences for this region and the world. In the Pacific Northwest, rising temperatures will cause mountain snow pack to diminish, while winter precipitation could increase, altering our region's hydrology–upon which our key industries depend–in numerous ways. Rivers fed by snowmelt will see reduced summer flow, increased winter flow, and earlier peak flow, while rain fed streams may also see increased wintertime flow. This could lead to more flooding in the winter and spring and

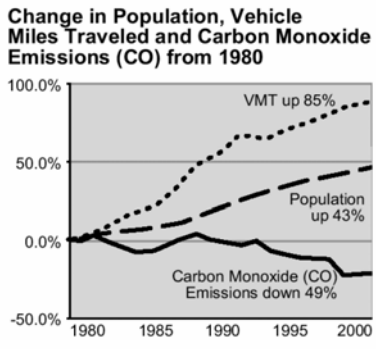
[7] Climate Impacts Group. Climate Impacts Group Web site. Accessed from www.cses.washington.edu/cig/. 2004.

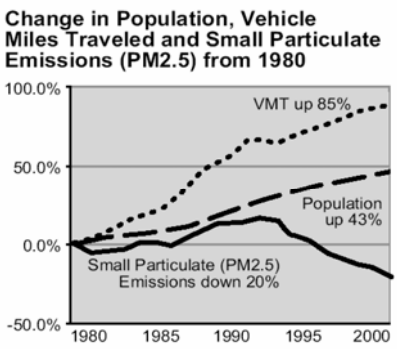
more water shortages in the late summer and fall. The frequency of forest fires, diseases, and pest infestations may increase. Sea-level rise will affect parts of the Northwest coast and wetter winters could lead to more landslides.[8]

It is expected that the citizens of Washington are likely to want some type of action on global warming, and transportation sources will need to be addressed. This WTP update examines the policies and actions that other states are taking on this issue and proposes several potential actions for Washington.









Source: WSDOT.

Trends in Washington's air quality

The good news about air quality in Washington and throughout the nation is that for most of the regulated pollutants there has been substantial improvement in the past 20 years, even as the state's population and amount of driving have increased. As shown in the accompanying charts, emissions of carbon monoxide, nitrogen oxides, hydrocarbons, and particulate from vehicles have steadily decreased over the past two decades. This can be attributed to federal emissions standards, improved vehicle technologies and designs such as the catalytic converter and other pollution control devices, and better fuel technologies. Better fuels and better vehicles have led to a large reduction in air pollution emissions per vehicle.

Even more important is that the number of days monitored as having unhealthy air–where federal standards were exceeded–has been nearly eliminated in recent years. Particulate matter (PM_{10}) is currently the only pollutant for which Washington occasionally exceeds standards in a limited area.

Pollutant concentrations do not exist uniformly throughout the state. As shown in the map below, different areas of the state have varying pollutant levels unique to the area's geography, economy, population, and other factors.

[8] Ibid.

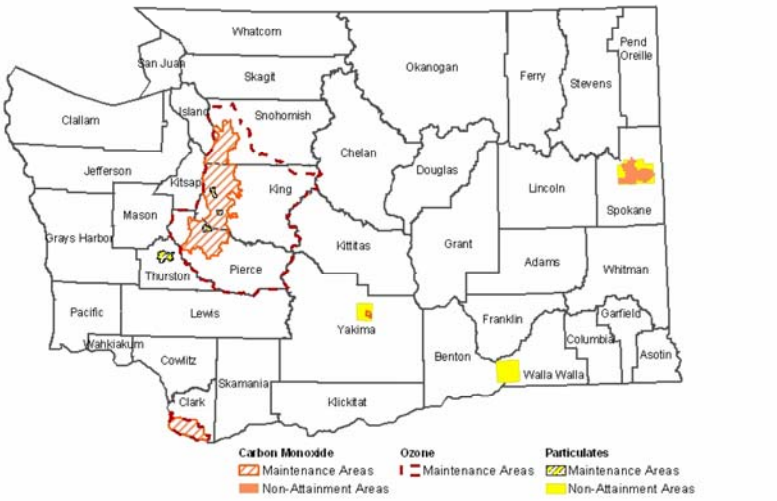
State and local clean air authorities are responsible for implementing air quality regulations and pollutant controls; transportation projects must conform to these regulations. The Puget Sound area and the urbanized area of Clark County are in maintenance status for ozone, which means that these areas had violations of the ozone standard in the past but are currently in compliance.

For carbon monoxide, the urban area of Puget Sound region and Clark County had violations of the standard in the past. Spokane is still technically considered a non-attainment area for carbon monoxide and is especially challenged by weather factors and the bowl-like geography of the area, though Spokane's monitored levels of carbon monoxide have been on a steady decline over the past eight or so years. Yakima has been approved as a maintenance area.

For particulate matter (PM_{10}), the Kent Valley, Seattle Duwamish, Tacoma Tideflats, and Thurston County areas are now maintenance areas. Yakima, Wallula, and Spokane have developed maintenance plans and approval from EPA is expected by the end of 2005.

No recorded violations of the standards in the state's air quality problem areas have been recorded since 1997. In the City of Colville there continues to be about one exceedance per year of PM_{10} related to road dust and sanding for winter traction. At this time the EPA has not decided whether to designate it as a non-attainment area. The town is taking active measures to reduce PM_{10} by purchasing vacuum street sweepers and using lower-dust-emitting sanding material.

Washington's Non-Attainment and Maintenance Areas



Source: Department of Ecology

When an area is determined to be out of compliance (non-attainment), the state is required to act quickly to reduce air pollution to healthful levels and establish controls to keep the area compliant through a 20-year maintenance plan. This framework is called a State Implementation Plan (SIP). The special requirements that apply to ensure that proposed transportation projects do not cause or contribute to existing air quality problems in non-attainment and maintenance areas are discussed below.

Diesel exhaust and inhalable soot

$PM_{2.5}$ emissions leveled off in the late 1980s and then began declining in the early 1990s. That decline is due mostly to federal regulatory changes in fuel and diesel engine performance standards for heavy-duty trucks. In 1988, new electronic exhaust and fuel efficiency equipment became required. In 1993, permissible sulfur content for all diesel fuel used for on-road driving was reduced from 5,000 to 500 parts per million (ppm). Some further particulate emission reductions in 1994 were achieved with the urban bus program that helped to retrofit bus engines to meet new emissions standards.

Truckers are required to stay off the road for at least eight hours per day to combat potential fatigue. While taking their required rest at truck stops, they most often need to idle their engines to provide heating, air conditioning, and power for equipment in the cab. The EPA estimates that nationally, truck idling consumes more than 1 billion gallons of fuel each year at a cost of almost $2 billion and emits 11 million tons of pollution.[9]

Transportation actions on air quality

Regulated pollutants

State transportation projects must conform to the SIP in air quality nonattainment and maintenance areas before the Federal Highway Administration (FHWA) and EPA can approve construction. In general, under conformity rules, transportation plans, programs, and projects cannot:

- Cause or contribute to any new violation of air quality standards;
- Increase the frequency or severity of any existing violation of air quality standards; or
- Delay timely attainment of air quality standards.

Conformity is determined by modeling future emissions using assumptions about current and future population, employment, travel, and congestion trends developed by the local Regional Transportation Planning Organization (RTPO) or Metropolitan Planning Organization (MPO). Some projects require a "hot-spot analysis" that estimates impacts to carbon monoxide and PM_{10} levels on a smaller scale than the entire non-attainment or maintenance area, such as at congested intersections and highways or transit terminals. Projects that don't meet conformity tests cannot move forward without design fixes, which usually involve reducing idle time for vehicles through improving signal timing or adding turn lane options.

Projects that involve earthwork or have the potential to create fugitive dust (particulate matter that is suspended in the air by wind or human activities) are required to use best management practices (BMPs) to control dust at project sites. Air quality studies also address potential odors and how to reduce the potential for airborne asbestos from natural sources in the ground or from demolition work.

[9] Environmental Protection Agency. Office of Transportation and Air Quality. "Idling Impacts." Accessed from www.epa.gov/smartway/idlingimpacts.htm. 2004.

One way that other states (such as California) are moving toward decreased emissions goals is by adopting Low Emission Vehicle (LEV) programs. These are more stringent than federal requirements and target tailpipe emissions for steady declines, forcing a higher percentage of advance technology vehicles to be sold in their states. Seven states have adopted California's LEV II standards: New Jersey, Rhode Island, Connecticut, New York, Massachusetts, Vermont, and Maine. These seven states and California account for nearly 26 percent of the nation's auto market.

Diesel exhaust and inhalable soot: Improving human health

Three main emphases are emerging as effective ways to reduce pollution from diesel engines: using less polluting fuels and engines, reducing diesel idling, and retrofitting older vehicles with emission reduction technologies.

Standards for less polluting fuels and engines. $PM_{2.5}$ emissions should decline as new regulatory standards for sulfur levels in gasoline take effect. Additional particulate reductions are coming in the near future. Between 2004 and 2006, the permissible sulfur content in gasoline will decline from about 350 ppm to 30 ppm. EPA estimates that lowering gasoline sulfur levels will bring an annual reduction of about 4,300 premature human deaths and 2,300 cases of bronchitis.

In 2006, EPA will require sulfur levels in on-road diesel fuel to decline from 500 ppm to 15 ppm and in 2007, new heavy duty diesel engines will be required to include exhaust systems that will filter out more than 90 percent of the soot and toxic chemicals that come out of the truck stack. This change is anticipated to reduce annually about 8,300 premature deaths and 360,000 asthma attacks, in addition to many other health benefits. Between 2009 and 2012 off-road construction equipment, marine vessels, and railroads will also be required to use lower sulfur diesel, which will reduce another 12,000 premature deaths by the year 2030, according to EPA. As a package of controls that affect transportation, these will move the nation toward substantial improvement in the air environment over the next five- to eight- years.

Conversion of diesels used in transportation to low sulfur or ultra low sulfur at an even faster rate than required by regulation is a step that may be attractive to fleet operators and transit systems. Steps in this direction are in progress around the state and country.

The Washington State Ferries recently began using lower sulfur fuels in 2004 at a cost of only about an additional penny per gallon. The entire fleet has switched to low sulfur diesel fuel, which will reduce particulate emissions by about 30 percent fleet-wide. Ultra-low sulfur diesel fuel and biodiesel made from renewable vegetable oils is undergoing controlled tests.

Intercity Transit in Olympia was the first transit agency in the state to use biodiesel. Its fleet uses a blend of 20 percent biodiesel and 80 percent regular diesel. Federal studies by the EPA and Department of Energy have indicated that an 80/20 mix reduces vehicle emissions by 20 percent for particulates, 13 percent for carbon monoxide, and more than

10 percent for hydrocarbons. Other transit agencies, cities, counties and private citizens in Washington also use biodiesel for fuel.

Reducing diesel idling. A number of steps to reduce diesel idling are underway and in consideration around the country. The California Air Resources Board recently implemented limits on the amount of time heavy diesel trucks and buses can idle. Other initiatives include promoting truck stop electrification, electrification options at highway rest areas, and port-oriented idling reductions near loading facilities. EPA has initiated the West Coast Diesel Collaborative to reduce diesel emissions along the I-5 corridor between Mexico and Canada. The collaborative seeks funding of $100 million per year, for the next five years, to fund projects that reduce diesel emissions.

Idle reduction technology allows trucks to use the power grid's more efficient electricity, rather than their own diesel engines, to provide a comfortable space and needed in-cab services. New Jersey recently unveiled its first diesel emission reduction project, a $1.5 million advanced electrification installation at a truck stop in Paulsboro that will cost truckers less to use (about $1.40 an hour) than the cost of idling a diesel engine (an estimated $3 an hour). The Department of Ecology has developed a $400,000 project supported by funding from EPA and the Climate Trust to install truck stop electrification equipment at some truck stops in Washington. Installation of equipment to allow trucks stopping overnight to shut off their engines and get grid-powered climate controlled air will be installed by the end of 2005.

Implementing emission reduction technologies. The technology gains that enable newer trucks to operate with dramatically lower levels of emissions than older trucks should be extended. Older vehicles should be retired or retrofitted. Major gains in $PM_{2.5}$ emissions can occur by expediting in-service fleet turnover and purchasing newer diesel trucks.

School buses are a special concern. Emissions from older school buses expose children to harmful pollutants. In 2003, the Washington legislature provided $25 million to upgrade the state's existing school buses with emission reduction technology. The Office of Superintendent for Public Instruction, the Washington State Patrol, Department of Ecology, and Local Clean Air Authorities have implemented a statewide school bus diesel emissions reduction program that is installing diesel oxidation catalysts on existing school buses to reduce air pollution contributions. When possible, this program is also installing particulate filters on school buses to even further reduce emissions. According to the Office of the Governor, a similar program in Iowa reduced diesel soot emissions by 27 percent.

Rail use provides current emissions savings and future opportunities. Another way to reduce emissions is using efficient transportation systems and modes. Continued emphasis on rail to move freight in and through Washington provides region-wide air quality benefits by reducing small particulate and air toxic emissions from diesel. Locomotives can move greater amounts of agricultural and commercial products long-distance across the state while burning less fuel than the equivalent number of trucks.

Since the trains (both passenger rail and freight) mostly run on track separate from the roadway network, competition with cars and trucks is minimized.

Unregulated air toxics

The Clean Air Act does not make transportation agencies directly responsible to address air toxic emissions, and there are currently no approved methods to evaluate air toxic emissions from transportation sources at either project or regional levels. Efforts to address diesel exhaust, as described above, will also help address air toxics. In addition, EPA is expected to work on new rules for air toxics in 2005.

The Federal Highway Administration's ongoing work in air toxics includes research to determine and quantify the contribution of mobile sources to air toxic emissions, possibly establishing policies for addressing air toxics in environmental documentation, and assessing scientific literature on health impacts associated with motor vehicle toxic emissions[10].

The 2004 Ford Focus ZTW Wagon and the 2004 Volkswagen Jetta Sedan GL, two new models that meet California's emissions standards as Partial Zero Emission Vehicles (PZEV).

Unregulated greenhouse gas emissions

In September 2003, the governors of Washington, Oregon and California committed to a regional greenhouse gas reduction initiative. They developed joint policy recommendations on five emissions reduction strategies: hybrid vehicle procurement by government agencies, reduced port and highway diesel emissions, renewable energy investments, energy efficiency investments, and measurement and reporting.[11] Recommendations were released in November 2004 and outgoing Washington Governor Gary Locke introduced several draft bills for the 2005 legislative session seeking emissions reductions for new vehicles, efficiency gains in appliances, and investments in renewable energy and energy conservation.

Transportation's large share of carbon dioxide emissions in this state means it has a large role to play in reducing emissions. There are two primary ways to reduce transportation's carbon dioxide emissions: improve vehicle technology and reduce driving. Both of those are worth pursuing in various ways.

Experience with controlling other pollutants has shown that improved vehicle technology can provide substantial benefits. Using fuel more efficiently, as well as using new and alternative fuels, can reduce motor vehicle greenhouse gas emissions and the emissions

[10] Federal Highway Administration [FHWA]. Planning, Environment, and Realty. "Transportation and Toxic Air Pollutants." Accessed from www.fhwa.dot.gov/environment/airtoxic/. 2004.
[11] West Coast Governors' Global Warming Initiative. *Staff Recommendations to the Governors.* November 2004. Accessed from www.energy.ca.gov/global_climate_change/westcoastgov/index.html.

of other harmful pollutants as well. Some of these technologies, including more efficient vehicles, are available today.

In the meantime, other major gains can be achieved with current technology. There are immediate opportunities to substantially reduce greenhouse gas emissions through personal choices:

- Conserving fuel;
- Using energy-efficient vehicles;
- Carrying less weight in your car;
- Maintaining your vehicle for optimum performance (e.g., maintain tire pressure);
- Linking trips so that your trips take advantage of a warm engine and improved fuel economy; and,
- Carpooling, taking the bus, walking or riding a bike instead of driving alone.

State regulatory actions. California is proposing new carbon dioxide pollutant standards for passenger cars and light trucks beginning in 2009. They are controversial and are being challenged by some automakers. Other states, including New York, Massachusetts, New Jersey, Vermont, Connecticut, Rhode Island and Maine, as well as the nation of Canada, have indicated that they will follow California's lead and adopt similar carbon dioxide standards. If all of those states and Canada adopt the rule, the number of cars required to meet the rule will triple. The Washington State Legislature passed a vehicle emissions bill in April 2005 that would adopt the California standards for Washington.

According to the California Air Resources Board (CARB), the standards would reduce per vehicle carbon dioxide emissions by about 22 percent in 2012 and another eight percent in 2016. The improved vehicle technology is projected to add a cost of $325 per vehicle in 2012 and about $1,050 per vehicle to comply by 2016, according to CARB. CARB concludes that the new rule will result in an overall cost savings for vehicle buyers by lowering operating expenses over the long term.

The new carbon dioxide regulations stem from a 2002 law authored by California Assemblywoman Fran Pavley. Automakers and the federal government initially litigated against the Pavley law, arguing that only the federal government has the authority to establish fuel economy standards (known as CAFE–Corporate Average Fuel Economy). California won that challenge and Governor Schwarzenegger has vowed to go to court to defend the regulations, which have broad bipartisan support in California. In early 2005, the California legislature will review the regulations, and the rules will go through a final administrative process by CARB and the Office of Administrative Law.

New Jersey recently proposed amendments to the state's air pollution control regulations to classify carbon dioxide as a pollutant. The state says that this action will lay the groundwork for regional initiatives to reduce emissions.

Next steps for transportation agencies

The Washington State Ferries should continue its low-sulfur diesel and biodiesel pilot research, and implement fuel and technology conversions as appropriate.

WSDOT should continue to monitor and support local, state and national efforts to address air toxics in project planning and construction.

Public works agencies (including WSDOT) should monitor changes in regulations that require improvements throughout the agency and its contractors (such as those for on- and off-road equipment, the ferry fleet, and performing compliance and air quality assessments to remove and replace high emitting equipment and vehicles). The agencies should also stay abreast of improvements in fuel source and fuel efficiency technologies.

WSDOT should support freight rail and passenger rail efforts to reduce locomotive idling and improve the fuel efficiency of locomotives. WSDOT should also support rail based farm-to-market initiatives that reduce particulate and toxics emissions by decreasing the number of diesel trucks on the road by continuing or implementing more efficient freight rail service. And WSDOT should continue to support grade-separation projects that eliminate vehicle idling at train crossings and allow rail movement that is safe and fuel-efficient.

WSDOT should support the EPA's effort to further reduce aviation pollutant emissions and encourage research for fuel-efficient airport operations in the state (it is expected that with new clean engine technology and advancements in airport operations procedures that emissions will be reduced).

Transportation-related agencies in the state should partner to actively educate the public about fuel-efficient travel habits and proper vehicle maintenance. In this regard, WSDOT should work with FHWA to update air quality messaging with improved public service announcements (PSAs) and a public education campaign.

Draft recommendations for the Transportation Commission

State policy-makers should continue to engage in the policy discussion to address carbon dioxide emissions, following the lead of the West Coast Governor's Global Warming Initiative.

Encourage MPOs and Clean Air Agencies to work closely together on the transportation and land use issues that impact air quality.

Continue to support commute trip reduction (CTR) programs to reduce the number of single-occupancy vehicles on the road, to promote the use of alternative transportation modes, and to advocate for changes in laws, regulations and policies that will result in improvements to our transportation system.

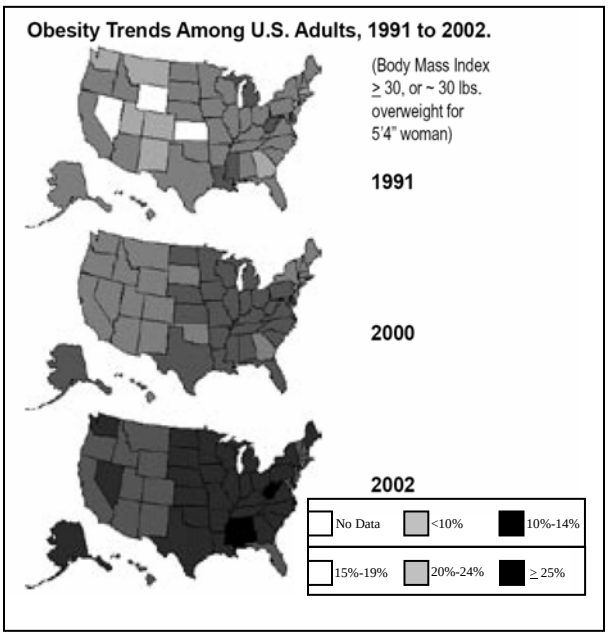
Active Living and Healthy Communities

Transportation not only determines how we move from place to place, but also the character of our communities. There is an increasing body of research showing that automobile-oriented land uses (e.g., those that create auto dependency) limit transportation options, adversely affect air quality, water quality and safety, and discourage physical activity. As a result, the public health profession has a renewed interest in transportation issues that has not been seen for more than 200 years. In the early to mid-1800s, public health officials first addressed urban issues such as diseases resulting from crowded housing with poor drainage and unpaved streets littered with horse manure and other forms of garbage. America saw massive policy changes and the creation of a new profession (urban planning) to address these public health issues.[12]

Transportation and human health trends

Some of the most compelling new research related to transportation and health has shown that:

- Children's walking trips to school have declined by 40 percent between 1977 and 1999, and children between the ages of 5 and 15 make only 10 to12 percent of their school trips by walking or riding their bicycles.[13]
- Nearly a third of our nation's children and adolescents are overweight or at risk of becoming overweight. This proportion has more than doubled over the past 20 years.[14]
- Statistics from the Centers for Disease Control and Prevention show that obesity trends among adults in Washington State went from less than 10 percent in 1991 (according to the CDC's definition of obesity) to the 20 to 24 percent category today.[15]
- One half of all trips people make are less than three miles, but most of these are made by car.[16]



Source: Centers for Disease Control and Prevention

[12] Frumkin, Howard, Lawrence Frank, and Richard Jackson. *Urban Sprawl and Public Health*. Washington, D.C.: Island Press, 2004.
[13] Centers for Disease Control and Prevention. Active Community Fact Sheets. 2000.
[14] Centers for Disease Control and Prevention. National Center for Chronic Disease Prevention and Health Promotion. "Obesity Trends." Accessed from www.cdc.gov/nccdphp/dnpa/obesity/trend/index.htm. 2004.
[15] Ibid.
[16] FHWA. National Personal Transportation Survey, 1977, 1995, 2001.

- People walking and biking on the road face disproportionately high risks as 13 percent of all traffic deaths are pedestrians.[17]

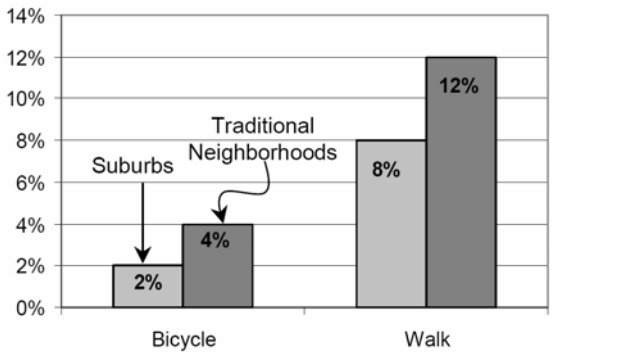
The rapid increase in obesity, diabetes, and asthma among children and adults has been widely covered in the media and is a serious concern across the country. Many people are trying to diagnose the cause of this. Transportation and land use have been implicated along with diet and other factors in this discussion.

Transportation

WSDOT recognizes its role in helping to sustain the environment and quality of life by improving transportation in Washington. A recent study sponsored by WSDOT and conducted by the University of Washington compared two Puget Sound urban areas: the Wallingford neighborhood near the City of Seattle and the Crossroads neighborhood near the City of Bellevue. These communities had very similar population densities but the frequency of walking trips and transit trips was much greater in Wallingford than in Crossroads because Crossroads did not have the same level of supportive pedestrian facilities. The increased walking in Wallingford was attributed to the presence of sidewalks, lower speeds, connections between transportation systems, and the overall layout of this traditional neighborhood that was built to support walking.

Studies to date have found that walking trips increase with street connection efficiency, such as grid patterns.[18] Additionally, people who report having access to sidewalks are 28 percent more likely to be physically active.[19] In traditional neighborhoods with sidewalks and connected streets, walking and bike trips tend to substitute for auto trips, particularly in urban neighborhoods.

Percentage of Population Traveling by Walking or Biking



Source: Friedman, Gordon, Peers. Transportation Research Record 1466, 1996.

Land use

Spread out and segregated land use patterns and trends are commonly implicated as contributing to increased auto dependency and a rise in obesity. Mixed land uses have been shown to increase the number of biking and walking trips. For trips less than a mile long, mixed use communities generate up to four times as many walking trips.[20] From 1960 to 1990, the percentage of workers with jobs outside their counties of residence tripled.[21] Research

[17] Surface Transportation Policy Project. *Mean Streets*. 2004.
[18] Ewing and Cevero, *Transportation and the Built Environment: A Synthesis*. 2001.
[19] Brownson R. "Environmental Determinants of Physical Activity in the US," *American Journal of Public Health,* Vo. 91, 2001.
[20] Holtzclaw, J. Using Residential Patterns and Transit to Decrease Auto Dependence and Cost. Natural Resources Defense Council, 1994, pp. 16-23.
[21] Bureau of Transportation Statistics. Journey to Work. 2001.

also points to siting of new schools outside urban areas as a factor in increasing auto dependency and decreasing physical activity for America's youth. In some cities and counties, minimum acreage standards for new schools require that they be built in outlying areas, away from established neighborhoods. As a result, only one in eight children walk to school.[22]

Trails and parks

A number of resent studies suggest that the presence of trails, greenways, and parks can increase physical activity among adults as well as children. Several state studies show that when people have access to trails or parks near their homes, they are more likely to walk.[23]

The problem is evident, but the solution will require much more discussion and research. It is likely that these discussions will shape future transportation policy to support human health.

Promoting health and active living

There are three types of state transportation investments that promote health: investments in general pedestrian safety, investments in safe routes to schools, and investments in planning for active community environments at the regional level.

Pedestrian safety programs

WSDOT places a priority on improving pedestrian and bicycle safety through the construction of sidewalks, trails, crosswalks, medians, and other features, particularly when these features result in increased opportunities for children and others to be physically active and reduce environmental impacts.

Safe Routes to Schools Program

This state-funded grant program provides children a safe, healthy alternative to being driven by parents or riding the bus to school. Eligible projects target:

- Engineering fixes such as sidewalks, pathways, street safety, and design improvements
- Safety education curriculums and programs to encourage children to become physically active by walking and bicycling to school
- Local law enforcement agencies enforcement programs to improve traffic safety around schools with school zones, school route law and safety enforcement programs

[22] Beaumont, C. *Why Johnny Can't Walk To School*. National Trust for Historic Preservation, 2000.
[23] See Nebraska Health and Human Services System. Strategies to Promote Physical Activity in Nebraska. 1998, and Brownson R. "Promoting Physical Activity in Rural Communities: Walking Trail Access, Use and Effects." *American Journal of Preventative Medicine*, Vol. 18, 2000.

- Community health and encouragement initiatives that educate people about the long-term community health benefits when parents and children can take advantage of safe ways for biking and walking to school

Active community environments

This five-year partnership between the Departments of Transportation, Health, and Community, Trade and Economic Development, and Regional Transportation Planning Organizations seeks to incorporate transportation policy and infrastructure changes to improve walking and bicycling safety, and use urban planning approaches related to zoning and land use that promote physical activity with a particular focus on aging populations.

There are several other pilot projects with funding from agencies and organizations like the Centers for Disease Control and Prevention, Washington State Department of Health, and the Washington Traffic Safety Commission that promote the increase of activity in communities through transportation research and investments.

Next steps for WSDOT

Context Sensitive Solutions (CSS) and healthy communities

WSDOT will examine new program opportunities to evaluate and prioritize projects that incorporate good planning and design and help WSDOT incorporate context sensitive elements into mainstream project development. An example of this approach would be prioritizing small bridge projects that, through good planning and design, provide a pedestrian or bicycle connection, eliminate barriers to fish passage, and preserve functionally obsolete or structurally deficient bridges for pedestrian use. Another example would be to target main street and town center improvements to help concentrate development, stimulate the economy and improve safety for pedestrians.

Research and program development

WSDOT will continue to build on the existing partnership with Departments of Health and Community Trade and Economic Development to collect health impact assessments and identify areas for improvement within targeted communities. WSDOT will also continue to conduct research to assist in developing a more integrated and more efficient transportation system.

Draft recommendations to the Transportation Commission

As outlined in more detail in the *Bicycle and Pedestrian Element* of the *Washington Transportation Plan*, state resources for pedestrian safety will focus on the most cost-effective solutions and locations to improve modal connections. Existing resources for paths and trails should go toward statewide priorities that are consistent with local and regional needs.

Highway, Ferry, and Transit Noise

Noise from transportation is an important issue for roadside residents and transportation agencies. Excessive traffic noise is a common complaint and thousands of people in Washington are affected. One of the more common complaints is traffic noise interfering with conversations in yards and patios. When traffic noise approaches 67 decibels it starts interfering with normal speech between two people standing about a meter apart. Sixty-seven decibels is around the normal sound level at which people talk.

Traffic noise affects people differently. It may interfere with talking. It may also affect the ability to work, learn, and sleep. Long-term exposure to high noise levels can cause hearing loss.

The level of traffic noise depends primarily on three factors:

- The volume of traffic,
- The speed of the traffic, and
- The number of trucks in the traffic.

Other items that affect roadway sound levels are pavement age and type, tire type, distance of listeners from traffic, terrain, amount of vegetation, and objects between the noise sources and listeners. Transit noise levels also depend on the number and location of buses, number of train engines, train wheel type, curvature of the rail, if there are rail joints on the tracks, etc. Ferry noise comes from vessel engine emissions, whistle blows, and the noise from cars, trucks and motorcycles that as they load and unload.

Federal and state noise evaluations are required for certain types of transportation projects. Noise is studied for projects that construct highways at new locations or significantly alter the alignment or number of lanes on existing highways. Noise may also be evaluated for projects that substantially change roadside topography (such as through flattening slopes or removing earth berms), or if sound levels are increased for wayside residents. Park and ride lots, new transit stations, substantially altered transit stations, rail yards, and other facilities are evaluated for their transit oriented noise impacts. Light rail and monorail routes are also evaluated for noise and vibration.

For public buildings like schools, hospitals, and libraries, interior noise reduction options include insulating windows, walls, and sealing openings, and installing air conditioning so windows can remain closed.

Highway noise trends

Traffic noise has been increasing for wayside residences due to growing traffic levels. The number of complaints that WSDOT receives about noise and requests for noise barriers where they were never considered or constructed continues to rise.

From 1963 to 2004, WSDOT built approximately 70 miles of noise barriers throughout the state. Noise barriers tend to favor more densely populated areas and are not proposed for roadway projects at locations that would not receive a feasible noise reduction or where the barrier would cost too much. Transit-oriented noise mitigation follows a similar pattern.

The goal for noise barriers is to cut the noise level in half at the first row of residences. Barriers are good at reducing sound levels behind them for about 200 to 300 feet. Concrete noise walls average about $32 a square foot to build–a nine-foot-high, one-mile-long concrete noise barrier costs approximately $1.5 million. Noise barriers in urban areas may cost much more to build (sometimes more than $100 per square foot), depending on the location.

Ways to reduce transportation-related noise

There are three general strategies for controlling traffic and transit noise:

- **Land use control**: develop land adjacent to the highway, ferry, or transit route in a manner that reduces or eliminates noise problems. Shopping malls, office space, and other commercial areas are better choices near highways than schools or homes. Designating open space to help dissipate noise before it reaches receivers is another land use option. Some states have enacted land use regulations to reduce the need for future noise barriers.

- **Motor vehicle control**: implement source control and quiet vehicles at the source (e.g., quieter truck exhaust stacks and tire tread patterns, reduce the need for truck compression braking, lubricate tracks to reduce or eliminate curve squeal for light rail). The Noise Control Act of 1972 gives EPA the authority to establish noise regulations to control major sources of noise, including transportation vehicles and construction equipment. The legislation requires EPA to issue noise emission standards for motor vehicles used in interstate commerce. Both the Federal Highway and Transit Administrations follow similar procedures and standards for the respective transportation projects they fund.

- **Highway planning and design**: incorporate noise reduction measures in highway construction projects. Highway planning and design noise reduction options include constructing barriers (concrete walls or earth berms),

providing thickly vegetated buffer zones of 200 feet or more, managing traffic (reduce speeds, reduce trucks), and moving the roadway away from receivers.

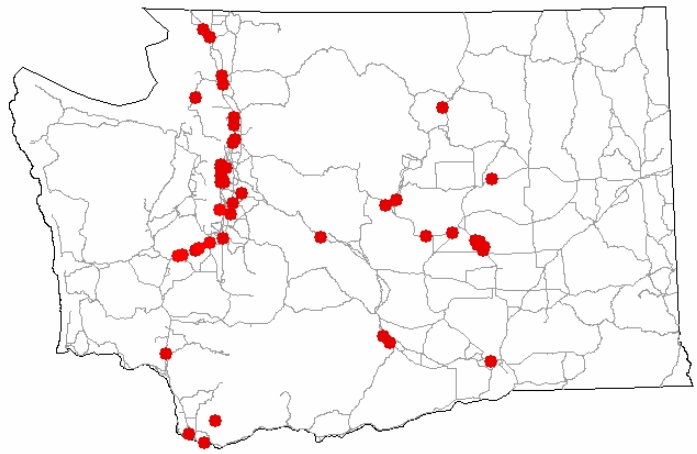
WSDOT and other transportation agencies primarily address noise reduction through the means most under their control: facility planning, construction, and design.

Reducing highway noise

Highway Improvement Program projects. Noise studies are considered for all highway projects that add through-lanes, significantly realign roadways or substantially change existing ground contours. For highway noise, impacts are identified when noise levels reach 66 dBA (decibels A-weighted) or if sound levels increase by 10 dBA for sensitive land uses like homes, apartments, parks, day care facilities, hospitals, and schools. Once noise impacts are identified, noise mitigation is considered (e.g., walls, earth berms). Transit noise impacts occur when the proposed project raises the noise level by certain amounts (sliding scale) based on the existing background noise level. If impacts are identified, mitigation is considered similar to roadway noise.

Retrofit Program. WSDOT has a prioritized list of locations to retrofit existing highways with noise barriers where homes existed before May 1976. These homes were never considered for noise reduction since noise regulations were not in place before that time. WSDOT currently has about 70 sites listed and prioritized throughout the state. Priority is determined by several factors, including the number of people that a barrier would benefit, the estimated barrier cost, and noise level. Retrofit locations are mostly in populated urban areas; some are near schools. Construction and funding of walls from this list should take priority over stand-alone noise reduction projects outside of the highway improvement program.

Noise Barrier Retrofit Locations on State Highways



Source: WSDOT

Reducing construction noise

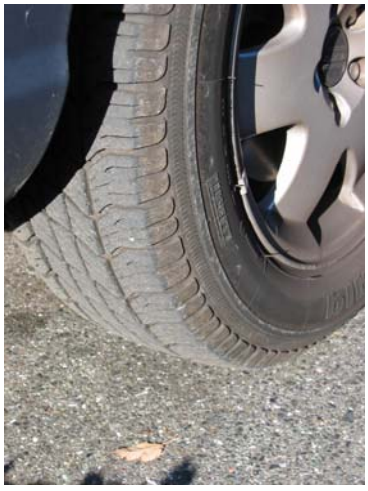
WSDOT works with many cities and counties to assure compliance with local ordinances that may limit construction noise levels at night and on weekends.

Although there is a state law[24] and accompanying administrative code[25] concerning noise control in the state, WSDOT is continually challenged by substantially different noise requirements from jurisdictions along the same roadway project (for example, for a 30-mile project along I-405, WSDOT needed to obtain 13 nighttime noise variances with 13 different sets of requirements). Such differences lead to difficulties in scheduling projects during the construction season without substantial delays for the traveling public. Even though the local jurisdictions may have good intentions when crafting the ordinances that limit and sometime eliminate night and weekend work, the unintended consequences for WSDOT, the local communities, and the traveling public can make the differences between jurisdictions very cumbersome.

Methods to reduce the number of differences and restrictions on night work for vital roadway stretches are needed to assure worker safety and continued and predictable traffic flow. WSDOT is working on a programmatic approach to create an umbrella of requirements for some nighttime noise variances, but additional efforts may be needed to provide exemptions in either the WAC or RCW. WSDOT is working on recommendations for the Department of Ecology to consider modifying the WAC to possibly exempt highway construction from state property line noise requirements. The state legislature could also update the RCW to exempt highway construction projects from the property line noise levels, in appreciation of the greater public benefit provided by the speedy completion of construction work on our congested roadways.

New pavement types for potential noise mitigation

Citizens have asked WSDOT about the potential use of alternative pavement types, such as the rubberized asphalt piloted in Arizona and the open graded asphalt pavement under study in California. Most citizen inquiries come from urban areas along I-5, I-90, I-405, and SR 520.



Open graded and rubberized asphalts are not currently considered by WSDOT or the Federal Highway Administration as a viable answer to noise mitigation, when compared to noise walls, berms or moving a highway. Both pavements have been shown to be more costly (on a life cycle basis) and less durable than traditional dense graded hot-mix asphalt (HMA) pavements or Portland Cement Concrete (PCC) pavements. Open graded and rubberized asphalt mixes may measurably reduce tire noise on the road, but they do nothing to mitigate for engine and exhaust noise.

[24] RCW 70.107
[25] WAC 173-60

Although current studies in Arizona and California show audible noise reductions from these pavements in the short term, the level of reduction does not meet this state's minimum noise reduction criteria of seven decibels and would therefore be considered infeasible for noise mitigation. WSDOT's goal for its barriers is a 10-decibel reduction. Arizona and California continue to study the long-term noise improvements from these different surfaces.

Climate, the practice of traction sanding, and the use of studded tires in the Pacific Northwest provide for a very different environment than California and Arizona. Only select areas of Washington have the warm temperatures needed for application of the rubberized asphalts (Arizona requires that the pavement temperature on the ground be above 85 degrees Fahrenheit for placing this type of pavement). In urban western Washington, to avoid severe roadway congestion, most paving is conducted at night when pavement temperatures rarely exceed 85 degrees Fahrenheit. In winter and during icy driving conditions, traction sanding fills in the voids of the open graded asphalt, effectively nullifying noise benefit within a few years. Studded tires rapidly grind the surface of open graded asphalt, shortening the pavement life much sooner than standard mixes of dense graded asphalt or Portland cement concrete.

Reducing rail noise

Noise and vibration from the operations of freight trains, Amtrak, and Sounder commuter trains is a concern to residents living close to the tracks. Engine noise, the clacking of wheels over older, jointed track, and freight rail yard operations are the largest sources of noise from rail. The piercing sound of train whistles going through at-grade crossings, as required by federal law for safety, is also a high level of concern in certain locations.

WSDOT works with freight rail companies, federal funding sources, and local jurisdictions and coalitions, such as the Freight Action Strategy (FAST) Corridor Program, to construct grade separations and other grade crossing improvements to increase public safety and eliminate the need to use whistles at some locations. Unfortunately, unless engine noise is reduced and most grade crossings are eliminated or separated, much of the rail noise is here to stay. There is little funding available through the Federal Railroad Administration to provide noise mitigation that would benefit residents living next to the railroad tracks. Communities interested in establishing whistle

quiet zones may work with rail track owners and the Federal Rail Administration to install appropriate safety improvements at applicable at-grade crossings.

Reducing ferry noise

As more people choose to live along the banks of the Puget Sound, noise from the loading of ferries and their engines has become a greater area of concern for residents neighboring ferry terminals. Some residents near the Vashon/West Seattle route say they prefer the use of passenger-only ferries because of the perceived lower noise levels of the vessels and associated lack of vehicle loading noise.

WSDOT takes ferry noise seriously; unfortunately, successful mitigation would require noise barriers in front of homes (blocking scenic views) or converting to different vessel types, which is beyond the resources of the department. Another approach is for cities or counties to limit new building permits and remodel approvals near ferry terminals, or require the incorporation of noise reduction standards in new or remodeled homes (thus transferring potential noise mitigation responsibility to owners and developers).

Underwater noise impacts

There are emerging concerns about the noise impacts on fish and diving birds from underwater pile driving for steel piles. WSDOT conducts in-water pile driving to maintain the safety of key facilities for both ferry terminals and highway bridges. The department is performing independent research and working jointly with other states and resource agencies to identify how noise works underwater, how fish and diving birds are affected by the noise, and what mitigation may be warranted (if any). This area is evolving quickly and there is much yet to understand.

Research needs

Research needs related to impacts from noise discussed above are summarized here. These needs are being addressed through the normal WSDOT process for identifying, prioritizing and funding research projects.

Research new pavement types for potential noise mitigation

WSDOT recommends additional funding to study and test noise-reducing hot-mix asphalt pavements, including open graded and rubberized asphalt mixes, and new surface texturing of concrete pavements. With continued technological improvements, there may be an asphalt mix or alternative concrete texture available that provides noise reduction and durability at a more reasonable life cycle cost. The public has indicated that they would consider even a small noise reduction a benefit, and research and testing are needed before a product could be fully implemented or approved as an option for noise mitigation.

Underwater noise

Due to the lack of information on how noise from underwater pile driving may affect fish and diving birds, additional research funding is needed to determine how noise radiates through water and if key fish or bird species are harmed, in order to optimize evaluation and potential mitigation measures for ferry terminal and bridge projects.

Draft recommendations to the Transportation Commission

Legislative relief with noise-appropriate development

WSDOT and the state's taxpayers need legislative relief that would require local jurisdictions to mandate noise mitigation as a condition of approving noise sensitive development near existing and planned highways. New residential development near roadways increases the cost of road construction projects if noise barriers are required. Costs are on average of about $1.5 million for every mile of one side of the roadway, $3 million for both sides. WSDOT proposes to work with local cities and counties to facilitate development that is designed with noise prevention in mind, but legislative assistance is needed to encourage noise compatible land use decisions.

Retrofits

To continue in good faith to provide noise mitigation for projects that were constructed before the advent of noise regulations, WSDOT recommends reinstating funding for the noise barrier retrofit category in subprogram I-4 to improve the livability of some of the older communities affected by increases in traffic noise. Ten million dollars per biennium was approved as part of the Referendum 49 package, which was then rescinded with the passage of Initiative 695. Referendum 51 included reinstatement of part of the funding, but was not approved by voters. Given the generally higher expense for retrofit noise barriers compared with barriers built with new projects, especially in urban areas, WSDOT recommends biennial funding of $48.5 million per biennium.[26] This figure represents a "ballpark," planning-level estimate aimed to provide for the construction of approximately 70 noise retrofit locations over 10 years. Consistent funding would allow preliminary engineering and cost risk analyses to provide more detailed predictions of cost and benefit.

[26] Other possible scenarios include $32.5 million per biennium over 15 years, $25 million per biennium over 20 years, or $20 million per biennium over 25 years.

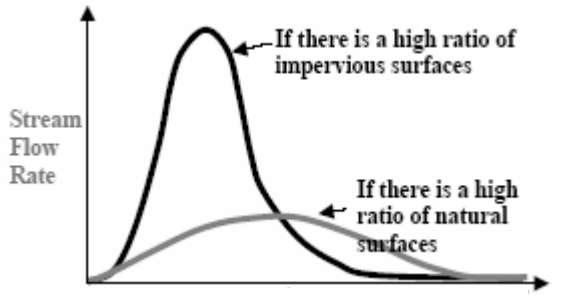
Stormwater Runoff

Stormwater is the water that runs off surfaces such as rooftops, paved streets, graveled highways, and parking lots. It can also flow over hard grassy surfaces such as lawns and play fields. It originates from rain, snowmelt, and people watering their lawns or washing their cars. Stormwater eventually flows into lakes, streams, rivers, wetlands and reservoirs.

As stormwater (also known as runoff) washes along, it dissolves and picks up materials in its path. When stormwater flows over roads and through roadway drainage systems, it carries pollutants originating from motor vehicles, the atmosphere, and other sources into surface water bodies. Stormwater also conveys pollutants originating from construction activities, lawn and garden chemicals, and snow and ice control. Sediments and pollutants (nutrients, oil, grease, metals) are carried into rivers and streams in this way, affecting the quality and health of the water for people, animals, and plants. The runoff may also elevate water temperatures, which is a problem for salmon and trout because they require cool water for survival.

The amount of runoff increases with the addition of impervious surfaces such as pavement and rooftops to the landscape, interrupting the natural hydrologic cycle by preventing infiltration of precipitation into the ground. Where there is a paved environment, all the runoff water has to go someplace. It goes someplace quickly, as opposed to gradually soaking into the ground and moving through the natural system. Impervious surfaces typically replace vegetation, which serves a natural function to intercept precipitation and reduce runoff.

Peak flow in a nearby stream after a heavy rainstorm



Source: Walesh (1989).

Stormwater can cause serious damage to habitat, property, and transportation infrastructure. High flows can:

- Cause flooding and erosion that disrupts the movement of people and goods, damages transportation infrastructure, and damages public and private property,
- Accelerate stream channel bed and bank erosion and scour away habitat (for example, bottom gravel that is used for spawning and stream bank and over-bank vegetation),
- Reduce groundwater recharge,[27]
- Reshape channels and affect side channel habitat,

[27] Replenishment of aquifers from precipitation soaking into the ground.

- Increase sedimentation and water turbidity and raise water temperatures, affecting salmon habitat, and
- Lead to lower dry-weather stream flows (due to less wet-weather groundwater recharge) and elevated stream temperatures, causing more habitat stress.

The potential effects of runoff pollution to drinking water, streams, rivers, and lakes are also serious. Human and environmental health depends on clean, clear water.

Stormwater management regulations

Stormwater management falls under a complex framework of national and state regulations and state, regional, and local program management. The legal foundation for stormwater management is based in the federal Clean Water Act (CWA) and augmented by the state Water Pollution Control Act (Chapter 90.48 RCW). The federal CWA has evolved from a law in the late 1940s primarily concerned with "end of pipe" ("point") discharges from industrial and wastewater treatment plants to a law that also regulates "non-point" source pollution. Stormwater regulation is rather unique in the distinction between point and nonpoint pollution, in that stormwater originates as a non-point source but then becomes (through collection, conveyance, and discharge) a point source. Reauthorization of the CWA in 1987 formalized this regulatory evolution by extending the CWA permit program[28] to stormwater. Stormwater permits are categorized by the type of activity or land use that runoff emanates from–construction, industrial, and municipal. State highways are affected by all three categories; municipal permits have the largest potential regulatory impact on these facilities as well as on local jurisdictions.

Legally, the state is bound to provide "swimmable" and "fishable" water bodies under the Clean Water Act. The state is thus obligated to implement water quality standards, National Pollutant Discharge Elimination System (NPDES) permits, total maximum daily loads (TMDLs), and other programs to protect the waters of the United States. The state is also legally bound to protect all ground water from potential water quality impacts through the Underground Injection Control (UIC) Program under the Safe Drinking Water Act (SDWA).[29]

Stormwater regulations for a particular transportation project vary depending upon geographic location, species affected, neighboring jurisdictions and whether the project is in or out of the Puget Sound basin. The state's primary approach is to use NPDES permits to implement runoff quality and quantity treatment. Beginning in the mid-1990s, NPDES permits regulated municipal stormwater in the state's most highly populated jurisdictions and the state highway system within those jurisdictions. The largest construction sites (based upon the acreage of clearing, grading, and grubbing) were also

[28] National Pollutant Discharge Elimination System, or NPDES

[29] Ground water is also protected by the State Wastewater Discharge Program for discharges from industrial facilities and wastewater treatment plants. An increase in the number of aquatic species listed under the Endangered Species Act (ESA) has brought additional requirements for aquatic resource management and stormwater management. The Coastal Zone Management/Coastal Zone Act Reauthorization Amendment (CZM/CZARA) addresses water quality issues in coastal watersheds and water bodies, including nonpoint sources.

subject to these permits. The NPDES permits issued in the 1990s are overdue for re-issuance and Phase II of the permit program will lower the population and acreage thresholds and thus increase the regulatory scope.

The Department of Ecology's *Stormwater Management Manual for Western Washington*, first issued in 1992, underwent a complete revision in 2001 and was again revised in 2005. Ecology recently published the *Stormwater Management Manual for Eastern Washington*.

As a result of the *Puget Sound Water Quality Management Plan*, first published in the mid-1980s, Ecology promulgated the Highway Runoff Rule in 1991.[30] The rule provided WSDOT the option of using Ecology's stormwater management manual or developing its own Highway Runoff Manual (HRM). WSDOT chose the latter and first published the HRM in 1995. This manual guides how the department manages runoff from highways. It underwent a complete revision that was published in March 2004.[31] This revised manual incorporates current science and encourages applying newer management techniques.

The science and regulation of stormwater continues to evolve. Characterization of roadway runoff–in terms of the pollutants it contains and at what concentrations–is pretty well established. The character of stormwater is usually a function of the predominant land use of the area and traffic volume, but the importance of other factors such as atmospheric deposition is becoming better understood.

Stormwater contribution from transportation facilities

Highways contribute less to runoff pollution than residential and commercial/industrial sources because highways are a smaller percentage of total impervious surfaces in an area. The example from Portland, Oregon in the table at right compares typical sources of pollutants in urban runoff. While *all* transportation-related facilities and land uses in an area, including roadways, parking lots, and driveways, are considered impervious surface, WSDOT only considers the facilities within its jurisdiction–those that constitute the state highway system–when controlling stormwater. Cities and counties have jurisdictions over local roadways.

Typical Sources of Pollutants in Urban Runoff

	Highways	Residential	Commercial/ Industrial
Phosphorus	4%	39%	53%
Hydrocarbons	16%	28%	54%
Copper	9%	10%	79%
Suspended Sediments	7%	44%	44%

Source: NPDES Municipal Stormwater Permit Application, Volume I, Portland OR Metropolitan Area, May 1993

Construction sites, if not properly managed, can discharge sediment-laden or high-pH water into water bodies and cause impacts. Proper management is focused on preventing erosion by limiting the amount of bare ground and by maintaining a

[30] Chapter 173-270 WAC.
[31] Highway Runoff Manual, Publication # M 31-16, March 2004.

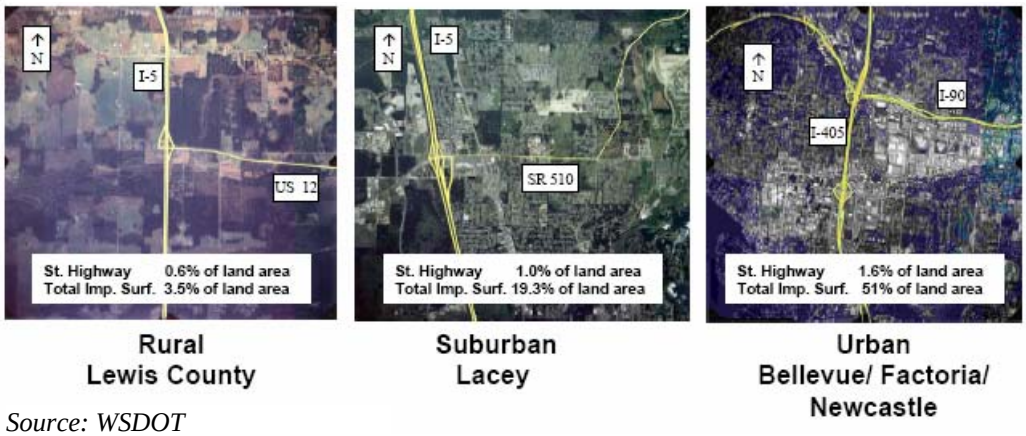
separation between site runoff and off-site runoff, and between stormwater and process water (e.g., concrete grinding slurry).

Other transportation activities can affect water quality, including construction and operation of ferry vessels and terminals, storage of hazardous materials at maintenance shops and construction staging areas, and operation of park and ride lots and rest areas.

Different strategies for urban and rural facilities

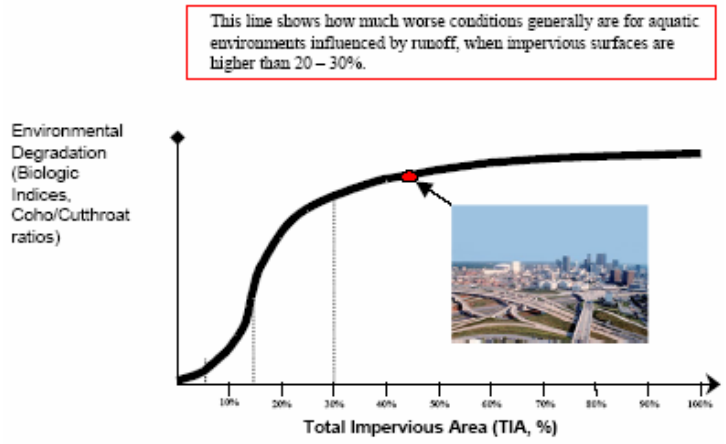
Managing stormwater flowing over transportation facilities is achieved through use of runoff treatment and flow control. In a rural setting, highways make up a greater proportion of the impervious surface, so they contribute relatively more runoff. In an urbanized area, highways are a much smaller percentage of the total impervious land area and contribute less to the total runoff load due to other impervious surface area contributed by roofs, parking lots, and driveways.

Impervious Surfaces as a Percentage of Rural, Suburban, and Urban Land Areas



Source: WSDOT

In urban settings, even the highest level of runoff controls may deliver little or only marginal benefits to nearby streams or wetlands or the habitat they provide. This is because water bodies in watersheds with large amounts of impervious surfaces are often already highly degraded. Runoff from non-highway sources, such as residential and industrial/commercial land uses, may overwhelm any gain from highway runoff treatments. The chart at right shows how much worse conditions generally are for aquatic environments influenced by runoff, when impervious surfaces (as a percentage of total watershed area) are higher than 20 to 30 percent. In these urban settings, working with cities, counties and regulators to expand off-site mitigation



Source: Adapted from Schueler and Holland (2000).

options could create more effective management and restoration opportunities.

Because urban areas have a high proportion of impervious surface and development, stormwater historically has been collected and conveyed prior to discharge to prevent flooding and other damages. Rural roads typically do not have this problem, because the only stormwater management necessary is an adjacent roadside ditch for dispersing runoff along both sides of the roadway. Local transportation agencies indicate that while current stormwater guidance and regulation developed for urban areas, assuming little infiltration, rural settings have the benefits of ditch infiltration and natural dispersion. Many rural roads have relatively low volumes of traffic and don't contribute the level of pollutants associated with urban areas.

Managing stormwater on state highway facilities

Construction projects, primarily highway projects that improve safety or mobility and also other facilities such as ferry terminal holding areas or airport runways, typically result in the addition of impervious surfaces. Regulations require that the impact of these added surfaces–new traffic lanes or interchanges, for example–be mitigated with runoff quality and quantity treatment Best Management Practices (BMPs). After highway runoff flows through these BMPs, it is discharged off the right of way via outfalls into receiving water bodies and storm sewers, or onto the adjacent landscape.

In response to municipal stormwater permit requirements, WSDOT has tracked the number of new stormwater treatment facilities built in King, Pierce, Snohomish, and Clark counties, where about 40 percent of statewide highway construction has occurred since 1996. From 1996 to 2003, 300 treatment facilities (an average of 43 per year) were built in these counties. Out of 1,140 miles of highway within the four counties, an estimated one percent of state highway miles have new stormwater treatment facilities constructed each year.

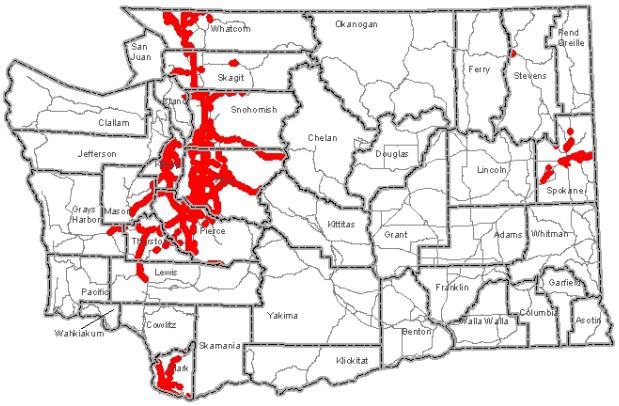
WSDOT is investigating the performance of stormwater BMPs in terms of their ability to remove pollutants from stormwater. Monitoring and research about the performance of various BMPs by WSDOT and state, tribal, and local jurisdictions is leading to the development of new BMPs. Infiltration BMPs that both clean the water and mimic the natural hydrologic cycle are gaining prominence.

Monitoring helps transportation agencies and regulators evaluate the effectiveness of treatment facilities and helps match the right treatment to each unique situation. For example, WSDOT's research has shown that grass-lined swales prove to be pretty effective in reducing most pollutants from the runoff and are very economical in areas having existing right of way.

Fixing stormwater deficiencies

Most of WSDOT's outfalls[32] were built in the middle of the 1900s before the advent of stormwater regulations. They have no treatment facilities associated with them. There is an incomplete inventory of stormwater facilities–to date only 4,000 of WSDOT's estimated 18,000 to 24,000 outfalls have been inventoried, at the locations shown on the map at right. About 80 percent of WSDOT's outfalls still need to be identified.

Highways with Inventoried Stormwater Facilities



Source: WSDOT

Runoff from existing pavement that is not treated or controlled is considered a deficiency. Whenever feasible, WSDOT fixes stormwater deficiencies in conjunction with improvement projects; at the current rate of new construction, it will take at least a century to fix all of the places lacking treatment facilities.

When the department's current priority funding and programming structure was developed, a component for environmental retrofit was created. The Stormwater Retrofit Program (a category in subprogram I-4) fixes some of the highest priority stormwater deficiencies, but the program remains under funded and only a handful of retrofit projects have been planned to date, with fewer yet actually constructed. Adequate data to prioritize outfalls for retrofit exits for about 900 outfalls, most in the highly urban Seattle-Tacoma-Everett metropolitan area.

Maintenance and operations of stormwater facilities

Maintenance of stormwater control facilities is critical to ensure that they continue to provide benefits over their useful life. To date, WSDOT's Maintenance Office has focused its efforts on maintaining these control facilities to ensure stormwater flow, and to a lesser degree stormwater quality. During the 2003-05 biennium, approximately $18 million has been budgeted for drainage maintenance. WSDOT's new NPDES municipal stormwater permit will address maintenance of stormwater BMPs to ensure that these facilities meet their intended stormwater design criteria.

WSDOT is taking steps to inventory stormwater treatment BMPs and inspect them for problems. Currently the drainage maintenance budget does not include funds to correct

[32] WSDOT uses the term outfall to describe the structure that conveys stormwater off the right of way. For example, stormwater can be conveyed horizontally via a pipe or channel, or vertically via a dry well or infiltration basin.

problems found in stormwater (runoff) treatment BMPs. Once an inventory and initial inspection has been completed, WSDOT plans to approach the Legislature for additional funding to provide for additional inspections and to correct identified problems.

Doing the right thing at a reasonable cost

Some BMPs for controlling pollutants and preserving water quality can be simple and fairly inexpensive to implement, such as a wet pond or filter strip. The concept of filter strips is that with sufficient space, natural vegetation can be used to filter some of the pollutants out of the runoff before the water enters streams or the ground. Long linear BMPs such as filter strips and the "Ecology Embankment" have the added advantage of achieving water quality treatment while avoiding impacts to wetlands that may be adjacent to the roadway.

Where space is not available, such as in an urban environment, the BMPs start to get more expensive. For example, WSDOT constructed an underground concrete box along I-405 and SR 522 in north King County to hold and treat water. The vault was constructed using expensive soil-freezing equipment to minimize construction impacts and protect groundwater. Building a large structure to do the same thing that a big open field or pond could do in a more rural area makes this type of BMP more expensive, as does the higher cost of additional right of way in urban areas that these structures often require. Without additional right of way, a vault may have to be located near or under the roadway shoulder.

This relatively cheap infiltration pond installed along SR 512 in Pierce County captures water and temporarily stores it. Water either evaporates or infiltrates to recharge the groundwater. No discharge to surrounding surface water bodies occurs.

BMPs for controlling water quantity can range from simple and cheap to complex and expensive and must match the right technology to the road situation. In urban settings this is sometimes a difficult discussion. Depending on how much impervious area there is in an urbanized watershed, less benefit may be gained from fixing a transportation problem because there are many other factors contributing to the watershed's environmental quality. Runoff controls by themselves cannot provide all the needed protections for streams, and water quality and runoff impacts cannot be completely eliminated for some highways and bridges.

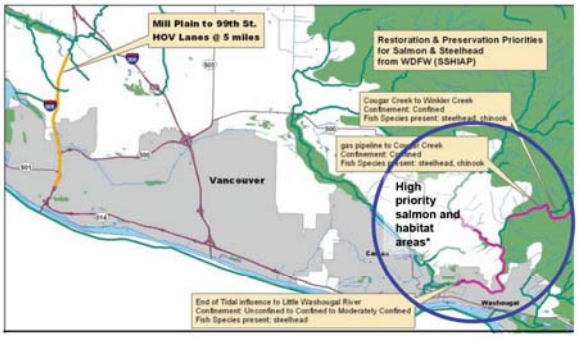
This stormwater detention vault near Woodinville was installed as part of the I-405/SR 522 interchange project at a cost of $460,000. The 90,000-cubic-foot, 673,000-gallon detention vault was constructed within a narrow right of way to avoid impacts to the surrounding sensitive area.

The amount of runoff a road contributes in a highly urbanized area is a much smaller percentage than a road in a rural watershed and cost/benefit must always be considered in the decision of what BMP to implement. Sometimes, especially in suburban and urban settings, the highest levels of highway runoff controls may be very expensive. Land areas for large new detention or infiltration ponds or other systems may fall outside of WSDOT rights of way, and may have high acquisition costs in dollars and local controversy. The alternative of using constructed vaults and complicated filtration systems is difficult to site and expensive to build and operate. Where is the best place to spend the money?

Although it may be environmentally and economically sound to mitigate on-site impacts with on-site solutions at some urban locations, there may be other places within the watershed where that money could be invested and have a bigger environment benefit for the money spent. Not everyone agrees on the right approach for stormwater–some people think all stormwater impacts everywhere should be corrected regardless of cost.

In some watersheds, dollars could be better spent to deliver larger benefits to water quality protection, habitat conservation, restoration, and enhancement by investing in water quality protections away from the roadway compared to localized runoff controls near the roadway. The Department of Fish and Wildlife would like to see investments that address habitat restoration priorities like the locations pictured at right, five miles from where the I-5 Mill Plain to 99th St High Occupancy Vehicle project will add one lane in each direction of I-5. There are also progressive ideas like the Riparian Restoration Plan proposed on the SR 167, Puyallup to Fife project, which accomplishes multiple aquatic resource benefits including water quality and quantity treatment while also providing riparian habitat improvements and possibly wetland creation/restoration opportunities.

WSDOT is taking steps to ensure that stormwater investments do more while costing less so limited dollars can be stretched further. WSDOT's revised Highway Runoff Manual encourages applying newer management techniques and WSDOT is now working with Ecology and other agencies on acceptable approaches to managing stormwater more broadly within a watershed, as opposed to immediately next to the project area, when this approach can yield better environmental results.



The use of the watershed approach for stormwater management is gaining support among scientists. In its review of Ecology's 2001 *Stormwater Management Manual for Western Washington*, the Independent Science Panel stressed the need for watershed-scale considerations, writing that "watershed-scale

approach recognizes that all locations do not have the same potential to benefit from rigid project scale requirements" and that "the watershed-scale approach provides a means to optimize the application costs of stormwater management in locations with the potential for greatest benefits."

The watershed approach is also institutionalized in the efforts of the interagency Transportation Permit Efficiency and Accountability Committee (TPEAC), a committee created by the Legislature to coordinate and streamline the environmental permitting process for transportation projects through March 2006. TPEAC's Watershed Mitigation Subcommittee is working to facilitate the development of a watershed-based approach to mitigation for transportation projects and to develop methodologies for mitigation on a watershed basis at appropriate scales that meet multiple agency criteria for permitting.

Local agency perspective

Doing the right thing at a reasonable cost presents a challenge, particularly for small state and local agency projects, such as adding a few feet of roadway shoulder for safety purposes. Even the low-cost ponds may be hard to apply to local roadways with numerous low spots to drain to and limited property. The use of the watershed approach in particular seems to have little use by smaller local agencies. More work needs to be done to develop and approve BMPs for these projects.

Next steps for WSDOT

WSDOT's new NPDES stormwater permit will address difficult issues:

- What quantity of flow needs to be managed from roadways and other developed areas (e.g., flows based on existing site conditions, or flows based on forested or predevelopment [historic] site conditions)?
- How much should WSDOT invest in correcting problems from existing roadways and other developed areas?
- How much should WSDOT invest in maintaining stormwater facilities?

Increasing stormwater monitoring, expanding the inventory of stormwater outfalls, and funding more retrofits will most likely each be requirements—to some degree—of the future NPDES permit. Within existing funding constraints, WSDOT will address stormwater needs by:

1. Redoubling our pursuit of watershed-based mitigation

   Watershed-based mitigation involves improved site selection and planning to make the most of our programs and mitigation opportunities—and results in higher returns on our retrofit investments. Watershed-based mitigation is a good fit for stormwater because of the constraints many projects face with on-site treatment and the ability to provide environmentally equivalent mitigation elsewhere in the watershed. WSDOT has the know-how and financial resources from new construction budgets to implement watershed-based tools;

but the constraint is acceptability on the part of resource and regulatory agencies and the laws and regulations they work under. Runoff quantity treatment easily lends itself to the watershed approach but taking this approach for runoff treatment faces stiff regulatory hurdles.

2. Increasing the stormwater monitoring program.

   WSDOT monitors a representative sample of our wetland mitigation sites and construction sites and in so doing, brings considerable credibility to the effectiveness of these activities. Monitoring of stormwater BMP effectiveness is limited and WSDOT, as well as public works and resource agencies in general, could benefit from a more robust stormwater monitoring program.

Draft recommendation to the Transportation Commission

WSDOT proposes that the Transportation Commission significantly increase the Stormwater Retrofit Program to fund more retrofits and to expand the stormwater inventory.

WSDOT's priority funding and programming emphasizes system preservation but a holistic approach could include upgrading the environmental performance of existing facilities. The preservation program does not now include an environmental retrofit component (as noted it's a separate subprogram under the *Improvement* program), and preservation would cost more if it did include retrofit. These dollars would have to come from the Improvement program, or from decreasing the number of preservation projects in a given timeframe, in a financially constrained budget. This is a fundamental policy choice for the agency, Commission and the Legislature.

In order to determine what to fix first, WSDOT needs to continue and expand its inventory of outfalls and stormwater facilities. Only when the inventory is more complete can we be sure that we are addressing the highest priorities and identifying the most cost-effective locations.

Protecting and Connecting Habitat

Washington State has a wide diversity of habitats that support more than 650 native fish and wildlife species. This significant natural biodiversity is highly valued by the citizens of the state for enjoyment and well-being.

Wetlands and streams support many aquatic and terrestrial species and also provide important functions on which our society depends, such as protecting water quality and reducing flooding impacts. Washington's forests are well known as an icon of our state as well as for the species they support. Estuaries and nearshore marine habitat represent some of the most productive habitats known, supporting endangered species as well as commercial fisheries and recreation.

In 2004, WSDOT presented a draft policy statement for addressing habitat protection and connectivity in its transportation programs. This identifies some of the potential impacts of the transportation system and sets the direction for the department's actions.

These impacts include:

- Direct effects such as noise disturbance, wetland fill, or loss of native vegetation during project construction.
- Habitat fragmentation where the size or integrity of remaining habitats are reduced or the distance between them is increased.
- Barrier effects involving the different ways roads and other transportation facilities can impede the movement of fish and wildlife across the landscape.
- Vehicle collisions with animals, posing a threat to motorists as well as wildlife.
- Indirect effects of the highway that may occur long after a project is built, such as constraining the natural migration of stream.
- Operational effects such as the spread of invasive species, polluted highway runoff, or the potential effects of herbicide use.

Natural resource protection has been a significant part of planning transportation projects for many years. This has been primarily driven by environmental regulations that apply to the planning and permitting of projects, but simply satisfying the regulatory requirement is not the whole story. As awareness of the issues has increased, beginning in the early 1990s, transportation agencies have looked beyond the standard of regulatory compliance toward an integration of stewardship for natural resources into all applicable transportation activities.

WSDOT has made significant investment and progress in finding innovative and effective ways to meet regulatory requirements, deepening understanding of potential effects, and developing the best measures for avoiding, minimizing, and compensating for unavoidable impacts.

Habitat trends

The environmental context for transportation planning in Washington is very complex. While the state has a wealth of natural resources and many prized and pristine places, there is cause for concern. As the human population increases, and development expands, added pressure is placed on natural systems that are already heavily stressed in many cases. Many natural resources in Washington are at risk or in decline. This presents special challenges for continuing to meet the state's mobility needs.

Habitat loss

It is well known that development is displacing native habitats. Nationally, from 1970 to 1990, more than 30,000 square miles (equal to approximately one third of Oregon's total land area) of rural lands in the United States became urban. In Washington more than 300 new residents arrive each day and each day 100 acres of forest in Washington are converted to development. More then one third of Puget Sound Region's most heavily forested areas have disappeared since the 1970s. Most of Washington's 29 habitat types contain plant associations that are considered imperiled or critically imperiled.[33]

Transportation activities occur in the context of expanding human population, increased development, and decreasing habitat. Transportation infrastructure contributes to the ongoing loss and fragmentation of these habitats, so it is important to avoid and minimize these effects and to seek opportunities to restore and enhance native habitats as part of transportation work.

Endangered species

As of September 2004, Washington had 46 species listed as threatened or endangered by the federal government. These include 36 animal species, such as the Oregon silverspot butterfly, the gray wolf and the humpback whale, and ten plant species, such as the showy Stickseed and the golden Paintbrush. Another 17 species are candidates or currently proposed for listing under the ESA. In addition, there are 22 designated critical habitats for listed species that are either listed or proposed for listing.

Seventeen of the species currently listed as threatened or endangered are various populations of salmon, steelhead, and bull trout. Salmon and other fish need access to freshwater habitat for spawning and juvenile rearing. Stream crossings such as undersized culverts can block fish from passing upstream and using large areas of upstream habitat. These fish passage barriers have long been identified as a significant detriment to fish recovery efforts that required attention.

Highway collisions affect people and animals

Vehicle-animal collisions are a serious safety issue for humans and animals. Nationally, fatal crashes involving animals have increased since the mid-1990s. During 1998 to 2002,

[33] *Wildlife-Habitat relationships in Oregon and Washington*, Johnson and O'Neil (2001).

the annual average was 155 crashes in which vehicle occupants died, compared to an average of 119 fatal crashes during 1993 to 1997.[34]

According to an Insurance Institute for Highway Safety study, "deer were struck in three out of every four crashes, but collisions with other animals such as cattle, horses, dogs, and a bear also led to fatalities. Crashes with deer were most likely to occur in the late fall, coinciding with breeding season and migration. These crashes occurred most frequently in rural areas, on roads with 55 mph or higher speed limits, and in darkness or at dusk or dawn."

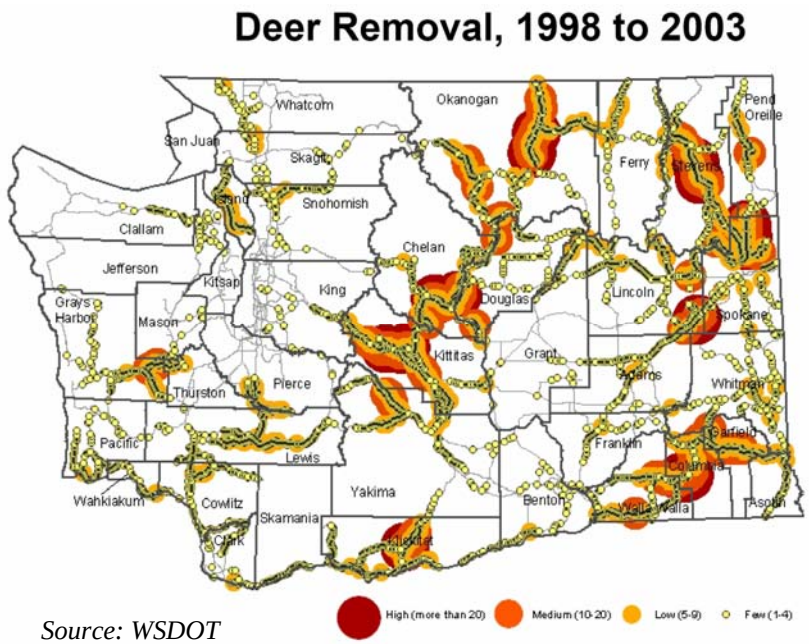
An estimated 1.5 million deer-vehicle crashes occur each year in the United States. These crashes result in at least $1.1 billion in vehicle damage (Insurance Institute for Highway Safety, 2004).

Aircraft-Wildlife Collisions

Aircraft-wildlife collisions are the second leading cause of aviation-related fatalities in the United States. While these strikes do not happen often relative to the millions of aircraft trips every year, the potential for catastrophe is substantial. Between 1990 and 2002, there were 696 bird strikes reported in Washington State. This number is expected to increase as more people use air transportation; from 1997 and 2003, airport operations and airport-based aircraft increased about 8 percent, at roughly the same rate as the population.

The nature and magnitude of wildlife strikes at individual airports depends on many factors, including air traffic type and volume, local and migratory wildlife populations, and local habitat conditions. About 78 percent of wildlife strikes occur within the immediate airport influence area (between ground elevation to 1,000 feet up). It is estimated that wildlife strikes led to an average of 461,165 hours of aircraft downtime per year from 1990 to 1998, with annual losses of $253 million in direct costs and $133 million in associated costs nationally.

The number of vehicle-animal collisions each year in Washington is significantly lower than other states such as Wisconsin, Michigan, and Minnesota, but collisions in this state still cause injury and death. On Washington state highways from 1999 to 2002, there was an average of 1,200 reported accidents involving animal collisions per year. These accidents led to an average of 134 people injured and one fatality each year. By August 2004, five people



Source: WSDOT

[34] Insurance Institute for Highway Safety, 2004.

had been killed in two separate collisions in that year alone.

Some of the heavier animal mortality locations on state highways are around Spokane, north of Spokane on U.S. 395, on U.S. 97 south through Okanogan and central Washington, and in southeastern Washington along U.S. 12.

Historic wetland losses

Protecting habitat is an essential part of protecting wildlife and maintaining a healthy ecosystem. Wetlands support a high number of species and also provide many physical, chemical, and ecological processes that maintain environmental health and benefit society. Wetlands are an area of special focus for regulatory protection and as part of the environmental programs for transportation agencies.

The U. S. Fish and Wildlife Service is required to conduct status and trends studies for wetlands nationally each decade. The most recent Wetlands Inventory, covering 1986 to 1997, found the following:

- In 1997, there were an estimated 105.5 million acres of wetlands in the conterminous United States. Of this, 100.5 million acres (95 percent) were freshwater wetlands and 5 million acres (5 percent) were saltwater wetlands.
- Between 1986 and 1997, the nation lost a net of 644,000 acres of wetlands.
- The Service reports that the estimated wetland loss rate is now 58,500 acres annually. This represents an 80 percent reduction in the rate from the previous decade.
- Forested wetlands experienced the greatest decline of all wetland types, with a loss of 1.2 million acres (a 2.4 percent change). For the first time in the nation's history, there are fewer than 50 million acres of forested wetlands in the conterminous United States. Freshwater emergent wetlands declined by 1 million acres (4.6 percent change) during the study period.
- Freshwater vegetated wetlands continued to decline, while freshwater ponds continued to increase (by nearly 13 percent in the last decade). Trends indicate that the acreage of ponds is now about equal to that of all estuarine wetlands.
- Estuarine emergent wetlands declined slightly by 14,450 acres. Most of these wetlands were lost to urban and other types of development in coastal areas.
- The analysis during this study period attributed causes of wetland losses nationally to urban development (30 percent), agriculture (26 percent), silviculture (23 percent), and rural development (21 percent).
- Although the nation has not met its goal of “no net loss” of wetlands, substantial progress has been made in reducing the rate of loss.

A recent publication by the National Academies of Sciences, *Compensating for Wetland Losses Under the Clean Water Act* (2001), summarizes wetland losses nationally as follows:

TABLE 1–1 Wetland Losses Due to Agricultural and Nonagricultural Causes

Time Period	Wetland Losses Due to Agriculture	Rate of Wetland Loss Due to Nonagriculture	Total Acreage Lost and Annual Average Loss
Mid-1970s to mid-1980s[a] (10 years)	137,540 acres/year[a] 54% of loss[a]	117,230 acres/year[a] 46% of loss[a]	2,547,700 acres;[b] 254,770 acres/year[a]
1986-1997[c] (11 yrs)	15,222 acres/year[c] 26% of loss[c]	43,324 acres/year[c] 74% of loss[c]	644,000 acres;[b] 58,545 acres/year[c]

[a] Dahl and Johnson (1991).

[b] Total acreage lost was determined by multiplying the annual average loss by the total number of years evaluated in the study.

[c] Dahl (2000).

Considering fish, wildlife and habitat in transportation projects

Transportation agencies make extensive effort to avoid and minimize impacts to wetlands, streams, and other types of natural habitats from transportation projects. Avoidance and minimization can include alignment choices that reduce direct habitat losses, special construction techniques, timing work within scheduled windows to avoid sensitive species, and environmental enhancements as part of the project.

WSDOT's new Connectivity Policy sets the direction

In 2004, WSDOT presented a draft policy statement for addressing habitat protection and connectivity in its transportation programs. This sets the direction for the Department's actions and states:

> "WSDOT, in partnership with other agencies, organizations and the public, must assure that road and highway programs recognize, together with other needs, the importance of protecting ecosystem health, the viability of aquatic and terrestrial wildlife species, and the preservation of biodiversity.
>
> To meet these aims, WSDOT intends:
>
> - To identify potentially affected fish and wildlife habitat during the planning process for projects and programs and in preparation of long-range transportation plans. This planning should seek to integrate state conservation and biodiversity plans and other available natural resource information. Transportation planning should recognize and respond to particular concerns and opportunities for habitat preservation and the need for habitat connections. The earlier that habitat concerns are taken up in project planning, the likelier that good

habitat approaches to state investment in habitat protection and habitat connectivity can be incorporated into projects.

- To locate specific opportunities to restore habitat connectivity already damaged by human transportation corridors. Such opportunities should be prioritized for maximum ecological benefit by taking account of such factors as the multiplicity of benefited species as well as the opportunity to support recovery of threatened and endangered species, the long-term security and viability of the habitat connection, and the cost-effectiveness of achieving connectivity gains. Such opportunities can be located and achieved both as part of capital projects and in ordinary maintenance activities.

- To cooperate and coordinate with other agencies involved in wildlife habitat. This will aim to ensure compatibility of natural resource and habitat management in adjacent areas so that wildlife connections at roadways will be linked to functional and permanently protected wildlife corridors. WSDOT and other agencies ultimately should seek to develop a statewide habitat connectivity plan to better integrate overall habitat management with transportation planning.

- To support the use of native plant species in roadside landscaping and vegetation management and to protect existing adjacent natural plant communities.

- To develop and follow design criteria for transportation structures that help promote fish and wildlife movement and minimize habitat degradation. WSDOT recognizes the Washington Department of Fish and Wildlife's manual, *Design of Road Culverts for Fish Passage* (2003), as a primary source for information on fish passage designs. Guidance, criteria and manuals for structures affecting terrestrial species will be developed.

- To protect and enhance important wildlife habitat areas near highways on highway right of way in ways compatible with highway operations, and to support efforts to promote the traveling public's awareness and enjoyment of wildlife in the state.

WSDOT's Environmental Services Office will coordinate the implementation of this policy by working with the support and cooperation of planning, design and engineering, construction and maintenance offices throughout the WSDOT, including all of its departments and divisions."

Dedicated funding for removing barriers to fish passage

Fish barriers on WSDOT highways were first comprehensively surveyed and inventoried beginning in 1991 under a cooperative program with the Washington State Department of Fish and Wildlife (WDFW). This statewide inventory of the stream systems includes data on upstream characteristics in order to prioritize the most important fish barriers to remove–in some cases removing just one barrier opens significant areas of high quality habitat. The program involves survey and inventory work, training of designers on the proper design of fish passable road crossings, and technical assistance.

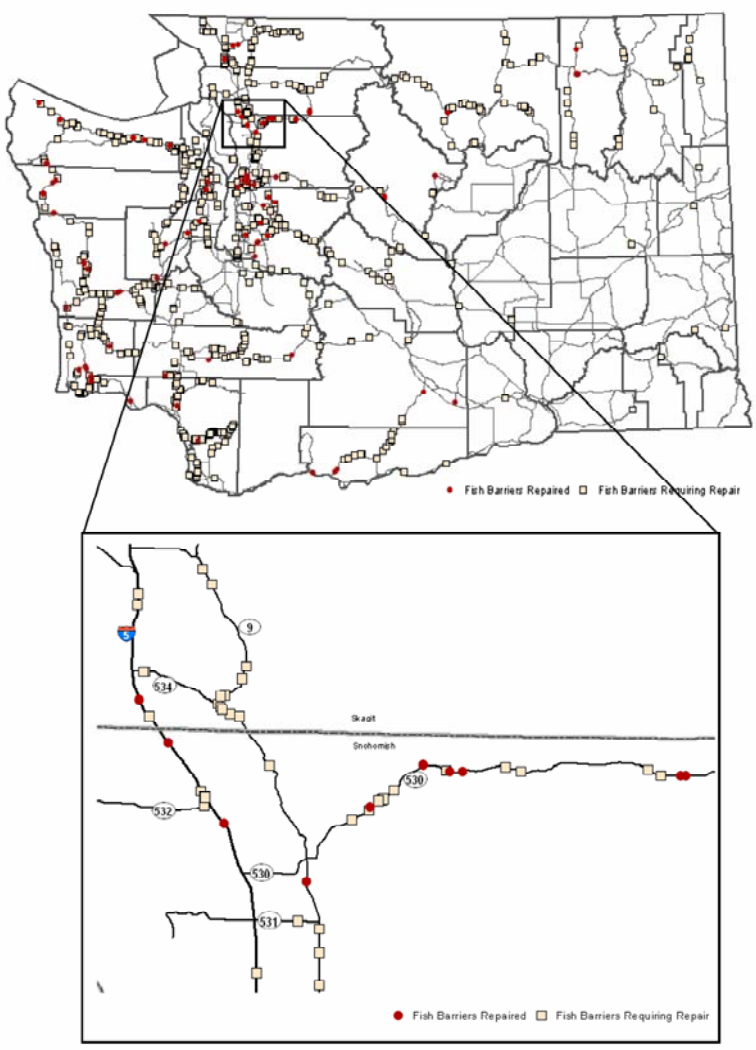
The adoption of more stringent criteria for evaluating streams by WDFW in 1995 and 1998 have required expansion of the survey and evaluation work that is expected to take another eight to ten years to complete for the more than 7,000 centerline miles of highway. As of January 2005, WDFW has identified 876 fish passage barriers to be fixed.

WDFW has estimated there are another 33,000 non-WSDOT fish passage barriers located on city, county, federal, private, and tribal roads.

WSDOT corrects fish passage barriers using a three-pronged approach. First, funding is dedicated to correct the highest priority fish passage barriers as part of a prioritized six-year plan produced jointly with WDFW. Second, as road projects are constructed, additional fish passage barriers within the scope of the project are removed whenever a Hydraulic Project Approval (HPA) is required from WDFW. And lastly, some fish passage barriers are corrected as a result of routine maintenance of failing culverts.

Since 1991, about 140 barriers have been corrected, restoring access to nearly 370

Fish Passage Barriers on State Highways, 2005



Source: WSDOT/WDFW.

linear miles of stream habitat. See the map on the previous page for repaired barriers and those still requiring repair.

Corrections are designed to meet the needs of returning adult salmon as well as juvenile salmon, which can remain in freshwater systems for up to two years before migrating out to sea. In many cases, retrofit project replace failing culverts with bridges or bottomless arch culverts that allow a more natural streambed to exist at the crossing.

Once corrected, the benefits to fish habitat are real and immediate–in many cases fish have been observed upstream of improved culverts within weeks of the work to restore access.

WSDOT accomplished its goals for the fish passage barrier program for the 2001-2003 biennium. WSDOT inventoried an additional 441 miles of highways for fish barriers and completed 16 fish passage retrofit and replacement projects.

The *Washington State Highway System Plan* (2002 update) sets a 20-year goal for the correction of all state highway culvert barriers. Expenditures for barrier removal in the 2001-2003 biennium were approximately $7 million. Estimates show that this spending level would have to approximately double to complete the correction of all culvert barriers in the state highway system within twenty years. This does not include the costs of addressing tens of thousands of barriers that are not in the state highway system, an unknown number of which may require corrective action.

Fixing Chronic Environmental Deficiencies to improve fish habitat

"Chronic environmental deficiencies" (CED) are defined as locations along the state highway system where recent, frequent and chronic maintenance and/or repairs to the state transportation facilities are causing impacts to fish or fish habitat. In 2002 WSDOT established a collaborative process with the Washington Department of Fish & Wildlife (WDFW) to move away from the repetitive repair of infrastructure, and to instead concentrate on long-term solutions that will optimize the improvements for fish and fish habitat, while also addressing transportation infrastructure needs.

Those projects meeting eligibility criteria are added to the list of CED sites. For each site, WSDOT conducts either a reach or site analysis that evaluates and identifies the hydrologic mechanisms for failure and develops a conceptual design solution.

CED retrofit efforts are funded primarily through the I-4 Retrofit Program, with other fixes occurring during relief to correct a natural disaster and in the course of highway projects. WSDOT utilizes each of these funding sources to optimize the number of chronic environmental deficiency problems it can address. The amount of funding available for retrofit falls far short of the amount needed to address all of the identified deficiencies.

Reducing animal collisions and improving habitat connections

WSDOT maintenance crews remove about 3,000 dead deer and elk from state highway right of way annually. This data is used to identify the greatest problem areas on the state highways; it does not include killed deer or elk along local roads.

Techniques that have been effective for reducing vehicle-animal collisions include special signs for motorists that are motion-activated or even radio collar-activated when wildlife are in the vicinity. An elk herd near Sequim Washington has several radio-collared individuals and since they travel together in the herd, it was only necessary to collar a few of them. When they travel close to the sign (shown on at right) the receiver picks up the signal and warning lights are activated. This lets motorists know that there is a herd in the vicinity and gives warning that animals are actually present.

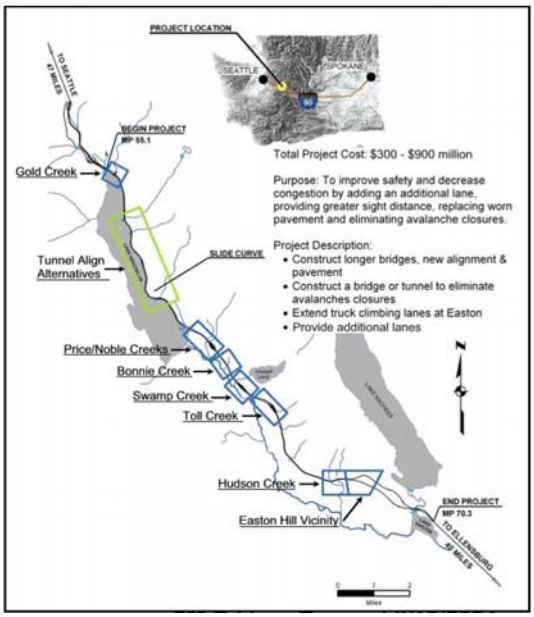
Standard animal crossing signs and fences are also used across the state. A more comprehensive approach is to incorporate widened bridges, larger culverts, and crossing structures designed specifically for wildlife. The example at right is on I-90 near North Bend where fencing and a wider under-crossing are used to provide access for species movement under the freeway.

In key areas of the state where state highways bisect large blocks of habitat, WSDOT is looking at ways to improve safe passage. WSDOT is currently working to address the need for connections in construction and design of several projects:

- One example, shown at right, is on SR 240 in south-central Washington where the road is being widened between the cities of Richland and Kennewick. The road goes through a wildlife refuge area and WSDOT is planning to provide additional bridges for water flow as well as for wildlife movement underneath the freeway.

- Proposed designs for the I-90 Hyak to Easton project over the Cascade Mountains look at the possibilities of improving connections there [figure next page].

- Planning for the Cross Base Highway in Pierce County has involved extensive work to develop measures for reducing fragmentation effects on rare Oak woodlands and prairie habitats.



Offsetting unavoidable impacts to wetlands

WSDOT operates under a "no net loss" policy for wetlands, outlined in Departmental Directive D31-12. Significant effort is invested in selecting alternatives and developing project designs that avoid and minimize impacts to wetlands. Mitigation sites are developed to help compensate for unavoidable impacts to wetlands.

When impacts to wetlands are unavoidable, wetlands are enhanced, restored, created, or preserved to achieve the state's no net loss policy. To compensate for unavoidable wetland impacts, WSDOT has developed 121 mitigation sites, totaling 709 acres (as of January 2005–the *Gray Notebook* for the quarter ending December 31, 2004 has an update on the performance of WSDOT's replacement wetlands).

Monitoring and reporting on the status of replacement wetlands is critical to the success of the program. During the permitting process for replacement wetland sites, success standards are developed and the monitoring period is determined. After construction, data is collected and analyzed to determine if success standards are being met. Each site has various standards to achieve at different points in its development.

If regulatory requirements are met at the end of the monitoring period, the

Aviation and Wildlife

Land uses that provide habitat for wildlife and are located on or near airports can increase the risk of hazardous wildlife strikes. Prohibiting nearby municipal solid waste dumps, composting operations, wastewater treatment facilities, artificial marshes, wastewater discharge and sludge disposal, wetlands, crop production, livestock and fish production are some of the land use controls that airports consider when attempting to minimize wildlife collisions.

One difficulty in minimizing hazardous wildlife collisions at airport facilities is related to stormwater and wetland mitigation requirements. For airports, mitigation requirements that result in open water features, such as stormwater ponds or wetland mitigation sites, can attract birds and fowl and thus become hazards to aircraft. The WSDOT Aviation Division is currently working with federal and state agencies and aviation and environmental interests to develop mitigation options that don't involve open water or are done off-site. Development of an "Airport Runoff Manual" or airport stormwater guidelines could further explore the options for stormwater treatment that don't involve open water.

replacement wetland is considered successful, and monitoring is complete. Reasonable ecological success was achieved on six more WSDOT sites in 2003, bringing the total of completed sites since 1988 to 53. The total of sites judged successful in this group is 49 (267 acres). The four unsuccessful sites (five acres) failed due to unpredicted or changed hydrology, the most important parameter of wetland success. WSDOT is considering options to meet the environmental commitments for these projects.

Concerns exist around the adequacy of compensatory mitigation. Is it going to function as well as planned, to reasonably compensate for unavoidable impacts? Is there a "temporal loss" to the environment between when an impact occurs and when a mitigation site is established and functioning? To help address these concerns, WSDOT has been involved in the creation of large mitigation sites years in advance of expected project impacts. Mitigation banking compensates for many small impacts in one mitigation site in advance of a transportation project. Advance mitigation is building replacement wetlands before unavoidable impacts take place. These are carefully planned and developed with regulatory agencies and monitored to demonstrate success on the ground and help offset project impacts in advance of when the impacts occur.

Using watershed-based tools to improve environmental mitigation

Even with stringent measures to avoid and minimize effects, not all impacts can be avoided. Watershed-based tools look at watershed needs and improvement opportunities beyond the immediate area of a project.

Watershed characterization helps find site locations that match mitigation objectives that provide the greatest ecological benefit, including:

- Wetland restoration
- Stormwater treatment
- Flood protection
- Groundwater recharge

In conducting a watershed characterization, WSDOT works with local jurisdictions and watershed planning and environmental groups to identify priority mitigation and restoration sites that have the benefit of resulting from local consensus. By characterizing overall watershed health, mitigation investments can target those areas that most need restoration.

Protecting estuaries and nearshore marine habitats

WSDOT addresses the environmental effects of our projects on marine habitats as well. In Washington's marine nearshore environments, WSDOT has been actively engaged in the replanting of eelgrass to mitigate for Washington State Ferries impacts. WSDOT's research program developed the technique for growing and transplanting eelgrass so that the marine habitat could be recreated.

Project environmental screening

As WSDOT works to improve the existing transportation system, important natural habitats are factored into the planning and design of transportation facilities. The agency's GIS workbench is one important tool for evaluating project locations to determine if there are known records for wetlands, rare species, or habitats in the area.

Transportation planning would benefit from better data on habitat and its relationship to transportation, so that habitat can be taken into greater account during the planning and design processes. One advantage to having this type of information is to help avoid impacts to sensitive environmental features, where in the past lines might have been drawn on a map without fully realizing what was there. Better data and information provide designers with the insight to avoid sensitive areas and create the best possible design for the landscape.

Careful analysis is needed to determine the best locations for investments to improve wildlife connectivity. The analysis must build in how connectivity can be provided, potential costs, and possible alternatives. The challenge is to identify the locations where investments will have the greatest benefit and what the range of investments could be.

The long-term protection of viable habitats can't be accomplished by WSDOT alone; coordination and partnerships are needed, as are planning and data. There are a number of sources of maps, data, and other information that can help–but there is currently no single plan for habitat connectivity for the state.

WSDOT is a member of the newly formed Governor's Biodiversity Council and is participating in an advisory committee to WDFW's development of a comprehensive wildlife strategy. Coordination with these efforts may eventually help provide a forum to build a statewide plan for habitat connectivity.

Next steps for WSDOT

WSDOT will seek to integrate electronic databases for natural resource data more fully into early project screening, and system and corridor planning.

WSDOT will pursue the initiatives outlined in WSDOT's Draft Habitat Connectivity Policy, including:

- Identify potentially affected fish and wildlife habitat during the planning process for projects and programs and in preparation of long-range transportation plans.

- Continue to integrate state conservation and biodiversity plans and other available natural resource information into project planning and design. Transportation planning should recognize and respond to particular concerns and opportunities for habitat preservation and the need for habitat connections.
- Coordinate with other agencies involved in wildlife habitat to ensure compatibility of natural resource and habitat management in adjacent areas so that wildlife connections at roadways will be linked to functional and permanently protected wildlife corridors.
- WSDOT in cooperation with other agencies and stakeholders ultimately should seek to develop a statewide habitat connectivity plan to better integrate overall habitat management with transportation planning.
- Locate specific opportunities to restore habitat connectivity already damaged by human transportation corridors. Such opportunities should be prioritized for maximum ecological benefit by taking account of such factors as the multiplicity of benefited species as well as the opportunity to support recovery of threatened and endangered species, the long-term security and viability of the habitat connection, and the cost-effectiveness of achieving connectivity gains. Such opportunities can be located and achieved both as part of capital projects and in ordinary maintenance activities.
- Continue to promote the use of native plant species in roadside landscaping and vegetation management and the protection of existing adjacent natural plant communities.
- Develop and follow design criteria for transportation structures that help promote fish and wildlife movement and minimize habitat degradation. WSDOT recognizes the Washington Department of Fish and Wildlife's manual, *Design of Road Culverts for Fish Passage* (2003), as a primary source for information on fish passage designs. Guidance, criteria and manuals for structures affecting terrestrial species will be developed.
- Protect and enhance important wildlife habitat areas near highways on highway right of way in ways compatible with highway operations, and support efforts to promote the traveling public's awareness and enjoyment of wildlife in the state.

Build on WSDOT's experience from long term monitoring of wetland mitigation sites to improve site performance:

- Invest in a thorough process, involving multi disciplinary expertise including Hydrology, Biology and Landscape Architecture, for wetland mitigation site selection and design.
- Set appropriate, scientifically based success standards for evaluating site performance. These should incorporate data collected from actual site monitoring as a basis for expected performance.
- Strengthen processes for follow through and remediation of underperforming mitigation sites.
- Continue the development effective watershed characterization tools and promote the use of watershed -based approaches to the location and design of mitigation sites.

- Promote the development and use of wetland mitigation banks and advance mitigation as a means of providing compensatory mitigation with demonstrated success in advance of project impacts.
- Support development of an "Airport Runoff Manual" or airport stormwater guidelines to explore stormwater treatment options that minimize open water and lessen conflicts between wildlife and airport operations.

Draft recommendations to the Transportation Commission

WSDOT has made significant progress in identifying and understanding environmental issues related to transportation work. These topics are complex and still involve many unknowns, but they need to be addressed if we are to be successful with a transportation program in the environmental context of Washington State. Increased funding is needed in the I-4 Environmental Retrofit Program to address issues related to fish, wildlife and habitats. This entails two recommendations:

1. Increase funding for existing retrofit programs in fish passage and chronic environmental deficiencies. Fish Passage Retrofit funding should be increased to accelerate barrier corrections. This is a critical part of the state's efforts to protect and recover salmon and other aquatic species. Chronic Environmental Deficiencies (CED) has so far been funded for program startup, project identification, scoping and prioritization, but increased funding is needed to implement more retrofit projects.

2. A new I-4 category should be established for Habitat Connectivity–this would support identification and prioritization of problem areas, development of design guidance and coordination with agencies for planning for connectivity.

Conclusion: As We Move Ahead…

Transportation has a number of priority areas on the topic of health and the environment. WSDOT and others will pursue many of the "next steps" and policy development described in this chapter to address these priorities. Recommendations to the Transportation Commission include increased funding of existing programs, new funding categories, and statewide policymaking.

Air quality

1. State policy-makers should continue to engage in the policy discussion to address carbon dioxide emissions, following the lead of the West Coast Governor's Global Warming Initiative.

2. Encourage MPOs and Clean Air Agencies to work closely together on the transportation and land use issues that impact air quality.

3. Continue to support commute trip reduction (CTR) programs to reduce the number of single-occupancy vehicles on the road, to promote the use of alternative transportation modes, and to advocate for changes in laws, regulations and policies that would result in improvements to our transportation system.

Active living and healthy communities

4. State resources for pedestrian safety should focus on the most cost-effective solutions and locations that improve modal connections. Existing resources for paths and trails should be applied to statewide priorities that are consistent with local and regional needs.

Highway, ferry, and transit noise

5. To continue in good faith to provide noise mitigation for projects that were constructed before the advent of noise regulations, WSDOT recommends reinstating funding for noise barrier construction to improve the livability of some of the state's older communities affected by increases in traffic noise.

Stormwater runoff

6. WSDOT proposes that the Transportation Commission significantly increase the Stormwater Retrofit Program to fund more retrofits and to expand the stormwater inventory. In order to determine what to fix first, WSDOT needs to continue and expand its inventory of outfalls and stormwater facilities. Only when the inventory is more complete can we be sure that we are addressing the highest priorities and identifying the most cost-effective locations.

Protecting and connecting habitat

7. Increase funding for existing Environmental Retrofit Programs in fish passage and chronic environmental deficiencies. Fish Passage Retrofit funding should be increased to accelerate barrier corrections. This is a critical part of the state's efforts to protect and recover salmon and other aquatic species. The Chronic Environmental Deficiencies (CED) program has so far been funded for startup, project identification, scoping and prioritization, but increased funding is needed to implement more retrofit projects.

8. A new I-4 funding category should be established for habitat connectivity–this would support identification and prioritization of problem areas, development of design guidance and coordination with agencies for planning for connectivity.

Glossary of Terms

Advance mitigation. Building a mitigation wetland site before unavoidable impacts take place on a transportation project.

Air toxics. Those pollutants that are known or suspected to cause cancer or other serious health effects.

Attainment area. A geographic area in which levels of a criteria air pollutant meet the NAAQS for the pollutant.

Best management practice (BMP). Methods that have been determined to be the most effective, practical means of preventing or reducing pollution from nonpoint sources.

Biodiversity. The diversity of plant and animal life in a particular habitat.

Biogenic. Produced by living organisms.

Carcinogenic. Producing or inciting cancer.

Clean Air Act. Legislation that enabled the nation's air pollution control program.

Clean Water Act. Legislation that established the basic structure for regulating discharges of pollutants into the waters of the United States. It gave the U.S. Environmental Protection Agency the authority to implement pollution control programs such as setting wastewater standards for industry. The Clean Water Act also continued requirements to set water quality standards for all contaminants in surface waters.

Conformity. Projects are in conformity when they do not (1) cause or contribute to any new violation of any standards in any area, (2) increase the frequency or severity of any existing violation of any standard in any area, or (3) delay timely attainment of any standard or any required interim emission reductions or other milestones in any area (EPA's Conformity Rule).

Conterminous. Having a boundary in common; contiguous.

Corporate Average Fuel Economy (CAFE). Legislation enacted by Congress in 1975 to reduce energy consumption by increasing the fuel economy of cars and light trucks. The National Highway Traffic Safety Administration sets fuel economy standards and the Environmental Protection Agency calculates the average fuel economy for each manufacturer.

Criteria pollutants. Carbon monoxide, sulfur dioxide, particulate matter, ground level ozone, lead, and nitrogen dioxide.

Ecology. Shorthand for the Washington State Department of Ecology.

Endangered species. Any species that is in danger of extinction throughout all or a significant portion of its range.

Environmental document. A general term used for any document that identifies the social, economic, and environmental effects of a proposed action.

EPA. Environmental Protection Agency.

Estuary. The tidal mouth of a river valley where fresh water comes into contact with seawater and where tidal effects are evident.

FHWA. Federal Highway Administration.

Fish barrier. A barrier that prevents fish from passing upstream.

Fugitive dust. Particulate matter that is suspended in the air by wind or human activities and does not come out of a stack.

Global warming. Warming of the Earth's average global temperature. Global warming has occurred in the planet's past due to natural influences; many scientists believe that the increasing concentrations of greenhouse gases in the atmosphere due to emissions from human activities is causing the Earth to warm.

Greenhouse effect. A complex natural process that takes place when gases help trap heat from the sun by allowing the sun's radiant energy to pass through the atmosphere while absorbing the Earth's lower wavelength radiant energy.

Greenhouse gases. Gases in the atmosphere, such as carbon dioxide, methane, and water vapor, that trap heat from the sun and warm the earth.

Habitat. Place where a plant or animal naturally or normally completes its life cycle.

Habitat fragmentation. The breaking up of a continuous habitat, ecosystem, or natural land-use type into smaller fragments.

Herbicide. A chemical pesticide designed to control or destroy plants, weeds, or grasses.

Hot-spot analysis. An estimate of likely future localized CO and PM_{10} pollutant concentrations and a comparison of those concentrations to NAAQS. Hot-spot analysis assesses impacts on a scale smaller than the entire non-attainment or maintenance area (for example, congested roadway intersections and highways or transit terminals), and uses an air quality dispersion model to determine the effects of emissions on air quality (40 CFR 93.101).

Hydraulic Project Approval (HPA). A permit issued by the Washington State Department of Fish and Wildlife. Any person, organization, or government agency wishing to conduct any construction activity that will use, divert, obstruct, or change the bed or flow of marine waters and fresh waters of the state must do so under the terms of the permit.

Hydrology. The science that relates to the occurrence, properties, and movement of water on the earth. It includes water found in the oceans, lakes, wetlands, streams, and rivers, as well as in upland areas, above and below ground, and in the atmosphere.

Impervious surface. A surface incapable of being penetrated.

Invasive species. Those (typically) nonnative plant or animal species that often out compete native species.

Jurisdiction. Governing authority that interprets and applies laws and regulations.

Maintenance area. An area that previously was considered a "Non-attainment area" but has achieved compliance with the NAAQS.

Mitigation bank. A net gain in wetlands to be drawn upon to offset wetland losses from several off-site locations or projects. A property that has been protected in perpetuity, and approved by appropriate county, state and federal agencies, expressly for the purpose of providing compensatory mitigation in advance of authorized impacts. The compensatory mitigation may be through restoration, creation, and/or enhancement of wetlands, and the preservation of adjacent wetland or stream buffers and other habitats.

Monitoring. The systematic evaluation of a mitigation site to determine the degree to which the site meets its performance standards and to determine if modifications in the maintenance or management of the site are necessary to achieve the performance standards.

Mutagenic. Tending to increase the frequency or extent of mutation.

National Ambient Air Quality Standards (NAAQS). Maximum air pollutant standards set by EPA under the Clean Air Act for attainment by each state.

National Environmental Policy Act (NEPA). NEPA is our basic national charter for protection of the environment. Its procedures ensure that environmental information is available to public officials and citizens before decisions are made and before actions are taken. 40 CFR 1500-1508 articulates the rules of implementing NEPA; FHWA regulations for implementing NEPA are found in 23 DFR 771.

National Pollutant Discharge Elimination System (NPDES). The primary permitting program under the Clean Water Act that regulates most discharges to surface water.

Nearshore. This term most commonly refers to the backshore, intertidal and shallow subtidal areas of shoreline. The Shoreline Management Act defines the upland edge of this area to be 200 feet behind the shoreline.

Noise barrier. A solid wall or earth berm located between the roadway or railroad and receiver location that provides noise reduction.

Nonattainment area. Area that exceeds health-based NAAQS standards for certain air pollutants designated by the EPA.

Outfall. The place where a sewer, drain, or stream discharges; the outlet or structure through which water or treated effluent is discharged to a receiving water body.

Revised Code of Washington (RCW). The compilation of all permanent laws now in force in Washington. It is a collection of Session Laws (enacted by the Legislature and signed by the Governor or enacted via the initiative process), arranged by topic, with amendments added and repealed laws removed.

Stormwater. Rainwater that flows over land and into natural and artificial drainage systems. Stormwater runoff is a major transporter of non-point source pollutants.

Stormwater Retrofit. A stormwater management practice put into place after development has occurred, to improve water quality, protect downstream channels, reduce flooding, or meet other objectives.

Transportation Demand Management (TDM). Actions and strategies intended to modify travel behavior. TDM addresses traffic congestion by focusing on reducing travel demand rather than increasing transportation supply to increase transportation efficiency. Travel demand is reduced by measures that either eliminate trip making or accommodate person trips in fewer vehicles and may include incentives, disincentives, and the provision of transportation alternatives such as vanpooling and carpooling.

Watershed. Basin including all water and land areas that drain to a stream or common body of water; the watershed for a major river may encompass a number of smaller watersheds that ultimately combine at a common point.

Watershed characterization. A collection of all readily available natural resources and other data for a given watershed, used to determine its condition.

Washington Administrative Code (WAC). Regulations of executive branch agencies issued by authority of statutes. Like legislation and the Constitution, regulations are a source of primary law in Washington State.

Wetlands. Areas that are inundated or saturated by surface water or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas. Wetlands do not usually include those artificial wetlands intentionally created from non-wetland sites, including, but not limited to, irrigation and drainage ditches, grass-lined swales, canals, detention facilities, wastewater treatment facilities, farm ponds, and landscape amenities. However, wetlands may include those artificial wetlands intentionally created from non-wetland areas to mitigate conversion of wetlands, if permitted by the appropriate authority.

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